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**Vol. 39, No. 1, January 2024**

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# INSTRUCTION TO AUTHORS

## A. Introduction

Bangladesh Heart Journal is the official journal of Bangladesh Cardiac Society, and accepts articles for publication from home and abroad. This is a biannual, peer-reviewed journal and aims to publish work of the highest quality from all sub-specialties of cardiology and cardiovascular surgery. The aim of the publication is to promote research in Bangladesh and serve as platform for dissemination of scientific information in cardiology.

## B. Categories of Articles

The journal accepts original research, review articles, case reports, cardiovascular images and letters to the editor, for publication.

*Original Research:*

Original, in-depth research article that represents new and significant contributions to medical science. Each manuscript should be accompanied by a structured abstract of up to 250 words using the following headings: Objective, Methods, Results, and Conclusions. Three to 5 keywords to facilitate indexing should be provided in alphabetical order below the abstract. The text should be arranged in sections on INTRODUCTION, METHODS, RESULTS and DISCUSSION. The typical text length for such contributions is up to 3000 words (including title page, abstract, tables, figures, acknowledgments and key messages). Numberof references should be limited to 50.

*Review Articles:*

Generally review articles are by invitation only. But unsolicited reviews will be considered for publication on merit basis. Following types of articles can be submitted under this category: Newer drugs, new technologies and review of a current concept.The manuscript should not exceed 5000 words (including tables and figures). A review article should include an abstract of up to 250 words describing the need and purpose of review,methods used for locating, selecting, extracting and synthesizing data, and main conclusions. The number of references should be limited to 50.

*Case Reports:*

Only case reports of exceptional quality will be published in the case report format. The text should not exceed 1500 words and is arranged as introduction, case report and discussion. Include a brief abstract of about 150 words. Number of tables/figures should be limited to 3. Include up to 10 most recent references. The patient's written consent, or that of the legal guardian, to publication must be obtained.

*Cardiovascular Images:*

Only clinical photographs with or without accompanying skiagrams, pathological images, echocardiographic images, angiographic images etc. are considered for publication. Image should clearly identify the condition and have the classical characteristics of the clinical condition. Clinical photographs of condition which are very common, where diagnosis is obvious, or where diagnosis is not at all possible on images alone would not be considered. Photographs should be of high quality, usually 127 × 173 mm (5 × 7 in) but no larger than 203 × 254 mm (8 × 10 in). A short text of up to 250 words depicting the condition is needed. Figures should be placed exactly at a logical place in the manuscript. The submitted images should be of high resolution (>300 dpi). The following file types are acceptable: JEPG and TIFF. The number of authors should not exceed 3. The authors should ensure that images of similar nature have not been published earlier. Authors must obtain signed informed consent from the patient, or the legal guardian.

*Letter to the Editor:*

Letters commenting upon recent articles in Bangladesh Heart Journal are welcome.Such letters should be received within 16 weeks of the article's publication. Letters should be up to 250 words; should contain no more than 1 figure/table and upto 5 most recent references. The text need not be divided into sections. The number of authors should not exceed 3.

## C. Criteria for Acceptance

All manuscripts should meet the following criteria: the material is original, study methods areappropriate, data are sound, conclusions are reasonable and supported by the data, and the information is important; the topic has general cardiology interest; and that the article is written in reasonably good English. Manuscripts which do not follow the guidelines of Bangladesh Heart Journal are likely to be sent back to authors without initiating the peer-review process. All accepted manuscripts are subject to editorial modifications to suit the language and style of Bangladesh Heart Journal and suggestions may be made to the authors by the Editorial Board to improve the scientific value of the journal.

## D. Editorial Process

The Bangladesh Heart Journal commits to high ethical and scientific standards. Submitted manuscripts are considered with the understanding that they have not been published previously in print or electronic format

(except in abstract or poster form) and are not under consideration by another publication or electronic medium. Statements and opinions expressed in the articles published in the Journal are those of the authors and not necessarily of the Editor. Neither the Editor nor the Publisher guarantees, warrants, or endorses any product or service advertised in the Journal. Bangladesh Heart Journal follows the guidelines on editorial independence produced by the International Committee of Medical Journal Editors (ICMJE). All manuscripts correctly submitted to the Bangladesh Heart Journal are first reviewed by the Editors. Manuscripts are evaluated according to their scientific merit, originality, validity of the material presented and readability. Some manuscripts are returned back to the authors at this stage if the paper is deemed inappropriate for publication in the Bangladesh Heart Journal, if the paper does not meet the submission requirements, or if the paper is not deemed to have a sufficiently high priority. All papers considered suitable by the Editors for progress further in the review process, undergo peer review by at least two reviewers. If there is any gross discrepancy between the comments of two reviewers, it is sent to a third reviewer. Peer reviewers' identities are kept confidential; authors' identities are also not disclosed to the reviewers. Accepted articles are edited, without altering the meaning, to improve clarity and understanding. Decision about provisional or final acceptance is communicated within 8 weeks.

**E. Cover Letter**

The cover letter should outline the importance and uniqueness of the work. It should include the signed declaration from all authors on:

1. Category of manuscript (original research, review article, case report, cardiovascular image, letter to the Editor)
2. Statement that the material has not been previously published or submitted elsewhere for publication (this restriction does not apply to abstracts published in connection with scientific meetings.)
3. Transfer of copyright to the Bangladesh Heart Journal upon the acceptance of the manuscript for publication
4. All authors have reviewed the article and agree with its contents
5. Information of any conflicts of interest (of any) of the authors.
6. Sources of research support, if any, including funding, equipment, and drugs.

The cover letter should also include the mailing address, telephone and fax numbers, and e-mail address of the corresponding author.

**F. Manuscript Preparation**

The manuscripts should comply with the prescribed guidelines. It should be well organized and written in simple and correct English under appropriate headings. The abbreviations and acronyms should be spelled out when they occur first time.

The Introduction should address the subject of the paper. The Methods section should describe in adequate detail the laboratory or study methods followed and state the statistical procedures employed in the research. This section should also identify the ethical guidelines followed by the investigators with regard to the population, patient samples or animal specimens used. A statement should be made, where applicable, that their study conforms to widely accepted ethical principles guiding human research (such as the Declaration of Helsinki) AND also that their study has been approved by a local ethics committee.The Results section should be concise and include pertinent findings and necessary tables and figures.The Discussion should contain conclusions based on the major findings of the study, a review of the relevant literature, clinical application of the conclusions and future research implications. Following the Discussion, Acknowledgements of important contributors and funding agencies may be given.

*a. Title page information*

- Title. Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations where possible.
- Author names and affiliations. Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower case superscript letter immediately after the author's name and in front of the appropriate address. Provide the e-mail address of each author.
- Corresponding author. Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.

*b. Abstract*

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. References should be avoided. Also, non-standard or uncommon abbreviations should be

avoided, but if essential they must be defined at their first mention in the abstract itself.

*c. Keywords*

Immediately after the abstract, provide a maximum of 5 keywords. Keywords should be the listed terms in the Medical Subject's Headings (MeSH) of the National Library of Medicine (NLM), available at https://www.nlm.nih.gov/mesh.

*d. Abbreviations*

Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

*e. Acknowledgements*

Collate acknowledgements in a separate section at the end of the article before the references. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

*f. Units*

Follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI. Generic rather than trade names of drugs should be used.

*g. Figures and graphics*

- For graphics, a digital picture of 300 dpi or higher resolution in JPEG or TIFF format should be submitted.
- Figures should be numbered consecutively according to the order in which they have been first cited in the text, if there is more than 1 figure. Each figure should be cited in the text.
- Each figure/illustration should be provided with a suitable legend that includes enough information to permit its interpretation without reference to the text.
- All photomicrographs should indicate the magnification of the prints.
- When symbols, arrows, numbers or letters are used to identify parts of the illustrations, each one should be explained clearly in the legend.

*h. Tables*

Tables should be placed next to the relevant text in the article.

- Number tables consecutively in accordance with their appearance in the text. Each table should be cited in the text in Arabic numerals.
- Titles should be brief and a short or abbreviated heading for each column should be given.
- Explanatory matter should be placed in footnotes and not in the heading.
- Abbreviations in each table should be explained in footnotes.
- The data presented in a table should not be repeated in the text or figure.

*i. References*

References should follow the standards summarized in the NLM's International Committee of Medical Journal Editors (ICMJE) Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals (ICMJE recommendations), available at: http://www.icmje.org/recommendations/. The titles of journals should be abbreviated according to the style used for MEDLINE (www.ncbi.nlm.nih.gov/nlmcatalog/journals). Journals that are not indexed should be written in full.

- References should be numbered consecutively in the order in which they are first mentioned in the text.
- References in text, tables and legends should be identified by superscript Arabic numerals at the end of the sentence outside any punctuation. If several different studies or papers are cited within one sentence, the number should be placed where it will accurately identify the correct study.
- The names of authors in the text should concur with the reference list.
- References cited only in tables or in legends to figures should be numbered in accordance with a sequence established by the first identification in the text of the particular table or illustration.
- Abstracts as references may be used; "unpublished observations" and "personal communications" may not be used as references, although references to written, not oral, communications may be inserted (in parentheses) in the text.
- Papers accepted but not yet published may be included as references by adding "In press" after the journal name. Information from manuscripts submitted but not yet accepted should be cited in the text as "unpublished observations" (in parentheses).
- In general: All authors/editors should be listed unless the number exceeds six, when you should give six followed by "et al."

Examples of correct forms of references are given below:

**Articles in Journals** (see also *Journal article on the Internet*)

1. *Standard journal article*

List the first six authors followed by et al.

Halpern SD, Ubel PA, Caplan AL. Solid-organ transplantation in HIV-infected patients. N Engl J Med. 2002 Jul 25;347(4):284-7.

More than six authors:

Rose ME, Huerbin MB, Melick J, Marion DW, Palmer AM, Schiding JK, et al. Regulation of interstitial excitatory amino acid concentrations after cortical contusion injury. Brain Res. 2002;935(1-2):40-6.

2. *Organization as author*

Diabetes Prevention Program Research Group. Hypertension, insulin, and proinsulin in participants with impaired glucose tolerance.Hypertension. 2002;40(5): 679-86.

3. *Both personal authors and organization as author* (List all as they appear in the byline.)

Vallancien G, Emberton M, Harving N, van Moorselaar RJ; Alf-One Study Group. Sexual dysfunction in 1,274 European men suffering from lower urinary tract symptoms. J Urol. 2003;169(6):2257-61.

4. *Volume with supplement*

Geraud G, Spierings EL, Keywood C. Tolerability and safety of frovatriptan with short- and long-term use for treatment of migraine and in comparison with sumatriptan. Headache. 2002;42Suppl 2:S93-9.

5. *Issue with supplement*

Glauser TA. Integrating clinical trial data into clinical practice.Neurology. 2002;58(12 Suppl 7):S6-12.

6. *Type of article indicated as needed*

Tor M, Turker H. International approaches to the prescription of long-term oxygen therapy [letter]. Eur Respir J. 2002;20(1):242.

Lofwall MR, Strain EC, Brooner RK, Kindbom KA, Bigelow GE. Characteristics of older methadone maintenance (MM) patients [abstract]. Drug Alcohol Depend. 2002;66Suppl 1:S105.

7. *Article published electronically ahead of the print version*

Yu WM, Hawley TS, Hawley RG, Qu CK. Immortalization of yolk sac-derived precursor cells. Blood. 2002 Nov 15;100(10):3828-31. Epub 2002 Jul 5.

**Books and Other Monographs**

1. *Personal author(s)*

Murray PR, Rosenthal KS, Kobayashi GS, Pfaller MA. Medical microbiology. 4th ed. St. Louis: Mosby; 2002.

2. *Editor(s), compiler(s) as author*

Gilstrap LC 3rd, Cunningham FG, VanDorsten JP, editors. Operative obstetrics. 2nd ed. New York: McGraw-Hill; 2002.

3. *Organization(s) as author*

Advanced Life Support Group. Acute medical emergencies: the practical approach. London: BMJ Books; 2001. 454 p.

4. *Chapter in a book*

Meltzer PS, Kallioniemi A, Trent JM. Chromosome alterations in human solid tumors. In: Vogelstein B, Kinzler KW, editors. The genetic basis of human cancer. New York: McGraw-Hill; 2002. p. 93-113.

5. *Conference proceedings*

Harnden P, Joffe JK, Jones WG, editors.Germ cell tumours V. Proceedings of the 5th Germ Cell Tumour Conference; 2001 Sep 13-15; Leeds, UK. New York: Springer; 2002.

6. *Dissertation or thesis*

Borkowski MM. Infant sleep and feeding: a telephone survey of Hispanic Americans [dissertation]. Mount Pleasant (MI): Central Michigan University; 2002.

**Other Published Material**

*Newspaper article*

Tynan T. Medical improvements lower homicide rate: study sees drop in assault rate. The Washington Post. 2002 Aug 12;Sect. A:2 (col. 4).

**Unpublished Material**

*In press or Forthcoming*

Tian D, Araki H, Stahl E, Bergelson J, Kreitman M. Signature of balancing selection in Arabidopsis. ProcNatlAcadSci U S A. Forthcoming 2002.

**Electronic Material**

1. *Journal article on the Internet*

Abood S. Quality improvement initiative in nursing homes: the ANA acts in an advisory role. Am J Nurs. 2002 Jun [cited 2002 Aug 12];102(6):[about 1 p.]. Available from: http://www.nursingworld.org/AJN/2002/june/Wawatch.htm Article

Article published electronically ahead of the print version:

Yu WM, Hawley TS, Hawley RG, Qu CK. Immortalization of yolk sac-derived precursor cells.Blood. 2002 Nov 15;100(10):3828-31. Epub 2002 Jul 5.

Article with document number in place of traditional pagination:

Williams JS, Brown SM, Conlin PR. Videos in clinical medicine.Blood-pressure measurement. N Engl J Med. 2009 Jan 29;360(5):e6. PubMed PMID: 19179309.

Article with a Digital Object Identifier (DOI):

Zhang M, Holman CD, Price SD, Sanfilippo FM, Preen DB, Bulsara MK. Comorbidity and repeat admission to hospital for adverse drug reactions in older adults: retrospective cohort study. BMJ. 2009 Jan 7;338:a2752. doi: 10.1136/bmj.a2752. PubMed PMID: 19129307; PubMed Central PMCID: PMC2615549.

2. *Monograph on the Internet*

Foley KM, Gelband H, editors. Improving palliative care for cancer [Internet]. Washington: National Academy Press; 2001 [cited 2002 Jul 9]. Available from: http://www.nap.edu/books/0309074029/html/.

3. *Homepage/Web site*

Cancer-Pain.org [Internet]. New York: Association of Cancer Online Resources, Inc.; c2000-01 [updated 2002 May 16; cited 2002 Jul 9]. Available from: http://www.cancer-pain.org/.

**G. Submission Preparation Checklist**

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

1. The submission has not been previously published elsewhere, is original and has been written by the stated authors.
2. The article is not currently being considered for publication by any other journal and will not be submitted for such review while under review by the Bangladesh Heart Journal.
3. The submission file is in Microsoft Word file format, and the figures are in JEPG or TIFF format.
4. The text is single-spaced; uses a 12-point font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.
5. The text adheres to the stylistic and bibliographic requirements outlined in the Instruction to Authors. Make sure that the references have been written according to the ICMJE Recommendations Style.
6. Spell and grammar checks have been performed.
7. All authors have read the manuscript and agree to publish it.

**H. Submission**

Papers should be submitted to the Editor. Three copies of manuscript should be submitted duly signed by all authors with a copy of CD, to:

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The Editor, Bangladesh Heart Journal
Professor of Cardiology
Room No. 458, Block B, Anwer Khan Medical College
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Bangladesh.

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Email: bangladeshheartj@yahoo.com

*Original Article*

# Association Between Neutrophil to Lymphocyte Ratio and Severity of Coronary Artery Disease in Acute Myocardial Infarction Patients

Tania Easmin[1], Md. Khalequzzaman[2], Mohsin Ahmed[3], Md Mehadi Hasan[4]

**Abstract:**

**Background: Acute myocardial infarction is one of the leading causes of death across the world. Determination of severity is important in patients with acute myocardial infraction for the therapeutic decision making. Neutrophil to Lymphocyte Ratio (NLR) has been proposed as a new prognostic marker in patients with acute MI. Several international studies have found to compare the relation between NLR and severity of coronary artery disease. In these studies, they demonstrated that the NLR is higher in severe CAD. In our country no such study has been done yet to predict the severity of coronary artery disease by estimating NLR in acute MI patients. Moreover, NLR is cheap, easily available, non-invasive and routinely done procedure.**

**Objectives: This study was conducted to find out the association of NLR to severity of CAD in acute MI patients.**

**Methods: This observational cross sectional analytical study was carried out in the Department of Cardiology, Dhaka Medical College Hospital, SSMC and Mitford Hospital and NICVD, Dhaka from March 2021 to February, 2022. Patients with acute MI (STEMI and NSTEMI) were approached for this study according to inclusion and exclusion criteria. They were divided into two groups according to NLR: Group A NLR >2.5 and Group B NLR ≤2.5. Coronary angiogram was done during index hospitalization. The severity of coronary artery disease was assessed by Vessel score and Gensini score. According to Gensini score was non severe (≤50) severe (>50).**

**Results: Among 70 patients in our study 30 (42.8%) were in the high NLR group (Group A) and 40 (57.14%) were in low NLR group (Group B). In group A mean NLR was 5.15 ± 2.21 and in group B mean NLR was 1.65 ± 0.35, this difference was statistically significant. Severe coronary artery disease in terms of vessel score and Gensini score was significantly higher in group A than group B (p value 0.001). We found strong positive correlation between NLR and Gensini score (r= 0.7, p= 0.001), and moderate positive correlation between NLR nad vessel score (r= 0.5, p= 0.001). With the increase of NLR, vessel score and Gensini score increases demonstrating more severe CAD. Simple logistic regression analysis of variables of interest revealed that hypertension (p=0.003), diabetes mellitus (p=0.008), dyslipidaemia (p=0.007), WBC count(p=0.034), Neutrophil count (p=0.000), Lymphocyte count (p=0.000), NLR (p=0.000), LVEF (p=0.001) were independent predictor of severe coronary artery disease with odds ratio (OR) being 5.32, 3.88, 4.42, 1.00, 1.20, 0.834, 2.28, 0.805 respectively. In multivariate logistic regression analysis, after adjustment of confounding, hypertension (p=0.028, OR=5.87) and NLR (P=0.004, OR=1.81) remain independent predictor of severe CAD. In ROC curve analysis, the AUC of NLR for predicting severity of CAD is 0.8 with p value < 0.001, 95% CI (0.78-0.96) and with 75% sensitivity and 86.5% specificity. So, from this study, it is evident that NLR is directly associated with coronary artery disease severity.**

**Conclusion: Increased NLR was associated with angiographically severe coronary artery disease in acute Myocardial Infarction patients and this association is independent of conventional cardiovascular risk factors.**

***Key words:*** *NLR: Neutrophil to Lymphocyte Ratio; CAD: Coronary Artery Disease*

*(Bangladesh Heart Journal 2024; 39(1): 1-9)*

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*DOI: https://doi.org/10.3329/bhj.v39i1.70655*

**Introduction:**

Cardiovascular diseases (CVDs) are the leading cause of death globally and major contributor of disability. An estimated 17.9 million people died from CVDs in 2019, representing 32% of all global death, of these 85% due to heart attack and stroke. Three quarters of CVD death take place in low and middle-income countries[1].

CAD is growing by epidemic proportion day by day in Bangladesh[2]. The exact prevalence of coronary artery disease in Bangladesh is not known. Only a limited number of small-scale epidemiological studies are available[3]. Recent data indicates CAD prevalence in Bangladesh is between 1.85% and 3.4% in rural and 19.6% in urban population[4].

The dynamic nature of the CAD process results in various clinical presentations, which can be conveniently categorized as either acute coronary syndromes (ACS) or chronic coronary syndromes (CCS).

ACS are further classified into ST-elevation MI (STEMI), Non-ST elevation MI (NSTEMI) and Unstable angina (UA). (5) Acute myocardial infarction is the most severe manifestation of coronary artery disease.

Atherosclerosis plays a dominant role in the pathophysiological process of CAD and atherosclerosis are closely associated with inflammation.(6) Atherosclerosis is primarily an inflammatory disease and the role of inflammation in the process of initiation, progression and plaque de-stabilization in atherosclerosis has been well studied.(7) Evidence from various studies has demonstrated that increased levels of inflammatory markers are associated with increased rates of cardiac events in patients with CAD. (8) Different white blood cell (WBC) subtypes play crucial role in the pathogenesis of atherogenesis and atherothrombosis.[9]

The role of inflammatory markers in cardiovascular diseases has been studied extensively and a consistent relationship between various inflammatory markers and cardiovascular diseases has been established in the past. Among these C reactive protein (CRP), Highly sensitive CRP, Fibrinogen, Interleukin -6 (IL-6), Monocyte/ Macrophage colony stimulating factor (MCSF), Tumor necrosis factor alpha, Lipoprotein associated phospholipase A2 and Interlukin-1 isoform are noteworthy.

Recently neutrophil to lymphocyte ratio has emerged as a new addition to the long list of these inflammatory markers. (10) It has also predictive value of cardiovascular events in patients with covid 19 infection.[11] Normal NLR is roughly 1-3. We use cut off point for defining high NLR is 2.5 from study done by Kaya et al.(12) NLR is calculated by dividing the number of neutrophils by the number of lymphocytes, computed from same blood sample collected at admission.[13]

NLR is a combination of two independent marker of inflammation: neutrophil as a marker of ongoing non-specific inflammation and lymphocytes as a marker of the regulatory pathway. A higher NLR indicates a higher level of inflammation and integrates the predictive risk of these 2 leucocytes subtypes into a single risk factor.(14) As a representative indicator of inflammation, a high NLR is recognized as an independent risk factor for the progression of atheromatous plaque lesions, severity of CAD,[15] in stent restenosis, cardiac death after percutaneous coronary interventions or coronary artery bypass surgery and incidents of cardiac events in ACS.(16)

Coronary angiography is the gold standard for the clinical judgement of CAD whereas the Gensini score is a quantitative indicator for the estimation of the severity of coronary artery stenosis on the basis of coronary angiography.

Previous study has shown that higher the NLR, higher the severity of CAD in chronic stable angina patients. So, purpose of our study is to demonstrate relation between NLR and severity of CAD in acute MI patients.

**Methods:**

This cross-sectional observational study was carried out in the Department of Cardiology, Sir Salimullah Medical College and Mitford Hospital and National Institute of Cardiovascular Diseases, Dhaka from March,2021 to February, 2022. Patients with acute myocardial infarction who undergone coronary angiogram during the study period were selected by purposive sampling. Patients who underwent prior PCI and/or CABG, patients with heart failure - NYHA class III, IV, hematological diseases, malignancy, chronic kidney disease, chronic liver disease, ongoing infection, chronic inflammatory disease, autoimmune disease, pregnancy were excluded from the study. Total 70 cases were included in the study and were divided into two groups on the basis of NLR cut off level 2.5: Group A (NLR >2.5) and Group B (NLR $\leq$2.5). After taking informed written consent from each patient meticulous history was taken and detailed clinical examination was performed and recorded in predesigned structured proforma. Levels of hemoglobin, white blood cells, neutrophils, lymphocytes, other differentials of white blood cells and platelets were determined by automated hematology analyzer. Serum creatinine, random blood sugar, fasting lipid profile and other screening tests for coronary angiogram were done.

Coronary angiogram was done by conventional method in the same hospital setting. Severity assessment was done by Gensini score and vessel score.

NLR was calculated by dividing the number of neutrophils by the number of lymphocytes, from peripheral blood sample. Angiographic pattern and severity of coronary artery disease were assessed by interpretation of coronary angiogram by visual estimation by two cardiologists. Severity of coronary stenosis was graded according to the number of major epicardial vessel with significant stenosis (vessel score) and Gensini score.

In vessel score, significant coronary artery disease was defined as > 70% stenosis in any of the three major epicardial coronary arteries or a left main coronary artery stenosis > 50%. Angiograms revealing coronary artery stenosis < 70% in major epicardial coronary arteries were termed non-obstructive CAD. Extent of coronary artery disease was defined as significant single, double or triple vessel coronary artery disease. Score ranged from 0 to 3 depending on the number of vessels involve. Left main coronary artery was scored as single vessel disease.

i) Score 0 = no vessel involvement, ii) Score 1 = single vessel involvement, iii) Score 2 = double vessel involvement, iv) Score 3 = triple vessel involvement.

The Gensini score was developed by Gensini and takes into consideration the geometrical severity of lesions by angiography, the cumulative effects of multiple obstructions, and the significance of jeopardized myocardium. A nonlinear score was assigned to each lesion based on the severity of stenosis as indicated by the reduction of lumen diameter. A multiplier was applied to each lesion score based upon its location in the coronary tree depending on the functional significance of the area supplied by that segment. The final Gensini score was the sum of the lesion scores. The score assessed 14 coronary artery segments, which were scored according to their anatomical importance (ranging from 0.5 to 5) multiplied by the score regarding the maximum degree of obstruction. The points of the 14 segments were summed up to yield a final score.

Total Gensini score was calculated as:

| % of stenosis | Score |
|---|---|
| 1-25% | 1 |
| 26-50% | 2 |
| 51-75% | 4 |
| 76-90% | 8 |
| 91-99% | 16 |
| 100% | 32 |

| Vessel (S) involved | Vessel multiplier score |
|---|---|
| Left Main | 5 |
| Proximal LAD / LCX | 2.5 |
| Mid LAD/Mid LCX | 1.5 |
| Distal LAD/ Distal LCX /First Diagonal/ First OM/RCA/PDA/PLV | 1 |
| Second Diagonal/Second OM | 0.5 |

Total Gensini score = Sum of (Score for % of stenosis X Score for Vessel(s) involved)

Interpretation of coronary angiogram will be made as the Gensini score. According to Gensini score, CAD was categorized as non-severe CAD (≤50), severe CAD (>50).

SPSS 23 was used for data analysis. Continuous variables were expressed as mean ± SD and categorical variables as frequency and percentage. The Kolmogorov-Smirnov test was used to verify the normality of distribution of continuous variables. Quantitative variables were analyzed by student's t test and Man Whitney U test. Categorical variables were analyzed by Chi-square test. To test association between NLR and coronary artery disease severity Spearman's rank order correlation test were used. Simple logistic and multivariate logistic regression analysis were done to evaluate the independent predictor of severe CAD and results are shown as odds ratio and 95 % confidence intervals. P value < 0.05 was considered significant and p value <0.001 was considered as highly significant. ROC curve analysis was done to see the sensitivity and specificity of detecting severe CAD by NLR cut-off value 2.5.

**Results:**

This cross-sectional observational study was conducted in the department of cardiology, DMCH, SSMCH, NICVD from March 2021 to February 2022. The main objective of this study was to find out the association between neutrophil to lymphocyte ratio (NLR) and coronary artery disease severity in acute MI patients. Among the total 70 patients' group-A had 30 and group- B had 40 patients. The mean age differences between the group were statistically significant (p=0.014). Male: Female ratio was 10.6:1. Among the conventional CVD risk factors, hypertension, diabetes and dyslipidemia were significantly high in group-A (p<0.05). No significant difference (p>0.05) between two groups was found in case of smoking and family history of CAD (Table I).

The differences in mean hemoglobin, RBS and serum creatinine levels between two groups were insignificant (p>0.05). In lipid profile study, HDL was significantly low in group A

(p<0.01). LDL and serum TG were significantly higher in group-A (p value 0.001). Patients of group-A showed significantly higher mean WBC counts (p<0.01). Mean count of neutrophil and lymphocyte were statistically significant (p<0.001) across the group. The Mean NLR was 5.15 ± 2.21 in group-A & 1.65 ± 0.35 in group-B and the difference was statistically significant (p=0.001). Mean LVEF also showed statistically significant difference between two groups (p<0.001) (Table II).

This study shows that in "vessel score 0" and "vessel score 3" categories there was significant difference in patient number between the groups, and it was low in group A in "vessel score 0" (p value 0.01) and high in case of "vessel score 3" (p value 0.001). (Table 3)

According to Gensini score we found that severe CAD was significantly higher in group A than group B (p value 0.001). (Table IV)

There was a positive correlation between NLR and coronary artery disease severity in terms of vessel score (r=0.54). It was observed statistically significant (p=0.001) by Spearman's rank order correlation test (figure 1). There was also a moderately positive correlation between NLR and coronary artery disease severity in terms of Gensini score (r =0.7). With the increase of NLR Gensini score increases. It was found statistically significant (p=0.001) by Spearman rank order correlation test. (Figure 2).

**Table-I**

*Demographic and risk factors variables of study patients (N=70)*

| Variables | Group A (n=30) | Group B (n=40) | P value |
|---|---|---|---|
| Age, mean ± SD,yrs | 53.47±10.2 | 47.68±9.16 | $0.014^{S}$ |
| SexMaleFemale | 27(90%)<br>3(10%) | 37(92.5%)<br>3(12.5%) | $0.71^{NS}$ |
| Smoker,n(%) | 16 (53.3%) | 16(40%) | $0.335^{NS}$ |
| Hypertension,n(%) | 25 (83.3%) | 19 (47.5%) | $0.002^{S}$ |
| Diabetes Mellitus,n(%) | 20 (66.67%) | 16 (40%) | $0.03^{S}$ |
| Dyslipidaemia,n(%) | 25 (83.3%) | 18 (45%) | $0.001^{S}$ |
| Family history of CAD,n(%) | 3 (10%) | 7 (17.5%) | $0.378^{NS}$ |

Group A= NLR > 2.5; Group B= NLR ≤2.5; s =significant; ns = not significant
p value reached from Students t -test and Chi square test.

**Table-II**

*Laboratory characteristics of study patients (N=70)*

| Variables | Group A<br>n =30<br>Mean ± SD | Group B<br>n =40<br>Mean ± SD | P value |
|---|---|---|---|
| Hb (gm/dl) | 12.20 ± 1.58 | 12.91 ± 1.58 | $0.069^{ns}$ |
| WBC Count | 10675 ± 2727.4 | 8865 ± 2855.08 | $0.009^{s}$ |
| Neutrophil Count | 77.53 ± 5.03 | 56.45 ± 4.59 | $0.001^{s}$ |
| Lymphocyte Count | 17.53 ± 6.30 | 33 ± 5.33 | $0.001^{s}$ |
| NLR | 5.15 ± 2.21 | 1.65 ± 0.35 | $0.001^{s}$ |
| RBS (mmol/l) | 8.31 ± 2.36 | 7.67 ± 2.9 | $0.33^{ns}$ |
| Total Cholesterol (mg/dl) | 229.30 ± 59.7 | 209.9 ± 40.25 | $0.10^{ns}$ |
| LDL (mg/dl) | 125.6 ± 26.23 | 104.02 ± 23.45 | $0.001^{s}$ |
| HDL (mg/dl) | 32.33 ± 3.49 | 35.07 ± 3.87 | $0.003^{s}$ |
| Serum TG (mg/dl) | 185.73 ± 65.3 | 137.7 ± 37.8 | $0.001^{s}$ |
| Serum Creatinine (mg/dl) | 1.25 ± 1.4 | 0.9 ± 0.2 | $0.247^{ns}$ |
| Gensini score | 69.93 ± 33.26 | 25.23 ± 17.33 | $0.001^{s}$ |
| LVEF | 47.13 ± 4.60 | 51.95 ± 5.81 | $0.001^{s}$ |

Group A= NLR > 2.5; Group B= NLR ≤2.5
s =significant; ns = not significant
p value reached from Students t -test / Man Whitney U test.

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**Table-III**

*Distribution of the study patients according to Vessel Score (N=70)*

| Severity of CAD (Vessel Score) | Group A(n =30) | | Group B (n =40) | | P value |
|---|---|---|---|---|---|
| | Number | % | Number | % | |
| Score 0 | 0 | 0 | 7 | 17.5 | 0.01[s] |
| Score 1 | 6 | 20 | 14 | 35 | 0.17[ns] |
| Score 2 | 7 | 23.33 | 15 | 37.5 | 0.2[ns] |
| Score 3 | 17 | 56.67 | 4 | 10 | 0.001[s] |

Group A= NLR > 2.5
Group B= NLR ≤2.5
s =significant
ns = not significant
p value reached from Chi square test.

**Table-IV**

*Distribution of study patients according to Gensini Score (N=70)*

| Severity of CAD (Gensini Score) | Group A (n =30) | | Group B (n =40) | | P value |
|---|---|---|---|---|---|
| | Number | % | Number | % | |
| Non severe CAD (score ≤50) | 5 | 12.50 | 32 | 80 | |
| Severe CAD (Score >50) | 25 | 83.33 | 8 | 20 | 0.001[s] |

Group A= NLR > 2.5
Group B= NLR ≤2.5
s =significant
ns = not significant
p value reached from Chi square test.

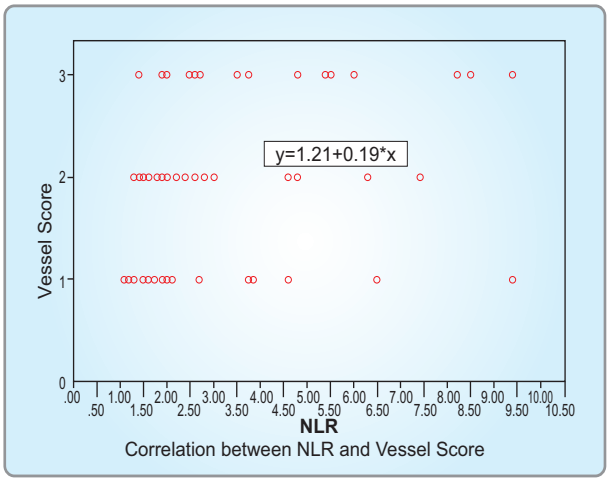


**Fig.1:** *Scatter diagram showing correlation between NLR and vessel score by Spearman's rank order correlation test.*

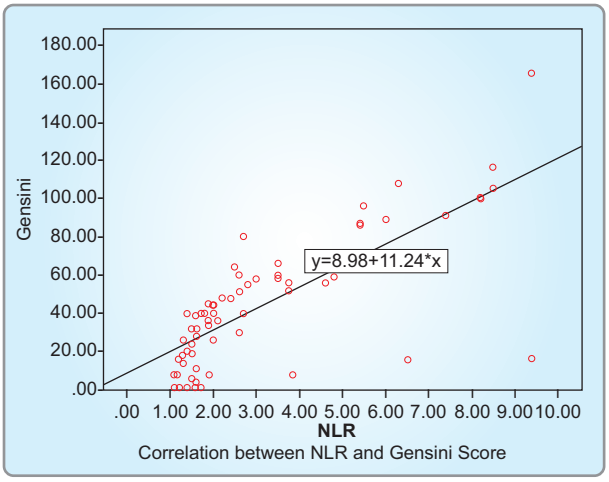


**Fig.2:** *Scatter diagram showing correlation between NLR and Gensini score by Spearman's rank order correlation test.*

In ROC curve analysis, the AUC of NLR for predicting severity of CAD is 0.8 with p value< 0.001, 95% CI (0.78-0.96). NLR cut-off value 2.5 can predict severe CAD with 75% sensitivity and 86.5% specificity (Figure 3).

Simple logistic regression analysis of variables showed that hypertension, diabetes, dyslipidemia, WBC count and NLR were the significant predictor of severe CAD with ORs being 4.03, 5.326, 3.89, 4.42, 0.83, 2.28 respectively (Table V). In multiple logistic regression analysis hypertension and NLR were found independent predictors of severe CAD with ORs being 5.87 and 1.813 respectively. (Table VI).

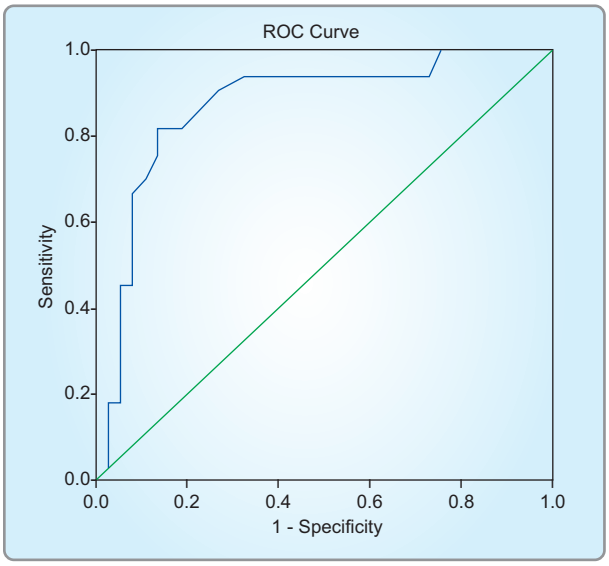


**Fig.3:** *The receiver-operating characteristics curve (ROC) analysis of NLR for predicting severe CAD.*

**Table-V**

*Simple logistic regression analysis of determinants of severe CAD.*

| Variables of interest | β | S. E | P value | OR | 95 % CI |
|---|---|---|---|---|---|
| Smoking | .067 | .458 | .890 $^{ns}$ | 1.069 | 0.414 – 2.76 |
| Hypertension | 1.71 | 0.583 | 0.003$^{s}$ | 5.326 | 1.762 – 17.336 |
| Diabetes Mellitus | 1.358 | 0.515 | 0.008 $^{s}$ | 3.889 | 1.417 – 10.674 |
| Dyslipidaemia | 1.486 | 0.556 | 0.007$^{s}$ | 4.421 | 1.488 – 13.13 |
| WBC Count | 0.000 | 0.000 | 0.034$^{s}$ | 1.00 | 1.00 – 1.00 |
| Neutrophil Count | 0.185 | 0.039 | 0.000 $^{s}$ | 1.204 | 1.116 – 1.298 |
| Lymphocyte Count | 1.81 | .041 | 0.000 $^{s}$ | 0.834 | 0.769 – 0.905 |
| NLR | 0.826 | 0.224 | 0.000 $^{s}$ | 2.284 | 1.472 – 3.446 |
| LVEF | 0.216 | 0.063 | 0.001$^{s}$ | 0.805 | 0.712 – 0.911 |

Dependent variable: Severe CAD (Gensini score > 50)
Independent variables: Smoking, Hypertension, Diabetes mellitus, Dyslipidaemia, WBC count, neutrophil count, Lymphocyte count, LVEF and NLR.
s =significant

**Table-VI**

*Multivariate logistic regression analysis of determinant of severe coronary artery disease.*

| Variables of interest | β | S. E | P value | OR | 95 % CI |
|---|---|---|---|---|---|
| Hypertension | 1.77 | 0.801 | 0.028$^{s}$ | 5.87 | 0.93 – 21.49 |
| Diabetes mellitus | 1.025 | 0.749 | 0.171 | 2.78 | 0.642– 12.09 |
| Dyslipidaemia | 1.028 | 0.763 | 0.178 | 2.797 | 0.627 – 12.47 |
| LVEF | 0.085 | 0.078 | 0.277 | 0.919 | 0.789 – 1.09 |
| NLR | 0.595 | 0.211 | 0.004$^{s}$ | 1.813 | 1.19 – 2.74 |

Dependent variable: Severe CAD (Gensini score > 50)
Independent variables: Hypertension, Diabetes mellitus, Dyslipidaemia, LVEF and NLR.
s =significant.

**Discussion:**

The mean age of study patients was 50.16 ± 9.9 years ranging from 24 to 70 years. The mean age of group A patients was 53.47±10.2 years and that of group B was 47.68±9.16 years. The mean age of group A patients was significantly higher than group B. In a similar study conducted by Datta et al [15] mean age was significantly (p=0.001) higher in high NLR (>2.38) group. It was evident from the study that group A patients tended to be older than group B.

The distribution of risk factors for coronary artery disease in the present study revealed that the most common risk factors, such as hypertension present in 83.33% (25) patients in group A and 47.5% (19) in group B, and the difference between two groups was statistically significant (p=0.002). Study conducted by Datta et al [15] showed that prevalence of hypertension was more in high (> 2.38) NLR group. Dyslipidaemia was found in 83.33% (25) patients in group A and 45% (18) patients in group B and the difference between the groups was statistically significant (p value 0.001).

Diabetes mellitus was found 66.67% (20) and 40% (16) patients in group A and B respectively and the difference was statistically significant (p value=.03). Lou et al [17] also showed that NLR is higher among diabetic patients. We didn't find any statistically significant difference of smoking and positive family history of premature CAD between the groups, which is consistent with previous study conducted by Dutta et al [15].

In group A the mean WBC count was 10675 ± 2727.4 (/ $mm^3$) and in group B mean WBC count was 8865± 2855.08(/$mm^3$) and this difference was statistically significant(p=.009). In a similar study conducted by Zhang et al [18] found mean WBC count 9.9 ± 3.1(K/μL) in higher NLR group and 8.3 ± 2.8 (K/μL) in lower NLR group and the difference was statistically significant. Mean neutrophil count was 77.53 ± 5.03(/$mm^3$) and 56.45 ± 4.59($mm^3$), mean lymphocyte count was 17.53 ± 6.30 ($mm^3$) and 33 ± 5.33 ($mm^3$), mean NLR was 5.15 ± 2.21 and 1.65 ± 0.35 in group A and group B respectively and the differences in values between the groups were statistically significant (p value<0.001). In a similar study done by Zhang et al[18] found mean neutrophil and NLR were higher, and lymphocyte was lower in high NLR group than in low NLR group.

In lipid profile study, no significant difference in mean total cholesterol but significant difference in mean LDL, HDL and Triglyceride level was observed. Kaya et al [12] also showed HDL was significantly lower in higher NLR group. Wang et al[19] showed association of dyslipidaemia with high NLR.

In our study we found the mean value of serum creatinine was 1.25 ± 1.4 mg/dl and 0.9 ± 0.2 mg/dl in group A and group B respectively and the difference was not statistically significant (p =.247). Chen et al [20] showed no significant difference in serum creatinine between low (≤2.76) and high (>2.76) NLR group. Mean left ventricular ejection fraction was 47.13 ± 4.60(%) in group A and 51.95 ± 5.81(%) in group B, the difference was statistically significant. LVEF was significantly lower in high NLR group. Chen et al[20] and Dutta et al [15] also showed significant difference in LVEF in low and high NLR group.

According to distribution of vessel score among sample population, 0% (0) patient has vessel score "0" in group A and 17.5% (7) in group B, 56.67% (17) patients and 10% (4) patients have vessel score "3" in group A and group B respectively. The difference between groups was statistically significant, meaning that group A patients have more severe involvement of coronary disease than group B in terms of vessel score.

According to Gensini score, severe CAD was present in 83.3% (25) patients in group A and 20.0% (8) patients in group B and the difference between two groups was statistically significant. Severe coronary artery disease was significantly higher in group A than group B.

Mean Gensini score was 69.93±33.26 and 25.23 ± 17.33 in group A and group B respectively and the difference between groups was statistically significant. All these findings were consistent with study done by Dutta et al [15] and Zhang et al[18].

A positive correlation between NLR and severity of CAD in terms of Gensini score and vessel score was found in our study. Correlation co-efficient between NLR and Gensini score was 0.691 (p=.001) and correlation co-efficient between NLR and vessel score was 0.541 (p=.001) and these were statistically significant. With the increase of NLR, Gensini score and vessel score also increased, indicating more severe CAD. These positive correlations were in agreement with other similar studies done by Kaya et al [21] and Dutta et al [15].

In this study, binary logistic regression analysis of variables likely to cause severe CAD was done and it revealed that hypertension, dyslipidaemia, diabetes mellitus, total WBC count, neutrophil count, lymphocyte count, NLR, LVEF were independent predictor of severe CAD. Hypertension, dyslipidaemia total WBC count and NLR were found as independent predictor of severe CAD

by Datta et al also. Elbasan et al[22] also showed LVEF as independent predictor of severe CAD. However, smoking was not found independent predictor of CAD, which is also consistent with previous study done by Datta et al.

In multivariate logistic regression analysis, after adjustment of confounding, NLR and hypertension were found the independent predictor of severe coronary artery disease with OR 1.81 and 5.87 & 95% confidence interval (1.19– 2.74) and (1.21-28.5) respectively. Dutta et al (15)& Kaya et al (12) also found NLR as an independent predictor of severe CAD.

By ROC curve analysis, our study found NLR > 2.5 value can predict severe CAD in terms of Gensini score with improved sensitivity and specificity (75% sensitivity, 86.5% specificity) than previous study by Kaya et al (21).They found NLR > 2.5 predicted severe atherosclerosis with sensitivity of 62% and specificity of 69%.

PPV and NPV of NLR for prediction of severe CAD according to Gensini score were 83% and 87% respectively and accuracy 85%.

**Conclusion:**

From this study it may be said that increased neutrophil to lymphocyte ratio is associated with angiographically severe coronary artery disease in acute myocardial infarction patients. So, this parameter might be useful for risk prediction of acute MI patients. Patients with acute MI, with NLR level of more than 2.5, warrants more attention by the physicians and cardiologists in terms of more aggressive medical management and interventional treatment.

**Limitations:**

Although the result of the study supports the hypothesis, there are some facts to be considered which might affect the results.

1. Relatively small sample size.
2. The assessment of the severity of CAD was performed by coronary angiography, which has got its inherent limitations. Intravascular ultrasound may be more sensitive in the assessment of the severity of CAD.
3. The other synchronous inflammatory biomarkers of the patients were not evaluated in the study.
4. Cross-sectional study design was used in this study which was not ideal for proving cause or effect relationship between NLR and severe CAD.

**Conflict of Interest** – None.

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*Original Article*

# Association of Left Atrial Volume Index with Adverse In-Hospital Outcome in Patients with ST-Elevated Acute Myocardial Infarction

Abu Md. Towab[1], Abdul Wadud Chowdhury [2], Haripada Roy [3], A.K.M Fazlul Kader [4], Md. Sharif Hasan [5], Anupam Kanti Thakur [6],Mohammad Khurshadul Alam [7] , Mohammad Fahad [8]

**Abstract:**

**Background: Coronary heart disease is the leading cause of death worldwide, with acute STEMI being the most severe manifestation. Left atrium (LA) plays a major role in left ventricular performance. LA function is a surrogate marker of LV diastolic dysfunction. In recent past, several studies conducted in different parts in the world have focused on the effect of ASTEMI on the volume and function of left atrium. So assessment of left atrial volume index (LAVI) by 2D echocardiography in patients who have suffered an acute STEMI helps to predict the adverse cardiovascular outcome.**

**Objective: The aim of the study is to assess the LAVI for prediction of adverse in-hospital outcomes following acute STEMI patients admitted in a tertiary care hospital.**

**Methods: This Hospital based prospective observational study was conducted in the department of cardiology in DMCH over 1-year period. Patients with acute STEMI admitted in the CCU of DMCH were approached for inclusion in the study. Clinical and echocardiographic parameters were collected within 48 hours of admission. LA volume is measured and then indexed to body surface area called LA volume index (LAVI) and the population was divided according to LAVI. The study comprised of 150 acute STE-MI patients and were divided into two groups, including 75 patients in each group. Patients with LAVI>34 ml/m²and LAVI ≤34 ml/m² were assigned as Group I and Group II respectively & followed up for adverse in-hospital outcome . All necessary information were recorded in a pretested case record form. Statistical analyses were done by SPSS 17.0.**

**Result: The mean age was 57.7 ± 7.0 years ranging from 39 to 80 years. Most of the patients were male 109 (72.7%). Majority of the patients had anterior wall ( anterior, antero-septal & extensive anterior) myocardial infarction (85%).It was observed that patients with LAVI>34 ml/m² (Group I) had more adverse in-hospital outcomes than patients with LAVI ≤34 ml/m2( Group II) (46.7% vs 14.7 % ; p< 0.001). By multivariate logistic regression analysis, LAVI>34 ml/m2 emerged as an independent significant predictor of adverse in-hospital outcome(Odds Ratio 6.55,95% confidence interval: 2.069 – 20.735, p = 0.001 )**

**Conclusion: In patents with acute STEMI , with LAVI>34 ml/m² had more adverse in-hospital outcomes than patients with LAVI ≤34 ml/m². So early assessment of LAVI by echocardiography is useful to predict adverse in-hospital outcome**

*Key Word: LAVI, Acute ST-segment elevated myocardial infarction, Outcome.*

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**Introduction:**

Cardiovascular diseases (CVD) are the most prevalent cause of death and disability worldwide and this is true for developed countries as well as developing countries.[1] The average prevalence of ischemic heart disease (IHD)

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according to three small scale population based studies in Bangladesh found that it was 6.56/1000.The prevalence of IHD was 3.3/1000;[2] 3.38/1000 ;[3] 13/1000 . [4]Acute Myocardial Infarction (AMI) is the leading cause of death in pointing to the serious health hazard as well as economic burden .[2] As a result of socioeconomic transition, lifestyle, as well as, the dietary pattern is changing in Bangladesh. Increasing prevalence of obesity, tobacco use, high intake of processed foods and less physical activity accompany the transition.[5] In Bangladesh, ACS is the major presenting form of CAD and accounts for 45% of all cause cardiac hospitalization.[6]Many factors have been shown to have prognostic value in STEMI. Demographic variables, symptoms, severiry, physical signs, echocardioagraphic and radiological measurements, hemodynamic and neuro-hormonal parameters, high TIMI and Mayo risk score, reduced exercise capacity have been shown to be associated with poor outcome .[7] Various degrees of left ventricular systolic and diastolic dysfunction occur during STEMI.[8]The enlargement of the LA has been associated with an increased incidence of atrial fibrillation, stroke, congestive heart failure, and mortality, especially in elderly people.[9,10,11] demonstrated that left atrium (LA) size has a greater predictive value compared with left ventricular (LV) diastolic function measurements and filling pressures, which are substantially influenced by hemodynamics. The prognostic usefulness of LA volume persisted after adjustment for clinical predictors of outcome and conventional echocardiographic indices of LV systolic and diastolic function. If confirmed in prospective studies, measurement of LA volume could emerge as a simple and important tool for risk stratification and as a guide for future surveillance and therapy in patients with AMI. Estimation of LA volume by Simpson ‘s method of disc is well validated and recommended by the American Society of Echocardiography (ASE) guidelines. LA volume is then indexed to body surface area and called LAVI. The upper normal limit for 2D echocardiographic LA volume is 34 mL/m2 for both sexes.[12] CHD encompasses a wide clinical spectrum ranging from silent ischemia to sudden death. Within this spectrum, acute ST-segment elevation myocardial infarction (STEMI) is the most significant form of disease with respect to its diagnosis, treatment, and prognosis. By identifying association of increase LAVI with adverse in-hospital outcome in the patients suffering from acute STEMI and we can be able to predict averse in-hospital outcome by only doing the LAVI in any low resource setting hospital in our country

**Materials & Methods:**

This prospective observational study was conducted at Department of Cardiology, Dhaka Medical College Hospital, Dhaka,from October‘ 2017 to September‘ 2018. A total of 150 patients with ST elevation acute myocardial infarction admitted in the CCU, department of Cardiology, DMCH, Dhaka, within the study period were included in this study by purposive sampling method after considering inclusion & exclusion criteria. Patients with unstable angina, significant valvular heart disease, congestive heart failure, post-PCI, post-CABG, cardiomyopathy and patient with not thrombolysed were excluded from the study. Written consent was taken from all the study subjects. Detailed history, physical examination was done before enrolling them in the study. All the subjects were evaluated for demographic profile (age, sex, weight & height); risk factors for coronary artery disease like diabetes, hypertension, smoking, overweight/obesity and family history of premature coronary artery disease; necessary investigations were done to evaluate the cardiac status and other comorbid conditions. Echocardiography was done to assess the LA diameter, LA volume, LA volume index (LAVI) and LV function within 48 hours of hospital admission. The enrolled patients were followed up till discharge or death. Patients were classified into two groups based on LAVI ( Lang et al.,2015) Group I: Patients with LAVI >34 ml/m2 Group II :Patients with LAVI ≤34 mL/m². All the patients were treated with standard treatment protocol of the institute. After collecting the data, it was edited, coded and entered into the computer. Statistical analysis of the study was done by computer software device as the Statistical Package for Social Science (SPSS) version 17.0. The results were presented in tables, figures and diagrams. Confidence interval was considered at 95% level. The qualitative variables were expressed as frequency and percentage and the quantitative variables were expressed as mean with standard deviation. All the patients included in this study were informed about the nature, of risk and benefit of the studies.

**Results:**

The main objective of the study was to assess the association of left atrial volume index (LAVI) with in-hospital outcome of acute ST-elevated myocardial infarction (STE-MI) patients. Patients with LAVI >34 ml/m$^2$ and LAVI ≤34 ml/m$^2$ were assigned as Group I and Group II respectively. The findings were documented below:

**Table-I**
*Age distribution of the study population (n=150)*

| Age in years | Group I (n=75) Number (%) | Group II (n=75) Number (%) | Total (n=150) Number (%) | P value |
|---|---|---|---|---|
| ≤40 | 0(0.0) | 8(10.7) | 8(5.3) | 0.01[s] |
| 41-50 | 9(12.0) | 16(21.3) | 25(16.7) | 0.13[ns] |
| 51-60 | 37(49.3) | 25(33.3) | 62(41.3) | 0.03[s] |
| >60 | 29(38.7) | 26(34.7) | 55(36.7) | 0.61[ns] |
| Mean±SD (in years) | 59.4±6.7 | 55.9±6.9 | ±57.7±7.0 | 0,002[s] |
| Range (in years) | 45-80 | 39-66 | 39-80 | |

Table I shows that the mean age of group I was higher than group II (59.4±6.7 vs.55.9±6.9, p=0.002) with statistically significant difference. The study population of group I was older than group II. The mean age of the total studied patients was 57.7±7.0 years ranging from 39 to 80 years. It was also observed that majority of the patients were in the age group of 51-60 years with 49.3% in group I and 33.3% in group II with statistically significant association (p=0.03).

Regarding the gender 109 (72.7%) patients were male and 41 (27.3%) patients were female. There was no statistical significant difference between two groups in terms of gender (p=0.58)

**Table-II**
*Comparison of risk factors profile between the groups (n=150).*

| Risk Factors | Group I (n=75) Number (%) | Group II (n=75) Number (%) | Total (n=150) Number (%) | P value |
|---|---|---|---|---|
| Smoking | 47(62.6) | 44(58.6) | 91(60.6) | 0.61[ns] |
| Hypertension | 40(53.3) | 35(46.7) | 75(50.0) | 0.41[ns] |
| Diabetes Melitus | 34(45.3) | 32(42.7) | 66(44.0) | 0.74[ns] |
| Dyslipidaemia | 33(44.0) | 34(45.3) | 67(44.7) | 0.87[ns] |
| Family H/O CAD | 28(37.3) | 22(29.3) | 50(33.3) | 0.29[ns] |
| Obesity | 6(8.0) | 5(6.6) | 11(7.3) | 0.75[ns] |

Table II shows that all traditional risk factors of CAD were found higher in group I than group II but failed to reach the level of significance (p>0.05).

**Table-III**
*Location of MI of the study population (n=150).*

| Location of STEMI | Group I (n=75) Number (%) | Group II (n=75) Number (%) | Total (n=150) Number (%) | P value |
|---|---|---|---|---|
| Anterior | 23(30.67) | 14(18.67) | 37(24.67) | 0.08[ns] |
| Inferior | 16(21.33) | 29(38.67) | 45(30.00) | 0.06[ns] |
| Anteroseptal | 5(6.67) | 10(13.33) | 15(10.00) | 0.17[ns] |
| Extensive anterior | 17(22.67) | 14(18.67) | 31(20.67) | 0.54[ns] |
| Inferior + posterior | 5(6.67) | 2(2.67) | 7(4.67) | 0.44[ns] |
| Inferior+Posterior+RVI | 4(5.33) | 3(4.00) | 7(4.67) | 1.00[ns] |
| Anterior + Inferior | 3(4.00) | 2(2.67) | 5(3.33) | 1.00[ns] |
| Inferior+Posterior+ Lateral | 2(2.6) | 1(1.3) | 3(2) | 1.00[ns] |

Table III shows that anterior MI was higher in group I than group II. On the other hand, inferior MI was higher in group II than group I. All the above location of MI were not statistically significant between two groups

**Table-IV**
*Comparison of LVEF between two groups (n=150).*

| Ejection fraction (percent) | Study Patients: Group I (n=75) Number (%) | Group II (n=75) Number (%) | Total (n=150) Number (%) | P value |
|---|---|---|---|---|
| <30 (Severe) | 11(14,7) | 5(6.7) | 16(10.7) | 0.11[ns] |
| 30-40 (Moderate) | 14(18.7) | 12(16.0) | 26(17.3) | 0.60[ns] |
| 41-49 (Mild) | 36(48.0) | 8(10.7) | 33(29.3) | 0.001[s] |
| ≥50 (Normal) | 14(18.7) | 50(66.7) | 64(43.7) | 0.004[s] |
| Mean±SD (%) | 47.8±8.2 | 51.7±8.1 | 49.8±8.3 | 0.004[s] |
| Range (%) | (32-57) | (34-59) | (32-59) | |

Table V shows that the mean LVEF in group I was significantly lower than in group II (47.8±8.2% vs. 51.7±8.1%, p = 0.004) .Mild LV dysfunction was higher in group I than group II ( 48.0% vs 10.7%, p= 0.001) with statistically significant difference. Normal LVEF was higher in group II than group I with statistically significant difference ( 66.7% vs 18.7%, p= 0.004).

**Table-V**
*Comparison of LA diameter, LAV and LAVI between two groups (n=150)*

| Variables | Group I (n=75) Number (%) | Group II (n=75) Number (%) | P value |
|---|---|---|---|
| LA diameter (mm) | | | |
| Increased (>40mm) | 7(9.3) | 3(4.0) | 0.32[ns] |
| Normal(≤40 mm) | 68 | 25(33.3) | |
| LAV(ml) | 59.5±4.2 | 27.4±2.9 | <0.001[s] |
| Mean±SD (Range) | (39 – 66) | (20 – 36) | |
| LAVI(ml/$m^2$) | 44.7±6.5 | 26.1±4 | <0.001[s] |
| Mean±SD (Range) | (35 – 60) | (19.5–34) | |

Table V shows that increased LA diameter was higher in group I than group II with statistically insignificant (9.3% vs. 4.0%, p=0.32) .The mean LAV was found significantly higher in group I

than group II (59.5±4.2 vs 27.4±2.9,p<0.001) . The mean LAVI in group I was significantly higher than group II (44.7±6.5 vs. 26.1±4, p<0.001)

**Table-VI**

*In-hospital outcomes variables in the study population (n=150)*

| Outcome variables | Group I (n=75) Number (%) | Group II (n=75) Number (%) | Total (n=150) Number (%) | P value |
|---|---|---|---|---|
| Acute heart failure | 23(30.7) | 8(10.7) | 31(20.7) | 0.002$^{s}$ |
| Recurrent ischemia | 6(8.0) | 3(4.0) | 9(6.0) | 0.31$^{ns}$ |
| Cardiogenic Shock | 8(10.7) | 3(4.0) | 11(7.3) | 0.20$^{ns}$ |
| Significant arrhythmia | 14(18.7) | 5(8.7) | 19(12.7) | 0.03$^{s}$ |
| Death | 2(2.7) | 0(0.0) | 2(1.3) | 0.49$^{ns}$ |

Table VI shows that Acute heart failure was significantly higher in group I than group II (30.7% vs. 10.7%, p=0.002). It was also observed that total significant arrhythmia (AF, VT, VF & 2°/3° AV block ) was occurred more in group I than group II (18.7% vs. 8.7%, p=0.03) with significant association. There were 02 patients died in group I.

**Table-VII**

*In-hospital adverse outcome according to LAVI in the study population (n=150).*

| Adverse in-hospital outcome | Group I (n=75) Number (%) | Group II (n=75) Number (%) | Total (n=150) Number (%) | P value |
|---|---|---|---|---|
| Present | 35(45.7) | 11(14.7) | 46(30.7) | <0.001$^{s}$ |
| Absent | 40(53.3) | 64(85.3) | 104(69.3) | |

Table VII shows that the occurrence of total adverse in-hospital outcomes 46.7% of the patients in Group I had adverse in-hospital outcomes while in Group II 14.7% patients had adverse inhospital outcomes and the difference was statistically significant (p<0.001)

Table VIII demonstrates the logistic regression analysis of Odds Ratio for characteristics of the subjects likely to cause in-hospital cardiac events. The above mentioned variables of interest are all entered into the model directly as confounding independent exposures for the developing of in-hospital outcomes (dependent variable). The variables age>50 years, low LVEF, obesity and LAVI>34 mL/m$^2$ were found to be significantly associated with in-hospital outcomes with the ORs being 10.05, 1.92, 1.17 and 6.55 respectively.

**Table-VIII**

*Multivariate logistic regression analysis of in-hospital cardiac events with confounding factors.*

| Variables interest of Regression factors (β) | Regression Factors | Odds Ratio (OR) | 95% CI of OR | P value |
|---|---|---|---|---|
| Advance age >50 yrs | 2.308 | 10.05 | 1.058-102.536 | 0.04$^{s}$ |
| Smoking | 2.308 | 1.21 | 0.637-5.282 | 0.26$^{ns}$ |
| Diabetes mellitus | 2.308 | 0.69 | 0.163-2.187 | 0.43$^{ns}$ |
| Hypertension | -0.537 | 0.59 | 0.165-2.073 | 0.40$^{ns}$ |
| Dyslipidaemia | -0.077 | 0.92 | 0.320-2.681 | 0.88$^{ns}$ |
| Family history of CAD | -0.472 | 0.62 | 0.206-1.887 | 0.40$^{ns}$ |
| Low LVEF% | 0.501 | 1.92 | 1.111-8.917 | 0,01$^{s}$ |
| Obesity | 1.880 | 1.17 | 1.019-6.412 | 0.04$^{s}$ |
| LAVI | 1.880 | 6.55 | 2.069-20.735 | 0.001$^{s}$ |

s= Significant ns= Not significant

**Discussion:**

The study comprised of 150 newly diagnosed acute STE-MI patients and were divided into two groups, including 75 patients in each group. Patients with LAVI>34 ml/m2 and LAVI ≤34 ml/$m^2$ were assigned as Group I and Group II respectively.The mean age of the study population was 57.7 ± 7.0 years ranging from 39 to 80 years. Mean age of group I was higher than group II (59.4±6.7 vs.55.9±6.9, p=0.002) with statistically significant difference. Majority of the patients were in the age group of 51-60 years with similar age distribution in both groups. Ristow, et al.,[13] observed that the mean age of patients was 66±11 years in LAVI <40 ml/$m^2$ group and was 69±11 years in LAVI> 40m1/m2group. Pritchett, et al.,[14] observed the mean age was 61±10 years in higher LAVI group. Similarly, Meris, et al.,[15] observed that mean age was 67.9± 10.4 years in LAVI < 32ml/$m^2$ Group and mean age 70.2±9.7 years in LAVI ≥32ml/m2patients group. Moller, et al.,[10] observed the mean age of LAVI < 32ml/$m^2$ patients group was 65 years with range from 53-75 years and mean age in LAVI ≥32m1/$m^2$ patients group was 76 years with range from 67-82 years. The higher mean age and age range obtained by the above authors may be due to geographical variations, racial, ethnic differences and genetic causes that had significant influence on coronary artery disease in their study subjects. Male patients were predominant in study population than female, male female ratio being 2.6:1. There was no significant difference between two groups in terms of gender distribution (72.7%vs.27.3%;p=0.58).In almost all studies related to coronary artery disease (CAD) similar male preponderance was found. As females are given less attention and access for them to the health care facilities is limited particularly in low socioeconomic population like our country may contribute for this male predominance. However, gender differences in LA Volume index does not occur as per reviewed literatures Spencer, et al.,16 and Pritchett, et al.,[17]. This study found smoking as the most prevalent (60.6%) risk factor for CAD. Among the other risk factors for CAD, diabetes mellitus was found in 44% of the study subjects, hypertension in 50%, dyslipidemia in 44.7%, obesity in 7.3% and family history of premature CAD in 33.3% and there was no statistically significant difference in risk factor prevalence between the two groups. Akanda, et al., [18] found smoking as the most prevalent (60%) risk factor among the patients of coronary artery disease of the Bangladeshi population. Islam and Majumder.,[5] reported high prevalence of hypertension in elderly Bangladeshi population (40-65%) to contribute to CAD. These differences might be due to variation in the life style. In the article by Tsang, et al.[19] they showed that LAVI correlated positively with hypertension, diabetes mellitus, dyslipidemia and smoking. These risk factors in the study population was consistent with those found by Matsushima, et al. [20] and Wang, et al.,[20]. Anterior MI was higher in number in group I than group II. Though inferior MI was higher in group II than group I. But it was not significant difference between two groups. Bacaksiz, et al.,[21] also showed no differences in location of MI in the study population. In this study, it was found that LA Diameter was Increased (>40mm) in Group I than Group II with no statistical significant difference (9.3% vs.4.0%; p=0.32).The mean LAV was found significantly higher in number in group I than group II (p <0.001) . So mean LAVI in group I was significantly higher than group II (44.7±6.5 vs. 26.1±4, p<0.001). Bacaksiz, et al.,[21] in their study also showed significant differences between the two groups. Increased left atrial volume index (LAVI) is consistent with chronic elevation of LV filling pressure and may be an indicator of increased cardiovascular risk (Tsang, et al.[20] 2002). LAVI has been showed to be highly predictive of cardiovascular risks including arrhythmias, atrial fibrillation, left ventricular failure, stroke and death after acute myocardial infarction (Tsang, et al.,[19] Moller, et al.,[10] and Beinart, et al.,[11].Mean left ventricular ejection fraction (LVEF) of the study population was 49.8 ± 8.3. Mean LVEF was less in Group I than Group II with statistically significant difference (47.8±8.2 vs. 51.7±8.1,p = 0.004).Among the adverse in-hospital outcomes acute left ventricular failure was significantly high in group I than group II (30.7% vs.10.7 %;p=0.002 ). Among the other in-hospital outcomes significant arrhythmia was high in group I than group II with statistically significant difference (18.7% vs. 12.7%;p=0.03) and mean hospital stay period also high in Group I than Group II ( 5.0 ±2.2 vs 4.4±2.4;p=0.03) .Other in-hospital outcomes like recurrent ischaemia , cardiogenic shock were high in group I than group II but there was no statistically significant difference. 2.7% died during the follow-up period in group I but no one died in group II and there was no statistically significant difference. Regarding the occurrence of total adverse in-hospital outcomes 46.7% of the patients in Group I had adverse in-hospital outcomes while in Group II 14.7% patients had adverse in-hospital outcomes and the difference was statistically significant (p<0.001). Moller, et al.,[10] demonstrated that, LAVI was a predictor of mortality after AMI, even after adjustment for conventional indices of systolic and diastolic function and concluded that LA volume could emerge as a simple and important tool for risk stratification and as a guide for future surveillance and therapy in patients with AMI.

Other study also showed that LAVI was associated with systolic and diastolic dysfunction which may result left ventricular failure. In a study by Teresa, et al.,[21] found that LA volume correlate positively with the grade of diastolic dysfunction, and negatively with LV systolic dysfunction. Moller, et al., [10] in their study proved that there is a positive correlation with the wall motion score index (WMSI) and LA volume index >32 ml/$m^2$. Greenberg, et al.,[21] suggested that when LV dysfunction is present with increased stiffness or non-compliance, LA pressure rises to maintain adequate LV filling and the increased atrial wall tension leads to chamber dilatation and stretch of the atrial myocardium. Gottdiener, et al.,[22] suggested that LA size is increased and LA emptying decreased in patients with either systolic or diastolic heart failure and it is associated with the new development of LV failure.

In this study, after multivariate logistic regression analysis LAVI >34 mL/$m^2$ emerged as a significant predictor of in-hospital outcome (odds ratio: 6.55, 95% confidence interval: 2.069-20.735, p=0.001). Other significant predictors were age>50 years (odds ratio: 10.05, 95% confidence interval : 1.058-102.536, p =0.04), LVEF (odds ratio: 1.92, 95% confidence interval:1.111-8.917,p=0.01), obesity(odds ratio: 1.17, 95% confidence interval: 1.019-6.412,p=0.04).Receiver perating characteristic curve (ROC) analysis identified an optimal cut off value for LAVI 34 ml/$m^2$ to predict the cardiac outcomes, with a sensitivity of 76.1% and specificity of 61.5% (area under the curve: 0.786, p=0.000). Hence the prediction in multivariate logistic regression analysis was significantly accurate. In a study Tsang, et al.,[19] showed Indexed LA volume ≥28 ml/$m^2$ was 82.0% sensitive and 93.0% specific and indexed LA volume ≥27 ml/$m^2$ was 89.0% sensitive and 86.0% specific for the detection of abnormal diastolic function. Indexed LA volume ≥32 ml/$m^2$ was 100.0% specific for the detection of abnormal diastolic function, although the sensitivity decreased to 76.1%, which are comparable with the current study. Finally, in the present study by ROC analysis it was found that LAVI with a cut off value of 34 ml/$m^2$ can predict adverse in-hospital outcome in patients of acute STEMI who received thrombolysis with a sensitivity of 76.1% and specificity of 61.5%.

**Conclusion:**

The findings of the present study showed significant association between increased LAVI (>34 ml/$m^2$) and adverse in-hospital outcome in patients with acute STEMI. LAVI can be measured by 2D Echocardiography machine in any low resourced setting hospital in our country and hence it can be used as a cost effective tool for prediction of adverse cardiovascular outcome in acute STEMI.

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*Original Article*

# Hospital Outcome of Hypertensive Non-ST Elevation Myocardial Infarction Patients in Diabetic and Non-Diabetic Groups

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**Abstract:**

**Objective: Acute myocardial infarction is one of the leading causes of all acute emergencies and is becoming an important public health problem in the developing countries. Non-ST elevation myocardial infarction (NSTEMI) is more heterogeneous in their presentation and may be poorly characterized in clinical practice, leading to greater variation in diagnosis and treatment. Patients with diabetes and hypertension who develop a NSTEMI are at increased risk for poor hospital outcome. This study is aimed to assess the differences between hypertensive diabetic and hypertensive non-diabetic patients with NSTEMI and to evaluate the prognostic impact of selected clinical and laboratory parameters on the occurrence of hospital complications.**

**Methods: This was a cross-sectional analytical study. All the adult hypertensive patients of newly diagnosed NSTEMI with or without diabetes mellitus admitted in Ibrahim Cardiac Hospital & Research Institute, Dhaka who fulfilled the inclusion and exclusion criteria were enrolled. The study population comprised of 100 hypertensive patients with their first NSTEMI, and were divided into two groups according to the presence of type 2 diabetes mellitus. Group I (n = 40) patients were diabetic and Group II (n = 60) were non-diabetic. Hospital outcome of the study population was recorded. The incidence of in hospital adverse clinical events in the two groups was compared by using the odds ratio of the two binomial proportion analyses.**

**Results: Among 100 hypertensive NSTEMI patients, 40% were diabetic (Group I) and 60% were non-diabetic (Group II). Mean age was 58.1±10.2 years in case of diabetic group (Group I) and 56.3±10.5 years in non-diabetic group (Group II) ranging from 30-70 years. Male patients (66%) were predominant in the study. Most common clinical presentation was chest pain which was 77.5% in Group I and 83.3 % in Group II followed by sweating (12.5% and 16.7%), dyspnea (10.0% and 11.7%), syncope (5.0% and 6.7%) and atypical chest pain (2.5% and 3.3%) respectively. Smoking was the commonest risk factor which was 62.5% in Group I and 75% in Group II followed by dyslipidemia (32.5% and 36.7%), family history of IHD (30% and 23.3%) and obesity (22.5% and 13.3%) respectively. Diabetic hypertensive patients had significantly higher heart rate, hypertensive peaks and more episodes of asymptomatic ST segment depression. Most common in hospital complications were heart failure (30% and 16.7%), arrhythmias (22.5% and 6.7%), renal failure (10% and 5.0%), cerebral ischemia (7.5% and 1.7%), death (7.5% and 3.3%) and cardiogenic shock (5.0% and 3.3%) in Group I and Group II respectively.**

**Conclusion: In hospital adverse clinical events were more frequent in diabetic hypertensive individuals compared to non-diabetics.**

***Keywords:*** *Hypertension, Diabetes, NSTEMI, Outcomes*

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**Introduction:**

Coronary artery disease (CAD) is one of the common causes of death and disability in developed countries, responsible for about one in every five deaths[1]. It is rapidly becoming a pandemic within the developing world as well where it involves a relatively younger population[2]. Being one of the leading causes of all acute emergencies, acute myocardial infarction has become an important public health problem in the developing countries[3]. Non-ST-segment elevation myocardial infarction (NSTEMI) is more heterogeneous in their presentation and may be poorly characterized in clinical practice, leading to greater variation in diagnosis and treatment[4]. Diabetes mellitus (DM) and hypertension frequently coexist in the same patient. This association has a negative impact on prognosis by strongly predisposing the individual patient to the development of an accelerated atherosclerotic cardiovascular disease. Consequently, diabetic hypertensive subjects have a higher incidence of coronary artery disease than patients with diabetes or hypertension alone[5]. Patients with diabetes who develop a NSTEMI are at increased risk for each hospital outcome including heart failure, renal failure, cardiogenic shock and death[6].

It is observed that the incidence rates (per 100,000) of STEMI declined appreciably (121 to 77), whereas the incidence rates of NSTEMI increased slightly (126 to 132)[7]. The annual incidence of NSTEMI varies significantly between countries, with a mean global annual incidence of about 3 per 1000 population[8]. Diabetes mellitus is becoming a pandemic worldwide. The worldwide number of people with DM is expected to double in thirty years, increasing from 171 million in 2000 to 366 million in 2030. The highest percentages of increases in disease prevalence are likely to be in developing nations. The prevalence of DM in the rural population of Bangladesh is 7.2%[9]. The incidence of DM in patients hospitalized with MI ranges between 10-20% and approximately 40% have impaired glucose levels[10]. Diabetic patients have a higher prevalence of coronary artery disease with an increased number of fatal coronary events due to a higher incidence of plaque rupture and superimposed thrombosis in diffusely diseased coronary arteries[11]. The increased risk of atherosclerosis in patients with DM is caused by endothelial dysfunction and abnormal platelet reactivity as well as coagulation fibrinolysis balance disorders[12]. Diabetic patients develop complications more frequently after MI and have doubled the in-hospital and long-term mortality compared to non-diabetic patients. Cardiogenic shock, heart failure, renal failure, arrhythmia, re-infarction, cerebral infarction are serious complications in diabetics[11].

In Bangladesh, few studies have been undertaken in the past regarding the association DM with adverse cardiovascular events but no study has done describing the presenting characteristics, management and outcomes of hypertensive diabetic and hypertensive nondiabetic patients with NSTEMI. The aim of this study was to describe hospital outcome of hypertensive diabetic and hypertensive nondiabetic groups with all clinical presentations of NSTEMI.

**Methods:**

This cross-sectional analytical study was conducted at the Department of Cardiology, Ibrahim Cardiac Hospital & Research Institute, Dhaka between August, 2017 to January, 2018. A total of 100 newly diagnosed NSTEMI patients within 24 hours of symptom onset and having hypertension with or without Diabetes Mellitus aged ≥30 years and < 70 years admitted in the Department of Cardiology, ICHRI within the study period fulfilling the inclusion and exclusion criteria were included in this study by convenient purposive sampling. Study subjects having presence of ST segment elevation on the presenting 12-lead electrocardiogram, clinical or laboratory evidence of any previous coronary event of any kind, or suffering from secondary hypertension, renal insufficiency, clinically significant liver disease, chronic obstructive lung disease, chronic alcoholism and severe anaemia, hypertensive emergency or crisis and unwilling to take part in the study were excluded from the study. The study patients (n=100) were divided into 2 groups:

Group I (Diabetic group): NSTEMI patients having Hypertension and with diabetes (n=40) and Group II (Non-diabetic group): NSTEMI patients having Hypertension and had no history of diabetes (n=60). Detailed clinical history and examination were carried out and recorded in preformed case record form. Blood was collected for glucose level and serum biochemical marker for myocardial necrosis. Other necessary laboratory investigations and imaging study were done and recorded. Finally, in hospital outcome were observed and compared between two groups. Comparison was done by using odds ratio.

**Results:**

A total of one hundred patients with NSTEMI and having hypertension admitted in the department of cardiology, ICHRI fulfilling the inclusion and exclusion criteria were included in this study during the period from August 2017 to January 2018. The patients were classified into two groups on the basis of presence or absence of DM. The patients with NSTEMI having hypertension and diabetes

were assigned as Group I and those with NSTEMI having hypertension and no diabetes were assigned as Group II.

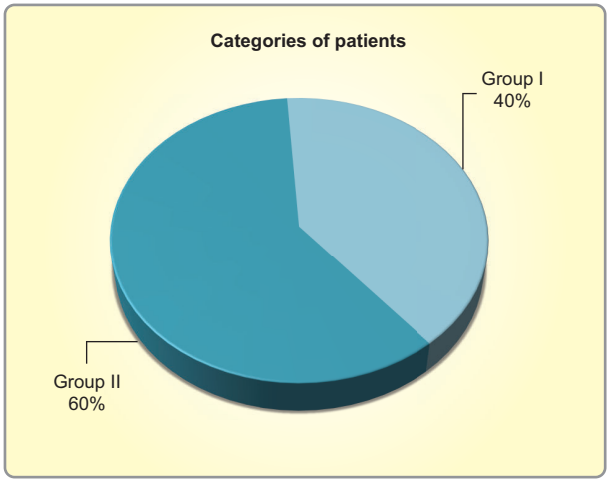


**Fig.-1:** *Pie chart shows distribution of patients according to presence of diabetes (n=100)*

Group I: Hypertensive Diabetic NSTEMI patients, Group II: Hypertensive Non-Diabetic NSTEMI patients.

In our study, it was observed that majority (42.5%) patients belonged to age group 61-70 years in diabetic NSTEMI group (Group I) and (36.6%) in non-diabetic NSTEMI (Group II). The mean age was 58.1±10.2 years in Group I and 56.2±10.5 years in Group II. There was no significant difference in age distribution between the two groups.

**Table-I**
*Distribution of the study population by age (n=100)*

| Age (in years) | Group I (n=40) | | Group II (n=60) | | P value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| 30 – 40 | 2 | 5 | 4 | 6.7 | |
| 41 – 50 | 8 | 20 | 15 | 25 | |
| 51 – 60 | 13 | 32.5 | 19 | 31.7 | |
| 61 – 70 | 17 | 42.5 | 22 | 36.6 | |
| Mean± SD | 58.1±10.2 | | 56.2±10.5 | | $0.904^{ns}$ |

ns = not significant, P value reached from Student's *t* test
Group I - Hypertensive Diabetic NSTEMI patients
Group II - Hypertensive Non-diabetic NSTEMI patients.

Majority (60%) patients were male in Group I and 70% in Group II. There was no significant difference in gender distribution between the two groups.

**Table-II**
*Sex distribution of patients (n=100)*

| Sex | Group I (n=40) | | Group II (n=60) | | P value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Male | 24 | 60 | 42 | 70 | |
| Female | 16 | 40 | 18 | 30 | $0.9^{ns}$ |

ns=not significant, P value reached from chi square test
Group I - Hypertensive Diabetic NSTEMI patients
Group II - Hypertensive Non-diabetic NSTEMI patients.

Among study subjects, most common clinical presentation was chest pain in both Group I (77.5%) and Group II (83.3%), Other common symptoms were sweating (12.5% and 16.7% in Group I and Group II respectively), dyspnea (10.0% and 11.7% in Group I and Group II respectively), syncope (5.0% and 6.7% in Group I and Group II respectively) and atypical chest pain was least common in both groups (2.5% and 3.3% in Group I and Group II respectively). There was no statistically significant difference in symptoms between the two groups.

**Table III**
*Clinical presentation of patients*

| Clinical Presentation | Group I (n=40) | | Group II (n=60) | | P value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Chest pain | 31 | 77.5 | 50 | 83.3 | |
| Sweating | 5 | 12.5 | 10 | 16.7 | |
| Dyspnea | 4 | 10.0 | 7 | 11.7 | $0.57^{ns}$ |
| Syncope | 2 | 5.0 | 4 | 6.7 | |
| Atypical chest pain | 1 | 2.5 | 2 | 3.3 | |

ns=not significant, P value reached from chi square test
Group I - Hypertensive Diabetic NSTEMI patients
Group II - Hypertensive Non-diabetic NSTEMI patients.

Smoking was the commonest risk factor which was 62.5% in hypertensive diabetic NSTEMI patients and 75% in hypertensive non-diabetic NSTEMI patients. Other risk factors were dyslipidemia (37.5% and 30%), family history of IHD (30% and 23.3%) and obesity (22.5% and 13.3%) in group I and group II respectively. No statistically significant difference was noted between groups in relation to risk factors of MI (p>0.05).

**Table-IV**
*Distribution of the study patients by risk factors (n=100)*

| Risk factors | Group I (n=40) | | Group II (n=60) | | P value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Smoking | 25 | 62.5 | 45 | 75 | 0.18$^{ns}$ |
| Dyslipidemia | 15 | 37.5 | 22 | 30 | 0.43$^{ns}$ |
| Family history of IHD | 12 | 30.0 | 14 | 23.3 | 0.45$^{ns}$ |
| Obesity | 9 | 22.5 | 8 | 13.3 | 0.23$^{ns}$ |

ns = not significant, P value is measured by Chi-square test

Group I – Hypertensive Diabetic NSTEMI patients

Group II – Hypertensive Non-diabetic NSTEMI patients.

NSTEMI diabetic patients (60%) developed more complications than non-diabetic NSTEMI patients (33%) which were statistically significantly (p<0.05).

**Table-V**
*In-hospital outcome of study participants (n = 100)*

| Hospital outcome | Group I (n=40) | | Group II (n=60) | | P value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Death | 3 | 7.5 | 2 | 3.3 | 0.35$^{ns}$ |
| Complications | 24 | 60 | 20 | 33 | 0.001$^{s}$ |
| Recovery | 13 | 32.5 | 38 | 63.3 | 0.003$^{s}$ |

ns= non-significant, s= significant, P value calculated by Chi-square test

Group I - Hypertensive Diabetic NSTEMI patients

Group II – Hypertensive Non-diabetic NSTEMI patients.

Most common complication was heart failure (30% in Group I and 16.7% in Group II). Other complications were renal failure (10% and 5.0%), cerebral ischemia (7.5% and 1.7%), death (7.5% and 3.3%) and cardiogenic shock (5.0% and 3.3%) respectively in diabetic and non-diabetic hypertensive patients with NSTEMI. Proportion of arrhythmia and cerebral ischemia was statistically significantly higher among diabetic patients than that of non-diabetic patients (p<0.05). Other complications were also higher in diabetic group but difference with non-diabetic patients was not statistically significant.

**Table VI**
*Distribution of patients according to complications (n = 100)*

| Complications | Group I (n=40) | | Group II (n=60) | | P value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Death | 3 | 7.5 | 2 | 3.3 | 0.349$^{ns}$ |
| Heart failure | 12 | 30.0 | 10 | 16.7 | 0.065$^{ns}$ |
| Arrhythmia | 9 | 22.5 | 4 | 6.7 | 0.004$^{S}$ |
| Renal failure | 4 | 10.0 | 3 | 5.0 | 0.078$^{ns}$ |
| Cardiogenic shock | 2 | 5.0 | 2 | 3.3 | 0.145$^{ns}$ |
| Cerebral ischemia | 3 | 7.5 | 1 | 1.7 | 0.012$^{S}$ |

s= significant, ns=not significant, P value calculated by Chi-square test

Group I – Hypertensive Diabetic NSTEMI patients

Group II – Hypertensive Non-diabetic NSTEMI patients.

Univariate logistic regression analysis shows that diabetic NSTEMI patients had significantly higher odds of developing arrhythmia (OR 4.06, 95%CI 1.16 – 14.28; p<0.05) than non-diabetic NSTEMI patients. Diabetic patients also had higher odds of developing other complications, but those were not statistically significant (p>0.05).

**Table-VII**
*Univariate logistic regression analysis showing odds ratio of developing different complications in hypertensive diabetic NSTEMI patients (n = 100)*

| Complications | Odds Ratio (OR) | 95% CI (Confidence interval) | | P value |
|---|---|---|---|---|
| Death | 2.35 | 0.37 | 14.75 | 0.361$^{ns}$ |
| Heart failure | 2.14 | 0.82 | 5.59 | 0.119$^{ns}$ |
| Arrhythmia | 4.06 | 1.16 | 14.28 | 0.029$^{s}$ |
| Renal failure | 2.11 | 0.45 | 9.99 | 0.346$^{ns}$ |
| Cardiogenic shock | 1.53 | 0.21 | 11.30 | 0.679$^{ns}$ |
| Cerebral ischemia | 4.78 | 0.48 | 47.73 | 0.182$^{ns}$ |

s= significant, ns=not significant, p value determined by logistic regression analysis

Group I – Hypertensive Diabetic NSTEMI patients

Group II – Hypertensive Non-diabetic NSTEMI patients.

**Discussions:**

Cardiovascular disease is the leading cause of morbidity and mortality in people with diabetes mellitus. Patient with DM have a 2 to 4 fold increase in risk of developing cardiovascular disease than those without DM[13]. Morbidity, mortality and re-infarction rate are higher following NSTEMI in diabetic than non-diabetic subjects,

with one-year mortality in this population as high as 50%[14].

This study was carried out with an aim to compare the in-hospital outcome of hypertensive diabetic and hypertensive non-diabetic patients with NSTEMI. Total 100 patients were included in the study. Forty diabetic hypertensive NSTEMI patients were included in Group I and 60 non-diabetic hypertensive NSTEMI patients were included in Group II.

The mean age was found to be 58.1±10.2 years in Group I and 56.2±10.5 years in Group II. No statistically significant ($p>0.05$) difference was observed between two groups. This is consistent with the study conducted by Colivicchi et al. (2008) where that mean age of diabetic patients was 54±2 years and of non-diabetic patients was 56±5 years[5]. The present observation is also similar to a study done in Bangladesh by Salim et al. (2015) which revealed that mean age was 58.7 ± 10.7 years in diabetic patients and 57.3 ± 13.2 years in non-diabetic patients with no statistically significant difference[15].

In the present study, majority of patients were in 7$^{th}$ decade of life in Group I and in Group II (42.5% and 36.6% respectively). In concordance with this study, Franklin et al. (2004) observed that higher incidence of MI was in 65-74 age group in both diabetic and non-diabetic patients[6].

NSTEMI was predominant in male patients in both diabetic and non-diabetic groups (respectively, 60% and 70%). Franklin et al. (2004) showed almost similar results, where male was 60.9% in diabetic group and 69.2% in non-diabetic group. There was no statistically significant difference between the two groups in term of sex distribution[6]. Kyto et al. (2015) have shown that men have a 2.4-fold overall risk for NSTEMI compared with women, which explains the higher prevalence of male in these studies[16].

The most common clinical presentation was chest pain in both diabetic and non-diabetic groups, which were 77.5% in Group I and 83.3 % in Group II. Dyspnoea was found in 10% and 11.7% cases respectively. Similarly, Cader et al. (2017) noted that 74.2% patients with NSTEMI were admitted with chest pain in their study and 42.3% patients had dyspnoea[17]. Other common symptoms at presentation were sweating, syncope and atypical chest pain in both groups. There was statistically insignificant difference in clinical presentation between two groups. Similar observations were also described by Dabek et al. (2016) that where NSTEMI patients usually presented with chest pain (78.8%), dyspnoea (10.6%), syncope (3.5%) and atypical chest pain (2.2%)[12].

In the present study, smoking was the commonest risk factor which was 62.5% in diabetic hypertensive and 75% in non-diabetic hypertensive patients with NSTEMI. Other risk factors were dyslipidaemia (32.5% and 36.7%), family history of IHD (30% and 23.3%) and obesity (22.5% and 13.3%) in Group I and Group II respectively. The difference between the groups was not statistically significant regarding risk factors. Similar proportion were found in a previous study by Salim et al. (2015) which enlisted that tobacco user was 65.4% and 76.9%, dyslipidaemia was present in 32.7% and 40.4%, family history of IHD present in 30.8% and 23.1% and obesity was found in 19.2% and 5.8% in diabetic and non-diabetic patients respectively[15]. Most common risk factor of NSTEMI reported by Dabek et al. (2016) was smoking (44%)[12]. Franklin et al. (2004) also stated that smoking was the most common risk factor of NSTEMI in both diabetic and non-diabetic patients, which was found 49.5% and 60.6% patients respectively in their study[6].

In this study, diabetic patients developed significantly more complications than non-diabetic patients ($p<0.05$). Most common complication was heart failure in both group of patients (30% and 16.7% respectively for Group I and Group II patients). Other complications were renal failure (10% and 5.0%), arrhythmia (22.5% and 6.7%), cerebral ischemia (7.5% and 1.7%), and cardiogenic shock (5.0% and 3.3%) in Group I and Group II respectively. Among them, arrhythmia and cerebral ischemia occurred at a significantly higher proportion in diabetic patients than non-diabetic patients ($p<0.05$). In hospital mortality for Group I and Group II patients were 7.5% and 3.3% patients respectively. Colivicchi et al. (2008) found significantly higher proportion of in-hospital events as well as heart failure in diabetic patients than those of non-diabetic patients[5]. Franklin et al. (2004) revealed that most common hospital outcomes were heart failure (28.9% and 16.5%), renal failure (8.4% and 4.5%), death (6.3% and 5.1%) and cardiogenic shock (4.8% and 4.1%) respectively in diabetic hypertensive and non-diabetic hypertensive patients with NSTEMI[6]. Cader et al. (2017) also reported that about 4.9% of NSTEMI patients had cardiogenic shock, 12.5% had heart failure, 6.6% had acute kidney injury and 8.3% had death[17].

Logistic regression analysis showed that the odds ratio of diabetic patients developing heart failure was 2.14, renal failure was 2.11, arrhythmia was 4.06, cerebral ischemia was 4.78, cardiogenic shock was 1.53 and death was 2.35. Iqbal et al. (2011) reported that the OR of

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NSTEMI patients with DM developing heart failure was 2.5, ($p<0.05$) and cardiogenic shock was 1.9, ($p<0.05$)[3].

In a systematic review by Johansson and colleagues (2017), MI survivors remain at higher risk of dying at first year than the general population, particularly when additional risk factors such as diabetes, hypertension, or older age are present[18]. Therefore, it is pertinent to emphasize on control of diabetes and hypertension in the secondary prophylaxis of patients with myocardial infarction.

**Conclusion:**

NSTEMI in diabetic hypertensive patients is significantly associated with more in-hospital complications and worse outcome in comparison to non-diabetic hypertensive patients particularly cardiac arrhythmia and cerebral ischaemia. There were no statistically significant differences in terms of presentation and risk factors for coronary artery disease among diabetic versus non-diabetic patients with hypertension presenting with NSTEMI.

**Limitations of the study:**

Although the result of this study supports the hypothesis, there are some facts to be considered which might have affected the result of the current study. It was a single center study. The number of study population was relatively small. Sampling method was non-randomized, so there was risk of selection bias. Long term follow up was not possible.

**Recommendations:**

In this study it was observed that most diabetic hypertensive patients with NSTEMI come at the late stage, making treatment options difficult and so more complications have already developed. However, if limitations of this study are considered, this is a one hospital based prospective study that may not represent the total scenario of our community or country. So, further study can be done with community based large sample size at national level.

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*Original Article*

# Correlation Between HbA1c, Serum Magnesium (Mg) and Lipid Profile in Type 2 Diabetic Foot Ulcer and without Foot Ulcer Patients – a Cross-Sectional Study

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**Abstract:**

**Introduction : Diabetes mellitus, especially Type 2, is a common metabolic problem in Bangladesh with serious complications like diabetic foot ulcer. The relationship between HbA1c, serum magnesium, and lipid profile in type 2 DFU patients was examined in this study.**

**Aim of the study: The aim of this study was to examine the correlation between HbA1c, serum Magnesium, and lipid profile in type 2 diabetic foot ulcer and without foot ulcer patients.**

**Methods: This cross-sectional study was conducted in the Department of Biochemistry and Molecular Biology, BIRDEM Academy, Dhaka, Bangladesh during the period from January 2018 to December 2018**

**Result: In total 120 respondents who were adult male and female were included in the study. In our study, we found that the majority of our patients (58.3%) were aged between 41-50 yrs. in group II. We found the percentage of male and female participants were 66.7% and 33.3% in group I and 51.7% and 48.3% in group II respectively. The negative correlation was found between serum magnesium with fasting plasma glucose and Triacylglycerol in group I. The significant positive correlation was found between serum Mg and HDL-c (r=0.443; p<0.01) in group I.**

**Conclusion: Diabetes Mellitus, notably Type 2, poses challenges in Bangladesh, including Diabetic Foot Ulcer (DFU). This study explores links between HbA1c, serum magnesium, and lipid profile in Type 2 DFU patients, potentially guiding early interventions and improving diabetic care outcomes.**

***Key words:*** *HbA1c, Serum Magnesium, Lipid Profile, Type 2 DFU*

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**Introduction:**

Diabetes mellitus (DM) is a chronic metabolic disease due to insufficient insulin production or action or both, causing elevated blood glucose level and harm to many of body's systems, especially blood vessels and nerves[1] In Bangladesh, the prevalence of DM was 7.1 million in 2015 and is projected to increase to 13.6 million by 2040. Type 1 DM accounts for about 5%, and Type 2 DM accounts for 90-95% of all Diabetes Mellitus cases.[2] Type 1 DM results from autoimmune destruction of ß-cells of pancreas, while Type 2 is due to progressive insulin

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secretion defect and resistance.[3] Persistent high blood glucose leads to long-term vascular complications, including microvascular and macrovascular issues in Type 2 diabetes.

Diabetic foot ulcers are a major complication of diabetes, causing significant morbidity and hospital admissions.[4] Around 1-4% of type 2 diabetic patients develop foot ulcer yearly, leading to gangrene and amputation.[5,6] Contributing risk factors include micro and macro angiopathy, peripheral neuropathy, and ischemia.[7] HbA1c is a crucial indicator of glycemic control, reflecting average glucose level over two months.[8] The ADA and EASD recommend an HbA1c level e"6.5% as a diagnostic criteria for diabetes.[9] Regular monitoring of blood glucose and HbA1c is standard practice in diabetes management now a days,[10] as good glycemic control reduces the complication risk.[11] Elevated HbA1c levels indicate poorly controlled diabetes and an increased risk of complications.[12]

Magnesium is important cation for carbohydrate metabolism and enzyme actions.[13,14] Low magnesium in type 2 diabetes affects glycemic control and insulin sensitivity.[15] Several factors like diet, insulin resistance, and medications contribute to hypomagnesemia.[13,16,17] Hypomagnesemia is linked to diabetic complications, including neuropathy and diabetic foot ulcer.[18] Magnesium level should be controlled and magnesium supplementation is beneficial for diabetic foot ulcer patients.[19] Diabetes also disrupts lipid metabolism, leading to changes in cholesterol, Triacylglycerol, HDL-c, and LDL-c levels.[20] Low magnesium is associated with dyslipidemia and hypertension,[21] and studies link it to reduced HDL-c level.[22] Diabetic foot ulcer patients show elevated total cholesterol, triacylglycerol, and LDL-c, and lower HDL-c levels.[20] These factors contribute to cardiovascular risk and vascular damage.[23] The aim of the study was to evaluate the correlation between HbA1c, serum Magnesium (Mg), and lipid profile in individuals diagnosed with type 2 diabetes, regardless of whether they had foot ulcer or not.

**Objectives**

The objective of this study was to investigate the potential correlations between HbA1c, serum Magnesium (Mg), and lipid profile in individuals with type 2 diabetes, both with and without foot ulcer.

**Methodology & Materials**

This was a cross-sectional study and was conducted in the Department of Biochemistry and Molecular Biology, BIRDEM Academy, Dhaka, Bangladesh during the period from January 2018 to December 2018.

A total of 120 patients who were male and female, aged 30 years above were included in the study. Among them, 60 were previously diagnosed Type 2 diabetic patients with foot ulcer were selected as Group I and another 60 were previously diagnosed Type 2 diabetic patients without foot ulcer were selected as Group II. Data were collected through structured questionnaire and review of patients clinical and biochemical records. We included patients having type 2 diabetes with and without foot ulcer and excluded who were not eligible for the study. Type 2 diabetes mellitus was diagnosed according to WHO criteria. Diagnosed cases of type 2 diabetic foot ulcer patients were selected from inpatient and outpatient departments of medicine and surgery. Height and weight were measured and recorded in the questionnaire. Blood pressure was also measured. At first 5 ml blood sample was collected from each study subject after an overnight fasting of 10-12 hours. From this blood sample, 1.5 ml was delivered in a fluoride tube for estimation of fasting plasma glucose and another 1.5 ml was delivered in a EDTA tube for HbA1c estimation and remaining 2 ml in red tube for measurement of serum magnesium and lipid profile.

Statistical Analysis: All data were recorded systematically in preformed data collection form and quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. Statistical analysis was carried out by using Statistical analysis was done by using SPSS (Statistical Package for Social Science) Version 23 for windows 10. P value <0.05 was considered as statistically significant. Ethical clearance was obtained from BIRDEM to undertake the current study.

**Results:**

**Table-I**

*Distribution of age in Group I (type 2 diabetes with foot ulcer) and Group II (type 2 diabetes without foot ulcer) of the study subjects (N=120)*

| Age | Group I | | Group II | |
|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage |
| 31-40 | 8 | 13.3 | 12 | 20 |
| 41-50 | 18 | 30 | 35 | 58.3 |
| >50 | 34 | 56.7 | 13 | 21.7 |

Table 1 shows the distribution of age in Group I and Group II. In Group I, most of the study participants were more than 50 years age group (56.7%) and in Group II, the study participants belonging to the age group (41-50) year were more prevalent (58.3%).

Figure 1 shows gender distribution of study subjects of Group I and Group II. This study found that in Group I,

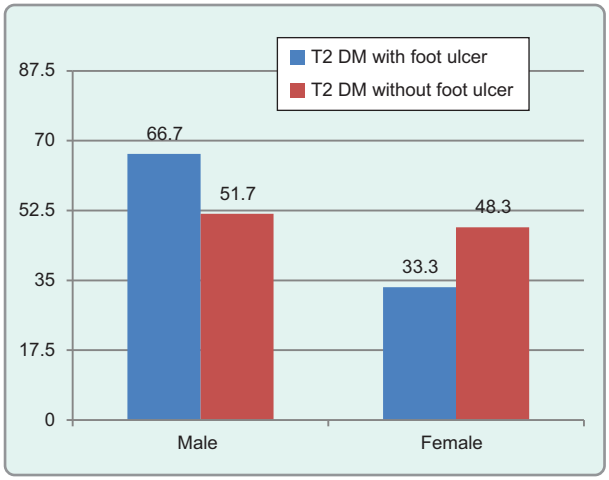


**Fig.-1:** *Gender distribution in Group I (type 2 diabetes with foot ulcer) and Group II (type 2 diabetes without foot ulcer) of the study subjects.*

percentage of male and female participants were 66.7% and 33.3% respectively. In Group II percentage of male participants were more prevalent that female (51.7% vs 48.3%).

Table 2 shows that high hemoglobin A1c (HbA1c e”7.5%) was significantly more affected by diabetic foot ulcer than compared with near normal HbA1c (61.6% vs 31.9%; $X^2$=10.10; p value <0.001). As for serum magnesium, we found the prevalence of hypomagnesaemia was more in group I (69.6%) and in group II, it was 30.4%.

Table 3 shows the Lipid profile among Group I and Group II. The study found that the mean value of TC was 177.01 ± 27.83, TAG was 170.21 ±5 6.01, that of LDL-c was 99.31 ± 32.31 and HDL-c was 30.40 ± 9.93 in group I; in group II the mean value of TC, TAG LDL-c and HDL-c were 161.23 ± 28.35, 149.30 ± 46.95, 87.60 ± 21.44 and 37.91 ± 7.48 respectively. This study also found that the mean value of TC, TAG, LDL-c were significantly higher in Group I than Group II (p<0.01, p<0.05, p<0.05 respectively), on the other hand the mean value of HDL-c was significantly lower in Group I than Group II (p<0.001).

Table 4 shows the correlation of serum magnesium with other biochemical variables in Group I and Group II (type 2 diabetes with and without foot ulcer). In this study, in Group I significant negative correlation was found between serum magnesium with fasting plasma glucose and Triacylglycerol (r= -0.296; p=0.022 and r= -0.280; p=0.030) respectively. However, significant positive correlation was found between serum magnesium with high density lipoprotein cholesterol (HDL-c) level (r = 0.443; p=0.001). As for Group II, the serum magnesium was negatively correlated with fasting plasma glucose (r= -0.176, p= >0.05), TC (r= -0.029, p= >0.05), TG (r= -

**Table-II**

*HbA1c and Serum magnesium status in type 2 diabetic with and without foot ulcer patients (n=120)*

| Group | | Group I (DM with foot ulcer) (%) | Group II (DM without foot ulcer) (%) | p-value |
|---|---|---|---|---|
| HbA1c | Within reference (<7.5%) | 15 (31.9%) | 32 (68.1%) | 0.001 |
| | Uncontrolled (≥7.5%) | 45 (61.6%) | 28 (38.4%) | |
| Serum magnesium | Hypomagnesaemia (<0.70 mg/dl) | 39 (69.6%) | 17 (30.4%) | 0.001 |
| | Within reference (≥0.70 mg/dl) | 21 (32.8%) | 43 (67.2%) | |

**Table-III**

*Lipid profile of Group I (type 2 diabetes with foot ulcer) and Group II (type 2 diabetes without foot ulcer)*

| Lipid profile | T2 DM with foot ulcer (n=60) Mean ± SD | T2 DM without foot ulcer (n=60) Mean ± SD | p value |
|---|---|---|---|
| Total cholesterol (TC) (mg/dl) | 177.01 ±27.83 | 161.23 ±28.35 | 0.003 |
| Triacylglycerol (TAG) (mg/dl) | 170.21 ±56.01 | 149.30 ±46.95 | 0.029 |
| Serum LDL-cholesterol (mg/dl) | 99.31 ±32.31 | 87.60 ±21.44 | 0.021 |
| Serum HDL-cholesterol (mg/dl) | 30.40 ±9.93 | 37.91 ±7.48 | 0.001 |

**Table-IV**

*Correlation of serum magnesium level (mmol/L) with other biochemical variables in Group I and Group II (type 2 diabetes with and without foot ulcer).*

| Variables | With foot ulcer DM patients | | Without foot ulcer DM patients | |
|---|---|---|---|---|
| | r | P value | R | p value |
| Fasting plasma glucose | -0.296 | 0.022 | -0.176 | >0.05 |
| Total cholesterol (TC) | 0.053 | 0.687 | -0.029 | |
| Triacylglycerol (TAG) | -0.280 | 0.030 | -0.143 | |
| LDL cholesterol | 0.044 | 0.740 | 0.014 | |
| HDL cholesterol | 0.443 | 0.001 | -0.04 | |

**Table-V**

*Correlation of HbA1c (%) level with other biochemical variables in Group I and Group II (type 2 diabetes with and without foot ulcer).*

| Variables | With foot ulcer DM | | Without foot ulcer DM | |
|---|---|---|---|---|
| | r | p value | r | p value |
| Total cholesterol (TC) | 0.094 | | 0.134 | >0.05 |
| Triacylglycerol (TAG) | 0.023 | | 0.144 | |
| LDL cholesterol | 0.008 | | 0.160 | |
| HDL cholesterol | -0.066 | | -0.055 | |

0.143, p= >0.05), HDL-c (r= -0.04, p= >0.05) respectively.

Table 5 shows correlation of HbA1c level with other biochemical variables in Group I and Group II (type 2 diabetes with and without foot ulcer). In this study Group I, the HbA1c was positively correlated with TC (r= 0.094, p= >0.05), TAG (r= 0.023, p= >0.05) and LDL-c (r= 0.008, p= >0.05). However, negative correlation was found between HbA1c with high density lipoprotein cholesterol (HDL-c) level (r = -0.066, p=>0.05). As for Group II, the HbA1c was positively correlated with TC (r= 0.134, p= >0.05), TAG (r= 0.144, p= >0.05), LDL—c (r= 0.160, p= >0.05) respectively.

**Discussion:**

The cross-sectional study was conducted in the Department of Biochemistry and Molecular Biology, BIRDEM Academy, Dhaka, Bangladesh during the period from January 2018 to December 2018 to estimate HbA1C, serum Magnesium and lipid profile level in type 2 diabetic foot ulcer and without foot ulcer patients. A total of 120 subjects were selected in this study according to inclusion and exclusion criteria. Among them 60 diagnosed type 2 diabetic foot ulcer patients were placed in Group I and another 60 diagnosed type 2 diabetic patients without foot ulcer were placed in Group II. In this study we found that the majority (56.7%) of our patients of Group I were aged more than 50 years and 58.3% of our patients of Group II were aged between 41-50 years. [Table-1] In the study male respondents were found more than female in both Groups. In Group I there were 66.7% male and 33.3% female, whereas in Group II male and female participants were 51.7% and 48.3% respectively. [Figure-1] The mechanism behind could be that male were less insulin sensitive than female due to more hepatic and visceral fat than women.[24] This finding was similar with this study where we found more male participants (66.67%) than female (34.4%) of type 2 diabetic foot ulcer group.[25] Another study also found male participants more predominant than female in their study (67% and 33% respectively).[26] In our study we found uncontrolled glycemia is considered as the strongest indicator of development of diabetic complications. Frequency of uncontrolled HbA1C was higher in Group I than Group II (61.6% and 38.4% respectively). Frequency of hypomagnesaemia was also higher in group I than group II (69.6% and 30.4% respectively). In a study by Rodriguez Moran and Guerrero Romeo, it was observed that 93.9% of patients with diabetic foot ulcer had hypomagnesaemia in contrast to 73.1% of diabetic patients without foot ulcer.[27] Regarding lipid profile, we found the mean value of Total cholesterol (TC), Triacylglycerol (TAG), Low density lipoprotein cholesterol (LDL-c) and High density lipoprotein cholesterol (HDL-c) in Group I were 177.01±27.83 (mg/dl), 170.21± 56.01 (mg/dl), 99.31± 32.31 (mg/dl) and 30.40 ±9.93 (mg/dl) respectively, whereas the mean value of TC, TAG, LDL-c and HDL-c in Group II were 161.23±28.35 (mg/dl), 149.30

± 46.95 (mg/dl), 87.60 ± 21.44 (mg/dl) and 37.91±7.48 (mg/dl) respectively. This study also found that the mean value of TC, TAG, LDL-c were significantly higher in Group I than in Group II ($p<0.05$), on the other hand the mean value of HDL-c was significantly lower in Group I than in Group II ($p<0.05$). This finding was consistent with Hasan et al. (2013) who found the level of TC, TAG & LDL-c significantly higher in diabetic foot ulcer patients than that of patients without foot ulcer. They also found significantly lower HDL-c in type 2 diabetic foot ulcer patients than diabetic patients without foot ulcers.[28] Some study showed that elevated triacylglycerol and decreased HDL-c levels are the most common lipid metabolism disorders in diabetic patients, and claim that LDL-c level is relatively similar to non-diabetic individuals.[29] In our study group I, significant negative correlation was found between serum magnesium with fasting plasma glucose (r= -0.296) and Triacylglycerol (r= -0.280) respectively and group II was negatively correlated with fasting plasma glucose (r= -0.176), TC (r= -0.02), TAG (r= -0.143), HDL-c (r= -0.04) respectively. [Table-IV] The study found that the serum magnesium level was negatively correlated with postprandial plasma glucose level.[30] This study is reinforced by previous studies who reported that serum magnesium deficiencies were present in patients with type 2 DM, showing a strong relationship with foot ulcer.[31] We found the patients with diabetic foot ulcer had positive correlation of HbA1c level with TC (r= 0.094), TAG (r= 0.023), LDL-c (r= 0.008). It was also found that patients without diabetic foot ulcer had positive correlation of HbA1c level with TC (r= 0.134), TAG (r= 0.144), LDL-c (r= 0.160) respectively. [Table-V] This finding was similar with the finding of Keskek et al (2013) who also found negative correlation between serum magnesium with fasting serum glucose and HbA1C level.[32] No correlation was found between HbA1C and other biochemical variables. But in another study of Hasan et al. (2013) found positive correlation between HbA1C and TC, TAG and negative correlation with HDL-c in diabetic foot ulcer patients. It was observed that complications of diabetes mellitus are associated with high HbA1C, low serum magnesium level and dyslipidemia Consequently, we determined that low serum magnesium level is associated with high level of blood glucose, HbA1C and also high TC, TAG, LDL-c and low HDL-c levels. Uncontrolled diabetes and low HDL-C level are important risk factors for atherosclerosis, which contribute to the development of foot ulcer. Neuropathy, another risk factor for diabetic foot ulcers, can develop from high glucose level due to magnesium deficiency.[28] We also found a significant relationship between HbA1c and FBS level, which is in line with findings of some other studies.[33,34,35] Except for LDL-c level, we found significant relationship between HbA1c, FBS, cholesterol and triacylglycerol levels. Pujari found a statistically significant correlation between HbA1c level and dyslipidemia.[35] In Oman, Al-Alawi reported a correlation between improved dyslipidemia and HbA1c control.[36] In a similar study in India, reported a significant positive correlation between HbA1c, total cholesterol, triacylglycerol, HDL-c and LDL-c levels.[37] In 2013, Parial et al. reported that 86% of patients and almost all patients with foot ulcer had high HbA1c levels (8.88 mg/dl), while 88% of patients without diabetic foot ulcer had satisfactory HbA1c level. HbA1c, total cholesterol, LDL-c and triacylglycerol levels had a significant positive correlation with diabetic foot ulcer, indicating major contributing factor for diabetic foot ulcer. In a study in India on females patients with type 2 diabetes, HbA1c had a positive correlation with total cholesterol (r=0.414) and LDL-c (r = 0.8686) levels, which is consistent with our findings.[38] In a study by Mahajan and Koley, HbA1c had a significant positive correlation with blood glucose, total cholesterol, triacylglycerol, LDL-c and HDL-c levels.[39] In Pakistan, Naeem et al. found that female diabetic patients had significantly increased systolic and diastolic blood pressure, total cholesterol and LDL-c level compared to male patients.[40] So along with glycemic control, magnesium level should be maintained in patients with DM, with or without foot ulcer and dietary supplementation of magnesium in addition with classical therapies for diabetes may help in prevention or delaying diabetic complications. Oral magnesium supplementation may improve insulin sensitivity and metabolic control in type 2 DM with lower serum magnesium levels thus reducing the risk of both micro and macrovascular complications. It has also a beneficial effect on lipid profile of diabetic patients.[31]

**Limitations of the study**

Our study was a single center study so we cannot draw conclusions regarding causality. We could only study a few adverse effects within a short study period. There are many things that could have been included here such as the patients with H/O cerebrovascular accident, chronic systemic disease, other endocrine disorders and peripheral arterial disease.

**Conclusion and recommendations**

Diabetes Mellitus, especially Type 2, presents a significant challenge in Bangladesh, with Diabetic Foot Ulcer (DFU) as a major complication. In this study we explored the relationship between HbA1c, serum

magnesium, and lipid profile in Type 2 DFU patients. The findings could offer insights into early screening and interventions, reducing the burden of DFU-related complications on both individual and society. This research has the potential to reshape diabetic care and improve the quality of life for many.

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*Original Article*

# Efficacy and Safety of Fondaparinux Versus Enoxaparin in The Management of Unstable Angina and NSTEMI

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**Abstract:**

**Background: Unstable angina (UA) and Non-ST elevation myocardial infarction (NSTEMI) impose significant health and economic burden on Bangladesh. Anticoagulants are recommended as standard therapy by various clinical practice guidelines. Recent studies have shown fondaparinux's superiority over enoxaparin in patients with UA & NSTEMI, especially in bleeding reduction. The description of this finding has not yet been documented in any study from Bangladesh. This study aimed to evaluate the efficacy and safety of fondaparinux compared with enoxaparin in the management of UA & NSTEMI.**

**Methods: This prospective observational study included 177 patients (fondaparinux=87, enoxaparin=90) with UA and NSTEMI admitted to the Department of Cardiology of Abdul Malek Ukil Medical College Hospital, Noakhali, Bangladesh. The primary outcome was to determine whether fondaparinux was non-inferior to enoxaparin in preventing the composite of death, new myocardial infarction, and refractory ischemia, readmission in the hospital for heart failure within six months after anticoagulant therapy. The primary safety outcome was to evaluate the rates of major bleeds in the two groups.**

**Results: The minor (6.9% versus 20%, p=0.002) and major (0% versus 3.3%, p=0.002) bleeding events were less frequently observed with Fondaparinux than enoxaparin. Myocardial ischemia (3.4% vs. 14.4%, p=0.011) and recurrent ischemia (11.5% vs. 24.4%, p=0.025) were less frequent in Fondaparinux than in the enoxaparin group. Fondaparinux was associated with a reduced number of deaths in 3 months (6.2% vs. 12.5%) and 6 months (5.1% vs. 13.3%) without any statistical significance (p>0.05). In the fondaparinux group, 20.7% of patients experienced a composite event within 6 months, compared with 40% of patients in the enoxaparin group (OR:0.659, 95% CI 0.500-0.867, p=0.005).**

**Conclusion: Similarly, to recently published data in international literature, fondaparinux proved superior to enoxaparin for the Bangladeshi population, with a significant reduction of combined events and bleeding in patients with UA & NSTEMI.**

***Keywords:*** *Unstable Angina; NSTEMI; Enoxaparin; Fondaparinux; Hemorrhage; Mortality; Morbidity.*

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**Introduction:**

Coronary artery disease (CAD) is a leading cause of death worldwide and the global prevalence of IHD is rising. Moreover, health systems have to manage an increasing number of cases due to population aging.[1] In

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a recent meta-analysis a high CAD prevalence along with an upward trend was observed in Bangladeshi adults. So, it can be assumed that CAD is a major health issue and represents a significant economic burden for Bangladesh.[2] From our practical experiences it has been observed that there is a rising trend of hospitalization due to CAD in both public and private hospitals in Bangladesh. Actually, CADs are growing by epidemic proportions day by day in Bangladesh.[3]

Acute coronary syndrome (ACS) is a spectrum of life-threatening CADs usually due to coronary artery plaque rupture, with subsequent thrombin generation, platelet activation, and thrombus formation.[4] Patients present either with typical acute chest pain and persistent (>20 min) ST-segment elevation on ECG, which is usually indicative of acute total occlusion, or more commonly (and the population discussed in this review), with acute chest pain without persistent ST-segment elevation, which is usually indicative of partial or intermittent occlusion.[4,5]

Once a diagnosis of NSTE-ACS (UA & NSTEMI) is likely or definite, anti-ischemic drugs are introduced as indicated, including beta-adrenoceptor antagonists and angiotensin II receptor antagonists. A management strategy is then decided based on the level of risk.[5] Current treatment guidelines for patients with NSTE-ACS generally recommend an invasive strategy (i.e., diagnostic angiography followed by possible percutaneous and/or surgical revascularization) for average- to high-risk patients or a conservative management approach (i.e., a selectively invasive strategy) for those with lower risk scores.[5,6]

Pharmacological recommendations and sequence of therapy will depend on the individual hospital's management strategy and treatment guidelines, but, for both invasive and conservative strategies, a combination of antiplatelet and anticoagulation agents is recommended.[5] Most commonly, antiplatelet therapy will comprise aspirin plus clopidogrel and/or a glycoprotein IIb/ IIIa (GP) inhibitor, followed by an anticoagulation agent. Options for anticoagulation therapy include unfractionated heparin (UFH), bivalirudin, and low-molecular-weight heparins, such as enoxaparin, and fondaparinux.[4,5]

Fondaparinux is a well-established synthetic anticoagulant that inhibits thrombus formation by interrupting the blood coagulation cascade through antithrombin III-mediated selective inhibition of factor Xa.[6,7] The Fifth Organization to Assess Strategies in Ischemic Syndromes (OASIS 5) trial showed fondaparinux to reduce the rate of major bleeding and net clinical benefit including death, Myocardial Infarction (MI), stroke, and major bleeding in comparison to enoxaparin.[8,9] However, results from the French Registry of ST-segment elevation and non-ST segment elevation MI (NSTEMI) 2010 showed a similar rate of bleeding and mortality between fondaparinux and enoxaparin.[10] On the other hand different registry-based data provided evidence in favor of fondaparinux compared to enoxaparin in terms of cost effectivity and efficacy. [11-22]

Though data from different settings are increasingly available in the literature regarding the comparative benefit of fondaparinux over enoxaparin in cases of NSTE-ACS, this issue is rarely addressed in Bangladesh. In this background, this study is designed to compare fondaparinux to enoxaparin in in-hospital prognosis and short-term outcome of NSTE-ACS in a group of Bangladeshi population.

**Methods:**

A prospective observational study was conducted in the department of cardiology, Abdul Malek Ukil Medical College & Hospital, Noakhali, Bangladesh from January 2022 to December 2022. Prior approval was obtained from the Ethical and Review Committee of Abdul Malek Ukil Medical College and permission for data collection was obtained from the hospital administrator. Prior to inclusion in the study, written informed consent was obtained from the study participants after the study purpose and procedures were explained to them.

Consecutively Admitted patients with a diagnosis of Unstable Angina and NSTEMI were included. Patients were excluded if they had contraindications to LMWH, recent hemorrhagic stroke, indications for anticoagulation other than an ACS, have a serum creatinine level of at least 3 mg per deciliter, patients with STE-ACS, pregnancy, and comorbid conditions with life expectancy <6 months. Finally, it was possible to include 177 patients in the study within the limited time and resources.

The primary efficacy parameters are preventing death, MI, or refractory ischemia in the acute treatment of patients with Unstable Angina and NSTEMI. The primary safety objective is to evaluate whether fondaparinux is superior to enoxaparin in reducing major bleeding. Obesity was defined as BMI e" 27.5 kg/m$^2$.[22] Dyslipidemia: Diagnosed by NCEP: ATP-III criteria:[23] Major or minor bleeding was defined using the BARC score types 3 and 5, and minor bleeding using types 1 and 2.[24]

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From the eligible participants the following data were obtained: age, gender, presence of diabetes mellitus, systemic arterial hypertension, smoking habit, dyslipidemia, family history of early onset coronary disease, previous coronary artery disease (previous angioplasty or coronary artery bypass surgery), hemoglobin, creatinine, peak troponin, Killip classification, left ventricle ejection fraction, medications used in the first 24 hours of hospital admission and adopted coronary treatment. Eligible patients received either fondaparinux 2.5 mg once daily by subcutaneous injection or enoxaparin (1 mg/kg) twice daily by subcutaneous injection. If creatinine clearance is <30 mL/min, the enoxaparin dosage was reduced to 1 mg/kg once daily. Fondaparinux was given for a mean of 6 days or hospital discharge (whichever was earlier), and enoxaparin was given for 2 to 8 days or until clinically stable as per its current approval for use in UA and NSTEMI. The minimum duration of therapy was 2 days; however, catheterization and PCI can be scheduled earlier than this time if necessary.

Outcome assessment: Patients were followed up regularly during their hospital stay for the outcome assessment. After discharge, they were asked to attend follow-up monthly for six months. Moreover, they were requested to inform the research assistant if there were any adverse events.

Data were expressed as frequency and proportion for the qualitative variables and mean (standard deviation) or Median (interquartile range) for the continuous variables. The analyses include all patients who underwent randomization. Comparisons between groups were done using the Chi-Square test for categorical variables. For continuous variables, when data showed normal distribution, the t-test was used, with significance considered at $p < 0.05$. When the distribution did not follow the normality pattern, we used the Mann-Whitney U test. $P$ value < 0.05 was considered to represent a statistically significant difference. All calculations were made using the SPSS 23.0 statistical.

**Results:**

The mean age was around 60 years and there was male preponderance in both groups, 61 years old, and approximately 63% of participants were male. The most prevalent risk factor was systemic arterial hypertension, followed by smoking, diabetes Mellitus, and dyslipidemia. The majority of the patients in both groups were in Killip class-I. Overall, 100% of patients in the fondaparinux group and 98.9% in the enoxaparin group received aspirin, 51.7% and 53.3% received ACE inhibitors, and 56.3% and 50% received Beta blockers, respectively. Table 1 shows that both groups were similar in terms of their baseline clinical and biochemical characteristics.

**Table-I**

*Baseline demographic and clinical characteristics between two groups*

| Variables | Fondaparinux (n=87) | Enoxaparin (n=90) | P value |
|---|---|---|---|
| Age, years | 60.2±8.3 | 60.1±10.7 | 0.928† |
| Sex | | | |
| Male | 62 (71.3) | 75 (83.3) | 0.055* |
| Female | 25 (28.7) | 15 (16.7) | |
| Interval from symptom onset to injection, hours | 7.3 ± 2.0 | 7.3 ± 3.5 | 0.915† |
| Risk factors | | | |
| Hypertension | 57 (65.5) | 54 (60.0) | 0.448* |
| Smoking | 57 (65.5) | 67 (74.4) | 0.195* |
| Obesity | 7 (8.0) | 2 (2.2) | 0.078‡ |
| Dyslipidemia | 38 (43.7) | 42 (46.7) | 0.690* |
| Diabetes mellitus | 37 (42.5) | 37 (41.1) | 0.848* |
| H/O CAD | 21 (24.1) | 22 (24.4) | 0.962* |
| H/O stroke | 7 (8.0) | 7 (7.8) | 0.947* |
| H/O ACS | 19 (21.8) | 26 (28.9) | 0.282* |
| H/O PCI | 5 (5.7) | 2 (2.2) | 0.229 |
| H/O CABG | 1 (1.1) | 1 (1.1) | 0.998* |
| Examination findings | | | |
| Heart rate, /min | 75.7±12.9 | 76.5±11.5 | 0.633† |
| SBP, mmHg | 118.5±13.3 | 119.8±20.6 | 0.628† |
| DBP, mmHg | 75.5±10.8 | 75.7±14.4 | 0.938† |
| Killip classification | | | |
| Class I | 70 (80.5) | 69 (76.7) | 0.539* |
| Class II | 17 (19.5) | 21 (23.3) | |
| Ejection fraction, % | 55.2±6.6 | 54.5±9.5 | 0.5588† |
| Medication received | | | |
| Aspirin | 87 (100.0) | 89 (98.9) | 0.998‡ |
| Clopidogrel | 87 (100.0) | 90 (100.0) | NA |
| ACE inhibitor | 45 (51.7) | 48 (53.3) | 0.830* |
| Beta-blocker | 49 (56.3) | 45 (50.0) | 0.339* |
| CCB | 2 (2.3) | 4 (4.4) | 0.680‡ |
| Anti lipid | 85 (97.7) | 86 (65.6) | 0.430‡ |
| Biochemical parameters | | | |
| Hemoglobin, g/dl | 11.4±1.1 | 11.6±1.5 | 0.209† |
| S. Creatinine, mg/dl | 1.3±0.4 | 1.2±0.4 | 0.545† |
| RBS, mmol/L | 8.3±3.0 | 8.6±3.5 | 0.565† |

Data were expressed as frequency (%) or mean ±SD; CAD: Coronary artery disease; ACS: Acute coronary syndrome; PCI: Primary coronary intervention; CABG: Coronary artery bypass graft; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; CCB: Calcium channel blocker; RBS: Random blood sugar. *Chi-square test; †Unpaired t test; ‡Fisher's exact test.

Comparatively fewer patients had recurrent ischemia and in-hospital mortality in the fondaparinux group than in the enoxaparin group without any statistical significance (Table II) during their initial hospital stay. At 3-month follow-up, there was a trend toward a lower rate of death,

myocardial infarction, or refractory ischemia with fondaparinux than with enoxaparin without any statical significance. At the 6-month follow-up, there was a trend of a lower rate of death reaching statistical significance in fondaparinux than in enoxaparin. The rate of minor bleeding during hospital stay was substantially down in the fondaparinux group than in the enoxaparin group (17.8% vs 4.6%). However, this difference did not persist during 3 and 6- months of follow-ups. Very few patients had major or minor bleeding after discharge from the hospital. No significant difference was observed between the two groups regarding major or minor bleeding at 3-month and 6-month follow-ups (Table II).

**Table-II**
*Outcome parameters between two groups up to 6 months*

| Variables | Fondaparinux (n=87) | Enoxaparin (n=90) | P value |
|---|---|---|---|
| In-hospital outcome | | | |
| Mortality | 0 (0) | 2 (2.2) | 0.497‡ |
| Minor bleeding | 4 (4.6) | 16 (17.8) | 0.005* |
| Major bleeding | 0 (0) | 1 (1.1) | 1.0‡ |
| Recurrent ischemia | 8 (9.2) | 16 (17.8) | 0.095* |
| Heart failure | 17 (19.5) | 21 (23.3) | 0.539* |
| 3-months outcome | (n=87) | (n=88) | |
| Mortality | 8 (6.2) | 11 (12.5) | 0.360* |
| Minor bleeding | 1 (1.1) | 1 (1.1) | 1.0‡ |
| Major bleeding | 0 (0) | 2 (2.2) | 1.0‡ |
| Myocardial infarction | 2 (2.3) | 4 (4.4) | 0.682‡ |
| Recurrent ischemia | 2 (2.3) | 8 (8.9) | 0.058‡ |
| Stroke | 1 (1.1) | 3 (3.3) | 0.621‡ |
| Hospitalization for HF | 1 (1.1) | 3 (3.3) | 0.444‡ |
| Heart failure | 7 (8.0) | 14 (16.9) | 0.109* |
| 6-months outcome | (n=79) | (n=75) | |
| Mortality | 4 (5.1) | 10 (13.3) | 0.074* |
| Minor bleeding | 1 (1.3) | 1 (1.3) | 1.0‡ |
| Myocardial infarction | 1 (1.3) | 9 (12.0) | 0.008‡ |
| Recurrent ischemia | 1 (1.3) | 2 (2.7) | 0.480‡ |
| Stroke | 0 (0) | 1 (1.3) | 0.487‡ |
| Hospitalization for HF | 2 (2.5) | 8 (10.7) | 0.052‡ |
| Revascularization | 0 (0) | 3 (4.0) | 0.115‡ |
| Heart failure | 13 (16.5) | 21 (28.0) | 0.084* |

Data were expressed as frequency (%); HF: Heart failure; *Chi-square test; ‡Fisher's exact test.

Overall, during the 6-month follow-up period, there were significant differences in recurrent ischemia, stroke, and hospitalization requirement for heart failure between the fondaparinux and enoxaparin group, with a lower risk of these events in the fondaparinux group than the enoxaparin group (Table III). The minor and major bleeding events were less frequently observed with Fondaparinux than with enoxaparin. Still, only the difference in minor bleeding rate between the two groups reached statistical significance (6.9% versus 20%, p=0.002) (Table III).

**Table-III**
*Comparison of 6 months outcome between two groups*

| Variables | Fondaparinux (n=87) | Enoxaparin (n=90) | P value |
|---|---|---|---|
| Mortality | 12 (13.8) | 23 (25.6) | 0.049* |
| Minor bleeding | 6 (6.9) | 18 (20.0) | 0.002* |
| Major bleeding | 0 (0) | 3 (3.3) | 0.416‡ |
| Myocardial infarction | 3 (3.4) | 13 (14.4) | 0.011* |
| Recurrent ischemia | 10 (11.5) | 22 (24.4) | 0.025* |
| Stroke | 1 (1.1) | 4 (4.4) | 0.368‡ |
| Hospitalization for HF | 4 (4.6) | 13 (14.4) | 0.026‡ |
| Revascularization | 0 (0) | 3 (3.3) | 0.246‡ |
| Heart failure | 25 (28.7) | 32 (35.6) | 0.322 |

Data were expressed as frequency (%); HF: Heart failure; *Chi-square test; ‡Fisher's exact test

In the fondaparinux group, 20.7% of patients experienced a hospital admission for heart failure, death, MI, recurrent ischemia, or stroke within 6-months, compared with 40.0% of patients in the enoxaparin group, which indicated that the fondaparinux was associated with lower risk of the composite outcome of those events (OR:0.659, 95% CI 0.500-0.867, p=0.005) than the enoxaparin (Table IV).

**Table-IV**
*Comparison of composite efficacy parameters between two groups*

| Any of the adverse cardiovascular event | Fondaparinux (n=87) | Enoxaparin (n=90) | OR (95%CI) | P value |
|---|---|---|---|---|
| No | 69 (79.3) | 54 (60.0) | 0.659 | 0.005 |
| Yes | 18 (20.7) | 36 (40.0) | (0.500-0.867) | |

Data were expressed as frequency (%); OR: Odds ratio; CI: Confidence interval; *Chi-square test.

**Discussion:**

The present study showed important data reproduced in the Bangladeshi population that are in line with results from recent publications from literature.[14] The present study has three important findings. First, in the short term, fondaparinux and enoxaparin have similar efficacy. Second, as compared with enoxaparin, fondaparinux substantially reduces bleeding. Third, the reduced bleeding that accompanies the use of fondaparinux is associated with lower long-term mortality and morbidity. The present study findings were in line with a recent meta-analysis where the authors concluded in patients who were treated for ACS, fondaparinux might be a better choice when compared to enoxaparin in terms of short to midterm bleeding events.[25]

Fondaparinux was statistically superior to enoxaparin with respect to the primary composite outcome of death, myocardial infarction, or refractory ischemia at 6 months. Analysis of the rates of each component of the composite outcome, including death or myocardial infarction, yielded similar results. In the present study, major bleeding events were few, and no event was detected in the fondaparinux group and only three events in the enoxaparin group. However, minor bleeding events were significantly less in fondaparinux than in enoxaparin.

Bleeding increased the long-term risk of death,[26,] and differences in bleeding appeared to account for the reduction in the long-term risk of death with fondaparinux. In addition, there were significantly fewer strokes with fondaparinux than with enoxaparin. Therefore, the net clinical benefit is clearly in favor of fondaparinux. The reduction in bleeding was consistently observed for episodes that were fatal, serious, or minor. Several previous studies have found increased rates of death, stroke, and myocardial infarction among persons who had a bleeding episode.[26,27]

Lastly, due to bleeding reduction and the consequent smaller rate of mortality and events stemming from fondaparinux use, several studies have shown better cost-benefit of its use in relation to enoxaparin.[22,28-30] An OASIS-5 study sub-analysis showed, after 180 days, an average cost reduction of up to 547 dollars per patient in the group that used fondaparinux, highlighting the medication's superiority even further.[22]

In Bangladesh, hospital-based data have shown that the prevalence of ACS is quite varied, and the time taken to reach the hospital after symptom onset is more than in the Western world and it is an area of concern. Hence, a patient who is presented later than 6 h (i.e., has been suffering for an extended period) especially needs prompt and effective treatment. Effective antithrombotic treatment in the form of antiplatelet agents and anticoagulants has been accepted as the cornerstone of therapy for ACS. However, reducing ischemic events without increasing bleeding risk with matchless anticoagulant therapy is the need of the hour. This requirement is remarkably fulfilled by the novel anticoagulant Fondaparinux, with its unique mode of action, once-daily administration, efficacy across patient groups, and consistent effectiveness in reducing bleeding risk.

**Limitations:**

There are some limitations in this study. This was a single-center-based study with a small sample size. The non-randomized observational design was another major limitation.

**Conclusions:**

Similarly, to the recently published data in international literature, fondaparinux was proved superior to enoxaparin when administered in Bangladeshi patients with unstable angina and NSTEMI, with a significant reduction of combined events and bleeding. Fondaparinux at a dose of 2.5 mg daily is superior to enoxaparin in the short term in preventing ischemic events among patients with ACS without STEMI, and it is associated with substantially less bleeding — an effect that translates into lower long-term mortality and morbidity.

**Recommendations:**

Fondaparinux is an attractive option as an anticoagulant in the short-term care of patients with UA and NSTEMI. However, a large-scale multicenter randomized controlled trial is necessary to validate the current findings in the Bangladeshi population.

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*Original Article*

# Bacterial Isolation from Wound Swab and Pus with their Antibiotic Susceptibility Pattern in a Tertiary Care Hospital of Bangladesh

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**Abstract:**

**Background: Wound infection is a global health problem, plays an important role in development of chronicity, delaying wound healing associated with long hospital stay.**

**Objective: This study was aimed to identify the bacterial pathogens present in infected wounds and characterize their resistance profile to the most common antibiotics used in the therapy.**

**Methods: This observational study was conducted from January, 2023 to June, 2023 in a tertiary care hospital in Dhaka, Bangladesh. A total of 220 wound swabs and pus samples were collected from the outpatient and inpatient department of this hospital with skin and soft tissue infection. Samples were inoculated on appropriate media and cultured and the isolates were identified by standard procedure as needed. Antimicrobial susceptibility testing was done by disc diffusion method according to 'The Clinical Laboratory Standard Institute Guidelines'.**

**Results: Out of 220 cases 165(75%) were Male and 55(25%) were female. Majority of the patients 77(35%) were in the age group of 21-31 years. Of the total 220 isolates, 156(70.91%) were culture positive cases. Among the isolated organisms, predominant bacteria was Pseudomonas spp 76(48.22%) followed by Klebsiella 27(17.31%), Escherichia coli 19(12.18%), Proteus 13(8.33%), Staphylococcus aureus 12(7.69%) and Acinetobacter 9(5.77%). Among the gram negative isolates, Pseudomonas was highly sensitive to colistin(88.15%), followed by piperacillin-Tazobactam(77.63%)and Imipenem(50%) and low sensitivity found in ceftriaxone(14.47%), Amoxiclav(13.16) and Clotrimoxazole (13.16%). Klebsiella found sensitive to colistin (90.47%), Piperacillin-Tazobactam (85.71%), Imipenem (76.19%), Gentamycin (71.43%). Escherichia coli shows low sensitivity to almost all the drug except Imipenem (94.74%), Piperacillin-Tazobactam (84.21%) and colistin(84.21%). Stapylococcus aureus show sensitivity to linezolid (100%), vancomycin (91.67%) and Ciprofloxacin (61.67%).**

**Conclusion: Antibiotic sensitivity pattern of various isolates will guide for appropriate selection of the antibiotic against wound infection and reduce the spread of resistance bacteria.**

***Keywords:*** *Antibiotic susceptibility, Resistance, Wound swab.*

*(Bangladesh Heart Journal 2024; 39(1): 38-43)*

**Introduction:**

Wound infections adversely affect morbidity and mortality, delay wound healing, cause wound breakdown and are also associated with longer hospital stay and increased the cost of health care.[1] Wound infection is one of the most common and serious complications among the hospital acquired infections.[2] Microbial colonization or

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infection of wounds is an important factor in poor wound healing. In the United States, chronic wounds affect 6.5 million patients and the care costs over 25 billion dollars, In the United Kingdom, the prevalence of wounds was about 3.55/1000 population, Wound prevalence in India was 15.03/1000 of the population .[3] The prevalent organisms that have been associated with wound infection include Staphylococcus aureus 20-40% and Pseudomonas aeruginosa 5-15% of the nosocomial infection, Other pathogens such as Enterococci and members of the Enterobacteriaceae have been implicated.[4]

Indiscriminate use of anti-microbials, the spread of antimicrobial resistance is now a global problem.[5] Antimicrobial prophylaxis (AMP) is one of the most important methods for preventing surgical site infections.[6] Emergence of resistance to multiple antimicrobial agents in pathogenic bacteria has become a significant public health threat as there are fewer, or even sometimes no effective antimicrobial agents available for infections caused by these bacteria. Gram-positive and Gram-negative bacteria are both affected by the emergence and rise of antimicrobial resistance.[7]

There is need for a more rational approach to the use of antibiotics based on microbial prevalence and antibiotic susceptibility. Hence the present study was carried out to identify the causative agent of wound infection and antibiotic susceptibility pattern of the isolates, which will be beneficial as guidance for clinician to select empirical antimicrobial therapy and on the implementation of infection control measures that play an important role in reducing the emergence rate of antimicrobial resistance.

**Material and Methods:**

This observational study was conducted in the Department of Microbiology at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka from January 2023 to June 2023 for a period of six months. A total of 220 wound swabs and pus samples were collected from patients attending at outpatient and inpatient department of NITOR and transported to microbiology laboratory of this hospital. Socio-demographic and laboratory results which contain different bacterial isolates and antibiotic susceptibility patterns of patients were collected from the Hospital Microbiology Laboratory unit registration books by using standard data collection format. All the samples were cultured on Blood agar, MacConkey's agar media, Chromogenic media and incubated aerobically at $37^0$c for 24 hours. Organisms were identified by standard microbiological procedures including colony morphology, Gram staining and biochemical tests like catalase test, Coagulase test, Oxidase test and reaction in TSI agar, MIU and Simmon's citrate agar media. Sensitivity was done using commercially available antibiotic disc (Oxoid, UK); Amikacin (30ìg), amoxyclav(20 ìg amoxycillin/10ìg clavulanic acid), ceftazidime (30 ìg ), ceftriaxone (30ìg),ciprofloxacin (5ìg), Cotrimoxazole (1.25/23.75 ìg), colistin (10ìg)) gentamycin (10 ìg),imipenem (10ìg),piperacillin/tazobactum (100/10 ìg), vancomycin(30 ìg), linezolid (30ìg). The isolates were tested for antimicrobial susceptibility by the Kirby-Bauer disc diffusion technique according to the Clinical Laboratory Standard Institute (CLSI) guidelines.[8] Collected data were classified according to characteristics and various statistical methods and 'Microsoft Excel' software were used data for analysis.

**Results:**

Out of 220 cases 165(75%) were Male and 55(25%) were female and majority 77(35%) were in the age group of 21-30 years followed by 41 to 50 years and 31-40years which was 55(25%) cases and 37(16.82%) cases respectively (Table-I). A total number of 220 isolates, 156(70.91%) yielded growth and 64(29.09%) yielded no growth (Table-II).

**Table-I**

*Age and gender distribution of the Participants (n=220)*

| Age group | Male(%) | Female(%) | Total(%) |
|---|---|---|---|
| 21-30 | 57(34.55) | 20(36.36) | 77(35.00) |
| 31-40 | 32(19.39) | 5(9.09) | 37(16.82) |
| 41-50 | 43(26.06) | 12(21.82) | 55(25.00) |
| 51-60 | 27(16.36) | 7(12.73) | 34(15.45) |
| 61-70 | 6(3.64) | 11(20.00) | 17(7.73) |
| Grand Total | 165(100) | 55(100) | 220(100) |

**Table-II**

*Culture characteristics of isolates(n=220)*

| Culture | Frequency | Percentage |
|---|---|---|
| No growth | 64 | 29.09% |
| Growth | 156 | 70.91% |
| Grand Total | 220 | 100.00% |

Among the isolated organisms Predominant bacteria was Pseudomonas 76(48.22%) followed by Klebsiella 27(17.31%) Escherichia coli 19(12.18%), proteus 13(8.33%), staphylococcus aureus 12(7.69%) and Acinetobacter 9(5.77%) (Table-3) and ( Table-IV).

**Table-III**
*Growth of bacteria in different samples*

| Culture | Wound swab(%) | Pus(%) | Total(%) | P value |
|---|---|---|---|---|
| Growth | 105(66.88) | 51(80.95) | 156(70.91) | <0.05s |
| No growth | 52(33.12) | 12(19.05) | 64(29.09) | <0.05s |
| Grand total | 157(100.0) | 63(100.0) | 220(100.0) | |

s-significant. Difference between growth of wound swab and pus are statistically significant

**Table-IV**
*Organism isolated from wound swab and pus (n=220)*

| Organism name | Number | Proportion |
|---|---|---|
| Pseudomonas | 76 | 48.72% |
| Klebsiella | 27 | 17.31% |
| Escherichia coli | 19 | 12.18% |
| Proteus | 13 | 8.33% |
| Staphylococcus Aureus | 12 | 7.69% |
| Acinetobacter | 9 | 5.77% |
| Grand total | 156 | 100.00% |

All the bacterial isolates were tested for antimicrobial susceptibility. Pseudomonas was highly sensitive to colistin(88.15%), followed by piperacillin-Tazobactam(77.63%)and Imipenem(50%) and low sensitivity found in ceftriaxone(14.47%), Amoxiclav(13.16) and Clotrimoxazole (13.16%). Klebsiella found sensitive to colistin (90.47%), Piperacillin-Tazobactam (85.71%), Imipenem (76.19%), Gentamycin (71.43%), Amikacin(71.43%), Ciprofloxacin(66.67%). Escherichia coli shows lowest sensitivity to almost all the drug except Imipenem(94.74%), Piperacillin-Tazobactam(84.21%), colistin(84.21%) and Amikacin(57.89%).Proteus found 92.31% sensitive to Piperacillin-Tazobactam, 69.23% sensitive to Imipenem, 53,84% sensitive to Ceftriaxone, 46.15% sensitive to Ciprofloxacin and Gentamycin.100% Staphylococcus aureus were sensitive to Linezolid. Staphylicoccus aureus were also sensitive to Vancomycin(91.67%), Ciprofloxacin(61.67%), Clotrimoxazole (61.67%).(Table-V)

**Table-V**
*Antibiotic sensitivity pattern of bacterial isoltes from wound swab and pus samples of study participants*

| | Sensitivity pattern of bacterial isolates n (%) | | | | | |
|---|---|---|---|---|---|---|
| Antibiotics | Pseudomonas (n=76) | Klebsiella (n=21) | Escherichia (n=19) | Proteus (n=13) | Staphylococcus (n=12) | Acinetobacter (n=9) |
| Amikacin | 33(43.42) | 15(71.43) | 11(57.89) | 5(38.46) | 4(33.33) | 3(33.33) |
| Amoxiclav | 10(13.16) | 3(14.28) | 4(21.05) | 5(38.46) | 0(0.0) | 11(11.11) |
| Ceftazidime | 16(21.05) | 1(4.76) | 0(0.00) | 0(0.00) | 0(0.0) | 0(0.0) |
| Ceftriaxone | 11(14.47) | 11(52.38) | 6(31.58) | 7(53.84) | 0(0.0) | 0(0.0) |
| Ciprofloxacin | 27(35.53) | 14(66.67) | 7(36.84) | 6(46.15) | 5(61.67) | 0(0.0) |
| Cotrimoxazole | 10(13.16) | 6(28.57) | 3(15.79) | 1(7.69) | 5(61.67) | 2(22.22) |
| Colistin | 67(88.15) | 19(90.47) | 16(84.21) | 2(15.38) | 0(0.0) | 7(77.78) |
| Gentamycin | 26(34.21) | 15(71.43) | 8(42.10) | 6(46.15) | 4(33.33) | 1(11.11) |
| Imipenem | 38(50.0) | 16(76.19) | 18(94.74) | 9(69.23) | 0(0.0) | 1(11.11) |
| Piperacillin-tazobactam | 59(77.63) | 18(85.71) | 16(84.21) | 12(92.31) | 0(0.0) | 2(22.22) |
| Vancomycin | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 11(91.67) | 0(0.0) |
| Linezolid | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 12(100.0) | 0(0.0) |

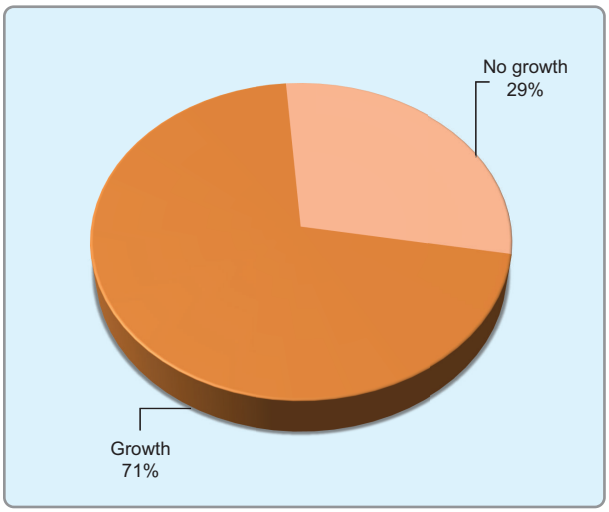


**Fig.-1:** *Culture pattern of bacterial isolates*

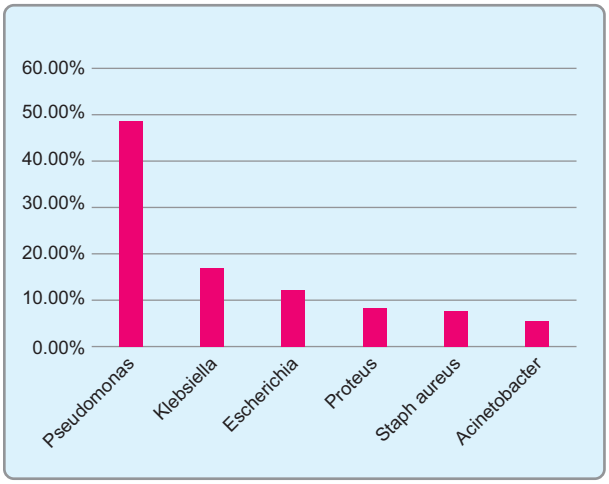


**Fig.-2:** *Percentage of isolated organism from patients of infected wound*

**Discussion:**

Wound infection is one of the health problems that are caused and aggravated by the invasion of pathogenic organisms. Patients who develop wound infection, require proper identification of the organisms for appropriate management. A changing pattern of isolated organism and their antimicrobial sensitivity which varies from hospital to hospital is usual feature. Antibiotic resistant bacterial infections have become a threat, in particular in developing countries, but to obtain an effective treatment plan, it is vital to have an overview of the current resistance level.

In the present study, about three fourth samples showed growth of bacteria on culture which was similar to other studies.[9,10] The incidence of wound infection was higher in males (75%) than in females (25%) in the present study which was consistent with another study[11] which could be explained by the fact that males were more prone to develop wound infection perhaps due to study area was an orthopaedic hospital and males were mostly attacked by accidental injury by road traffic accident than female.

In the present study majority of the cases was reported in the age group of 21-30years (35%) which coincides of the results of previous study.[12] In the present study 2nd most common age group was reported (25%) in 41-50 years and the lowest (7.76%) in 61-70 years age group.

Among Gram negative bacteria Pseudomonas (48.72%) was the most commonly isolated organism in this study followed by klebsiella (17.31%), Escherichia coli (12.18%), Proteus (8.33%). In another study in Belgian[13], Pseudomonas was found to be the most common gram-negative bacteria which was consistent with this study. This higher rate of Pseudomonas infection might be due to the fact that Pseudomonas was found the common predominant bacterial cause of nosocomial infection in many studies. [14,15] As the study area is an orthopaedic hospital, patients stay long duration in hospital and aquire nosocomial infection.

In the present study, staphylococcus aureus was found (7.69%) which was lower than the other study.[16] The discrepancy of the isolation rate may be due to infection caused by bacteria from hospital to hospital differ as different hospital deals with different type of infection.

Pseudomonas showed lower sensitivity to ceftriaxone (14.47%), Amoxiclav (13.16%) and Clotrimoxazole (13.16%) and highly susceptable to colistin (88.15%), followed by piperacillin-Tazobactam (77.63%) and Imipenem (50%) which was incosistant with the other study in China.[17]

Klebsiella was found sensitive to colistin (90.47%), Piperacillin-Tazobactam (85.71%), Imipenem (76.19%), Gentamycin (71.43%), Amikacin (71.43%), Ciprofloxacin (66.67%) which was higher than the another study.[18]

Staphylococcus aureus was highly sensitive to Linezolid (100%), Vancomycin (91.67%) which was higher than another study.[1919] Iyamba JM, Wambale JM, Lukukula CM, za Balega Takaisi-Kikuni N. High prevalence of methicillin resistant staphylococci strains isolated from surgical site infections in Kinshasa. Pan Afr Med J. 2014 Aug 21;18:322. doi: 10.11604/pamj.2014.18.322.4440. PMID: 25478043; PMCID: PMC4250016

**Conclusion**

The findings of the study showed that Pseudomonas was found to be the predominant among all of the isolates of wound infections and most of the gram negative isolates showed highest sensitivity to colistin, piperacillin-tazobactam followed by imipenem. Staphylococcus aureus were highly sensitive to linezolid, vancomycin followed by amikacin. So this knowledge of the most likely causative organisms and prevailing drug susceptibility pattern of this study may be helpful in deciding empirical therapy to reduce mortality and morbidity in wound infections. Therefore, periodic monitoring of the bacteriological profile and antibiotic susceptibility pattern should be done at regular intervals to identify resistant bacteria for infection control and to preserve the effectiveness of antibiotics.

**Conflict of interest :** None

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*Original Article*

# Correlation Between Magnitude of ST Segment Elevation and the Proximal Right Coronary Artery Lesion in Acute Inferior Myocardial Infarction

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**Abstract:**

**Introduction: The determination of the probable site of occlusion within RCA in acute inferior MI is very important because proximal occlusions are likely to cause greater myocardial damage and an early invasive strategy may be planned in such cases. Furthermore, identification of infarct-related artery and its site in acute inferior myocardial infarction not only guide decision regarding the urgency of revascularization but also guide to avoid therapy that may adversely affect the outcome.**

**Objective: To predict the site of lesion in right coronary artery in acute inferior myocardial infarction by the magnitude of ST segment elevation in inferior leads (II, III and aVF) .**

**Methodology: This cross-sectional study was conducted in the Department of Cardiology, Sylhet MAG Osmani Medical College Hospital, from January 2014 to December 2015. A total of 50 consecutive patients with inferior MI who present within 12 hours of symptom onset and received fibrinolytic therapy were selected according to inclusion and exclusion criteria. Using 12-lead ECG, height of ST segment elevation in leads II, III and aVF were measured & coronary angiography(CAG) was performed during index hospital period .CAG which showed culprit lesion in RCA were only taken for the study. The sum of STsegment elevation in inferior leads were then correlated with the proximal lesion in RCA.**

**Results: The age of the patients ranged from 31 to 70 years with the mean age of 51.1 (SD 9.2) years. Majorities (88%) of the patients were male and ratio of male to female was 7.33:1.Out of 50 patients, 26(52%) had the lesion in proximal, 19 (38%) in mid and 05 (10%) in distal RCA. Patients with proximal RCA lesion showed a mean ST segment elevation of 12.5(SD 1.07) mm, with mid RCA lesion 8.5 (SD 0.80) mm and distal RCA lesion 6.5(SD 0.42) mm. There was a positive correlation of sum of ST segment elevation in inferior leads II, III and aVF to the proximal lesion in RCA (r=0.923, P < 0.05).**

**Conclusion: From the study it is concluded that the magnitude of ST segment elevation in inferior leads (II,III, aVF) can predict site of lesion in RCA in acute inferior wall myocardial infarction; the greater the sum of the height of ST segment elevation in inferior leads, the higher is the probability of lying the lesion in proximal right coronary artery.**

***Key Wards:*** *Magnitude ST Elevation ,Proximal RCA , Acute Inferior MI*

*(Bangladesh Heart Journal 2024; 39(1): 44-48)*

**Introduction:**

Coronary heart disease (CHD) is a major cause of mortality and is a global health problem reaching epidemic proportions in both developed as well as developing countries[1].In Bangladesh coronary artery disease is the third largest cause of death today[2].Despite marked disparity in values, there seems to be a rising prevalence of CAD in Bangladesh[3].

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Acute myocardial infarction (AMI) is a major component of acute coronary syndrome which is usually due to anterior and inferior wall involvement [4].The presentation of acute myocardial infarction is different depending on the coronary artery involved. Unlike anterior wall acute myocardial infarction, which is fairly homogenous entity, the extent of acute inferior wall MI depends on the infarct related artery and its site [5]. Nearly 50% of patients with acute inferior wall MI have specific hemodynamic and brady-arrhythmic complications, usually due to the total occlusion of the proximal right coronary artery (RCA) which significantly alters; an otherwise favorable prognosis[6].Such patients, including those in whom electrocardiogram(ECG) shows evidence of right ventricular infarction (RVI), having increased risk for death, shock and arrhythmia [7].

The incidence of mortality and complications are high in patients of acute inferior wall MI with right ventricular involvement. The incidence of right ventricular infarction in acute inferior MI setting is about 30%[8]. The mortality of patients with only inferior wall acute myocardial infarction is5 - 6%,which increases to 25 - 30% along with involvement of right ventricle. The patients with RVI had a higher hospitalization rate (31% vs. 6%, p<0.001) and a higher incidence of major hospital complications (64% vs. 28%, p < 0.001) than those without RVI[9].

In majority (80%) of acute inferior wall myocardial infarction cases the infarct related artery is right coronary artery (RCA), while it is left circumflex artery in the rest. Acute inferior myocardial infarction (AIMI) is often complicated by atrioventricular conduction disturbanceand in the presence of such complications, right coronary artery (RCA) is generally the infarct related artery and frequently associated with complication of AMI particularly hypotension and death. Therefore, immediate diagnosis the infarct-related artery and its site of lesion, has implication in evaluating prognosis and deciding management. But conclusive diagnosis of culprit artery and its site and size of lesion is feasible with the help of angiogram which is time-consuming and an invasive procedure. Several ECG criteria has been recommended for the infarctrelated artery prediction with variable results[10].It is shown that in the setting of Acuteinferior myocardial infarction while there is ST segment elevation; the severity of ST segment elevation is well known to be related to the extent of infarction and prognosis. However it has been observed in several studies that height of ST-segment elevation from bed-side ECG can predict the site of lesion in major coronary arteries with fair degree of accuracy.

Methods and procedure of Data Collection: Data were collected by both qualitative and quantitative methods using a pre-designed questionnaire designed for the study. After admission a detailed history, general and physical examination were performed. Informed written consent was taken from the patients after detailed explanation of the purpose of study. A 12 lead ECG was taken on admission by placing the leads in proper position. Acute inferior wall myocardial infarction was diagnosed by typical chest pain, ST segment elevation of more than 0.1mV in at least two leads representing the inferior wall (II, III, aVF) in ECG and raised Troponin-I. Those, who met the inclusion criteria by detail history, clinical examination and relevant investigations, were taken as sample. In this way, 50 patients with acute inferior MI were selected.

All patients were managed according to the treatment protocol of the Department of Cardiology Sylhet MAG Osmani Medical College Hospital, Sylhet.

Demographic profile such as age and sex were recorded. Clinical profile such as pulse and BP were recorded. Major risk factors of ischemic heart diseases such as hypertension, diabetes mellitus, smoking, dyslipidemia and family history of premature CAD were recorded. Baseline laboratory investigations such as RBS, serum creatinine, Fasting lipid profile, serum electrolytes and Troponin-I were measured. The amount of ST segment elevation after the J point were recorded for the quantification of ST segment elevation from leads of II, III, aVF in mm. Magnitude of ST elevation was calculated by sum of ST segment elevation of leads from II, III, aVF .This summation conferred a value in mm. Diagnostic coronary angiography were performed in index hospital period via the trans-femoral approach.The lesion with highest degree of stenosis along the RCA was accepted as the culprit lesion and left circumflex artery lesion were excluded. Right coronary artery was divided into proximal (from the RV branch to the acute marginal branch) mid from the RV branch to the acute marginal branch, and distal from this point onward .In this way, total 50 patients, ECG findings sum of ST segment elevation of inferior leads were then correlated with angiographic findings of proximal right coronary artery lesion.

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**Results:**

Fifty patients with inferior myocardial infarction were studied. The results were shown in below:

**Table-I**

*Distribution of the Patients by Age (n=50)*

| Age | Frequency | Percentage |
|---|---|---|
| 31- 40 years | 07 | 14.0 |
| 41-50 years | 19 | 38.0 |
| 51- 60 years | 22 | 44.0 |
| 61- 70 years | 02 | 4.0 |
| Mean(SD) | 51.1(SD 9.2) | |

The age of the patients ranged from 31 to 70 years with the mean age of 51.1 (SD 9.2) years.

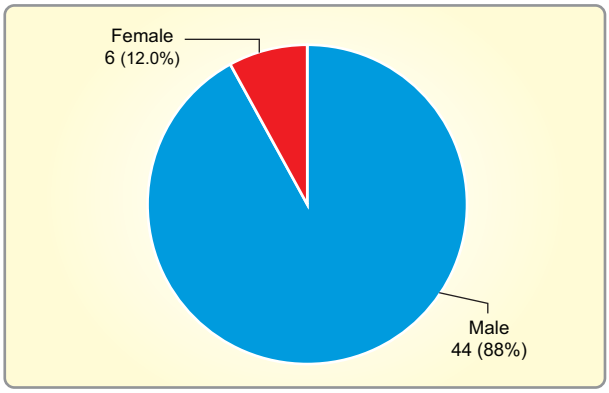



**Fig.- 1.** *Distribution of the Patients by Sex (n=50)*

Figure 1 showed the frequency distribution of patients according to sex. There were 44 (88%) male and 6(12%) female with ratio of male to female was 7.33:1

**Table-II**

*Distribution of the patients by CV Risk Factors (n=50)*

| Risk Factors | Frequency | Percentage |
|---|---|---|
| Smoker | 27 | 54 |
| Hypertension | 21 | 42 |
| Diabetes mellitus | 18 | 36 |
| Dyslipidaemia | 13 | 26 |
| Family history of IHD | 08 | 16 |

Table IIshowed that smoking was the most prevalent risk factor (54%) follo.wed by hypertension (42%), diabetes mellitus (36%), Dyslipidaemia (26%) and family history of IHD (16%)

Table III showed that approximately two third (65%) of the patients in proximal group experienced hypotension followed by 60% had atrioventricular block, 31% had arrhythmia and 7.69 % had cardiogenic shock.

Table IVshowed that out of 50 patients, 26 (52%) had the lesion in proximal, 19(38%) in mid and 05 (10%) in distal RCA.Patients with proximal RCA lesion showed a mean ST segment elevation of 12.5(SD 1.07) mm, with mid RCA lesion 8.5 (SD 0.80) mm and distal RCA lesion 6.5 (SD 0.42) mm.

**Table-III**

*Distribution of Patients by In-Hospital Complications*

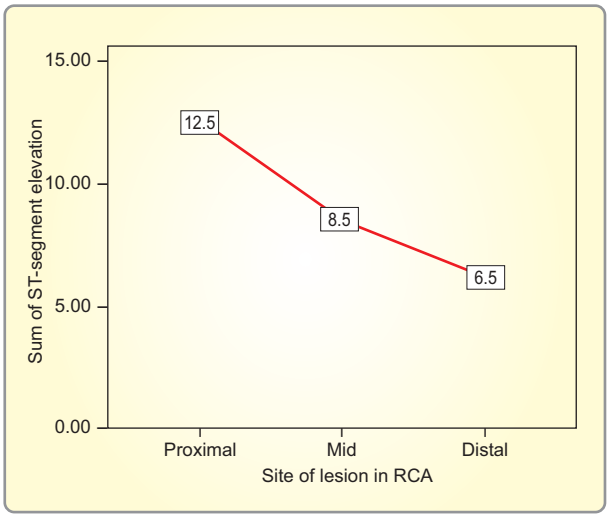
| In hospital Complications | Proximal (n=26) | | Mid (n=19) | | Distal (n=05) | |
|---|---|---|---|---|---|---|
| | No | % | No | % | No | % |
| Hypotension | 17 | 65 | 02 | 10.5 | 00 | 00 |
| Atrioventricular block | 16 | 60 | 03 | 15.7 | 00 | 00 |
| Arrhythmia | 08 | 31 | 01 | 5.26 | 00 | 00 |
| Cardiogenic shock | 02 | 7.69 | 00 | 00 | 00 | 00 |

**Table-IV**

*Association Between ST Segment Elevation and site of lesion in RCA*

| ST segment elevationSite of lesion in RCA (mm) | Mean(SD) Proximal (n = 26) | Mean(SD) Mid (n = 19) | Mean(SD) Distal (n = 05) | p |
|---|---|---|---|---|
| Lead II | 3.5 (0.42) | 2.00 (0.44) | 1.5(0.45) | <0.05 |
| Lead III | 4.5 (0.39) | 3.50 (0.43) | 2.5 (0.50) | <0.05 |
| aVF | 4.5 ( 0.85) | 3.00 (0.45) | 2.5 (0.24) | <0.05 |
| sum of ST segmentelevation | 12.5(1.07) | 8.5 (0.80) | 6.5 (0.42) | <0.05 |

ANOVA




**-2:** *Relationship between sum of ST elevation and of lesion in RCA*

Fig.-2: showed that the mean heights of ST-segment elevation in Lead II, Lead III and aVF having a decreasing trend from proximal to distal site of RCA

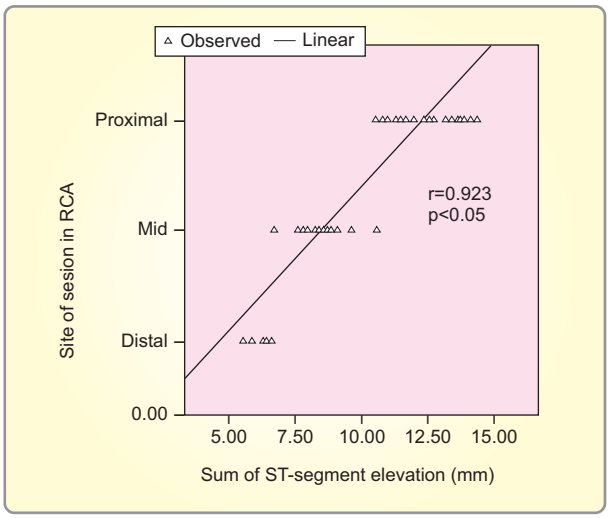



**Fig.-3 :** *Scatter diagram showing correlation between magnitude of ST segment elevation (sum) in Lead II, III and aVF and the proximal right coronary artery lesion (n=50)*

Figure 3 showed that there was a significant positive correlation between magnitude of ST segment elevation (sum) in Lead II, III and aVF and the proximal right coronary artery lesion:(r=0.923;p<0.05).

Discussion: In this study, the age of the patients ranged from 31 to 70 years with the mean age of 51.1 (SD 9.2) years. This result correlated with the study where the mean age of the patients with acute inferior myocardial infarction was 53.6 (SD 10.3) years ranging from 31 to 73 years[11].

In the present study 44(88%) were male and 6 (12%) were female with a ratio of male to female was 7.33:1. This result correlated with the study where found that 85% patients were male and 15% patients were female with male and female ratio was 5.6:1[12].

In this study smoking was the most prevalent risk factor (54%) followed by hypertension (42%), diabetes mellitus (36%), dyslipidemia (26%) and family history of IHD (16%). Nearly similar distribution of risk factors reported in the studies of others. In acute inferior myocardial infarction reported smoking (71.6 %) was the most common risk factor in all Patients, followed by hypertension (50%) family history of IHD (26.6%), diabetes mellitus (21.6%) and dyslipidemia (18.3%) among the series of acute inferior myocardial infarction with right ventricular infarction[12.]

In the present study majority of the patients in proximal group exhibited higher rates of in-hospital complications like hypotension (65%), atrioventricular block (60%) and arrhythmias (31%) compared to their mid and distal counter parts which bears similarity with findings of others; where it is found that higher incidence (58.6%) of conduction disturbance among the series of acute inferior myocardial infarction.

In the current study showed that more than half (52%) of the patients had lesion in proximal, 38% in mid and rest 10% in distal part of RCA. In similar type study, (2008) reported that out of 60 patients, 29 (48.4%) had the culprit lesion in proximal, 23(38.5%) in mid and 8(13.4%) in distal part of RCA[13.]

In the present study, the sum of ST segment elevation in inferior leads (II + III +aVF) was 12.5 (SD 1.07) mm for proximal, 8.5 (SD 0.80) mm for mid and 6.5 (SD 0.42) mm for distal RCA. This study showed a positive correlation of sum of ST segment elevation in inferior leads to the proximal lesion in RCA (r=0.923, P < 0.05). These findings were consistent with other studies. Similarly in a study found that sum of ST elevation 12.61 (SD 3.79) mm for proximal, 6.88 (SD 1.20) mm for mid and 5.05 (SD 0.97) mm for distal RCA[14.] They also demonstrated a significant positive correlation between the magnitude of ST segment elevation and the proximal lesion in RCA (r = 0.82, p <0.01)[14]. Similar study found

sum of ST segment elevation 11.7(SD 1.8) mm in proximal, 7.2 (SD 0.97) mm in mid and 5.8 (SD 0.2) mm in distal RCA lesions[15].Similar study also reported sum of ST segment elevation of 10.90 (SD1.30) mm for proximal, 7.38 (SD 1.19) mm for mid and 5.5 (SD 0.53) mm for distal RCA[-]. The findings of positive correlation of sum of ST segment elevation in inferior leads to the proximal lesion in RCA seen in my study, was consistent with the previously reported literatures.

Conclusion: From the finding of this study we may conclude that the sum of ST Segment elevation in inferior leads is associated with the site of lesion in right coronary artery. We may also conclude that the more is the sum of ST Segment in the inferior leads, the more proximal is the site of lesion in right coronary artery.

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*Review Article*

# Unlocking the Secrets of Valvular Heart Disease: A Journey through the World of Imaging Modalities

Md. Toufiqur Rahman[1], AKM Monwarul Islam[2], Mohammad Ullah [3], AAS Majumder[4]

**Abstract:**

**Valvular heart disease is a prevalent and clinically significant condition with potential complications and adverse outcomes if left untreated or poorly managed. Accurate assessment of valve structure, function and hemodynamics is crucial for effective evaluation and management of valvular heart disease. In this systematic review, we provide a comprehensive overview and comparison of imaging modalities used in the assessment of valvular heart disease.**

**The introduction highlights the background and significance of valvular heart disease, emphasizing its impact on cardiovascular health, global prevalence, and associated complications. Furthermore, it emphasizes the importance of imaging modalities in the evaluation and management of valvular heart disease, discussing their role in providing crucial information for accurate diagnosis, risk stratification, treatment planning, and monitoring.**

**The objective of this review article is to summarize the strengths, limitations and diagnostic accuracy of different imaging modalities in valvular heart disease assessment. We present detailed discussions on echocardiography, computed tomography (CT) imaging, nuclear imaging techniques and emerging imaging modalities, such as 3D echocardiography, strain imaging and fusion imaging. Each section explores the specific role of the imaging modality, its advantages, limitations and diagnostic accuracy in the evaluation of valvular heart disease.**

**Additionally, we provide a comparative analysis of these imaging modalities, highlighting their strengths, weaknesses and specific indications. The integration of multiple imaging modalities for a comprehensive evaluation in specific scenarios is also discussed, emphasizing the complementary roles of different modalities in optimizing diagnostic accuracy and treatment planning.**

**The review concludes with implications for clinical practice and future research directions. It underscores the importance of selecting the appropriate imaging modality or combination of modalities based on individual patient characteristics and clinical needs. Furthermore, it highlights the potential clinical impact of emerging imaging techniques and the need for standardization, cost-effectiveness studies, and further research to optimize the utilization of imaging modalities in valvular heart disease management.**

**Key Words: valvular heart disease, imaging modalities, echocardiography, computed tomography, nuclear imaging, comparative analysis, diagnostic accuracy, treatment planning, emerging techniques, clinical practice**

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**Introduction:**

**A. Background and significance of valvular heart disease**

Valvular heart disease refers to conditions affecting the heart valves, which play a crucial role in ensuring proper blood flow within the heart. The most common types of valvular heart disease include aortic stenosis, mitral regurgitation, mitral stenosis and tricuspid regurgitation. These conditions can significantly impact cardiovascular health and overall well-being.

Valvular heart disease has a considerable prevalence and incidence worldwide. It affects millions of individuals, both young and old, contributing to substantial morbidity and mortality. The increasing prevalence can be attributed to various factors such as an aging population, advances in diagnostic techniques and improved survival rates of patients with other cardiac conditions.

If left untreated or poorly managed, valvular heart disease can lead to severe complications and adverse outcomes. These may include heart failure, arrhythmias, infective endocarditis, thromboembolic events and ultimately, a reduced quality of life and increased mortality rates. Therefore, early detection, accurate diagnosis and appropriate management of valvular heart disease are crucial to improving patient outcomes.

B. Importance of imaging modalities in the evaluation and management of valvular heart disease

Imaging modalities play a fundamental role in the evaluation and management of valvular heart disease. They provide valuable information that aids in the accurate diagnosis, characterization and quantification of valvular abnormalities. By visualizing the valve structure, function and hemodynamics, imaging techniques offer critical insights for clinical decision-making.

Imaging modalities, such as echocardiography, allow for non-invasive assessment of the heart valves. They provide real-time images of the heart's structure and function, facilitating the identification of valve pathology, measuring regurgitant or stenotic severity and assessing ventricular function. Echocardiography, both transthoracic and transesophageal, is often the initial imaging modality of choice for evaluating valvular heart disease due to its wide availability, cost-effectiveness and high diagnostic accuracy.

Other imaging techniques, including cardiac magnetic resonance imaging (CMR), computed tomography (CT) and nuclear imaging, offer complementary information in the evaluation of valvular heart disease. CMR provides detailed anatomical and functional assessment, particularly in complex valve lesions and associated myocardial pathology. CT imaging is valuable for evaluating valve calcification, assessing prosthetic valves and providing high-resolution images for pre-procedural planning. Nuclear imaging techniques offer insights into valve function, myocardial viability and infection assessment in valvular heart disease.

Imaging modalities also play a vital role in risk stratification, treatment planning and monitoring of valvular heart disease. They help clinicians determine the appropriate timing and type of intervention, whether it be surgical or transcatheter, by providing accurate measurements and functional data. Imaging techniques aid in procedural guidance and follow-up assessment, allowing for the monitoring of treatment outcomes and potential complications.

The purpose of this review article is to provide a comprehensive overview and comparison of the various imaging modalities used in the assessment of valvular heart disease. By systematically reviewing the existing literature, this article aims to summarize the strengths, limitations and diagnostic accuracy of each imaging technique. The review will explore the specific roles and applications of echocardiography, CMR, CT and nuclear imaging in valvular heart disease evaluation.

Understanding the nuances and differences among these imaging modalities is crucial for healthcare professionals involved in the diagnosis, management and treatment of valvular heart disease. By examining the evidence and comparative studies, this review article will offer insights into the practical implications and potential clinical impact of utilizing different imaging techniques. Ultimately, it seeks to enhance the knowledge and decision-making abilities of clinicians, leading to improved patient care and outcomes in valvular heart disease [1-4].

**II. Echocardiography [1-7]**

**A. Overview of transthoracic echocardiography**

- Trans thoracic echocardiography (TTE) is a widely used imaging modality in the evaluation of valvular heart disease.
- It utilizes ultrasound waves to produce real-time images of the heart, providing information about valve structure, function and hemodynamics.
- TTE is non-invasive, readily available and generally well-tolerated by patients.
- It allows for the assessment of valve morphology, regurgitation, stenosis and the overall function of the heart chambers.

- Doppler echocardiography, a component of TTE enables the quantification of blood flow velocities and pressure gradients across the valves.

**B. Transesophageal echocardiography and its role in valvular heart disease assessment**

- Transesophageal echocardiography (TEE) is a specialized technique that provides higher-resolution images by positioning an ultrasound probe in the esophagus.
- TEE allows for a closer and more detailed examination of the heart valves compared to TTE.
- It is particularly useful for evaluating valvular anatomy, assessing prosthetic valves, detecting small vegetations in infective endocarditis and guiding interventions.
- TEE provides better visualization of the posterior structures of the heart, such as the mitral valve and left atrium, which can be challenging to assess using TTE.

**C. Advantages, limitations, and diagnostic accuracy of echocardiography in valvular heart disease**

**Advantages:**

- Echocardiography is non-invasive, safe and widely available, allowing for routine screening and follow-up of valvular heart disease patients.
- It provides real-time imaging, allowing for dynamic assessment of valve function and hemodynamics.
- Echocardiography offers the ability to assess multiple valves and associated cardiac structures in a comprehensive manner.
- Doppler echocardiography allows for the quantification of valve regurgitation severity, stenotic gradients and cardiac output.

**Limitations:**

- Echocardiography is highly operator-dependent and the quality of imaging can vary based on the expertise of the sonographer.
- It may have limited visualization in patients with poor acoustic windows due to obesity, lung disease or chest wall deformities.
- Certain valve regions, such as the aortic valve cusps or the tricuspid valve, may be challenging to visualize adequately.
- Calcification or prosthetic materials may produce artifacts that can affect image quality and interpretation.

**Diagnostic accuracy:**

- Echocardiography has demonstrated high diagnostic accuracy in the assessment of valvular heart disease.
- It allows for the identification and characterization of valve abnormalities, including valve thickening, calcification, leaflet prolapse and restricted motion.
- Doppler echocardiography provides accurate measurements of regurgitant volumes, regurgitant fraction, valve areas and pressure gradients.
- Echocardiography is particularly valuable in monitoring disease progression, assessing response to treatment and guiding clinical decision-making.

**III. Computed Tomography (CT) Imaging [1-5]**

**A. Role of CT in valvular heart disease evaluation**

- Computed Tomography (CT) imaging has an increasingly important role in the evaluation of valvular heart disease.
- CT provides detailed anatomical information and allows for the assessment of valve morphology, calcification and associated cardiac structures.
- It offers excellent spatial resolution and enables visualization of the entire heart in a single acquisition, facilitating comprehensive assessment.
- CT imaging is particularly useful in complex cases, such as patients with congenital heart disease, multiple valve pathologies or pre-procedural planning for interventions.

**B. Assessment of valve morphology, calcification, and transcatheter valve interventions using CT**

- Valve Morphology: CT imaging provides precise visualization of valve anatomy, including leaflet morphology, number of leaflets and presence of abnormalities such as bicuspid aortic valve.
- Valve Calcification: CT is highly sensitive in detecting and quantifying valve calcification, which is essential for assessing the severity of valvular stenosis and determining the need for intervention.
- Transcatheter Valve Interventions: CT plays a critical role in pre-procedural planning for transcatheter valve interventions, such as transcatheter aortic valve replacement (TAVR) or transcatheter mitral valve repair (TMVR). It helps determine the appropriate valve size, assess access routes, and evaluate the suitability of the patient's anatomy for the procedure.

**C. Advantages, limitations, and diagnostic accuracy of CT imaging in valvular heart disease**

**Advantages:**

- CT imaging provides excellent spatial resolution, allowing for detailed assessment of valve anatomy, calcification and surrounding structures.
- It offers rapid acquisition times, reducing motion artifacts and the need for breath-holding.
- CT allows for multiplanar reconstructions, enabling precise measurements and visualization from different angles.
- It provides accurate quantification of valve calcification, which correlates well with the severity of valvular stenosis.

**Limitations:**

- CT involves exposure to ionizing radiation which should be considered, particularly in young patients or those requiring repeated imaging.
- Patients with impaired renal function may be at risk of contrast-induced nephropathy, requiring cautious use of intravenous contrast agents.
- CT imaging may have limitations in assessing valve regurgitation severity compared to echocardiography.
- It may not provide real-time information about dynamic valve function and hemodynamics.

**Diagnostic accuracy:**

- CT imaging has demonstrated excellent diagnostic accuracy in evaluating valve morphology, calcification, and detecting complications such as valve perforation or abscess.
- It allows for precise measurements of valve annulus dimensions which are crucial for selecting appropriate valve sizes in transcatheter valve interventions.
- CT provides valuable information regarding access routes, coronary artery anatomy and potential complications related to transcatheter valve procedures.
- CT has emerged as a valuable adjunct to echocardiography in the evaluation of valvular heart disease, providing complementary information and aiding in clinical decision-making.

## IV. Nuclear Imaging Techniques [1-9]

**A. Overview of nuclear imaging modalities in valvular heart disease**

- Nuclear imaging techniques, such as myocardial perfusion imaging and positron emission tomography (PET), have important applications in the evaluation of valvular heart disease.
- Myocardial perfusion imaging utilizes radiopharmaceuticals to assess myocardial blood flow and identify areas of ischemia or infarction.
- PET imaging offers high-resolution images and enables the assessment of myocardial metabolism, inflammation, and specific molecular targets.

**B. Evaluation of valve function, myocardial viability, and assessment of infective endocarditis using nuclear imaging**

- Valve Function: Nuclear imaging techniques can provide valuable information about valve function, particularly in cases where echocardiography has limitations. For example, gated SPECT imaging allows for the assessment of valvular regurgitation severity and ventricular function.
- Myocardial Viability: Nuclear imaging techniques, such as PET with glucose metabolism tracers (e.g., FDG), are useful in assessing myocardial viability in patients with valvular heart disease and concomitant coronary artery disease. They can help determine if dysfunctional myocardium is viable and may benefit from revascularization.
- Assessment of Infective Endocarditis: Nuclear imaging techniques, particularly labeled leukocyte imaging and PET with radiotracers targeting infection (e.g., FDG-PET), play a role in the evaluation and diagnosis of infective endocarditis. They aid in detecting and localizing infective foci, assessing the extent of infection, and guiding the management of these patients.

**C. Advantages, limitations, and diagnostic accuracy of nuclear imaging techniques in valvular heart disease**

**Advantages:**

- Nuclear imaging provides functional and metabolic information that complements anatomical imaging modalities.
- It allows for the assessment of valve function, myocardial viability and detection of infectious processes in valvular heart disease.

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- Nuclear imaging techniques have high sensitivity in detecting myocardial ischemia, infarction, and infective endocarditis.
- Quantitative analysis can be performed to provide objective measurements, such as myocardial perfusion defects or the extent of inflammation.

Limitations:

- Nuclear imaging techniques may involve radiation exposure and the use of radiopharmaceuticals should be considered in relation to potential risks and benefits.
- Access to nuclear imaging facilities and the availability of specific radiotracers may be limited in some regions.
- Image quality and diagnostic accuracy can be influenced by patient motion artifacts and suboptimal imaging conditions.
- Nuclear imaging techniques generally have lower spatial resolution compared to other modalities such as CT or MRI.

**Diagnostic accuracy:**

- Nuclear imaging techniques have demonstrated good diagnostic accuracy in the evaluation of valvular heart disease, particularly in assessing myocardial perfusion and viability.
- Myocardial perfusion imaging is highly sensitive and specific for detecting myocardial ischemia and infarction, which can be useful in determining the severity of valvular heart disease and guiding management decisions.
- PET imaging, especially with FDG-PET, has shown promising results in detecting and localizing infective endocarditis, aiding in diagnosis and treatment planning.
- Comparative Analysis of Imaging Modalities [1-12]

A. Comparison of echocardiography, CMR, CT, and nuclear imaging in valvular heart disease assessment

- Echocardiography: Echocardiography is the primary imaging modality for initial evaluation and serial follow-up of valvular heart disease due to its widespread availability, real-time imaging capabilities, and accurate assessment of valve morphology, function and hemodynamics.
- CMR (Cardiovascular Magnetic Resonance): CMR offers excellent soft tissue contrast and multiplanar imaging capabilities. It provides comprehensive assessment of valve anatomy, function, myocardial viability, and quantification of blood flow across the valves. CMR is particularly valuable in complex cases or when echocardiography yields suboptimal results.
- CT (Computed Tomography): CT imaging provides detailed anatomical information, precise assessment of valve morphology, and quantification of valve calcification. CT is particularly useful for pre-procedural planning in transcatheter valve interventions and for evaluating complex cases with multiple valve pathologies or congenital heart disease.
- Nuclear Imaging: Nuclear imaging techniques offer functional and metabolic information, such as myocardial perfusion, viability, and assessment of infectious processes. They are particularly useful for detecting myocardial ischemia, evaluating myocardial viability in patients with valvular heart disease and concomitant coronary artery disease, and diagnosing infective endocarditis.

**B. Strengths, weaknesses, and specific indications for each imaging modality**

**Echocardiography:**

- Strengths: Real-time imaging, non-invasive, excellent for assessing valve structure and function, quantification of hemodynamics.
- Weaknesses: Operator-dependent, limited visualization in certain patients, challenging to assess certain valve regions or prosthetic valves.
- Indications: Initial evaluation, follow-up, assessment of valve regurgitation severity, stenotic gradients, and cardiac function.

**CMR:**

- Strengths: Excellent soft tissue contrast, multiplanar imaging, comprehensive assessment of valve anatomy, myocardial viability, blood flow quantification.
- Weaknesses: Limited availability, longer acquisition times, contraindicated in patients with certain metallic implants.
- Indications: Complex cases, inconclusive echocardiography, assessment of valve regurgitation severity, myocardial viability evaluation.

**CT:**

- Strengths: Detailed anatomical information, precise assessment of valve morphology, quantification of valve calcification, pre-procedural planning in transcatheter valve interventions.

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- Weaknesses: Radiation exposure, limited availability of specialized facilities, contraindicated in patients with impaired renal function.
- Indications: Pre-procedural planning, evaluation of valve morphology, assessment of calcification, evaluation of complex cases.

**Nuclear Imaging:**

- Strengths: Functional and metabolic information, assessment of myocardial perfusion, viability, detection of infective endocarditis.
- Weaknesses: Radiation exposure, limited spatial resolution, specific radiotracers and facilities may be required.
- Indications: Myocardial perfusion assessment, viability evaluation, diagnosis of infective endocarditis.

**C. Integration of multiple imaging modalities for comprehensive evaluation in specific scenarios**

- In complex cases or when initial imaging yields inconclusive results, a multimodality approach involving two or more imaging modalities may be necessary to obtain a comprehensive evaluation.
- For example, combining echocardiography with CT or CMR can provide complementary information about valve morphology, calcification and associated cardiac structures.
- In transcatheter valve interventions, pre-procedural planning may involve the integration of echocardiography, CT and CMR to assess valve dimensions, access routes, coronary artery anatomy, and myocardial viability.
- The selection of the most appropriate imaging modality or combination of modalities depends on the specific clinical scenario, availability of resources, patient characteristics and the information required for accurate diagnosis, risk stratification and treatment planning.

## VI. Emerging Imaging Techniques and Future Directions [1-4]

**A. Overview of novel imaging techniques**

- 3D Echocardiography: Three-dimensional echocardiography allows for the acquisition of volumetric data sets, providing detailed visualization of valve anatomy and function. It offers improved accuracy in valve measurements, assessment of valve morphology, and quantification of regurgitation or stenosis.
- Strain Imaging: Strain imaging, including speckle tracking echocardiography and feature tracking CMR, measures myocardial deformation and provides insights into regional and global myocardial function. Strain imaging has the potential to detect early changes in myocardial mechanics, including subtle alterations in valvular heart disease.
- Fusion Imaging: Fusion imaging combines data from different imaging modalities, such as echocardiography and CT or CMR, to create a comprehensive and integrated visualization of valvular heart disease. It enables simultaneous assessment of anatomical and functional information, improving diagnostic accuracy and treatment planning.

**B. Potential applications and ongoing research in valvular heart disease imaging**

Novel imaging techniques have several potential applications in valvular heart disease assessment. For example:

- 3D echocardiography allows for improved visualization of complex valve anatomy and accurate assessment of valve regurgitation or stenosis.
- Strain imaging provides insights into myocardial mechanics and may help identify early myocardial dysfunction associated with valvular heart disease.
- Fusion imaging combines the strengths of different modalities, enhancing the accuracy of valve assessment and aiding in treatment planning.

Ongoing research focuses on further optimizing and validating these emerging imaging techniques in various aspects of valvular heart disease, such as:

- Refining the integration of 3D echocardiography with other imaging modalities to improve accuracy in valve measurements and procedural guidance.
- Investigating the role of strain imaging in predicting outcomes and guiding treatment decisions in patients with valvular heart disease.
- Exploring the utility of fusion imaging in complex valve interventions, such as transcatheter procedures, to enhance procedural success and minimize complications.

**C. Challenges and opportunities in the future of imaging modalities for valvular heart disease**

**Challenges:**

- Standardization: As emerging imaging techniques become more widespread, standardization of

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protocols, measurements and reporting becomes crucial for consistency and comparability across different centers.

- Cost and Accessibility: Novel imaging techniques may require specialized equipment, expertise and resources, limiting their availability in certain regions or healthcare settings.
- Integration and Workflow: Incorporating these emerging techniques into routine clinical practice and integrating them seamlessly with existing imaging workflows can be challenging and may require further technological advancements and training.

**Opportunities:**

- Personalized Medicine: Advanced imaging techniques have the potential to provide individualized and tailored assessment of valvular heart disease, leading to optimized patient management and treatment strategies.
- Enhanced Diagnostic Accuracy: The continued development of imaging modalities offers the opportunity for improved diagnostic accuracy, particularly in challenging cases or when traditional imaging has limitations.
- Therapeutic Guidance: Imaging techniques can guide therapeutic interventions, such as transcatheter valve procedures, by providing detailed anatomical and functional information and aiding in procedural planning and monitoring.

**VIII. Conclusion**

- Echocardiography remains the primary imaging modality for initial evaluation and follow-up of valvular heart disease, given its real-time imaging capabilities and accurate assessment of valve morphology and function.
- CMR and CT imaging offer detailed anatomical information and are particularly useful in complex cases or when echocardiography yields suboptimal results.
- Nuclear imaging techniques provide functional and metabolic information, aiding in the assessment of valve function, myocardial viability and the diagnosis of infective endocarditis.
- The comprehensive evaluation of valvular heart disease requires a multimodality approach, considering the specific clinical scenario, availability of resources and the information required for accurate diagnosis and treatment planning.
- Integration of imaging modalities, such as echocardiography, CMR, CT, and nuclear imaging, can provide complementary information, enhancing the accuracy of valvular heart disease assessment.
- Novel imaging techniques, including 3D echocardiography, strain imaging and fusion imaging, hold promise in improving diagnostic accuracy and personalized assessment of valvular heart disease.
- Future research should focus on standardization of protocols and measurements, cost-effectiveness studies, and evaluating the clinical impact of emerging imaging techniques in valvular heart disease management.
- Advancements in technology and imaging algorithms, as well as increased accessibility to specialized imaging facilities, will play a significant role in the integration of novel imaging techniques into routine clinical practice.

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*Review Article*

# Evaluation & Assessment of Chest Pain among Dyslipidemic Out-Door Patients without Prior Clinical Ischemic Heart Disease

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**Abstract:**

**Dyslipidemia is a significant risk factor for atherosclerotic cardiovascular diseases, including ischemic heart disease. However, hypercholesterolemia patients without a history of clinical ischemic heart disease (IHD) may experience chest pain that presents diagnostic and management challenges. This review aims to summarize the existing literature and assess the prevalence of chest pain in this specific patient without having previous heart disease.**

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**Introduction:**

Dyslipidemia is the imbalance of lipids such as [1,2]

- Total cholesterol,
- low-density lipoprotein cholesterol (LDL-C)
- Triglycerides
- High-density lipoprotein (HDL)

Here dyslipidemia mostly interchanging with hyperlipidemia. Atherosclerotic plaque formation is major in the development of cardiovascular disorder [3-5]. Lipids play an important role in the formation of plaque.

**[A] Biochemistry of Lipids**

**Lipoproteins and apolipoproteins**

Lipoproteins are complex plasma particles containing a core of cholesterol esters and triglycerides surrounded by free cholesterol, phospholipids, and apolipoproteins, and are classified based on size, density, and major lipid and apolipoprotein content[6]. Apolipoproteins, structural proteins that bind triglyceride and cholesterol and enable the formation of lipoproteins, enjoy important roles in lipoprotein structure and metabolism by acting as ligands for lipoprotein receptors and activators or inhibitors of enzymes involved in lipoprotein metabolism [6, 7]. The size, structure, and apolipoprotein content of the lipoproteins, namely chylomicrons (CM), very-low-density lipoprotein (VLDL), intermediate-density lipoprotein (IDL), low-density lipoprotein (LDL), high-density lipoprotein (HDL), and lipoprotein(a) [Lp(a)], crystallize into individualized atherosclerotic risk profiles for the specific lipoprotein [8, 9].

**Chylomicrons and chylomicron remnants**

CMs, the largest and least dense of the lipoproteins, are triglyceride rich, released from the intestine, and primarily responsible for delivery of dietary cholesterol and triglycerides to peripheral tissue and the liver [6, 10]. Removal of triglycerides from circulating CMs generates CM remnants that possess a considerably higher cholesterol concentration [6, 11].

**Very-low-density lipoprotein (VLDL) and intermediate-density lipoprotein (IDL)**

Triglyceride consumption by adipose tissue and the resulting cholesterol-rich CM remnants subsequently

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reach the liver, which reorganizes triglycerides and cholesterol in the form of VLDL that are secreted into circulation and allow for lipoprotein lipase (LPL) mediated absorption of triglycerides by cardiomyocytes, skeletal muscle, and adipose tissue [4, 6]. CMs, CM remnants, and VLDL contain apolipoprotein C (Apo C), specifically Apo C-II, an essential cofactor for LPL, and transposition of triglycerides from circulating lipoproteins to tissue steadily increases the concentration of cholesterol and overall density of the lipoprotein while simultaneously decreasing the size [6, 13].

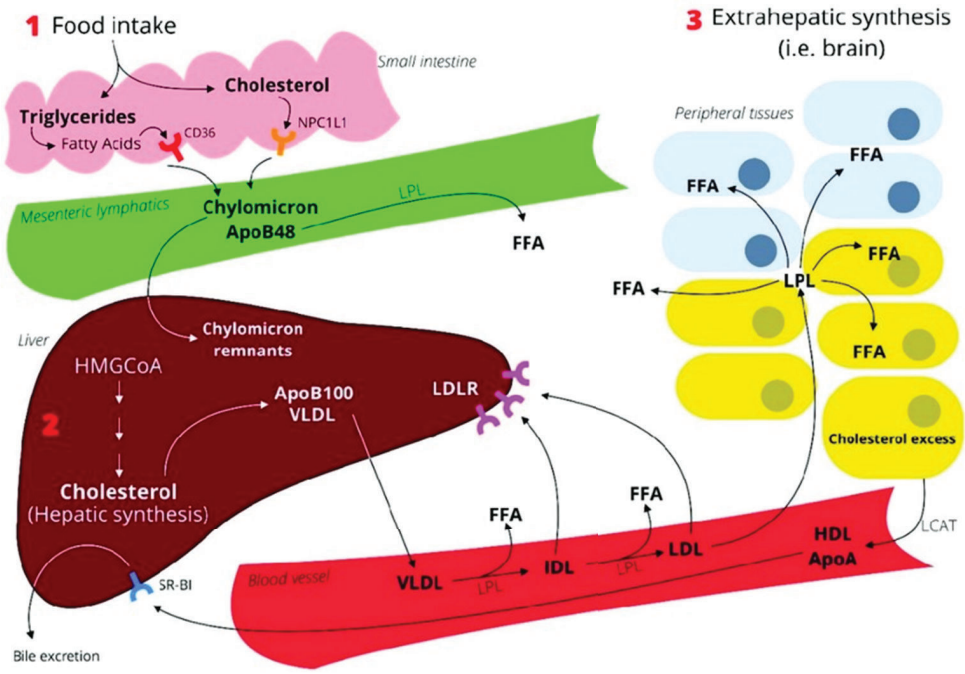
**Low-density lipoprotein (LDL)**

LDL, derived from LPL/Apo C-II-mediated triglyceride removal from VLDL and IDL, is the lipoprotein responsible for cholesterol transport to peripheral tissue and the lipoprotein that has been extensively studied and directly implicated in the development of atherosclerosis [4, 5]. With an average size of 18–25 nm, LDL and the predominant apolipoprotein it contains, Apo B-100, undergo oxidation and other molecular modifications that are responsible for endothelial damage, macrophage chemoattraction, and pathologic arterial changes [1, 6, 14].

The metabolism of LDL, and thus the circulatory availability and arterial wall extravasation ability of LDL, is determined by the quantity of hepatic LDLR, as the concentration of LDL generated from the metabolism of VLDL and IDL is regulated by the amount of IDL that is absorbed into the liver via the LDLR prior to LPL-mediated triglyceride removal [6, 18]. Hepatic levels of LDLR are primarily modulated by hepatocyte cholesterol levels, with adequate cholesterol levels stimulating LDLR targeting for degradation by PCSK9, a protein synthesized by hepatocytes that binds the LDLR and promotes lysosomal LDLR degradation [5, 6, 17].

**High-density lipoprotein (HDL)**

HDL differs from VLDL, IDL, and LDL in size, lipid, and apolipoprotein content, role in cholesterol metabolic pathways, and antiatherogenic characteristics. HDL is responsible for peripheral cholesterol uptake and delivery to the liver- and cholesterol-derived hormone-producing organs, and it provides important antioxidant and anti-inflammatory functions that can inhibit atherosclerosis [4, 6, 18]. After cholesterol uptake from peripheral tissue and macrophages, HDL facilitates transfer to the liver via scavenger receptor class B type I (SR-B1), where the cholesterol can be converted into bile acids for excretion or be directly secreted into bile [18,19]. The apolipoprotein profile and receptors involved in cholesterol movement from HDL sheds light on some of the physiologic pathways involved in HDL attenuation of atherosclerosis and conversely the highly atherogenic contents and formulation of LDL.



A basic principle of prevention is that the intensity of risk-reduction therapy should be adjusted to a person's absolute risk. Hence, the first step in selection of LDL-lowering therapy is to assess a person's risk status. Risk assessment requires measurement of LDL cholesterol as part of lipoprotein analysis and identification of accompanying risk determinants.

**[B] Lipid Profile Values:**

In all adults aged 20 years or older, a fasting lipoprotein profile (total cholesterol, LDL cholesterol, high density lipoprotein (HDL) cholesterol, and triglyceride) should be obtained once every 5 years. If the testing opportunity is non fasting, only the values for total cholesterol and HDL cholesterol will be usable. In such a case, if total cholesterol is ≥ 200 mg/dL or HDL is <40 mg/dL, a follow-up lipoprotein profile is needed for appropriate management based on LDL [20,21]. The relationship between LDL cholesterol levels and CHD risk is continuous over a broad range of LDL levels from low to high. Therefore, ATP III adopts the classification of LDL cholesterol levels shown in Table 1, which also shows the classification of total and HDL cholesterol level

**Table-I**

| | |
|---|---|
| LDL Cholesterol | |
| <100 | Optimal |
| 10D-129 | Mear optimal/above optimal |
| 130-159 | Borderline high |
| 160-169 | High |
| ≥190 | Very high |
| Total Cholesterol | |
| <200 | Desirable |
| 200-239 | Borderline high |
| ≥240 | High |
| HDL Cholesterol | |
| <40 | Low |
| ≥60 | High |

Risk determinants in addition to LDL-cholesterol include the presence or absence of CHD, other clinical forms of atherosclerotic disease, and the major risk factors other than LDL (see Table 2)[22]. (LDL is not counted among the risk factors in Table 2 because the purpose of counting those risk factors is to modify the treatment of LDL.) Based on these other risk determinants, ATP III identifies three categories of risk that modify the goals and modalities of LDL-lowering therapy[23]. Table III defines these categories and shows corresponding LDL-cholesterol-goals.

**Table-II**

- Cigarette smoking
- Hypertension (BP >140/90 mmHg or on anti-hypertensive medication)
- low MDI cholesterol (40 mg/dl)
- Family history of premature CUD (CUD in male **first** degree relative -55 years: CUD in female first degree relative —65 years)
- Age (men >45 years: women >55 years)*

In ATP III, diabetes is regarded as a CHD risk equivalent

HDL cholesterol >60 mg/dl counts as a negative risk factor: its presence removes one factor from the total count

**Table-III**

| Risk Category | LDL Goal (mg/dL) |
|---|---|
| CHD and CHD risk equivalents | —100 |
| Multiple (2+) risk factors* | <130 |
| Zero to one risk factor | <160 |

*Risk factors (hot modify the LDL god are fated m Table 3

The category of highest risk consists of CHD and CHD risk equivalents. The latter carry a risk for major coronary events equal to that of established CHD, i.e., >20% per 10 years (i.e., more than 20 of 100 such individuals will develop CHD or have a recurrent CHD event within 10 years). CHD risk equivalents comprise:

**[C] Chest Pain:**

Chest pain is a very common complaint. Many patients are well aware that it is a warning of potential life-threatening disorders and seek evaluation for minimal symptoms. Other patients, including many with serious disease, minimize or ignore its warnings [24]. Pain perception (both character and severity) varies greatly between individuals as well as between men and women. However, described, chest pain should never be dismissed without an explanation of its cause.

**Pathophysiology of Chest Pain**

The heart, lungs, esophagus, and great vessels provide afferent visceral input through the same thoracic autonomic ganglia. A painful stimulus in these organs is typically perceived as originating in the chest, but because afferent nerve fibers overlap in the dorsal ganglia, thoracic pain may be felt (as referred pain) anywhere between the umbilicus and the ear, including the upper

extremities.

Painful stimuli from thoracic organs can cause discomfort described as pressure, tearing, gas with the urge to eructate, indigestion, burning or aching. Uncommonly, other descriptions of chest pain are given such as stabbing or sharp needle-like pain. When the sensation is visceral in origin, many patients deny they are having pain and insist it is merely “discomfort.”

Etiology of Chest Pain

Mostly chest pain divides by cardiac & non-cardiac origin [24]

Cardiac chest pain is mainly caused by coronary heart disease that has Pressure, fullness, burning or tightness in the chest. Crushing or searing pain that spreads to the back, neck, jaw, shoulders, and one or both arms. Pain that lasts more than a few minutes, gets worse with activity, goes away and comes back, or varies in intensity [25].

Non-cardiac causes such as - musculoskeletal, gastrointestinal, pulmonary, and psychogenic factor [26].

Causes of Chest Pain in Patients Who Seek Care in a Primary Care Office[3-67]

**Table-IV**

| Etiology of chest pain | % of patients with diagnosis |
|---|---|
| Musculoskeletal conditions (including costochondritis) | 29%-36% |
| Nonspecific chest pain | 11%-16% |
| Gastrointestinal disease | 10%-19% |
| Stable CAD | 8%-10% |
| Psychosocial or psychiatric disease | 8%-17% |
| Pulmonary disease (pneumonia, pneumothorax, lung cancer) | 5%-20% |
| Other cardiovascular disease (pulmonary embolus, heart failure) | 3.5%-5% |
| Unstable CAD | 1.5% |

Abbreviation: CAD, coronary artery disease.

**Objectives:**

To summarize the existing literature and assess the prevalence of chest pain in this specific dyslipidemia/ hyperlipidemia patient population.

To improve understanding the etiology of chest pain

Try to find out the prevalence of chest pain among dyslipidemia patient who doesn’t have previous clinical ischemic heart symptoms/disease.

Try to give encouragement for further research.

**Methods:**

**Observational -Descriptive Study**

Here comprehensive search of medical databases, including Google Scholar, PubMed, Embase, and relevant academic sources/journals/publications, was conducted to identify relevant studies published from 2000 to 2023.

**Results:**

The review revealed a considerable assessment of chest pain among dyslipidemia outpatients without a prior clinical diagnosis of IHD.

Comprehensive analysis data showing mostly dyslipidemic outdoor patient without prior IHD presented with atypical chest pain needed diagnostic test, risk stratifications tools, individualized assessment are essential components of patient care in this population [27].

Furthermore, the potential role of statin/Fenofibrate therapy in modifying chest pain symptoms warrants further investigation.

Few cases are associated statin induced myalgia chest / myocarditis / hypertriglyceridemia induced pancreatitis were reported as non-cardiac chest pain [28-32].

**Discussion:**

Reviewing the data tells the fact that hyperlipidemia, marked by high levels of cholesterol and triglycerides, has been identified as a significant risk factor for atherosclerosis, a condition where plaque accumulates in the arteries.

Analyzing previous data there is arising an observation- Could this contribute to chest pain in those without a prior heart disease[28].

It seems plausible. Even in the absence of established heart disease, the gradual buildup of plaque in the coronary arteries could compromise blood flow to the heart muscle, triggering ischemia chest pain.

So, if any hyperlipidemic patient presenting with chest pain though having no previous heart disease should give great emphasis for evaluation of recent development cardio-vascular disease.

**Conclusion:**

This review highlights the significant prevalence of chest pain among dyslipidemia outpatients without previous clinical IHD.

Healthcare providers/Physicians must be vigilant in evaluating these patients, considering a broad range of

differential diagnoses and tailoring their approach to individual patient needs.

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*Case Report*

# A Rare Case Series: Cardiac Myxoma and their Versatile Presentation

Poppy Bala[1], A. Q. M. Reza[2], M. Atahar Ali[3], Nighat Islam[4], Mahmood Hasan Khan[5], Abeeda Tasnim Reza[5].

**Abstract:**

**Background: Although rare, cardiac myxomas are the most common primary cardiac tumor with an incidence of 0.5 per million per year. Clinical presentation is variable and ranges from intracardiac obstruction, embolization to the pulmonary and systemic circulation, heart failure or constitutional symptoms. Surgical resection is the only effective treatment to prevent its debilitating and catastrophic complication.**

**Case summary: Here, three atypical presentations as well as three different locations of cardiac myxomas were reported. First one is a rare case of ST-elevated myocardial infarction due to myxoma that originated from the left ventricle. One case involved right sided myxomas with pulmonary embolism. The third case involved huge left atrial myxoma combined with recurrent syncope. All three cases were almost misdiagnosed due to their atypical presentation. Echocardiography was the primary tool for detecting and diagnosing these cases. Subsequently all three patients underwent successful resection of myxoma. We also review clinical presentations and diagnostic characteristics of cardiac myxomas.**

**Conclusion: Rare cardiac myxomas may have various clinical and imaging features. Physicians especially other non-cardiologist must increase their awareness of this disease and engage in the early diagnosis. Echo-cardiography is the diagnostic procedure of choice. The long-term survival after surgical resection is excellent and recurrence is rare.**

***Keywords:*** *Cardiac tumor, Atrial myxoma, Ventricular myxoma, Echocardiography , Imaging, • Case report*

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**Introduction:**

Myxoma is the most common non-malignant primary cardiac tumor with an estimated incidence of 0.5 per million per year [1]. Typically, it is diagnosed by echocardiography. However, certain myxomas have rare features such as rare sites of attachment, coexistence with other heart disease, multiple masses, recurrent masses, severe calcification, familial masses and necrosis of the myxoma that are likely to lead to misdiagnosis. We report three rare cases of cardiac myxoma and review relevant literature.

**Case Descriptions:**

**Case 1:**

A 50-year-old man presented with an-hour history of sudden onset of severe central chest pain and

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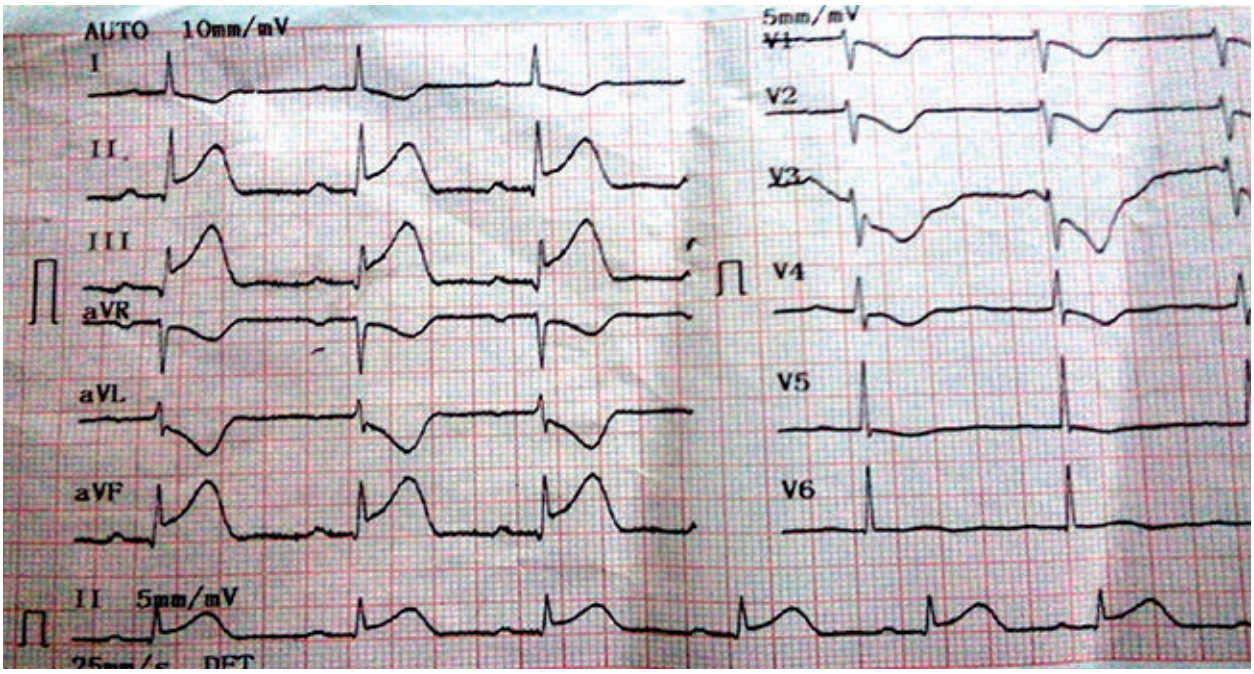



**Fig.-1:** *12 lead ECG shows Acute ST-elevation MI inferior.*

diaphoresis. Patient was hypotensive and pulse rate was 60 beat per minutes Electrocardiogram demonstrated normal sinus rhythm with ST-T-wave elevation in lead II, III and aVF (Fig. 1). Laboratory investigations were remarkable for leucocytosis and elevated troponin. Transthoracic echocardiogram demonstrated wall motion abnormalities and multiple myxomatous masses in left ventricle attached to interventricular septum. Coronary angiography demonstrated no significant coronary artery disease. In the absence of obstructive lesion, normal coronaries and presence of myxoma, it's a possibility of myxoma embolization to the coronary arteries as the cause of her troponin elevation and wall motion abnormality. Subsequently he underwent successful resection of the ventricular myxoma.

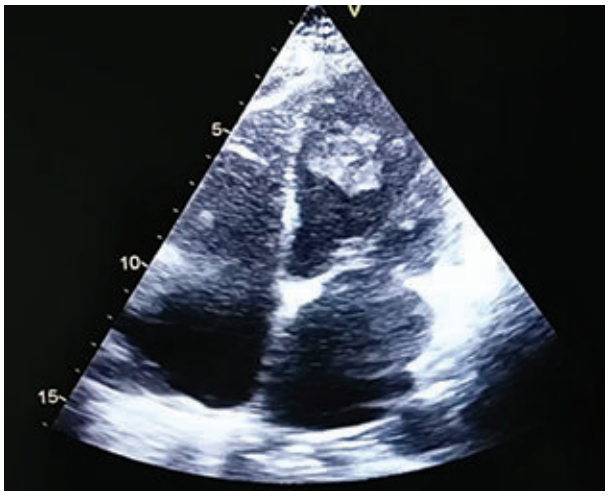



**Fig.-2:** *2D Echocardiography showing left ventricular Myxoma attached to interventricular septum.*

**Case 2:**

A 35 year old housewife was admitted with progressive exertional dyspnoea for the last three weeks and palpitation. She did not admit to pain at any site nor to hemoptysis. There was nothing relevant in the past history. On admission, the pulse rate was 160 beats/ minute and irregular in rhythm (Fig. 4). Blood pressure, measured in the left arm, was 90/60 mmHg . There were no murmurs. Chest radiography was unremarkable. The electrocardiogram showed atrial fibrillation with fast ventricular rate. Immediately pharmacological cardioversion was done which reverted AF to sinus rhythm. But still dyspnea persisted. D-dimer, troponin I, pro- BNP and other blood parameters were normal. Echocardiography showed the presence of a medium size myxoma attached to intra-atrial septum in right atrium and not prolapsing through the tricuspid valve (Fig 3). CT scan showed filling defect in pulmonary arteries (Fig.5). Patient was sent for surgery.

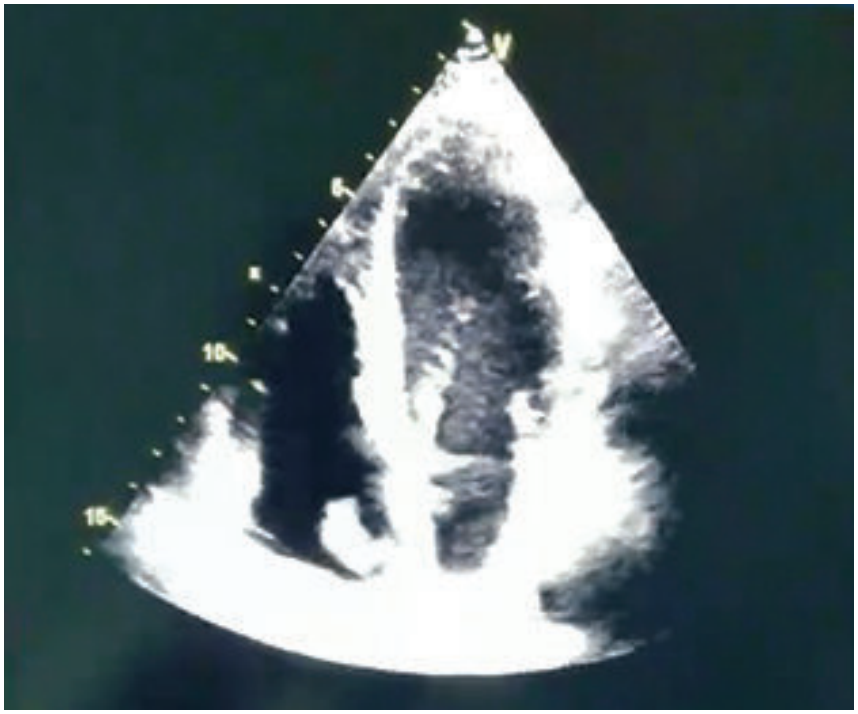
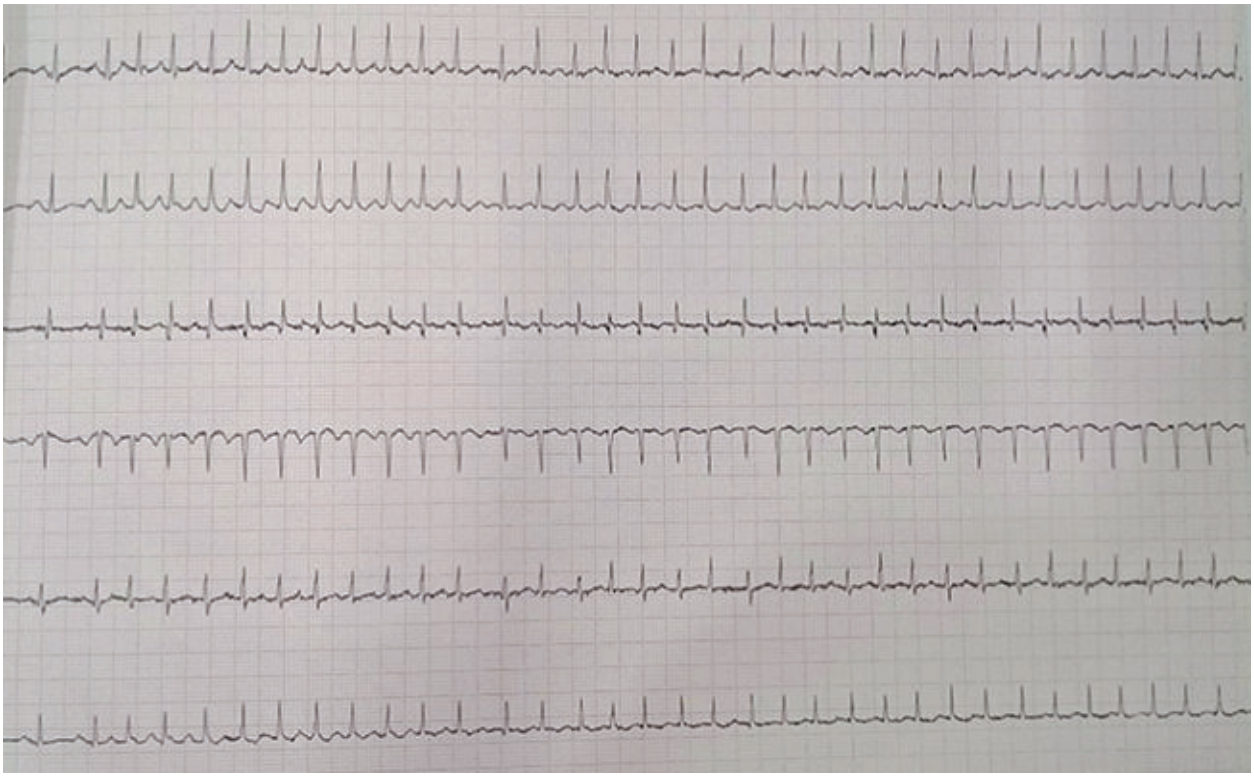


**Fig.-3:** *2D Echocardiography showing right atrial Myxoma attached to upper part of interatrial septum.*



**Figu.-4:** *12 lead ECG atrial fibrillation with fast ventricular rate*

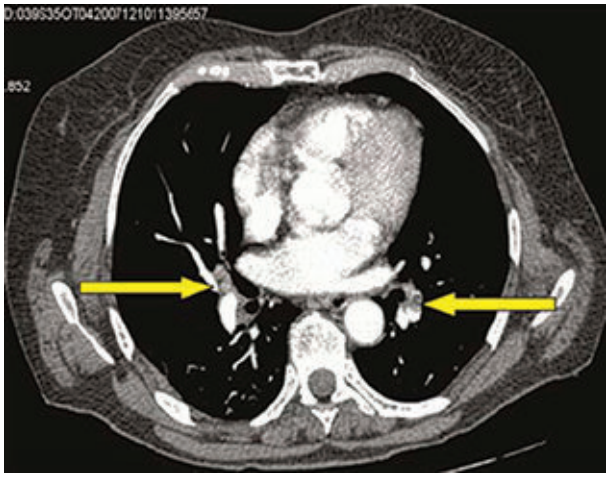


**Fig.-5:** *CT scan shows filling defect in pulmonary arteries.*

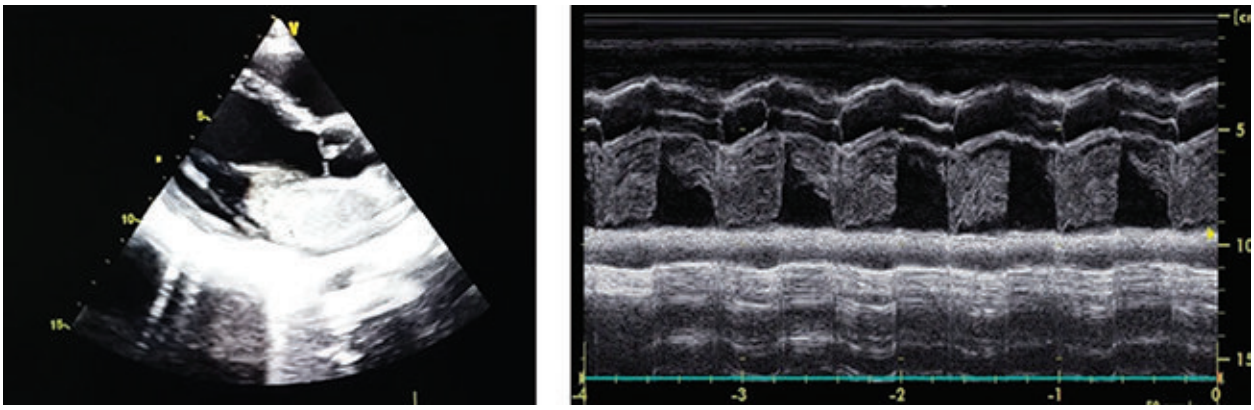


**Fig.6 and 7:** *2D and M mode echocardiography showing large myxoma occupying most of the LA.*

**Case 3:**

A 45-year-old diabetic, hypertensive woman with a longstanding history of exertional dyspnea admitted into the hospital with complaints of recurrent loss of consciousness. Previously she was evaluated neurologically and did repeat CT scan of brain, which was unremarkable. Constitutional symptoms such as arthralgia, myalgia, and weight loss were also present. On physical examination bilateral pedal oedema was noted and mid diastolic murmur and pan systolic murmur in mitral area. The electrocardiogram showed left bundle branch block. Chest X-ray revealed mild cardiomegaly. Echocardiography revealed a large myxoma occupying in two third of the left atrium, which was attached to inter atrial septum and move towards left ventricle during diastole, producing mitral valve obstruction. Left the cardiac chambers were dilated and interventricular septum paradoxical in motion. Moderate LV systolic dysfunction was present. There was Grade II mitral regurgitation (MR) - and mild pulmonary artery hypertension (PAH). The patient was diagnosed with LA myxoma and scheduled for surgical resection.

**Discussion:**

Cardiac tumors represent 0.2% of all tumors, secondary and metastatic form are 20 to 40 times more common than primary tumors [2]. Among primary cardiac tumors, 75% are benign and 50% are myxoma with an incidence of 0.0017% in general population [2-4]. Most common site of myxoma is in left atrium (75%) followed by right atrium (18%), 5% in both atria & the ventricle and more rarely in aorta, pulmonary artery, ventricles vena cava or even in other organ [3-5]. The majority of cardiac myxomas are sporadic and mostly occur as an isolated lesion in middle-aged women [6]. The differential diagnosis formed between thrombus and rhabdomyoma [7].

Signs and symptoms caused by myxomas depends on mobility, size, shape, location, growth rate; pedicle length; tumor activity; the shedding of debris (or lack thereof); intra-tumoral bleeding, degeneration, and/or necrosis; as well as physical activity and body position. Most of the patient present with the one or more symptoms of classical triad of intracardiac obstruction to blood flow, thromboembolic events and constitutional symptoms. Constitutional symptoms consist of shortness of breath, fever, anemia, fatigue, joint pain, weight loss, and even cachexia and other systemic reactions [8].

Here, first case involved a myxoma attached to the interventricular septum of left side. The incidence of coronary artery embolization from atrial myxoma resulting in MI is rare (0.06%) (9); occurrence with left ventricular myxoma is even rarer. Low occurrence is may be due to the coronary apertures form a right-angled junction within the aortic root, which allows some level of protection of the coronaries by the aortic valve cusps [9]. A study by Braun et al. [10], 40 cases of myxoma-related MI were reviewed and it was noted that the right coronary artery is most commonly involved and up to one-third of documented coronary angiogram was normal. The reason behind having a normal coronary angiogram in patients with myxoma and acute MI is still not clearly known. It was suggested hypothesis is that the high rate of spontaneous recanalization after the myxomatous embolization from myxoma [11–13].

Most myxomas are soft and friable. Our second case involved a patient with pulmonary embolism caused by right atrial myxoma. RA myxoma may present with a feature of obstructed tricuspid valve or pulmonary embolism. Common site of origin in right atrium is fossa oval is or base of interatrial septum. Most common manifestation is dyspnea (80%) and right sided heart failure but patients may also present with atypical chest pain, palpitation pulmonary embolism, hemoptysis and syncope [14].

Last case involved a patient with a long medical history of shortness of breath and recurrent syncope. The long list of reported symptoms and signs includes chest pain, dyspnea, orthopnea, fever, malaise and fatigue, weight loss, cough, palpitation, cyanosis and clubbing, Raynaud's phenomenon, arthralgia, myalgia, muscle weakness, loss of hair, dizziness, fainting, aphasia, peripheral embolism, syncope, transient ischemic attack (TIA), cerebrovascular accident (CVA), sudden cardiac death and heart failure [1,15,16.] These symptoms may accompany the change in body position. Recent studies suggest that myxomas produce and release interleukins into the blood circulatory system, which may be responsible for the wide spectrum of systemic inflammatory or autoimmune problems. Constitutional symptoms may be related to the production of interleukin 6 (IL-6), a principal mediator of the acute phase protein response [17]. In our case mitral regurgitation can cause dyspnea. LV inflow obstruction causing low cardiac output was the reason behind recurrent syncope. It was easily mistaken as TIA in the absence of abnormality in CT scan.

Two-dimensional echocardiography and color Doppler are the most common approaches used to diagnose myxoma and detect hemodynamic changes. In some cases, cardiac computed tomography or magnetic resonance imaging are recommended. Certain conditions must be distinguished from myxoma, such as thrombi, other primary cardiac tumors (eg, cardiac rhabdomyoma, sarcoma, vascular tumor, mitral valve papillary fibroelastoma), metastases, and vegetations. The gold standard for diagnosis remains pathological evidence [1, 6]. Myxomas should be surgically removed as soon as they are diagnosed. Surgical excision of myxoma include large resection of their pedicle to prevent recurrence [1]. After surgery patients' symptoms usually disappear. Recurrence after the surgical resection of primary lesions has been observed in 1 to 4% of sporadic cases and 12 to 22% of familial cases [18].

**Conslusion:**

Cardiac myxomas may have various clinical and imaging features. Clinicians and echo- cardiographer must increase their awareness of this disease. Early diagnosis and prompt surgical resection are essential to prevent further major complication.

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*Case Report*

# Successful Excision of the Left Ventricular Thrombus in a Young Stroke Patient

Md Sayedur Rahman Khan [1], Mohammad Arman Hossain [2], Arif Ahmed Mohiuddin [3] Jahangir Kabir [4]

**Abstract:**
**In this case report, a 29-year young male patient who presented with a history of right sided hemiparesis for 12 hours with no apparent cause. He showed no cough, palpitations, breathlessness, chest pain, syncope, or loss of vision. He had no relevant family history but had a history of two times admission in a National Neuroscience hospital for stroke. Echocardiography showed a freely mobile LV apical mass with hypokinetic apical septum and apex. He underwent successful removal of the mass via the LA roof. The postoperative TEE was normal. Histopathological examination of the resected mass revealed organized thrombus and patient had a satisfactory outcome.**

***Keywords:*** *Left ventricle; Left ventricular mass; Transthoracic Echocardiography; Cardiopulmonary bypass*

*(Bangladesh Heart Journal 2024; 39(1): 69-72)*

**Introduction:**
A patient with repeated history of stroke should always be evaluated for cardiac masses. Mass in the left ventricle (LV) can be a myxoma or thrombus even in a normal functioning heart. In either case, mobile mass with embolic potential should be surgically resected. [1-4]. Here we report a case of a left ventricular thrombus that was supposed to be myxoma preoperatively undergoing successful resection presenting as right sided hemiparesis.

**Case Presentation**
A 29-year-old young man was admitted to our hospital on February 21, 2023. He had a history of right sided hemiparesis for 12 hours with no apparent cause. He showed no cough, palpitations, breathlessness, chest pain, syncope, or loss of vision. He had no relevant family history but had a history of two times admission in a National Neuroscience hospital for stroke. Physical examination revealed right sided limb weakness. Computed tomography scan revealed the embolic infarct in left middle cerebral artery territory. He was managed conservatively with an anticoagulant warfarin keeping international normalized ratio value between 2 and 3. Patient was evaluated and he was found to have LV mass on echocardiography. He recovered gradually and was referred to our center for further management after 15 days of the diagnosis. Echocardiographic evaluation showed freely mobile LV apical mass. Hypokinetic apical septum and apex. Normal LV systolic function with LV ejection fraction of 55-60%. Patient had normal sinus rhythm without any arrhythmia or ischemia. MDCT coronary angiography revealed unremarkable study of coronary arteries with thrombus in left ventricle. The mass was presumed to be myxoma and considering the clinical presentation of the patient and the potential for further embolization the patient was scheduled for an

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emergency. The pre-operative transthoracic echocardiography (TEE) showed freely mobile mass present in the left ventricle towards the apex (Figure 2). A median sternotomy was performed. The ascending aorta and both venae cavae were cannulated and standard cardiopulmonary bypass (CPB) was performed. The heart was stopped by cross-clamping the ascending aorta. Myocardial protection was achieved by means of intermittent anterograde administration of cold blood cardioplegia. The venae cavae were snared with tourniquets and via the LA roof. Then LV thrombus was identified, which was attached with LV wall by two connecting stalks. With care not to injure the other structure of the heart, the mass was completely removed and the tumor's pedicle was completely shaved from the endocardium. The patient was weaned from CPB easily, without inotropic support. The postoperative TEE was normal. Resected mass was sent for histopathological examination (Figure 6). Microscopic examination

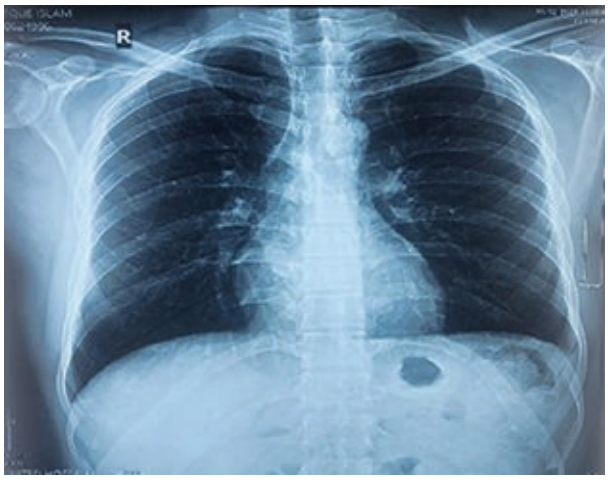


**Fig.-1:** *Pre-operative Chest X-ray*

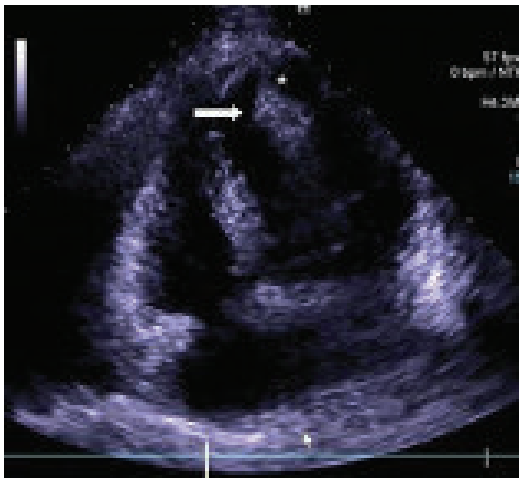

**Fig.-2:** *Transthoracic Echocardiography showing mass in the left ventricular cavity*

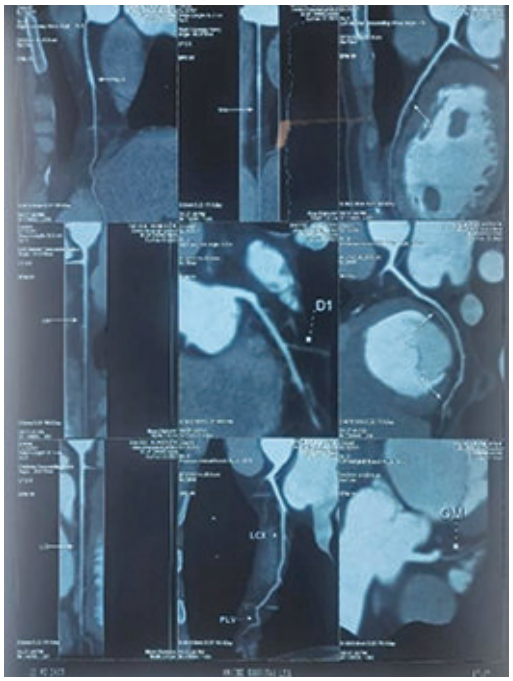


**Fig.-3.** *MDCT coronary angiography revealed unremarkable study of coronary arteries*

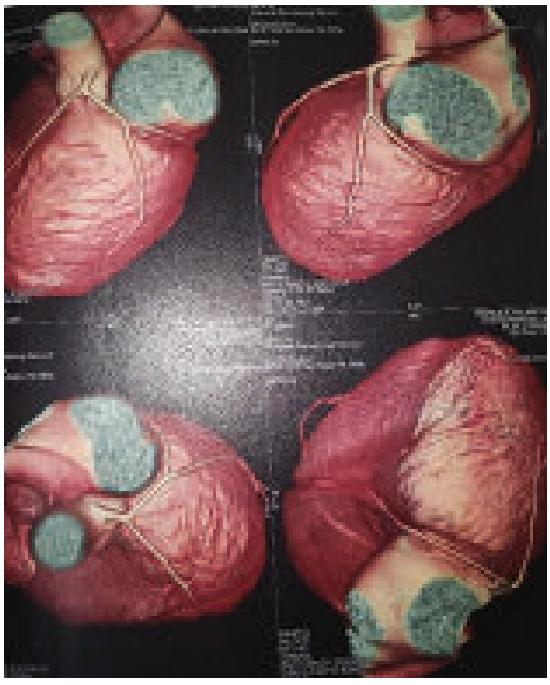

**Fig.-4:** *MDCT coronary angiography revealed thrombus in left ventricle*

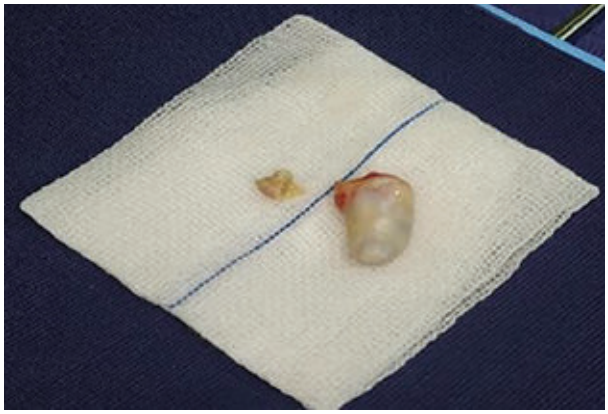

**Fig.-5:** *Photograph shows resected mass*

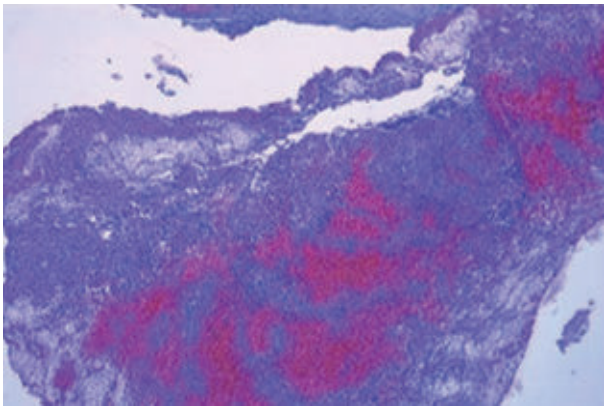

**Fig.-6:** *Histological examinations (Hematoxylin & Eosin stain): mixed thrombus*

revealed organized thrombus. No classical or diagnostic features of cardiac myxoma were observed. The post-operative course was uneventful, the patient was put on anticoagulation treatment and on postoperative day 8 he was discharged home. However, thrombophilia profile could not be evaluated due to noncompliance of the patient. An echocardiography, performed at follow-up examination 7 days postoperatively and revealed no evidence of residual mass.

**Discussion:**

Cardiac tumors may be primary or secondary tumors. Primary cardiac tumors are rare, with a incidence of 0.02% (1). Benign cardiac myxomas constitute 88% of cardiac tumor cases and LV myxomas account for only 2.5% of cases (2,3). The clinical features of LV myxoma are mostly caused by embolization and obstruction to left ventricular outflow tract (LVOT). Arrhythmias, conduction disturbances, and LV dysfunction can also be seen. [4-6] Embolic phenomenon LV myxoma are more common than LA myxomas, occurring in 64% of patients with LV myxoma.[7] Considering the risk for embolization, myxomas should be surgically resected as early as possible.[8] Thrombus formation in LV is a known complication of heart failure and acute myocardial infarction (9, 11). Left ventricular thrombus formation in individuals with normal ejection fraction is a rarely seen phenomenon.

Very rarely, in a normal functioning LV has been reported in the presence of a hypercoagulable state (10). Main causes of inherited thrombophilia such as, factor V gene mutation, prothrombin gene mutation, antithrombin and protein C and S (12), and the presence of autoimmune disorders, such as antiphospholipid antibody syndrome (13), Behcet disease, lupus erythematosus (14, 15) and myeloproliferative disease, are all associated with LV thrombus formation in normal LV. In addition, other causes that lead to the formation of an LV thrombus in a normal LV are: idiopathic hypereosinophilic syndrome (toxic eosinophilic granules directly traumatize the endocardium), inflammatory bowel disease (platelet aggregation), pheochomocytoma (transient LV dysfunction) and Takatsubo cardiomyopathy (reversible LV dysfunction) (16).

The differential diagnosis of an LV mass between thrombus and myxoma can be challenging. However, there is no diagnostic feature, either by 2D-echocardiography or by direct inspection in which the diagnosis can be confirmed and either pathology may masquerade as the other (18). Histopathology is the final court of appeal and must always be performed, as in our report.

The surgical approach we chose to remove the mass in this location was through the LA roof, but can be carried also by other ways: (i) through the left atrium and mitral valve (18), (ii) through the ascending aorta with video assistance (19), and (iii) through a small longitudinal incision in the left ventricle (6). We chose the LA roof approach because it avoids ventriculotomy and its potential complications like deterioration of the LV function and bleeding, despite the fact that ventriculotomy provides good visibility and the possibility for complete resection. A potential disadvantage of the approach through the mitral valve would be limited room for maneuvering during the mass resection. Recently, endoscopy and minimally invasive techniques have also been applied.

In evaluation of clinical features, and laboratory results and in the absence of cardiac rhythm abnormality, left

ventricular dysfunction, malignancy or hypercoagulable state, it is not clear why the patient developed an LV thrombus. In these patients' hypothesis of microvascular ischemia has been proposed as a triggering mechanism for the aggregation of platelets by means of inducing patchy areas of endocardial fibrosis and formation of thrombi in these endomyocardial areas (12). ECG in this patient was unremarkable, and he did not describe any episode of chest pain.

First line treatment for a LV thrombus is anticoagulation, although a mobile thrombus presented as an embolic complication, as in this case often requires urgent surgical resection.

In conclusion, we report an unusual case of LV thrombus leading to stroke. Early detection such as TEE and 2D echocardiography can be used and patients could acquire complete recovery after total thrombus resection.

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# Our Homage

**Professor Brig. (Rtd.) Abdul Malik**
(1st December 1929 - 5th December 2023)

Professor Brig. (Rtd.) Abdul Malik our beloved teacher, our mentor has left this world on 5 December 2023 at the age of 94 years. - Inna Lillahi Wa Inna Ilaihi Rajiun.

We on behalf of Bangladesh Cardiac Society condole his death and pray to ALLAH for the eternal peace of his soul.

Prof. Abdul Malik was an internationally recognized cardiologist whose five decades of work as clinician, mentor, advocate and policy maker has impacted millions of lives in Bangladesh. His visionary steps in sub specialty development back in 1970s has resulted in availability of modern cardiac treatment facilities in the country and is regarded as the Father of Cardiology in Bangladesh.

Professor Malik was the pioneer to take the initiative and leadership to establish a 20-bed cardiac unit in the then Institute of Post Graduate Medicine and Research (IPGMR) in 1972 in Bangladesh- the newly independent country where there was no facilities of cardiovascular care. Subsequently he pursued the government to establish the National Institute of Cardiovascular Diseases in 1978 and was the Founder Director of this newly established Cardiac Institute in the country. Professor Dr Malik, was a mentor to many young trainee cardiologists like myself during eighties of last century while he was the Director and Founder of National Institute of Cardiovascular Diseases(NICVD) Dhaka. He was instrumental in the development of this new institute which started as a 100-bed hospital and now is the top government hospital with more than 1000 beds for cardiac treatment, education, training and research. He has established the post graduate courses in cardiology and cardiac surgery in the country at that time and as a result hundreds of physicians were trained in the field of cardiology and cardiac surgery. Under his leadership, first open-heart surgery in Bangladesh was done in 1982. He was also the Founder Director of the National Centre for Control of Rheumatic Fever and Heart Diseases (NCCRFHD) and played an important role in controlling rheumatic fever and heart diseases in this country.

Furthermore, he was the Founder President of Bangladesh Cardiac Society and South Asian Association for Regional Cooperation (SAARC) Cardiac Society. He was the Vice President of Asian Pacific Society of Cardiology and also a member of WHO Expert Panel Committee on Cardiovascular Diseases.

National Heart Foundation of Bangladesh (NHF), a non-government and non-profit organization, was established at his initiative with some medical and non-medical social workers in 1978. After his retirement from government service in 1989, he became fully involved with the development of National Heart Foundation of Bangladesh. Under his able leadership and guidance this foundation has become an internationally acclaimed center for cardiac treatment and education and playing a vital role for control and prevention of cardiovascular diseases in the country and supplements the activities of the Government.

Prof. Abdul Malik was a member of the National Health Council headed by Honorable Prime Minister of the country. He was also bestowed with the highest-level national award: “National Independence Award” in 2004 and was appointed as National Professor by government of Bangladesh since 2006. Moreover, he served as the Advisor (Ministry of Health & Family Welfare and Ministry of Religious Affairs) for the Caretaker Government of Bangladesh in 2001.

Prof. Malik was the President of Bangladesh Network for NCD Control and Prevention (BNNCP) - a network of 10 health professional and civil society organizations, which is advocating and working for prevention and control of NCD in Bangladesh. He was also leading the tobacco control activities through United Forum Against Tobacco (UFAT) - a network of five health professional organizations. For his relentless effort he was awarded with the ‘World No Tobacco Day Award 2014’ by World Health Organization (WHO).

His image and attributes coupled with his long list of significant accomplishments in cardiology are truly representative of a person who has changed the face of medicine particularly cardiology in Bangladesh.

We always remember with gratitude his selfless, life-long commitment and achievements in cardiac care sevices in Bangladesh as well as across the world.

Our heartfelt homage to this iconic role model personality- Professor Brig. (Rtd.) Abdul Malik

May ALLAH keep him in peace.