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CONTENTS

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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.htmArticle

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:

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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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House No. 17, Road No 8, Dhanmondi, Dhaka 1205
Bangladesh.

Papers can also be submitted via the email using the following address:

Email: bangladeshheartj@yahoo.com

Vol. 37, No.2, - July 2022 Heart J.

Original Article

Blood Pressure Screening at a Non-Government Tertiary Care Hospital in Bangladesh: A Pilot Study

Mehrunnissa Khanom[1], Md. Akhtarul Islam Chowdhury[2], Md Amir Hossain[3]

Abstract:

Objective: The general objective of this pilot study was to unveil the findings of blood pressure screening program at a Non-Government Tertiary Care Hospital in Bangladesh. The specific objectives were to find out socio-demographic profile of the participants, to categorize the blood pressure readings according to the defined variables, to select among the participants who would require intervention and to encourage people in order to adopt healthy diet as well as lifestyle behaviors.

Methods: It was a cross-sectional study conducted at outpatient department of Chattagarm International Medical College Hospital (CIMCH), Shamsherpara, Chattogram from 16.05.2022 to 19.05.2022. The study participants were volunteers of 18 years or older who wished to get the free blood pressure checkup on observation of world hypertension day at CIMCH outpatient premises. Results: Altogether 232 patients participated in the blood pressure screening program, 10.7% were pre-hypertensives and 11.2% had high blood pressure; none of them visited any physician previously for checking blood pressure. Pre-existing hypertensives constituted 16.4% of total participants; nearly half of them had good compliance to medication or life style modification. The maximum (26 out of 51) 'pre-hypertensive' and 'high blood pressure' were in the 30-49 years age group.

Conclusion: Community based blood pressure screening and patient education covering a wider area can be an effective approach to reduce the burden of hypertension as well its conquences on the patient, family, society, nation, and the globe. The results of the current pilot study might provide preliminary data and encourage for future prospective studies.

Keywords: *Blood pressure screening, hypertension*

(Bangladesh Heart Journal 2022; 37(2): 84-88)

Introduction:

Hypertension is the leading and most important modifiable risk factor for global non-communicable disease burden. [1] Nonetheless, the awareness about hypertension and its complication is not satisfactory. At the initial stage, hypertension is easy and inexpensive to diagnose; the management ranges from life style modification and/or low cost antihypertensive drugs at very initial stage, up to high cost management at high dependency or intensive care units at complicated stage. Despite several initiatives, the prevalence of raised BP and adverse impact on cardiovascular morbidity and mortality are increasing globally, irrespective of income. Many risk factors for hypertension are behavioral and modifiable. It is therefore critical that population-based

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initiatives are applied to reduce the global burden of raised BP. The International Society of Hypertension (ISH) has developed worldwide practice guidelines for the management of hypertension in adults, applicable to both high resource and low resource settings. [2]

As per the data from non-communicable disease risk factor survey of Bangladesh, more than one one-third of the adults did not have their blood pressure measured in lifetime.[3,4] According to WHO NCD STEPS (World Health Organization STEPwise approach to surveillance for Non-communicable Disease) survey in 2018, 21% of adults aged 25years or above had hypertension whereas half of them were unaware of having high blood pressure.[5]

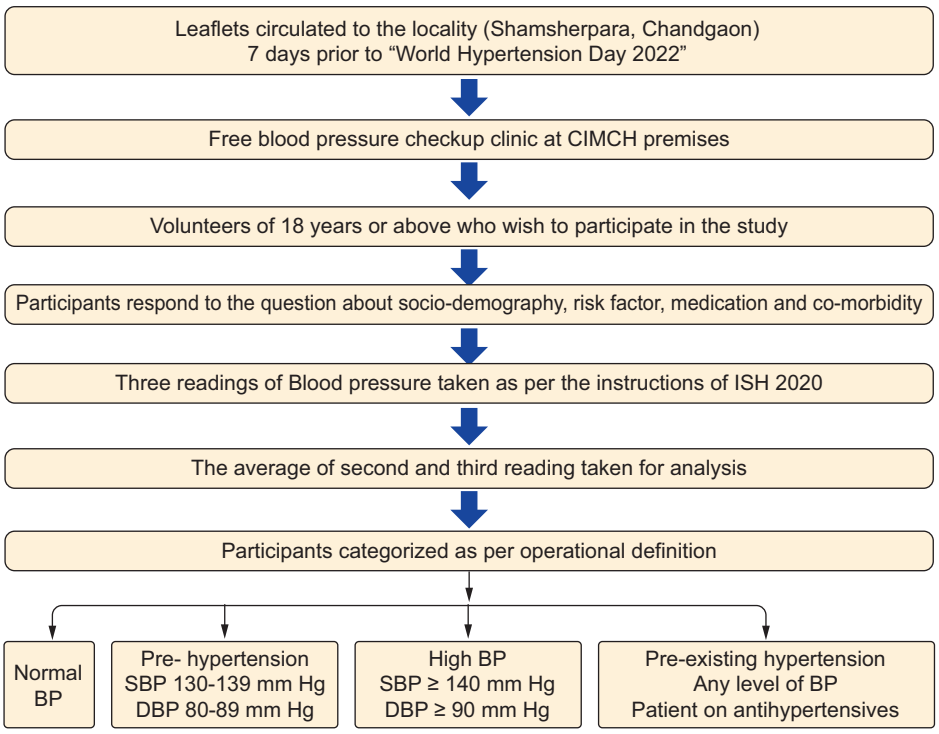
The current paper presents the results of a blood pressure screening program conducted at a non-Government medical college of Bangladesh, on observation of world hypertension day. The general objective of this study was to identify and facilitate the reduction of blood pressure of those people who would require life style modification or pharmacological intervention. The specific objectives of this study were to find out socio-demographic profile of the participants, to categorize the blood pressure readings according to the defined variables, to select the people from the participants who require intervention and to encourage people in order to adopt healthy diet as well as lifestyle behaviors.

Methods:

It was a cross-sectional study conducted at outpatient department of Chattagarm International Medical College Hospital (CIMCH), Shamsherpara, Chattogram from 16.05.2022 to 19.05.2022. The study participants were volunteers of 18 years or older who wished to get the free blood pressure checkup on observation of world hypertension day at CIMCH outpatient premises. The data collection sheet included sociodemographic profiles, family history, drug history, co-morbidity and the correct reading of blood pressure using standard aneroid sphygmomanometer and following the instructions as per International Society of Hypertension (ISH) 2021 guideline.

Three blood pressures readings were taken at 5 minutes interval, and the mean of second and third reading of both SBD and DBP were taken for analysis.

Since this study was conducted as a part of awareness program, leaflets were circulated to the local area 7 days prior to the study. Participation was voluntary and verbal consent was taken from each participant. The patients were categorized as normal blood pressure and high



blood pressure accordingly. The blood pressure value of less than 120 mm Hg SBP and less than 80 mm Hg DBP was considered normotensive. SBP 130-139 mm Hg and/or DBP 80-89 mm Hg was considered pre-hypertensive. Since defining hypertension requires two or more office visit with high blood pressure recording, despising using the term "hypertension", "high blood pressure" was used as operational definition. High blood pressure was defined as average of 2nd and 3rd reading SBP ³140 mm Hg and/ or DBP ³90 mm Hg or anyone on antihypertensive drug therapy. All the patients were informed about hypertension and its target organ effects; all of them were counselled regarding lifestyle modification for prevention as well as control of hypertension. The contact numbers of the participants were preserved for the future follow up studies.

Results:

Altogether 232 patients participated in the blood pressure screening program, male to female ratio was 4:1 (Table 1). Among all participants, 10.7% were pre-hypertensives and 11.2% had high blood pressure; none of them were aware of their health condition, none of them visited any physician previously for checking blood pressure. Pre-existing hypertensives constituted 16.4% of total participants; nearly half of them had good compliance to medication or life style modification (Table II).

Table-I

Demographic distribution of the participants attending hypertension screening program

	Variable	Frequency (%)
Age (years)	Mean ±SD	40 ± 12.26
	Range	19 - 75
Sex	Male	137 (81%)
	Female	34 (19%)

Age distribution of pre-hypertensive and high blood pressure group showed maximum (26 out of 51) 'pre-hypertensive' and 'high blood pressure' in the 30-49 years age group (50.9%); which indicates more middle-aged population being unknowingly affected by hypertension (Table III).

The 'pre-hypertensive' and 'high blood pressure' were categorized according to presence of risk factors (smoking, overweight or obesity, family history, sedentary life style) and co-morbidity (DM, CKD) (Figure 1); the striking feature was presence of two or more risk factors in half of those under 'pre-hypertensive' and 'high blood pressure' category.

Table-II

Distribution of participants according to BP status

Total participants	Number (%) Normotensive	Number (%) pre-hypertensive	Number (%) High blood pressure (New)	Number (%) pre-existing hypertensives on regular medication	Number (%) pre-existing hypertensives not on regular medication or life style modification
232	143 (61.7%)	25 (10.7%)	26 (11.2%)	20 (8.6%)	18 (7.8%)

Table-III

Distribution of pre-hypertensive and high blood pressure groups according to age

Class interval	Pre-hypertensiveNumber	High blood pressureNumber
18-29 years	0	0
30 - 49 years	14	12
50 - 69 years	11	6
70-89 years	0	8

Discussion:

This pilot study revealed the findings of blood pressure screening program at a non-Government medical college hospital of Bangladesh. Mean age of patients was 40 years, which was a middle age; however, male to female ratio was remarkably high, indicating less accessibility of females to health care facilities. The majority of 'pre-hypertensive' and 'high blood pressure' population were distributed in the age group 30-49 years. However, this picture might be a tip of iceberg, since the apparently healthy middle age group does not often seek for medical advice or routine blood pressure checking unless any symptom arises. Though 61.7% had normal blood pressure, there might be missing of information on masked hypertension. Screening for masked hypertension would require future studies using home blood pressure monitoring or ambulatory blood pressure monitoring. [6]

As a part of global observation of May Measurement Month (MMM), the national Heart Foundation of Bangladesh organized a hypertension screening program in 16 districts of Bangladesh in 2019 (MMM19), which revealed 28% newly diagnosed hypertensive patients, that was higher than the reported national prevalence rate of 21%. In that study, only 46% of all pre-existing hypertensives had their blood pressure controlled; this finding indicated a treatment gap or compliance gap or both.[3]

As per the guideline from the world hypertension league, majority of people in low resource country are unaware of hypertension and do not have adequate access to health care system.[7-8] Recommendation for community based blood pressure screening also came from systematic review of literatures. [9-10]

Limitation: In this study, sample size was small, data on blood pressure was documented only for a short duration and follow up visit was not included in the study. A community-based blood pressure screening program for a long period covering a wider area of city might reflect more representable data.

Conclusion:

Awareness of hypertension is the first crucial step in achieving target blood pressure goal and preventing lifelong consequences as well as morbidity. Community based blood pressure screening and patient education program for a longer period covering a wider area can be an effective approach to reduce the health and economic burden of hypertension as well its complications on the patient, family, society, nation, and the globe. The results of the current pilot study might provide preliminary data and encourage for future prospective studies.

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Original Article

Association of Serum Vitamin D level with in-hospital Outcome in Patients with Acute Myocardial infarction

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Abstract:

Objective: Vitamin D deficiency is emerging as a new risk factor for various cardiovascular events. Several studies have been done to find out association of vitamin D level with CAD with varying results. Very few studies, however, have investigated the association between serum vitamin D levels and clinical outcomes in ACS patients thus far. The objective of this study was to assess the association between serum vitamin D levels and in-hospital complications of AMI patients in Department of Cardiology, Dhaka Medical College Hospital (DMCH), Dhaka.

Methods: This was a cross-sectional observational study. We measured serum vitamin D level in AMI (STEMI and NSTEMI) patients (n=198) admitted in Department of Cardiology, DMCH. Patients with normal vitamin D level (e"30 ng/ml) were considered as Group I and patients with low serum vitamin D level (<30 ng/ml) were considered as Group II; and in-hospital complications were evaluated.

Results: The study showed that 51% of study subjects of AMI had in-hospital complications; 71.1% patients with low vitamin D level had adverse in-hospital outcome whereas 14.3% patients with normal vitamin D level had AMI complications which was statistically significant (p<0.001). Heart failure and arrhythmias were the most frequently observed complications. The results of the study demonstrates that the association between low vitamin D level and in-hospital complications after AMI remains statistically significant (p<0.001).

Conclusions: Low serum vitamin D level is independently associated with a higher frequency of several in-hospital adverse clinical events including mortality after acute myocardial infarction (STEMI and NSTEMI). Whether low vitamin D levels represent a risk marker or a risk factor in ACS remains to be elucidated.

Keywords: AMI, Serum vitamin D, Adverse in-hospital outcome.

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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]. Great reduction in mortality has been achieved by improvement in myocardial revascularization techniques. However, the results are still unsatisfactory in high-risk

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patients[3,4]. Therefore, more interests have been focused on the identification of new risk factors for coronary artery disease (CAD) and its prevention[5]. Calcium metabolism disorders, and especially vitamin D deficiency, represent a rising problem. Recently vitamin D has been received greater interests for its multiple effects on inflammatory system and potential role in atherothrombosis[6,7,8].

Beyond its fundamental role in bone metabolism and calcium homeostasis, vitamin D may influence several other medical conditions, including cardiovascular disease. Indeed, vitamin D receptors have been found in the myocardium as well as in vascular cells, and hypovitaminosis D, a common finding in many industrialized countries, has been independently associated with increased risk of developing acute myocardial infarction and heart failure[9]. Moreover, vitamin D deficiency has been linked to conditions such as hypertension, diabetes mellitus, metabolic syndrome, cardiac hypertrophy and chronic kidney disease that predispose to cardiovascular disease[10,11,12,13]. More importantly, vitamin D supplementation has been shown to be associated with improved survival in heart failure patients[14]. Thus, vitamin D seems to play an important role in cardiac function and in the development and progression of CAD.

Moreover, observational studies, small clinical trials, and meta-analyses indicate that vitamin D therapy may reduce cardiovascular events and mortality[14,15,16]. Although these data from apparent healthy subjects support a role of vitamin D deficiency as a new potential cardiovascular risk factor; there is still paucity of information regarding the implications of vitamin D deficiency in ACS and its possible association or causal relationship with morbidity and mortality. Clinical interest derives from the fact that vitamin D deficiency can be readily determined by blood testing and treated by supplementation. In particular, a single oral ultra-high dose of vitamin D has been shown to restore normal 25(OH) D levels within 2 days in critically ill patients, without causing adverse effects, thus providing the basis of an easy-to-administer dosing regimen for prospective intervention trials in acute cardiovascular settings[17]. Thus far, the largest study evaluating vitamin D and prognosis in ACS patients was that by Ng et al.[18]. They found an association between the lowest vitamin D quartile (<7.3 ng/mL) and long-term major adverse cardiovascular outcomes in 1259 patients. Notably, the association was predominantly with nonfatal adverse outcomes, such as re-hospitalization for ADHF (acute decompensated heart failure) or for another ACS, rather than mortality.

Very few studies, however, have investigated the association between vitamin D levels and clinical outcomes in ACS patients thus far[18,19,20]. Therefore, convincing data demonstrating the possible impact of vitamin D insufficiency or deficiency on morbidity and mortality of ACS patients are still lacking. Notably, vitamin D has been demonstrated to suppress the renin-angiotensin-aldosterone system and to affect endothelial function, inflammatory processes, platelet function, insulin resistance, and blood pressure[12,21,22,23]. All these effects are relevant during ACS, and related to patients' clinical course. Moreover, low levels of vitamin D have been associated with ventricular dysfunction and cardiac remodeling after ACS and with heart failure mortality and sudden cardiac death[8,20]. Thus, both the short and long-term outcomes of ACS patients could be significantly affected by vitamin D status.

However, there is no data on the association of serum vitamin D with in-hospital outcome of AMI in Bangladeshi population. So, we aimed to study the association of serum vitamin D level with AMI complications in our population. We analyzed serum vitamin D level in cases of newly diagnosed acute myocardial infarction patients to study this association.

The purpose of this study was to determine the clinical implications of vitamin D levels in acute MI (STEMI & NSTEMI) patients at hospital admission, and their possible association with in-hospital morbidity and mortality. Very few studies, however, have investigated the association between vitamin D levels and clinical outcomes in ACS patients thus far. Therefore, convincing data demonstrating the possible impact of vitamin D insufficiency or deficiency on morbidity and mortality of ACS patients are still lacking. No such study has been done in Bangladesh so far to investigate association between in-hospital outcome of coronary artery disease and vitamin D level. The purpose of this study was to measure vitamin D levels in AMI (STEMI & NSTEMI) patients during hospital admission and their possible association with in-hospital complications in patients with acute myocardial infarction; so that both primary and secondary preventive measures can be taken to reduce/ prevent AMI complications by improving serum vitamin D level.

Methods

This observational cross-sectional study was conducted at the Department of Cardiology, Dhaka Medical College Hospital (DMCH), Dhaka between July, 2017 to June, 2018. All the newly diagnosed acute MI (STEMI & NSTEMI) patients admitted in the Department of Cardiology, DMCH

within the study period fulfilling the inclusion and exclusion criteria were included in this study by convenient purposive sampling. Study subjects having previous history of myocardial infarction, heart failure, Percutaneous Coronary Intervention (PCI), Coronary Artery Bypass Graft (CABG), cardiomyopathy, any valvular heart disease, congenital heart disease; other myocardial or pericardial diseases; severe co-morbid conditions such as liver disease, thyroid disorder, renal disease, malabsorption or malignancy; who received vitamin D supplement in recent times; and unwilling to be included in the study were excluded. According to serum vitamin D level, all the study subjects were divided in two groups – patients with serum vitamin D level of 30 ng/ml or more were considered as normal group and patients with serum vitamin D level less than 30 ng/ml were considered as low vitamin D level group. Then all the patients were closely monitored till discharge or death for in-hospital complications like heart failure, cardiogenic shock, clinically significant tachy/brady-arrhythmias and AKI; and the association of serum vitamin D level with in-hospital complications of AMI was studied.

Results

One hundred & ninety-eight AMI patients admitted in the Department of Cardiology, DMCH, Dhaka fulfilling the inclusion and exclusion criteria were included in this study during the period from July, 2017 to June, 2018. Among the 198 patients, those who had normal serum vitamin D level (e˘30 ng/ml) were assigned as Group I and patients with low serum vitamin D level (<30 ng/ml) were assigned as Group II.

Minimum age of the respondent was 30 years and maximum was 73 years. Major proportion of the patients (48%) were in 50-59 years age group; whereas few patients (1%) belonged to age less than 40 years. The mean age of the study population was 52.8±6.7 years. The patients with low vitamin-D level (Group I) were more older than patients with normal vitamin-D level (Group II) (58.1±7.1 vs. 53.1±.7.4). Analysis revealed statistically highly significant (p<0.001) mean age difference between the study groups.

Table I

Age distribution of the study population (n=198)

Age group (years)	Normal 25 (OH) vitamin D level (n=70)		Low 25 (OH) vitamin D level (n=128)		Total (n=198)		p-value
	Number	%	Number	%	Number	%	
<40	2	2.9	0	0.0	2	1.0	
40 – 49	20	28.6	15	11.7	35	17.7	
50 – 59	36	51.4	59	46.1	95	48.0	
≥60	12	17.1	54	42.2	66	33.3	
Mean±SD	53.1±.7.4		58.1±7.1		56.3±7.6	**<0.001****	

Unpaired t-test was done. **means significant (p<0.05).

Out of total 198 patients, proportion of male (79.8%) was higher than female (20.2%). In Group I, 73.4% were male and 26.6% were female. In Group II, 91.4% were male and 8.6% were female. Statistically significant association was seen in term of sex among the study groups (p=0.003). Male: female ratio was 4:1. Male patients were predominant in the study.

Table II

Sex distribution of the study population (n=198)

Sex	Normal 25 (OH) vitamin D level (n=70)		Low 25 (OH) vitamin D level (n=128)		Total (n=198)		p-value
	Number	%	Number	%	Number	%	
Male	64	91.4	94	73.4	158	79.8	**0.003****
Female	6	8.6	34	26.6	40	20.2	

Chi-square test was done. **means significant (p<0.05).

On an average, female patients had lower vitamin D level than male (18.8±8.0 ng/ml vs. 26.1±10.5 ng/ml). It was statistically significant (p<0.001).

Table III
Comparison of vitamin D level of the study population by gender (n=198)

25 (OH) vitamin D level (ng/ml)	Male (n=158)	Female (n=40)	p-value
mean±SD	26.1±10.5	18.8±8.0	**<0.001****

Unpaired t-test was done.
**means significant (p<0.05).

Vitamin D levels of the study population were categorized as ≤10, 11-20, 21-29 and ≥30 ng/ml classes. Major proportion of the patients (45.5%) had vitamin-D level within 11-20 ng/ml (vitamin D deficiency). No patients were found to have severe vitamin D deficiency. Average serum vitamin D level was 24.62±10.45 ng/ml with minimum 11 ng/ml and maximum 46 ng/ml.

The presence of some established risk factors were collected by asking close ended questions and observing previous medical records. Patients with history of diagnosed diabetes mellitus and smoking were significantly higher in Group I compared to Group II with p value 0.002 and <0.001 respectively. Patients with hypertension had higher vitamin D level within 11-20 ng/ml (42.2%) but did not show any significant association (p=0.14).

Heart failure was significantly higher in patients having vitamin D level within 11-20 ng/ml (41.1%), followed by 26.3% within 21-29 ng/ml group and 5.7% patients had normal vitamin D level with significant association (p<0.001). Cardiogenic shock occurred more frequently in patients having vitamin D level within 11-20 ng/ml (17.8%) and 5.3% patients were within 21-29 ng/ml group; no patient with normal vitamin D level had cardiogenic shock with highly significant association (p<0.001). Six patients died who were in 11-20 ng/ml group.

Table IV
Distribution of vitamin D level in the study population (n=198)

25 (OH) vitamin-D level (ng/ml)	Number	Percentage (%)
Normal (≥30)	70	35.4
Insufficiency (21 – 29)	38	19.2
Deficiency (11 – 20)	90	45.5
Severe deficiency (≤10)	0	0.0

Table V
Distribution of the study population according to cardiovascular risk factors (n=198)

Risk Factors	25 (OH) vitamin D level (ng/ml)			Total	p-value
	≥30 (n=70) No. (%)	21 -29 (n=38) No. (%)	11 - 20 (n=90) No. (%)	(n=198) No. (%)	
Smoking	54 (77.1)	30 (78.9)	43 (47.8)	127 (64.1)	**<0.001****
Hypertension	20 (28.6)	11 (28.9)	38 (42.2)	69 (34.8)	0.14*
Diabetes mellitus	16 (22.9)	9 (23.7)	42 (46.7)	67 (33.8)	**0.002****
Dyslipidaemia	0 (0.0)	0 (0.0)	2 (2.2)	2 (1.0)	0.29*
Family history of CAD	2 (2.9)	1 (2.6)	2 (2.2)	5 (2.5)	0.96*

Chi Square test was done
** means significant (p<0.05)
*means not significant (p>0.05)

Table VI

Comparison of outcome variables by vitamin D level (n=198)

Outcome variables	25 (OH) vitamin D level (ng/ml)			Total (n=198)	p-value
	≥30 (n=70) No. (%)	21 - 29 (n=38) No. (%)	11 - 20 (n=90) No. (%)	No. (%)	
Heart failure	4 (5.7)	10 (26.3)	37 (41.1)	51 (25.8)	<0.001**
Cardiogenic shock	0 (0.0)	2 (5.3)	16 (17.8)	18 (9.1)	<0.001**
Arrhythmia	2 (2.9)	10 (26.3)	28 (31.1)	40 (20.2)	<0.001**
AF	0 (0.0)	4 (10.5)	8 (8.9)	12 (6.1)	
VT	0 (0.0)	4 (10.5)	6 (6.7)	10 (5.1)	
1st degree AV block	0 (0.0)	0 (0.0)	4 (4.4)	4 (2.0)	
Complete AV block	2 (2.9)	0 (0.0)	10 (11.1)	12 (6.1)	
Trifascicular block	0 (0.0)	2 (5.3)	0 (0.0)	2 (1.0)	
AKI	0 (0.0)	0 (0.0)	12 (13.3)	12 (6.1)	<0.001**
Death	0 (0.0)	0 (0.0)	6 (6.7)	6 (3.0)	0.02**

Chi Square and Fisher's Exact test were done
** means significant (p<0.05)
*means not significant (p>0.05)

Mean hospital stay was found higher in Group I compared to Group II (6.88±2.02 vs. 5.20±0.83 days) and the mean difference was statistically significant (p<0.001). The average hospital stay was 6.29±1.89 days of the study patients.

Table VII

Comparison of the study population according to hospital stay (n=198)

Hospital stay (days)	Study population		p-value
	Normal 25 (OH) vitamin D level (n=70)	Low 25 (OH) vitamin D level (n=128)	
Mean ± SD	5.20±0.83	6.88±2.02	<0.001**

Chi Square test was done
** means significant (p<0.05)

The study indicates that 68.8% patients with adverse in-hospital outcome had low vitamin D level and 8.6% patients with adverse in-hospital outcome had normal vitamin D level with significant association (p<0.001).

Table VIII

Comparison between adverse in-hospital outcomes and vitamin D level (n=198)

Adverse in-hospital outcome	Normal 25 (OH) vitamin D level (n=70) Number (%)	Low 25 (OH) vitamin D level (n=128) Number (%)	Total (n=198) Number (%)	p-value
Present	6 (8.6)	88 (68.8)	94 (47.5)	**<0.001****
Absent	64 (91.4)	40 (31.2)	104 (52.5)	

Chi Square test was done
** means significant (p<0.05)

Table IX

Multivariate logistic regression analysis of in-hospital cardiac events with confounding factors (n=198)

Variables of interest	Standardized coefficient (â)	Odds Ratio (OR)	95% CI of OR	p-value
Age>50 years	0.298	1.35	0.446 – 4.074	0.59
Female gender	-2.796	0.06	0.012-0.304	0.001
Smoking	-0.485	0.62	0.146 – 2.599	0.51
Diabetes mellitus	2.654	14.20	4.555 – 44.313	<0.001**
Low HDL-C	0.017	1.02	0.944 – 1.096	0.66
Elevated TG	0.006	1.00	0.998 – 1.014	0.13
Elevated Troponin I	0.142	1.15	1.052 – 1.263	0.002**
Presence of low vitamin D level	2.981	19.70	6.697 – 57.976	0.001**

**means significant (p<0.05)

*means not significant (p>0.05)

Multivariate logistic regression model was constructed with age >50yrs, female gender, smoking, diabetes mellitus, low HDL-C, elevated TG, elevated Troponin I and presence of low vitamin D level as independent variables and adverse in-hospital outcome as the dependent variable. The variables diabetes mellitus, elevated Troponin I and presence of low vitamin-D level were found to be significantly associated with adverse in-hospital outcomes with the ORs being 14.20, 1.15 and 19.70 respectively.

Discussions

This cross-sectional observational study was carried out to find out the association of low serum vitamin D level with more in-hospital complications in patients with acute myocardial infarction. The results of our study demonstrates that low vitamin D level increases the chance of adverse in-hospital outcomes after AMI and the association between vitamin D level and in-hospital complications remains statistically significant even after adjustment for significant cardiovascular risk factors. The mean age of the study population was 52.8 ± 6.7 years ranging from 30 to 73 years and most of the patients (48%) belonged to 50-59 years of age. Male patients were predominant in the study population which were 79.8%. Female patients were 20.2%. In our study female patients had lower vitamin D level than male (Mean 26.1±10.5 ng/ml vs. 18.8±8.0 ng/ml) which was statistically significant (p<0.001). Lips, 2007 and Hagenau et al., 2009 showed women often have lower levels of 25(OH)D levels than men[24,25]. Potential causes include differences in body fat composition, inadequate dietary intake, childbearing and menopause[26]. As Bangladesh has a predominantly muslim society, the practice of purdah/borkha (a covered-up style of dress) and 'shari' are very common in women of different socio-economic classes. In addition, avoiding sun exposure predispose to a reduced endogenous synthesis of vitamin D. Among the risk factors for CAD, the frequency of smoking was higher (64.1%) whereas the frequency of hypertension (34.8%) and diabetes mellitus (33.8%) were nearer to each other. Patients with history of smoking and diabetes mellitus were significantly higher in low vitamin D level compared to normal vitamin-D level with p-value <0.001 and 0.002 respectively. Patients with hypertension had higher vitamin D level (42.2% patients were within 11-20 ng/ml range) but did not show any significant association (p=0.14). This study found smoking as the most prevalent (64.1%) risk factor for CAD. Akanda et al., (2011) also found smoking as the most prevalent (60%) risk factor among the patients of CAD of the Bangladeshi population similar to our study findings[27]. Major proportion of diabetic patients had vitamin D deficiency (46.7%); 23.7% patients with insufficiency and 22.9% patients with normal vitamin D level. Mauss et al., (2015) found that Vitamin D deficiency is associated with DM in working older adults[28].

Vitamin D insufficiency and deficiency were very common among our study population. 64.6%(128 cases) patients with AMI had vitamin D level less than 30 ng/ml, while 35.4%(70 cases) patients had normal level (≥30 ng/ml). A significant proportion (45.4%) of study population had vitamin D deficiency (less than 20 ng/ml). No patients were found as severe deficiency. Average serum vitamin D level was 24.62±10.45 ng/ml with minimum 11 ng/ml and maximum 46 ng/ml. Kumar, et al., (2016) showed

that vitamin D deficiency was present in 39.5% of patients as compared to 26% in control population and insufficient vitamin D levels were present in 18% of patients as compare to 11% in control population[29]. Karur et al., (2014) in a study published in India stated that of the patients enrolled 67.5% were vitamin D deficient and 16% insufficient, for a total of 83.5% of patients with low vitamin D level[30]. Akin et al., (2012) found that 83% of the patients had vitamin D level less than 30 ng/ml[31]. Syal et al., (2012) also found in his study higher proportion (93%) of vitamin D deficiency and insufficiency, while only 7% had normal vitamin D levels[32]. The high prevalence of vitamin D deficiency is a reflection of generalized hypovitaminosis D in our country as well.

In this study, adverse in-hospital outcome was considered as the presence of any early complications of acute coronary syndrome, such as heart failure, tachy/brady-arrhythmia, acute kidney injury, cardiogenic shock and death; occurring after the index event during hospital stay before discharge from hospital. The study showed that 51% patients had adverse in-hospital outcome; 71.1% patients with low vitamin-D level had adverse in-hospital outcome whereas 14.3% patients with normal vitamin-D level had adverse in-hospital outcome with significant association (p<0.001). Kumar, et al., (2016) showed that the patients with vitamin D deficiency were associated with a higher risk for several in-hospital MACEs, including mortality and it was statistically significant (p-value<0.05)[29].The study supports the close association between low vitamin D levels at hospital presentation and worse prognosis in ACS patients[29]. Indeed, patients with 25 (OH) D deficiency had a 3-fold higher mortality risk, even after adjustment for important independent variables associated with mortality in ACS[29]. In our study, heart failure was significantly higher in patients with low vitamin D level than patients with normal vitamin D level with significant association (p<0.001). Cardiogenic shock was observed in 9.1% patients who all had low vitamin D level; while no AMI patients with normal vitamin D level developed cardiogenic shock with highly significant association (p<0.001). Arrhythmia and AKI were also more frequent in AMI patients with low vitamin D level. Among the AMI patients, 6.7% patients died who all had vitamin D level in the deficient range.

Heart failure was the most frequently observed adverse in-hospital outcome among the ACS patients (25.8% patients). Only 5.7% patients with normal vitamin D level developed heart failure whereas 41.1% patients with vitamin D deficiency and 26.3% patients with vitamin D insufficiency developed heart failure with significant association (p<0.001). Gotsman et al., (2012) found that the percentage of patients with vitamin D deficiency was higher in patients with HF compared with the control group (p<0.00001); only 8.8% of the HF patients had optimal vitamin D levels[14]. Pilz et al., (2008) also showed that vitamin D was negatively correlated with N-terminal pro-B-type natriuretic peptide and was inversely associated with higher New York Heart Association classes and impaired left ventricular function[8]. The major potential mechanisms that may explain a direct protective effect of vitamin D against heart failure include effects on myocardial contractile function, regulation of natriuretic hormone secretion, effects on extracellular matrix remodeling, reduced left ventricular hypertrophy and the regulation of inflammatory cytokines[33,34]. Indirectly, vitamin D can also affect cardiac function by altering parathyroid hormone and serum calcium levels. The initial evidence in humans came from dialysis patients. In patients with uremic cardiomyopathy, treatment with 1-alfa hydroxyl cholecalciferol 1g per day for 6 weeks produced a decrease in plasma parathyroid concentration and an increase in fractional fiber shortening on M-mode echocardiography (p<0.025)[35].

Arrhythmia was observed in 20.2% AMI patients in this study. AF(6.1%), VT(5.1%), First degree AV block(2%), Trifascicular block(1%) and Complete AV block(6.1%) were noted among the arrhythmias. All the arrhythmias developed more frequently in patients with vitamin D deficiency except trifascicular block which more frequently developed in patients with vitamin D insufficiency. In a recent report, the correction of vitamin D deficiency and hypocalcemia resulted in control of incessant ventricular tachycardia and cardiomyopathy[36]. A rare case of fetal atrial flutter was reported in vitamin D–resistant rickets[37]. In an animal study, rats fed a vitamin D–deficient diet for 12 weeks developed significant QT-interval shortening despite normal serum calcium levels compared to normal rats[38]. These findings suggest a possible role for vitamin D deficiency as a causal factor for arrhythmia and the need for further exploration.

The patients who developed cardiogenic shock, all had low vitamin D level; none with normal vitamin D level developed cardiogenic shock with highly significant association (p<0.001). 17.8% patients with vitamin D deficiency developed this adverse outcome while it was present in 5.3% patients with vitamin D insufficiency. The association of low vitamin D level with cardiogenic shock due to AMI needs to be further evaluated.

Death occurred in 3% of AMI patients as a consequence of adverse outcome andall those patients had vitamin D level in deficient range while no death occurred in AMI patients with normal vitamin D level which was statistically significant ($p<0.02$). There are studies that have shown an association between vitamin D intake and death due to CAD. An example is a cohort study that provided evidence that inadequate amounts of vitamin D in the body may predict a higher risk of coronary heart disease death[39]. Ginde, et al., (2009) also showed that serum vitamin D levels had an independent, inverse association with cardiovascular disease and all-cause mortality in non-institutionalized older adults, a group at high risk for all-cause mortality[6].

Conclusion

The results of the study demonstrates that the association between low vitamin D level and in-hospital complications after AMI remains statistically significant ($p<0.001$). Low serum vitamin D level is independently associated with a higher frequency of several in-hospital adverse clinical events including mortality after AMI. Whether low vitamin D levels represent a risk marker or a risk factor in ACS remains to be elucidated.

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. The data were only hypothesis generating as they did not provide evidence to support a causal relationship and they require confirmation in suitably designed clinical trials. Many factors that affect vitamin D status (eg, latitude, season, sunlight exposure, skin color, dietary vitamin D intake, serum albumin, serum calcium etc.) were not taken into account in the study and might have influenced, at least in part, the results. The Parathyroid Hormone (PTH) level was not assessed and thereby we could not determine whether the association between vitamin D status and cardiovascular risk was mediated in part by secondary hyperparathyroidism.

Recommendations

The results of the present study suggest that low vitamin D level is a risk factor for developing adverse outcome following AMI. The correction of vitamin D deficiency and maintenance of an optimal status may be a promising approach for acute treatment and secondary prevention of AMI complications that requires confirmation in interventional trials with vitamin D supplementation. Further clinical and experimental studies may be warranted to validate the findings, to investigate the mechanisms underlying increased cardiovascular risk and to determine whether correction of vitamin D deficiency could contribute to the prevention of cardiovascular disease.

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Original Article

In-Hospital Outcome of Patients with ST - T Changes in Non ST Segment Elevation Myocardial Infarction

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Abstract

Background: This cross sectional observational study was carried out with an aim to find out in-hospital outcome in patients with ST-T changes in non-ST-segment elevation myocardial infarction (NSTEMI).

Methods: This cross sectional observational study was carried out in the department of cardiology, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh from January 2014 to December 2014. A total of 120 patients with NSTEMI were the study population. Patients were divided into two groups on the basis of ST-T changes, 60 patients with ST-T changes were in group I and 60 patients without ST-T changes were in group II.

Result: In this study, the mean age was 54.2 ±14.2 years. Male female ratio was 2.75:1 among the study population. There was no statistically significant difference in mean BMI among the two groups. Smoking was the most common risk factor present (47.5%). Smoking was found significantly more in Group I than patients of group II (p=0.02). Serum troponin I was found significantly raised in group I (42.8±5.5 vs 10.5±8.3, p=0.002). The mean left ventricular ejection fraction (LVEF) of patients in group I was significantly lower than group II (52.1±9.1% vs 61.7±6.9%. p=0.001). Adverse in-hospital outcome was significantly more in group I than group II (48.3% vs 26.7%, p=0.01). Recurrent angina pectoris, STEMI, significant arrhythmia, acute LVF and cardiogenic shock were also more in group I than in group II. In-hospital mortality was noted in group I patients with both ST segment depression and T wave inversion (6.7%). Emergency revascularization was done more commonly in patients of group I (6.7%). The mean duration of hospital stay was statistically significant between the groups (6.24±2.58 vs 4.44±1.71 days. p<0.05)). Multivariate logistic regression analysis revealed that ST-T changes are an independent predictor for developing adverse in-hospital outcome in patients with non-ST-segment elevation myocardial infarction.

Conclusion: The ST-segment depression and T-wave inversion on admission ECG are important predictors of outcome in patients with NSTEMI. The ST-segment depression on admission ECG of patients with NSTEMI is associated with higher adverse in hospital outcome and mortality.

Key words: *Non-ST-segment elevation myocardial infarction (NSTEMI), ST-T Changes, Adverse in hospital outcome.*

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Introduction

Over the last decade, cardiovascular diseases (CVD) have become the single largest cause of death worldwide. Like many high-income countries during the last century, low and middle-income countries are experiencing an alarming increase in the rates of CVD and this change is accelerating[1]. In 2008, age standardized all cause mortality rate in Bangladesh was 1210 per 100,000 population, among them mortality due to non-communicable disease was 702 per 100,000 population[2]. Mortality rate due to cardiovascular and respiratory disease were 421 and 97 per 100,000 populations respectively[3].

The prevalence of coronary heart disease was found to be 3.3 per thousand in 1976 and 17.2 per thousand in 1986 indicating fivefold increase of the disease by ten years[4]. Three small scale population based studies showed average prevalence of ischemic heart disease (IHD) 6.5 per thousand rural population of Bangladesh[5].

Acute coronary syndrome (ACS) is a useful operational term which distinguishes acute myocardial ischemia from stable coronary artery (CAD) disease. Non-ST-segment elevation ACS (NSTE-ACS) comprises unstable angina and non-ST-segment elevation myocardial infarction (NSTEMI). Where as ST elevation MI is due to acute total occlusion, NSTEMI is due to severe obstruction but not total occlusion of culprit coronary artery[6].

In the setting of NSTEMI, macro or micro-vascular coronary flow is diminished enough to produce detectable myocardial necrosis, which presents with elevation of cardiac enzymes[7]. Unstable angina and NSTEMI can be viewed as very closely related clinical conditions with similar presentation but the diagnosis of NSTEMI is established if there is evidence of myocardial necrosis based on elevated cardiac serum markers, such as creatine kinase isoenzyme (CK-MB) , and/or troponin T or I in the absence of ST-segment elevation[8]. NSTEMI constitutes a clinical syndrome subset of the ACS that is usually, but not always, caused by atherosclerotic CAD and is associated with an increased risk of cardiac death and subsequent MI[9]. NSTEMI results from nonocclusive thrombus on pre-existing plaque, dynamic obstruction, progressive mechanical obstruction, inflammation and secondary UA[8].

The incidence of NSTE-ACS, both absolute and relative to STEMI is increasing, probably as a result of demographic changes in the population, including progressively increasing numbers of older persons and higher rates of diabetes mellitus. Approximately two thirds of patients with unstable angina have evidence of myocardial necrosis on the basis of elevated cardiac serum markers, such as cardiac-specific troponin T or I and creatine kinase isoenzyme (CK)-MB and thus have a diagnosis of NSTEMI[8].

The ST-segment depression and T-wave inversion on admission ECG are important predictors of outcome in patients with NSTEMI. Cumulative ST-segment deviation of at least one mm on admission ECG identifies patients at risk for subsequent adverse cardiac events[7]. The baseline ECG has an important prognostic value for ACS, as the risk of new or reversible ST-segment depression greater or equal to 0.5 mm has comparable risks to transient ST elevation or new left bundle branch block and increased mortality up to 2 fold. The magnitude of ST-segment deviation and the degree of troponin 1 elevation predicted the likelihood of failure of a conservative strategy, the extent of CAD, and the likelihood of death or MI[7].

In patients with NSTEMI, the study by Barrabes et al showed that ST depression in two lateral leads(I,avl,V5 and V6) was associated with lower LVEF and left main (LM) coronary artery or tripple vessels disease more often than in patients without ST-depression in the lateral leads[10]. Khan et al found that the extent of ST segment depression can predict in-hospital outcome in non-ST-segment elevation acute coronary syndrome[11]. In patients of NSTEMI, the presence of ST segment depression in lateral leads indicates severity of coronary artery disease[12]. Savonitto et al found that in patients with NSTE ACS the sum of ST-segment depression in all ECG leads is a powerful predictor of 30 days mortality independent of clinical variables and correlates with the severity of coronary artery disease[13].

The ECG is an important non-invasive, easy, widely available, inexpensive diagnostic tool that helps rapidly establish a working diagnosis for patients with ischemic symptoms and helps in risk stratification and decision about optimal therapeutic option. The ST-segment depression and T-wave inversion on admission ECG are important predictors of outcome and associated with higher mortality in patients with NSTEMI. In our country there is no such type of study, as such, this study is justified and time worthy.

Methods

This cross sectional observational study was carried out in the department of cardiology, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh from January 2014 to December 2014. By means of purposive

sampling total of 120 patients with NSTEMI recruited as study population. Patients were divided into two groups on the basis of ST-T changes, 60 patients with ST-T changes were in group I and 60 patients without ST-T changes were in group II. Patients with STEMI, unstable angina, previous myocardial infarction, previous history of revascularization (PCI or CABG), valvular heart disease, congenital heart disease, cardiomyopathy, bundle branch block pattern or evidence of pre-excitation in ECG, Ventricular hypertrophy and Paced rhythm were excluded from the study.

Detailed history was taken and detailed clinical examination was performed and recorded in predesigned data collection sheet. Routine investigations were done, cardiac troponin-I was measured at least 4 hours after the onset of chest pain. A cardiac troponin-I level of more than 1ng/ml was considered as significant. A 12 lead resting ECG was done at a paper speed of 25 mm/s and 10 mm standardization at admission and every morning and if required. The ST-segment depression was defined as J-point depression e"1 mm followed by a horizontal or down slopping ST segment for at least 0.08 seconds. Degree of ST segment depression was measured in mm. It was measured in that lead where maximum ST segment depression was present. The T-wave inversion was defined as T-wave inversion e"1mm from baseline. It was measured in that lead where maximum T wave inversion was present. Trans-thoracic echocardiography was done by 2D & M-mode and Doppler modalities within 24 hours of hospitalization. Routine follow-up was done everyday to find out any adverse cardiac events till discharge or death.

The study protocol was approved by the Ethical Review Committee of NICVD. Informed consent was taken from each patient or relatives. The Statistical Package for Social Sciences version 16 software (SPSS inc., Chicago, Illinois, USA) was used for data analysis. Categorical variables were expressed as percentage and frequency and continuous variables as mean and standard deviation. Continuous variables were compared through the Student's t-test and for the categorical variables the chi-square test was done. Multivariate logistic regression analysis was done to identify predictors of in-hospital outcome. A p value of less than 0.05 was considered statistically significant.

Results

All the variables e.g. baseline characteristics and outcome variables were compared between the two groups. In table I comparison between the groups according to age was shown, the mean age was 57.80±14.21 years and 50.53±13.32 years in group I and II respectively, age difference was statistically significant (p=0.005). The sex distribution of the study patients were almost identical in both groups (p=0.41) with male predominance (Figure 1). In table II, considering the risk factors smoking was found significantly more in group I patients (pd"0.02). Table III shows the distribution of the study patients by presenting complaints. All the patients in the study groups presented with chest pain. Shortness of breath was significantly (p=0.04) more in group I.

Table IV shows different parameters of the study population. In haemodynamic evaluation, systolic blood pressure was 130.6±19.4 mmHg and 120.0±15.9 mmHg in group I and II respectively, which was statistically significant (p=0.01). Other clinical parameters were similar between the two groups. There was statistically insignificant difference of mean BMI among the groups. The biochemical investigations findings were higher in group I but were statistically insignificant, except Troponin I level, which was significantly high in group I (p=0.02). Statistically significant difference in ejection fraction was found among the study groups (p=0.001). It was observed that regional wall motion abnormality was significantly higher in group I patients. Table V shows distribution of ST-T changes in ECG in Group I patients (n=60).

Table VI shows the distribution of the study patients by adverse in-hospital outcome. 48.3% patients in group I experienced adverse in-hospital outcome, on the contrary 26.7% of the patients in group II (p=0.01). In group I clinical findings of left ventricular failure and cardiogenic shock were statistically significant. STEMI, arrhythmia, recurrent angina pectoris and in hospital mortality was predominantly higher among group I patients. It was observed that the mean duration of hospital stay was prolonged in group I patients (p<0.05).

Table VII projects the logistic regression analysis of Odds Ratio for characteristics of the subjects likely to develop adverse in-hospital outcome. In univariate analysis, reduced LVEF and ST-T changes were observed as significant predictors for developing adverse in-hospital outcome with OR being 3.10 and 1.88. It was also observed in multivariate analysis, reduced LVEF and ST-T changes were found to be the independent predictors for developing adverse in-hospital outcome with ORs being 2.55, and 1.67. Advance age, smoking and SBP were not observed as independent predictors for developing adverse in-hospital outcome (p>0.05).

Table I

Comparison of the study population according to age (n=120)

Age in years	Group I(n = 60) Number	%	Group II (n = 60) Number	%	P value
<40	4	6.7	10	16.7	
40 – 49	13	21.7	18	30.0	
50 – 59	18	30.0	18	30.0	
60 – 69	12	20.0	8	13.3	
≥70	13	21.7	6	10.0	
Mean±SD	57.80±14.21		50.53±13.32		0.005[s]

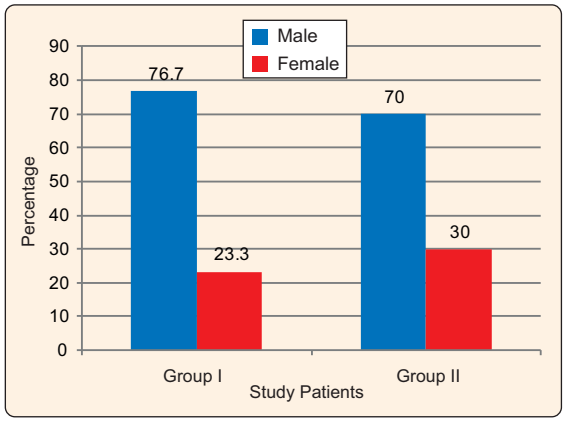

Fig.-1: *Sex distribution among the study patients by bar diagram (n=120)*

Table II

Cardiovascular risk factors in-between the groups (n=120)

Characteristics	Group I Frequency (%)	Group II Frequency (%)	P value
Smoking	35 (58.3%)	22 (36.7%)	0.02[S]
Hypertension	18 (30.0%)	18 (30.0%)	1.00[ns]
Diabetes mellitus	18 (30.0%)	21 (35.0%)	0.56[ns]
Dyslipidaemia	06 (10.0%)	08 (13.3%)	0.56[ns]
Family H/O IHD	06 (10.0%)	06 (10.0%)	1.00[ns]

Table III

Comparison of in between the groups according to presenting complaints of the patients (n = 120)

Complaints	Group I(n = 60)		Group II (n = 60)		P value
	Number	%	Number	%	
Chest pain (Angina)	60	100.0	60	100.0	1.00[ns]
Shortness of breath	14	23.3	06	10.0	0.04[s]
Vomiting	08	13.3	06	10.0	0.57[ns]
Sweating	09	15.0	12	20.0	0.47[ns]
Syncope	05	8.3	02	3.3	0.24[ns]
Palpitation	10	16.7	04	6.7	0.15[ns]

Table IV

Distribution of clinical, biochemical and echocardiography parameters of study population in between the groups (n=120)

Parameters	Group I (n=60) Mean ± SD	Group II (n=60) Mean ± SD	p value
Heart rate (bpm)	81.3±9.3	79.5±14.3	0.11^{ns}
SBP (mm of Hg)	130.6±19.4	120.0±15.9	**0.01^{s}**
DBP (mm of Hg)	84.4±9.1	78.8±8.8	0.34^{ns}
BMI(kg/m^2)	26.67±8.73	23.58±7.72	0.14^{ns}
RBS (mmol/L)	9.8±3.4	9.3±3.6	0.40^{ns}
S. Creatinine (mg/dl)	1.08±0.21	1.03±0.16	0.18^{ns}
Troponin I (ng/ml)	42.8±5.5	10.5±8.3	**0.002^{s}**
Total Cholesterol (mg/dl)	188.9±45.8	185.2±46.9	0.29^{ns}
LDL (mg/dl)	117.3±38.8	110.7±38.9	0.34^{ns}
HDL (mg/dl)	37.8±5.5	39.4±5.8	0.30^{ns}
Triglyceride (mg/dl)	160.5±65.5	158.4±62.3	0.42^{ns}
Echocardiography Parameters			
• EF (%)	52.1 ± 9.1	61.7 ± 6.9	**0.001^{s}**
• RWMA [n, (%)]	15, (25.0%)	5, (8.3%)	**0.01^{s}**

Table V

Distribution of ST-T changes in ECG in Group I patients (n=60)

ECG findings	Number(n)	Percentage (%)
• ST segment depression	22	36.7
• T wave inversion	23	38.3
• ST segment depression and T wave inversion	15	25.0

Table VI

Comparison of patients by adverse in-hospital outcome (n=120)

In-hospital outcome	Group I(n = 60)		Group II (n = 60)		P value
	Number	%	Number	%	
STEMI	05	8.3	01	1.7	0.20^{ns}
Recurrent angina pectoris	08	13.3	03	5.0	0.20^{ns}
Arrhythmias	10	16.7	04	6.7	0.15^{ns}
Acute left ventricular failure	17	28.3	08	13.3	0.04^{s}
Cardiogenic shock	08	13.3	01	1.7	0.02^{s}
Emergency revascularization	04	6.7	03	5.0	1.00^{ns}
Death	04	6.7	00	0.0	0.11^{ns}
Adverse in-hospital outcome	29	48.3	16	26.7	0.01^{s}
Duration of hospital stay(Mean± SD)	6.24±2.58 days		4.44±1.71days		0.02^{s}

Table VII
Factors related to adverse in-hospital outcome

Variables of interest	Univariate analysis			Multivariate analysis		
	OR	95% CI of OR	p value	OR	95% CI of OR	p value
Age (≥50 years)	0.90	0.458-2.104	0.96^{ns}	0.81	0.356-1.824	0.60^{ns}
Smoking	1.68	0.797-3.538	0.17^{ns}	1.55	0.699-3.443	0.28^{ns}
SBP	1.01	0.989-1.031	0.36 ^{ns}	1.00	0.987-1.032	0.42^{ns}
LVEF (<50)	3.10	1.217-7.831	0.006^{s}	2.55	1.016-6.551	0.03^{s}
ST-T changes	1.88	1.181-5.324	0.01^{s}	1.67	1.011 – 4.133	0.02^{s}

Discussion

This cross sectional observational study was carried out with an aim to find out in-hospital outcome in patients with ST-T changes in non-ST-segment elevation myocardial infarction (NSTEMI). The age difference was statistically significant (p≤0.005) among the two groups. The mean age of total study population was 54.2±14.2 years. Khan et al in their study, mean age in non ST segment elevation ACS patients was 57.6±10.1 years[11]. A study done by Ullah et al found mean age of 54.58 years in NSTEMI patients[12]. Uddin et al found mean age of 49.7±11.3 years in patients with IHD[14]. Although results are similar, small variations of mean age among different study may be due to differences in study design. Male patients were predominant among the study population. Similar male preponderance was found in almost all studies in patients with IHD. Male female ratio was 5.9, 4.6 and 4.95 in respectively in studies by Ullah et al and Uddin at al[12, 14].

This study found that smoking was the most common risk factor in study population. Smoking was found significantly more in group I than group II (p≤0.02). Uddin, Khan and Ullah et al had shown smoking as the highest prevalent risk factor in CAD[14,11,12]. Ullah et al in their study found, prevalence of smoking in 81%, hypertension 34%, diabetes mellitus 32%, family history of CAD 20% and dyslipidemia in 9% patients[12].

All the patients of the study group presented with chest pain. Shortness of breath was significantly (p=0.04) more in ST-T changes group (23.3%vs.10%). Vomiting, sweating, syncope and palpitation were also observed in both study group but there was no statistically significant difference (p>0.05).

In hemodynamic evaluation, pulse and diastolic blood pressure did not vary significantly between the two groups. Clinical findings of left ventricular failure were found statistically significant (p=0.04) in patients with ST-T changes group. Ghaffari et al found higher SBP on admission and S3 gallop on heart auscultation during admission[7]. The BMI difference was not statistically significant among two groups. The mean BMI of total study population was 23.6±3.2 kg/m^2. Mean BMI of IHD patients was 24.1±4.1 in the study by Uddin et al, which was very similar to present study[14].

In term of biochemical parameters there is no statistically significant difference between two groups except serum troponin I which was found significantly raised in group I (42.8±5.5vs.10.5±8.3 ng/ml, p=0.002). Khan et al found similar observation in their study[11]. In this study, among the ST-T changes group, 23(38.3%) ,22(36.7%),15(25%) patients had significant T wave inversion, ST segment depression and both ST segment depression and T wave inversion respectively. Muller et al found significant ST depression in 38.2% of study population[15].

The mean left ventricular ejection fraction was 52.1 ± 9.1% and 61.7 ±6.9% in group I and group II respectively (p=0.001). Ghaffari et al found that the mean left ventricular ejection fraction (LVEF) of patients with ECG changes were significantly lower than those without ECG changes (p=0.001)[7]. 25% of ST-T changes patients and 8.3% of patients without ST-T changes had regional wall motion abnormality (RWMA). It was observed that RWMA had significantly higher in patients with ST-T changes group than without ST-T changes group (p=0.01).

Adverse in-hospital outcome was observed in 48.3% patients of group I and 26.7% patients of group II. The difference was significant statistically (p=0.01)). In this study, 28.3% patients with ST-T changes developed acute left ventricular failure and it was the most common complication among two groups of patients, followed by arrhythmia (16.7%), recurrent angina pectoris and cardiogenic shock (13.3%) respectively and STEMI

(8.3%). In group I 6.7% patients needed emergency revascularization (PCI) and in group II 5% patients needed emergency revascularization (PCI). None of the two groups required emergency CABG during in-hospital period. In-hospital mortality was 6.7% in group I and none in group II. The incidence of STEMI, recurrent angina pectoris, arrhythmia, emergency revascularization and death were found almost identical with no statistical significant difference (p>0.05). Mueller et al reported mortality rates of 8% in patients with no ECG changes, 19.9% in patients with ST depression and only 5.1% in patients with T wave inversion[15]. Khan and Ullah et al found similar type of complications in their study[11,12]. Barrabes et al showed that ST depression in two lateral leads(I,aVL,V5 and V6) was associated with lower LVEF and left main coronary artery disease or triple vessel disease more often than in patients without ST depression in the lateral leads10. The mean duration of hospital stay was 6.24±2.58 days and 4.44±1.71 days in group I and group II respectively and the mean difference was statistically significant (p<0.05)).

Multivariate logistic regression analysis was done among traditional predictors of adverse in-hospital outcome such as advanced age (e”50 years), smoking, systolic blood pressure, left ventricular ejection fraction and ST-T changes. Among these, ST-T changes and reduced LVEF were found to be the independent predictor for developing adverse in-hospital outcome with ORs being 2.55 and 1.67 and p value<0.05. Most important finding of the present study is that ST-T changes have significant impact on adverse in-hospital outcome in patients with non-ST-segment elevation myocardial infarction.

Conclusion

The ST-T changes in ECG are an important and independent predictor of in-hospital adverse outcome in patients with NSTEMI. ST-T changes could be considered as a good tool for identification of high risk group of NSTEMI. As early optimal medical and intervention treatment has been shown to reduce cardiac events particularly in high risk patients, thus may offer a useful tool to target aggressive medical and interventional therapy to patients for highest risk for ischemic complications.

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Original Article

ABO Blood Group and Severity of Coronary Artery Disease Assessed by Syntax Score in Patients with Acute Myocardial

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Abstract:

Introduction: As coronary artery disease (CAD) is a major cause of morbidity and mortality; timely diagnosis and appropriate therapy is of paramount importance to improve clinical outcomes. Though there are major risk factors for CAD but sometimes it does not correlate with ACS. So, search for new risk factor is necessary for better management of CAD specially STEMI.

Aim: To see the association between ABO blood group and severity of CAD in patients with STEMI.

Methods: This study was done during the period of January 2016 to June 2016 with STEMI at National Institute of Cardiovascular diseases, Dhaka, Bangladesh. 100 patients were grouped in I and II where group-I having 50 patients of non-O blood group and group-II having 50 patients of O blood group. After CAG all reports were analyzed by two experts and SYNTAX score were calculated and data were analyzed by SPSS.

Results: Baseline characteristics (100 patients) were well matched between the groups. Low SYNTAX score (d"22) was 16% and 56%; intermediate score (23-32) was 40% and 36% and high score (>32) was 44% and 8% in group-I and group-II respectively. These indicate that patients of non-O blood group have high SYNTAX score that is more severe CAD. Univariate and multivariate regression analysis showed that non-O blood group is an independent risk factor for CAD. So easily available ABO blood grouping can be helpful to determine the severity of CAD in patients with STEMI.

Keywords: ABO blood group, Coronary Artery Disease(CAD), SYNTAX score, Acute Myocardial Infarction(AMI).

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Introduction:

Over the last two centuries, the industrial and technological revolutions and the economic and social transformations dramatically shift the major cause of death from infectious diseases and malnutrition to cardiovascular disease (CVD) and cancer. At the beginning of the 21th century, CVD accounts for nearly half of all deaths in the developed world and 25% in the developing world.

Regarding blood group in Dhaka, the capital city of Bangladesh, majority (39.8%) of people were identified having blood group B, while 27.6% were blood group O,

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23.5% and 9.2% were blood group A and AB respectively. Rh-D positive 97.4% and Rh-D negative were 2.6%.[1]

As CAD is a major cause of morbidity and mortality, timely diagnosis and appropriate therapy is of paramount importance to improve clinical outcome.[2]

Acute coronary syndrome (ACS) encompasses acute myocardial infarction (AMI) (resulting in ST-segment elevation or non–ST segment elevation) and unstable angina. ST-segment elevation myocardial infarction (STEMI) is a clinical syndrome defined by characteristic symptoms of myocardial ischemia in association with persistent electrocardiographic (ECG) ST elevation and subsequent release of biomarkers of myocardial necrosis. Non-ST elevation myocardial infarction (NSTEMI) and unstable angina can be viewed as very closely related clinical conditions with similar presentation but the diagnosis of NSTEMI is established if there is evidence of myocardial necrosis based on elevated cardiac markers especially elevated High Sensitivity Troponin-I with or without ECG change but with classical symptoms of ischaemia.[3]

It is well known that smoking, hypertension, diabetes mellitus, dyslipidemia, family history of premature CAD and obesity are most important risk factors for CAD.[4]

Risk factors of acute myocardial infarction (AMI) in younger people (<40 years) was observed in a study in Bangladesh, where smoking and triglyceride were found to be strikingly associated risk factor for AMI in that group.[5] Family history has been said to be more likely positive in the younger patients with CAD .[6]

The incidence of atherosclerosis increases as blood pressure rises, and this excess risk is related to both systolic and diastolic blood pressure as well as pulse pressure.[7]

Accurate but simple methods of risk assessment are important for patient care and for determining the prognosis and providing information for the patient.[8]

Despite improvement in risk scoring, there still remain patients identified as being low risk who experience CAD events, as well as, patients deemed high risk who remain free of CAD events. This information leads to search for additional emerging risk factors that may aid in further risk discrimination. In some cases, the tests are not universally available (apolipoprotein B) or are relatively expensive (lipoprotein-associated phospholipase A. In other cases, the tests harbor potential risk (radiation with myocardial perfusion imaging or cardiac CT) or require specialized laboratories for testing (brachial flow mediated dilation and genetic testing).[9]

ABO blood groups are composed of complex carbohydrate molecules with different antigenic structures expressed on the surface of red blood cells and a variety of human tissues, including epithelium, sensory neurons, platelets, and vascular endothelium.[10] The A and B alleles of the ABO locus encode A and B glycosyltransferase activities, which convert precursor H antigen into either A or B determinants, the A and B antigens having an extra saccharide unit to the 0 unit (N--acetyl galactosamine and galactose, respectively). Group O individuals lack such transferase enzymes (loss of function) and express basic, unchanged H-antigen.[11]

It has long been acknowledged that human ABO blood type might affect the risk factors of cardiovascular disease. In non-0 individuals, plasma levels of factor VIII–von Willebrand factor (vWF) complex are 25% higher than group O individuals.[12] Accumulating evidence indicates that elevated vWF level is a risk factor for coronary heart disease.[13] Other studies also indicates that ABO blood group might influence plasma lipid levels.[14] Recently, several genome-wide association studies found that variants at ABO locus were associated with plasma lipid levels[15]and inflammatory markers, including soluble intercellular adhesion molecule I[16,17],plasma soluble E-selectin levels. [18,19] and P-selectin levels[17] and tumor necrosis factor-á[20,] which were associated with the CAD risk.

The SYNTAX score is an angiographic lesion-based scoring system originally invented to evaluate the severity of CAD. It is able to aid revascularization decisions and predicts mortality and morbidity in patients with CAD[21].The relationship between ABO blood group and the severity of CAD assessed by SYNTAX Score in patients with CAD has not been clearly determined.

Therefore, we aimed to assess the association between the severity of coronary artery disease by SYNTAX Score with ABO blood group in patients with AMI.

Hypothesis

Non-O blood group is associated with more severe coronary artery disease than O blood groups in patients with acute myocardial infarction

Objectives

General Objective

To evaluate the relationship of non-O blood group and 0 blood group with severity of coronary artery disease in patients with acute MI.

Specific Objectives

1. To determine ABO Blood group of study subjects.
2. To calculate the severity of coronary artery disease of study subjects after angiogram by SYNTAX score.

3. To find out the association of non-O blood group and O blood group with severity of coronary artery disease.

Methodology

All study patients admitted during the period of January'16 to June'16 with acute myocardial infarction in the Department of Cardiology, NICVD, Dhaka, who agreed to undergo coronary angiography included for the study after considering inclusion and exclusion criteria. Patients with Unstable angina, significant valvular heart disease, congestive heart failure, post-PCI, post-CABG and patient with thrombolytic were excluded from the study. Informed written consent were taken from each patient or legal guardian before enrollment. After meticulous history taking and clinical examination demographic data such as, age, sex, body mass index (BMI) was recorded. AMI will be diagnosed as per the criteria of Joint ESC/ACCF/ AHA/WHF Task Force for the definition of AMI in usual clinical setting. Risk factors include smoking, tobacco consumption, hypertension, diabetes, dyslipidemia, family history of premature CAD, Pulse and Blood pressure (BP) was recorded.

ABO blood group determination was done using a commercially available hemagglutination technique. Routine investigations (troponin I, blood sugar, serum creatinine, fasting lipid profile) and other screening tests for coronary angiogram, resting ECG, left ventricular ejection fraction by echocardiogram (LVEF) were done**.** Coronary angiogram was done after appropriate patient preparation by femoral artery cannulation and Judkin's system was applied for cannulation of the left and right coronary arteries. All angiographic views were evaluated by two experienced cardiologists who were blinded to the study. The severity of the CAD was assessed by SYNTAX score. Data were collected by using a preformed data sheet. The numerical data obtained from the study were analyzed and significance of differences 3was estimated by using statistical methods. The SPSS Statistical Software (21.0 version, SPSS Inc., Chicago, Illinois, USA) was used for data analysis.

Results and Observations:

This observational study was carried out at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, during the period from January 2016 t0 June 12016. This study was done with an aim to evaluate the relationship between ABO blood group and severity of coronary artery disease in patients with acute myocardial infarction (AMI). A total of 100 patients with acute MI who agreed to undergo coronary angiography were included in the study. Coronary angiogram was done during index hospital admission. On the basis of ABO blood group, study subjects were categorized into two groups: 50 patients of acute MI having non O blood group were considered as group I and 50 patients of acute MI having O blood group were considered as group II.

Table I

Age distribution of the study patients (n=100)

Age in Years	Group I (n=50)		Group II (n=50)		Total(n=100)		P
	Number	%	Number	%	Number	%	Value
<40	13	26.0	3	6.0	16	16.0	
41-50	18	36.0	23	46.0	41	41.0	
51-60	11	22.0	17	34.0	28	28.0	
> 60	8	16.0	7	14.0	15	15.0	
Mean ± SD(Range)	49.2±12.6(27-78)		52.9±8.8(38-78)		51.0±10.9(27-78)		0.09^{NS}

The mean age of the studied patients were 51.0±10.9 years ranging from 27 to 78 years. In group I mean age was 49.2±12.6 years and in group II was 52.9±8.8 years, the difference between two groups was not statistically significant (p=0.09).

Regarding the gender 86% was male in group I and 90% was in group II. No significant difference (p=0.53) was found between the groups in terms of sex distribution.

Table II
Risk factors of the study patients (n=100)

Risk Factors	Group I (n=50)		Group 11 (n=50)		Total (n=100)		p value
	Number	%	Number	%	Number	%	
Smoking							
Yes	38	76.0	26	52.0	64	64.0	0.018[s]
No	12	24.0	24	48.0	36	36.0	
Hypertension							
Yes	35	70.0	24	48.0	59	59.0	0.028[s]
No	15	30.0	26	52.0	41	41.0	
Diabetes mellitus							
Yes	21	42.0	24	48.0	45	45.0	0.54[NS]
No	29	58.0	26	52.0	55	55.0	
Dyslipidaemia							
Yes	33	66.0	22	44.0	55	55.0	0.03[s]
No	17	34.0	28	56.0	45	45.0	
Family H/O of premature CAD							
Yes	23	46.0	14	28.0	37	37.0	0.06[NS]
No	27	54.0	36	72.0	63	63.0	

Table II shows among the studied patients, highest percentage had history of smoking (76%) followed by hypertension (70%), dyslipidemia (66%), family history of premature CAD (46%) and diabetes mellitus (42%) in Group I. On the contrary, highest percentage had history of smoking (52%) followed by hypertension and diabetes mellitus (48%), dyslipidemia (44%) and family history of premature CAD (28%) in Group II. Smoking, hypertension and dyslipidemia were significantly more in group I than in group II ($p<0.05$). It was also observed that diabetes mellitus and positive family history of CAD were almost identical in the study groups ($p>0.05$).

Mean body mass index of the group I was 23.6±2.7 (kg/m^2) and that of group II was 24.8±3.6 (kg/m^2) indicates that patients are identical in both groups. (p=0.07)

Table III
Biochemical status of the study patients (n=100)

Biochemical parameters	Group I (n= 50)	Group 11 (n=50)	p value
	Mean ± SD	Mean ± SD	
Total Cholesterol(mg/dl)	166.9±43.2	164.1±46.1	0.75[NS]
Triglyceride (mg/dl)	180.3±54.2	164.4±40.6	0.1011[NS]
LDL cholesterol(mg/di)	111.0±29.2	97.3±16.2	0.0046[NS]
HDL cholesterol	38.4±5.8	41.3±6.7	0.08[NS]
S. creatinine (mg/di)	1.3±0.7	1.1±0.6	0.14[NS]
RBS (mg/dl)	7.5±1.9	8.0±1.1	0.68[NS]

The mean total cholesterol level was 166.9±43.2 mg/dl in group I and 164.1±46.1 mg/dl in group II (p=0.75). The mean triglyceride was 180.3±54.2 mg/dl in group I and 164.8±40.6mg/dl in group II (p=0.10). The mean LDL cholesterol level was 111.0±29.2mg/dl in group I and 97.3±16.2 mg/dl in Group II and the mean difference was statistically significant between the two groups (p=0.004). The mean HDL cholesterol level was 38.4±5.8 mg/dl in group I and41.3±6.7 mg/dl in group II (p=0.08). The mean S. creatinine level was1.3±0.7 mg/dl in group I and 1.1±0.6 mg/dl in group II (p=0.14).The mean RBS level was7.5±1.9m/dl in group I and 8.0±1.1 mg/dl in group II (p=0.50).

The mean ejection fraction 48.9±9.8% for the patients with group I and 55.8±6.9% for the patients of group II (p=0.04).

Table IV
Distribution of the study patients according to ABO bood group (n=100)

ABO blood group	Number	%
A	21	42.0
B	14	28.0
AB	15	30.0
0	50	100.0

ABO blood group in study patients and it was found that 42%, 28% and 30% patients having in A, B, AB blood group respectively. Remaining,50% patients having O blood group.

Positive Rh typing was found (84% vs 74%) in group I and group II patients respectively. (p=0.22).

Table V
Distribution of the study patients according to SYNTAX (n=100)

SYNTAX Score	Group I (n= 50)		Group II (n=50)		p
	Number	%	Number	%	value
Low (up to 22)	8	16.0	28	56.0	0.001^{S}
Intermediate (23 to 32)	20	40.0	18	36.0	0.68^{S}
High (above 32)	22	44.0	4	8.0	0.001^{S}
Mean ± SD	32.2±10.3		22.5±6.8		0.001^{S}

Table V shows low SYNTAX score was found (16% vs 56%) in group I and group II respectively with highly significant association (p=0.001). Intermediate SYNTAX score was found (40% vs 36%) in group I and group II respectively with no statistical association (p=0.68). High SYNTAX score was found (44% vs 8%) in group I and group II respectively with highly significant association (p=0.001).

Mean SYNTAX score significantly higher in group I than group II (32.2±10.3 vs 22.5±6.8) respectively. So, the severity of CAD is significantly more in patients having non 0 blood group than 0 blood group.

Table VI
Mean SYNTAX score among the non-O blood group patients (n=100)

Non-O blood group	SYNTAX score		p value
	Mean	SD	
A (n=21)	29.8	9.3	
B (n=14)	32.6	11.0	0.32^{NS}
AB (n=15)	35.1	10.8	

Table VI shows the mean SYNTAX Score of non-O blood group study patients according to A, B, AB. The mean SYNTAX Score of A, B and AB blood groups were29.8±9.3, 32.6±11.0 and 35.1±10.8 respectively. The SYNTAX Score increased accordingly in A, B and AB blood group and the differences were not statistically significant (p=0.32).

Table VII
Univariate logistic regression of determinants of high SYNTAX score

Variables of interest	B	S.E	p value	OR	95% CI
Smoking	0.979	0.302	0.02	3.21	1.66-7.180
Diabetes mellitus	0.294	0.104	0.24 ^{NS}	0.50	0.159– 1.583
Hypertension	0.675	0.336	0.03^{s}	1.77	1.201– 6.185
Dyslipidemia	0.773	0.535	0.02^{s}	2.17	1.325– 7.518
LVEF	0.693	0.435	0.03^{s}	1.89	1.221– 7.518
Serum Creatinine	0.214	0.114	0.33 ^{NS}	0.49	0.112– 1.524
Non-O blood group	0.826	0.465	0.001^{s}	3.42	1.81–5.649

Table VIII
Multivariate logistic regression of determinants of high SYNTAX score

Variables of interest	B	S.E	p value	OR	95% CI
Smoking	0.829	0.322	0.02 S	3.11	1.45-6.880
Diabetes mellitus	0.289	0.109	0.27s	0.47	0.149-1.423
Hypertension	0.625	0.436	0.04s	1.66	1.101-.285
Dyslipidemia	0.623	0.505	0.03s	1.98	1.125-6.118
LVEF	0.493	0.235	0.1 INS	1.11	0.221-3.518
Serum creatinine	0.204	0.104	0.27 NS	0.42	0.102-.424
Non-O blood group	0.806	0.495	0.001s	3.05	1.75-5.219

Table VII demonstrates the binary logistic regression analysis of odds ratio (OR) for characteristics of the subjects likely to cause of high SYNTAX Score. The variables revealed to be significantly associated with high SYNTAX score by univariate analysis. Of the 5 variables smoking, hypertension, dyslipidemia, LVEF and non-O blood group *were* found to be the independently significant predictors of high SYNTAX Score with ORs being 3.21, 1.77, 2.17, 1.89 and 3.42 respectively

Dependent variable: high SYNTAX Score; Independent variables: smoking, diabetes mellitus, hypertension, Dyslipidemia, LVEF, Serum creatinine and non-0 blood group; S = Significant, NS = Not significant

Table XII demonstrates the binary logistic regression analysis of odds ratio (OR) for characteristics of the subjects likely to cause of high SYNTAX Score. The variables revealed to be significantly associated with high SYNTAX Score by univariate analysis were entered into the model directly. Of the 4 variables smoking, hypertension, dyslipidemia and non-O blood group were found to be the significant predictors of high SYNTAX Score with ORs being 3.11, 1.66, 1.98 and 3.05 respectively.

Discussion:

This observational study was carried out at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, during the period from January, 2016 to June, 2016. This study was done with an aim to evaluate the relationship between non-O blood group and O blood group with severity of coronary artery disease in patients with acute myocardial infarction (AMI) by SYNTAX score, a new modality of severity scoring system which gain vast acceptance in PCI era. A total of 100 patients with acute MI were included in the study, 50 patients in group I and 50 patients in group II.

The mean age of the studied patients was 51.0±10.9 years ranging from 27 to78 years. The mean age of group I patients was 49.2±12.6 years ranging from 27 to 78 years and the mean age of group II was 52.9±8.8 years ranging from 38 to 78 years. In a study it was found mean age of patients having coronary artery disease in Bangladesh was 50.15±8.8 and ranging from 22 to 76 [22]. In a similar study it was 51.48 ±

9.32 years [23]. In group I, 43 (86%) patients were male and 45 (90%) patients were male in group II. No significant difference (p=0.53) was found between the groups in terms of sex distribution. In a study in 2012 reported 73.1% patients were male and several other studies repot the male predominance in AMI study population[24]. This sex-difference should be cautiously interpreted because of small sample size.

Among the studied patients, highest percentage had history of smoking (76%) followed by hypertension (70%), dyslipidemia (66%), family history of premature CAD (46%) and diabetes mellitus (42%) in Group I. On the contrary, highest percentage had history of smoking (52%) followed by hypertension and diabetes mellitus (48%), dyslipidemia (44%) and family history of premature CAD (28%) in Group II. Smoking, hypertension and dyslipidemia were significantly more in group I than in group II. According to Akhand et al[22]most prevalent risk factors were smoking (60%) and dyslipidemia (60%) among the patients of CAD. Islam & Majumder (2013) reported high prevalence of hypertension (20% in adult and 40-65% in elderly) in Bangladeshi population that contributes to CAD[25]. However, a study in USA Mukherjee et al 2005, these findings are different, where 30.5% was diabetic, 66.8% hypertensive, 60.6% dyslipidemic, 21.3% smoker. These differences might be due to variation in the life style [26]. Carpeggiani et al (2010) found

a significance association between non-O blood group and family history of ischemic heart disease, hypercholesterolemia and presence of coronary atherosclerosis[27]. We found significance presence of lipid disorder in non-O blood group. Interestingly, both groups have similar incidence of DM. In the current study, mean body mass index (BMI) of the group I was 23.6±2.7 (kg/m2) and that of group II was 24.8±3.6 (kg/m2). BMI demonstrates that patients are identical in both groups. It was observed that there was no significant difference between the groups regarding BMI. The mean total cholesterol level was 166.9±43.2 mg/dl in group I and 164.1±46.1mg/dl in group II. The mean difference of total cholesterol between the two groups was statistically insignificant. The mean triglyceride was 180.3±54.2 mg/dl in group I and 164.8±40.6 mg/dl in group II. Mean difference of triglyceride level was statistically insignificant among the two groups. The mean LDL cholesterol level was111.0±29.2 mg/dl in group I and 97.3±16.2 mg/dl in Group II and the mean difference was statistically significant between the two groups in terms of LDL cholesterol. The mean HDL cholesterol level was 38.4±5.8 mg/dl in group I and 41.3±6.7 mg/dl in group II and the mean difference of HDL cholesterol between the two groups was statistically insignificant. There was no statistically significant difference in mean total cholesterol, HDL-C, triglyceride level between two groups (P>0.05) but significant difference was observed in case of LDL-C. Dyslipidemia was found statistically significant in risk factor analysis. The Nurses' Health study (2012) also found non-O group have raised level of LDL-C. Both groups are well matched regarding kidney function and glycemic level.

The mean percent of ejection fraction of the study patients was 48.9 ± 9.8%for the patients with group I and 55.8±6.9% for the patients of group II and the mean difference between the two groups was statistically significant.

Among Non O group, 42%, 28% and 30% patients are belonging to A, B and AB blood group respectively, remaining 50% patients are O blood groups. Positive Rh typing was found (84% vs 74%) in group I and group II patients respectively. At the same time, rest are negative Rh typing in group I and group II patients respectively. Rayhana et al 2013[1] found majority (39.8%) of population in Dhaka city were identified as having blood group B, while 27.6% were blood group O, 23.5% and 9.2% were blood group A and AB respectively. Rh-D positive were 97.4% and Rh-D negative were 2.6%. No statistical association was found between study groups in terms of Rh typing.

SYNTAX score was found low up to 22 (16% vs 56%) in group I and group II respectively with highly significant association (p=0.001). Intermediate SYNTAX score >22 up to 32 was found (20% vs 36%) in group I and group II respectively with no statistical association (p=0.07). High SYNTAX score was found (44% vs 8%) ingroup I and group II respectively with highly significant association (p=0.001). Ahmetet al (2014)[28] found Non-O blood group was found significantly higher in the upper SYNTAX score tertiles (56.2 vs 75.9 vs 80.2%, p<.05). However, the frequencies of Rh type similar in all tertiles. This finding supports that Rh antigen do not play any role on CAD and its severity.

The mean SYNTAX Score of A, B and AB blood groups were 29.8±9.3, 32.6±11.0 and 35.1±10.8 respectively. The differences were not statistically significant(p=0.32). The mean SYNTAX score significantly higher in group I than group II (32.2±10.3 vs 22.5±6.8) respectively. Ahmet et al (2014)[28] found high SYNTEX score among A, B and AB were 49.5%,26.4% and 4.4% respectively. No statistically significance association found among Non-O blood groups.

In this study, univariate logistic regression analysis revealed that among the 5 variables smoking, hypertension, dyslipidemia, LVEF and non-O blood group were found to be the independently significant predictors of high SYNTAX Score with ORs being 3.21, 1.77, 2.17, 1.89 and 3.42 respectively. The variables revealed to be significantly associated with high SYNTAX Score by multivariate analysis were entered into the model directly. Of the 4 variables smoking, hypertension, dyslipidemia and non-O blood group were found to be the significant predictors of high SYNTAX Score with ORs being 3.11, 1.66, 1.98 and 3.05 respectively. In multivariate logistic regression analysis, after adjustment of factors blood group remain independent predictors of severe CAD. A meta-analysis was performed by Meian et al in 2012 from two large prospective cohort studies, "The Nurses' Health Study" and "The Health Professionals Follow-up Study", were found in combined analysis adjusted for cardiovascular risk factors, compared with participants with blood group O, those with blood groups A, B, or AB were more likely to develop CAD (adjusted hazard ratios [95% CI] for incident CAD were 1.06 [0.99-1.15], 1.15 [1.04-1.26], and 1.23 [1.11-1.36], respectively[29]. Overall, 6.27% of the CAD cases were attributable to inheriting a non-0 blood group. Meta-analysis indicated that non-0 blood group had higher risk of CAD (relative risk =1.11; 95% CI, 1.05-1.18; P=0.001) compared with 0 blood group. Ahmet et al found non-0 blood group (OR: 2.68,

95% CI 1.65-4.35, p<0.001), LVEF (OR: 0.93, 95% CI 0.91-0.95, p<0.001), LDL (OR: 0.98, 95% CI 0.97-0.99, p<0.001) were independent predictors of high SYNTAX Score.

Summary and Conclusion

Coronary artery disease (CAD) is a major cause of morbidity and mortality and timely diagnosis and appropriate therapy is of paramount importance to improve clinical outcomes. Though there are major risk factors for CAD but sometimes it does not correlate with ACS. So, search for new risk factor is necessary for better management of CAD.

With the aim to see the association between ABO blood group and severity of CAD of patients with STEMI, we conducted a study with 100 patients, were grouped in I and II where group-I having 50 patients of non-O blood group and group-II having 50 patients of O blood group. After analysis of data reveals well matched baseline characteristics. Low SYNTAX score (d"22) was 16% and 56% in group I and II respectively indicates that patients of non-O blood group having less severe disease in comparison to O blood group patients. Similar results were observed in intermediate (23-32) and high (>32) SYNTAX score in group-I and group-II respectively.

After univariate and multivariate regression analysis it was shown that non-O blood group is an independent risk factor for CAD patients who presented as STEMI. So easily available ABO blood grouping can be helpful to determine the severity of CAD & its measurement of patients with STEMI.

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Original Article

Correlation of Sum of ST Segment Depression in Leads V_1 to V_4 in Acute Inferior Myocardial Infarction with Angiographic Severity of Coronary Artery Disease

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Abstract

Background: Inferior wall acute myocardial infarction accounts for 40 to 50% of all acute STEMI. Patients of acute inferior myocardial infarction with ST depression in lateral leads often have greater incidence of triple vessel disease and proximal RCA lesion but in case of patients of acute inferior myocardial infarction with ST depression in precordial leads (leads V1 to V4), is a subject of determination whether it is associated with more sever coronary artery disease. The aim of this study is to determine the association of sum of ST depression in precordial leads with the probability of concomitant severity of coronary artery disease in patients with acute inferior STEMI.

Methods: this cross sectional observational study was done at National institute of cardiovascular diseases (NICVD), Dhaka, Bangladesh. Total 90 patients of acute inferior myocardial infarction with precordial lead ST depression admitted at CCU within 12 hours of onset of chest pain were the study population. They were divided in two groups on the basis of sum of ST depression in precordial leads (Sum of ST depression d"4mm and >4mm), 36 patients in group I and 54 patients in group II. Coronary angiography was performed during the index hospitalization period. Gensini score and Reardon score were measured.

Results: Overwhelming majority of the patients was male (83.3% and 90.7%) with mean age of 51.0±9.7 and 51.0±9.9 years in group I and II respectively. Smoking, hypertension and diabetes mellitus were the most frequent risk factors in both groups. Serum troponin level was significantly high in group II (6.2±2.2 vs. 13.6±17.7, p <0.05). Sum of ST depression in precordial leads was 2.84±0.66 and 7.53±3.51 in group I and group II respectively, and was statistically significant. Consideration of mean of ST depression in individual leads shows significantly higher mean in leads V2, V3 and V4 among group II patients. SVD was more frequent in group I but group II patients had higher statistically significant incidence of DVD and TVD. Gensini score (20.26±13.0 vs. 36.98±16.9) and Reardon score (4.63±2.2 vs. 6.83±2.2) was high in group II patients. Positive correlation had been depicted between summation value of ST segment depression with that of Gensini score & Reardon score (Gensini score r=0.61 and Reardon score r= 0.52).

Conclusion: Involvement Triple vessel and double vessel disease was remarkably higher with increasing sum of ST segment depression in precordial leads. The severity of ST segment depression in terms of summation of ST depression in leads V1 to V4 is directly proportional to the extent and severity of coronary artery disease.

Key words: *Inferior AMI, Sum of ST depression, Gensini score, Reardon score.*

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Introduction:

In the era of thrombolytic therapy and primary percutaneous coronary intervention (PCI), it is increasingly important to identify patients with an acute myocardial infarction (AMI) who are likely to develop complications during the early phase of infarction. This is especially true for inferior wall STEMI with ST depression in anterior leads[1].In inferior wall AMI; the infarct related artery can be either the RCA or the LCX[2]. Acute inferior infarction is accompanied by ST segment depression in the precordial chest leads in approximately one half of the patients suffering a first, inferior infarction[3]. Reasons of precordial ST depression is thought to be multi-factorial in terms of infarct size, peri-infarction ischemia, extension of infarction, concomitant LAD or LCX involvement and collateral vessels stenosis[4].

Hospital mortality in patients with ST depression (9.2%) is as twice as high as that in those without ST depression (4.6%)[5]. Coronary angiography (CAG) unveils more frequent left coronary artery disease in patients with precordial ST depression than without it[6]. Anterior reciprocal ST depression accompanying acute Inferior myocardial infarction is known to be attributable to the co-existent LAD & LCX lesion [7]and disease with lower LVEF[8] and henceforth associated with poor prognosis. The prognosis of inferior AMI is adversely affected when it is associated with proximal occlusion of RCA which leads to right ventricular infarction (RVI) with hypotension, high degree AV conduction disturbances, sinus bradycardia and ventricular tachycardia[9].

The magnitude of precordial ST segment depression (sum of leads V1 to V4) adds significant independent prognostic information after adjustment for clinical risk factors[10]. The risk of 30-day mortality increases by 36% for every 0.5 mV of precordial ST segment depression[10]. Therefore, assessment of the magnitude of precordial ST segment depression is useful for risk stratification in patients with an inferior myocardial infarction. Magnitude of sum of ST depression also known as Sigma ST (total degrees of ST segment depression in leads V1 to V4) depression in the acute stage is significantly greater in patients with LAD lesion[11]. Patients of acute inferior myocardial infarction with ST depression in lateral leads often have greater incidence of triple vessel disease and proximal RCA lesion. But in case of ST depression in leads V1 to V4, it is subject of determination whether it is associated with single, double or triple vessel disease and severity of CAD.

So in the abovementioned context, magnitude of ST depression play a paramount importance in assessing number of vessels involved. The greater the ST depression in leads V1 to V4 the more is the probability of concomitant double or even triple vessel disease. Therefore, in this study we attempted to unearth the association between the magnitude of ST depression with the coronary artery severity as determined by number of vessels involvement and severity of the lesions.

Method:

This was cross sectional observational study, carried out in the Department of Cardiology, National Institute of Cardiovascular Disease (NICVD), Dhaka, during the period of January 2011 to December 2011. Sampling method was purposive sampling. Patients with acute inferior myocardial infarction with ST depression of >1mm in at least two contiguous leads of V_1 to V_4 in 12 leads admission ECG, who had undergone thrombolytic therapy, in CCU of NICVD were included in the study. A total 90 subjects were included in the study on the basis of pre defined inclusion and exclusion criteria. Previous myocardial infarction, previous revascularization, valvular heart diseases and associated posterior myocardial infarction and right ventricular myocardial infarction and ST depression in leads V_5 and V_6 were excluded.

The measure of ST segment depression at 0.08 second after the J point in the reciprocal leads had been recorded for the qualification of ST segment depression from V_1 to V_4 precordial leads in mille meter (mm). Magnitude of ST depression was calculated by summation of ST depression in leads V_1 to V_4. This summation resulted value was expressed in mm. On the basis of sum of ST depression in precordial leads e.g. summation of ST depression V1 to V4 precordial leads patients were divided in two groups. In group I 36 patients with sum of ST depression at or less than 4mm was included and rest of the 54 patients made up the group II whose sum of ST depression was more than 4mm. Coronary angiography was performed during the hospital stay.

Severity of coronary artery disease was assessed by Gensini score and Reardon score. For severity of CAD the Gensini score system was used. The reduction in the lumen diameter and the angiographic appearance

of concentric lesions and eccentric plaques were evaluated (reductions of 25%, 50%, 75%, 90%, 99%, and complete occlusion are given Gensini scores of 1, 2, 4, 8, 16, and 32, respectively). Each principal vascular segment was assigned a multiplier in accordance with the functional significance of the myocardial area supplied by that segment, e.g.: the left main coronary artery, X5; the proximal segment of left anterior descending coronary artery (LAD), X2.5; proximal segment of the circumflex artery, X2.5; the mid-segment of the LAD, Xl.5; the right coronary artery, the distal segment of the LAD, the posterolateral artery and the obtuse marginal artery X1.0 and others XO.5. The Gensini score was expressed as the sum of all scores of all coronary arteries. This score therefore, places emphasis on the severity of stenosis, while including some of the extent of CAD21.

In Reardon score system we divided coronary arteries into four parts (Left main, left anterior descending, right coronary, left circumflex artery).Each part divided to segments. Atherosclerotic lesion of each segments was scored (Normal: 0 point, <50%:1point, 50-74%:2 point, 75-99%:3 point, 100%:4 point).Total scores were calculated by sum of each segment score.

All data were analyzed through SPSS 21 software system. Pearson's correlation coefficient was used for correlation study (for r value) and level of significance was carried out by Pearson's correlation T test (for p value)and where appropriate student T test and chi square test were used (p=<0.05). This study was approved by ethical review committee of NICVD and written informed consent was taken from all participants.

Results:

There was male predominance in between the groups among the study population (Figure 1). Smoking, hypertension, diabetes mellitus and family history of coronary heart disease was the conventional risk factors present in both groups (Table I). In table II, mean age, BMI, hemodynamic parameters and biochemical parameters were similar in both groups except serum troponin level which was significantly high in group II patients. In table III, mean values of ST depression was high in group II and the changes in precordial lead V2, V3, V4 and sum of ST depression was significantly high in group II(p=<0.05). Coronary angiographic profile as depicted in table IV, SVD was common in group I whereas, prevalence of DVD and TVD was significantly high in group II. Severity of CAD measured by Gensini score and Reardon score was high in group II patients (Table V). Correlation between sum of ST segment depression and Gensini score and Reardon score revealed positive correlation. (r=0.61 & r=0.52 respectively) which depicted below in figure 2.

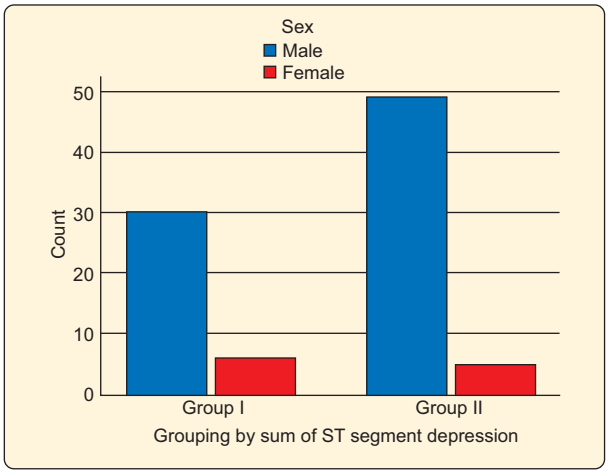

Fig.-1: *Distribution of the study subjects by gender among the groups.*

Table I

Risk factor analysis of the study population

Characteristics	Group I Frequency (%)	Group II Frequency (%)	P value
Smoking	22(24.4%)	39(43.3%)	0.269^{ns}
Hypertension	21(23.3%)	37(41.1%)	0.323^{ns}
Diabetes	14(15.5%)	23(25.5%)	0.726^{ns}
Dyslipidaemia	4(4.4%)	9(10.0%)	0.463^{ns}
Family H/O IHD	18(20.0%)	30(33,3%)	0.605^{ns}

Table II

Age, hemodynamic parameters, biochemical variables and ejection fraction of study population.

Characteristics	Group I	Group II	P value
	Mean ± SD	Mean ± SD	
Age (in years)	51.03±9.3	52.09±9.9	0.983^{ns}
BMI(kg/m^2)	26.67±8.73	29.58±7.72	0.145^{ns}
Hemodynamic parameters			
Heart rate (bpm)	77.9±10.6	78.1±14.2	0.480^{ns}
Systolic BP (mmHg)	112.4±18.0	117.5±18.2	0.0936^{ns}
Diastolic BP (mmHg)	76.3±11.6	78.7±11.3	0 .309^{ns}
Biochemical variables			
RBS (mmol/L)	7.39±2.54	8.55±4.14	0.514^{ns}
S. Creatinine (mg/dl)	1.08±0.34	1.02±0.24	0.257^{ns}
Troponin-I (ng/ml)	6.2±12.2	13.6±17.7	0.003^{s}
Ejection fraction (%)	53.39±6.7	53.78±7.0	0.985^{ns}

Table III

Distribution of mean ST depression in individual precordial leads and the sum of ST depression among the groups.

ST depression in precordial leads(mm)	Group I	Group II	P value
	Mean ± SD	Mean ± SD	
V1	0.56±0.62	1.34±0.97	0.330^{ns}
V2	1.54±0.76	2.89±1.75	0.028^{s}
V3	1.09±0.30	2.48±1.33	0.001^{s}
V4	1.10±0.38	2.08±1.35	0 .022^{s}
Sum of ST depression	2.84±0.66	7.53±3.58	0.001^{s}

Table IV

Coronary angiographic profile of the study population (n=160).

Number of involved vessels	Group I(n=36)		Group II(n=54)		p value
	n	%	n	%	
None	02	5.5%	00	0.0%	0.228^{ns}
SVD	10	27.7%	08	14.8%	0.169^{ns}
DVD	13	36.1%	22	40.7%	0.022^{s}
TVD	11	30.5%	23	42.6%	0.026^{s}
LM	00	0.0%	01	1.8%	0115^{ns}

Table V

Severity of CAD among the study groups by Gensini and Reardon score

Severity of CAD	Group I (n=36)	Group II (n=54)	p Value
	Mean ± SD	Mean ± SD	
Gensini Score	20.26 ±13.0	36.98±16.9	0.428^{ns}
Reardon Score	4.63±2.21	6.83±2.20	0.744^{ns}

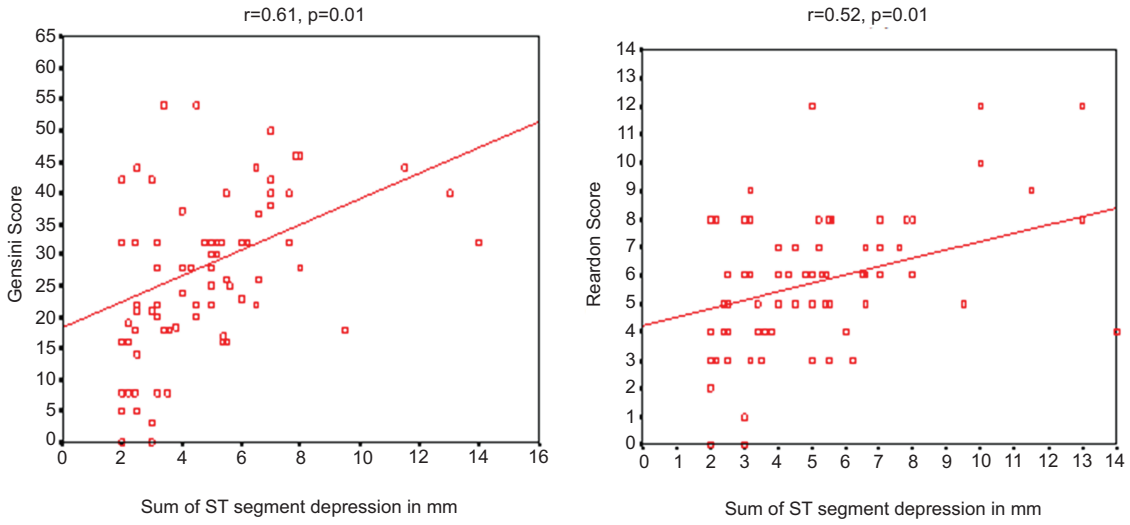

Fig.-2: *Correlation between sum of ST segment depression and Gensini score & Reardon score.*

Discussion

In this study there was male predominance in both group, similar distribution was reported by Fiol et.al. in their study[12]. Conventional risk factors of CAD similarly present in both groups, in studies by Fiol et.al. and Karapýnar et.al. distribution was similar except smoking[12, 13]. Mean age was 51.03±9.3 and 52.09±9.9 years in group I and II respectively. Karapýnar et.al.in their study mean age was 54±5 years, which was similar with this study[13]. Serum troponin level was significantly high in group II, other hemodynamic, biochemical variables and ejection fraction was similar in between the groups. Roubin et.al. had increased level of CKMB and troponin in patients with anterior and lateral ST depression in precordial leads[14].

ST depression in precordial leads were significantly high in group II patients and 40% with <4mm ST depression were in group I, similarly Nishian K et.al. had 40% patient with <4mm ST depression and rest had more precordial lead ST depression[11]. Mean value of sum of ST segment depression was 2.84±0.6 and 7.53±3.58 in group I and II, which was much higher than the previous similar study by Karapýnar et.al.[13].

Coronary angiographic profile revealed prevalence of DVD and TVD was significantly high in group II. LM involvement was only 1.8%, all patients had sum of ST depression > 4 mm. Roubin et.al. and David et.al. also reported comparable finding in their studies[14, 15].

Mean value of Gensini score 20.26 ±13.0 and 36.98±16.9 in between the groups, in terms of severity in group II patients Karapýnar et.al. found Gensini score 31.2 ± 30.2, who had more severe CAG lesion[13]. Mean value of Reardon score was 4.63±2.21 and 6.83±2.20 which was little lower for group I patients and similar with group II patients as asserted in the aforementioned study[13].

Correlation test unveiled a positive linear correlation between magnitude of sum of ST depression in leads V1 to V4 with the angiographic score of Gensini and Reardon (r =0.61, p=0.01 for Gensini and r=0.52, p=0.01 for Reardon). Karapýnar et.al found significant correlation between reciprocal ST depression and disease extension (r=0.68 for Gensini score, r= 0.88 for Reardon score, p<0.05 for both).These data provide strong evidence that precordial ST-segment depression during acute inferior infarction is a marker for larger infarction as a result of either ischemia at a distance due to the presence of multi-vessel disease or a greater amount of myocardium supplied by the infarct-related artery.

Conclusion

This study revealed that severity of ST segment depression in terms of summation of ST depression in leads V1 to V4 is directly proportional to the extent of coronary artery disease as reflected by the r value of Gensini score and Reardon score. ST segment depression in leads V1 to V4 during acute inferior myocardial infarction is associated with frequent multi-vessel disease and more severe CAD.

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Original Article

Association of Waist and Hip Ratio with the Angiographic Severity of Coronary Artery Disease in Patients with Non ST Segment Elevation Myocardial Infarction

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Abstract:

Background: Obesity is a proven independent risk factor for coronary artery disease. There are different methods for evaluation of obesity. The aim of this study is to evaluate the association between waist hip ratio and the severity of CAD in non-ST-segment elevation myocardial infarction patients.

Methods: This cross-sectional observational study was done at the National Institute of Cardiovascular Diseases (NICVD), Dhaka. A total of 100 patients with NSTEMI who underwent coronary angiogram during the indexed hospitalization period were included in this study. On the basis of WHR, study patients were divided into two groups 50 patients of NSTEMI with normal WHR (Male <0.90, Female <0.80) were assigned as group I and 50 patients of NSTEMI with increased WHR (Male ≥0.90, Female ≥0.80) were assigned as group II.

Results: The mean age of patients was 49.6±7.9 years and 52.3±8.7 years in Group I and Group II respectively with a male predominance in both the groups. No significant difference was found in between two groups in terms of demographic characteristics and traditional risk factors for CAD. Different parameters of angiographic severity of CAD were significantly higher in patients with increased WHR. Patients with non critical CAD (14% vs 0%, *P* = 0.02) and single vessel disease (58% vs 24%, *P* = 0.005) were more frequent in Group I, on the contrary double vessel disease (24% vs. 56%, *P* = 0.001) and triple vessel disease (4% vs. 20%, *P* = 0.03) were significantly more frequent in patients of Group II. Patients with moderate to severe CAD (Gensini score ≥36) were found more in Group II than that of in Group I (24% vs. 76%, *P* <0.001) and there was statistically significant higher Gensini score was found in Group II (21.96±19.72 vs. 44.18±28.91, *P* <0.001). Significant positive correlation was found in between WHR and coronary artery disease severity measured by vessel score (r = 0.41, *P* < 0.001) and Gensini score (r = 0.31, *P*< 0.001). Multivariate regression analysis yielded that the risk of having significant CAD are 3.45 times more in patients with increased WHR than those of normal WHR (95% CI: 1.229-12.979, *P* = 0.01).

Conclusion: Abdominal obesity, as evidenced by increased WHR, may be considered as a predictor of the severity of CAD in patients with acute NSTEMI.

Keyword: Waist-hip ratio (WHR), Coronary artery disease (CAD), NSTEMI.

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Introduction

Coronary artery disease (CAD) is a common and leading cause of death all over the world. Like other South Asians, Bangladeshis are disproportionately prone to develop CAD, which is often premature in onset, angiographically more severe and follows a rapidly progressive course[1]. Previous studies suggest that, Non-ST elevated Myocardial Infarction (NSTEMI) occur more frequently than ST elevated Myocardial Infarction (STEMI) [2]. Non-ST elevation ACS (NSTEMI and UA) characterized by partial or near complete occlusion of a coronary artery. Also NSTE-ACS patients suffer more recurrent events and worse long-term outcomes[3, 4].

Obesity has association with all cause mortality from cardiovascular disease (CVD), along with diabetes is an important component of metabolic syndrome[5]. The deposition of adipose tissue is associated with systemic inflammation which has a direct effect on CAD risk[6]. Visceral adipocytes differ from subcutaneous adipocytes in their release of secretory proteins potentially protective for diabetes and show lower expression levels in visceral than subcutaneous tissue[7]. Over the last two decades the prevalence of overweight and obesity in Dhaka city has increased at least five folds and it was much higher among those with better socioeconomic status[8].

Currently used general and central obesity anthropometric measures for assessing adiposity related risk include, body mass index (BMI), waist circumference (WC), hip circumference (HC), waist-hip ratio (WHR) and waist-height ratio (WHtR)[6]. BMI is often used to reflect total obesity, whereas the WC, WHR and WHtR are used as surrogates for intra-abdominal adiposity[9]. BMI does not differentiate between fat and fat free mass so for is inadequate for identifying individuals at increased risk of CAD[6]. Waist and hip circumferences measures different aspects of body composition and fat distribution and have independent and often opposite effects on CVD risk factors[10] . The larger waist circumference may be associated with a higher risk of developing CVD or CVD mortality. Because of the opposing effects of waist and hip circumferences, the WHR has become a popular method of assessing atherogenic risk[11].

Computed tomography scan (CT scan) and Magnetic resonance imaging (MRI) are accurate for measuring body composition[12]. Sonographically based obesity measurements are not superior to anthropometric indices in predicting the presence CAD[13]. de Koning et al. found a 1cm increase in WC was associated with a 2% increase in risk of future CVD[14]. Lakka et al. found abdominal obesity was an independent risk factor for coronary heart disease in middle-aged men[15]. In a study Kaur et al. demonstrated waist related anthropometric measures were important predictors of CAD risk factors among middle aged and older women, as compared to BMI. Dalton et al. demonstrated that WHR was the most useful measures of obesity to use to identify individuals with CVD risks[16]. Yusuf et al. demonstrated that, among the various anthropometric measures commonly used, WHR showed the strongest relation with the risk of MI worldwide both in men and women[17]. Canoy et al. also demonstrated indices of abdominal obesity were more consistently and strongly predictive of coronary heart disease than BMI[18]. In a large study, Czernichow et al. showed that greater WC and WHR were associated with an increased risk for CVD[19] .

NSTEMI patients show greater heterogeneity than patients with STEMI who, as a group, present with a relatively predictable prognosis; however, either presentation is equally dangerous. There remains a lack of supporting evidence on the impact of central obesity on clinical outcomes in patients with NSTEMI, especially when considering WHR. Lee, et al. evaluated the relationship between the WHR, as a surrogate marker of central obesity, and clinical outcomes in patients with non-ST-segment elevation myocardial infarction (NSTEMI) undergoing percutaneous coronary intervention (PCI) and found that central obesity represented by WHR values was associated with poor clinical outcomes among NSTEMI patients[20].

In a recent study done in Bangladesh, Bhowmik et al. found indices of central obesity

better predicted cardio-metabolic risk factors than general obesity defined by BMI[9]. Sabah, et al. found positive correlation between waist to height ratio and severity of coronary artery disease and also with BMI[21]. Another study done by Hossain et.al., found significant association between waist-hip ratio (WHR) and the severity of CAD in patients with acute STEMI[22].

Coronary angiography is undoubtedly the most sensitive and specific method available for assessing CAD. It also has the advantage that, even minor atherosclerotic lesion at a subclinical stage can be detected. Severity of CAD are measured by several scoring system and interpretations are important regarding preventive and therapeutic interventions. A few studies were done to evaluate the association between WHR and angiographic severity of CAD in patients with STEMI. But no study was done regarding patients with NSTEMI in our population. So, this study on association of WHR with angiographic severity of coronary artery disease in patients with NSTEMI

was helpful for understanding the scenario among the Bangladeshi population.

Methods

This cross sectional observational study was carried out in the department of Cardiology at National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh from April, 2018 to May, 2019. All patients admitted with NSTEMI in the department of cardiology, NICVD, fulfilling the inclusion and exclusion criteria were considered for the study. Total 100 patients were selected for data collection. They were divided into two groups, group I (Normal WHR, Male < 0.90, Female < 0.80) 50 patients and in group II (Increased WHR, Male e"0.90, Female ≥0.80) 50 patients.

Detailed history were taken and clinical examination were done and recorded in pre designed structured form including demographic data and risk factor profile. NSTEMI were diagnosed by third universal definition of Myocardial Infarction. Data collection was done after taking informed written consent from each patient. Waist circumference and hip circumference were measured on the day before coronary angiography (CAG). Waist circumference was measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch resistant tape at the end of a normal expiration. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor.

Routine laboratory investigations (ECG, Troponin-I, RBS, serum creatinine, serum electrolytes, fasting Lipid profile and next morning FBS) were done. Base line investigations for CAG were done. Coronary angiogram was done using Shimadzu BRANSIST alexa F12 MiX package. All procedures were performed by experienced interventional cardiologists through radial or femoral route. Angiographic findings were evaluated by two independent cardiologists blinded to treatment and clinical interpretation. Angiographic severity of coronary artery disease was assessed by visual estimation (in at least two orthogonal views) by which estimation of vessel score and Gensini score was done.

Data were analyzed by using SPSS version 25. (Statistical package for social science) Continuous data were expressed as mean ± SD; dichotomous data were expressed as percentage. Comparison of continuous variables were done by unpaired t-test, categorical data were analyzed with Chi-square (X^2) test and Fisher's exact test and ANOVA tests were used as applicable. The significance of the results as determined in 95% confidence interval and a value of P < 0.05 were considered to be statistically significant. Spearman's rank correlation coefficient test, Pearson's correlation coefficient test and logistic regression analysis were used as appropriate.

RESULTS

There was no significant difference in mean age and sex in between the groups as the patients were homogenously distributed in between the groups. There was male predominance in both groups with no significant difference (Table I & Figure 1). In Table II, WHR were higher in male patients than female patients and the differences between them were statistically significant (p<0.05). There was no significant difference of distribution of patients in terms of different traditional risk factors for CAD in between two groups (Table III).

The mean body mass index and anthropometric status of the study patients were significantly higher in group II than group I (table IV). The ejection fraction of the patients and the mean difference between the two groups was not statistically significant (Table V). Patients with non critical CAD (14% vs 0%, *P* = 0.02) and single vessel disease (58% vs 24%, *P* = 0.005) were more frequent in Group I, on the contrary double vessel disease (24% vs 56%, *P* = 0.001) and triple vessel disease (4% vs 20%, *P* = 0.03) were more frequent in patients of Group II with significant difference (Table VI).

Table VII shows the sequence of mean WHR of study patients according to the number of vessels involvement. The mean WHR of subjects with normal angiographic findings was 0.85±0.029. The mean WHR of single, double and triple vessel disease were 0.91±0.135, 0.97±0.162 and 1.05±0.259 respectively and this differences were statistically significant (p=0.01).

Table VIII shows coronary artery disease (CAD) severity of the study patients.

Moderate to severe CAD was found 76% and 24% in group II and group I respectively.

The moderate to severe CAD patients are significantly higher in group II than group I (p<0.001). The difference of mean Gensini Score between the group I and group II was statistically significant (p<0.001).

The mean WHR was found 0.99±0.19 and 0.89±0.12 in moderate to severe and normal to mild CAD respectively. The difference of mean WHR between the moderate to severe and normal to mild CAD groups was statistically significant (Table IX).

The figure 2, depicts that there was a positive correlation between WHR and CAD severity in terms of vessel score (r=0.41). The figure 3, demonstrates that there was also

a positive correlation between WHR and CAD severity in terms of Gensini score (r=0.31). The table X depicts the multivariate logistic regression analysis of odds ratio (OR) for characteristics of the subjects likely to cause coronary artery disease severity. It was observed that waist circumference; increased BMI and increased WHR were found to be the significant predictors of severe CAD.

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

Age in years	Group I (n=50) Number	%	Group II (n=50) Number	%	p value
≤ 40	6	12.0	6	12.0	
41 -50	22	44.0	19	38.0	
51- 60	19	38.0	18	36.0	
> 60	3	6.0	7	14.0	
Mean± SD	49.6±7.4		52.3±8.7		0.009^{ns}
Range	28 – 65		35 - 75		

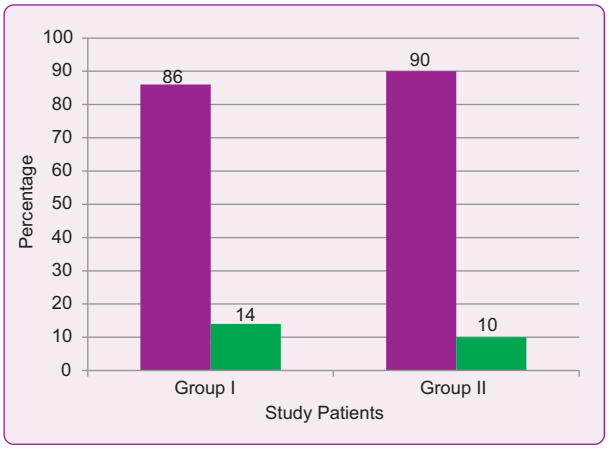

Fig.-1: *Distribution of gender in between the groups.*

Table-II
Gender wise distribution of WHR status of the study population (n=100)

Study Group	WHR Male Mean±SD	WHR Female Mean±SD	p value
Group I (n=50, M-43, F-7)	0.85±0.023	0.81±0.045	0.01^{S}
Group II (n=50, M-45, F-5)	1.06±0.194	0.92±0.039	0.04^{S}
Total (n=100, M-88, F-12)	0.95±0.174	0.86±0.067	0.03^{S}

Table-III
Distribution of risk factors of the study population (n=100)

Risk Factors	Group I (n=50) Number	%	Group II (n=50) Number	%	p value
Hypertension	21	42.0	28	56.0	0.16^{ns}
Diabetes Mellitus	19	38.0	25	50.0	0.22^{ns}
Dyslipidaemia	21	42.0	27	54.0	0.23^{ns}
Smoking	22	44.0	26	52.0	0.42^{ns}
Family H/O CAD	11	22.0	15	30.0	0.36^{ns}

Table-IV
Distribution of anthropometric parameters of study population(n=100)

Characteristics	Group I (n=50) Mean ± SD	Group II (n=50) Mean ± SD	p value
Body Mass Index (kg/m2)	21.78±3.55	26.90±3.24	0.001s
Waist circumference (cm)	77.70±6.03	98.84±5.53	0.001s
Waist-Hip ratio	0.84±0.03	1.04±0.19	0.001s

Table-V
Distribution of ejection fraction of study population (n=100).

Ejection fraction (%)	Group I Number	%	Group II Number	%	p value
Moderate LV dysfunction (35-44)	0	0.0	2	4.0	
Mild LV dysfunction (45-54)	13	26.0	18	36.0	
Normal LV function (≥55)	37	74	30	60.0	
Mean ± SD	57.5±5.3		55.1±4.8		0.12ns
Range	48-68		36-68		

Table-VI
Distribution of the study population according to vessel score (n=100).

Vessel score	Group I Number	%	Group II Number	%	p value
Score – 0	7	14.0	0	0.0	0.022s
Score – 1	29	58.0	12	24.0	0.005s
Score – 2	12	24.0	28	56.0	0.001s
Score – 3	2	4.0	10	20.0	0.031s

Table-VII
Association between WHR and number of vessels involvement (n=100).

Number of vessel involved	Waist-hip Ratio (WHR) Mean	±SD	p value
None (n=7)	0.85	0.029	?
Single (n=41)	0.91	0.135	?
Double (n=40)	0.97	0.162	0.01s
Triple (n=12)	1-05	0-259	

Table-VIII
Distribution of study population according to CAD severity between the groups by Gensini score (n=100).

CAD severity by Gensini Score	Group I Number	%	Group II Number	%	p value
Moderate to severe (≥36 points)	12	24.0	38	76-0	0.001s
Normal to mild (≥36 points)	38	76.0	12	24.0	0.001s
Mean ±SD	21.96±19.72		44.18±28.91		<0.001s

Table-IX
Mean status of WHR of the study patients according to significant coronary artery disease defined by Gensini Score (n=100)

WHR	Moderate to severe CAD (n=50) (GS ≥36)	Normal to mild CAD (n=50) (GS<36)	p value
Mean±SD	0.99±0.19	0.89±0.12	0.004s

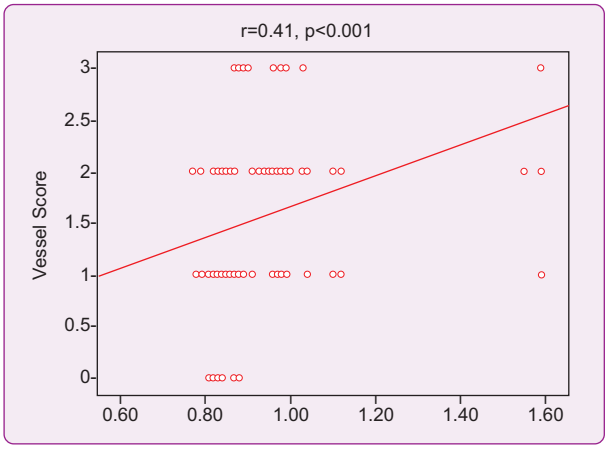

Fig.-2: *Correlation between WHR and vessel score.*

Table X
Multivariate regression of determinants of significant CAD (Gensini Score).

Variables	Regression coefficient (B)	OR	95% CI	p value
Waist Circumference	0.398	1.37	1.045 - 8.290	0.04s
Increased BMI	0.504	1.52	1.021 - 7.912	0.02s
Increased WHR	0.812	3-45	1.229 - 12.979	0.01s

Discussion

This study intended to evaluate the association between WHR and the severity of coronary artery disease in patients with Non ST-segment elevation myocardial infarction (NSTEMI). Mean body mass index and anthropometric status were observed between two groups. Both BMI and Waist-hip ratio were significantly (p<0.001) higher in group II than group I.The results were compatible with the study done by Rofiquzzaman et. al[23].

Among group II, highest percentage was of 2 vessel score (56%) followed by 1 vessel score 24%, 2 vessel score (20%) and none in 0 vessel score. On the contrary among group I, highest percentage was of 1 vessel score (58%) followed by 24% in 2 vessel score, 14% patients had 0 vessel score and 4% of 2 vessel score. 0 vessel involvement was found statistical association in both group (p=0.02). 1 vessel score significantly higher in group I (p=0.005) than group II. 2 vessel involvement was significantly higher in group II than group I (p=0.001). Three vessel involvement was observed more in group II than group I and was statistically significant (p=0.03).This result was comparable with the study of Rofiquzzaman[23].

The mean WHR of subjects with normal angiographic findings was 0.85±0.029. The mean WHR of single, double and triple vessel disease were 0.91±0.135, 0.97±0.162 and 1.05±0.259 respectively. The WHR increased in proportion with the number of vessel involved from no vessel involvement to triple vessel involvement and the differences were statistically significant (p=0.01). Ahmad et al., found that the WHR was abnormally increased in 65% of patients with CAD, whereas only 34% were normal WHR were diagnosed to have CAD[5].

Moderate to severe CAD was found 76% and 24% in group II and group I respectively.

The moderate to severe CAD patients are significantly higher in group II than group I (p<0.001). It was also found that the relative risk of CAD was approximately twice in the group with increased WHR than among

normal WHR (RR= 3.16, CI=1.888 – 5.312, p<0.001). Ahmad et al., found that the relative risk of CAD was approximately twice in the group with increased WHR than among normal WHR which supported the finding of the present study[5].

The mean Gensini Score was found 21.96±19.72 and 44.18±28.91 in group I and group II respectively. The difference of mean Gensini Score between the group I and group II was statistically significant (p<0.001). Bakhoum, et al. found that the mean Genseni's score was 85.1±38.5 vs 60.4 ± 43.6 in patints with or without abdominal obesity in terms of WC respectively that indicated that Genseni's score was higher in abdominal obese than normal population[24].

The mean WHR was found 0.99±0.19 and 0.89±0.12 in moderate to severe and normal to mild CAD respectively. The difference of mean WHR between the moderate to severe and normal to mild CAD groups was statistically significant (p=0.004). Similar finding was evaluated by Parsa et al., who found mean±SD of their WHR in relation to CAD severity in terms of duke score from 0.951±0.07 to 0.987 ±0.05 and was statistically significant (p=0.03)[25].

There was a positive correlation between WHR and coronary artery disease severity in terms of vessel score (r=0.41). It was observed that the Spearman's rank correlation was statistically significant (p<0.001). There was also a positive correlation between WHR and coronary artery disease severity in terms of Gensini score (r=0.31). It was observed that the Pearson's correlation was statistically significant (p=0.001). It was supported by the study of Ahmadet al., and Parsaet al[24, 25].

Multivariate logistic regression analysis of odds ratio (OR) for characteristics of the subjects likely to cause coronary artery disease severity. The variables revealed to be significantly associated with severe CAD by multivariate analysis were entered into the model directly. It was observed that waist circumference, increased BMI and increased WHR were found to be the significant predictors of severe CAD with ORs being 1.37, 1.52 and 3.45 respectively. This result was compatible with the study of Parsa et al[25].

Conclusions:

The present study concluded that increased WHR was significantly associated with the angiographic severity of coronary artery disease in patients with Non ST-segment elevation myocardial infarction. Significant positive correlation was observed between the vessel score and WHR. Similarly WHR levels were found to be higher in patients with high degree of angiographic stenosis in terms of Genseni's score. So, abdominal obesity, as evidenced by increased WHR, may be considered as a predictor of the severity of CAD in patients with acute Non ST-segment elevation myocardial infarction.

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Review Article

Echocardiographic Evaluation of Atrial Septal Defects and Clinical Applications; A Focused Review

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Abstract:

Atrial septal defect (ASD) is a commonly encountered congenital lesion in paediatric and adult populations and accounts for 8-10 % of all congenital heart disease. Echocardiography is the most sensitive and specific imaging tool to diagnose this condition and also to determine management guidelines. Various modalities of echocardiography imaging can assess atrial septal defects completely with associated changes in cardiac chambers, haemodynamic status, relationship with neighboring structures, suitability for percutaneous closure or need for surgical intervention. Echocardiography can guide percutaneous device closure procedure as well.

Keyword: *Atrial septal defects, Echocardiography, device closure*

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Introduction

Atrial septal defects (ASD) is a septal communication which accounts for 8-10 % of all congenital heart defects and causes shunting of blood between the systemic and pulmonary circulations[1]. If the defects are significant and remain untreated, patient might have exercise intolerance, supra ventricular arrhythmias, right ventricular dysfunction and pulmonary arterial hypertension with Eisenmenger change[2]. The incidence of ASD is 1 in 5000 live births. It accounts for 30-40% of clinically important intracardial shunts in adults[3]. Patient foramen ovale (PFO) is also a common defect in atrial septum of adults and it accounts for 20-25%. There is debate whether PFO should be recognized as atrial septal defect as no septal tissue is missing but clinical syndrome associated with PFO, ASD are extremely variable and represent a health burden for community & involves specialty like pediatrics, internal medicine, neurology and cardiac & Neurosurgery etc.

So interatrial septum needs proper evaluation following a systematic approach. Echocardiography is the conventional and best method to analyze atrial septum and its abnormalities. 3 Transthoracic (TTE) Transesophageal (TEE) and Intracardiac (ICE) ultrasound are used and 2-dimentional(2D), 3-dimentional (3D), Doppler (color and spectra), transcranial Doppler types of imaging are utilized to delineate anatomy of the defect, flow direction and velocities[3].

The addition of 3-D imaging and TEE based description of anatomy of septum contributed to add more information's about atrial septum[4,5].

Development of atrial septum (IAS):

Atrial septum is composed of three separate components :1. Septum primum 2. Septum secundum 3. Atrioventricular canal septum (Endocardial cushion septum). Sinus venosus is not a component of atrial septum but defect in this results in atrial communication. Fig-1 showed development of atrial septum[1].

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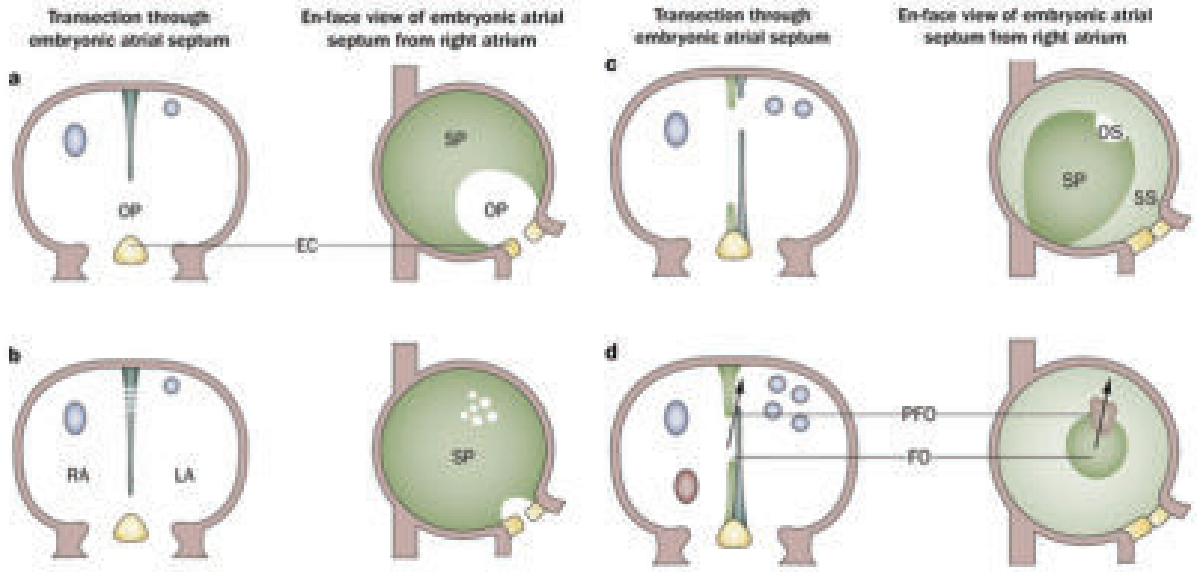


Fig.-1: *Atrial septum development.*

Atrium developed as a common cavity first. At about 28 days of gestation, septum primum originated for the aortic root and continue to grow towards endocardial cushions. The gap between these two is known “Ostium primum”. Later infoldings of atrial roof formed septum secundum in the right side of septum primum[6]’ Ostium primum normally closed by fusion of septum and superior / inferior endocardial cushion with the help of mesenchymal cells.

By two months’ septum primum and secundum fuses, leaving foramen ovale as only communication between two atrium[6,7,8]. Fossa ovalis is the flap of PFO formed by the septum secundum, septum premium and the AV canal septum. Sinus venosus part of septum is an adjacent structure that separates the right pulmonary veins from superior vena cava (SVC) and posterior right atrium.

Coronary sinus septum is a wall of tissue that separates coronary sinus from left atrium. To understand ASD’s, knowledge about septal development is very important and various defects are classified according to location in the inter atrial septum during development.

Atrial Septal abnormalities:

1. **Patent Foramen Ovale (PFO):**
   It is not a true defect but a potential space between septum primum and secundum (fig-2) PFO remain functionary closed as long as LA Pressure is high. PFO may be tunnel like if septum primum form a flap valve. PFO may be even circular, elliptical in shape and stretching of septum secundum due to atrial dilation lead to patency of foramen ovale. PFO is must in fetal life to maintain circulation of oxygenated blood from placenta to vital organs like heart, brain etc. After birth PFO close but 20-25% population has PFO up to adulthood. [9-11]

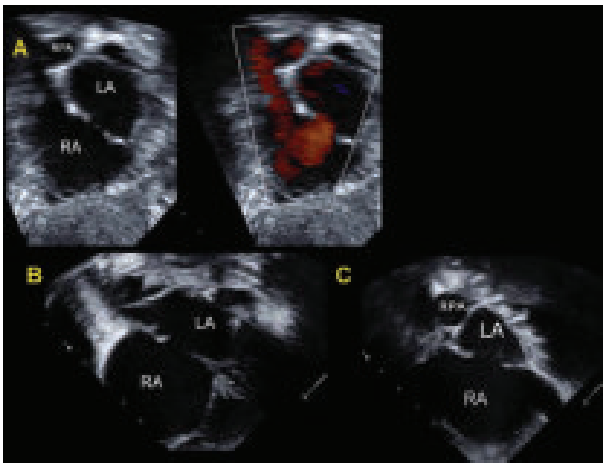


Fig.-2: *Ostium secundum ASD in TTE.*

PFO with left to right shunt occurs when atrial haemodynamics results in shunting of blood through potential communication and demonstrated by Doppler imaging. “Stretched PFO” is the defect when

PFO stretched open by atrial haemodynamics thus causing a defect. Direction of shunt depends on differences in the right and left atrial pressure.[12-14.]

Right to left shunt through PFO is of clinical significance and may cause stroke.

2. **Secundum type on Fossa ovalis Atrial Septal Defects:**

Secundum ASD is the most common type of ASD results for true deficiency of septum primum tissue. This defect is bordered superiorly and posteriorly by septum secundum, anteriorly by AV canal septum and inferiorly by septum secundum, Primum and left venous valve of inferior vena cava. These defects may be round or elliptical. Crossing of persistent strand of septum primum results in formation of fenestrated ASD's with multiple holes. Absence of superior limbic band of septum secundum results in a rare form of ASD which is located high in the septum not same as sinus venosus ASD which is often associated with anomalous pulmonary venous drainage. Secundum ASD can enlarge over time with age and cardiac growth.

3. **Ostium primum Atrial Septal Defect:**
This defect is characterized by absence of AV canal part of the septum in association with a common AV valve annulus and two different orifices. AV valve tissue attached to crest of ventricular septum and no shunt seen at ventricular level. Septum primum ASD is also known as incomplete or partial AV canal defect.

4. **Sinus Venosus Defects:**
Sinus venosus ASD is not true ASD and occurs due to partial or complete absence of sinus venosus septum between superior vena cava (SVC) and right upper pulmonary vein (SVC type) or between middle and lower pulmonary vein and right atrium (IVC type).

SVC type defect is most common and associated with anomalous drainage of right pulmonary vein.

5. **Coronary sinus defects:**
This is a rare type of ASD where roof of coronary sinus is absent and also known as unroofed coronary sinus. Left atrial blood drained to right through coronary sinus. Association of this defect with persistent left SVC is known as "Raghib syndrome"

6. **Common Atrium:**
All components of atrial septum as e.g., septum primum , secundum and AV canal septum may be absent result in common atrium.

7. **Atrial septal Aneurysm (ASA):**
It is a redundancy or secular deformity of atrial septum associated with increased mobility of the septal tissue. Excursion of septal tissue more than 1 mm or LA or RA side is defined as aneurysm. ASA is associated with PFO, stroke and embolic events.

8. **Eustachian valve and Chiari network:**
This is a remnant of the valve of inferior vena cava (IVC) that directs IVC flow to left atrium through fossa ovalis in fetal life. Chiari network is the remnant of right valve of sinus venosus and have filamentous appearance inside RA. Large and prominent eustachian valve with PFO contribute to paradoxical embolism.

Echocardiographic evaluation of interatrial septum:

Most important imaging modality to analyze interatrial septum (IAS) is Transthoracic echocardiography (TTE). In small children, image quality is good and permit full diagnostic study, selection of patient for percutaneous closure and even guidance of the device closure procedure [15,16,17.] In adult TTE is helpful for initial diagnosis of ASD, PFO but TEE is required for comprehensive evaluation of atrial septum. In adults TEE can identify margin and rims of the ASD clearly and also assess the proximity of the surrounding structures like aorta, pulmonary vein, AV valves, vena cava, coronary sinus etc. 3D TEE, offered real time anatomical details during device closure procedure.[18,19]

Intracardiac Echocardiography or ICE has been used to guide percutaneous ASD/PFO device closure procedure. Transcranial Doppler and contrast echocardiography with agitated saline has role in assessing shunt in PFO / doubt full ASD's and is not used for preliminary diagnostic purpose.[20,21]Three dimensional imaging of interatrial septum.

IAS is a dynamic complex structure & does not exist in a true flat plane. Moreover, both ASD and PFO exists in heterogeneous size, shape and configurations. 3D imaging provides clear view of IAS and allows Enface viewing of ASD and surrounding fossa and change of the morphology with cardiac cycle. It also delineates the relationship of the ASD with surrounding structures [22-25.] Table-I: showed components to be evaluated by echocardiography.[26] Table-II Showed strategy for overall evaluation of interatrial septum[1]

Transthoracic Echocardiography (TTE):

Atrial septum can be fully evaluated by using TTE guide (Table III). Size and shape of the detect, shunt direction, rim assessment, relationship of ASD to surrounding structure can be assessed thoroughly in children and even adults. TEE guide may be required in some cases with poor echo window. Fig 2 showed examples of ostium secundum ASD in TTE.

Table-I

Components to be evaluated by echocardiography.[26]

Ser	Name
1	Location of defect in the septum and type of ASD
2	Detection and qualification of shape and size of the ASD.
3	Measurement of rims surrounding ASD and adjacent structures.
4	Direction of shunting.
5	Change & remodeling in size and function of the chambers.
6	Qualification of pulmonary artery pressure.
7	Estimation of pulmonary / Systemic flow ratio
8	Examination of right heart.
9	Presence of fenestration
10	Dynamic nature of ASD / Measurement of area and maximum/ minimum diameter in end systole and diastole.
11	Stop flow diameters of ASD during balloon sizing.

Table-II

Evaluation of interatrial septum [1].

Ser	Patient Population	For establishing diagnosis	For guidance of device closure	Post-operative follow up
1	Paediatric patient <35kg	TTE	TTE/TEE/ICE	TTE
2	Paediatric patient>35-40kg	TTE,TEE,3D TEE	TEE,3D TEE,ICE	TTE
3	Adult patient	TTE, TEE,3D TEE	TEE,3D TEE,ICE	TTE

Table -III

TTE views for assessment of atrial septal anatomy.

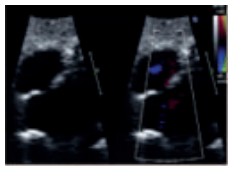
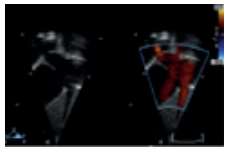
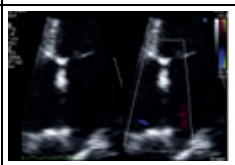
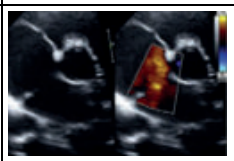
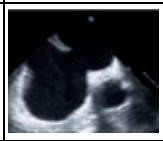
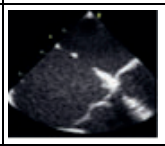
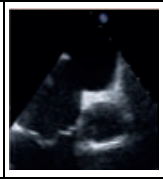
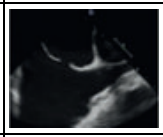
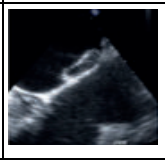
View	Example	Septal anatomy	Procedural assessment
Subxiphoid long –axis (frontal) or left anterior oblique (45^0)		Right pulmonary vein ASD rim, atrial septal defect diameter, and atrial septum length.	Position of device with regard to right pulmonary veins and assessment for residual leak.
Subxiphoid short-axis (sagittal)		SVC and IVC rim and atrial septal defect diameter.	Position of device with regard to SVC and IVC and assessment for residual leak.
Apical four-chamber		Rim of defect to AV valves , assessment of RV dilation RV pressure estimation from tricuspid regurgitation jet	Position of device with regard to AV valves.
Parasternal short-axis		Aortic and posterior atrial wall rim, atrial septal defect diameter, assessment of RV dilation.	Device relationship to aortic valve, assessment for impingement on aorta or straddle and relationship of device to posterior wall

Table-IV
Views for assessment of ASD by TEE.

View	Example	Atrial Septal anatomy	Procedural assessment	Suggested multiplane angles	Esophageal position
Basal transverse		SVC, superior aortic ,RUPV	Device relationship in atrial roof	0^0,15^0,30^0,45^0	Mid to upper esophagus
Four-chamber		Posterior and AV rims, maximal ASD diameter	Device relationship to AV valves	0^0,15^0,30^0	Mid-esophagus
Short-axis		Posterior and aortic rims, maximal ASD diameter	Device relationship to AoV and posterior atrial wall	30^0,45^0,60^0,75^0	Mid- to upper esophagus
Bicaval		IVC and SVC rims, maximal ASD diameter	Device relationship to RA roof/dome	90^0,105^0,120^0	Mid-to upper esophagus and deep transgastric
Long -axis		Dome/roof of LA	Device relationship to LA dome/ roof	120^0,135^0,150^0	Mid to upper esophagus

a) **Apical four chamber view:** In this view, ASD measurement may be overestimated as ultrasound beams is parallel to septum. This view can assess haemodynamic consequence of ASD like RA, RV dilation, Tricuspid valve regurgitation velocity etc.

b) **Subxiphoid four chamber view:** This is the best view for assessing atrial septum. The septum run perpendicular to ultrasound beams and provide highest resolution to measure ASD in long axis. Sinus venosus defects are difficult to visualize as vena cavae are not viewed longitudinally.

c) **Subxiphoid sagittal view: This** view is good for imaging atrial septum along its superior inferior axis. Dimension measured in this view can be compared with subxiphoid four chamber view to determine the shape (circular/ oval) of the defect, SVC and IVC rim can be measured here and is an excellent view to assess sinus venosus ASD. This view is obtained by 90^0 clockwise rotation of frontal view.

d) **Left anterior oblique view:** This view is obtained by 45^0 counter clockwise rotation of the frontal view. This view allows imaging of length of atrial septum and good to identify ASD primum, right sided pulmonary veins, coronary sinus dilation.

e) **Parasternal short axis view:** This view allows visualization of base of the heart anterior to aortic root with anteroposterior orientation of the defect and aortic rim can be measured nicely.

Transesophageal Echocardiography (TEE) guideline for inter atrial septum:

Multiple and sequential views are required to evaluate IAS, size and shape of the ASD's, its rim and relationship with surrounding structure.

American society of echocardiography recommend to start form a standard view and then stepwise increment of transducer angle by 15^0 or sweeping the beam through area of interest is good to image IAS. The color Doppler

scale should be 35-40 cm/sec to visualize low velocity flow across PFO or ASD. Continuous and pulsed Doppler can measure the velocity and direction of shunt[27]. Fig-3 showed large osteum secundum ASD in TEE [1]. Five basal views are important to interrogate IAS and its surrounding structures (Table -IV).

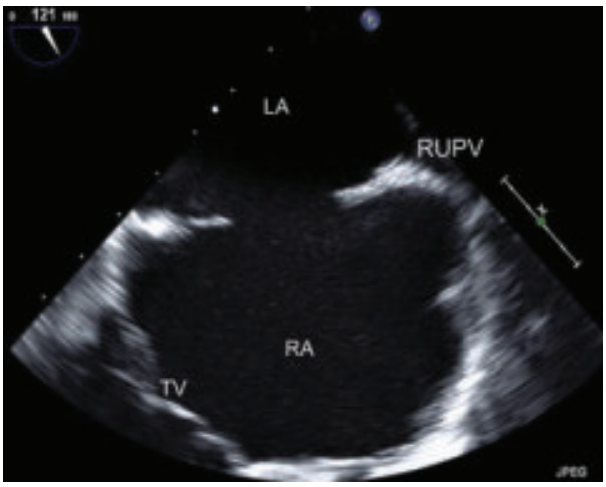


Fig.-3: *Ostium secundum ASD in TEE*

Upper esophageal short axis view: This view is obtained at upper esophagus with step wise sweeping at 15^0, 30^0 and 45^0. Superior aspect of atrial septum, ASD secundum, roof of RA, LA, surrounding vessels (SVC, aorta) entry of right pulmonary vein is visualized.

Mid esophageal short axis view

Mid oesophageal aortic valve short axis view is obtained at mid oesophageal level sweeping at 45^O, 60^0, 75^o Progression of angles allow visualization of AoV in short axis view to modified bicaval tricuspid valve view. This view capture anterior and posterior plane of atrial septum and anteroposterior diameter can be measured.

Mid Oesophageal four chamber view:

This view is obtained by multiple angles of 0^0 at mid oesophageal level with stepwise increment to 15o and 300. It can evaluate atrial Atrioventricular septum (Septum primum) and relationship of ASD if any to AV valve. .

Mid esophageal bicaval view: This view is obtained by sweeping with multiplane angles of 90^0, 105^0 and 120^0. It can image superior and inferior plane of IAS and surrounding SVC, IVC and right pulmonary veins. This view is good to visualize sinus venosus ASD (SVC & IVC type) and anomalous pulmonary veins.

Mid esophageal long axis view: This view is obtained by sweeping at 120^0,135^0 and 150^0 and good to evaluate roof of LA when a device is implanted.

3D TEE imaging of interatrial septum:

A through 3D examination begins with a real time narrow angled acquisition of images from standard views. To obtain higher resolution, 3D wide angled acquisition is performed. American Society of Echocardiography (ASE) recommends narrow angled, zoomed and wide angled acquisition of 3D data's sequentially is several important views.[28]

3D display: When IAS is viewed from LA, atrial septum should be oriented with the right upper pulmonary vein at the 1-0 clock position. The qualitative parameters obtained from 3D TEE imaging are type of ASD location in atrial septal shape, orientation etc. Quantitative analysis by 3D include maximum length, width and area measured in atrial diastole. ASD dimension measured in end systole is necessary to determine change with cardiac cycle.

Intracardiac Echocardiography imaging (ICE) Protocol:

Radial and phased array ICE is useful for comprehensive assessment of the atrial septum, septal defects, rims etc. ICE offer a radial rotational or phased area imaging plane that is manipulated by insertion and withdraw of catheter. In case of axial phased array, manipulation is controlled by steering with adjustable tension, so that catheter can be held in up to four directions (anterior, posterior, left and right) Insertion and withdrawal of probe images IAS superiorly and inferiorly. Axial rotation allows visualization in multiple planes.

Role of echocardiography in percutaneous device closure of secundum ASD:

Secundum ASD's the commonest type of ASD and are amenable for device closure if anatomy is favorable. Echocardiography is the most important imaging guide to select patient, guide whole intervention procedure and also to check complication like device embolization, cardiac perforation, tamponade and device erosion[29].

Table V showed indications and contraindications of ASD and PFO closures 1.

By virtue of its ease of use from patients bed side, lack of radiation and portability, it has taken a key role in interventional procedure in catheterization laboratory[30].

ASD secundum is surrounded by six rims and rim length of 5mm or more is considered as favorable for transcatheter closure. Less than 5mm is considered as deficient rim.

Deficient aortic rim is a potential risk for erosion [31,32].

ASD rims can be named as follows:

1. Aortic rim, the antero superior rim between ASD and aortic valve annulus and aortic root.
2. **AV valve rim:** The anteroinferior rim between ASD and the AV valves.
3. **SVC rim:** Posterosuperior rims between ASD and SVC.
4. **IVC rim:** Posteroinferior rim between ASD and IVC.
5. **Posterior rim:** Between ASD and posterior anterior walls.
6. Right upper pulmonary vein rim (RUPV rim) between the ASD and the RUPV.

TEE can evaluate all six rims in upper oesophageal short axis, mid esophageal short axis, four chamber and bicaval views. TTE can provide adequate information in paediatric patients. Mid esophageal 4 chamber view is (0^0-15^0) good for identifying anteroinferior rim and posterosuperior rim. Mid esophageal AV short axis view (30^0-45^0) is good for anterior and posterior rims. Mid esophageal bicaval view (110^0-130^0) is good to visualizing superior & inferior rims. During deployment of device, most important views are four chamber view and short axis view. [33,34]

Device size selected should be 2mm greater than stop flow diameter or largest diameter measured by TTE or TEE. LA disc is deployed first inside body of LA and remote from pulmonary veins and LA appendage. Waist of the device is partially deployed in LA with continuous pull towards septum with an aim to stent the ASD. Afterwards continuous traction is maintained towards RA and RA disc released. Delivery cable is advanced towards the septum to bring both disc closer. Follow up evaluation can be performed with TTE at 1,6,12 months of procedure and yearly thereafter for 3 years or as per institutional protocol. RV size normalize usually by one month but long standing RV dilation take time even might not normalize completely.

Conclusion:

Interatrial septum is a complex structure and associated with abnormalities varied from septal defects at different locations to atrial septal aneurysm, presence of remnant of eustachian valve, Chiari network etc. All information like type, size, shape, rims surrounding the defect, degree of shunting through defects changes in size and function of cardiac chambers, pulmonary artery pressure, Eisenmenger change can be assessed with the help of TTE, TEE commonly and ICE and 3D imaging during device implantation in some centers. In future more refinement in all modalities including 3D imaging, fusion imaging of Echocardiography with cardiac computed tomography, fluoroscopy and more procedural refinement of device implantation is under consideration. All will lead to more successful device implantation rate in coming days even for large secundum ASDs.

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Case Report

3D Mapping and Ablation of Left Sided Atypical Atrial Flutter

Poppy Bala[1], Anil Saxena[2], Aparna Jaswal[3], Amitesh Chakravarty[4], Ravikanth Telikicherla[5], Nighat Islam[6], Mahmood Hasan Khan[6]

Abstract:

Atypical atrial flutter has become amenable to catheter ablation with remarkable improvement in the acute and long-term efficacy of this therapy for this macro reentrant atrial arrhythmia. Here it was described a case of atypical atrial flutter which arises from left atrium and demonstrates the importance of a systematic approach to mapping and ablating atypical atrial flutter to prevent a recurrence of symptomatic arrhythmia. We also highlighted importance of 3D mapping which is a key tool for analysis and successful ablation

Keywords: *Cardiac electrophysiology, Radiofrequency ablation, Atypical atrial flutter, 3D mapping.*

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Introduction:

Atrial flutter (AFL) is one type of macro-reentry atrial tachycardia. It accounts for 15% of all supraventricular arrhythmias and frequently coexists with or precedes AF (1–6). Depending upon whether Cavo tricuspid isthmus (CTI) is critical to re-entry circuit, it is divided into two categories- 1) CTI dependent macro re-entry tachycardia and 2) non-CTI dependent macro re-entry tachycardia. Atypical AFL falls into category of non-CTI dependent macro re-entry tachycardia. Atypical atrial flutter ECG usually showed a variable flutter wave morphology and faster atrial rates compared to typical atrial flutter (7-9). Because atypical atrial flutter does not necessarily have a fixed anatomically defined reentrant circuit, thus to find out the re-entry pathway and slow conduction zone - three-dimensional (3D) activation mapping is a key tool for analysis and successful ablation.

Case report:

A 74-year-old hypertensive woman presented with worsening shortness of breath on exertion and palpitations for 3 months which increased in last one week. ECG (Fig. 1) revealed atrial flutter with 2:1 conduction and a ventricular rate of 156 beats per minute with RBBB morphology in V1. Echocardiography showed normal left ventricular ejection fraction and left ventricular hypertrophy. Patient was referred for ablation. She arrived at the electrophysiology laboratory in fasting state. A deflectable decapolar catheter and a quadripolar catheter were placed into the coronary sinus (CS) and the right Ventricle, respectively. Adjustable duodecapole halo catheter placed around the tricuspid valve annulus and an ablation catheter placed on the cavotricuspid isthmus at the 6 o'clock position (Fig.2). All catheters were

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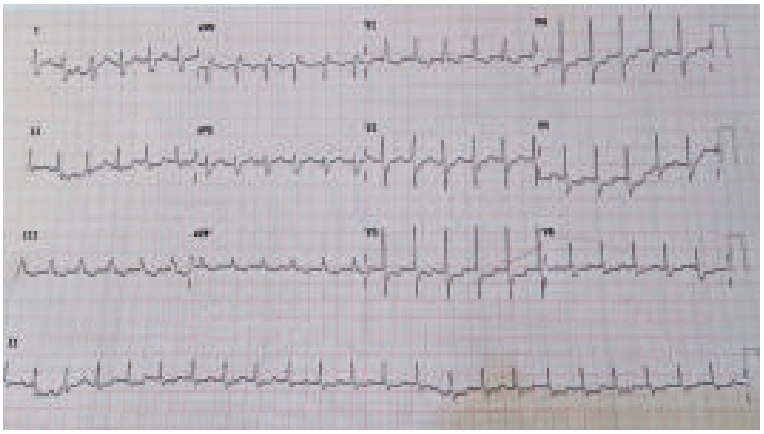

Fig.-1: *ECG showed atrial flutter.*

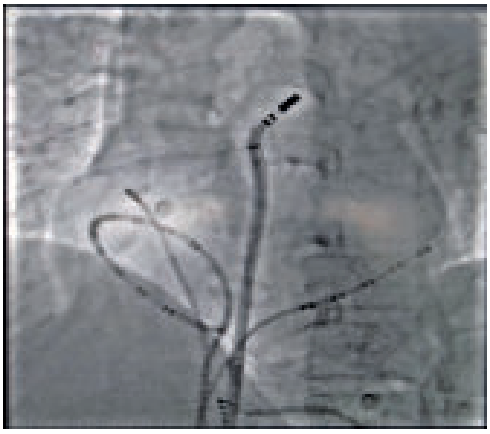

Fig.-2: *Location of catheters.*

introduced via the right femoral vein. The CARTO 5 Multi-Electrode Mapping (MEM) technology with high-resolution maps used for the HD coloring feature.

An ECG pattern (Fig.1) with a negative F wave in leads II, III, aVF and V1, and positive in aVL was found which gave rise of suspicion of atypical form of atrial flutter. The tachycardia cycle length (TCL) was measured to 250ms, with a concentric atrial activation (Fig. 3-proximal-to-distal CS activation). Excluded RA atypical flutter circuit based on RA activation time as determined by sequential conventional mapping (evenly distributed points) accounting for <50% of the arrhythmia cycle length and post pacing interval (PPI) in the RA longer than the cycle length by >20 ms in different points in the RA, including the Cavo tricuspid isthmus and RA free wall but excluding coronary sinus os. Also, it took relatively longer time to entrain the circuit from CTI.

Direct LA mapping by NaviStar ablation catheter (Biosense Webster) was done (Fig.4). A transseptal puncture (Brockenbrough needle and Daig sheath) was required. The electrogram at this site was usually of low amplitude, fragmented signals were recorded in a wide area of the roof of left atrial to left atrial appendage (LAA). Propagation mapping also showed impulse travelling from LA roof to LA appendage to downward direction. The location of the ablation site was obtained by concealed entrainment, by the demonstration of a poststimulation cycle that did not exceed the flutter cycle by more than 20 ms, demonstration of slow conduction area and zone of block; which was a line between upper left pulmonary vein to os of LAA.

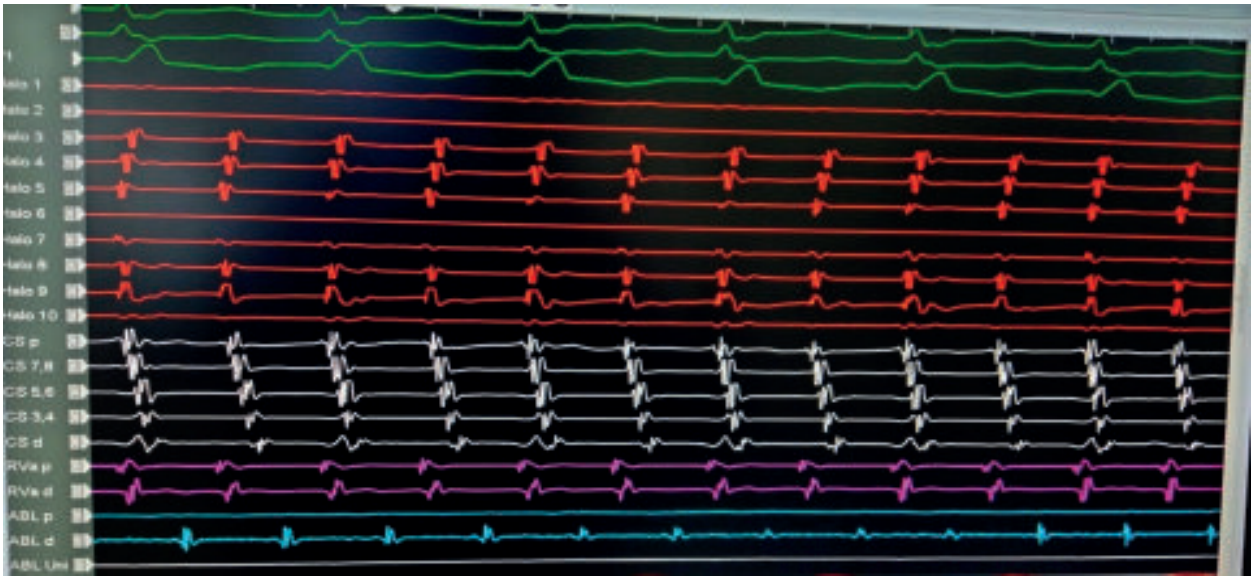

Fig.-3: *Intracardiac EKG of AFl.*

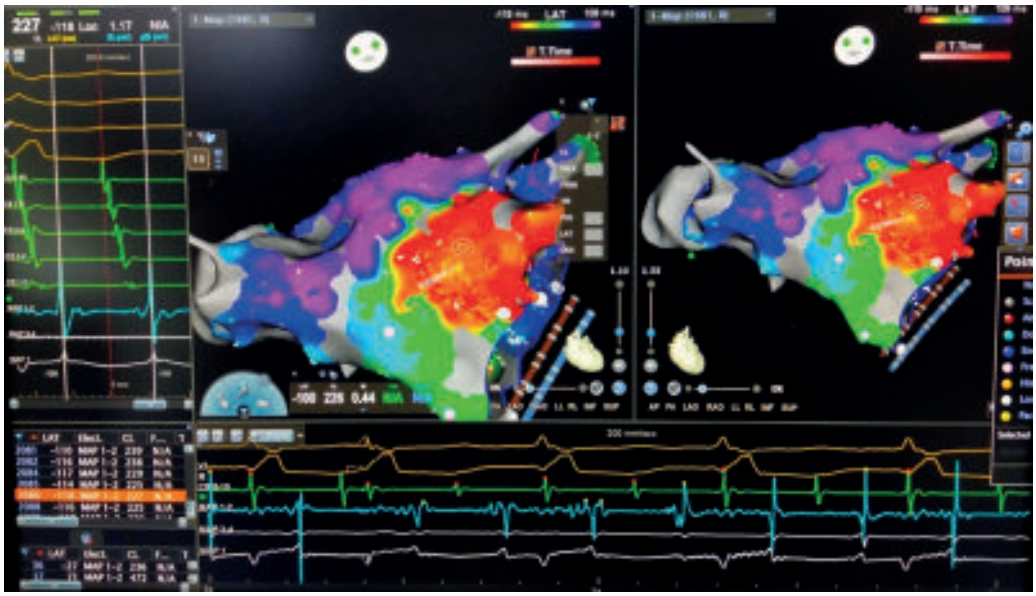

Fig.-4: *showing 3D mapping of left atrium and low amplitude slow conduction signal.*

Based on the 3D mapping, the ablation strategy was to complete conduction block. Therefor radiofrequency energy was applied, power output of 35 watts and temperature 55 degree Celsius. The ablation terminated the flutter and a complete block was achieved within 30 minutes. Patients' rhythm converted into sinus (Fig.5). Repeated atrial stimulations, on and off isoproterenol infusion, with atrial programmed stimulation and burst down to the atrial refractory period demonstrated no inducible atrial arrhythmia. Post-procedure, the patient recovered well with no complications.

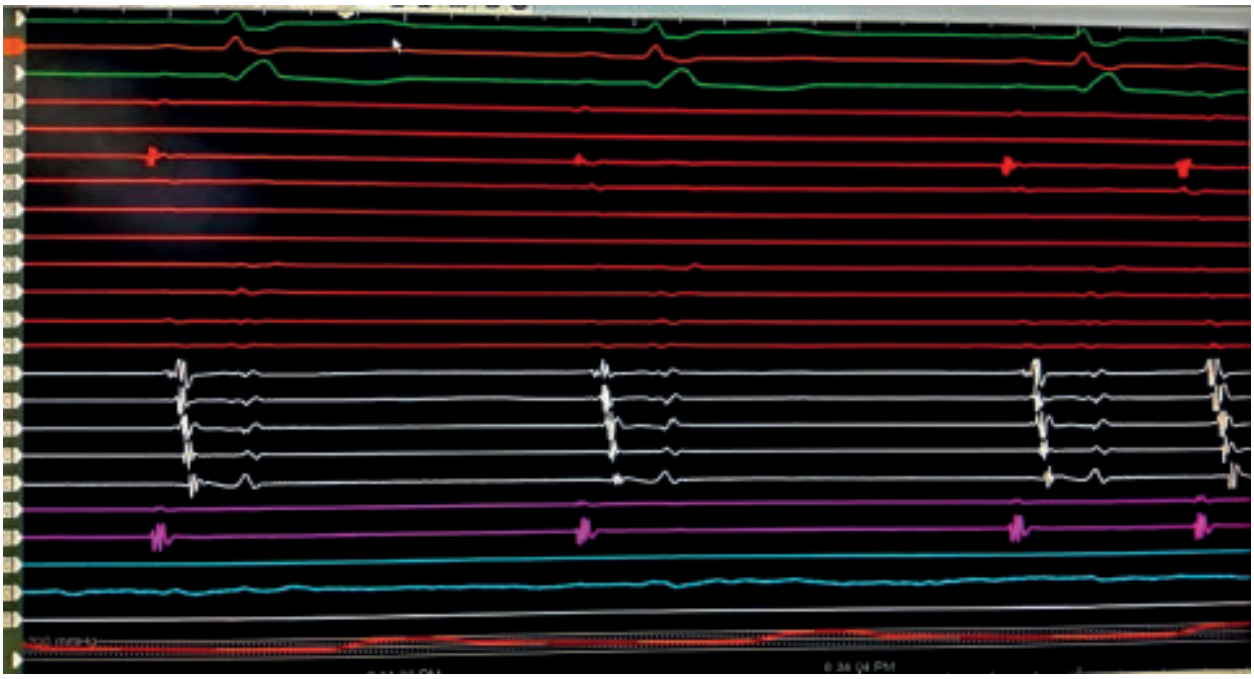

Fig.-5: *showing rhythm was converted back to sinus after successful ablation.*

Table-I

Classification of atypical atrial flutter (10).

Right sided atypical atrial flutter
• Lower loop reentry (isthmus-dependent)
• Double wave reentry (isthmus-dependent)
• Intra-isthmus reentry (isthmus-dependent)
• Upper loop reentry
• Scar-related macroreentrant atrial tachycardia
• Scar-related MAT without prior cardiac surgery
• Complex right atypical atrial flutter
Left sided atypical atrial flutter
• Left septal atrial flutter
• Perimitral atrial flutter
• Scar- and pulmonary vein-related atrial flutter
• Coronary sinus atrial flutter

Discussion:

The simplified way to understand the atypical atrial flutter is any atrial reentry which does not circle around the tricuspid valve and does not use the Cavo tricuspid isthmus as a critical zone of slow conduction is called atypical atrial flutter. However, there are three isthmus-dependent atrial flutter forms which fall under the umbrella of atypical atrial flutter.[10] Table1 showed the types of atypical flutters.

Jaïs P et al study showed eleven electrically silent areas were noted, among them 50% were located in posterior LA. The posterior silent area was of varying dimensions, extending to the roof and septum. Zones of block were identified in various locations, where 35% in block at the ostium of the left PV, 15% at right PV and 22% at base of the appendage.[12] In this case also showed silent area located in roof; conduction is situated in-between left pulmonary vein and base of LAA.

Ablation is a definitive therapy for atrial flutter. However, successful procedures as well as complications rates are different depending of the location of the circuit. It's truer in case left sided Afl in terms of complication. Conventional pacing combined with 3D electroanatomic mapping was an effective method to differentiate between typical and atypical atrial flutter.[11]

Conclusion

Atypical atrial flutter represents a versatile dimensions of macro reentrant atrial tachycardias in both the right and the left atrium. The combined use of 3D mapping and entrainment pacing provides insight about the reentrant circuit and helps to identify the target zones for potential ablation. Thus, atypical atrial flutter has become amenable to catheter ablation with remarkable improvement in the acute and long-term efficacy of this therapy for this macro reentrant atrial arrhythmia.

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Case Report

Lutembacher's Syndrome in a young female treated Surgically: A Case Report

Sultan Sarwar Parvez[1], Saikat DasGupta[2], Reazul Haque[3], Jalal Uddin[4]

ABSTRACT

Lutembacher's syndrome is a rare clinical condition presenting with a combination of congenital atrial septal defect (ASD) and acquired mitral stenosis (MS). Lutembacher's syndrome is more prevalent in developing countries and its prevalence depends on the prevalence of rheumatic fever in that geographical area. The syndrome can present at any age but is usually more commonly observed in young female adults. Echocardiography remains the gold standard for diagnosis and evaluation of Lutembacher's syndrome (LS). Now a days many treatment options are available for LS – either percutaneous intervention or surgical correction. But pericardial patch closure of atrial septal defect and prosthetic mitral valve replacement is the treatment of choice for Lutembacher's syndrome.

Keywords: Lutembacher's Syndrome, Mitral Stenosis, Atrial Septal Defect, Surgical Correction.

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Introduction

Lutembacher's Syndrome is defined as a rare cardiac abnormality presenting with a combination of congenital atrial septal defect (ostium secundum type) and acquired mitral stenosis.[1]

Mitral stenosis can be either congenital, or acquired in origin, most commonly due to rheumatic mitral valve disease. However, the current consensus defines Lutembacher's Syndrome (LS) as any combination of ASD (congenital or iatrogenic) and Mitral stenosis (congenital or acquired) [2]. In a typical case with Lutembacher's Syndrome, the atrial septal defect (ASD) is usually more than 15 mm in size. However, in the current era of percutaneous balloon mitral valvuloplasty for acquired mitral stenosis (MS), residual iatrogenic ASD secondary to trans septal puncture is more common than congenital ASD. Physicians refer to this as iatrogenic Lutembacher's Syndrome (LS) [3]. Lutembacher's Syndrome is more prevalent in developing countries where the incidence of rheumatic fever is high and a history of rheumatic fever has been reported in 40% of patients with Lutembacher's Syndrome. It is more common in females than males. There is a predilection for females because ASD and rheumatic MS are both more prevalent in females. The hemodynamic features and the natural history of the patients with LS depend upon the size of the atrial septal defect, severity of the mitral stenosis, compliance of the right ventricle and the degree of pulmonary vascular resistance [4]. Patients may remain asymptomatic for many years with this syndrome. Signs and symptoms vary according to the

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size of the atrial septal defect (ASD). Palpitation, shortness of breath and fatigue, are common presenting symptoms and appear early in patients with LS due to increased left to right shunt and decreased systemic cardiac output. Echocardiography is the gold standard method to establish the diagnosis of Lutembacher's Syndrome. Many treatment options are available now for LS – either percutaneous intervention or surgical correction. Here, we will present a case of Lutembacher's Syndrome with large atrial septal defect (ostium secundum type) with moderately calcified mitral stenosis treated surgically.

Case Report

A 28 years old female diagnosed as a case of Lutembacher's Syndrome, was admitted in cardiac surgery unit from cardiac out patient department. For almost one and half years, she complained of palpitations and chest discomfort on exertion. She was not diabetic or hypertensive. She had no previous symptoms of chest discomfort, syncope, orthopnea, paroxysmal nocturnal dyspnea, or limb edema.

She had experienced rheumatic fever when she was ten years old.

She was fairly built, with a consistent pulse rate of 76/min, blood pressure of 110/60mmhg, and a respiratory rate of 20/min on physical examination. On auscultation-S2 was wide and fixed splitted and there was a mid-diastolic murmur in the mitral region, but no crackling or wheezing in the lungs. There was no evidence of ankle oedema or hepatomegaly. Her electrocardiogram revealed normal sinus rhythm and RVH. Chest radiograph showed cardiomegaly and pulmonary plethora. All biochemical tests were within normal limit.

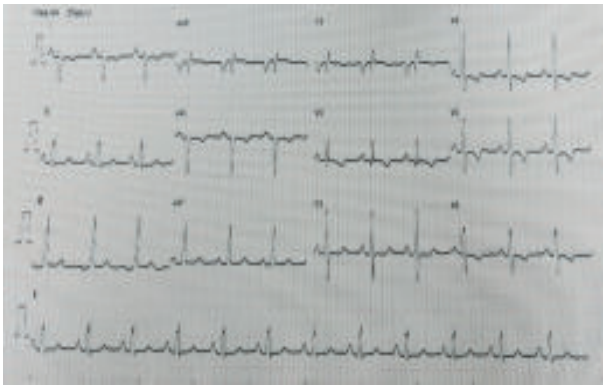

Fig.-1: *ECG showed normal sinus rhythm and features of RVH.*

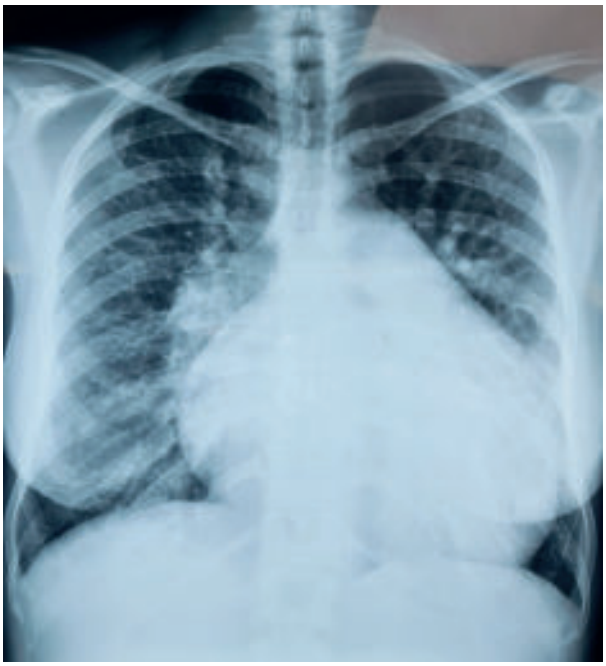

Fig.-2: *Chest radiograph showed cardiomegaly and pulmonary plethora.*

Later on echocardiographic evaluation (Both 2D & Doppler) was done which revealed large atrial septal defect (Ostium Secundum type) with left to right shunt with moderate mitral stenosis.

Fig.-1: *Transthoracic Echocardiography*
(Apical 4C view) showing atrial septal defect and mitral stenosis.

Left atrium, right atrium and right ventricle were dilated. Size of ASD was 43 mm with deficient posterior, superior and IVC rims. There were thickening of both mitral valve leaflets. There was systolic doming of anterior mitral leaflet with restricted mobility of posterior mitral leaflet. Mitral valve area (MVA) was 1.3 cm2 which was calculated by 2D planimetry method, mean trans mitral pressure

gradient was 5.70 mmhg, pulmonary artery systolic pressure was 45 mmhg.

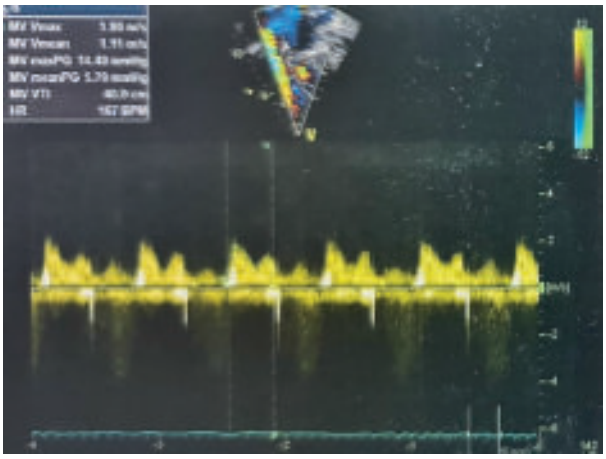

Fig.-3: *CW Doppler of mitral inflow of patient with Lutembacher's Syndrome*

All other valves morphology appeared to be structurally normal. Left ventricular ejection fraction was 60%. Coronary angiogram was not performed. After evaluation of the patient, elective surgical procedure was done under general anesthesia in supine position. After a median sternotomy , cardiopulmonary bypass (CPB) was established using aortic and standard bicaval cannulation with moderate hypothermia. After cross clamping , heart was arrested with antegrade cold blood cardioplegia through aortic root along with topical myocardial cooling using cold normal saline. The right atrium was opened obliquely (RA tomy) and large ostium secundum type of ASD was visualized. Both the leaflets

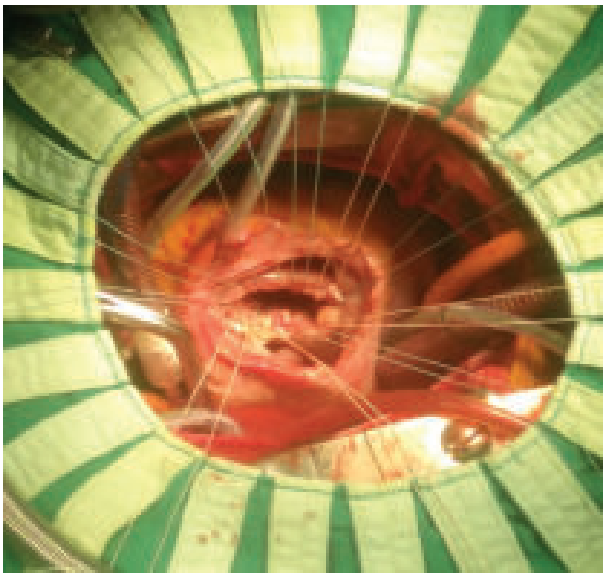

Fig.-4: *After excising diseased mitral valve.*

of mitral valve was visualized which were thickened & calcified, both commissures were fused. So, the decision was made for surgical correction. Then mitral valve was excised and sized.

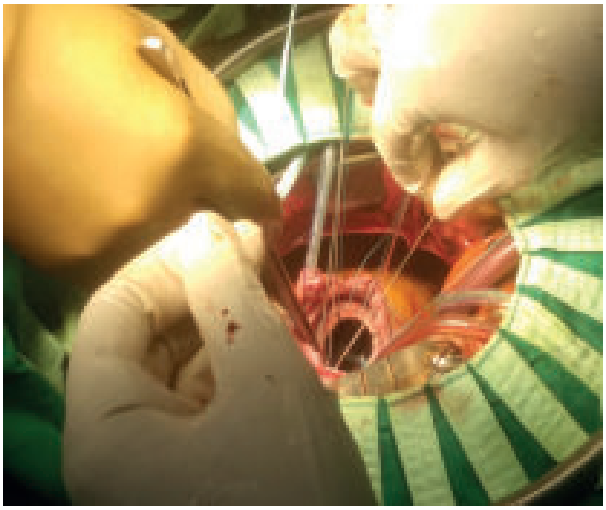

Fig.-5: *Metallic mitral valve replacement done.*

After that, the mitral valve was replaced with 25mm Medtronic bileaflet mechanical heart valve (BLMV). ASD was closed using autologous pericardial patch.

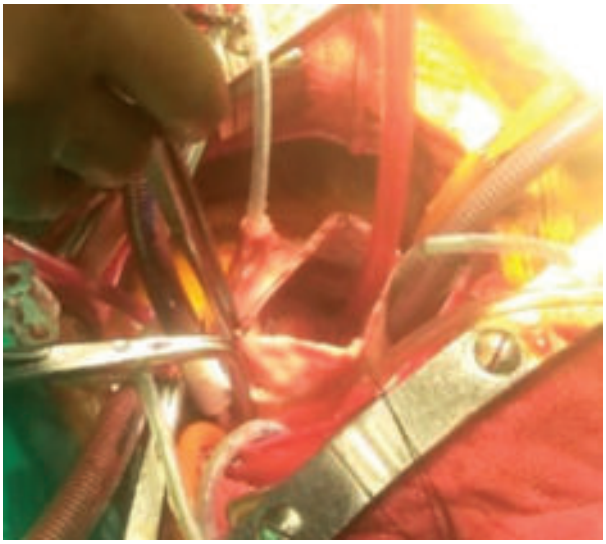

Fig.-6: *ASD closed with autologous pericardial patch .*

RA-tomy was closed, heart was deaired and gradually weaned from CPB. Decannulation done. Heparin was reversed with protamine sulfate. After maintaining proper hemostasis, wound was closed in layers, leaving two chest drain tubes and two RV pacing wires in situ. Patient

was shifted to ICU with stable hemodynamics with dobutamine 3 mics. She was extubated on 1st post-operative day and subsequent post-operative period was uneventful. Post-operative biochemical investigations were within normal limits. Dobutamine was tapered off on 3rd POD. Patient was discharged on 10th POD with smooth recovery.

Follow Up

At one year follow up, patient was asymptomatic and maintaining normal daily activities and echocardiogram showed 60% LVEF, well seated and functioning mitral prosthesis, no paravalvular leakage. ASD patch was intact with no residual flow.

Discussion

In 1750, Lutembacher syndrome (LS) was first described in a letter by anatomist Johann Friedrich Meckel. Corvisart who first described the association of mitral stenosis (MS) and atrial septal defect (ASD) in 1811. Rene Lutembacher, a French physician born in 1884, described his first case of this syndrome in a 61 year old women who had been pregnant 7 times before and published the first data described as LS in 1916[5,6,7]. Lutembacher's Syndrome was described as a rare combination of congenital ostium secundum defect type of ASD and acquired mitral stenosis. Congenital MS is rare. The current consensus is that LS consists of a congenital defect in the atrial septum upon which acquired MS is imposed. The incidence of MS in patient with ASD is 4% while the incidence of ASD in MS is 0.6-0.7% [8]. Its prevalence depends on the prevalence of rheumatic fever in that geographical area[9]. The exact prevalence of LS is not known. It is more prevalent in areas with higher prevalence of rheumatic heart disease[10]. In developing countries, a history of rheumatic fever has been reported in 40% of patient with LS. This condition can present at any age but more commonly found in young adult female patients. The hemodynamic effects of this syndrome are the result of the interplay between the relative effects of atrial septal defect and mitral stenosis. The hemodynamic features depend upon the size of the ASD, severity of MS, compliance of the right ventricle and the degree of pulmonary vascular resistance. When mitral stenosis (MS) is severe and atrial septal defect (ASD) is non-restrictive, left atrium (LA) finds another exit through the septum in addition to the mitral valve (LA decompression). Therefore, LA pressure does not rise in proportion to the severity of MS. For this reason, pulmonary venous hypertension takes a long time to develop resulting increased left to right shunt across the ASD. Right atrium (RA) and right ventricle (RV) are progressively dilated with increased pulmonary blood flow. In untreated cases, the pulmonary vascular resistance continues to increase which leads to right ventricular failure.[11] In contrast, if the ASD is restrictive, the shunt across the defect will be less and hence, the patient will follow the course of isolated MS. Patient with restrictive ASDs and moderate to severe MS, present much earlier and usually with features of pulmonary congestion from MS.[12]

Two-dimensional echocardiography with color flow doppler is the diagnostic modality of choice in patients with Lutembacher's Syndrome (LS). The type and size of ASD and severity of MS are accurately estimated by this technique[13].

Typically, ASD in LS should have a diameter of more than 15mm. Planimetry by 2D/3D echo is the more reliable method to assess MVA and severity of MS in patients with LS[3].

The patient with Lutembacher's Syndrome is managed either by open heart surgery or percutaneous interventional techniques. But open heart surgery is the gold standard treatment for LS. Many limitations are found for percutaneous intervention like large ASD, with lack of margin of ASD, mitral valve restenosis, presence of left atrial thrombus, presence of anomalous pulmonary drainage, MR(Gr-III) or higher, bi-commissural calcification and finally lack of expertise[14]. The classical LS can be treated satisfactorily where as the acquired LS usually need early surgical intervention as they are more prone to deteriorate with the development of severe pulmonary hypertension and right heart failure[15].

Prognostic factor of this syndrome include pulmonary vascular resistance, right ventricle (RV) compliance, size of ASD and severity of MS.

Conclusion

Lutembacher's Syndrome is a rare cardiac abnormality. Early diagnosis and corrective surgical treatment including, ASD closure with mitral valve replacement, is associated with a good outcome and prolongs survival. Preoperative assessment and effective management depend on the better outcome of surgical procedures.

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