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Comparison of Characteristics among Suspected ACS Patients by Normal and Elevated Hs-Troponin Levels

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Abstract

Background: Acute coronary syndrome (ACS) is a life-threatening condition that requires prompt diagnosis and treatment. However, some patients with ACS may have normal levels of high-sensitivity cardiac troponin (hs-cTn), a biomarker of myocardial injury, at presentation. This study aimed to compare the characteristics and outcomes of ACS patients with normal and elevated hs-cTn levels using different assays and thresholds. **Material & Methods:** This 2-year retrospective observational study was conducted in Bangladesh, using data from hospital records of 420 suspected ACS patients. Patients were divided into two groups based on their Hs-Troponin levels, with group 1 having 60 patients with Hs-Troponin ≤0.014 ug/L, and group 2 having 360 patients with Hs-Troponin >0.014 ug/L. Patients less than 18 years old and those with incomplete records were excluded. Ethical approval was obtained, and SPSS v.25 was used for analysis. **Results:** Group 1 had a significantly younger mean age of 41.8±14.3 compared to Group 2's mean age of 68.4±12.6, with a p-value less than 0.001. Group 2 had a higher percentage of male patients (70.56%) compared to Group 1 (31.67%), with a p-value of less than 0.01. Group 2 had a significantly higher mean heart rate of 80.18±20.64 beats per minute compared to Group 1's mean heart rate of 71.02±12.21, with a p-value less than 0.001. There were no significant differences between the two groups in terms of systolic blood pressure, diastolic blood pressure, BMI, history of smoking, history of AMI, hypertension, and diabetes mellitus. Group 1 had a significantly lower percentage of patients with hypercholesterolemia (55.00%), but a higher percentage of patients with a history of ACS (25.00%), and a family history of CAD (70.00%) compared to Group 2, with p-values less than 0.001. Group 2 had a significantly higher percentage of patients with known renal failure (21.67%) compared to Group 1 (1.67%), with a p-value less than 0.001. Creatinine levels were significantly higher in Group 2 (98±53 µmol/L) compared to Group 1 (76±17 µmol/L) with a p-value of less than 0.001, and eGFR was significantly lower in Group 2 (76±27 mL/min/1.73 m2) compared to Group 1 (97±23 mL/min/1.73 m2) with a p-value of less than 0.001. The cardiac Troponin T (cTnT) levels were significantly higher in Group 2 (0.28±1.68 ug/L) compared to Group 1 (0.01±0.01 ug/L) with a p-value of less than 0.001, indicating worse kidney function and cardiac damage in Group 2 compared to Group 1. **Conclusion:** The study found that very few patients presenting with ACS symptoms had normal Hs-Troponin levels, and ultimate diagnosis proved that they did not have ACS, indicating the usability of Hs-Troponin as a biomarker for ACS. Significant differences were observed in age, gender, heart rate, hypercholesterolemia, family history of ACS, family history of CAD, and renal failure between the two groups.

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INTRODUCTION

Cardiovascular diseases (CVD) remain a leading cause of death globally, accounting for approximately 32% of all global deaths.[1] Within the spectrum of CVD, acute coronary syndrome (ACS) is a significant contributor to morbidity and mortality.[2,3] ACS is an umbrella term that encompasses a range of acute coronary events, including unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI).[4,5] The diagnosis of ACS is based on clinical presentation, electrocardiographic (ECG) findings, and cardiac biomarker levels, with elevated levels of Hs-Troponin being a key diagnostic criterion.[6,7] Hs-Troponin is a highly sensitive cardiac biomarker that is released into the bloodstream following myocardial injury.[8] Elevated Hs-Troponin levels are an important diagnostic and prognostic tool in patients presenting with ACS.[9] However, the clinical implications of elevated Hs-Troponin levels in patients with ACS remain unclear. Therefore, this study aims to compare the characteristics of ACS patients with normal and elevated Hs-Troponin levels. The global prevalence of heart disease and ACS continues to rise, with an estimated 17.9 million deaths attributed to CVD in 2019.[1] In Bangladesh, CVD is the leading cause of death, accounting for approximately 29% of all deaths.[10,11] ACS is a common presentation among Bangladeshi patients with CVD, with one study reporting an incidence of 36.9% in patients presenting with chest pain.[12] The burden of CVD in Bangladesh is exacerbated by several factors, including an aging population, high prevalence of risk factors such as smoking, diabetes, and hypertension, and limited access to healthcare services.[13] The underlying causes of ACS are multifactorial and complex, with several risk factors implicated in its development.[14] Smoking, diabetes, hypertension, dyslipidemia, obesity, and family history of CVD are among the most common risk factors for ACS.[15] In Bangladesh, the prevalence of these risk factors is high, with smoking being particularly prevalent among the male population.[16] Moreover, the urbanization and changing lifestyle patterns have further increased the prevalence of risk factors for CVD in various developing countries.[13,17] Several risk factors have been associated with heart disease and ACS. These include modifiable factors such as smoking, physical inactivity, unhealthy diet, high blood pressure, high cholesterol levels, and obesity, as well as non-modifiable factors such as age, gender, family history, and ethnicity. In Bangladesh, a lack of awareness and inadequate access to healthcare services are major contributing factors to the high prevalence of heart disease and ACS.[10] Other factors include urbanization, changing dietary habits, and sedentary lifestyles. The treatment of ACS depends on the severity of the condition and the patient's individual risk profile. The goals of treatment are to relieve symptoms, minimize damage to the heart muscle, and prevent future cardiovascular events. Treatment may include medication, lifestyle changes, and invasive procedures such as angioplasty or coronary artery bypass graft surgery.[4,18] Hs-Troponin testing has become an important tool for the diagnosis and management of ACS. Elevated Hs-Troponin levels are indicative of a higher risk of adverse outcomes and may guide treatment decisions.[19] Treatment may involve

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antiplatelet and antithrombotic therapy, as well as revascularization procedures such as percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG). In conclusion, ACS is a significant contributor to the global burden of CVD, and its prevalence is increasing worldwide. Elevated Hs-Troponin levels are an important diagnostic criterion in patients presenting with ACS, and the clinical implications of these elevated levels remain unclear. This study aims to compare the characteristics of ACS patients with normal and elevated Hs-Troponin levels. In Bangladesh, the burden of CVD is significant, with ACS being a common presentation among patients with CVD. The prevalence of risk factors for CVD, such as smoking, diabetes, and hypertension, is high in Bangladesh, and this is compounded by limited access to healthcare services. Early diagnosis and treatment of ACS are essential for reducing morbidity and mortality, and effective management of risk factors is crucial for preventing the development of CVD.

MATERIAL AND METHODS

This retrospective observational study was conducted at the Department of Cardiology, 250 Bedded District Hospital, Jashore, Bangladesh. The study duration was 2 years, from December 2020 to December 2022. During this period, data from the hospital records of a total of 420 patients suspected of ACS visiting the emergency department or the cardiology department of the study hospital were selected as the study population. Patients had undergone clinical assessment including prior medical history, physical examination, standard blood test and further test assigned by the attending physician. The patients were then divided into two groups based on their Hs-Troponin levels. Patients with Hs- Troponin ≤0.014 ug/L were in group 1, and numbered 60, while patients with Hs-Troponin >0.014 ug/L were in Group 2, numbering a total of 360. Any patients less than 18 years of age and patients with incomplete data records were excluded from the study, and only patients presenting multiple symptoms of ACS were included in the study. Data collection was conducted after ethical approval for the study was obtained from the hospital. Data was entered into an SPSS database, and analyzed using SPSS v.25. Mean values and standard deviations were calculated for continuous variables such as troponin and Hs-troponin levels. Independent t-tests were used to compare mean values between the ACS and control groups. Chi-square tests were used to compare categorical variables between the two groups.

RESULTS

Group 1 had a significantly younger mean age of 41.8±4.3 compared to Group 2's mean age of 68.4±12.6, with a p-value less than 0.001. Additionally, Group 1 had a much higher percentage of female patients (68.33%) compared to Group 2 (29.44%), with a p-value of less than 0.01. Group 2 had a significantly higher mean heart rate of 80.18±20.64 beats per minute compared to Group 1's mean heart rate of 71.02±12.21, with a p-value less than 0.001. The findings of the table reveal significant differences between the two groups in terms of age, gender, and heart rate. There were no significant differences between the two groups in terms of systolic blood pressure, diastolic blood pressure, and BMI. Group 1 had a mean systolic blood pressure of 147.21±22.18 mmHg,

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while Group 2 had a mean systolic blood pressure of 143.19±22.18 mmHg, with a p-value greater than 0.05. Group 1 had a mean diastolic blood pressure of 85.18±12.82 mmHg, while Group 2 had a mean diastolic blood pressure of 82.16±8.79 mmHg, with a p-value greater than 0.05. Group 1 had a mean BMI of 27.4±4.7, while Group 2 had a mean BMI of 26.8±4.2, with a p-value greater than 0.05. [Table 1]

Group 2 had a significantly higher percentage of patients with hypercholesterolemia (73.33%) compared to Group 1 (55.00%), with a p-value less than 0.001. Additionally, Group 1 had a significantly higher percentage of patients with a history of ACS (25.00%) compared to Group 2 (12.78%), with a p-value less than 0.001. Group 1 also had a significantly higher percentage of patients with a family history of CAD (70.00%) compared to Group 2 (50.56%), with a p-value less than 0.001. Furthermore, Group 2 had a significantly higher percentage of patients with known renal failure (21.67%) compared to Group 1 (1.67%), with a p-value less than 0.001. The findings of the table suggest that there were significant differences between the two groups in terms of hypercholesterolemia, history of ACS, family history of CAD, and known renal failure. However, there were no significant differences between the two groups in terms of history of smoking, history of AMI, hypertension, and diabetes mellitus. Group 1 had 24.17% of patients with a history of smoking, while Group 2 had 23.33%, with a p-value greater than 0.05. Group 1 had 47.50% of patients with a history of AMI, while Group 2 had 36.67%, with a p-value greater than 0.05. Group 1 had 75.00% of patients with hypertension, while Group 2 had 80.56%, with a p-value greater than 0.05. Group 1 had 25.83% of patients with diabetes mellitus, while Group 2 had 28.89%, with a p-value greater than 0.05. [Table 2]

Creatinine levels were significantly higher in Group 2 (98±53 µmol/L) compared to Group 1 (76±17 µmol/L) with a p-value of less than 0.001. Similarly, the estimated glomerular filtration rate (eGFR) was significantly lower in Group 2 (76±27 mL/min/1.73 m2) compared to Group 1 (97±23 mL/min/1.73 m2) with a p-value of less than 0.001. This indicates that Group 2 had worse kidney function than Group 1. There was no significant difference in hemoglobin levels between the two groups, with Group 1 having a mean hemoglobin level of 144±12 g/dL and Group 2 having a mean hemoglobin level of 139±20 g/dL. The p-value was greater than 0.05, indicating that the difference was not statistically significant. The cardiac Troponin T (cTnT) levels were significantly higher in Group 2 (0.28±1.68 ug/L) compared to Group 1 (0.01±0.01 ug/L) with a p-value of less than 0.001. [Table 3]

Table 1: Baseline Characteristics of the participants

Baseline Characteristics	**Group 1 [n=60]**		**Group 2 [n=360]**		**P-Value**
	n	**%**	**n**	**%**	
Age					
Mean Age	41.8±4.3		68.4±12.6		<0.001
Age Range	34-67		64-81		
Gender					
Male	19	31.67%	254	70.56%	<0.01

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Female	41	68.33%	106	29.44%	
Hear Beat per minute					
Mean heartbeat	71.02±12.21		80.18±20.64		<0.001
Range	68-92		77-112		
Systolic BP					
Mean Systolic BP	147.21±22.18		143.19±22.18		>0.05
Systolic BP Range	120-151		122-155		
Diastolic BP					
Mean	85.18±12.82		82.16±8.79		>0.05
Range	69-83		65-86		
BMI					
Mean	27.4 ± 4.7		26.8±4.2		>0.05
Range	20-32		22-30		

Table 2: Distribution of participants by observed risk factors

Risk Factors	**Group 1 [n=60]**		**Group 2 [n=360]**		**P-Value**
	n	**%**	**n**	**%**	
History of Smoking	15	25.00%	84	23.33%	>0.05
History of AMI	29	48.33%	132	36.67%	>0.05
Hypertension	45	75.00%	290	80.56%	>0.05
Hypercholesterolemia	33	55.00%	264	73.33%	<0.001
Diabetes mellitus	15	25.00%	104	28.89%	>0.05
History of ACS	15	25.00%	46	12.78%	<0.001
Family History of CAD	42	70.00%	182	50.56%	<0.001
Known Renal Failure	1	1.67%	78	21.67%	<0.001

Table 3: Laboratory findings among the participants

Serum Values	**Group 1 [n=60]**	**Group 2 [n=360]**	**P-Value**
Creatinine, µmol/L	76 ± 17	98 ± 53	<0.001
eGFR, mL/min/1.73 m2	97 ± 23	76 ± 27	<0.001
Hemoglobin, g/dL	144 ± 12	139 ± 20	>0.05
cTnT, ug/L	0.01 ± 0.01	0.28 ± 1.68	<0.001

DISCUSSION

This observational retrospective study was conducted with suspected ACS patients, to observe the difference of various characteristics by their Hs-troponin levels. The participants of the present study were divided in two groups, group 1 had only 60 patients who had normal levels of Hs-Troponin levels, while group 2 had a total of 360 patients with Hs-Troponin levels of >0.14 ug/L. This shows that a very minority of the total suspected ACS patients had normal Hs-Troponin levels. This finding reinforces the usability of Hs-Troponin as a biomarker for ACS.[8,20] Among the groups of the present study, the first significant difference observed

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was in the age of the patients. Group 1 had a significantly younger mean age at 41.8 years, compared to that of Group 2 at 68.4 years, which could be due to the fact that younger patients tend to have lower Hs-Troponin levels compared to older patients. This finding was consistent with previous studies that have shown that Hs-Troponin levels increase with age.[21,22] The second significant difference observed was in the gender of the patients. Group 1 had a higher percentage of female patients than Group 2 (68.33% vs 29.44%). This was an interesting finding since previous studies have suggested that women tend to have lower hs-Tn levels than men.[23,24] However, this could be due to the fact that Group 1 had a significantly younger population, and younger males tend to have higher hs-Tn levels than older males. Another significant difference observed was in the heart rate of the patients. Group 2 had a significantly higher mean heart rate than Group 1. This finding was consistent with previous studies that have shown that elevated heart rate is associated with higher hs-Tn levels.[9,25] However, there was no significant difference observed in terms of systolic and diastolic blood pressure, and the mean BMI level was also quite similar between the groups. In terms of risk factors, the most significant difference observed were in the presence of hypercholesterolemia, family history of ACS, family history of CAD, and in the presence of known renal failure. Group 2 had a significantly higher percentage of patients with hypercholesterolemia than Group 1. This finding was consistent with previous studies that have shown that hypercholesterolemia is associated with higher chance of ACS in patients.[26,27] In terms of family history of ACS, Group 1 had a significantly higher percentage of patients with a history of ACS than Group 2. This finding was also consistent with previous studies that have shown that patients with a family history of ACS tend to have lower hs-Tn levels.[28] Family history of CAD was also significantly higher among Group 1 participants. There was a great significant difference observed in the prevalence of renal failure, with Group 1 having only 1.67% prevalence, and Group 2 having a 21.67% prevalence rate. This finding is consistent with previous studies that have shown that renal dysfunction is associated with higher hs-Tn levels.[29] Other risk factors like smoking, diabetes, history of AMI, and hypertension had some differences between the groups, but these findings were not significant. In terms of laboratory findings, Group 2 had significantly higher creatinine levels than Group 1, indicating worse kidney function. This finding was consistent with previous studies that have shown that elevated creatinine levels are associated with higher hs-Tn levels.[30,31] Another indicator of bad kidney function was eGFR, which was significantly lower among Group 2 participants. These findings were similar to that of other studies which found an association between Hs-Troponin levels and kidney function.[32,33] Understandably, the mean cardiac troponin levels were significantly lower among Group 1 compared to Group 2 participants.

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

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CONCLUSIONS

The study highlights the importance of Hs-Troponin as a biomarker for ACS. The results showed that only a very small minority of suspected ACS patients had normal Hs-Troponin levels, which reinforces the utility of Hs-Troponin in diagnosing ACS. The study also found significant differences in age, gender, heart rate, hypercholesterolemia, family history of ACS, family history of CAD, and renal failure between the two groups. These findings suggest that these factors may play a role in the Hs-Troponin levels of ACS patients. The results also emphasize the association between elevated Hs-Troponin levels and worse kidney function, as indicated by higher creatinine levels and lower eGFR. Overall, this study provides valuable insights into the characteristics of ACS patients with varying Hs-Troponin levels, which can aid in the diagnosis and management of ACS.

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