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Original Research Article

A clinical study of arrhythmias associated with acute coronary syndrome: a hospital based study of a high risk and previously undocumented population

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ABSTRACT

Background: ACS represents a global epidemic. Arrhythmia in ACS is common. Careful investigation may lead to further improvement of prognosis. Retrospectively analyzed the year- round data of our center. Study was undertaken to analyze the incidence, frequency and type of arrhythmias in ACS. This is to aid timely intervention and to modify the outcome. Identification of the type of arrhythmia is of therapeutic and prognostic importance.
Methods: This cross sectional analytical study was conducted in the Department of Cardiology, Apollo Hospitals Dhaka, from January 2019 to January 2020 with ACS patients. Enrolled consecutively and data analyzed.
Results: There were 500 patients enrolled considering inclusion and exclusion criteria. Sample was subdivided into 3 groups on the type of ACS. Group-I with UA, Group-II with NSTE - ACS and Group-III with STE - ACS. Different types of arrhythmia noted. Types of arrhythmia were correlated with type of ACS. 500 patients included. Mean age 55.53±12.70, 71.6% male and 28.4% female. 60.4% hypertensive, 46.2% diabetic, 20.2% positive family history of CAD, 32.2% current smoker, 56.4% dyslipidaemic and 9.6% asthmatic. 31.2% UA, 39.2% NSTE-ACS and 29.6% STE-ACS. Type of arrhythmias noted. 22% sinus tachycardia, 20.2% sinus bradycardia, 9% atrial fibrillation, 5.2% ventricular ectopic, 4.8% supra ventricular ectopic, 2.8% bundle branch block, 2.2% atrio-ventricular block, 1% broad complex tachycardia, 0.4% narrow complex tachycardia, 0.2% sinus node dysfunction and 32.2% without any arrhythmia. Significant incidences of arrhythmia detected - respectively 29.8%, 39.2% and 31%, $p<0.001$.
Conclusions: In conclusion, arrhythmias in ACS are common. More attention should be paid to improve their treatment and prognosis.

Keywords: Acute coronary syndrome, Cardiac arrhythmia, Non- ST elevated ACS, ST elevated ACS

INTRODUCTION

Acute coronary syndrome (ACS) refers to a spectrum of conditions compatible with acute myocardial ischemia or infarction due to an abrupt reduction in coronary blood flow.[1] It consists of ST elevation ACS (STE- ACS), non-ST elevation ACS (NSTE- ACS) and unstable angina (UA). Myocardial infarction (MI) can be diagnosed by clinical features like typical chest pain (angina) lasting for more than 30 minutes, typical electrocardiographic (E.C.G.) findings like ST segments elevation, depression and T wave inversion, elevated values of biochemical markers (Troponin, Creatine Kinase) of myocardial necrosis (differentiating it from angina/ischemia), by detection of regional wall abnormality by imaging (echocardiography), or may be defined by pathology. It is a major cause of death and disability worldwide. [2] Despite the considerable progress in management over the recent years, coronary artery disease (CAD) remains the leading cause of death in the industrialized world. Asians, especially Indians show higher incidence, morbidity and mortality than other ethnic groups.[3]

Similar studies in the Bangladeshi population are lacking, although similar findings may be expected due the similarities in population genetics, nutrition and lifestyle. Majority of the deaths in ACS are attributed to the development of arrhythmias.[4] In particular, ventricular fibrillation is attributable to 60% of all deaths related with ACS that occur within 1st hour.[5] The recent improvement in arrhythmia detection and treatment has had a key impact on the result of ACS. Some arrhythmias may be benign while some can be life threatening. With the advent of thrombolytic/reperfusion therapy, it was found that some rhythm disturbances in patients with ACS may be related to coronary artery reperfusion.[3]

Identification of the type of arrhythmia is of therapeutic and prognostic importance as they can indicate either reperfusion, which is a good prognostic sign, or pathological arrhythmia, which can precipitate further ischemia, failure or shock.[6]

This study was done to evaluate the incidence and profile of arrhythmias after acute coronary syndrome. This study will help us to develop a better understanding of the incidence and profile of these arrhythmias in the Bangladeshi population.

METHODS

This was a cross sectional analytical study conducted at the Department of Clinical and Interventional Cardiology, Apollo Hospitals Dhaka, Bangladesh for a period of 13 months from January 2019 to January 2020. 500 consecutive cases of acute coronary syndrome were included in the study on the basis of inclusion and exclusion criteria. The study obtained ethical clearance from the institutional ethical clearance committee.

Inclusion criteria

- Patients with Acute Coronary Syndrome.
- Age >20 years.
- Both males and non – pregnant females.

Symptoms of ischemia

- ECG changes indicative of new ischemia (new ST-T changes or new left bundle branch block {LBBB})
- Development of pathological Q wave in the ECG
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality
- In case of sudden, unexpected cardiac death only those patients will be included whose ECG is suggestive of acute coronary syndrome.
- Detection of rise and/or fall of cardiac bio-markers (preferably Troponin) with at least one value above the 99th centile of upper reference limit (URL) together with evidence of myocardial ischemia with at least one of the following:

Exclusion criteria

- Age < 20 years.
- Patients those who don`t fulfill the inclusion criteria.
- Chest pain due to other causes.
- Patients who have arrhythmia before the onset of MI on the basis of history and documentation.
- Patients with valvular heart disease, congenital heart disease and cardiomyopathy.
- Patients having major non cardiovascular disorder causing elevation of Troponin-I such as severe renal impairment, prolonged immobilization, major surgery, chest trauma, myocarditis (pericarditis) and acute pulmonary embolism.
- Any systemic infection.
- Patients who were under chemotherapy on discovery of malignancy.

For all the patients coming with chest pain first 12 lead ECG was taken immediately after admission. Oxygen was given via mask; IV line was secured. Detailed history regarding chest pain, palpitation, sweating, vomiting, dyspnoea, giddiness was asked, past personal and family history was asked. General and systemic examinations were done.

Patient was connected to the cardiac monitor. All patients were evaluated for risk factors like diabetes, hypercholesterolemia, hypertension and smoking. The diagnosis of ACS was made on the basis of clinical presentation, ECG changes and serum enzymes (Troponin-I) levels. Serial ECGs were taken. Enzyme studies (Troponin- I, and BNP) were done in all the cases.

Following standard treatment was given in emergency: oxygen via mask, analgesic such as morphine, pethidine. anti-platelets and vasodilators such as Sublingual

nitroglycerine, Tab. aspirin (300 mg), Tab. clopidogrel (300 mg), Tab. atorvastatin (80 mg) were given according to the ECG findings. Anticoagulant therapy such as low molecular weight heparin was given unless contraindicated. All patients received standard treatment as per ACC/AHA and ESC guidelines regarding supportive and reperfusion therapy (either Primary PCI or thrombolysis) and cardiac failure.

Special situations

Cases were studied for arrhythmias complicating ACS, in terms of their incidence, timing, duration, severity and type. Patient who showed arrhythmias on monitor, but whose arrhythmias couldn't be recorded on ECG paper due to the transient nature of the arrhythmias, were included in the study. Patients having Ventricular Fibrillation or any other arrhythmias, who died before recording could be done or in whom urgency of the situation prohibited the recording, were also included in the study.

Statistical analysis

SPSS software was used to analyze data. Frequency and percentages were calculated for variables like age, gender, BMI, risk factors, types of ACS and various arrhythmias. The association of certain variables like types of ACS and various arrhythmias along with statistical significance were calculated using Pearson Chi Square tests. The data was compared, and p-values were calculated using the student's t test.

RESULTS

This was a cross sectional analytical study conducted at the Department of Clinical and Interventional Cardiology, Apollo Hospitals Dhaka, Bangladesh for a period of 13 months from January 2019 to January 2020. 500 consecutive cases of acute coronary syndrome were included in the study on the basis of inclusion and exclusion criteria. The study population was subdivided into 3 groups on the basis of type of ACS. Group-I constitutes the patients diagnosed as unstable angina (UA), Group-II constitutes the patients diagnosed as non ST elevated ACS (NSTE - ACS) and Group-III constitutes the patients diagnosed as ST elevated ACS (STE - ACS). Age distribution of the study population showed that the individuals having NSTE-ACS are more aged than the other groups. Most of the study population belonged to 51-60 year age group then 61-70 and 41-50 year groups. Significant differences were found between different age groups (Table 1). The above bar diagram (Figure 1) shows the sex distribution among the study group. Percentage of females is more in group - I (46.2%) than group – II (26%) and group – III (12.8%). Over all the number of male cases is highly significant (71.6%) as compared to females (28.4%).

Table 1: Age distribution of the study population (N=500).

Age	Type of ACS						p value
	Group-I (n=156)		Group-II (n=196)		Group-III (N=148)		
	No	%	No	%	No	%	
20-30	13	8.3	1	0.5	1	0.7	<0.001[s]
31-40	23	14.7	9	4.6	21	14.2	
41-50	31	19.9	41	20.9	33	22.3	
51-60	42	26.9	70	35.7	51	34.5	
61-70	31	19.9	50	25.5	29	19.6	
71-80	16	10.3	20	10.2	10	6.8	
81-90	0	0.0	4	2.0	3	2.0	
Above 90	0	0.0	1	0.5	0	0.0	
Mean ±SD	52.51±14.55		58.73±11.12		54.47±11.65		
Overall n Mean±SD			55.53±12.70				

s-significant, Group-I: Individuals with UA. Group-II: Individuals with NSTE- ACS. Group-III: Individuals with STE- ACS

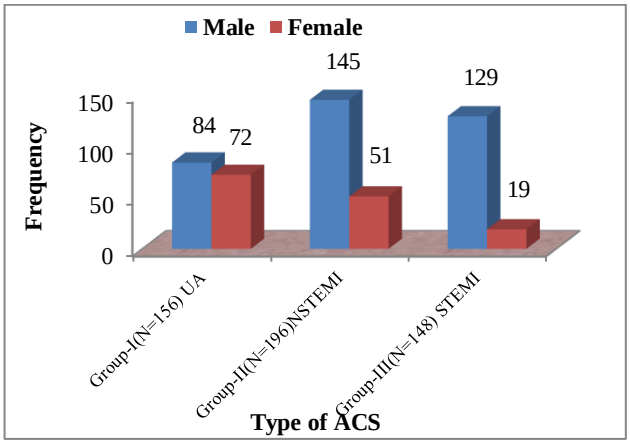

Figure 1: Sex distribution of the study population (n=500).

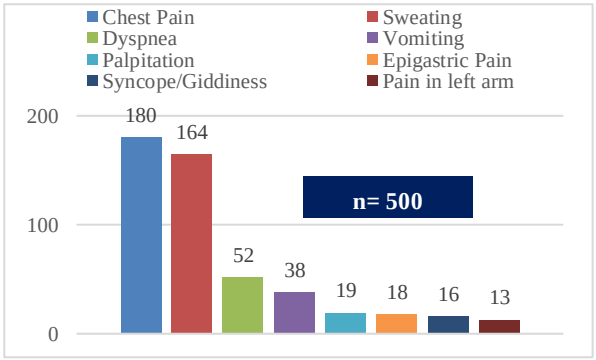

Figure 2: Presenting symptoms of the study population (n=500).

Anthropometric distribution (Table 2) of the study population shows that the individuals with UA were more obese than the other groups. Significant differences were found between different age groups.

Risk factor analysis table (Table 3) shows hypertension remained at the top of the table with 302 (60.4%) followed by dyslipidaemia 282 (56.4%), diabetes 231 (46.2%), Current smoker 161 (32.2%), positive family H/O CAD 101 (20.2%) and asthma 48 (9.6%). Except bronchial asthma statistical significance was seen in the risk factors among the study groups. Among the presenting complaints (Figure 2) of the study population chest pain topped the ranking with 36% (180).

Among other complaints sweating 32.8% (164), dyspnea 10.4% (52), vomiting 7.6% (38), palpitation 3.8% (19), epigastric pain 3.6% (18), syncope/ giddiness 3.2% (16) and pain in left arm 2.6% (13) were also in significant numbers.

Table 2: Anthropometric status of the study population (n=500).

Parameters	Group-I (n= 156)	Group-II (n= 196)	Group-III (n= 148)	p value
BMI	26.03±5.02	24.82±2.69	25.43±4.32	<0.021[s]
Mean ± SD	25.38±4.05			

Table 3: Risk factors analysis of the study population (n=500).

Risk factors		Type of ACS						p value
		Group-I (N=156)		Group-II (N=196)		Group-III (N=148)		
		Count	%	Count	%	Count	%	
Hypertension	No	72	46.2	59	30.1	67	45.3	<0.001[s]
	Yes	84	53.8	137	69.9	81	54.7	
Diabetes	No	106	67.9	85	43.4	78	52.7	<0.002[s]
	Yes	50	32.1	111	56.6	70	47.3	
FH of CAD	No	126	80.8	152	77.6	121	81.8	<0.589[ns]
	Yes	30	19.2	44	22.4	27	18.2	
Smoking	Non-smoker	130	83.3	130	66.3	60	40.5	<0.001[s]
	Smoker	19	12.2	61	31.1	81	54.7	
	Ex-smoker	7	4.5	5	2.6	7	4.7	
Dyslipidaemia	No	98	62.8	71	36.2	49	33.1	<0.001[s]
	Yes	58	37.2	125	63.8	99	66.9	
Bronchial Asthma	No	133	85.3	186	94.9	133	89.9	<0.009[s]
	Yes	23	14.7	10	5.1	15	10.1	

s means significant, ns means not significant

Table 4: ECG changes of the study population (n=500).

ECG Change	Type of ACS						p value
	Group-I (N=156)		Group-II (N=196)		Group-III (N=148)		
	Number	%	Number	%	Number	%	
Normal	128	82.1	44	22.4	0	0	<0.001[s]
ST depression	6	3.8	44	22.4	0	0	
T inversion	9	5.8	54	27.6	0	0	
AMI	0	0.0	0	0.0	148	100	
OMI	2	1.3	43	21.9	0	0	
BBB	4	2.6	7	3.6	0	0	
Others	7	4.5	4	2.0	0	0	

s means significant

Table 5: Cardiac biomarker profile of the study population (n=500).

Cardiac biomarker profile	Group-I (n=156)	Group-II (n=196)	Group-III (n=148)	p value
Troponin-I	0.30±1.32	14.76±17.16	20.57±20.73	<0.001[s]

s means significant

Table 6: LV ejection fraction of the study population (n=500).

Echo profile	Group-I (N=156)Mean±SD	Group-II(N=196)Mean±SD	Group-III(N=148)Mean±SD	p value
LVEF	61.69±7.83	45.08±8.38	40.72±7.39	<0.001[s]

s means significant

Table 7: Type of arrhythmia of the study population (n=500).

Type of arrhythmia	Group-I (n=156)	Group-II (n=196)	Group-III (n=148)	p value
No arrhythmia	96	33	32	
Sinus tachycardia	28	55	27	
Sinus bradycardia	16	56	29	
Atrial fibrillation	7	18	20	
SVE	1	14	9	
VE	4	11	11	<0.001[s]
AV block	1	2	8	
BBB	2	4	8	
NCT	0	1	1	
BCT	1	2	2	
SND	0	0	1	

s means significant

ECG changes of the study population (Table 4) shows majority in group-I and II had normal ECG. Then T-inversion and ST - depression were predominant. Statistical significance among the study population was observed in ECG changes. Table 5 shows the Troponin-I levels of the different study groups. It shows group-III topped the ranking with 20.57±20.73 followed by group-II with 14.76±17.16 and group-I having 0.30±1.32. They also showed statistically significant differences among them. Table 6 shows the left ventricular ejection fraction (LVEF) levels of the different study groups. It shows group-III had the worst left ventricular function with 40.72±7.39 followed by group-II having worse left ventricular function with 45.08±8.38. However, group-I having good left ventricular function with mean LVEF 61.69±7.83. They also showed statistically significant differences among them. Table 7 , among different types of arrhythmias 110 (22%) had sinus tachycardia, 101 (20.2%) exerted sinus bradycardia, 45 (9%) had atrial fibrillation, 26 (5.2%) showed ventricular ectopic, 24 (4.8%) had supra ventricular ectopic, 14 (2.8%) had bundle branch block, 11 (2.2%) had atrio-ventricular .block, 5 (1%) had broad complex tachycardia, 2 (0.4%) had narrow complex tachycardia, 1 (0.2%) had sinus node dysfunction and 161 (32.2%) did not have any arrhythmic episode. The bar chart also showed all arrhythmias are not prevalent in all types of ACS. Statistical significance observed between types of arrhythmias with different types of ACS.

Table 8: Regression analysis of the significant variables of the study population (n=500).

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.998	0.775		5.156	0.000
	Age of Patient	-0.005	0.002	-0.079	-2.467	0.014[s]
	Sex of Patient	-0.129	0.056	-0.075	-2.305	0.022[s]
	BMI of Patient	0.002	0.006	0.009	0.293	0.770
	Hypertension	0.020	0.048	0.013	0.419	0.676
	Diabetes	-0.139	0.072	-0.089	-1.947	0.052
	Smoking	0.056	0.044	0.041	1.278	0.202
	Dyslipidaemia	0.127	0.060	0.081	2.120	0.035[s]
	Bronchial asthma	0.084	0.075	0.031	1.123	0.262
	Creatinine	-0.034	0.018	-0.055	-1.912	0.056
	Troponin-I	0.009	0.001	0.203	6.800	0.000[s]
	ECG change	0.087	0.016	0.190	5.502	0.000[s]
	LVEF	-0.028	0.005	-0.429	-6.314	0.000[s]
	a. Dependent variable: Type of ACS					

s means significant

Table 9: Regression analysis of the significant variables of the study population (n=500).

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.291	0.187		12.274	0.000
	Troponin-I	0.008	0.001	0.179	5.478	0.000[s]
	LVEF	-0.034	0.003	-0.517	-11.715	0.000[s]
	a. Dependent Variable: Type of ACS					

s means significant

Table 10: Regression analysis of the significant variables of the study population (n=500).

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.024	0.625		0.039	0.969
	Age of Patient	0.003	0.002	0.072	1.783	0.075
	Sex of Patient	-0.029	0.045	-0.027	-0.654	0.513
	BMI of Patient	0.002	0.005	0.013	0.340	0.734
	Hypertension	0.111	0.039	0.109	2.852	0.005[s]
	Diabetes	-0.011	0.058	-0.011	-0.194	0.846
	Smoking	0.041	0.036	0.046	1.140	0.255
	Dyslipidaemia	-0.014	0.048	-0.014	-0.293	0.770
	Bronchial Asthma	-0.101	0.060	-0.059	-1.676	0.094
	Trop-I at 10 hrs	0.002	0.001	0.082	2.202	0.028[s]
	ECG Change	0.036	0.013	0.122	2.796	0.005[s]
	LVEF	0.019	0.004	0.439	5.150	0.000[s]
	a. Dependent variable: arrhythmia					

s means significant

Table 11: Regression analysis of the significant variables of the study population (n=500).

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.002	0.143		-0.016	0.987
	Troponin-I	0.003	0.001	0.093	2.368	0.018[s]
	LVEF	0.001	0.002	-0.510	0.-10.515	0.000[s]
	a. Dependent variable: arrhythmia					

s means significant

Tables (Table 8, 9, 10 and 11) shows the regression analysis of the statistically significant variables of the study population which depicted that among all significant study variables level of Troponin-I and LV ejection fraction were the most important variables for developing arrhythmias in different types of ACS.

Figure 3 show the correlation between unstable angina and extent of arrhythmia (n= 156). It shows statistically significant mild negative correlation with low strength of association- correlation coefficient between unstable angina and extent of arrhythmia (R2 = 0.0852**, p=<0.001**).

Figure 4 shows the correlation between NSTE-ACS and extent of arrhythmia (n= 196). It shows statistically significant mild negative correlation with low strength of association- correlation coefficient between NSTE-ACS and extent of arrhythmia (R2 = 0.015**, p=<0.001**).

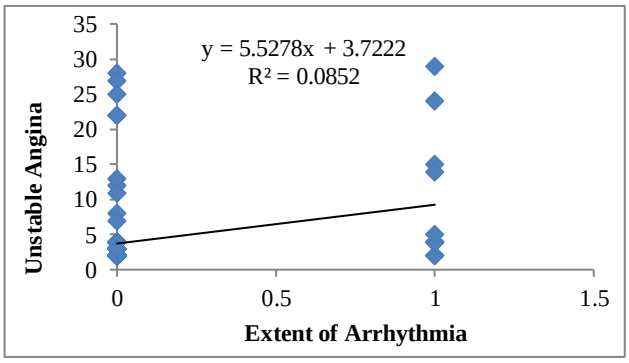

Figure 3: Correlation between unstable angina and extent of arrhythmia (n= 156).

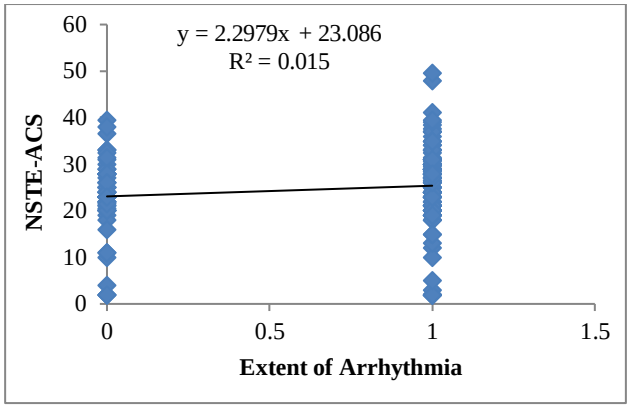

Figure 4: Correlation between NSTE-ACS and extent of arrhythmia (n=196).

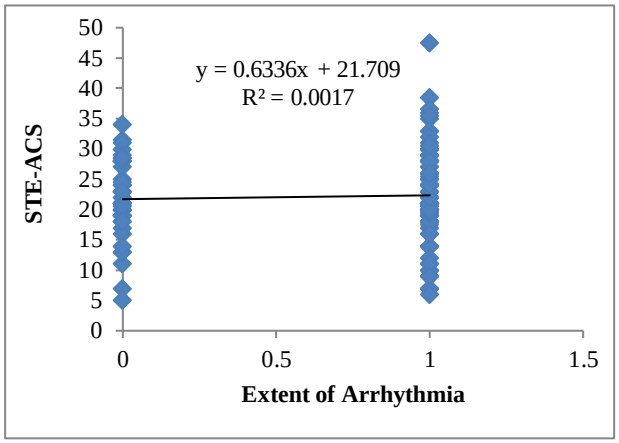

Figure 5: Correlation between STE-ACS and extent of arrhythmia (n=148).

Figure 5 shows the correlation between STE-ACS and extent of arrhythmia (n= 148). It shows statistically significant mild negative correlation with low strength of association- correlation coefficient between STE-ACS and extent of arrhythmia (R2 = 0.0017**, p=<0.001**).

DISCUSSION

Age and sex incidence

In this study the maximum incidence of ACS was in the age group of 41-70 years (75.6%) (Table 1). 13.6% of the cases were below 40 years of age. A study done in, Martin TC et al, showing incidence of 85% between ages 35 to 75 years compares well with our findings[7]. Incidence of ACS in males (Figure 1) was 71.6 % and female was 28.4 % which again compares well with the same study showing incidence of 74% in males and 24% in females.[7]

Risk factors

Incidence of diabetes was 46.2 % (Table 3) in our study compared to a study Svensson AM et al. (19%) which was higher and incidence of hypertension was 60.4% (Table III) which again was higher compared to a study Kokobo Y et al in.[8,9] These higher incidences can be attributable to poor life style of the people in Indian subcontinent.

Arrhythmias

In present study 20.2% (101 cases) of patients had sinus bradycardia (Table 7). The incidence of bradycardia varies from 15-19.4% in various studies.[10,11] In all the patients whoever had sinus bradycardia it was transient and by the end of the 1st day majority had normal sinus rhythm. Similar findings were there in Malla RR and Sayani A.[12]

Sinus tachycardia was observed in 22% of the cases. Same observation of anterior wall being commonly involved is shown by Crimm et al.[13] In present study APC was found in 4.8% of cases, AF in 9% and Narrow complex tachycardia including SVT in 0.4% of cases. Incidence of AF correlates with the finding of Novaro GM et al study where incidence of AF was 4.7-7.6%.[14]

In AV blocks the total incidence was 2.2 % compared to other studies like Majumder et al showing conduction disturbance almost 15%.[15] There were 2 cases of complete heart block in our study and the remaining was first- and second-degree AV blocks. This decreased incidence of conduction block and relative absence of complete heart block can be attributed to timely reperfusion therapy.

Similar was the case with BBB which showed total of 2.8% but lesser in compared to a study done by Perron and Sweeney, attributable to the institution of reperfusion therapy.[16] In most of the cases it was transient.

Ventricular arrhythmias were very common and incidences were VEs 5.2%, broad complex tachyarrhythmias in the form of idio-ventricular rhythm (AIVR), non-sustained VT (NSVT), sustained VT, VF and ventricular couplets with bigeminy in almost 1% of cases. Reperfusion arrhythmias mainly are AIVR, ventricular couplets, ventricular bigeminy, sinus bradycardia (which is already discussed).[17] Except sinus bradycardia all were of ventricular origin. In a study Tatli et al concluded non-sustained VT, AIVR, and frequent VE were the most frequently occurring reperfusion arrhythmias (RA) and that reperfusion arrhythmias are noninvasive indicators of myocardial cell damage.[18]

This Limitation of the Study was a single center study. By incorporating multiple centers will give more insight about the arrhythmias and their clinical significance.

CONCLUSION

Arrhythmias associated with ACS are common, and may be related to more complicated co-morbidities and more severe impairment of myocardium (identified by

significant level of Troponin-I and left ventricular ejection fraction levels), all of which indicated a feeble clinical status and leading to a poorer prognosis. The research team also came into inference that, sinus tachycardia was the most common form of arrhythmia than others and the incidences of arrhythmias are more prevalent in unstable angina and NSTE-ACS than STE-ACS. More attention should be paid to these patients to improve their treatment and prognosis.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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