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ANTIARRHYTHMIC MANAGEMENT OF ARRHYTHMIAS ASSOCIATED WITH PERCUTANEOUS CORONARY INTERVENTION: A RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Arrhythmias occurring before, during, or after percutaneous transluminal coronary angioplasty (PTCA) range from benign reperfusion rhythms to life-threatening ventricular arrhythmias. Evidence describing real-world antiarrhythmic selection and associated outcomes in these patients remains limited. This study evaluated the spectrum of peri-procedural arrhythmias, treatment choices, and in-hospital outcomes among patients undergoing PTCA.

Materials and Methods: This retrospective observational study included 243 adults who developed a documented peri-procedural arrhythmia while undergoing PTCA at a tertiary care centre. Demographic, clinical, angiographic, arrhythmic, therapeutic, and outcome data were extracted from hospital records. Successful initial control was defined as rhythm termination, restoration of sinus rhythm, adequate ventricular rate control, or haemodynamic improvement without immediate rescue therapy. Factors associated with major adverse in-hospital outcomes were assessed using multivariable logistic regression.

Results: The mean age was 58.6 ± 10.2 years; 175 (72.0%) patients were male, and 174 (71.6%) presented with ST-segment elevation myocardial infarction. Accelerated idioventricular rhythm was the most common arrhythmia, occurring in 62 (25.5%) patients, followed by atrial fibrillation/flutter in 45 (18.5%). Overall, 111 (45.7%) arrhythmias occurred intra-procedurally. Amiodarone was the most frequently used pharmacological agent, administered to 73 (46.8%) of 156 drug-treated patients. Successful initial control was achieved in 200 (82.3%) patients but was significantly lower in patients with sustained ventricular tachycardia/ventricular fibrillation, 30 (63.8%) ($p<0.001$). Major adverse in-hospital outcomes occurred in 24 (51.1%) patients with sustained ventricular tachycardia/ventricular fibrillation, including 10 (21.3%) deaths. Independent predictors of major adverse outcomes were sustained ventricular tachycardia/ventricular fibrillation (adjusted odds ratio [aOR]: 4.06; $p=0.001$), unsuccessful initial control (aOR: 3.47; $p=0.002$), and left ventricular ejection fraction <40% (aOR: 2.14; $p=0.042$).

Conclusion: Peri-procedural arrhythmias require rhythm-specific management. Benign reperfusion rhythms generally respond to conservative treatment, whereas sustained ventricular arrhythmias identify patients requiring immediate electrical therapy, intensive monitoring, and haemodynamic support.

Keywords: Antiarrhythmic drugs; arrhythmia; percutaneous coronary intervention; ventricular tachycardia; ventricular fibrillation.

INTRODUCTION

Percutaneous transluminal coronary angioplasty (PTCA), currently encompassed within percutaneous coronary intervention, is an established revascularisation procedure for patients with acute coronary syndromes and symptomatic coronary artery disease.[1] Although restoration of coronary blood flow reduces myocardial ischaemia and infarct size, the peri-procedural period remains electrically unstable.[2] Patients may develop premature ventricular complexes, accelerated idioventricular rhythm, atrial fibrillation, supraventricular tachycardia, ventricular tachycardia, ventricular fibrillation or atrioventricular conduction block.[1,2] These arrhythmias may result from acute myocardial ischaemia, reperfusion injury, electrolyte disturbances, autonomic activation, left ventricular dysfunction or mechanical stimulation during catheter and guidewire manipulation.[2]

The clinical significance of peri-PTCA arrhythmias varies according to their type, duration, timing and haemodynamic consequences.[3] Transient reperfusion arrhythmias are often self-limiting, whereas sustained ventricular arrhythmias may cause haemodynamic collapse, cardiac arrest and death.[4] Ventricular tachycardia or ventricular fibrillation has been reported in approximately 5%–9% of patients with ST-segment elevation myocardial infarction undergoing primary PCI and is associated with increased short-term mortality.[3,4] Atrial fibrillation is also frequently encountered in acute myocardial infarction and may worsen cardiac output, increase thromboembolic risk and complicate post-procedural management.[2]

Management primarily involves correction of reversible factors, including ongoing ischaemia, hypoxaemia, acidosis and potassium or magnesium abnormalities.[5] Electrical cardioversion or defibrillation is indicated for haemodynamically unstable tachyarrhythmias, while antiarrhythmic drugs are used for stable arrhythmias, recurrent episodes or as adjuncts to electrical therapy.[5] Commonly used agents include amiodarone, lidocaine, beta-blockers, adenosine, procainamide and magnesium sulphate. Drug selection depends on the arrhythmia mechanism, ventricular function, blood pressure, QT interval, comorbidities and potential adverse effects. Certain drugs may cause hypotension, bradycardia, conduction disturbances or proarrhythmia, particularly in patients with structural heart disease.[6,7]

Despite guideline recommendations, limited real-world evidence is available regarding antiarrhythmic prescribing patterns across different arrhythmias occurring during PTCA and their relationship with clinical outcomes.[8,9,10] Therefore, this study aimed to evaluate the choice of antiarrhythmic drugs used for various arrhythmias encountered in patients undergoing PTCA and to assess the associated clinical outcomes.

MATERIALS AND METHODS

Study Design and Setting

This retrospective observational study was conducted in the Department of Cardiology at a tertiary care teaching hospital located in North India. The medical records of patients who underwent percutaneous transluminal coronary angioplasty (PTCA), currently referred to as percutaneous coronary intervention, over a period of 2 years between June 2022 and May 2024 were reviewed. The study evaluated the spectrum of arrhythmias encountered during the peri-procedural period, the antiarrhythmic drugs used for their management, and the associated in-hospital clinical outcomes.

Study Population

All consecutive patients aged ≥18 years who underwent elective, urgent, or emergency PTCA during the study period were screened. Patients were included when they developed at least one clinically documented arrhythmia during the defined peri-procedural period and received pharmacological or electrical treatment. Arrhythmia was considered documented when confirmed by a 12-lead electrocardiogram, rhythm strip, cardiac monitor recording, catheterisation laboratory record, or cardiologist's clinical documentation. Patients undergoing diagnostic coronary angiography without balloon angioplasty or stent implantation were excluded. Patients with incomplete records regarding arrhythmia type, treatment, or outcome; isolated premature complexes not requiring treatment; electrolyte-related rhythm disturbances resolving solely after electrolyte correction; and patients transferred before outcome assessment were also excluded. All eligible records 243 were included through consecutive sampling. Because this was a retrospective study involving all available cases during the study period, no formal sample size calculation was performed.

Data Collection

Data were extracted from inpatient files, electronic health records, catheterisation laboratory registers, coronary care unit charts, electrocardiograms, medication sheets, procedure notes, and discharge summaries using a predefined data collection form. Baseline variables included age, sex, clinical presentation, smoking status, hypertension, diabetes mellitus, dyslipidaemia, chronic kidney disease, previous myocardial infarction, previous PTCA, and prior arrhythmia. Admission diagnosis was categorised as ST-segment elevation myocardial infarction, non-ST-segment elevation myocardial infarction, unstable angina, or chronic coronary syndrome. Heart rate, systolic and diastolic blood pressure, serum potassium, magnesium, creatinine, cardiac biomarkers, and left ventricular ejection fraction were recorded. Angiographic variables included the culprit coronary artery, number of diseased vessels, number of vessels treated, stent deployment, pre- and post-procedural Thrombolysis

in Myocardial Infarction flow grade, and procedural complications such as no-reflow, coronary dissection, acute vessel closure, or cardiogenic shock.

Classification of Arrhythmias

Arrhythmias were classified as atrial fibrillation, atrial flutter, supraventricular tachycardia, sustained ventricular tachycardia, non-sustained ventricular tachycardia, ventricular fibrillation, accelerated idioventricular rhythm, symptomatic sinus bradycardia, or second- or third-degree atrioventricular block. Sustained ventricular tachycardia was defined as ventricular tachycardia lasting ≥30 seconds or requiring earlier termination because of haemodynamic instability. Non-sustained ventricular tachycardia was defined as three or more consecutive ventricular beats lasting <30 seconds. Atrial fibrillation was defined as an irregular rhythm without discrete P waves lasting ≥30 seconds. Haemodynamic instability was defined as systolic blood pressure <90 mmHg, altered sensorium, ongoing ischaemic chest pain, acute pulmonary oedema, cardiogenic shock, or cardiac arrest. Arrhythmias were categorised according to timing as pre-procedural, occurring within 24 hours before PTCA; intra-procedural, occurring from catheter insertion until removal of the arterial sheath; or post-procedural, occurring after completion of PTCA within the defined observation period. When multiple episodes occurred, the first clinically significant episode was considered the index arrhythmia, while recurrent episodes were recorded separately.

Assessment of Treatment

For each arrhythmia, the initial antiarrhythmic drug, dose, route, repeat dosing, additional medication, and duration of treatment were recorded. Drugs evaluated included intravenous or oral amiodarone, lidocaine, adenosine, beta-blockers, digoxin, diltiazem, verapamil, procainamide, and magnesium sulphate. Atropine was recorded for symptomatic bradyarrhythmias. Electrolyte replacement alone was not classified as antiarrhythmic therapy.

The use of synchronised cardioversion, defibrillation, temporary transvenous pacing, cardiopulmonary resuscitation, vasopressors, and mechanical ventilation was also documented. When more than one drug was administered, the first agent was classified as initial therapy and subsequent agents as rescue therapy.

Outcome Measures

The primary outcome was successful arrhythmia control. For tachyarrhythmias, success was defined as conversion to sinus rhythm or achievement of a ventricular rate <100 beats/min within six hours without rescue treatment. For ventricular tachycardia or ventricular fibrillation, success was defined as termination of the arrhythmia with maintenance of an organised rhythm for at least 30 minutes. For bradyarrhythmias, success was defined as improvement in heart rate and haemodynamic status without temporary pacing. Secondary outcomes included arrhythmia recurrence within 24 hours, requirement for rescue antiarrhythmic therapy, electrical cardioversion, defibrillation, temporary pacemaker insertion, hypotension, acute heart failure, cardiogenic shock, cardiac arrest, length of hospital stay, and in-hospital mortality. Documented drug-related hypotension, bradycardia, QT prolongation, atrioventricular block, or proarrhythmia was recorded.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences, version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation or median with interquartile range, depending on data distribution. Categorical variables were expressed as frequencies and percentages. Normality was assessed using the Shapiro–Wilk test. Continuous variables were compared using the independent Student's *t*-test, Mann–Whitney *U* test, one-way analysis of variance, or Kruskal–Wallis test, as appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test. Associations between arrhythmia type, antiarrhythmic drug selection, and clinical outcome were evaluated using appropriate statistical tests. Multivariable logistic regression was performed, where feasible, to identify independent predictors of unsuccessful rhythm control or adverse in-hospital outcome. Adjusted odds ratios with 95% confidence intervals were reported. A two-sided *p*-value <0.05 was considered statistically significant.

RESULTS

The mean age of the participants was 58.6 ± 10.2 years, with most patients belonging to the age groups of 50–59 years, 78 (32.1%), and 60–69 years, 80 (32.9%). Males constituted 175 (72.0%) of the study population. ST-segment elevation myocardial infarction was the most common clinical presentation, observed in 174 (71.6%) patients, followed by non-ST-segment elevation myocardial infarction in 43 (17.7%). Dyslipidaemia, hypertension, and diabetes mellitus were present in 111 (45.7%), 105 (43.2%), and 97 (39.9%) patients, respectively. The mean left ventricular ejection fraction was 42.9 ± 9.3%, and 93 (38.3%) patients had an ejection fraction below 40%. Primary percutaneous coronary intervention was performed in 132 (54.3%) patients. The left anterior descending artery was the most frequently treated vessel, 118 (48.6%), while post-procedural TIMI grade 3 flow was achieved in 225 (92.6%) patients. No-reflow or slow-flow was documented in 19 (7.8%) patients. [Table 1]

Table 1: Baseline Demographic, Clinical, and Angiographic Characteristics of Participants Undergoing PTCA Who Developed Peri-procedural Arrhythmias (N=243)

Characteristic	Frequency (%)/mean ± SD
Age (years)	58.6 ± 10.2
Age group	
<50 years	53 (21.8%)
50–59 years	78 (32.1%)
60–69 years	80 (32.9%)
≥70 years	32 (13.2%)
Gender	
Male	175 (72.0%)
Female	68 (28.0%)
Clinical presentation	
STEMI	174 (71.6%)
NSTEMI	43 (17.7%)
Unstable angina/chronic coronary syndrome	26 (10.7%)
Cardiovascular risk factors/comorbidities	
Hypertension	105 (43.2%)
Diabetes mellitus	97 (39.9%)
Dyslipidaemia	111 (45.7%)
Current or former smoking	81 (33.3%)
Chronic kidney disease	15 (6.2%)
Previous myocardial infarction	41 (16.9%)
Left ventricular ejection fraction (%)	42.9 ± 9.3
LVEF <40%	93 (38.3%)
PTCA strategy	
Primary PCI	132 (54.3%)
Pharmaco-invasive/rescue PCI	42 (17.3%)
Urgent or elective PCI	69 (28.4%)
Culprit/treated coronary artery	
Left anterior descending artery	118 (48.6%)
Right coronary artery	77 (31.7%)
Left circumflex artery	36 (14.8%)
Left main coronary artery	12 (4.9%)
Extent of coronary artery disease	
Single-vessel disease	104 (42.8%)
Double-vessel disease	86 (35.4%)
Triple-vessel/left main disease	53 (21.8%)
Post-procedural TIMI grade 3 flow	225 (92.6%)
No-reflow or slow-flow phenomenon	19 (7.8%)
Drug-eluting stent deployment	238 (97.9%)

LVEF: left ventricular ejection fraction; NSTEMI: non-ST-segment elevation myocardial infarction; PCI: percutaneous coronary intervention; PTCA: percutaneous transluminal coronary angioplasty; STEMI: ST-segment elevation myocardial infarction; TIMI: Thrombolysis in Myocardial Infarction.

Accelerated idioventricular rhythm was the most frequently encountered index arrhythmia, occurring in 62 (25.5%) patients, followed by atrial fibrillation or flutter in 45 (18.5%), non-sustained ventricular tachycardia in 39 (16.0%), sustained ventricular tachycardia in 26 (10.7%), and ventricular fibrillation in 21 (8.6%). Overall, 111 (45.7%) arrhythmias occurred intra-procedurally, 89 (36.6%) occurred after the procedure, and 43 (17.7%) were recorded before PTCA. Accelerated idioventricular rhythm was predominantly intra-procedural, 42 (67.7%), whereas atrial fibrillation or flutter was most commonly post-procedural, 22 (48.9%). Ventricular fibrillation was also predominantly observed during PTCA, 12 (57.1%). The timing of arrhythmia occurrence differed significantly according to arrhythmia type (p=0.002). [Table 2]

Table 2: Distribution and Timing of Index Arrhythmias Encountered During the Peri-procedural PTCA Period (N=243)

Index arrhythmia	Total (n=243)	Pre-procedural (n=43)	Intra-procedural (n=111)	Post-procedural (n=89)
	Frequency (%)			
Accelerated idioventricular rhythm	62 (25.5%)	3 (4.8%)	42 (67.7%)	17 (27.4%)
Atrial fibrillation/flutter	45 (18.5%)	14 (31.1%)	9 (20.0%)	22 (48.9%)
Non-sustained ventricular tachycardia	39 (16.0%)	7 (17.9%)	18 (46.2%)	14 (35.9%)
Sustained ventricular tachycardia	26 (10.7%)	4 (15.4%)	11 (42.3%)	11 (42.3%)
Ventricular fibrillation	21 (8.6%)	2 (9.5%)	12 (57.1%)	7 (33.3%)
Supraventricular tachycardia	18 (7.4%)	5 (27.8%)	5 (27.8%)	8 (44.4%)
Symptomatic sinus bradycardia	17 (7.0%)	3 (17.6%)	8 (47.1%)	6 (35.3%)
High-grade atrioventricular block	15 (6.2%)	5 (33.3%)	6 (40.0%)	4 (26.7%)

Pre-procedural arrhythmia was defined as occurrence within 24 hours before PTCA; intra-procedural arrhythmia as occurrence from catheter insertion until completion of the procedure; and post-procedural arrhythmia as occurrence after completion of PTCA during the defined monitoring period.

Initial management varied significantly according to the type of arrhythmia ($p<0.001$). Most patients with accelerated idioventricular rhythm were managed conservatively with observation or electrolyte correction, 54 (87.1%), and successful initial control was achieved in 58 (93.5%). Amiodarone was the most frequently used initial agent for atrial fibrillation or flutter, 25 (55.6%), non-sustained ventricular tachycardia, 18 (46.2%), and sustained ventricular tachycardia, 14 (53.8%). Adenosine was administered in 12 (66.7%) patients with supraventricular tachycardia, with successful control in 17 (94.4%) patients overall. Defibrillation combined with amiodarone was used in 14 (66.7%) patients with ventricular fibrillation. Overall, successful initial arrhythmia control was achieved in 200 (82.3%) patients. Treatment success differed significantly among the individual arrhythmia types ($p=0.002$), with the lowest success observed in ventricular fibrillation, 12 (57.1%), and sustained ventricular tachycardia, 18 (69.2%). [Table 3]

Table 3: Initial Management Selected for Different Index Arrhythmias and Immediate Treatment Success (N=243)

Index arrhythmia	Initial management	Successful initial control
	Frequency (%)	
Accelerated idioventricular rhythm (n=62)	Observation/electrolyte correction: 54 (87.1%)	58 (93.5%)
	Atropine: 6 (9.7%)	
	Temporary pacing: 2 (3.2%)	
Atrial fibrillation/flutter (n=45)	Amiodarone: 25 (55.6%)	38 (84.4%)
	Beta-blocker: 12 (26.7%)	
	Diltiazem: 5 (11.1%)	
	Synchronised cardioversion: 3 (6.7%)	
Non-sustained ventricular tachycardia (n=39)	Amiodarone: 18 (46.2%)	34 (87.2%)
	Lidocaine: 12 (30.8%)	
	Beta-blocker: 7 (17.9%)	
	Observation/electrolyte correction: 2 (5.1%)	
Sustained ventricular tachycardia (n=26)	Amiodarone: 14 (53.8%)	18 (69.2%)
	Synchronised cardioversion: 7 (26.9%)	
	Lidocaine: 5 (19.2%)	
Ventricular fibrillation (n=21)	Defibrillation plus amiodarone: 14 (66.7%)	12 (57.1%)
	Defibrillation plus lidocaine: 4 (19.0%)	
	Defibrillation alone: 3 (14.3%)	
Supraventricular tachycardia (n=18)	Adenosine: 12 (66.7%)	17 (94.4%)
	Beta-blocker: 3 (16.7%)	
	Amiodarone: 2 (11.1%)	
	Synchronised cardioversion: 1 (5.6%)	
Symptomatic sinus bradycardia (n=17)	Atropine: 12 (70.6%)	13 (76.5%)
	Temporary pacing: 5 (29.4%)	
High-grade atrioventricular block (n=15)	Temporary pacing: 10 (66.7%)	10 (66.7%)
	Atropine: 5 (33.3%)	
Overall (N=243)	—	200 (82.3%)

Successful initial control was defined as termination of the arrhythmia, restoration of sinus rhythm, achievement of adequate ventricular rate control, or haemodynamic improvement without immediate rescue medication or additional electrical intervention.

Among the 156 participants who received pharmacological treatment, amiodarone was the most frequently used drug, administered to 73 (46.8%) patients, followed by atropine in 23 (14.7%), beta-blockers in 22 (14.1%), and lidocaine in 21 (13.5%). Successful initial control was achieved in 55 (75.3%) patients treated with amiodarone, 16 (76.2%) treated with lidocaine, 19 (86.4%) treated with beta-blockers, and all 12 (100%) patients receiving adenosine. Recurrence was most frequently observed among patients receiving lidocaine, 6 (28.6%), and amiodarone, 19 (26.0%), reflecting their greater use in severe ventricular arrhythmias. Documented adverse drug reactions occurred in 20 (12.8%) patients overall and were most frequent with amiodarone, 11 (15.1%). There was no statistically significant difference in initial treatment success ($p=0.458$) or adverse drug reactions ($p=0.930$) among the pharmacological agents. [Table 4]

Table 4: Utilisation, Treatment Response, and Documented Adverse Effects of Pharmacological Agents Among Drug-treated Participants (n=156)

Drug	Principal indications	Participants treated	Successful initial control	Recurrence	Rescue treatment required	Documented adverse drug reaction
	Frequency (%)					
Amiodarone	AF/flutter: 25; NSVT: 18; sustained VT: 14; VF: 14; SVT: 2	73 (46.8%)	55 (75.3%)	19 (26.0%)	24 (32.9%)	11 (15.1%)
Lidocaine	NSVT: 12; sustained VT: 5; VF: 4	21 (13.5%)	16 (76.2%)	6 (28.6%)	7 (33.3%)	2 (9.5%)
Beta-blocker	AF/flutter: 12; NSVT: 7; SVT: 3	22 (14.1%)	19 (86.4%)	3 (13.6%)	0 (0.0%)	3 (13.6%)
Adenosine	SVT: 12	12 (7.7%)	12 (100%)	0 (0.0%)	0 (0.0%)	1 (8.3%)
Diltiazem	AF/flutter: 5	5 (3.2%)	4 (80.0%)	0 (0.0%)	1 (20.0%)	1 (20.0%)
Atropine	Sinus bradycardia: 12; AIVR: 6; high-grade AV block: 5	23 (14.7%)	18 (78.3%)	3 (13.0%)	3 (13.0%)	2 (8.7%)
Total	—	156 (100%)	124 (79.5%)	31 (19.9%)	35 (22.4%)	20 (12.8%)

AF: atrial fibrillation; AIVR: accelerated idioventricular rhythm; AV: atrioventricular; NSVT: non-sustained ventricular tachycardia; SVT: supraventricular tachycardia; VF: ventricular fibrillation; VT: ventricular tachycardia. Amiodarone and lidocaine use included administration as adjunctive therapy with defibrillation in ventricular fibrillation. Direct comparisons between drugs should be interpreted cautiously because of confounding by indication.

Successful initial control was highest among patients with reperfusion or non-sustained ventricular arrhythmias, 92 (91.1%), and supraventricular arrhythmias, 55 (87.3%), but was significantly lower among patients with sustained ventricular tachycardia or ventricular fibrillation, 30 (63.8%) ($p<0.001$). Patients with sustained ventricular tachycardia or ventricular fibrillation also had the highest rates of arrhythmia recurrence, 18 (38.3%), rescue treatment requirement, 25 (53.2%), cardiogenic shock, 20 (42.6%), acute heart failure, 15 (31.9%), and cardiac arrest, 16 (34.0%) (all $p\leq0.002$). Major adverse in-hospital outcomes occurred in 24 (51.1%) patients with sustained ventricular tachycardia or ventricular fibrillation compared with 11 (17.5%) with supraventricular arrhythmias and 11 (10.9%) with reperfusion or non-sustained ventricular arrhythmias ($p<0.001$). In-hospital mortality was also highest in the sustained ventricular tachycardia or ventricular fibrillation group, 10 (21.3%) ($p<0.001$). The mean hospital stay was longest in this group at 6.0 ± 1.6 days ($p<0.001$). [Table 5]

Table 5: Treatment Response and In-hospital Clinical Outcomes According to Arrhythmia Category (N=243)

Outcome	Supraventricular arrhythmias (n=63)	Reperfusion/ non-sustained ventricular arrhythmias (n=101)	Sustained VT/VF (n=47)	Bradyarrhythmias/ conduction block (n=32)	p-value
Successful initial control	55 (87.3%)	92 (91.1%)	30 (63.8%)	23 (71.9%)	<0.001
Arrhythmia recurrence	9 (14.3%)	8 (7.9%)	18 (38.3%)	3 (9.4%)	<0.001
Rescue treatment required	6 (9.5%)	9 (8.9%)	25 (53.2%)	3 (9.4%)	<0.001
Cardiogenic shock	4 (6.3%)	4 (4.0%)	20 (42.6%)	3 (9.4%)	<0.001
Acute heart failure	9 (14.3%)	8 (7.9%)	15 (31.9%)	4 (12.5%)	0.002
Cardiac arrest	0 (0.0%)	1 (1.0%)	16 (34.0%)	3 (9.4%)	<0.001
Major adverse in-hospital outcome	11 (17.5%)	11 (10.9%)	24 (51.1%)	9 (28.1%)	<0.001
In-hospital mortality	1 (1.6%)	1 (1.0%)	10 (21.3%)	2 (6.3%)	<0.001
Duration of hospital stay (days)	4.9 ± 1.4	4.7 ± 1.5	6.0 ± 1.6	5.2 ± 1.3	<0.001

Major adverse in-hospital outcome was defined as the occurrence of at least one of the following: cardiogenic shock, acute heart failure, cardiac arrest, or in-hospital death. Supraventricular arrhythmias included atrial fibrillation/flutter and supraventricular tachycardia; reperfusion/non-sustained ventricular arrhythmias included accelerated idioventricular rhythm and non-sustained ventricular tachycardia. Categorical variables were compared using the chi-square test or Fisher's exact test, and duration of hospital stay was compared using the Kruskal–Wallis test. VF, ventricular fibrillation; VT, ventricular tachycardia.

On univariable analysis, left ventricular ejection fraction below 40%, sustained ventricular tachycardia or ventricular fibrillation, and unsuccessful initial arrhythmia control were significantly associated with major adverse in-hospital outcomes. After adjustment for age, clinical presentation, ventricular function, arrhythmia type, timing, and initial treatment response, sustained ventricular tachycardia or ventricular fibrillation remained the strongest independent predictor of an adverse outcome (adjusted odds ratio [aOR]: 4.06; 95% confidence interval [CI]: 1.84–8.94; p=0.001). Unsuccessful initial arrhythmia control was associated with more than threefold higher odds of an adverse outcome (aOR: 3.47; 95% CI: 1.55–7.76; p=0.002). An LVEF below 40% was also independently associated with adverse outcomes (aOR: 2.14; 95% CI: 1.03–4.46; p=0.042). Age ≥65 years, STEMI presentation, and post-procedural timing of arrhythmia were not independently significant predictors. [Table 6]

Table 6: Univariable and Multivariable Logistic Regression Analysis of Factors Associated with a Major Adverse In-hospital Outcome (N=243)

Predictor	Univariable OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age ≥65 years	1.34 (0.69–2.60)	0.382	1.37 (0.65–2.90)	0.407
STEMI presentation	0.85 (0.44–1.65)	0.638	0.58 (0.28–1.23)	0.159
LVEF <40%	4.35 (2.30–8.23)	<0.001	2.14 (1.03–4.46)	0.042
Sustained VT or VF	5.55 (2.79–11.06)	<0.001	4.06 (1.84–8.94)	0.001
Post-procedural arrhythmia	1.78 (0.97–3.27)	0.062	1.44 (0.72–2.91)	0.305
Unsuccessful initial arrhythmia control	6.04 (2.97–12.26)	<0.001	3.47 (1.55–7.76)	0.002

Binary logistic regression was performed with major adverse in-hospital outcome as the dependent variable. The model was simultaneously adjusted for all variables displayed. Results are expressed as odds ratios with 95% confidence intervals. CI: confidence interval; LVEF: left ventricular ejection fraction; OR: odds ratio; STEMI: ST-segment elevation myocardial infarction; VF: ventricular fibrillation; VT: ventricular tachycardia. Model McFadden pseudo-R^2=0.185.

DISCUSSION

The present study evaluated the pattern, management, and clinical implications of peri-procedural arrhythmias among 243 patients undergoing percutaneous transluminal coronary angioplasty. The study population was predominantly male (72.0%), with a mean age of 58.6 ± 10.2 years, and ST-segment elevation myocardial infarction was the principal presentation (71.6%). Hypertension, diabetes mellitus, and dyslipidaemia were frequent, while 38.3% of patients had a left ventricular ejection fraction (LVEF) below 40%, indicating a substantial burden of myocardial dysfunction. A comparable Indian primary-PCI registry by Subbu et al., reported a mean age of 52 years, 86.7% male participants, hypertension in 40.9%, and diabetes in 50.0%.[11] The achievement of post-procedural TIMI grade 3 flow in 92.6% of the present cohort indicated generally successful epicardial reperfusion; however, no-reflow or slow-flow in 7.8% may have promoted electrical instability through persistent microvascular ischaemia, heterogeneous repolarisation, and catecholaminergic activation.[12]

Accelerated idioventricular rhythm (AIVR) was the most frequent index arrhythmia, occurring in 25.5% of patients, and was predominantly intra-procedural (67.7%). This finding is consistent with its recognised association with myocardial reperfusion.[13] In a study by Shah et al., of acute myocardial infarction patients undergoing primary PCI, AIVR was also the most frequently observed arrhythmia, accounting for 37.3% of rhythm disturbances.[14] More recent data by Wu et al., reported AIVR in 18.9% of patients with reperfusion-related ventricular arrhythmias.[15] Sudden restoration of coronary flow alters potassium and calcium gradients, autonomic tone, and automaticity within injured Purkinje fibres, producing a transient ventricular rhythm. Accordingly, 87.1% of patients with AIVR were managed by observation or electrolyte correction, and 93.5% achieved successful control. This supports conservative management because AIVR is generally self-limiting and does not routinely require antiarrhythmic suppression.[16]

Atrial fibrillation or flutter represented 18.5% of arrhythmias and occurred most frequently after PTCA. This proportion was higher than the 6.1% incidence of new-onset atrial fibrillation reported among 1,603 STEMI patients undergoing primary PCI.[17] The difference may be explained by the present study's inclusion of only arrhythmia-positive patients and the probable inclusion of both pre-existing and newly developed atrial fibrillation.[18] Post-infarction atrial fibrillation may arise from raised atrial pressure, ventricular dysfunction, atrial

ischaemia, systemic inflammation, and sympathetic activation. Amiodarone was used in 55.6% of these patients, followed by beta-blockers in 26.7%, and successful initial control was achieved in 84.4%. The HORIZONS-AMI analysis demonstrated by Rene et al., that new-onset atrial fibrillation following primary PCI was associated with higher three-year mortality, reinfarction, stroke, and major bleeding, confirming that it is an important prognostic marker rather than a benign transient event.[19]

Amiodarone was the most frequently used pharmacological agent overall, administered to 46.8% of drug-treated patients. Its frequent selection may reflect its broad effectiveness against atrial and ventricular tachyarrhythmias and its relative suitability in patients with structural heart disease or impaired ventricular function.[20] Adenosine achieved successful initial control in all 12 patients treated for supraventricular tachycardia, although this finding should be interpreted cautiously because of the small subgroup. No significant differences were observed among drugs in initial treatment success (p=0.458) or adverse reactions (p=0.930).[21,22] These findings do not establish therapeutic equivalence because amiodarone and lidocaine were preferentially administered to patients with more severe ventricular arrhythmias. This confounding by indication is particularly relevant because the PROCAMIO trial by Ortiz et al., found intravenous procainamide to be more effective and associated with fewer major adverse cardiac events than amiodarone for haemodynamically tolerated monomorphic wide-QRS tachycardia.[8]

The poorest outcomes were observed among patients with sustained ventricular tachycardia or ventricular fibrillation. Successful initial control was achieved in only 63.8%, while recurrence, cardiogenic shock, cardiac arrest, and in-hospital mortality occurred in 38.3%, 42.6%, 34.0%, and 21.3%, respectively. Mehta et al., reported VT/VF in 5.7% of STEMI patients undergoing primary PCI and demonstrated a marked increase in 90-day mortality.[3] Similarly, a contemporary cohort of 174,126 patients by Rymer et al., found late VT/VF in 2.4%, with a strong association between late ventricular arrhythmias and in-hospital death.[4] Sustained VT/VF likely reflects extensive myocardial injury, persistent ischaemia, impaired microvascular reperfusion, and reduced haemodynamic reserve rather than an isolated electrical abnormality.[23,24]

Multivariable analysis further demonstrated that sustained VT/VF was the strongest independent predictor of a major adverse in-hospital outcome (adjusted odds ratio [aOR]: 4.06), followed by unsuccessful initial arrhythmia control (aOR: 3.47) and LVEF <40% (aOR: 2.14). Reduced LVEF promotes arrhythmogenesis through myocardial scar, slowed conduction, dispersion of refractoriness, and diminished tolerance of rapid ventricular rates.[25,26]

Limitations: This study has several limitations. Its retrospective, single-centre design restricts causal inference and may limit generalisability. Reliance on medical records may have resulted in incomplete documentation of arrhythmia duration, drug dose, recurrence, and adverse effects. Treatment selection was clinician-dependent, introducing confounding by indication. The study evaluated only in-hospital outcomes and did not assess long-term recurrence, rehospitalisation, mortality, or post-discharge antiarrhythmic use.

CONCLUSION

Peri-procedural arrhythmias among patients undergoing PTCA showed marked variation in frequency, treatment, and clinical outcome. Accelerated idioventricular rhythm was the most common and generally responded to conservative management, whereas sustained ventricular tachycardia and ventricular fibrillation were associated with poor initial control, frequent recurrence, cardiogenic shock, cardiac arrest, and higher mortality. Amiodarone was the most frequently used antiarrhythmic drug, although apparent drug-response differences were influenced by arrhythmia severity. Reduced left ventricular ejection fraction, sustained ventricular arrhythmias, and unsuccessful initial control independently predicted adverse in-hospital outcomes. These findings support rhythm-specific treatment, early electrical intervention for unstable arrhythmias, and intensified monitoring of high-risk patients.

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