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INCIDENCE OF IN-HOSPITAL GASTROINTESTINAL BLEEDING IN ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION (STEMI) & NSTEMI PATIENTS, UNDERGOING PERCUTANEOUS CORONARY INTERVENTION

Abiha Urooj[*1], Sumaira Fareed Khan[2], Saher Ali[3], Reema Ashok[4], Sana Mehboob[5], Rabia Ramzan[6], Kaveeta Lohana[7], Shagufta Kanwal[8], Bibi Kiran[9], Fawad Farooq[10]

[*1,2,3,4,5,6,7,8,9,10]*National Institute of Cardiovascular Disease (NICVD), Karachi*

[*1]abihaurooj427@gmail.com, [2]dr.sumaira7@gmail.com, [3]saherali276@gmail.com, [4]dholia.dr@gmail.com, [5]doctersanamehboob9@gmail.com, [6]rabianatha@gmail.com, [7]drkavi92@gmail.com, [8]drshaguftaismail@gmail.com, [9]kiransyed1990@gmail.com, [10]drfawadfarooq@yahoo.com

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Corresponding Author: *
Abiha Urooj

Abstract

OBJECTIVE: *To determine the frequency of in-hospital gastrointestinal bleeding in ST-segment Elevation Myocardial Infarction (STEMI) and NSTEMI patients, undergoing percutaneous coronary intervention.*

METHODOLOGY: *This descriptive cross-sectional research is scheduled for execution in 2024 within the Adult Cardiology Department of National Institute of Cardiovascular Diseases, Karachi, with an enrollment of 247 patients diagnosed with ST-segment elevation myocardial infarction (STEMI) who underwent primary percutaneous coronary intervention (PCI) within 24 hours of symptom onset. Eligible participants, aged between 45 and 70 years, irrespective of gender, will be incorporated for the objective of assessing the primary outcome. The dataset shall undergo meticulous analysis employing SPSS version 26, which will integrate both descriptive statistical techniques and the Chi-square test for thorough evaluation.*

RESULTS: *Among a cohort of 247 patients undergoing percutaneous coronary intervention (PCI), the average age was recorded at 62.17 ± 7.68 years, with 181 individuals (73.3%) identified as male. A diagnosis of ST-elevation myocardial infarction (STEMI) was established in 185 patients (74.9%), whereas non-ST-elevation myocardial infarction (NSTEMI) was diagnosed in 62 patients (25.1%). The incidence of gastrointestinal bleeding was observed in 20 patients (8.09%), with 14 (70%) originating from the STEMI cohort and 6 (30%) from the NSTEMI cohort. Gastrointestinal bleeding (GIB) demonstrated a significant correlation with cardiogenic shock (25.0%, p=0.0001), the necessity for circulatory support (20.0%, p=0.002), and mortality rates (25.0%, p=0.0001).*

CONCLUSION: *This study highlights that gastrointestinal hemorrhage represents a considerable in-hospital complication for patients diagnosed with ST-Elevation Myocardial Infarction (STEMI) and Non-ST-Elevation Myocardial Infarction (NSTEMI) who undergo percutaneous coronary intervention. The findings emphasize the clinical significance of identifying individuals at heightened*

risk, particularly those demonstrating hemodynamic instability, to enable the execution of timely preventative measures. Enhanced risk stratification and proactive management are essential to alleviate gastrointestinal complications and improve short-term clinical outcomes within this patient population.

INTRODUCTION

Ischaemic heart disease (IHD) remains one of the leading cause of mortality in the world, approaching 20% of deaths in Europe and 30% in the USA being in people over 35 years of age [1]. Myocardial infarction (MI), an acute and severe form of IHD, occurs in (23.3%) of patients with the disease [2]. Coronary atherosclerotic plaque development has often been described as the dominant mode of inducing myocardial cell necrosis and, finally, resulting in infarction. Myocardial infarction is diagnosed in the presence of classically clinical and electrocardiographic changes and elevated cardiac markers [1].

The STEMI is a cardiac emergency that occurs due to transmural myocardial ischemia secondary to total occlusion of a coronary vessel, in absence of collateral flow. Coronary reperfusion achieved through early and complete recanalization of occluded vessel significantly reduces morbidity and mortality associated with STEMI [3]. However, in STEMI, Primary Percutaneous Coronary Intervention (PCI) a minimally invasive procedure, has replaced thrombolysis as a reperfusion strategy [4].

Acute complications of PCI mainly result from platelet activation and drugs blocking platelet aggregation play central role post-procedural management. This results in increased tendency of bleeding with access-site being the most common location [5]. Most common location of spontaneous, non-access site bleeding following PCI is reported is to be gastrointestinal tract [6]. Bleeding into the gut after PCI has attracted special attention because this complication is preventable with prophylaxis with proton pump inhibitors, aspirin free strategies and H. Pylori eradication [6]. This is particularly useful in patients who are at greater risk of suffering from gastric ulcer including patients with gastritis history, patients with chronic NSAIDs or steroids therapy, and patients prescribed with anticoagulant therapy and on anticoagulants. Various studies have been performed to determine the incidence of GIB following PCI with contrasting results in significance. Jin et al, studied the incidence of In-hospital Gastrointestinal Bleeding in STEMI patients undergoing primary PCI and reported that 11.63% of these patients had GIB [7]. Khan et al, also studied the incidence of GIB in STEMI patients undergoing primary PCI and reported that 7.7% patients in their study had GIB [8]. Contrary to these findings, Kwok et al. reported that only 0.09% MI patients in their study undergoing primary PCI had GIB. 25% of patients of GIB had preprocedural diagnosis of NSTEMI while 68% patients were of STEMI [9]. Aziz et al, studied incidence of GIB following primary PCI in STEMI and NSTEMI patients and reported 7.1% incidence of GIB in these patients [10].

It is evident from literature that gastrointestinal bleeding is one of the most dreadful complications following PCI and may be associated with mortality in 1.1% patients [11]. Therefore, preventive measures should be recognized as high-risk patients and be designed, accordingly.

An estimated >600,000 PCI is performed in the U.S. each year [12]. Pakistan has one of the highest prevalences of IHD (17%) in the world, and therefore, a significant number of patients require primary PCI to achieve coronary reperfusion [13]. Gastrointestinal bleeding (GIB) is one of the frequent complications after PCI, and its risk could be decreased by prophylaxis [14,15]. This study evaluates the incidence of in-hospital GIB after PCI from a local perspective, which would enable the cardiologists to understand the extent of the problem and implement prophylactic measures particularly in high-risk category of individuals. So, this study will also help in bridging the gap of scarcity of local research.

METHODOLOGY

This study was a descriptive cross sectional study that was carried out over a period of 6 months in the

Department of Adult Cardiology, NICVD, Karachi. This is a nonprobability consecutive sampling of 247 patients with ST-segment elevation myocardial infarction (STEMI) which received primary percutaneous coronary intervention (PCI) within 24 hours from onset of symptoms.

STEMI was diagnosed based on the following electrocardiographic (ECG) criteria: a J point ST-elevation greater than 0.1 mV (1mm) in at least two contiguous leads, excluding leads V2 and V3. The cut points for the various leads V2 and V3 were used as follows: ⩾0.2 mV (2mm) for men and ⩾0.15 mV (1.5mm) for women. Gastrointestinal bleeding is defined as if two or more episodes of hematemesis (vomiting of blood), melena (passage of black, tarry stools), or hematochezia (presence of fresh blood in the stool) occur from the time of PCI to hospital discharge.

Inclusion criteria were patients aged 45-70 years, of either gender, diagnosed with STEMI or NSTEMI, and those undergoing primary PCI within 24 hours of symptom onset. Exclusion criteria were gastrointestinal malignancy, decompensated liver disease (Child-Pugh ≥ 7), palpable hemorrhoids on digital rectal examination, positive pre-PCI fecal occult blood, thrombocytopenia (platelet count < 150,000 per microliter) and bleeding disorder (hemophilia and Von Willebrand disease).

Patients with sufficient inclusion criteria for study subjects were invited, and the informed consent was also obtained in writing. A form was prepared, and baseline demographic and clinical data were recorded using the same.

Data were analyzed using SPSS version 26. Continuous variables were summarized with descriptive statistics (mean ± SD). Frequency and percentages were calculated for categorical variables. Statistical significance at 5% level of significance was assessed by using Chi-square test.

RESULTS

The investigation encompassed a total of 247 subjects exhibiting a mean age of 62.17 ± 7.68 years, alongside a mean body mass index of 28.29 ± 5.32 kg/m². The average left ventricular ejection fraction was recorded at 53.43 ± 7.35%. Males accounted for 73.3% of the subjects, whereas females constituted 26.7%. The most prevalent form of myocardial infarction was ST-elevation myocardial infarction (STEMI) at 74.9%, followed by non-ST-elevation myocardial infarction (NSTEMI) at 25.1%. Within the cohort, 24.7% were identified as current smokers, 19.0% had a diagnosis of diabetes, 52.2% exhibited hypertension, and 43.7% were diagnosed with hypercholesterolemia. A history of previous myocardial infarction was documented in 28.3% of subjects, previous stroke in 4.0%, peripheral vascular disease in 6.1%, renal disease in 3.6%, and valvular heart disease in 1.6%. Prior coronary artery bypass grafting (CABG) was noted in 9.3% of the participants. Radial access was employed in 49.4% of cases, while cardiogenic shock was observed in 4.0% of patients, necessitating circulatory support in 3.2%. Concerning coronary artery involvement, left main disease was identified in 4.9% of cases, left anterior descending (LAD) artery in 47.4%, left circumflex (LCx) artery in 23.5%, and right coronary artery (RCA) in 36.0%. Multivessel disease was recognized in 19.0% of cases, while 14.2% of subjects presented with triple vessel disease. A blood transfusion was required in 3.6% of patients, and in-hospital mortality was recorded at 4.5%. Major adverse cardiac events (MACE) were documented in 4.0% of patients during their hospitalization, as delineated in TABLE I.

Patients exhibiting gastrointestinal (GI) bleeding (n=20) were statistically significantly older than their counterparts without GI bleeding (66.85 ± 3.95 vs. 61.75 ± 7.80 years, p=0.004). No statistically significant disparities were observed in body mass index (BMI) (p=0.782) or left ventricular ejection fraction (LVEF) (p=0.275). Males comprised 65.0% of the GI bleeding cohort and 74.0% of the non-bleeding cohort (p=0.383). STEMI was the predominant classification of myocardial infarction across both groups (70.0% vs. 75.3%, p=0.598). The prevalence of cardiogenic shock (25.0% vs. 2.2%, p=0.0001) and the requirement for circulatory support (20.0% vs. 1.8%, p=0.002) were significantly elevated in patients experiencing GI bleeding. Other clinical parameters, such as smoking status, diabetes, hypertension, hypercholesterolemia, prior myocardial infarction, stroke, peripheral vascular disease, renal disease, valvular heart disease, and history of CABG, exhibited no significant differences between the two cohorts (p>0.05). The incidence of

blood transfusion was markedly higher in the GI bleeding group (35.0% vs. 0.9%, p=0.0001). Mortality rates were also significantly heightened in patients with GI bleeding (25.0% vs. 2.6%, p=0.0001), as was the occurrence of in-hospital major adverse cardiac events (MACE) (15.0% vs. 3.1%, p=0.038). No significant differences were detected in coronary artery involvement, multivessel disease, or triple vessel

Table I: Clinical and Demographic Characteristics of Study Participants (n=247)	
Age in years **(Mean ± SD) = 62.17 ± 7.68**	
Body Mass Index in kg/m^2 **(Mean ± SD) = 28.29 ± 5.32**	
Left Ventricular Ejection Fraction **(Mean ± SD) = 53.43 ± 7.35**	
Gender	**n** (%)
Male	181 (73.3)
Female	66 (26.7)
Type of MI	
STEMI	185 (74.9)
NSTEMI	62 (25.1)
Smoking Status	
Current Smoker	61 (24.7)
Diabetes	47 (19.0)
Comorbidities	
Hypertension	129 (52.2)
Hypercholesterolemia	108 (43.7)
Renal Disease	9 (3.6)
Peripheral Vascular Disease	15 (6.1)
Prior cardiac history	
Previous Stroke	10 (4.0)
Previous MI	70 (28.3)
Previous CABG	23 (9.3)
Valvular Heart Disease	4 (1.6)
Previous CABG	23 (9.3)
Procedural details	
Radial Access	122 (49.4)
Circulatory Support	8 (3.2)
Cardiogenic Shock	10 (4.0)
Angiographic findings	
LAD	117 (47.4)
LCx	58 (23.5)
RCA	89 (36.0)
Multivessel Disease	47 (19.0)
Triple Vessel Disease	35 (14.2)
Left Main Coronary Artery	12 (4.9)
Outcomes	
Blood Transfusion	9 (3.6)
Mortality	11 (4.5)
In-Hospital MACE	10 (4.0)

disease between the two groups, as presented in TABLE II.

Table II: Comparison of Patients Characteristics with and without GI Bleeding (n=247)					
n (%)		GI Bleeding		95% C. I	P-Value
		Yes (n=20)	No (n=227)		
Age in years		66.85 ± 3.95	61.75 ± 7.80	(1.617–8.576)	0.004
Body Mass Index in kg/m^2		27.98 ± 5.56	28.32 ± 5.31	(-2.795–2.106)	0.782
LVEF		51.70 ± 7.46	53.58 ± 7.33	(-5.253–1.499)	0.275
Gender	Male	13 (65.0)	168 (74.0)	(0.371–8.792)	0.383
	Female	7 (35.0)	59 (26.0)		
Type of MI	STEMI	14 (70.0)	171 (75.3)	(0.280–2.083)	0.598
	NSTEMI	6 (30.0)	56 (24.7)		
Current Smoker		5 (25.0)	56 (24.7)	(0.354–2.927)	0.974
Diabetes		4 (20.0)	43 (18.9)	(0.340–3.361)	0.551
Hypertension		12 (60.0)	117 (51.5)	(0.555–3.580)	0.468
Hypercholesterolemia		11 (55.0)	97 (42.7)	(0.653–4.108)	0.289
Previous MI		6 (30.0)	64 (28.2)	(0.402–2.964)	0.864
Previous Stroke		1 (5.0)	9 (4.0)	(0.153–10.605)	0.577
Peripheral Vascular Disease		3 (15.0)	12 (5.3)	(0.813–12.295)	0.110
Renal Disease		2 (10.0)	7 (3.1)	(0.675–18.061)	0.159
Valvular Heart Disease		1 (5.0)	3 (1.3)	(0.390–39.635)	0.288
Previous CABG		2 (10.0)	21 (9.3)	(0.236–5.025)	0.578
Radial Access		9 (45.0)	113 (49.8)	(0.329–2.068)	0.682
Cardiogenic Shock		5 (25.0)	2 (2.2)	(3.855–56.825)	0.0001
Circulatory Support		4 (20.0)	4 (1.8)	(3.186–60.971)	0.002
Left Main Coronary Artery		2 (10.0)	10 (4.4)	(0.490–11.853)	0.252
LAD		10 (50.0)	107 (47.1)	(0.449–2.799)	0.806
LCx		4 (20.0)	54 (23.8)	(0.257–2.498)	0.474
RCA		8 (40.0)	81 (35.7)	(0.472–3.061)	0.700
Multivessel Disease		3 (15.0)	44 (19.4)	(0.206–2.615)	0.449
Triple Vessel Disease		5 (25.0)	30 (13.2)	(0.741–6.462)	0.147
Blood Transfusion		7 (35.0)	2 (0.9)	(11.427–321.138)	0.0001
Mortality		5 (25.0)	6 (2.6)	(3.356–44.912)	0.0001
In-Hospital MACE		3 (15.0)	7 (3.1)	(1.314–23.402)	0.038

CABG: Coronary Artery Bypass Graft, **MACE:** Major Adverse Cardiovascular Event, **MI:** Myocardial Infarction, **LAD:** Left Anterior Descending Artery, **LCx:** Left Circumflex Artery,

RCA: Right Coronary Artery, **LVEF:** Left Ventricular Ejection Fraction

DISCUSSION

Gastrointestinal bleeding (GIB) is a major complication with considerable mortality in patients withST-segment elevation myocardial infarction (STEMI) who are treated with primary percutaneous coronaryintervention (PCI). Such a complication is often associated with the use of antiplatelet and anticoagulant therapies, which are crucial to reducing thromboembolic events, but also increase the risk of bleeding [16]. Furthermore, the physiological insult incurred by the myocardial infarction and the PCI may cause gastrointestinal susceptibility [17].

Gastrointestinal bleeding (GI) associated with a STEMI is classically recognized by the presence of hematemesis (hemoptysis), melena (black, tarry stools), or hematochezia (bright red blood in the stool). The significant morbidity associated with these bleeding episodes that occur during or after the PCI procedure can associate with longer hospital stays or complications that influence recovery of the patient [14].

The characteristics of GIB in STEMI patients include several contributing factors related to the hemodynamic instability owing to the acute myocardial event, aggressive pharmacotherapy like dual antiplatelet therapy (DAPT), and the nature of the PCI procedure itself [19]. Because of the bleeding risk, therefore close monitoring and early intervention should be implemented to avoid this complication. Our study should generate hypotheses on the specific mechanisms leading to GIB in these patients and allow to refine the prevention strategies accordingly.

The cumulative occurrence of gastrointestinal bleeding (GIB) in individuals diagnosed with ST-segment elevation myocardial infarction (STEMI) who are subjected to primary percutaneous coronary intervention (PCI) was determined to be 8.09%, with GIB affecting 70% of STEMI patients and 30% of NSTEMI patients as evidenced in our research. This result is consistent with previous studies, though some differences exist. Shi W, et al reported GIB in STEMI (75.2%) and NSTEMI (24.8%) of patients [20]. Jin et al. conducted a comprehensive investigation on patients diagnosed with STEMI who underwent percutaneous coronary intervention (PCI), revealing that gastrointestinal bleeding (GIB) occurred in 11.63% of the study population [7]. In a parallel investigation, Khan et al. documented GIB in 7.7% of STEMI patients undergoing PCI [8]. These findings underscore the prevalence of gastrointestinal bleeding within the context of primary PCI for STEMI, which may be attributed not only to the pharmacological effects of antiplatelet agents and anticoagulants but also to the hemodynamic strain resulting from the myocardial infarction and the PCI procedure itself.

In contrast, research conducted by Kwok et al. reported a significantly lower incidence of GIB with 0.09% of STEMI patients treated with PCI developed gastrointestinal complications [9].

The study found an incidence of GIB in STEMI patients (68%) and (25%) in NSTEMI patients [9]. This stark contrast might be due to differences in the patient population, study design, or perhaps the specific management protocols for antithrombotic therapy during the procedure. In comparison, Aziz et al. found an incidence of 7.1% for GIB in their study, which is closer to our findings [10].

Our investigation indicated that 70% of the subjects who suffered from gastrointestinal bleeding (GIB) were diagnosed with ST-elevation myocardial infarction (STEMI), whereas 30% presented with non-ST-elevation myocardial infarction (NSTEMI). This observation is consistent with the prevailing understanding that individuals with STEMI, due to the acute severity of their medical condition, frequently undergo more intensive pharmacological treatments, which encompass elevated dosages of antiplatelet and anticoagulant medications, consequently heightening the likelihood of hemorrhagic incidents. The utilization of highly effective pharmacological agents, encompassing dual antiplatelet therapy (DAPT), in conjunction with the necessity for systemic anticoagulation during the entirety of percutaneous coronary intervention (PCI), constitutes recognized risk determinants for the incidence of gastrointestinal hemorrhage within this particular cohort of patients.

The current study provides some important insights, there are certain limitations and shortcomings that need to be addressed. First, the non-probability

consecutive sampling method is very well known and easy to employ for exploratory studies, but can produce selection bias which could reduce the generalizability of the findings. The analysis had some limitations, including that it included only patients 45–70 years of age, and thus cannot identify risk factors for GI bleeding in those younger or older. Moreover, exclusion of patients with prior GI neoplasm, liver disease or coagulopathy may introduce a selection bias as these comorbid conditions may independently influence the rate of bleeding complications.

The other limitation includes the use of retrospective data for some parameters. Since the diagnosis of gastrointestinal hemorrhage required clinical documentation, which may be incomplete or vary in terms of clinical reporting. In addition, the study only evaluate at bleeding incidents that occurred within the hospital; it did not examine longer-term consequences, including bleeding events that occurred after discharge or death from bleeding.

A multicenter study with a larger and more heterogeneous population is warranted to generalize the findings. In addition, it was recommended that new prospective research designs be implemented to reduce the bias of retrospectively obtained data. Follow-up studies should also explore the underlying processes that lead to GI bleeding after percutaneous coronary intervention in STEMI patients, particularly in the context of antithrombotic therapy. Finally, the potential addition of a broader analysis of complications that occur post-discharge may provide important insights into the long-term risks of GI bleeding after PCI in STEMI patients.

CONCLUSION

This study highlights that gastrointestinal hemorrhage represents a considerable in-hospital complication for patients diagnosed with ST-Elevation Myocardial Infarction (STEMI) and Non-ST-Elevation Myocardial Infarction (NSTEMI) who undergo percutaneous coronary intervention. The findings emphasize the clinical significance of identifying individuals at heightened risk, particularly those demonstrating hemodynamic instability, to enable the execution of timely preventative measures. Enhanced risk stratification and proactive management are essential to alleviate gastrointestinal complications and improve short-term clinical outcomes within this patient population.

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