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Predisposing factors and Prevalence of Urinary Tract Infection in Patients with Acute Coronary Syndrome Undergone Percutaneous Coronary Intervention: Evaluating the Effect on Outcome

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ABSTRACT

The connection between acute infections and acute cardiovascular events was gaining more attention. There was limited research regarding the incidence and impact of Urinary Tract Infection (UTI) in patients undergoing Percutaneous Coronary Intervention (PCI). **Objective:** To determine the prevalence and risk factors of urinary tract infection in patients with Acute Coronary Syndrome (ACS) undergone PCI and to determine the effect on outcome. **Methods:** Cross-sectional study conducted in department of cardiology and pathology, Sheikh Zayed Hospital, Rahim Yar Khan from January 2021 to November 2023. ACS patients aged between 25 to 85 years both genders undergone PCI were included. Patients diagnosed with malignant tumor, cardiogenic shock and pregnant females were excluded. All study subjects grouped on the basis of presence and absence of UTI. Outcome studied were bleeding during hospital stay, in-hospital re infarction, atrial fibrillation and Congestive Cardiac Failure (CCF) after procedure. **Results:** Mean age of study subjects was 48±9.023years with 207(57.98%) males and 150(42.01%) females. Of the total 357 study subjects, UTI was diagnosed in 102(28.57%) patients. Among all patients with UTI, frequency was high among older individuals (n=68) and females (n=58). UTI was associated with higher rate of re-infarction with 40 patients affected among the total 55 patients with re-infarction. **Conclusions:** On the basis of this study, it has been concluded that concomitant UTI was frequent in patients undergoing PCI for ACS and associated with advancing age, female gender, responsible for prolonged hospital stay and increased risk of reinfarction.

INTRODUCTION

A growing number of observational studies have discovered a link between myocardial infarction and acute infections [1, 2]. There were three possible ways that an acute infection could lead to significant cardiovascular problems. Initially, acute infections might cause an inflammatory response that can destabilize atherosclerotic plaques [3, 4]. Secondly, the acute infection-related prothrombotic and procoagulant state could raise the chance of thrombosis at the site of plaque disintegration. Third, heat and inflammation raise heart rate, which can result in "demand ischemia" if myocardial cells' metabolic needs exceed the availability of oxygen. Severe infections, such as sepsis and bacteremia, have also been linked to a long-term risk of acute cardiovascular events [5, 6]. The development and instability of atherosclerotic disease have been associated with inflammation. Acute coronary syndromes can be brought on by factors that contribute to systemic inflammation, such as subclinical infections (ACSs). However, there is very limited data available on the incidence of infections in patients who have undergone Percutaneous Coronary Intervention (PCI) and how those infections affect the course of treatment [7, 8]. Globally, ischemic heart disease is currently the leading cause of death. Significant risk factors include age, sex, family history, genes, high plasma low-density lipoprotein, low plasma high-density

lipoprotein, diabetes mellitus, hypertension, and smoking. Numerous theories have been put out to explain the connection between inflammation and coronary events, such as endothelial dysfunction, the interaction of cytokines with coagulation factors, and the start of proteases that increase plaque disintegration. The Sympathetic Nervous System (SNS), Nitric Oxide (NO), and the Renin-Angiotensin System (RAS) are the main players involved in these interactions. Each of these frameworks is individually impacted by acute renal damage, which has implications for cardiovascular function. Growing evidence suggests that inflammation plays a major role in the pathophysiology of atherosclerosis and, consequently, CAD. A number theories have been put out to explain the relationship between coronary events and aggravation, such as Endothelial Dysfunction (ED), cytokine interaction with coagulation factors, and protease activation that promotes plaque disintegration [9]. An infection may cause the coagulation system and platelets to become activated, creating a prothrombotic environment. Moreover, among patients receiving Percutaneous Coronary Intervention (PCI), infection is a rare but significant complication. Because older individuals frequently present with atypical non-urinary symptoms such disorientation, tiredness, loss of interest in eating, nausea and vomiting, falls, and nocturia, UTI in older patients can be a challenging problem in terms of diagnosis, treatment, and prevention. It has been established that infection is linked to a higher risk of cardiovascular events in patients with acute coronary syndrome, even though the reported prevalence is less than 4%. Still, there is a dearth of information regarding infection in acute coronary syndrome patients [10, 11].

Study aimed to determine the prevalence and risk factors for urinary tract infection in patients with acute coronary syndrome undergoing percutaneous coronary intervention and to study the effect on outcome in these patients. There is very limited research regarding the prevalence of infections during hospital stay in patients undergone PCI and how urinary tract infection affect the outcome in such patients.

METHODS

After taking ethical approval from institutional review board vide reference no. (14/IRB/SZMC/SZH), a cross-sectional observational study was conducted at Sheikh Zayed Hospital, Rahim Yar Khan from January 2021 to December 2023. Acute coronary syndrome diagnosed patients aged between 25 to 85 years both gender undergoing percutaneous coronary intervention were included after taking informed consent. Sample size (n=357) calculated by using confidence interval 95%, margin of error 5% and prevalence of acute coronary syndrome. Patients diagnosed with malignant tumor, pregnant females and patients with cardiogenic shock were excluded. All the study subjects were grouped on the basis of presence and absence of Urinary Tract Infection (UTI) during hospital stay after percutaneous coronary intervention and characteristics of UTI was reported in

detail on the basis of urine complete examination and urine culture. Outcome studied were bleeding during hospital stay, in-hospital re infarction, atrial fibrillation and congestive cardiac failure. Data were recorded on a pre designed proforma. SPSS version 25.0 used for data entry and analysis. Quantitative variables presented in terms of mean and standard deviation. Qualitative variables shown in terms of frequency and percentages. All variables stratified. Post stratification, univariate Pearson chi square test applied to see the statistically significant difference between the groups of different variables with and without urinary tract infection and to determine the significant association of UTI post PCI. P value <0.05 considered as significant.

RESULTS

Of the total 357 study subjects, mean age was 48 ± 9.023years with 121(33.89%) were ≤ 40years and 236 (66.10%) having >40 years of age (Table 1). Males were 207 (57.98%) while females were 150 (42.01%) as shown in table 1. 255(71.42%) were having no UTI during hospital stay while 102 (28.57%) were diagnosed to have UTI during hospital stay(Table 1).

Table 1: Distribution of Study Subjects with Respect to different Variables(n=357)

Variables	Subgroups	N(%)/ Mean ± SD
Age	≤40	121(33.89%)
	>40	236(66.10%)
	Total	357(100%)
	Mean	48 ± 9.023
Gender	Male	207(57.98%)
	Female	150(42.01%)
Urinary Tract Infection	No UTI	255(71.42%)
	UTI	102(28.57%)
	Total	357(100%)
Hospital Stay (Days)	≤4	275(77.03%)
	>4	82(22.96%)
	Total	357(100%)
Re Infarction	Yes	55(15.40%)
	No	302(84.59%)
	Total	357(100%)
Major Bleeding	Yes	30(8.4%)
	No	327(91.59%)
	Total	357(100%)
Atrial Fibrillation	Yes	42(11.76%)
	No	315(88.23%)
	Total	357(100%)
CCF	Yes	32(8.96%)
	No	325(92.85%)
	Total	357(100%)

Figure 1 showed the Frequency of UTI in ACS Patients Undergone PCI.
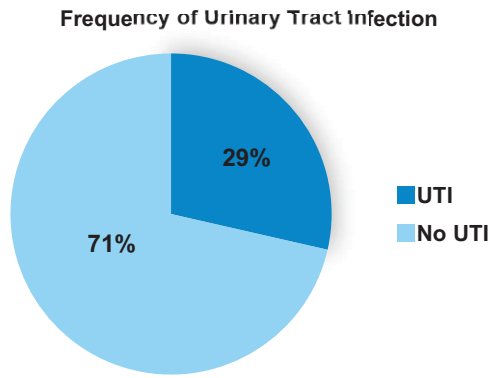
Figure 1: Frequency of UTI in ACS Patients Undergone PCI(n=357)

Of the total 102 study subjects with UTI, 34 (9.52%) were ≤40years age while 68 (19.04%) were >40 years' age. Statistically significant difference of UTI with respect to age was found with p value 0.003 (Table 2). Among all patients with UTI, 44(12.32%) were males while 58(16.24%) were females. Statistically significant difference of UTI was found with respect to gender (p value 0.001) as showed in table 2. Of the total 357 study subjects, 275(77.03%) were having hospital stay ≤ 4days while 82 (22.96%) were having > 4days hospital stay. Among all study subjects with prolong hospital stay, 80 (22.40%) were having UTI while 2 (0.56%) were not having UTI with statistically significant difference between the groups with p-value 0.021(Table 2). Of the total 357 study subjects, 55(15.40%) were having re infarction during hospital stay. Among all these subjects with re infarction, 40(11.20%) were having UTI and 15 (4.20%) were having no UTI with statistically significant difference between the groups (p-value: 0.013) as showed in table 2.

Table 2: Distribution of different Variables with Respect to Presence and Absence of Urinary Tract Infection. Effect on Outcome due to Presence of Urinary Tract Infection.

Variables	Subgroups	Urinary Tract Infection (UTI) N (%)			p-value
		UTI	No UTI	Total	
Age	≤40	34 (9.52%)	87 (24.36%)	121 (33.89%)	0.003*
	>40	68 (19.04%)	168 (47.05%)	236 (66.10%)	
	Total	102 (28.57%)	255 (71.42%)	357 (100%)	
Gender	Male	44 (12.32%)	163 (45.65%)	207 (57.98%)	0.001*
	Female	58 (16.24%)	92 (25.77%)	150 (42.01%)	
	Total	102 (28.57%)	255 (71.42%)	357 (100%)	
Hospital Stay	≤4	22 (6.16%)	253 (70.86%)	275 (77.03%)	0.021*
	>4	58 (16.24%)	02 (0.56%)	82 (22.96%)	
	Total	102 (28.57%)	255 (71.42%)	357 (100%)	
Re infarction	Yes	40 (11.20%)	15 (4.20%)	55 (15.40%)	0.013*
	No	62 (17.36%)	240 (67.22%)	302 (85.49%)	

	Total	102 (28.57%)	255 (71.42%)	357 (100%)	
Major bleeding	Yes	14 (3.92%)	16 (4.48%)	30 (8.4%)	2.314
	No	88 (24.64%)	239 (66.94%)	327 (91.59%)	
	Total	102 (28.57%)	255 (71.42%)	357 (100%)	
Atrial fibrillation	Yes	20 (5.60%)	22 (6.16%)	42 (11.76%)	1.896
	No	82 (22.96%)	233 (65.26%)	315 (88.23%)	
	Total	102 (28.57%)	255 (71.42%)	357 (100%)	
Congestive Cardiac Failure	Yes	14 (3.92%)	18 (5.04%)	32 (8.96%)	4.298
	No	88 (24.64%)	237 (66.38%)	325 (92.85%)	
	Total	102 (28.57%)	255 (71.42%)	357 (100%)	

*P-value <0.05 taken as significant

No significant difference of major bleeding, atrial fibrillation and CCF found in both groups with and without UTI(p value >0.05) as shown in table 2. Comparison of effect on outcome in patients with and without UTI has been showed in figure 2.
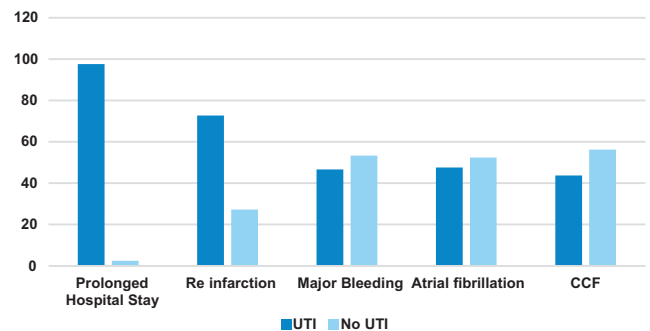
Figure 2: Comparison of Effect on Outcome in Patients with and without UTI

DISCUSSION

The frequency of urinary tract infection has been found high among patients of ACS undergone PCI and it has been observed that patients diagnosed with UTI were older than patients without UTI. Frequency was high among females and UTI diagnosed patients were having prolonged hospital stay. By evaluating the effect on outcome, reinfarction during hospital stay was high among UTI subgroup. While no significant difference of major bleeding, atrial fibrillation and CCF was found in both groups. Adverse events were more common in young women receiving Percutaneous Coronary Intervention (PCI) for Acute Coronary Syndrome (ACS) than in males, possibly as a result of under treatment. Chandrasekhar J *et al.*, carried out a study to compare the 1-year results by gender in patients aged 55 and older from a current PCI cohort. On the basis of their study, it was concluded that when having ACS PCI, women over the age of 55 had much more comorbidities than young males. Prasugrel use was much lower in women than in men, despite the fact that women

had a greater risk clinical profile. Due to baseline differences, female sex was linked to a considerably higher risk of 1-year MACE (Major Adverse Cardiovascular Events composite of mortality, myocardial infarction, stroke, or unscheduled revascularization) and bleeding than male sex [12]. Acute Myocardial Infarction (AMI) patients receiving Percutaneous Coronary Intervention (PCI) were at high risk for re infection throughout their hospital stay. Nevertheless, there was currently no reliable way to estimate this risk as demonstrated by Liu Y *et al.*, They have found infection risk post PCI in ACS patients ranging from 0.7 to 99.6%. The findings of their study were consistent with this findings [13]. According to a research de Oliveira PP *et al.*, on 1486 patients with myocardial infarction, the 30-day mortality rate for these individuals was as high as 53%, and the prevalence of severe infection was 3.9% [14]. A retrospective cohort analysis of 174 octogenarians with ACS by Keskin K *et al.*, demonstrated that the patients with infection had higher in-hospital, 30-day, and long-term mortality than patients without infection. The findings were consistent with this study findings [15]. Although, infections were detrimental to ACS patients, the underlying pathophysiological mechanism was still unknown. According to some theories, infection raised the mortality rate of patients undergoing elective PCI because of the alteration in plaques brought on by acute inflammatory responses. In fact, an infection has been linked to the development, advancement, and rupture of an atherosclerotic plaque [16]. Sometimes an Indwelling Urethral Catheter (IUC) was implanted. Urinary catheters were inserted to monitor urine volume as a metric of cardiac output or to prevent infection at the puncture site following the introduction of percutaneous reperfusion therapy using the femoral artery route. However, using an IUC was linked to side effects include hematuria and Urinary Tract Infections (UTI) [17]. Suzuki T *et al.*, demonstrated in their study that patients with acute myocardial infarction have worse clinical outcomes when urinary catheterization was performed before PCI [18]. In a study conducted by Matic DM, it has been demonstrated that after primary PCI, patients who were older, female, have a higher baseline WBC count, and anemia were more likely to bleed. While bleeding was linked to unfavorable outcomes and could be a significant indicator of a patient's weakness, it was not a reliable indicator of mortality or adverse events on its own [19]. There were three possible ways that an acute infection could lead to significant cardiovascular problems. Initially, acute infections might cause an inflammatory response that can destabilize atherosclerotic plaques. Secondly, the acute infection-related prothrombotic and procoagulant state could raise the chance of thrombosis at the site of plaque disintegration. Third, heat and inflammation raise heart rate, which can result in "demand ischemia" if the myocardial cells' metabolic needs exceed the available oxygen [20]. It was first study at this institution evaluating the UTI determinants and prevalence in ACS patients undergone PCI. This study had certain limitations. It was single centered study with cross sectional study design. Further larger prospective studies should be done to validate this study finding.

CONCLUSIONS

On the basis of this study, it has been concluded that concomitant UTI was frequent in patients undergoing PCI for ACS and associated with advancing age, female gender, responsible for prolonged hospital stay and increased risk of in hospital re infarction. It was important for practitioners to be aware of populations at high risk and screening for UTI should be done in these high-risk groups to prevent the further complications and adverse outcome.

Authors Contribution

Conceptualization: RT
Methodology: RT, SAH, MU
Formal analysis: MDK, MU
Writing, review and editing: MDK, FN, AN

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1]   Musher DM, Abers MS, Corrales-Medina VF. Acute infection and myocardial infarction. New England Journal of Medicine. 2019 Jan; 380(2): 171-6. doi:10.1056/NEJMra1808137.

[2]   M. Dalén, F. Biancari, A. Perrotti, G. Mariscalco, F. Onorati, G. Faggian, I *et al.* Holm, Infectious complications in patients receiving ticagrelor or clopidogrel before coronary artery bypass grafting, Journal of Hospital Infection. 2020 Feb; 104(2): 236-238. doi: 10.1016/j.jhin.2019.09.018.

[3]   Reeve NF, Best V, Gillespie D, Hughes K, Lugg-Widger FV, Cannings-John R *et al.* Myocardial infarction and stroke subsequent to urinary tract infection (MISSOURI): protocol for a self-controlled case series using linked electronic health records. BMJ Open. 2022 Sep; 12(9): e064586. doi:10.1136/bmjopen-2022-064586.

[4]   Suzuki T, Fujino M, Murai K, Nishimura K, Tsujita K, Noguchi T *et al.* Urinary catheterization prior to PCI worsens clinical outcomes in patients with acute myocardial infarction. Journal of Cardiology. 2023 Apr; 81(4): 373–377. doi: 10.1016/j.jjcc.2022.12.007.

[5] Jang AY, O'Brien C, Chung WJ, Oh PC, Yu J, Lee K *et al*. Routine Indwelling Urethral Catheterization in Acute Heart Failure Patients Is Associated with Increased Urinary Tract Complications Without Improved Heart Failure Outcomes. Journal of Circulation. 2018 May; 82(6): 1632-1639. doi: 10.1253/circj.

[6] Lampert J, Finn MT, Kantor A, Akkoc D, Chen S, Brandwein R *et al*. Urologic Complications in Patients Receiving Indwelling Urinary Catheters During Transcatheter Aortic Valve Replacement. Journal of Invasive Cardiology. 2020 Jul; 32(7): 269-274.

[7] John G, Arcens M, Berra G, Garin N, Carballo D, Carballo S *et al*. Risks and benefits of urinary catheterisation during inpatient diuretic therapy for acute heart failure: a retrospective, non-inferiority, cohort study. BMJ Open. 2022 Aug; 12(8): e053632. doi: 10.1136/bmjopen-2021-053632.

[8] Leistner DM, Münch C, Steiner J, Lauten A, Landmesser U, Stähli BE. Effect on outcomes: infections complicating percutaneous coronary interventions in patients ≥ 80 years of age. The American Journal of Cardiology. 2019 Jun; 123(11): 1806-11. doi: 10.1016/j.amjcard.2019.03.003.

[9] Sathyapriya SV, Arumugam E, Appandraj S. A study on prevalence of urinary tract infection in patients with acute ST segment elevation myocardial infarction in a tertiary care centre in Chengalpattu district. International Archives of Integrated Medicine. 2020 Dec; 7(12).

[10] Chen PY, Liu YH, Duan CY, Jiang L, Wei XB, Guo W *et al*. Impact of infection in patients with non-ST elevation acute coronary syndrome undergoing percutaneous coronary intervention: insight from a multicentre observational cohort from China. British Medical Journal Open. 2020 Sep; 10(9): e038551. doi: 10.1136/bmjopen-2020-038551.

[11] Morici N, Savonitto S, Ferri LA, Grosseto D, Bossi I, Sganzerla P *et al*. Outcomes of elderly patients with ST-elevation or non-ST-elevation acute coronary syndrome undergoing percutaneous coronary intervention. The American Journal of Medicine. 2019 Feb; 132(2): 209-16. doi: 10.1016/j.amjmed.2018.10.027.

[12] Chandrasekhar J, Baber U, Sartori S, Faggioni M, Aquino M, Kini A *et al*.Sex-related differences in outcomes among men and women under 55 years of age with acute coronary syndrome undergoing percutaneous coronary intervention: results from the PROMETHEUS study. Catheterization and Cardiovascular Interventions. 2017 Mar; 89(4): 629-37. doi: 10.1002/ccd.26606.

[13] Liu Y, Wang L, Chen P, Dai Y, Lin Y, Chen W *et al*. Risk estimation for infection in patients with ST-segment elevation myocardial infarction undergoing percutaneous coronary intervention: development and validation of a predictive score. Frontiers in Cardiovascular Medicine. 2022 Apr; 9: 845307. doi: 10.3389/fcvm.2022.845307.

[14] de Oliveira PP, Gonzales V, Lopes RD, Schmidt MM, Garofallo S, Dos Santos RP *et al*. Serious infections among unselected patients with ST-elevation myocardial infarction treated with contemporary primary percutaneous coronary intervention. American Heart Journal. 2016 Nov; 181: 52-9. doi: 10.1016/j.ahj.2016.08.005.

[15] Keskin K, Çetinkal G, Sığırcı S, Yıldız SS, Çetin Ş, Gürdal A *et al*. The impact of infection on mortality in octogenarians who were admitted due to acute coronary syndrome. Archives of Gerontology and Geriatrics. 2018 May; 76: 48-53. doi: 10.1016/j.archger.2018.01.012.

[16] Pothineni NV, Subramany S, Kuriakose K, Shirazi LF, Romeo F, Shah PK *et al*. Infections, atherosclerosis, and coronary heart disease. European Heart Journal. 2017 Nov; 38(43): 3195-201. doi: 10.1093/eurheartj/ehx362.

[17] Wallis CJ, Juvet T, Lee Y, Matta R, Herschorn S, Kodama R *et al*. Association between use of antithrombotic medication and hematuria-related complications. Journal of the American Medical Association. 2017 Oct; 318(13): 1260-71. doi:10.1001/jama.2017.13890.

[18] Suzuki T, Fujino M, Murai K, Iwai T, Sawada K, Matama H *et al*. Urinary catheterization prior to PCI worsens clinical outcomes in patients with acute myocardial infarction. Journal of Cardiology. 2023 Apr; 81(4): 373-7. doi: 10.1016/j.jjcc.2022.12.007.

[19] Matić DM, Ašanin MR, Stanković SD, Mrdović IB, Marinković JM, Kočev NI *et al*. Incidence, predictors and prognostic implications of bleeding complicating primary percutaneous coronary intervention. Vojnosanitetski pregled. 2015 Jun; 72(7).doi:10.2298/VSP140223064M.

[20] Medina VF. Acute Infection and Myocardial Infarction. 2019 Jan; 380(2): 171-176. doi: 10.1056/NEJMra18081=37.