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Risk factors of access site pain following coronary interventions through upper extremities

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ABSTRACT

Introduction: Coronary artery disease (CAD) is recognized as the major cause of mortality and morbidity worldwide. Coronary artery interventions are considered the best therapeutic choice for most patients. Similar to other invasive procedures, these interventions whether performed from femoral or upper extremities have their own complications. There is a paucity of studies regarding access site pain and its related factors as a common complication of coronary intervention. With this background in mind, the present study aimed to determine the prevalence and the risk factors associated withthe development of upper extremity pain following coronary artery interventions.

Material and methods: The present cross sectional studywas conductedin Ghaem and Imam-Reza hospitals (Mashhad, Iran) from July to December 2019. Every patient who underwent coronary intervention using radial and ulnar arterieswere enrolled in the present study, and the development of pain on the first day of intervention was evaluated. The relationship between upper extremity pain after the procedure and the study variables was assessed using Chi-square and Fisher's exact tests. A p-value less than 0.05 was considered statistically significant.

Results: Most of 370 patients who underwent coronary artery angiography were male (n=202; 54.6%), and the cardiovascular risk factors were not significantly different betweenthe patients who developed upper extremity pain and those who did not. Upper extremity pain was detectedin 43.8% of patients within their first day after the procedure. Most of the patients reported pain at the puncture site (n=80). The female gender and the development of hematoma were significantly related to experiencing upper extremity pain (P<0.001 both).

Conclusion: There is a paucity of studies regarding the upper extremity pain following coronary intervention. The present study demonstrated that approximately 44% of patients who undergo coronary intervention on their upper extremities will experience upper extremity pain mostly at the puncture site within their first day after the surgery. Planning specific pre-procedure management program for female patients who are most likely to develop pain may be of great help in reducing the limb pain following the procedure.

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Introduction

Cardiovascular disease (CAD) is recognized as a major cause of mortality and morbidity worldwide (1). A recent global report demonstrated that CAD will remain the leading cause of death until 2030 (2). Atherosclerosis and occlusion of coronary arteries are the main etiologies of CAD and appropriate management can provide favorable outcomes (3). Percutaneous coronary intervention (PCI) is a quick and efficient way for the management of occluded coronary artery which is used along with pharmacological treatments (4). During PCI, the visualization of cardiac circulation is possible, most of the atherosclerotic lesions in coronary arteries can be located, and revascularization can be performed (4). Akin to other invasive interventions, PCI has its own specific complications which can affect patients' health and lifestyle (5). Nowadays, transulnar and trans radial coronary interventions are at the peak of popularity due to their low incidence of vascular complications (6). Patients undergoing coronary interventions on their upper extremities experience early mobilization after the procedure. Moreover, such approaches are better tolerated in most patients and appropriate pre- and post-angiography management will further reduce angiography-related complications (6). Puncture site pain is one of the most common post-intervention complications which develop in every coronary intervention procedure (6, 7). Immediate sheath removal after trans radial approach alongside anticoagulant medications increases the chance of bleeding and hematoma at the puncture site [8]. Since the radial artery is smaller than the femoral artery, the manipulation of the radial sheath will cause further puncture site pain and spasm which may not be alleviated for several hours after the procedure (8-11). Moreover, mechanical pressure at the puncture site which will minimize some of the access-site vascular complications, such as bleeding, may also cause access site pain (8-10). Although puncture site pain is prevalent in almost every post-intervention care unit, there is adearth of data regarding the prevalence of upper extremity pain and its duration, as well as its possible relationship with patients' characteristics and management plans.

Material and methods

The present cross sectional study was conducted in Ghaem and Imam Reza hospitals (Mashhad, Iran) and was approved by Mashhad University of Medical Sciences Ethics Committee. From July to December 2019, every patient who was diagnosed with coronary artery disease and underwent successful PCI or upper extremity angiography was enrolled in the present study after filling an informed consent form. The patients with hemodynamic instability and hematoma expansion, as well as those who were not willing to complete the study period or well not able to answer the questions, were excluded. 24 h after the procedure, the patients were asked if they were experiencing any upper extremity pain and the location of their pain was documented. In addition, all patients were examined for the development of any hematoma at the puncture site. At the end of the study period, the patient's demographic data as well as procedural and pain characteristics were analyzed in SPSS software (version 16). The relationship between upper extremity pain after the procedure and the study variables were evaluated using Chi-square and Fisher's exact tests. A p-value less than 0.05 was considered statistically significant.

Results

A total number of 370 patients undergoing coronary artery angiography were enrolled in the present study. Most of the study participants were male (n=202; 54.6%).The cardiovascular risk factors were not significantly different among the pain and pain-free groups (Table 1). Most of the patients (n=365; 98.6%) underwent trans radial angiography, and only 5 patients (1.4%) underwent transulnar approach. Among the study participants, 56.2% (n=208) of patients did not experience upper extremity pain 24 h after the procedure. Most of the patients reported pain at the puncture site (n=80), while 44 and 38 patients reported pain proximal and distal to

the elbow, respectively. In addition, females reported greater upper-extremity pain (60.5%), as compared to male patients (39.5%); accordingly, it can be concluded that experiencing upper-extremity pain was significantly related to female gender (P<0.001). The patients were within the age range of 20-90 years, and most of them were older than 50 years old (74.3%). Moreover, age was not correlated with the upper-extremity pain when considering the age of 50 as a cutoff point (P=0.414; Table 2). Puncture site hematoma developed in 28.6% of patients, and half of the patients who reported puncture site pain after 24 h had a hematoma. The pain was significantly related to the development of hematoma at the puncture site (P<0.001). The procedure time was not related to pain and most of the patients underwent angiography in the morning (63.8%) and others did it in the evening (29.5%) and night (6.8%) (P=0.986). Most of the patients (62.7%) experienced successful puncture at the first attempt, and the number of puncture attempts was associated with the upper extremity pain. Six French catheters were used in 94.6% of patients, and the catheter size was not related to catheter size (P=0.943). Moreover, upper extremity pain showed no significant relationship with analgesics and angiography duration (P=0.806 and P=0.320) (Table 2). Furthermore, receiving vasodilators or development of clinical spasm was not related to the development of upper extremity pain after 24 h (P=0.612 and P=0.068).

Four main risk factors were chosen for a multivariate logistic regression model. The choice of risk factors was based on the current knowledge about risk factors for chronic postsurgical pain and clinical experience. In the multiple logistic regression model, pain was associated with a reduced OR for Male (OR, 0.39; CI, 0.24–0.63). hematom and Lepo sheet type was associated with increase OR (OR, 8.40and OR, 4.01, respectively).

Table 1. Distribution of clinical findings among study partipants with or without upper extremity pain

		No Pain (n=162)	Upper Extremity Pain(n=208)	total	P-value
Age	(>50)	158(76%)	117(72.2%)	275(74.3%)	0.414♦
Sex	(Male)	138(66.3%)	64(39.5%)	202(54.6%)	<0.001♦
Hypertension		103(49.5%)	84(51.8%)	187(50.5%)	0.656♦
Hyperlipidemia		57(27.4%)	46(28.3%)	103(27.8%)	0.833♦
Diabetes Mellitus		61(29.3%)	43(26.5%)	104(28.1%)	0.555♦
Smoking		46(22.1%)	32(19.7%)	78(21.1%)	0.580♦
Angiography		158(75.9%)	116(71.6%)	274(74.1%)	0.726♦
PCI± Angiography		49(23.5%)	47(29%)	96(25.9%)	0.343♦

PCI: percutaneous coronary intervention
♦Result of Chi Square Test

Table 2. Procedure Characteristic

		No Pain	Upper Extremity Pain	total	P value
Hematoma		25(12%)	81(50%)	106(28.6%)	<0.001♦
pain location	Puncture site		80(49.4%)		
	Below Elbow		38(23.4%)		
	Above Elbow		44(27.2)		
Procedure time	Morning	132(63/5%)	104(64.2%)	236(63.8%)	0.986♦
	Evening	60(28.8%)	49(30.2%)	109(29.5%)	
	Night	16(7.7%)	9(5.6%)	25(6.7%)	
Sheet Size	less than 6 French	15(7.2%)	5(3.1%)	20(5.4%)	0.943♦
	6 French	193(92.8%)	157(96.9%)	350(94.6%)	
Sheet Type	Trumo	3(1.4%)	1(0.6%)	4(1.1%)	0.119◊
	Merrit	10(4.8%)	6(3.8%)	16(4.3%)	
	Lepu	17(8.3%)	9(5.6%)	26(7.1%)	
	Acura	157(75.5%)	132(81.4%)	289(78.1%)	
	Bioteq	21(10%)	14(9.4%)	35(9.4%)	
Sedative	No sedative prescription	46 (22.1)	34 (21.0)	80 (21.6)	0.806♦
	Midazolam 1mg	130 (62.5)	99 (61.1)	229 (61.9)	
	>1mg	32 (15.4)	29 (17.9)	61 (16.5)	
Artery	Radial Artery	207(99.5)	158(97.5)	365(98.6)	0.173◊
	Ulnar Artery	1 (0.5)	4 (2.5)	5 (1.4)	
Number of tries to achieve successful puncture	In First Puncture	137(65.9)	95(58.6)	232(62.7)	0.145♦
	More than one Puncture	71 (34.1)	67(41.4)	138(37.3)	
Fluoroscopy Time	Less Than 30 min	141(67.8)	99(61.1)	240(64.9)	0.320♦
	30-60 min	52(25)	52(32.1)	104(28.1)	
	More Than 60 min	15(7.2)	11(6.8)	26(7)	
Clinical Spasm		41(19.7)	45(27.8)	86(23.2)	0.068♦
Vasodilator	Nitrate	193(92.8)	148(91.4)	341(92.2)	0.612♦
	Verapamil & Nitrate	15(7.2)	14(8.6)	29(7.8)	

♦ Result of Chi Square Test
◊ Result of Fisher Exact Test

Table3. multiplelogestic regression

		B	Sig.	Exp (B)	95% C.I. for EXP(B)	
					Lower	Upper
Sex	male	-.935	<0.001	.393	.244	.632
	female(Ref)			1		
Hematoma	Yes	2.085	<0.001	8.041	4.633	13.957
	No(Ref)			1		
Clinical Spasm	Yes	.558	.052	1.747	.995	3.066
	No(Ref)			1		
Sheet type			.023			
	Trumo	.169	.663	1.185	.553	2.539
	Merrit	.124	.842	1.133	.334	3.840
	Lepu	1.390	.002	4.013	1.660	9.703
	Acura(Ref)			1		

Discussion

Pain at the site of coronary artery surgery can be considered a neglected complication in most of the available literature. The present study demonstrated that upper extremity pain after the first day of intervention is reported in less than 50% of patients undergoing trans radial coronary interventions. Moreover, it was found that this pain is correlated with gender and the development of hematoma.

Although cardiovascular diseases are preventable, the management of such diseases is sought in many countries along with preventive measures (12, 13). Different types of coronary artery interventions are nowadays available for patients presented with coronary artery diseases. In contrast to the trans femoral approach for the management of coronary artery disease, trans radial coronary interventions are thought to cause fewer complications in most of the patients except for a specific population, including those with low body mass index (14). Ecchymosis, arterial occlusion, and hematoma are regarded as frequent access site complications in radial access angiography; nonetheless, limb pain is not clearly addressed (15, 16). So far, a few studies have pointed to the superiority of transradial to trans-femoral approach due to less puncture site pain (17). Cheng et al. demonstrated that the puncture site pain 24 h after the surgery is significantly less, as compared to the pain reported after 3 h (7). Moreover, they reported that the female gender was associated with higher bleeding and ecchymosis 24 h after the procedure (7). Furthermore, they found that longer sheath time is associated with radial artery occlusion, and larger compression volume at the puncture site is related to greater pain sensation 3 h after the intervention (7). In contrast to the current study, Cheng et al. used TR band ™ which provided progressive pressure reduction at the puncture site (7).They demonstrated that puncture site pain reduced at the end of the first day post-intervention, and only 7% of their patients reported pain(range 0-40 % after the first 24 h (7). Gwon et al. suggested similar findings and reported that only 4.5% of their patients experienced access site pain after 24 h of the intervention (9). Akin to the present study, both of these studies demonstrated that catheter size is not related to puncture site pain [7, 9]. In addition, it is noteworthy to reemphasis that the radial artery diameter varies among different populations. Therefore, the most appropriate sheath should be selected for each patient in order to reduce the manipulation of the artery's sheath and further pain and spasm [18]. The anatomy and diameters of upper extremity arteries are related to patients' individual factors, such as body mass index and age. Tas neem et al. reported that elevated body mass index and aging negatively affect pain sensation. The current study did not evaluate patients' body mass index. Nevertheless, we demonstrated that patients' age is not associated with the development of pain in the upper extremities. Moreover, other studies pointed out that special attention should be devoted to patients with low body mass index [18]. Akturk et al. compared the pain level in patients with different body mass

indexes (13). They reported that patients with higher body mass indexes are more likely to experience pain due to hematoma,where as those with lower body mass indexes are more susceptible to pain owing to smaller radial artery and arterial spasm (13). Regardless of age and body mass index, we demonstrated that female gender is more prone to the development of pain after the coronary procedure. Female gender and old age are reported to be the predictors of vascular complications, and these patients need prompt management in their post-procedure care (1).

The puncture site pain can be managed in various pharmaceutical and non-pharmaceutical ways. Sharma et al. illustrated that the pain at the access site can be significantly reduced by the application of PCI care program (6). Their program consisted of both educational and interventional package which could be used pre/post and during the PCI intervention (6). The authors stated that their program can provide assisted specific self-care activities, as well as informational booklets and educational audiovisual aids (6). As evidenced by their results, the patients who received their PCI care program had significantly lower levels of post PCI anxiety and median pain score (6). Although both of their intervention and control groups had similar pain scores 6 h after the intervention, the intervention group showed less pain 12 h post-PCI and no pain within 24 h post-PCI (6). Although the current study showed that the administration of analgesic is not linked to the development of upper extremity pain, some studies indicated that specific medications may be of great help in the reduction of pain. Although intra-arterial administration of lidocaine for Analgesia is not effective in pain reduction, topical lidocaine will reduce the puncture and sheath insertion during radial approach (18). Latsios et al. stated that using analgesic creams prior to the intervention can successfully reduce the puncture site pain in patients undergoing tran's radial interventions (19). Opioids and benzodiazepines are also reported to be effective in the reduction of pain and artery spasm, as well as the improvement of patient's tolerability (20).

Conclusion

There is a paucity of studies regarding the upper extremity pain following coronary intervention. The present study demonstrated that approximately 44% of patients who undergo coronary intervention on their upper extremities will experience upper extremity pain mostly at the puncture site within their first day after the surgery. Moreover, the pain was linked to female gender and the development of hematoma. Therefore, planning specific management plans for female populations,including sedatives or analgesics may reduce the upper extremity pain following coronary interventions.

Competing interests

The authors declare that they have no competing interests.

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