Pak Heart J

CHARACTERISTICS AND PREDICTORS OF CHRONIC NON-ANGINAL POSTOPERATIVE PAIN AFTER OPEN-HEART SURGERY IN A COHORT OF PAKISTANI POPULATION

Amjad Hussain[1], Saeed Bin Ayaz[2] , Syed Naveed Mumtaz[3] , Khalil Ahmad[4]

[1] Department of Cardiac Rehabilitation , Armed Forces Institute of Cardiology, Rawalpindi Pakistan
[2-4] Departments of Rehabilitation Medicine, Combined Military Hospitals, Okara, Peshawar Pakistan

Address for Correspondence:

Dr. Saeed Bin Ayaz,

Department of Rehabilitation, Combined Military Hospital, Okara, Pakistan

E-Mail: saeedbinayaz@gmail.com

Date Received: January 26, 2015
Date Revised: February 25, 2015
Date Accepted:February 28, 2015

Contribution
All the authors contributed significantly to the research that resulted in the submitted manuscript.

All authors declare no conflict of interest.

This article may be cited as: Hussain A, Ayaz SB, Mumtaz SN, Ahmad K. Characteristics and predictors of chronic non-anginal postoperative pain after open-heart surgery in a cohort of Pakistani population. Pak Heart J 2015;48(2): 101 - 6.

ABSTRACT

Objective: This study aimed to assess the location and intensity of chronic non-anginal post-operative pain (CPOP) after heart surgery and identify the predicting factors.

Methodology: This cross sectional study was conducted from August 2010 to July 2011 at Armed Forces Institute of Cardiology, Rawalpindi. The CPOP was defined as pain in chest-wall, shoulder or neck of at least 3 months duration, appearing after heart surgery, excluding angina. The relationship of CPOP was evaluated with age, gender, smoking, hypertension, diabetes mellitus (DM), hypercholesterolemia, chronic obstructive airway disease (COAD) and the type of operation.

Results: The post operative patients recruited were 100. Mean age was 47 ± 6 years. Majority were males (73.6%) and non-smokers (50.6%). Hypertension was found in 85.1%, DM in 44.8%, COAD in 16.1% and hypercholesterolemia in 89.7%.The bulk (62.1%) underwent coronary artery bypass grafting. Post-operatively 95.5% had pain in chest-wall, 89.7% in shoulders and 65.5 % in neck. Maximum (88.5%) subjects felt CPOP of moderate intensity. The shoulder pain was significantly more common in diabetics and neck pain in subjects with COAD. The chest-wall pain was significantly common in individuals after valve replacements. Age, gender, smoking, hypertension and hypercholesterolemia did not have significant relationship with CPOP development.

Conclusion: CPOP in our sample was found located primarily in the chest-wall and was moderate in intensity. Significant relationship existed between CPOP at shoulder and DM, CPOP in neck and COAD and CPOP in the chest-wall and the type of operation.

Key Words: Chronic Non-Anginal Post-Operative Pain, Open-Heart Surgery, Diabetes Mellitus

INTRODUCTION

Cardiovascular diseases are the major and growing contributors to mortality and disability in South Asia.[1,2] Though, there has been a tremendous advancement in the management of all categories of these diseases, open heart surgery remains the only method of treatment in selected cases of cardiovascular diseases. Coronary artery bypass grafting (CABG), valve replacement (VR) and repair of septal defects (SD) are suggested in such patients not only to improve survival but also to boost the quality of life. However, it has been found that postoperatively, these surgical procedures may lead to development of chronic non-anginal postoperative pain (CPOP), a syndrome that may include musculoskeletal pain in chest wall, shoulder or neck. Almost, one-third of postoperative patients experience moderate to severe CPOP and its management remains a challenge despite modern pharmaceutical preparations and new invasive and non-invasive pain-allaying techniques.[3] The studies examining the problem of CPOP are deficient in Pakistan. The objectives of this study were to assess the frequency of different locations for CPOP and its intensity and to identify demographic elements and medical factors that might be related to development of CPOP at these locations after open- heart surgery.

METHODOLOGY

This cross-sectional study was designed and carried out at Armed Forces Institute of Cardiology (AFIC) from August 2010 to July 2011 after approval from the institutional ethical review committee. Through non-probability consecutive sampling, we selected post-operative patients (belonging to both genders and any age group) who underwent open-heart surgery and attended cardiac rehabilitation clinic of AFIC for the complaints of CPOP irrespective of the time since surgery. CPOP was defined as musculoskeletal pain in chest wall, shoulder or neck, persisting for at least 3 months, which first appeared after surgery. Patients with continuing angina, marked cognitive deficits and pre-operative musculoskeletal pain in chest wall, shoulder or neck were excluded. Informed consent was taken from all patients after explaining the purpose of study and use of data for research and publication. All subjects were interviewed face-to-face and all relevant clinical and laboratory data were documented according to the parameters outlined in a proforma.

All patients were inquired about their age, smoking habits and their medical documents were searched for the type of surgery and comorbidities like diabetes mellitus (DM), hypertension, hypercholesterolemia and chronic obstructive airway disease (COAD). The designation "smoker" meant any cigarette smoking in the month preceding the interview. DM was defined as either taking hypoglycemic medications or having fasting plasma glucose level $\geqslant$ 7mmol/L. Hypercholesterolemia was defined as plasma total cholesterol level $\geqslant$240 mg/dL (6.21 mmol/L). Fresh blood pressure measurement of every patient was carried out by trained nurses in supine position using calibrated Yamasu 605-P (Kenzmedico Co. Ltd, Honjo-City, Saitama-Pref, Japan). Hypertension was termed as either taking antihypertensive medications or having systolic blood pressure $\geqslant$ 140 mmHg. At the time of interview, patients indicated their worst self-perceived pain on a 0 -100 mm visual analog scale (VAS) marked at one end as "no pain" and at the other as "worst imaginable pain".[4] VAS score "0" was defined as no pain, "$>$ 0 to 30mm" as mild pain, "$>$30 to 70mm" as moderate and "$>$ 70 -100mm" as severe pain.

The data were analyzed using IBM SPSS version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to calculate mean and standard deviations (SD) for age and VAS score. Two groups were made based on age i.e. age $<$ 50 years and age $\geqslant$ 50 years. Frequencies were calculated for age groups, gender, smoking, groups based on pain severity, type of surgery and presence or absence of hypertension, DM, COAD, hypercholesterolemia and post-operative neck, shoulder and chest wall pain. The correlation of different pain locations with above-mentioned variables was determined using Pearson's Chi-square test, Fischer's exact test or one-way ANOVA where applicable. A p-value $<$ 0.05 was considered significant.

RESULTS

Out of 100 recruited patients, 13 were excluded because they had continuing angina or already had musculoskeletal pain in shoulder or neck before operation or had musculoskeletal, pain in these locations but not for enough time duration set as target for our inclusion criteria. The final sample thus consisted of 87 patients including 64 (73.6%) males and 23 (26.4%) females with a mean age of 47 $\pm$ 6 (range: 12 - 70) years. Fifty-four (62.1%) patients underwent CABG, twenty-nine (33.3%) underwent mitral/aortic VR and four (4.6%) underwent atrial/ventricular SD repair. There were 43 (49.4%) smokers, 74 (85.1%) hypertensives and 39 (44.8%) diabetics. Seventy-eight (89.7%) had hypercholesterolemia and fourteen (16.1%) had COAD. After operation, 78 (89.7%) developed pain in shoulders, 57 (65.5%) developed pain in neck while 83 (95.4%) developed musculoskeletal pain in chest wall. On assessing severity of CPOP on VAS, the mean score was 5.6 $\pm$ 1.4 with a range of 1 - 9. Five (5.7%) patients had mild, 77 (88.5%) had moderate and 5 (5.7%) had severe pain.

Post-operative shoulder pain was more common in age group $\geqslant$ 50 years (94.3% vs 86.5%), females (91.3% vs 89.1%), smokers (93% vs 86.4%), diabetics (97.4% vs 83.3%) and patients suffering from COAD (100% vs 87.7%). Those who were operated for VR developed shoulder pain

Table 1: Relationship of Different Variables with the Development of Shoulder Pain after open-Heart Surgery

Variable	Sub Variables	Present n (%)	Absent n (%)	P-Value
Age group	< 50 years	45 (86.5)	7 (13.5)	0.3
	⩾ 50 Years	33 (94.3)	2 (5.7)	
Gender	Male	57 (89.1)	7 (10.9)	1.0
	Female	21 (91.3)	2 (8.7)	
Type of operation	CABG[1]	48 (88.9)	6 (11.1)	0.92
	Vr[2]	27 (93.1)	2 (6.9)	
	SD[3] Repair	3 (75)	1 (25)	
Smoking	Yes	40 (93)	3 (7)	0.48
	No	38 (86.4)	6 (13.6)	
Hypertension	Yes	66(89.2)	8 (10.8)	1.0
	No	12 (92.3)	1 (7.7)	
Diabetes Mellitus	Yes	38 (97.4)	1 (2.6)	0.04
	No	40 (83.3)	8 (16.7)	
Hypercholesterolemia	Yes	69 (88.5)	9 (11.5)	0.59
	No	9 (100)	0	
COAD[4]	Yes	14 (100)	0	0.34
	No	64 (87.7)	9 (12.3)	

CABG: coronary artery bypass grafting, VR:Valve replacement, SD: Septal defects, COAD: Chronic obstructive airway disease.

Table 2: Relationship of Different Variables with the Development of Neck Pain after open-Heart Surgery

Variable	Sub Variables	Present n (%)	Absent n (%)	P-Value
Age group	< 50 years	31 (59.6)	21 (40.4)	0.18
	⩾ 50 Years	26 (74.3)	9 (25.7)	
Gender	Male	40 (62.5)	24 (37.5)	0.44
	Female	17 (73.9)	6 (26.1)	
Type of operation	CABG[1]	38 (70.4)	16 (29.6)	0.21
	Vr[2]	17 (58.6)	12 (41.4)	
	SD[3] Repair	2 (50)	2 (50)	
Smoking	Yes	29 (67.4)	14 (32.6)	0.82
	No	28 (63.6)	16 (36.4)	
Hypertension	Yes	50(67.6)	24 (32.4)	0.36
	No	7 (53.8)	6 (46.2)	
Diabetes Mellitus	Yes	29 (74.4)	10 (25.6)	0.17
	No	28 (58.3)	20(41.7)	
Hypercholesterolemia	Yes	52(66.7)	26 (33.3)	0.5
	No	5 (55.6)	4 (44.4)	
COAD	Yes	13 (92.9)	1 (7.1)	0.03
	No	44 (60.3)	29 (39.7)	

CABG: Coronary artery bypass grafting, VR:Valve replacement, SD: Septal defects, COAD: Chronic obstructive airway disease.

more frequently than those who had CABG or SD repair (93.1% vs 88.9% and 75% respectively). However, those who had hypertension or hypercholesterolemia were less likely to develop shoulder pain (89.2% vs 92.3% and 88.5% vs 100% respectively). The relationship of shoulder pain was significant only for DM ($p < 0.05$) and insignificant for all other variables. ($p > 0.05$) (Table-1)

Post-operative neck pain was more common in age group ⩾ 50 years (74.3% vs 59.6%), females (73.9% vs 62.5%), smokers (67.4% vs 63.6%), diabetics (74.4% vs 58.3%), hypertensives (67.6 % vs 53.8%) and patients suffering from COAD (92.9% vs 60.3%). It was also more frequent in subjects who had hypercholesterolemia (66.7% vs 55.6%). Those who underwent CABG developed neck pain in greater frequency than those having VR or SD repair (70.4% vs 58.6% and 50% respectively).The relationship of neck pain was significant only for COAD ($p < 0.05$) and insignificant for all other variables. ($p > 0.05$) (Table-2)

Musculoskelatal chest-wall pain was more common in age group ⩾ 50 years (97.1% vs. 94.2%), males (96.9% vs. 91.3%), smokers (100% vs. 90.9%), diabetics (100% vs. 91.7%), and patients suffering from COAD (100% vs. 94.5%). Those who were operated for VR were having more chances to develop chest-wall pain than those had CABG or repair of SD (100% vs 96.3% and 50%). However, those who had hypertension or hypercholesterolemia were less likely to develop shoulder pain (94.6% vs 100% and 94.9% vs 100% respectively).The relationship of shoulder pain was significant for the type of operation ($p < 0.05$) and insignificant for all other variables ($p > 0.05$) (Table-3).

DISCUSSION

The prevalence of CPOP is found quite variable in review of the literature. Eisenberg and colleagues have reported a prevalence of 56% of chest-wall pain among patients who had undergone CABG.[5] Eng and Wells mentioned that 23% of their sample experienced chest-wall pain one year or more after surgery.[6] Meyerson et al. discovered that 28% of a total of 318 patients reported chest discomfort different from what they experienced before surgery.[7] Mailis et al. found

Table 3: Relationship of Different Variables with the Development of Chest-wall Musculoskeletal Pain after open-Heart Surgery

Variable	Sub Variables	Present n (%)	Absent n (%)	P-Value
Age group	< 50 years	49 (94.2)	3 (5.8)	0.65
	⩾ 50 Years	34 (97.1)	1(2.9)	
Gender	Male	62(96.9)	2 (3.1)	0.28
	Female	21 (91.3)	2 (8.7)	
Type of operation	CABG[1]	52 (96.3)	2 (3.7)	0.04
	Vr[2]	29 (100)	0	
	SD[3] Repair	2 (50)	2 (50)	
Smoking	Yes	43 (100)	0	0.12
	No	40 (90.9)	4 (9.1)	
Hypertension	Yes	70(94.6)	4 (5.4)	1.0
	No	13 (100)	0	
Diabetes Mellitus	Yes	39 (100)	0	0.12
	No	44 (91.7)	4(8.3)	
Hypercholesterolemia	Yes	74(94.9)	4(5.1)	1.0
	No	9(100)	0	
COAD	Yes	14 (100)	0	1.0
	No	69 (94.5)	4 (5.5)	

CABG: coronary artery bypass grafting, VR:Valve replacement, SD: Septal defects, COAD: Chronic obstructive airway disease.

evidence for persistent pain in only 15% of their patients.[8] Other studies subjected on the prevalence of CPOP have been summarized in table-4.[9-17]

The differences in the prevalence of pain between studies may result from varied definitions of CPOP, different sample sizes, variable follow-up periods and might be from differences in the surgical techniques used.

In our study, we unfortunately could not identify the prevalence of CPOP because of the restrictions in sampling of subjects, however, the frequency of different locations of CPOP could be identified. In our sample, majority of the patients had musculoskeletal pain in chest wall, (95.4%) followed by pain in shoulder (89.7%) and neck (65.2%). In a comparable study, Marie-Christine et al. reported CPOP localized in the thorax area being most common (84.5%) followed by pain in shoulders and neck together making 43%.[3] Considering the pain intensity, we found that maximum number of patients (77/88.5%) had pain of moderate intensity i.e. VAS score: >30 to 70mm. Meyerson et al. came up with different results and found that maximum patients (37/48.7%) with CPOP reported pain of minimal

Table 4: Chronic Post-operative Pain after Heart Surgery: A Review of Different Studies

S. No	The Study	Sample Size	Duration of follow up	Estimated Prevalence of symptoms
1.	Conacher I[9]	3109	⩾3 months	5%
2.	Nomori H et al.[10]	50	6 months	Antero-axillary thoracotomy 8% Postero-lateral thoracotomy 12%
3.	Keller SM et al.[11]	238	>3 months	11%
4.	Richardson J et al.[12]	883	⩾2 months	22%
5.	Landreneau RJ et al.[13]	343	>3 months	lateral thoracotomy 44% Video assisted surgery30%
6.	Kalso E et al.[14]	134	⩾ 6 months	44%
7.	Katz J et al.[15]	23	1.5 Years	52%
8.	Dajczman E et al.[16]	56	⩾2 months	54%
9.	Matsunaga M et al.[17]	77	6-18 months	67%

intensity.[7]

Our results showed that the development of CPOP at shoulder was significantly linked to the presence of DM. The age, gender, smoking, hypertension, COAD, hypercholesterolemia and the type of operation were not the significant predictors of CPOP at shoulder. The relationship of post-operative neck pain was significant only for COAD and insignificant for all other variables. Likewise, post-operative musculoskeletal chest-wall pain was significantly related to the type of operation but not to other variables. Comparably, results of work by Marie-Christine and associates have shown that advanced age, gender, body mass index and the type of operation were not significant risk factors of CPOP. These results contradict the findings of Kalso et al and Bruce et al, who concluded that some significant relationships existed between CPOP, younger age and obesity.[18-19]

The presence of CPOP after cardiac surgery is not surprising when magnitude of trauma is considered. CABG, valve replacement or other operations involve sawing the sternum, rib retraction and invasion of muscle and visceral tissues thus impinging many pain-sensitive structures. Although the precise pathophysiology remains unclear, different theories have suggested that post-operative chest wall pain might be due to iatrogenic nerve injury, nerve entrapment, fractured ribs, musculoskeletal trauma during operation, sternal non-union or separation of costal cartilages from sternum, pressure due to sternal wires, wound dehiscence or infection.[20,21] Continued rest after surgery adopting bad ergonomic postures may be the basis of neck pain and may result in shoulder pain after development of adhesive capsulitis. The pain may be nociceptive, neuropathic or mixed type and can persist for

variable periods of time after operation.

There were few limitations of the study. The sampling of the subjects for the study was restricted to only those who developed some pain after open-heart surgery. The study sample of one hundred was small considering the fact that heart diseases affect more than 30% of population over 45 years in Pakistan.[22] Moreover the study was carried out in a military health care institute and the results might not be truly representative of general Pakistani population who undergo surgery for a heart disease.

Pain after cardiac surgery is intense owing to stress response and tissue trauma that exceeds most other types of surgery. The findings from this study are important in the care of patients with CPOP because it is one of the initial efforts in this region to study such problems. The findings may provide basis for formulation of clinical guidelines for improved rehabilitation of these patients. We hope that this study opens new vistas in research for the problems of CPOP patients, which will be greatly beneficial to the patients and the health care resources of Pakistan, both in the short term and in the long run.

CONCLUSION

CPOP in our sample was found located primarily in the chest-wall. The pain perceived in the majority was moderate in intensity. Significant relationship existed between CPOP at shoulder and DM, CPOP in neck and COAD and CPOP in the chest-wall and the type of operation. Age, gender, smoking, hypertension and hypercholesterolemia did not appear to predict CPOP development.

REFERENCES

1. Murray CJ, Jamison DT, Lopez AD, Ezzati M, Mathers CD. Global burden of disease and risk factors. Washington, DC: World Bank and Oxford University Press; 2006.
2. Nishtar S. Prevention of coronary heart disease in south Asia. Lancet 2002;360:1015-8.
3. Taillefer MC, Carrier M, Bélisle S, Levesque S, Lanctôt H, Boisvert AM, et al. Prevalence, characteristics, and predictors of chronic nonanginal postoperative pain after a cardiac operation: a cross-sectional study. J Thorac Cardiovasc Surg 2006;131:1274-80.
4. Aveyard B, Schofield P. Visual analogue scale. In: Schofield P, editor. The management of pain in older people. West Sussex: John Wiley & Sons Ltd; 2007.
5. Eisenberg E, Pultorak Y, Pud D, Bar-El Y. Prevalence and characteristics of post coronary artery bypass graft surgery pain (PCP). Pain 2001;92:11-7.
6. Eng J, Wells FC. Morbidity following coronary artery revascularisation with the internal mammary artery. Int J Cardiol 1991;30:55-9.
7. Meyerson J, Thelin S, Gordh T, Karlsten R. The incidence of chronic post-sternotomy pain after cardiac surgery: a prospective study. Acta Anaesthesiol Scand 2001;45:940-4.
8. Mailis A, Umana M, Feindel CM. Anterior intercostal nerve damage after coronary artery bypass graft surgery with use of internal thoracic artery graft. Ann Thorac Surg 2000;69:1455-8.
9. Conacher I. Therapists and therapies for post-thoracotomy neuralgia. Pain 1992;48:409-12.
10. Nomori H, Horio H, Fuyuno G, Kobayashi R. Non-serratus-sparing antero-axillary thoracotomy with disconnection of anterior rib cartilage improvement in postoperative pulmonary function and pain in comparison to posterolateral thoracotomy. Chest 1997;111:572-6.
11. Keller S, Carp N, Levy M, Rosen S. Chronic post thoracotomy pain. J Cardiovasc Surg 1994;35:161.
12. Richardson J, Sabanathan S, Mearns A, Sides C, Goulden C. Post-thoracotomy neuralgia. Pain Clin 1994;7:87-97.
13. Landreneau RJ, Mack MJ, Hazelrigg SR, Naunheim K, Bowling RD, Ritter P, et al. Prevalence of chronic pain after pulmonary resection by thoracotomy or video-assisted thoracic surgery. J Thorac Cardiovasc Surg 1994;107:1079-85.
14. Kalso E, Perttunen K, Kaasinen S. Pain after thoracic surgery. Acta Anaesthesiol Scand 1992;36:96-100.
15. Katz J, Jackson M, Kavanagh BP, Sandler AN. Acute pain after thoracic surgery predicts long-term post-thoracotomy pain. Clin J Pain 1996;12:50-5.
16. Dajczman E, Gordon A, Kreisman H, Wolkove N. Long-term post-thoracotomy pain. Chest 1991;99:270-4.
17. Matsunaga M, Dan K, Manabe F, Hara F, Shono S, Shirakusa T. Residual pain of 90 thoracotomy patients with malignancy and non-malignancy. Pain 1990;41:S148.
18. Kalso E, Mennander S, Tasmuth T, Nilsson E. Chronic post-sternotomy pain. Acta Anaesthesiol Scand 2001;45:935-9.
19. Bruce J, Drury N, Poobalan A, Jeffrey R, Smith W, Chambers W. The prevalence of chronic chest and leg pain following cardiac surgery: a historical cohort study. Pain 2003;104:265-73.
20. Moore R, Follette DM, Berkoff HA. Poststernotomy fractures and pain management in open cardiac

surgery. Chest 1994;106:1339-42.

21. Sharma AD, Parmley CL, Sreeram G, Grocott HP. Peripheral nerve injuries during cardiac surgery: risk factors, diagnosis, prognosis, and prevention. Anesth Analg 2000;91:1358-69.

22. Nuri M, Nawaz A, Usman H. A proposed study of risk factors of heart disease in rural population of Punjab (Pakistan)-Time to act. Pak Heart J 2012;42-7.