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Original Research Article

Shoulder Joint Dysfunction in Patients with Cardiac Device Implantation

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ABSTRACT

Background: Fear associated with dislodgement or fracture of pacemaker lead is common following cardiac device implantation, hence immobilization of the upper extremity of the site of device implantation is advised. It has been an observation that these patients eventually have shoulder dysfunction. This study aimed to assess the dysfunction of shoulder joint in patients following cardiac device implantation with respect to range and scapular posture and measure the disability associated with it at two weeks and four weeks post implantation.
Method: It was a prospective observational study where 72 patients of either sex in the age group of 20-80 yrs who were admitted for cardiac device implantation for the first time, at a tertiary care hospital of Mumbai were enrolled. Patients with pre-existing shoulder complex dysfunction or not willing to participate in evaluation and refused to provide consent were excluded from the study. After recording of demographic details patients were asked to fill self-reported questionnaire to evaluate Shoulder Pain and Disability Index score (SPADI Score). Shoulder joint range of motion was measured using a universal goniometer. Scapular posture was measured at three levels in centimetres using a measuring tape. Measurements were recorded pre implantation, at 2 weeks and 4 weeks post implantation.
Statistical analysis was done using SPSS version 16.0. Friedman Anova test was applied for SPADI score, repeated measure Anova test was applied for the Shoulder range of motion and Scapula posture.
Results: A highly significant reduction in all the ranges of Shoulder joint ($p<0.05$) was observed at the end of 2 weeks. A trend towards significant gain in range of motion was seen at the end of 4 weeks however the ranges did not reach baseline levels. A greater reduction was observed in external rotation, abduction and extension range at the shoulder joint. Similarly scapula posture was altered at all 3 levels ($p< 0.05$) post 2 week of implantation of cardiac devices, it returned to baseline at end of 4 weeks. On evaluation of SPADI an increased disability was seen with score of pain and disability ($p<0.05$) post 2 week of implantation of cardiac devices with a reduction in SPADI score indicating improvement at the end of 4 weeks.
Conclusion: A significant dysfunction is observed in shoulder range of motion along with altered scapular posture at the end of two weeks post implantation. This resulted in increase in disability index as measured on SPADI. A trend was observed towards improvement in ranges and reduced disability at the end of 4 weeks however it did not return to baseline values.
Keywords- Shoulder dysfunction, Pain, Range of motion, Implanted cardiac devices

INTRODUCTION

Cardiac prosthetic devices have become integral part of modern cardiovascular medicine with exceeding number of pacemaker's, implantable cardioverter defibrillators (ICD's) and

cardiac resynchronization therapy per year globally. A cardiac pacemaker plays an important role in the treatment of cardiac rhythm disturbances, whereas ICDs target primarily patients at risk for life-threatening ventricular arrhythmias. [1] Role for physical therapy interventions and its impact on patients' lives with cardiac devices have changed tremendously with increased technology. [2,3] Although cardiac devices have prolonged the lives of countless patients, they have also paradoxically placed these same patients at risk for a number of complications, including infections, shoulder stiffness and pain. [4]

The pectoral approach to implantation of cardiac devices is a standard therapy because of reduced generator size, weight, and volume. Depending upon the location type (venous access, pocket lead and generator) it is possible to dissect several different clinical presentations of complications related to pacemaker implantation which occur, more frequently, in the immediate post-operative course. [2] Worst scenario for a normal healing process is exhausting physical activity. As a general rule shoulder joint is strictly immobilized for atleast 72 hrs following implantation with restricted use of shoulder on implanted site thereafter. A common advice is generally given to not to raise the shoulder above the head due to fear of dislocation of lead. This restricts the shoulder movements leading to shoulder dysfunction. Pain associated with injury to the musculoskeletal system can be secondary to the initial placement of the pocket, device migration, or trauma.

Shoulder range is needed for functionality in activities of daily living (ADL), where shoulder allows the use of hand in space. There is increased probability of decrease in range of motion (ROM) at the shoulder joint and affection of ADL due to immobilization of shoulder. Hence the aim of the study was to assess shoulder joint dysfunction in patients following cardiac device implantation, with an objective to compare ROM of shoulder joint, scapular posture and shoulder pain and disability index (SPADI) at two and four weeks post implantation.

MATERIALS AND METHODS

It was a prospective observational study. Ethical approval was taken from the Institutional Ethics committee. A total of approximately 150 patients were screened. 72 patients who were admitted for cardiac device implantation for the first time, in the age group of 20 to 80 years at a tertiary care hospital of Mumbai were enrolled. Patients with pre-existing shoulder complex dysfunction or not willing to participate in evaluation, or who refused to provide consent were excluded from the study. Pre implantation demographic details, age, gender, occupation, and dominance were recorded.

Three provocating shoulder test Hawkins Kennedy, Drop arm and Empty can were performed to rule out any pre-existing shoulder injury or impingement. [5] Post implantation pain on Visual Analog Scale, site of device implantation, incision and surgical notes were noted, duration of upper limb immobility, complication and its associated disorder and any other associated cardiac or medical morbidity was also noted.

As per standard protocol, post implantation the shoulder was draped with electro crepe pressure bandage which covered the suture site and immobilized the shoulder for two- three days. The patients were discharged with the general advice not to move the shoulder joint or use the arm. The first follow up was at end of 2 weeks and second at end of 4 weeks post implantation. Patients were evaluated for shoulder ROM (flexion, extension, abduction, adduction, internal and external rotation) using a universal goniometer and scapular posture [5] at three level i.e. (superior angle to T2 spine, root of spine of scapula to T4 spine, inferior angle to T8 spine), was measured in centimeters using a measuring tape. SPADI [6-8] Score was noted using a self-administered questionnaire.

SPADI scale measures the severity of pain and how much difficulty he/she experiences in tasks related to upper extremity. It consists of two dimensions, Pain & Disability with a total score of 130 points. Higher score indicates greater amount of disability. The standardized response mean for the SPADI ranged from 1.04 to 1.54.

Patients were asked to use a visual analogue scale (VAS) to report the present level of pain and new onset of shoulder pain or discomfort. Score ranged from 0 to 10 cm where 0 cm is no pain and 10 cm is pain at worst. Higher VAS score equates to worse pain and less shoulder mobility. [9]

Statistical analysis: Analysis was carried out using SPSS 16.0 version, Shoulder joint ranges in degree and scapula postures in centimeter were analyzed by using repeated measure ANOVA test. Shoulder Pain and Disability Index scores were analyzed using Friedman ANOVA test. Level of significance was established at p value <0.05.

RESULTS

Out of 72 patients enrolled there were 52 males (72%) and 20 females (27%) with mean age of 62.2±16.7yrs. Thirty six patients were in the age group of 61-80yrs whereas nineteen were in the age group of 40-60 and seventeen in age of 21-40 yrs respectively.

The device was implanted on left pectoral pouch in all the patients. Sixty two patients received permanent pacemaker implantation, six received cardiac resynchronization therapy and four patients underwent Intra cardiac defibrillator implantation.

As seen in Table 1, there was significant ($p<0.05$) reduction in all ranges of shoulder joint at two weeks followed by improvement in the range at four weeks ($p<0.05$). Pairwise comparisons and adjustment for multiple comparisons as seen in Table 2 shows that mean difference between baseline and week 2 and week 4 was significant at $p< 0.05$ level. The mean range of flexion and extension at shoulder joint reduced significantly at the end of two weeks by 87.2^{o} and 37.3^{o}respectively. The mean range of abduction reduced by 91.1^{o} at end of 2nd week. The range of internal rotation reduced by 46.5^{o} whereas external rotation reduced 45.9 degrees. There was gain in range at the end of 4 weeks compared to 2^{nd} week. At the end of 4th week flexion range of motion improved by a mean 13.6 degrees and extension range of motion improved by 8.87 degrees. The mean range of abduction improved by 20.65 degrees at end of 4 weeks. The range of internal rotation improved by 13.48 degrees and external rotation improved by mean by10.29 degrees at the end of 4 weeks.

Table 1 Mean comparison of range of shoulder joint, Scapula distance and SPADI scores

Range in degrees	Pre	End of 2 weeks	End of 4 weeks	p value*
Flexion	180	92.8	105.86	S
Extension	59.85	22.53	31.44	S
Abduction	180	88.98	109.63	S
Internal rotation	79.56	32.75	46.23	S
External rotation	70	24.13	34.42	S
Scapular Distance from spine in cms				
SA to T2	8.81	9.71	8.78	S
RS to T4	8.81	9.71	8.78	S
IA to T8	8 .81	9.71	8.7 8	S
Shoulder Pain and Disability Scores				
Mean Pain	0	70.63	47.85	S
Mean Disability	0	54.98	34.46	S
Total Score	0	62.8 8	41.07	S

*S=Significant at p<0.05; NS= Non significant

On evaluating scapular position at three levels (Table 1 and 2) there was a significant increase in the scapular distance at all three levels at 2^{nd}wk indicating altered posture followed by return to baseline markers at 4^{th}week. This showed that there

was a clear impact of cardiac device implantation on the shoulder movements altering the scapular humeral rhythm however it was restored significantly at the end of 4 weeks.

The disability index SPADI Scale scores (Table 1) obtained were compared in 2 different segments i.e. mean pain score and mean disability score. The mean Pain score increased to 70.63 at the end of two weeks and reduced to 47.85 at the end of four weeks. The mean disability score was 54.98 at the end of two weeks and reduced to 34.46 at the end of four weeks. The total SPADI score was 62.88 at the end of two weeks and reduced to 41.07 at the end of four weeks. Reduction in disability scores indicated improvement in function.

Table no 2: Pairwise comparison of shoulder joint ranges.

				Std. Error		95% Confidence Interval for Difference[a]	
	(I)	(J)	Mean Difference degrees (I-J)		P value	Lower Bound	Upper Bound
Factor 3=post 4 weeks Factor 2=post 2weeks Factor 1= baseline							
Flexion	3	1	-74.130*	1.534	<.005	-77.897	-70.364
		2	13.043*	.663	<.005	11.417	14.670
Extension	3	1	-28.406*	.711	<.005	-30.152	-26.660
		2	8.913*	.515	<.005	7.649	10.177
Abduction	3	1	-70.362*	1.054	<.005	-72.950	-67.774
		2	20.652*	.792	<.005	18.707	22.597
Internal Rotation	3	1	-33.333*	.988	<.005	-35.759	-30.907
		2	13.478*	.639	<.005	11.910	15.047
External Rotation	3	1	-35.580*	.776	<.005	-37.485	-33.674
		2	10.290*	.411	<.005	9.280	11.300

a. Adjustment for multiple comparisons: Bonferroni.

Based on estimated marginal means *. The mean difference is significant at the p< 0.05 level.

Table no 3: Pairwise comparison of Spine of Scapula.

	(I)	(J)	Mean Difference cms (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
						Lower Bound	Upper Bound
Factor 3= post 4 weeks Factor 2=post 2weeks Factor 1= baseline							
(SA to T2)	3	1	.971*	.231	.000	.404	1.538
		2	1.775*	.242	.000	1.182	2.368
(RS to T4)	3	1	-.406	.275	.434	-1.081	.269
		2	-2.167*	.274	.000	-2.840	-1.494
(IA to T8)	3	1	-.261*	.089	.014	-.480	-.042
		2	-1.159*	.192	.000	-1.631	-.688

Based on estimated marginal means *. The mean difference is significant at the p <0.05 level.
a. Adjustment for multiple comparisons: Bonferroni.

DISCUSSION

Our study inferred that there is a significant shoulder joint dysfunction in patients with cardiac device implantation. All Shoulder ranges were found to be reduced which also supports the findings of the study by Thakur et al [10] who reported that 12 % of patients with sub pectoral implantation had major shoulder problems; Daniel et al [11] reported a high incidence of shoulder related morbidity following implantation. On examination external rotation, abduction and extension were observed to be more affected followed by internal rotation and flexion. The scapula posture was altered at all three levels at end of 2 weeks. Most of the patients had trigger points in trapezius and deltoid muscles. They also complained of pain along the pectoralis muscle. This could be due to acute spasm of the pectoralis, serratus anterior, deltoid muscle because of the sub pectoral pocket created for implantation. The muscle weakness and imbalance in the rotator cuff and scapula is most likely to develop as patients tends to guard the implantation site due to pain and post operative instruction of not to move the arm with fear of potential complications. This results in positional change of scapula into

anterior tilt and downward rotations caused by tightness of the pectorals group and weakness of the serratus anterior and other shoulder girdle muscles because of disuse.

SPADI showed a significant increase in pain scores and disability index of the patients which persisted even after a month. Though there was a trend in significant improvement in the ranges and reduction in disability at the end of four weeks it did not return to normal. Implantation of the device in non dominant upper extremity eliminated the need of use of the extremity during basic chores. Also majority of patients were males hence many household tasks which are predominantly female oriented in Indian scenario were naturally eliminated. Indian costumes like wearing a *saree* or tying long hair which is more of female oriented task were not reflected in evaluation of disability y SPADI. The most common activity affected was wearing an overhead Tee shirt or inner wear. The female population found difficulty in most of the instrumental household task where cooking was concerned and in their dressing activities. There was a general fear associated with carrying any kind of weights and doing task like sweeping, mopping. These were avoided by all.

The instructions for immobilization of the shoulder joint have been part of formal pacemaker implant advice. Although we encourage our patients to avoid complete shoulder inactivity and advice against the shoulder use of slings, an absolute fear of moving the extremity and damaging the pacemaker limits arm mobility on the ipsilateral side to a more significant degree than it is desirable. Our study is supported by Z Nazari et al [12] who reported major shoulder related complications after pectoral ICD implantation.

Korte and colleagues [3] followed up 50 patients who received the sub pectoral ICD. They reported ipsilateral pain in 62% of the cohort and symptoms of insertion tendonitis in 42% almost all the affected patients demonstrated impaired shoulder mobility for 12 hours. Shoulder pain was seen mostly in the patients with immobility lasting after the first 24 hours (31.4%) and during the first implantation 24 hours (18.2%). P Magnusson [13] in his study reported favourable patient reported outcomes with respect to cosmetic results, shoulder movement, and sleep which contradict our observation. Shoulder range above 90 degrees is commonly used for activities as removing things from shelf and upper body dressing. This range seems to be largely affected post immobilization. Due to prolonged inactivity at shoulder complex, recovery of range is not complete and a slow process. Participation in a supervised exercise training program can greatly enhance the follow-up and management of pacemaker-dependent patients as well as afford them the opportunity to experience the physical and psychological benefits typically associated with cardiac rehabilitation. [14,15]

CONCLUSION

The incidence of pain and disability and decrease in range of motion and scapula posture dysfunction was a common finding in our study. In the majority of our patients with pain, complications such as immobility and range of motion restriction and scapula postural abnormality were frequently seen, and there were marked increased in the SPADI Scale score of pain and disability at the end of 2 weeks post implantation. This was followed by a trend towards improved range at end of four weeks.

For all the recent technological headway in cardiac rhythm management, post implantation complication in the pectoral and shoulder regions continues to negatively impact the quality of life, shoulder pain and disability in the first post implantation year is an overlooked complication of device implantation. Hence there is a need to maintain balance between immobilization and supervised graded shoulder mobilization to preserve the range at shoulder joint complex and reduce dysfunction and disability.

Limitations of study

As majority of the patients were from outside the Mumbai and Maharashtra therefore long term evaluation for 6 months and one year could not be done.

Clinical implication

The commonly used practice of limiting shoulder mobility after device implant appears to contribute to morbidity and dysfunction related to shoulder. A safe graded exercise programme may be effective at preventing shoulder joint dysfunction.

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