Journal of Health Sciences
Volume 3, Issue 6 – 2025

Evaluation of shoulder function and quality of life in patients with cardiac implantable electronic devices

Thi Van Khanh Nguyen[1]*, Thai Duy Vo[2]

ABSTRACT

Objective: Assessment of Shoulder Joint Function and Quality of Life in Patients with Cardiac Implantable Electronic Devices. ***Background:*** Some common complications after cardiac implantable electronic device implantation include shoulder pain, reduced range of motion, impaired shoulder function, and decreased quality of life after device placement, which may persist thereafter. ***Methods:*** A retrospective cohort study at a hospital in Southern Vietnam from February 2023 to February 2025. **Results:** The study included 116 patients who underwent cardiac implantable electronic device implantation. Women accounted for 45.7%, and the mean age was 64.5 ± 14.5 years. Common comorbidities were hypertension (52.6%), diabetes mellitus (53.4%), dyslipidemia (48.3%), and chronic coronary artery disease (42.2%). The implanted devices were predominantly dual-chamber pacemakers (49.1%) and single-chamber pacemakers (40.5%), followed by ICDs (7.8%) and CRT devices (2.6%). The most frequent indications were sick sinus syndrome (44.0%) and atrioventricular block (45.7%). Shoulder pain (VAS) increased markedly immediately after implantation (0.14 ± 0.09 pre-implantation to 7.85 ± 1.06 post-implantation), then gradually decreased at 1 month (4.53 ± 0.92) and 3 months (1.55 ± 0.93), remaining significantly different from baseline at all time points ($p < 0.001$). Upper-limb function assessed by QuickDASH deteriorated sharply immediately after implantation (1.31 ± 1.13 pre-implantation to 79.53 ± 6.90 post-implantation), with progressive improvement at 1 month (33.33 ± 7.49) and 3 months (11.97 ± 6.99) ($p < 0.001$ vs baseline). Health-related quality of life (SF-36) improved after implantation and continued to increase over time: 46.01 ± 10.06 (pre-implantation), 58.54 ± 12.39 (post-implantation), 77.54 ± 12.04 (1 month), and 81.97 ± 7.92 (3 months) ($p < 0.001$). **Conclusion:** After cardiac implantable electronic device implantation, patients commonly experience shoulder pain and marked early upper-limb functional limitation, reflected by a sharp immediate increase in VAS and QuickDASH scores. These measures gradually improved over time, with substantial recovery by 3 months, while quality of life (SF-36) increased significantly. These findings suggest that shoulder symptoms should be routinely monitored and that early rehabilitation interventions may help reduce pain, restore mobility, and optimize quality of life after device implantation.

Keywords: *upper limb dysfunction, quality of life, shoulder pain, cardiac implantable electronic devices.*

[1] *Can Tho University of Medicine and Pharmacy, Can Tho city, Vietnam*
[2] *Pham Ngoc Thach University of Medicine, Ho Chi Minh city, Vietnam*

*** Corresponding author**
Thi Van Khanh Nguyen
Email: nguyenthivankhanh0@gmail.com

Received: December 2, 2025
Reviewed: December 3 , 2025
Accepted: December 24, 2025

INTRODUCTION

Permanent pacemakers are widely used to treat bradyarrhythmias and to prevent

sudden cardiac death. Although pacemaker implantation is considered a minimally invasive procedure, approximately 10% of patients experience at least one post-procedural complication1. In addition to complications related to venous access, leads, and the pulse generator, shoulder-related problems have also been recognized as clinically relevant adverse outcomes after CIED implantation. Most patients report mild incisional discomfort and bruising shortly after the procedure; however, chronic shoulder pain and impaired shoulder function have been reported with notable frequency. Coşgun et al. (2023) emphasized that chronic complications such as reduced shoulder range of motion may result in prolonged disability and diminished quality of life2. Notably, patients who were recently implanted (<3 months) had greater limitation than those with longer implant duration (>3 months), suggesting partial improvement over time. Martignani et al. (2020) followed 50 ICD recipients for up to 5 years and found that, while shoulder function declined and mild pain occurred with a reduction in SF-36 scores at 2 weeks post-implantation, shoulder function improved substantially by 3 months and returned to near-normal by approximately 1 year; pain decreased and quality of life was restored accordingly3. Wongcharoen et al. (2019) conducted a randomized controlled trial in 200 patients, comparing immediate post-procedural pendulum exercises with usual care. At 1 month, the early-exercise group had a significantly lower rate of reduced shoulder ROM (e.g., limitation in shoulder flexion: 16.8% vs 40.4% in the control group; $p<0.001$) and significantly better (lower) QuickDASH scores (15.2 ± 16.4 vs 23.4 ± 18.1; $p=0.001$)4.

Therefore, from a cardiovascular perspective, pacemaker implantation clearly improves symptoms and prognosis, thereby enhancing overall quality of life (QoL) in patients with arrhythmias1. Nevertheless, musculoskeletal complications-particularly shoulder pain and restricted shoulder mobility-may partially offset these gains in quality of life.

SUBJECTS AND METHODS

Study population

All patients who underwent permanent pacemaker implantation between February 2023 and February 2025 were eligible for inclusion.

Study design: A retrospective cohort study.

Sample size: A convenience sample was used, including all consecutive patients who received a pacemaker during the study period.

Study variables

Clinical characteristics: reason for admission, diagnosis, age, sex, and other baseline clinical data.

Complications and device-related parameters: peri- and post-implantation complications and pacing-related variables

Statistical analysis

Data were collected and analyzed using Microsoft Excel 2016 and SPSS version 26. Continuous variables are presented as mean ± standard deviation, and categorical variables as frequency and percentage. Between-group comparisons were performed using the paired t-test or independent t-test for normally distributed continuous variables, and the Wilcoxon signed-rank test for non-normally distributed continuous variables. Categorical variables were compared using the Chi-square test or Fisher's exact test, as

appropriate. A two-sided p value < 0.05 was considered statistically significant.

RESULTS

Baseline clinical characteristics

During the study period (February 2023 to February 2025), 116 patients undergoing pacemaker implantation were included. Women accounted for 53/116 (45.7%), indicating a relatively balanced sex distribution. The mean age was 64.5 ± 14.5 years, consistent with an older population typical of patients requiring CIED therapy.

Common comorbidities included hypertension in 61 patients (52.6%), diabetes mellitus in 62 (53.4%), dyslipidemia in 56 (48.3%), and chronic coronary artery disease in 49 (42.2%), reflecting a high burden of cardiovascular and metabolic risk.

Regarding device type, most patients received a dual-chamber pacemaker (57/116, 49.1%) or a single-chamber pacemaker (47/116, 40.5%), whereas ICDs accounted for 9/116 (7.8%) and CRT devices for 3/116 (2.6%), indicating that the cohort primarily comprised conventional pacing indications. Accordingly, the most frequent implantation indications were atrioventricular block (53/116, 45.7%) and sick sinus syndrome (51/116, 44.0%), while primary prevention of sudden cardiac death/heart failure accounted for 9/116 (7.8%) and CRT indications for 3/116 (2.6%).

Shoulder pain, upper-limb function, and quality of life

Shoulder pain assessed by the VAS increased markedly immediately after implantation (0.14 ± 0.09 pre-implantation vs 7.85 ± 1.06 post-implantation) and subsequently decreased at 1 month (4.53 ± 0.92) and 3 months (1.55 ± 0.93). Compared with baseline, pain remained significantly different at all post-implantation time points ($p < 0.001$), suggesting prominent early postoperative shoulder pain with gradual improvement over time. Similarly, upper-limb function measured by QuickDASH deteriorated substantially immediately after the procedure (1.31 ± 1.13 pre-implantation vs 79.53 ± 6.90 post-implantation) and improved progressively at 1 month (33.33 ± 7.49) and 3 months (11.97 ± 6.99) (all $p < 0.001$ vs baseline), indicating severe early functional limitation followed by recovery within 3 months. In contrast, health-related quality of life (SF-36) improved continuously after implantation, increasing from 46.01 ± 10.06 at baseline to 58.54 ± 12.39 immediately after implantation, 77.54 ± 12.04 at 1 month, and 81.97 ± 7.92 at 3 months (all $p < 0.001$). These findings suggest an overall improvement in patient-reported quality of life following implantation despite early postoperative shoulder pain and transient functional impairment.

Table 1. *Baseline characteristics of the study population*

Characteristic	Overall
	N = 116
Female sex, n (%)	53 (45.7%)
Age, mean ± SD (year)	64.5 ± 14.5
Hypertension, n (%)	61 (52.6%)
Diabetes mellitus, n (%)	62 (53.4%)

Dyslipidemia, n (%)	56 (48.3%)
Chronic coronary artery disease, n (%)	49 (42.2%)

Table 2. *Device type and indications fo implantation*

Characteristic	Overall
	N = 116
Single chamber, n(%)	47 (40.5%)
Dual chamber, n(%)	57 (49.1%)
Implantable cardioverter defibrillator, n(%)	9 (7.8%)
Cardiac resynchronization therapy, n(%)	3 (2.6%)
Sick sinus syndrome, n(%)	51 (44%)
Atrioventricular block, n(%)	53 (45.7%)
Primary prevention of SCD/ heart failure, n(%)	9 (7.8%)
Cardiac resynchronization therapy indication, n(%)	3 (2.6%)

Table 3. *VAS score before and following after implantation*

Characteristic	Value	p
Pre-implatation	0.14 ± 0.09	
Immediately post-implantation	7.85 ± 1.06	< 0.001
1 month post-implantation	4.53 ± 0.92	< 0.001
3 month post-implantation	1.55 ± 0.93	< 0.001

Table 4. *QuickDASH score before and following after implantation*

Characteristic	Value	p
Pre-implatation	1.31 ± 1.13	
Immediately post-implantation	79.53 ± 6.90	< 0.001
1 month post-implantation	33.33 ± 7.49	< 0.001
3 month post-implantation	11.97 ± 6.99	< 0.001

Table 5. *SF-36 score before and following after implantation*

Characteristic	Value	p
Pre-implatation	46.01 ± 10.06	
Immediately post-implantation	58.54 ± 12.39	< 0.001
1 month post-implantation	77.54 ± 12.04	< 0.001
3 month post-implantation	81.97 ± 7.92	< 0.001

DISCUSSION

In our study (n = 116), the population was predominantly older adults (mean age 64.5 ± 14.5 years), with women accounting for 45.7%. A variety of devices were implanted; however, the majority were single- or dual-chamber pacemakers (single chamber 40.5%; dual chamber 49.1%), with fewer implantable cardioverter-defibrillators (ICDs; 7.8%) and cardiac resynchronization

therapy (CRT) devices (2.6%). The burden of cardiometabolic comorbidities was substantial (hypertension 52.6%; diabetes mellitus 53.4%; dyslipidemia 48.3%; chronic coronary artery disease 42.2%), reflecting a cohort with high baseline risk.

Regarding the temporal course of shoulder-related symptoms, our findings suggest an early "flare" immediately after implantation followed by gradual improvement. VAS pain increased markedly from 0.14 ± 0.09 (pre-implantation) to 7.85 ± 1.06 (immediately post-implantation), then decreased to 4.53 ± 0.92 at 1 month and 1.55 ± 0.93 at 3 months. QuickDASH increased from 1.31 ± 1.13 to 79.53 ± 6.90 immediately after implantation and subsequently improved to 33.33 ± 7.49 at 1 month and 11.97 ± 6.99 at 3 months. In contrast, SF-36 (overall quality-of-life score based on our study's scoring approach) increased progressively over time, from 46.01 ± 10.06 pre-implantation to 81.97 ± 7.92 at 3 months.

In the study by Choi et al. examining patients undergoing CIED implantation (PM/ICD/CRT)5, participants were stratified by whether they continued outpatient shoulder rehabilitation. The mean age was approximately 69–70 years, broadly comparable to our older cohort. However, sex distribution may differ across populations and study designs, which could influence pain perception and the extent of self-limited arm movement after the procedure. For shoulder pain (VAS), Choi et al5. reported a next-day post-implantation VAS of approximately 2.9–3.9, decreasing to around 1.0–1.6 at 30–90 days. In contrast, the "immediately post-implantation" VAS in our study was substantially higher (7.85 ± 1.06) and decreased to 1.55 ± 0.93 at 3 months. This discrepancy may be explained by differences in assessment timing (immediately after the procedure vs the following day), analgesic protocols, postoperative arm-movement instructions, and inter-population variation in pain thresholds.

With respect to upper-limb functional limitation (QuickDASH/DASH), Choi et al5 reported DASH scores of approximately 21–28 on the day after implantation, improving to about 8–18 at 30–90 days (with greater improvement in the rehabilitation group). Our study used QuickDASH and observed a much larger immediate postoperative increase (79.53 ± 6.90) with gradual improvement to 11.97 ± 6.99 at 3 months. Although DASH and QuickDASH are not fully interchangeable, both quantify upper-limb disability on a 0–100 scale; thus, the overall trajectory can be compared: severe early functional limitation with recovery over time, particularly when a structured shoulder-mobilization/rehabilitation program is provided.

Coşgun et al., in a cohort of 200 patients (123 pacemakers and 77 ICDs)6 found higher rates of restricted shoulder flexion and abduction ROM in the ICD group compared with the pacemaker group, while VAS scores were similar between groups. QuickDASH scores were higher in ICD recipients than in pacemaker recipients (median 8.2 vs 4.6), and SF-36 did not differ substantially. These findings suggest that beyond the early postoperative phase, upper-limb disability tends to decrease to mild–moderate levels in most patients; however, ICD implantation (often involving a larger generator than a pacemaker) may be associated with greater ROM restriction and higher QuickDASH scores. Compared with Coşgun et al., our 3-month QuickDASH (11.97 ± 6.99) remained higher than the reported medians, which may be attributable to (1) differences in follow-up

timing (their cohort may have included patients further out from implantation), (2) differences in device-type distribution and postoperative mobilization guidance, and (3) comorbidity profiles—particularly the high prevalence of diabetes mellitus in our sample, a known risk factor for shoulder stiffness.

For quality of life (SF-36), Choi et al reported domain-specific SF-36 outcomes (PF, BP, GH, and composite PHS/MHS), and overall differences between rehabilitation and non-rehabilitation groups were not statistically significant, although outcomes tended to be more favorable in the rehabilitation group. In our study, SF-36 (overall score per our protocol) increased from 46.01 ± 10.06 to 81.97 ± 7.92 by 3 months.

Taken together, our results and the existing literature suggest that post-CIED shoulder symptom monitoring should be considered a core component of post-procedural care, rather than focusing exclusively on pocket- or lead-related complications. Key points include: (i) early screening for pain and mobility limitation during the first days to weeks—when VAS/QuickDASH are typically at their worst; (ii) early, safe shoulder-mobilization guidance (controlled ROM) to prevent adhesive capsulitis; interventional rehabilitation studies generally indicate better pain and functional outcomes with structured programs; and (iii) attention to higher-risk subgroups—patients receiving "larger" devices such as ICDs and those with incision/pocket-related factors may have greater ROM limitation and higher QuickDASH scores and therefore warrant closer counseling and follow-up.

CONCLUSION

In this retrospective cohort study of 116 patients undergoing cardiac implantable electronic device implantation, shoulder pain and upper-limb functional impairment were prominent in the early post-procedural period, as evidenced by a marked immediate increase in VAS pain scores and a concomitant rise in QuickDASH scores. These indices improved progressively over time, with substantial recovery by 3 months of follow-up. Concurrently, quality of life assessed by the SF-36 increased steadily after implantation and continued to improve at 1 month and 3 months. These findings suggest that proactive monitoring of shoulder symptoms and early implementation of rehabilitation interventions are warranted to reduce pain, improve range of motion and upper-limb function, and optimize quality of life after device implantation.

REFERENCES

1. Şimşek E, Uslu Güvendi E, Şimşek A, et al. The effect on upper extremity functions of cardiac electronic device placement on the dominant hand side. J Arrhythm. Apr 2019;35(2):279-286. doi:10.1002/joa3.12156
2. Cosgun C, Cosgun MS, Buyukturan O, Buyukturan B. Functional impact of cardiac implanted devices on ipsilateral shoulder range of motion, scapular mobility, and self-reported quality of life. PLoS One. 2023;18(4):e0284178. doi:10.1371/journal.pone.0284178
3. Martignani C, Massaro G, Mazzotti A, et al. Shoulder Function After Cardioverter-Defibrillator Implantation: 5-Year Follow-up. Ann Thorac Surg. Aug 2020;110(2):608-614. doi:10.1016/j.athoracsur.2019.10.063
4. Wongcharoen W, Petvipusit W, Prasertwitayakij N, et al. Effect of early pendulum exercise on shoulder function after cardiac rhythm management device implantation. J Interv Card Electrophysiol. Sep 2019;55(3):343-347. doi:10.1007/s10840-019-00541-y

5. Choi SS, Son YJ, Kim SJ, et al. Efficacy of Shoulder Rehabilitation Post-Cardiac Implantable Electronic Device Implantation. J Clin Med. Nov 21 2024;13(23)doi:10.3390/jcm13237014
6. Cosgun MS, Cosgun C. Predictors of shoulder limitations and disability in patients with cardiac implantable electronic devices: Importance of device size. Pacing Clin Electrophysiol. Dec 2021;44(12):1979-1986. doi:10.1111/pace.14378