

Permanent Pacemaker Implantation in Southern Morocco: Clinical Characteristics, Implantation Practices, and Outcomes from A Four-Year Single-Centre Study

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Abstract

Original Research Article

Introduction: Permanent cardiac pacing is an established treatment for symptomatic bradyarrhythmias and clinically significant conduction disorders, but contemporary data from southern Morocco remain scarce. This study describes the clinical profile, pacing indications, implantation practices, and short- and mid-term outcomes of patients undergoing permanent pacemaker implantation at a tertiary military hospital in Agadir, Morocco. **Methods:** We conducted a retrospective, single-centre study of 286 consecutive patients who underwent permanent single- or dual-chamber pacemaker implantation between May 2022 and May 2026. Clinical, electrocardiographic, echocardiographic, procedural, and follow-up data were collected from medical records, pacing registries, and consultation reports. **Results:** Mean age was 72.9 ± 13 years, with 51.3% men, and 88.5% were symptomatic at admission. Degenerative conduction disease was the leading cause (72.34%), followed by ischemic heart disease (21.27%), and high-grade atrioventricular block was the predominant indication. Dual-chamber systems were implanted in 86.5% of cases, single-chamber in 13.5%; 66.7% were de novo implantations and 33.3% generator replacements. Twenty patients required temporary pacing. Early complications were limited to pneumothorax (1.25%), seven minor hematomas, and nine lead displacements, with no early infections. Over a median follow-up of three years, three pacemaker dysfunctions, one late pocket infection requiring extraction and reimplantation, and two cases of pectoral stimulation occurred, without deaths. **Conclusion:** In this southern Moroccan cohort, pacemaker implantation predominantly involved elderly patients with high-grade atrioventricular block, dual-chamber pacing was the main strategy, and outcomes were favorable. Larger multicentre studies and national pacing registries are needed to guide future practice and technology adoption.

Keywords: Cardiac pacing; permanent pacemaker; atrioventricular block; bradyarrhythmia; Morocco.

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INTRODUCTION

Permanent cardiac pacing is a well-established treatment for symptomatic bradyarrhythmias and clinically significant disorders of cardiac conduction. High-grade atrioventricular (AV) block remains one of the most frequent indications for permanent pacemaker implantation in contemporary practice [1-3]. Pacemaker recipients are generally older adults with a substantial burden of cardiovascular comorbidity, although the clinical profile varies according to the healthcare system and population studied [4-8].

Across Africa, access to permanent pacing remains heterogeneous. Financial constraints, limited numbers of specialized implantation centres, device availability, supply-chain difficulties, and disparities in healthcare coverage may delay diagnosis and treatment. Published data from several African countries also

remain limited, and national or regional pacing registries are uncommon [1,3,9-11]. In selected resource-limited settings, device reuse has also been discussed as a strategy to improve access, although this remains dependent on local regulatory, ethical, logistical, and infection-control considerations [12,13].

Single- and dual-chamber pacing are established approaches, with device selection determined by the underlying rhythm, presence or absence of atrial activity, clinical indication, patient characteristics, and local practice [14,15]. Contemporary implantation practice also increasingly includes conduction-system pacing and leadless pacemakers, although access to these technologies remains variable.

Data describing contemporary permanent pacing activity in southern Morocco are scarce. We therefore aimed to describe the clinical profile,

indications, implantation characteristics, and short- and mid-term outcomes of patients undergoing permanent single- or dual-chamber pacemaker implantation at a tertiary military hospital in Agadir, Morocco.

MATERIALS AND METHODS

Study Design and Setting

This was a retrospective, descriptive, analytical, single-centre study conducted in the Department of Cardiology of Oued Eddahab Military Hospital, Agadir, Morocco. The study included consecutive patients undergoing permanent pacemaker implantation between May 2022 and May 2026.

Study Population

A total of 286 patients were included. Eligible patients had a clinically established conduction disorder or bradyarrhythmia requiring permanent single- or dual-chamber pacing. Patients with incomplete or non-interpretable medical records were excluded.

Data Collection

Data were obtained from medical records, pacing registries, implantation reports, and follow-up consultations. Variables included demographic characteristics, presenting symptoms, cardiovascular risk factors and comorbidities, electrocardiographic and echocardiographic findings, pacing indication, device type, implantation characteristics, venous access, lead position, temporary pacing requirement, and early and mid-term complications.

Early complications were defined as complications occurring during hospitalization or the immediate postoperative period. Mid-term outcomes were assessed after discharge during scheduled follow-up. Follow-up was generally scheduled at approximately 10 days, two months, and then annually for device

interrogation. The median reported follow-up duration was three years.

Implantation Procedure

All procedures were performed using a prepectoral pocket. Cefazolin 2 g was administered as peri-procedural antibiotic prophylaxis. Venous access was predominantly obtained through the subclavian vein, with cephalic access used in a minority of procedures. Right-sided implantation was the predominant approach. Right ventricular leads were positioned in the apical or septal region according to operator practice and individual anatomy.

Ethical Considerations

Written informed consent for participation and use of clinical data was obtained from all patients. Patient confidentiality and anonymity were maintained throughout data collection and analysis.

Statistical Analysis

Statistical analyses were performed using Jamovi version 2.3.28. Categorical variables were summarized as frequencies and percentages. Continuous variables were summarized as means and standard deviations or medians and interquartile ranges, as appropriate. Comparisons between groups were performed using appropriate statistical tests. A two-sided P value <0.05 was considered statistically significant.

RESULTS

Clinical Characteristics

Among 286 consecutive patients, 139 (48.7%) were women and 147 (51.3%) were men, corresponding to a male-to-female ratio of approximately 1.05. The mean age was 72.9 ± 13 years. Hypertension was the most frequently reported cardiovascular risk factor. Most patients (88.5%) were symptomatic at admission (Figure 1).

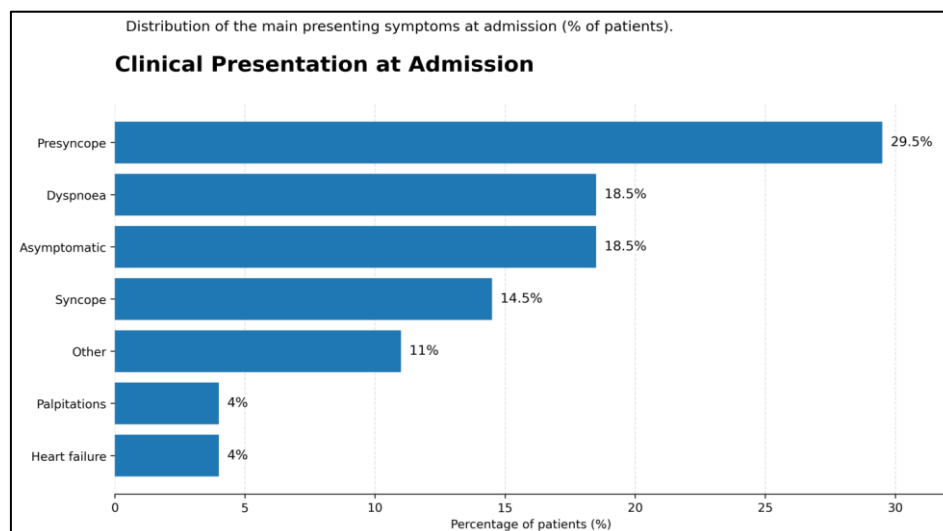


Figure 1: Clinical presentation of patients at admission

Degenerative conduction disease was the predominant identified cause (72.34%), followed by ischemic heart disease (21.27%). Echocardiography was performed in all patients. Approximately half had no

major structural abnormality reported, while hypertensive heart disease was identified in 16%, ischemic heart disease in 25%, valvular disease in 5.8%, and dilated cardiomyopathy in 4% (Figure 2).

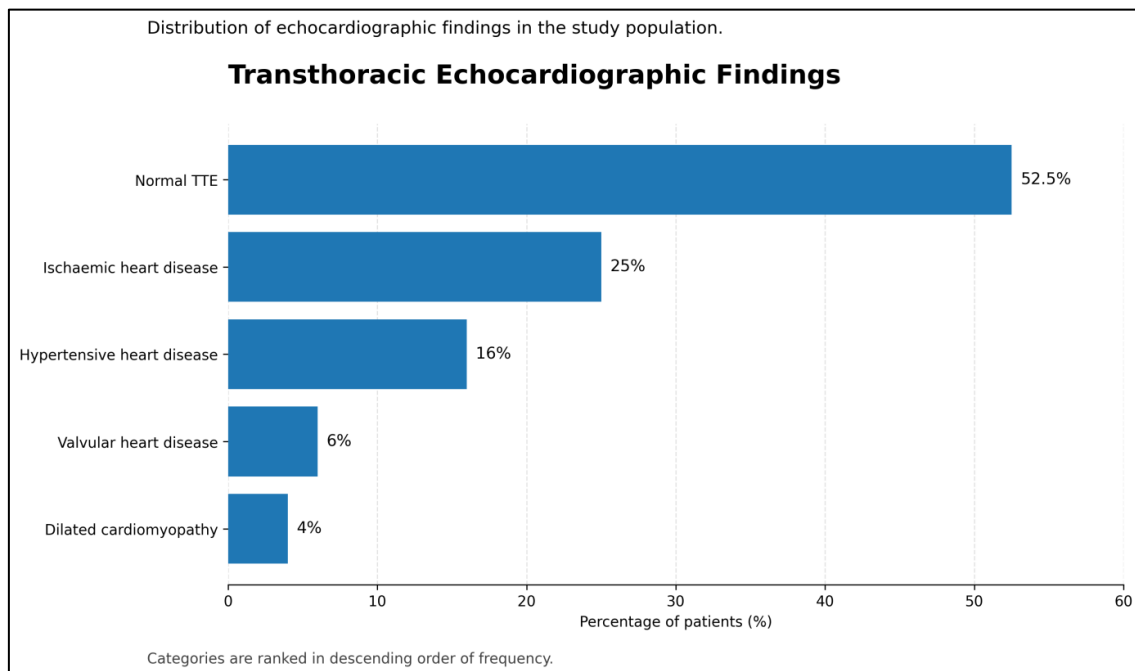


Figure 2: Transthoracic echocardiographic findings

Pacing Indications and Implantation Characteristics

High-grade AV block was the leading indication for permanent pacing, followed by slow atrial fibrillation and sinus node dysfunction. Dual-chamber

pacing was performed in 86.5% of patients, whereas 13.5% received single-chamber pacing. De novo implantation accounted for 66.7% of procedures, while 33.3% were generator replacements (Figure 3).

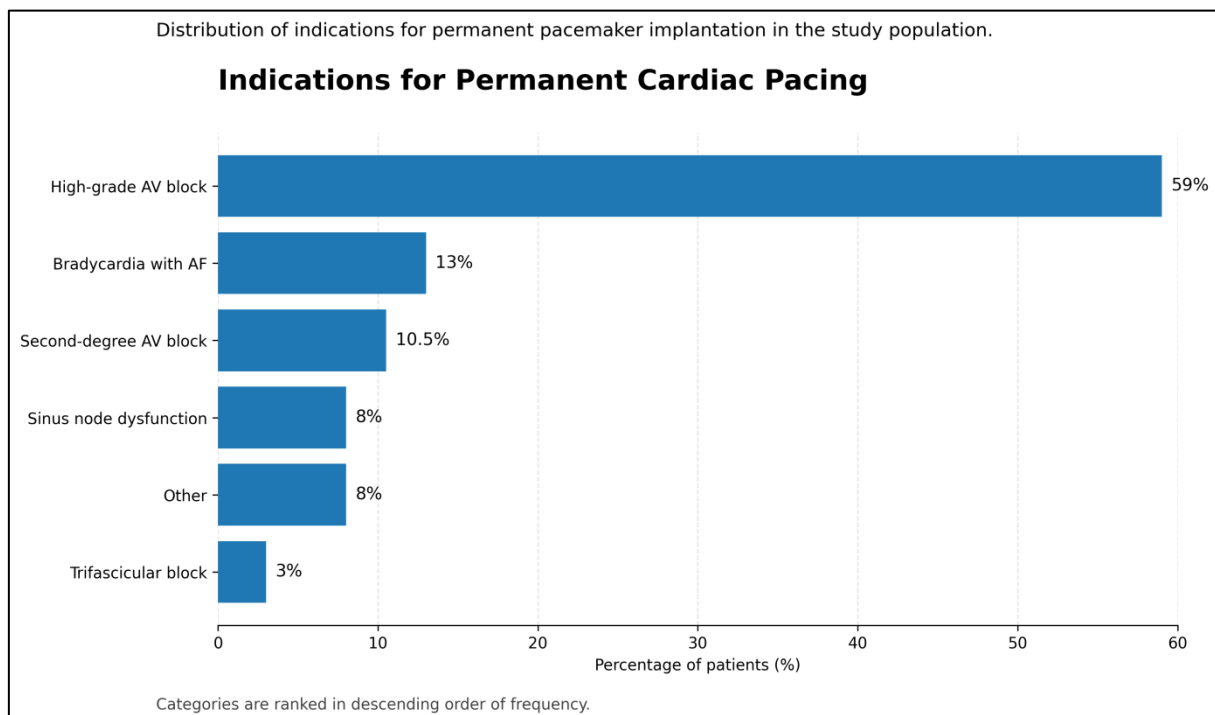


Figure 3: Indications for permanent cardiac pacing

Temporary transvenous pacing was required in 20 patients. Subclavian venous access was used in 98% of procedures and cephalic access in 2%. Implantation was performed on the right side in 96.25% and on the left side in 3.75%. Right ventricular lead placement was apical in 82% and septal in 18%.

Early Complications

Most patients, 277 of 286 (96.9%), experienced no recorded early complication. Pneumothorax occurred in 1.4% of patients and was associated with difficult

subclavian venous access. Seven patients developed minor pocket hematomas; four were receiving antithrombotic therapy. All hematomas resolved with conservative management and compression, without surgical evacuation. No early pocket infections were recorded.

Lead displacement occurred in nine patients, involving the ventricular lead in five cases and the atrial lead in four cases. Lead repositioning was performed when clinically indicated (Table 1).

Table 1: Procedural and follow-up complications

Complication	n	%
Pneumothorax	4	1,40
Pocket hematoma	7	2,45
Lead displacement	9	3,15
Device dysfunction	3	1,05
Pocket infection	1	0,35
Pectoral stimulation	2	0,70
Infective endocarditis	0	0,00

Follow-Up Outcomes

The median follow-up duration was three years. Three cases of pacemaker dysfunction were recorded during follow-up. One was related to ventricular lead displacement and required lead repositioning; two were related to inappropriate programming and were corrected by reprogramming.

One patient with poorly controlled diabetes developed a pocket infection during follow-up. Complete system extraction and intravenous antibiotic treatment were performed, followed by delayed contralateral reimplantation. No infective endocarditis was recorded. Two patients developed pectoral muscle stimulation, which was managed successfully by device reprogramming. No deaths were recorded during the available follow-up period.

DISCUSSION

The present study describes four years of permanent pacemaker activity at a tertiary military hospital in Agadir and provides contemporary real-world data from southern Morocco. The principal findings were the predominance of elderly patients, the high frequency of high-grade AV block as the pacing indication, the predominant use of dual-chamber systems, and a favorable observed complication profile during hospitalization and follow-up.

The mean age of 72.9 years is broadly consistent with the demographic profile reported in several African and international pacemaker cohorts [4-8,16]. The predominance of degenerative conduction disease in our cohort is also clinically plausible in an elderly population. The relatively high proportion of

symptomatic presentations may reflect the severity of conduction disorders leading to referral for implantation. Syncope, presyncope, dizziness, fatigue, and dyspnea are common clinical manifestations of clinically significant bradyarrhythmias and conduction disease.

High-grade AV block was the leading pacing indication in our cohort. Similar findings have been reported in African and other resource-limited settings [2,3,6,9,10,17]. Sinus node dysfunction and slow atrial fibrillation represented additional important indications. Differences between published cohorts may reflect population age, referral patterns, access to ambulatory rhythm monitoring, and local implantation practices.

Dual-chamber systems accounted for 86.5% of implants. This distribution reflects the clinical practice of the participating centre and the predominance of indications for which preservation of atrioventricular synchrony is relevant. Single-chamber pacing remains appropriate in selected patients, particularly those with permanent atrial fibrillation and a need for ventricular rate support [14,15]. The present data should therefore not be interpreted as evidence that one device strategy is universally superior; device selection remains indication- and patient-specific.

The observed early complication profile was favorable. Pneumothorax occurred in 1.25% of patients and was associated with difficult subclavian access. Pocket hematomas were minor and managed conservatively. Lead displacement was the most frequent mechanical complication, consistent with its recognition as an important early complication of pacemaker implantation [6,18,19]. The absence of early pocket

infection and the single later pocket infection requiring extraction are also reassuring, although the retrospective design and single-centre setting limit direct comparison with other series.

Several factors may have contributed to the favorable observed outcomes, including standardized peri-procedural antibiotic prophylaxis, procedural experience, systematic follow-up, and timely management of complications. However, these factors were not formally tested in the present study and should therefore be regarded as possible contributors rather than demonstrated determinants of outcome.

Access to cardiac pacing remains a broader healthcare challenge in many parts of sub-Saharan Africa and other resource-limited environments. Published studies have highlighted limitations related to device cost, availability of specialized centres, trained personnel, follow-up infrastructure, and continuity of device supply [1,3,10,11,16]. Contemporary registries can help quantify these disparities and guide health-policy decisions. In Morocco, the development of larger multicentre datasets and a national pacing registry would provide more representative information on implantation rates, indications, device selection, complications, and long-term outcomes.

Future development of the local pacing program may also include selected use of conduction-system pacing and leadless pacemakers. These technologies may provide advantages in appropriately selected patients, but their implementation requires appropriate training, equipment, patient selection, and long-term follow-up. Their future role in the Moroccan context warrants prospective evaluation.

CONCLUSIONS

This four-year single-centre experience from southern Morocco demonstrates that permanent pacemaker implantation was predominantly performed in elderly patients, with high-grade atrioventricular block representing the leading indication and dual-chamber pacing the predominant device strategy. The observed early and follow-up complication profile was favorable, with most complications managed successfully and no deaths recorded during the available follow-up period. These findings provide useful contemporary data from a region in which published pacing activity remains limited.

Multicentre studies and development of a national pacing registry would be valuable to define the burden of bradyarrhythmias, monitor procedural outcomes, and identify disparities in access to device therapy. Prospective evaluation of conduction-system pacing and leadless pacemakers may also help determine how newer pacing strategies can be integrated into Moroccan practice.

REFERENCES

1. Sama C, Miller TC, Ajibade A, *et al.*, Continental cartography of permanent pacemaker use in Africa: a scoping review. *Ann Clin Cardiol.* 2025. 10.4103/accj.accj_21_25
2. Edafe E, Odia J, Akpa M, *et al.*, Experience with cardiac pacing in the Nigerian Delta region. *Niger J Cardiol.* 2020. 10.4103/njc.njc_28_19
3. Chauhan A, Grace A, Newell S, *et al.*, Early complications after dual chamber versus single chamber pacemaker implantation. *Pacing Clin Electrophysiol.* 1994, 17. 10.1111/j.1540-8159.1994.tb03791
4. Ahmed M: Patients' characteristics, indications, and complications of permanent pacemaker implantation: a prospective single-center study. *Med J Babylon.* 2022, 19:152-156. 10.4103/mjbl.mjbl_3_22
5. Onakpoya U, Ojo O, Eyekpegba OJ, *et al.*, Early experience with permanent pacemaker implantation at a tertiary hospital in Nigeria. *Pan Afr Med J.* 2020, 36:177. 10.11604/pamj.2020.36.177.24425
6. Dia K, Sarr S, Mboup W, *et al.*, Cardiac pacing: indications, modalities, complications, and challenges: results of a multicenter cross-sectional study in four hospitals in Dakar, Senegal. *Pan Afr Med J.* 2024, 49:14. 10.11604/pamj.2024.49.14.43515
7. Bhat S, Kumar D, Parimoo A: Characteristics, indications and complications in patients undergoing permanent pacemaker implantation: a single-centre study. *Int J Res Med Sci.* 2018. 10.18203/2320-6012.ijrms20184906
8. Khanal J, Poudyal RR, Devkota S, *et al.*, Clinical profile and early complications after single and dual chamber permanent pacemaker implantation at Manmohan Cardiothoracic Vascular and Transplant Centre, Kathmandu, Nepal. *J Nepal Health Res Counc.* 2015, 13:138-143. 10.33314/jnhrc.v0i0.638
9. Muzamil M, Dar M, Sheikh JM, *et al.*, Clinico-demographic profile of patients receiving permanent pacemakers as bradyarrhythmia therapy: the Srinagar Registry. *Indian J Clin Cardiol.* 2024, 5:229-236. 10.1177/26324636241253357
10. Mohammed RN, Mansour H, Asfaw E, *et al.*, Clinical characteristics, indications, and outcomes of patients undergoing permanent pacemaker implantation: a retrospective descriptive study. *Eur Heart J Suppl.* 2025. 10.1093/eurheartjsupp/suaf085.002
11. Mabika M, Mpanya D, Patel AK, *et al.*, Clinical characteristics and complications in patients undergoing permanent pacemaker implantation. *Wits J Clin Med.* 2021, 3:19-24. 10.18772/26180197.2021.v3n1a3
12. Shogade T, Ogunleye E, Eyo C, *et al.*, Permanent pacemaker insertion for bradyarrhythmias in a secondary health facility in sub-Saharan Africa.

- Heart Rhythm O2. 2025, 6:537-541. 10.1016/j.hroo.2025.01.011
13. Nasir M, Dejene K, Bedru M, *et al.*, Predictors of complications and mortality among patients undergoing pacemaker implantation in resource-limited settings: a 10-year retrospective follow-up study. BMC Cardiovasc Disord. 2024, 24:400. 10.1186/s12872-024-04068-7
 14. Glikson M, Nielsen JC, Kronborg MB, *et al.*, 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy. Eur Heart J. 2021, 42:3427-3520. 10.1093/eurheartj/ehab364
 15. Kane A, Sarr SA, Ndobu JVD, *et al.*, Cardiac pacing challenge in Sub-Saharan Africa environment: experience of the Cardiology Department of Teaching Hospital Aristide Le Dantec in Dakar. BMC Cardiovasc Disord. 2019, 19:197. 10.1186/s12872-019-1176-2
 16. Carrión-Camacho MR, Marín-León I, Molina-Doñoro JM, González-López JR: Safety of permanent pacemaker implantation: a prospective study. J Clin Med. 2019, 8:35. 10.3390/jcm8010035
 17. Psaltikidis EM, Costa EAM, Graziano KU: Reuse of pacemakers and implantable cardioverter-defibrillators: systematic review, meta-analysis and quality assessment of the body of evidence. Expert Rev Med Devices. 2021, 18:553-567. 10.1080/17434440.2021.1927706
 18. Sinha SK, Sivasambu B, Yenokyan G, *et al.*, Worldwide pacemaker and defibrillator reuse: systematic review and meta-analysis of contemporary trials. Pacing Clin Electrophysiol. 2018, 41:1500-1507. 10.1111/pace.13488
 19. Kusumoto FM, Schoenfeld MH, Barrett C, *et al.*, 2018 ACC/AHA/HRS Guideline on the Evaluation and Management of Patients With Bradycardia and Cardiac Conduction Delay. Circulation. 2019, 140:e382-e482. 10.1161/CIR.0000000000000628