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Patterns of permanent cardiac pacing use at Abbeville Hospital, France: A cross-sectional study

Profil de la stimulation cardiaque permanente à l'Hôpital d'Abbeville, France : une étude transversale

Félicien Muanamutshi Tshikangu[1], Vincent Mouquet[2], Dieudonné Mbotawaba[1], Yves Nsimbi Lubenga[1], Blondy Mvete Mansoni[3], Brady Madioko Makanzu[1], Serge Mutombo Kazadi[1], Cédric Batudibia Mvita[1], Christian Mabiza Kutoloka[1], Zéphirin Tudienzele Kamuanga[1], Nathan Bimbi Buila[1].

Corresponding author

Félicien Muanamutshi Tshikangu

Cardiology Service, Kinshasa University Hospital

Phone :(+243) 990284920

Courriel : tshikangumwanamutshi@gmail.com

Résumé

Contexte &objectif. Malgré le fait que la stimulation cardiaque permanente soit reconnue comme le traitement de référence des bradyarythmies symptomatiques, elle est peu documentée en hôpital général. L'objectif de la présente étude était de décrire les caractéristiques, les indications, les techniques et les complications de stimulateurs cardiaques permanents. *Méthodes.* C'était une étude transversale incluant des patients implantés, entre décembre 2023 et juin 2025, au Centre Hospitalier d'Abbeville/France. Les paramètres d'intérêts englobaient les données cliniques (sociodémographiques et indications), sur les techniques des stimulateurs et la survenue des complications à 6 mois. *Résultats.* Cent vingt-six patients (âge moyen 79 ± 7,4 ans, sexe masculin, 63,4 %) ont été inclus**.** Le bloc auriculo-ventriculaire complet était l'indication principale (56,3 %), suivie de la dysfonction sinusale (20,6 %). Le pacemaker double chambre (DDD, 77,8 %), et la voie céphalique gauche (75,4 %) étaient fréquemment utilisés. Le taux d complications à 6 mois était de 9,5 % des cas. *Conclusion*. L'implantation de pacemaker dans un hôpital général est faisable et sure avec peu de complications.

Mots-clés : Stimulation cardiaque permanente, Pacemaker, Bradyarythmie, Bloc auriculo-ventriculaire – Complications

Summary

Context and objective. Although permanent cardiac pacing is recognized as the standard treatment for symptomatic bradyarrhythmias, data from general hospitals remain scarce. The objective of the present study was to describe the characteristics, indications, techniques and complications of permanent pacemakers at Abbeville Hospital, France. *Methods***.** This was a cross-sectional study involving all patients who underwent implantation between December 2023 and June 2025. Parameters of interest encompassed clinical data (sociodemographical, indications), techniques of pacemakers and complications at 6 months. *Results.* One hundred twenty-six patients (mean age 79 ± 7.4 years, male 63.5%) were involved. Complete atrioventricular block was the main indication (56.3%), followed by sinus node dysfunction (20.6%). Dual-chamber pacemakers (DDD, 77.8%) and left cephalic leads (75.4%) were frequently used. The complication rate at 6 months was 9.5%. *Conclusion***.** Pacemaker implantation in a general hospital is feasible and safe, with few complications.

Keywords: Permanent cardiac stimulation, pacemaker, Bradyarrhythmia, Atrioventricular block, Complication

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1. Cardiology Service, Department of Internal Medicine, Kinshasa University Hospital
2. Cardiology Department of Abbeville Hospital Center, France
3. Nephrology Service, Department of Internal Medicine, Kinshasa University Hospital.

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Introduction

Permanent cardiac pacing is an effective treatment for heart rhythm disorders, including symptomatic bradycardia and cardiac conduction disorders (1). Its implantation has become common practice in industrialized countries, driven by increased life expectancy and advances in medical techniques (2-3). However, despite well-established recommendations, disparities exist in implantation practices, patient profiles, and complications across hospital settings (4- 5)**.** Recent practices in local hospitals, outside of major university hospitals are poorly documented (6). A local assessment is therefore necessary to understand the specificities of the indications, techniques used and results observed in a real healthcare context. Although the indications and techniques for pacemaker implantation are well codified in international guidelines (7), there is local variability related to patient profiles, available resources, and institutional practices. In France, data on the population of patients implanted in general hospitals remain scarce outside of large national databases (1).

Methods

Study design

This was a cross-sectional study with an analytical aim. The study took place from December 3, 2023 to June 16, 2025 in the Cardiology Department of the Abbeville Hospital Center in France. This hospital has a Cardiology Department with a capacity of 28 inpatient beds and 6 intensive cardiac care beds, a high-performing interventional cardiology unit comprised of two interventional electrophysiologists, two interventional cardiologists, a team of cardiologists trained in implantation techniques, and two specially equipped operating rooms. It is part of the Somme Littoral Sud Hospital Group (GHT Somme Littoral Sud) and is located 45 km from the Amiens University Hospital (CHU d'Amiens), considered a reference hospital. Implantation has been performed at this hospital since March 2010 in a specially adapted operating room. Antibiotic prophylaxis was systematically administered (cefamandole 1.5 grams IV one hour before the procedure and 750 mg 6 hours after, adjusted according to renal function). In case of allergy to beta-lactams, vancomycin at a dosage of 1 gram should be given. Skin aseptic technique was performed using chlorhexidine alcohol. The implantation during the study period was performed by two rhythmologists.

Population

Included were all patients aged 18 years or older admitted for a serious conduction disorder. Excluded from the study were patients already implanted with a permanent pacemaker admitted for device replacement and those who did not provide informed consent. Participants were assessed at a single time point. The primary outcome of our study was the presence of a complication at the time of evaluation. The observation corresponded to the status of participants at the time of enrollment.

Study variables

The parameters taken into account were demographic data (age, gender), underlying conditions (chronic heart failure, ischemic heart disease, valvular heart disease, etc.), cardiovascular risk factors (type 2 diabetes, hypertension, smoking, overweight, obstructive sleep apnea, etc.), clinical data (syncope, presyncope, physical asthenia, heart failure, cardiogenic shock, resuscitated cardiac arrest), electrical data (complete atrioventricular block

(AVB), atrioventricular block 1, atrioventricular block 2 Mobitz 1, atrioventricular block 2 Mobitz 2, atrioventricular block 2:1, sinus node dysfunction, atrial rhythm disorder, subatrial fibrillation, trifascicular block, alternating block, etc.), echocardiographic data (left ventricular ejection fraction), and data concerning the implantation procedure (pacemaker type, pathway first, per procedural complication, brand of device, ventricular and atrial parameters, duration of procedure, duration of scopy, length of hospitalization and scheduling).

Bias management

Potential bias was minimized using following measures:

-Standardized data collection at a single time point to minimize information bias

-Diagnosis independently verified by two physicians

Sample size

Exhaustive non-probability sampling was used in the present study.

Operational definitions

- Severe conduction disorder: In this study, the following are considered severe conduction disorders: High degree AV block (advanced 2/1, 3/1 AV block), complete AV block, alternating bundle branch block, symptomatic bi- or trifascicular block, sinus node dysfunction with prolonged pauses, atrial rhythm disorder.
- Heavy bleeding: defined as bleeding requiring hemostatic intervention and a decrease in Hemoglobin of at least 1g.
- Pneumothorax: In the present study, a post-pacemaker implantation pneumothorax was defined as the presence of air in the pleural cavity, confirmed by a chest X-ray or CT scan performed within 24 to 72 hours following the procedure.
- Infective endocarditis: in this study, it is defined as an infection of the endocardial, valvular, or intracardiac tissue, diagnosed according to the modified Duke criteria
- The stimulation failure was defined by the absence of spikes on the ECG despite a heart rate lower than the programmed heart rate of the pacemaker, confirmed by questioning the device (absence of pulse emission).
- Capture failure: Defined by the presence of visible pacemaker spikes on the ECG not followed by P waves or QRS complexes, confirmed by questioning the device by an increase in the stimulation threshold or loss of capture.

Statistical analysis

Data were collected using the KoboCollect mobile phone app for all patients with severe conduction disorders admitted to the Emergency Department, outpatient clinic, or via remote monitoring (REVEAL). We collected data from all patients from admission until 3 months and 6 months post-implantation. All participants were reviewed at 6 months (no patients were lost to follow-up).

The data extracted from the said software were analyzed using Stata 17 and Jamovi.

- Quantitative variables are presented as mean ± standard deviation for normally distributed variables and as median with interquartile range for non-normal distributions.
- Qualitative variables are presented as frequencies. Associations between qualitative variables and sex were investigated using Pearson's chi-squared test, and some non-normally distributed quantitative variables were analyzed using the Mann-Whitney U test.

Due to the small number of events (n=12), log-rank and Cox regression models could not be applied or did not converge. This is in accordance with methodological recommendations (EPV<10).

Ethical considerations

The rules of confidentiality and ethics were respected in accordance with the Helsinki Protocol. We ensured compliance with three fundamental ethical principles during the course of the study, namely, the principle of respect for the person, the principle of beneficence, and the principle of justice.

Results

Of the 225 patients admitted to the Cardiology Department of the Abbeville Hospital for a serious conduction disorder, 198 received a pacemaker implantation, including 126 who underwent a primary implantation and constitute the population of the present study (Figure 1).

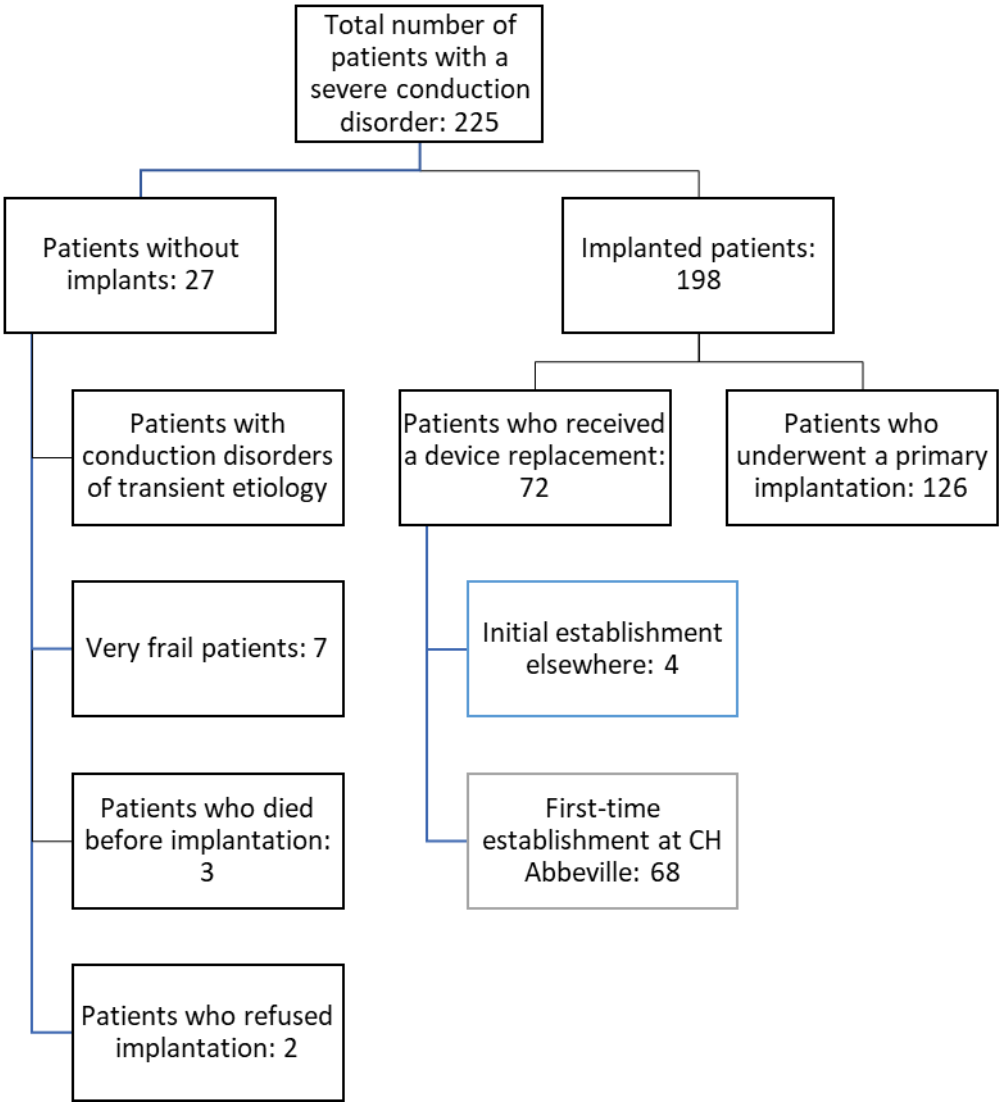

Figure 1. Flow diagram of the study population

General and clinical characteristics of the study population

General and clinical characteristics of the study population are presented in Table 1.

Table 1. General and clinical characteristics of the study population

Variables	**Men n=80(%)**	**Women n=46(%)**	**All N=126(%)**	**P-value**
Age category (years)				
60-80	44 (55.0)	14 (30.4)	58 (46.0)	0.008
<60	0	2 (4.3)	2 (1.6)	
≥80	36 (45.0)	30 (65.2)	66 (52.4)	
Input mode				
Consultation	10 (12.5)	7 (15.2)	17 (13.5)	0.667

EMERGENCIES	70 (87.5)	39 (84.8)	109 (86.5)	
Hypertension	46 (57.5)	25 (54.3)	71 (56.3)	0.731
Type 2 Diabetes	18 (22.5)	10 (21.7)	28 (22.2)	0.921
SAHOS	19 (23.8)	13 (28.3)	32 (25.4)	0.575
Dyslipidemia	21 (26.3)	9 (19.6)	30 (23.8)	0.396
Active smoking	27 (33.8)	12 (26.1)	39 (31.0)	0.370
Obesity	8 (17.4)	11 (13.8)	19 (15.1)	0.582
I CC	25 (31.3)	11 (23.9)	36 (28.6)	0.380
Congenital heart defects	1 (1.3)	1 (2.2)	2 (1.6)	0.690
Ischemic Heart Disease	16 (34.8)	27 (33.8)	43 (34.1)	0.906
Stroke	19 (23.8)	6 (13.0)	25 (19.8)	0.147
Cardiomyopathies	6 (7.5)	2 (4.3)	8 (6.3)	0.485
Taking beta-blockers	21 (26.3)	9 (19.6)	30 (23.8)	0.396
Taking anticoagulants	5 (10.9)	2 (2.5)	7 (5.6)	0.048
Taking anticoagulants				
AOD	3 (6.5)	1 (1.3)	4 (3.2)	0.107
VKA	1 (2.2)	0	1 (0.8)	
None	42 (91.3)	79 (98.8)	121 (96.0)	
Fainting	37 (46.3)	25 (54.3)	62 (49.2)	
Presyncope	5 (10.9)	5 (6.3)	10 (7.9)	0.356
Dyspnéa	46 (57.5)	23 (50.0)	69 (54.8)	0.415
Vertigo	1 (1.3)	0	1 (0.8)	0.446
Cardiogenic shock	3 (3.8)	1 (2.2)	4 (3.2)	0.627
Rhythm				
Nonsinus	8 (17.4)	17 (21.3)	25 (19.8)	0.601
Sinus	38 (82.6)	63 (78.8)	101 (80.2)	
FEVG %				
<50	43 (53.8)	25 (54.3)	68 (54.0)	0.948
≥ 50	37 (46.3)	21 (45.7)	58 (46.0)	

The data are presented as absolute frequencies and percentages in parentheses. P = significance level

HTA = Hypertension; LVEF = Left ventricular ejection fraction; AVC = Stroke; SAHOS = Obstructive sleep apnea-hypopnea syndrome

As shown in Table 1, Hypertension (56.1%), type 2 diabetes (22.2%), obstructive sleep apnea (OSA) (25.4%), and dyslipidemia (26.3%) were common, with no significant difference between men and women. Active smoking was more frequent in men (28.4% vs. 15.0%; p = 0.109).

Heart failure (28.6%), ischemic heart disease (34.1%), and a history of stroke (19.8%) were the main cardiovascular conditions. Beta-blocker use was reported by 23.8% of patients.

Anticoagulant use was observed in 5.6% of the entire study population. It was significantly more frequent in men (10.9%) than in women (2.5%) (p = 0.048).

Regarding the type of anticoagulant used, 3.2% of patients received a direct oral anticoagulant (DOAC) and 0.8% a vitamin K antagonist (VKA), while 96.0% were not taking any anticoagulant treatment. A trend towards more frequent use of DOACs in men (6.5%) compared to women (1.3%) was observed, although this difference did not reach statistical significance (p = 0.107).

The most frequently reported symptoms were dyspnea (54.8%) and syncope (49.2%). Presyncope (7.9%), dizziness (0.8%), and cardiogenic shock (3.2%) were less common. Sinus rhythm was observed in 80.2% of patients, and the LVEF was <50% in 54% of cases. None of these variables were significantly influenced by sex.

Electrical and installation data

Electrical and installation data are presented in Table 2.

Table 2. Electrical and installation data

Variables	**Men N=80 (%)**	**Women N=46 (%)**	**All patients N=126 (%)**
Average heart rate bpm (years)	32.9 ± 8	33.2 ± 8.51	33 ± 8.16
BAV 3	45 (56.3)	26 (56.3)	71 (56.3)
BAV 2 Mobitz 2	4 (5.0)	0	4 (3.2)
BAV 2/1	10 (12.5)	7 (15.2)	17 (13.5)
Sinus dysfunction	16 (20.0)	10 (21.7)	26 (20.6)
Alternating block	1 (0.8)	0	1 (0.8)
Trifascicular block	1 (0.8)	0	1 (0.8)
FA	10 (12.5)	5 (10.9)	15 (11,9)
Atrial rhythm disorder	6 (7.5)	3 (6.5)	9 (7,1)
Pre-implantation treatment			
Atropine	5 (6.3)	4 (8.7)	9 (7.1)
Isoprenalin	51 (63.7)	27 (58.7)	78 (61.9)
SEES	4 (5.0)	4 (8.7)	8 (6.3)
Time between discovery of the anomaly and implantation			
<24H	12 (26.1)	27 (33.8)	39 (31.0)
<48H	15 (32.6)	22 (27.5)	37 (29.4)
<72H	9 (19.6)	26 (32.5)	35 (27.8)
≥72H	10 (21.7)	5 (6.3)	15 (11.9)
First route			

Right cephalic	2 (2.5)	0	2 (1.6)
Left cephalic	59 (73.8)	36 (78.3)	95 (75.4)
Right side of keyboard	2 (2.5)	1 (2.2)	3 (2.4)
Under left keyboard	17 (21.3)	9(19.6)	26(20.6)
Case brand			
Biotronic	35 (43.8)	16 (34.8)	51 (40.5)
Boston	3 (3.8)	2 (4.3)	5 (4.0)
Medtronic	10 (12.5)	2 (4.3)	12 (9.5)
Sorin	10 (12.5)	4 (8.7)	14 (11.1)
St. Jude	22 (27.5)	22 (47.8)	44 (34.9)
Limp position			
Left prepectoral	77 (96.3)	46 (100.0)	123 (97.6)
Right prepectoral	3 (3.8)	0	3 (2.4)
Programming			
DDD	61 (76.3)	37 (80.4)	98 (77.8)
VVI	19 (23.8)	9 (19.6)	28 (22.2)

HR: Heart rate; BAV3: Third-degree atrioventricular block; BAV2: Second-degree atrioventricular block; SEES: Sequential external electrical stimulation; DDD: detects and stimulates both chambers with a dual VVI response: Ventricular stimulation and sensing with inhibition

As shown in Table 2, The mean heart rate at the time of implantation was 33 ± 8.16 bpm, with no significant difference between sexes. Type 3 atrioventricular block (AVB) was the primary indication (56.3%), followed by sinus node dysfunction (20.6%) and 2:1 AV block (13.5%). Other arrhythmias were less frequent (atrial fibrillation: 11.9%, atrial rhythm disorder: 7.2%).

Prior to implantation, 61.9% of patients had received isoprenaline, 7.1% atropine and 6.3% temporary external electrical stimulation (SEES).

The time between discovery of the rhythmic anomaly and implantation was less than 72 hours in 88.1% of patients, including 31.0% within the first 24 hours.

The most frequently used access route was the left cephalic vein (75.4%), followed by the left subclavian vein (20.6%). The port was positioned in the left prepectoral region in 97.6% of cases.

The most frequently implanted devices were Biotronik (40.5%), followed by St. Jude (34.9%), Sorin (11.1%), Medtronic (9.5%), and Boston Scientific (4.0%). The majority of pacemakers were programmed in DDD mode (77.8%), with VVI mode used in 22.2% of patients.

Distribution of stimulation, detection and implantation parameters

Distribution of stimulation, detection and implantation parameters are presented in table 3.

Tableau 3. Distribution of stimulation, detection and implantation parameters

	Median	Interquartile range	Minimum	Maximum	P Value
Atrial stimulation threshold	0.600	0.600	0.0000	4.00	<.001
Ventricular stimulation threshold	0.500	0.200	0.3000	1.40	<.001
Auricular detection threshold	2,200	4,050	0.0000	14.60	<.001
Ventricular detection threshold	8,400	6.844	1.5000	30.00	0.894
Atrial impedance	547,000	199,250	0	1491	0.859
Ventricular impedance	728,500	216,750	478	1247	0.962
Scope duration	3.355	2.945	0.0600	14.00	0.893
Implementation time	1,100	0.645	0.4200	2.10	0.903

The measured technical parameters (stimulation and detection thresholds, impedances, durations) showed a non-normal distribution according to the Shapiro-Wilk test (all $p < 0.05$), with W values ranging from 0.809 to 0.962 (Table 3). Consequently, the data are described using the median, interquartile range, and minimum and maximum values. High interindividual variability was observed for several variables, particularly the atrial detection thresholds (median = 2.20 mV, IQR = 4.05; min = 0.00; max = 14.60).

The stimulation thresholds measured at implantation were satisfactory, with a median of 0.6 V for the atrium (min: 0.0; max: 4.0) and 0.5 V for the ventricle (min: 0.3; max: 1.4). The mean impedance was 547 Ω for the atrium (range: 0–1491) and 729 Ω for the ventricle (478–1247).

The mean duration of scopy was 3.35 ± 2.84 minutes (min: 0.06; max: 14), while the mean duration of implantation was 1.10 ± 0.40 hours (min: 0.42; max: 2.10).

Per-procedural complications

As shown in Figure 2, significant bleeding was observed in 5.6% of patients, more frequently in women (10.9% vs 2.5%). Per procedural cardiac arrest was reported in one patient (0.8 %).

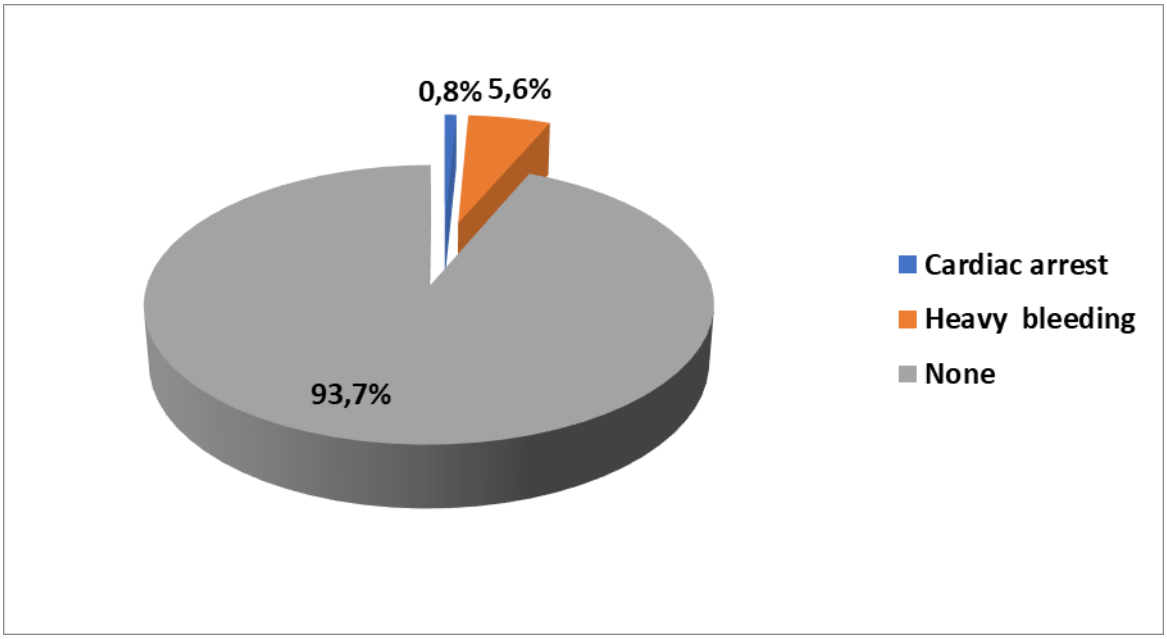

Figure 2. Per procedural complications.

Complications within 6 months

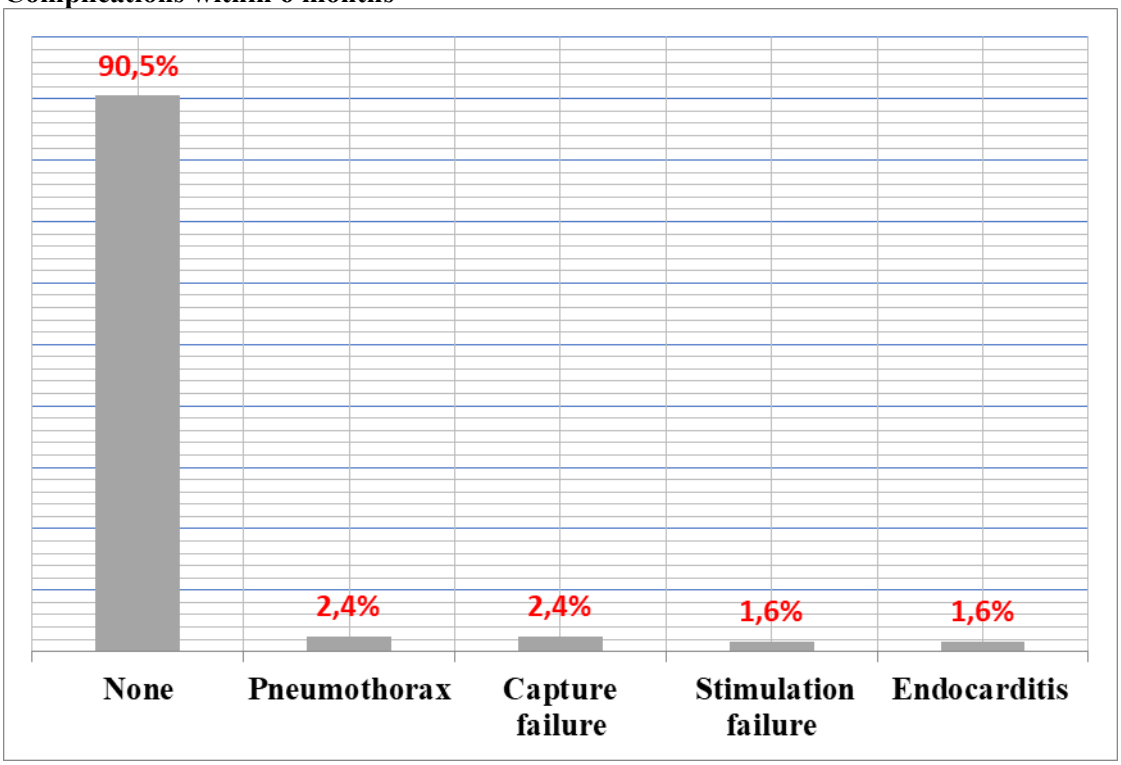

Figure 3. Complications within 6 months.

As shown in figure 3, the majority of patients (90.5 %) had no complications at six months. Observed complications included one capture failure (2.4 %), one elevated pacing threshold (1.6 %), one pacing failure due to a depleted battery (1.6 %), two cases of infective endocarditis on the lead (1.6 %), and three cases of pneumothorax (2.4 %), all in men.

Discussion

The study conducted at the Abbeville Hospital Center presents the clinical profile, indications, and complications associated with the implantation of permanent pacemakers in a predominantly elderly population. It highlights trends comparable to those observed in other African contexts, while also revealing notable differences, primarily related to organizational realities and available technical resources.

Demographic profile and cardiovascular risk factors

In the present study, the population had a median age of 80.0 (51-94) years, consistent with data from the literature, which generally report more frequent implantation in older patients due to the increased prevalence of conduction disorders with age (1,7). Results of the present study are significantly higher than those reported by Lubenga *et al.* in DR Congo with 69.5 ± 9.3 years (8). This difference is likely explained by better access to care, a more advanced age of the population in France, and earlier detection of arrhythmias.

The present study noted a male predominance comparable to that by Milligo and Jouven (9-10) unlike some African studies, which have observed a female predominance (7-8).

The majority of patients were admitted as emergencies, highlighting the severity of their clinical presentations at the time of admission, often dominated by symptoms such as dyspnea, syncope, and heart failure. These results corroborate observations made in other French and African hospital series, in contrast to that by Kane, who found vertigo to be the predominant symptom (14).

Regarding risk factors, arterial hypertension is the most frequent comorbidity, consistent with observations made by Lubenga et al. (8) and Coulibaly et al. (11).

Type 2 diabetes affects approximately one in five patients, a rate relatively similar to that observed in African series. However, dyslipidemia, sleep apnea, and active smoking appear to the Democratic Republic of Congo, probably linked to different lifestyles (8).

Indications for implantation

The main indications in the present series are dominated by complete atrioventricular blocks, followed by sinus node dysfunction and 2:1 blocks, which aligns with the observations by Lubenga et al. who found that third-degree AV blocks represent 68.2% (8). These data are comparable to those from Kane, who found complete AV block in 81.5% (14). This consistency confirms the central role of third-degree AV block as the primary indication across geographical contexts.

In contrast, the frequency of atrial fibrillation associated with bradycardia in the present study is higher than that reported by Lubenga and Dia K for AF from all causes (8, 15). This could reflect improved detection of supraventricular arrhythmias in France, facilitated by wider access to ambulatory ECG.

Technical aspects and choice of devices

Regarding the procedure, most patients had received isoprenaline before implantation, while some had received no prior treatment. In Coulibaly's series, the majority (88%) had received atropine, the differences being probably explained by drug availability (11).

The type of device implanted is predominantly a dual-chamber pacemaker, similar to that found in a Congolese study. This reflects a desire to optimize the physiology of stimulation, with less frequent use of the VVI mode, unlike some African series where financial and technical resources may limit the use of dual-chamber pacemakers, whereas in Moussa and Galand 's case, the VVI mode was used extensively, likely due to economic constraints and the operator's experience. (8,12, 16).

The preferred access route is the left cephalic vein, which aligns with modern European practices favoring this route for its safety and low risk of pneumothorax. By comparison, in Lubenga's series, the cephalic route is used more frequently, illustrating a progressive convergence of practices (8).

Unlike Hatem and Adoubi KA, who predominantly used the left subclavian pathway, likely dictated by their mastery of the technique (13,17), the dual-chamber pacemaker was the most frequently used. This reflects a practice consistent with ESC/HRS recommendations for AV block in active patients or those with preserved sinus function (11).

The majority of generators came from manufacturers Biotronik and St. Jude, reflecting local or institutional preferences (8).

The ventricular pacing thresholds (median: 0.5 V) and impedances (728 Ohms) are consistent with international standards and comparable to the results from Mali (where 55% of patients had a threshold between 0.4 and 0.5 V). These data

confirm the good quality of the implantation and the equipment used. These values are close to those reported by Kane (14).

Complications and comparison with the literature

The overall frequency of acute complications (< day 7) in the present series was relatively low, with a few cases of hemorrhage and one case of cardiac arrest. At six months, most patients had not developed any complications, which is reassuring. The main complications encountered included pneumothorax (exclusively in males), failure to capture the stent, and endocarditis. These results are lower than those reported in the Congolese series, likely reflecting more rigorous aseptic conditions and greater operator experience (8,17,20).

Strengths of the study

This study benefits from a prospective design with complete six-month follow-up, ensuring reliable short- and mid-term outcome assessment. Data were collected exhaustively using standardized procedures in a real-world clinical setting, enhancing internal validity and clinical relevance. The use of digital data collection and appropriate statistical analyses further strengthens the robustness and reliability of the findings.

Limitations

The main limitations are its single-center design, relatively small sample size, and six-month follow-up, which did not allow for the assessment of late complications or long-term survival. However, this study provides a solid basis for multicenter studies with extended follow-up.

Conclusion

This cross-sectional study conducted at the Abbeville Hospital Center provides a precise overview of the care provided to patients who have received their first permanent pacemaker implant. The results highlight a predominantly elderly patient profile with frequent comorbidities, reflecting epidemiological data observed in high-income countries.

The indications for implantation, the technical procedures, and the choice of devices are generally in line with current recommendations from learned societies. The preferred use of the left cephalic approach, the predominance of dual-chamber devices (DDD), and the low incidence of complications at 6 months demonstrate the quality and safety of care, even outside of tertiary centers. Although the majority of patients were treated on an emergency basis, technical and clinical performance remained satisfactory, with no significant factors associated with complications in our analysis. These results highlight the importance of capacity building in general hospitals and the need for long-term follow-up to optimize the care of patients with pacemakers.

Larger-scale, multicenter studies with prolonged follow-up are needed to confirm these results and guide continuous improvement strategies in the field of interventional rhythmology.

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Authors' Contribution

FTM designed the work was organized and the data obtained. BMM, DTM, and BMK performed the statistical analyses and interpreted the results. NBB coordinated the project. All authors approved the final and revised version of the manuscript; YNL, CKM, CMB, ZTK, and SMK reviewed the work.

Conflict of interest:

No conflict of interest to declare.

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