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Research Article

Outcomes of Patients Underwent Pacemaker Implantation During Sudan War 2023-2024

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Abstract

*Background***:** Implanted medical devices known as pacemakers deliver electrical pulses to one or more heart chambers through electrodes. This study aimed to evaluate the peacemaker intervention outcomes within the Sudan War 2023-2024. *Methodology***:** The study employed a retrospective descriptive analysis at El-Obeid International Hospital (Aldaman), North Kordofan State, Sudan, covering the period from April 2023 to April 2024. The Authors have collected data on patients who underwent procedures in the catheterization laboratory from 15 April 2023 to 15 April 2024. *Results***:** This study examined 52 patients aged 30 to 85 years, with a mean age of 67 years. Among the participants, 44.2% were males and 55.8% were females. The majority received dual-chamber pacemakers (65.3%), while the remaining 34.7% received single-chamber pacemakers. Only one fatality occurred during the discharge of approximately 98% of the patients, indicating favorable outcomes. *Conclusion***:** Despite conflicts and resource constraints, implantation of pacemakers produces remarkably favorable outcomes without complications. The majority of patients were females who were younger in comparison to international reports.

Keywords

Pacemaker, Heart Disease, Outcomes, Cardiac Abnormalities, Sudan

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1. Introduction

More than 64 million people worldwide suffer from heart failure (HF). Complex and severe HF necessitates multiple hospitalizations and therapies, making it difficult to provide cost-effective care. The key cost drivers in HF treatment are clinical (re) admission and decompensation, but we also examine the economic consequences of other device therapy choices. This includes cardiovascular implantable electronic devices (CIEDs) like CRT-P, CRT-D, ICDs, and various pacemakers. Also considered is the impact of semi-automated (tele) monitoring on care quality and cost [1, 2].

Heart electrical conduction is complex. This mechanism allows the heart to beat at its own pace and form a pulse, one of six vital signs in the myocardium. The heart's pacemaker controls its rate. This complex electrical circuit permits all cardiac cells to depolarize simultaneously. Heartbeats can be regular, irregular, rapid, or sluggish. Someone with an arrhythmia has a pulse that deviates from normal. ECGs help diagnose cardiac rhythm and pulse abnormalities. We categorize arrhythmias by rate (tachycardia, bradycardia), regularity (regular, irregularly regular, or irregularly irregular), and QRS complex breadth (narrow, wide) [3].

The first half of the 20th century saw successful heart stimulation using cardiac pacemaker therapy [4]. Cardiovascular surgery and transcatheter structural valve treatments often require permanent pacing. Leadless pacemakers (LPs) serve as an alternative to transvenous pacemakers. Leadless pacemakers have the potential to replace transvenous pacemakers in certain patients undergoing cardiac surgery and transcatheter structural valve procedures. The device's performance is excellent over medium-term follow-up. However, a large percentage of patients require transvenous pacing for cardiac resynchronization or atrial pacing support, necessitating a thorough electrophysiologic follow-up [5].

Nonetheless, Sudan possesses a limited number of facilities for cardiac intervention services. El-Obeid city serves as the sole center for a significant portion of western Sudan's population. During the 2023-2024 war, the collapse of the health system resulted in many heart patients dying before the research at El-Obeid Heart Center could take place. Nonetheless, given the limitations of the available resources, we conducted approximately 52 pacemaker interventions. As a result, this study focuses on assessing the outcomes of pacemaker interventions within one year during the war.

2. Materials and Methods

Data from El-Obeid International Hospital (Aldaman), North Kordofan State, Sudan, were conducted for this retrospective descriptive study from April 2023 to April 2024. We obtained all data pertaining to patients treated in El-Obeid International Hospital's catheterization laboratory from 15 April 2023 to 15 April 2024 from the hospital.

The sample size encompasses all patients operated on during the specified period, about one year following the onset of the Sudan war (2023-2024). We examined a total of 52 patients who underwent permanent transvenous pacemaker implantation, reviewed all patient records, and extracted the necessary information.

3. Results

This study consisted of 52 patients aged 30-85 years, with an average age of 67. Of the 52 patients, 23/52 (44.2%) were men and 29/52 (55.8%) were women. The bulk of patents were aged ≥70 years, followed by 60-69 and 50-59 years, with 26/52 (50%), 15 (28.8%), and 8 (15.3%), respectively. About 29/52 (55.7%) were rural residents, while the remaining 23 (44.3%) were urban. Approximately 39/52 patients (75%) were illiterate. About 22/52 (42.3%) of the patients were jobless, whereas 15 (28.8%) were farmers. As shown in Table 1 and Figure 1, the majority of the study subjects were married (49/52, 94.2%).

Table 1. *Distribution of patients based on demographic characteristics.*

Variable	Males n=23	Females n=29	Total n=52
Residence			
Rural	14	15	29
Urban	9	14	23
Age			
≤50 years	2	1	3
50-59	2	6	8
60-69	6	9	15

Variable	Males n=23	Females n=29	Total n=52
≥70	13	13	26
Education			
Illiterate	18	21	39
Primary	2	1	3
Secondary	0	4	4
University	1	1	2
Postgraduate	0	1	1
Others	2	1	3
Occupation			
Farmers	8	7	15
Armed forces	2	0	2
Teachers	1	4	5
Jobless	5	17	22
Retired	1	1	2
Labors	5	0	5
Business men	1	0	1
Marital status			
Single	1	0	1
Married	22	27	49
Divorced	0	1	1
Widowed	0	1	1

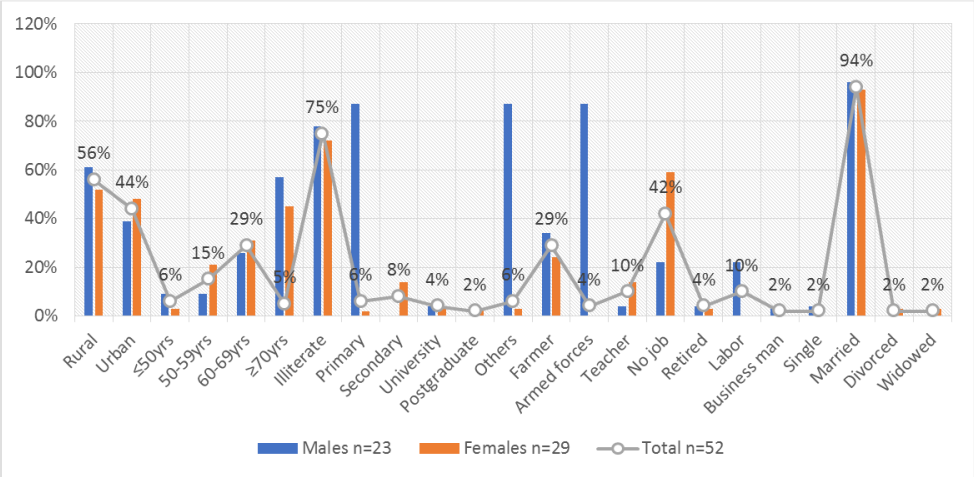

Figure 1. *Describes the patients based on their demographic characteristics.*

Table 2 and Figure 2 summarize the patient distribution by type of permanent pacemaker and demographic characteristics. The majority of patients (34/52, 65.3%) had dual-chamber pacemakers, with the remaining 18 (34.7%) receiving single chambers. There are no discernible differences in the distribution of pacemaker types and demographic factors.

Just one patient died, and about 51/52 (98%) of the patients had favorable outcomes upon discharge.

Table 2. *Patient distribution by type of permanent pacemaker and demographic features.*

Variable	Single chambers n=18	dual-chamber pacemaker n=34	Total n=52
Sex			
Males	7	16	23
Females	11	18	29
Age			
≤50 yrs	2	1	3
50-59 yrs	1	7	8
60-69 yrs	4	11	15
≥70 yrs	11	15	26
Residence			
Rural	11	18	29
Urban	7	16	23

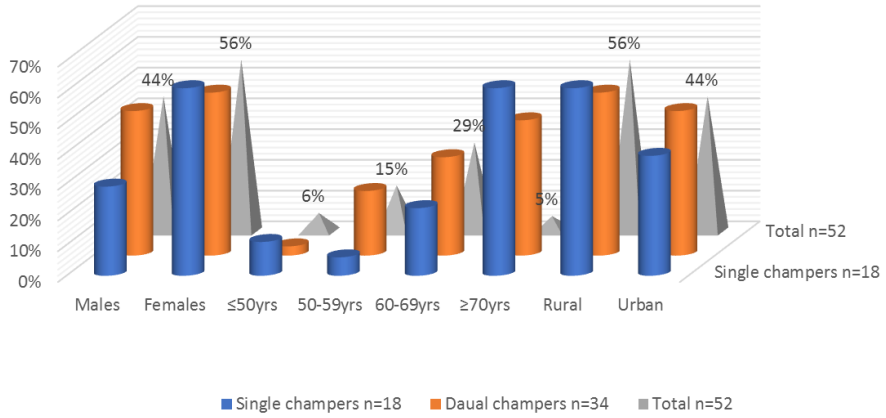

Figure 2. *Provides a description of the patients by type of permanentpacemaker and demographic features.*

We identified Hypertension and Diabetes Mellitus (DM) in 23/52 (44.2%) and 9/52 (17.3%), respectively. As shown in Table 3 and Figure 3, most of the patients who needed pacing had complete heart block, then generator exchange, and second-degree heart block, making up 44/52 (84.6%), 6 (11.5%), and 2 (3.8%) of the patients, respectively.

Table 3. *Shows the distribution of patients by type of permanent pacemaker and indication of pacing hypertension and diabetes.*

Variable	Single champers n=18	dual-chamber pacemaker n=34	Total n=52
Hypertension			
Yes	6	17	23
No	12	17	29
Diabetes Miletus (DM)			
Yes	5	4	9
No	13	30	43

Variable	Single champers n=18	dual-chamber pacemaker n=34	Total n=52
Indication of pacing			
Complete heart block	16	28	44
Second degree heart block	0	2	2
Generator exchange	2	4	6

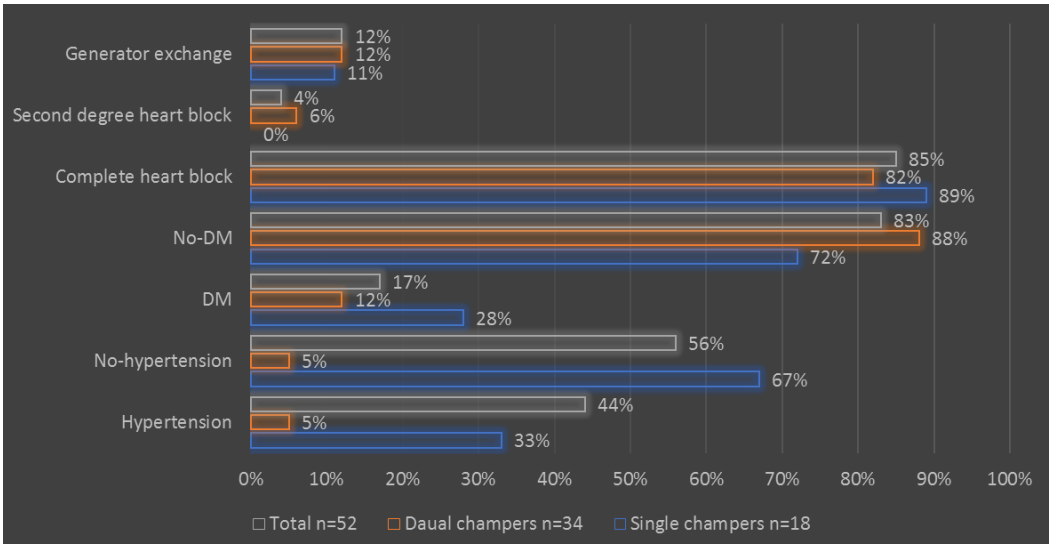

Figure 3. *Provides a description of the patients, broken down by the type of permanent pacemaker and indications of hypertension and diabetes.*

4. Discussion

Despite the catastrophic conflict in Sudan, the results for patients have been remarkable, with 98% achieving successful recovery. Despite their widespread use and notable success, traditional transvenous pacemakers have an estimated 15% complication rate over a three-year period. Leadless pacemakers' clear benefits over traditional transvenous pacemakers, including the absence of transvenous leads, reduced risk of infection, and simplified implantation process, have led to a rise in their use. Since their initial approval, the number of leadless pacemakers placed has significantly increased [6]. Transvenous pacemakers carry a notable risk of complications. Leadless pacemakers (LP) are becoming a noteworthy alternative to traditional devices. Leadless pacemakers appear to exhibit a notably low rate of complications. These devices could be a suitable choice for patients requiring single-chamber pacing, particularly in cases where conventional transvenous pacemaker implantations are not feasible. There is a necessity for studies that directly compare LP and transvenous pacemakers, as well as data on extended follow-up periods [7]. The successful procedure for implanting cardiac electric devices relies on the implant's positioning as well as its electrical performance. The capture threshold and pacing output are impacted by the battery's projected lifespan. Knowing how the capture threshold changes with rate and what is acceptable programming allows you to avoid unnecessary recapture and reimplantation, which lowers the procedure's risks [8].

A study has administered permanent dual-chamber devices to the majority of patients. The implantation of permanent pacemakers (PPMs), configured in either dual-chamber (DDD) or ventricular (VVI) pacing modes, is the management of bradycardia resulting from total atrioventricular block (TAVB). People consider DDD to be a more physiological pacing mode than VVI due to its ability to prevent atrioventricular desynchrony. Nonetheless, earlier trials have not succeeded in proving the advantages of DDD in enhancing quality of life and reducing morbidity [9]. Bradycardia, defined as a resting heart rate below 60 beats per minute (b.p.m.), may arise from conditions that impact the heart's natural pacemakers, including sick sinus syndrome (SSS) and atrioventricular (AV) blocks. Individuals experiencing bradycardia may exhibit symptoms such as palpitations, intolerance to physical activity, and episodes of fainting. Implantation of a permanent pacemaker is the only viable intervention for individuals experiencing symptomatic bradycardia. In patients with SSS who show no signs of impaired AV conduction, dual-chamber pacemakers seem

to offer a more cost-effective solution than single-chamber atrial pacemakers. Dual-chamber pacemakers, programmed to reduce unnecessary ventricular pacing, are necessary due to the potential for a complete AV block and the lack of effective tools to identify high-risk patients. The risk of heart failure, which may be affected by age and device, must be considered [10].

The findings of the current study indicated that females received pacemakers more frequently than males. Cardiac implantable electronic devices encompass pacemakers, cardioverter defibrillators, and resynchronization therapy. Women exhibited a lower rate of CIED implantation compared to men across almost all indications, such as complete heart block and ventricular tachycardia/ventricular fibrillation/cardiac arrest. The limited utilization of cardiac devices in women may indicate a potential bias based on sex, warranting additional investigation [11]. The existence of bias in the implantation of permanent pacemakers and the associated complications based on sex and age within the Australian population remains uncertain. Over the course of a decade, in a statewide Australian population exceeding 7 million, the rates of permanent pacemaker implantation (PPI) were consistently almost twice as high for men as for women, a trend that appeared to be increasing and was not explained by age. Women's rates of complications were significantly higher. Future studies ought to investigate the underlying causes of this disparity in PPI rates, along with its associated complications [12].

The current study's findings indicate that the majority of patients were older, with a mean age of 67 years. Studies reveal that older adults account for up to 80% of pacemaker placements, with the typical age of recipients currently hovering around 75 to 10 years. While often regarded as "minor" surgery, complications from pacemaker implantation can arise in approximately 3%–4% of instances [13].

This study, while offering significant updates during these challenging times, does have certain limitations, notably its small sample size.

In conclusion, pacemaker implantation during the conflict with limited resources yields better results free from problems. Most of the patients were women, whose age was rather lower than in worldwide statistics.

Abbreviations

PPM	Permanent Pacemakers
ECG	Electrocardiogram
CIED	Cardiovascular Implantable Electronic Device
LP	Leadless Pacemakers
DDD	Dual-chamber
SSS	Sick Sinus Syndrome
AV	Atrioventricular
TAVB	Total Atrioventricular Block
VVI	Ventricular

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Najla Adam Elsharef Salem: Data curation, Formal Analysis, Methodology, Resources, Visualization, Writing – review & editing

Hussain Gadelkarim Ahmed: Data curation, Validation, Visualization, Writing – review & editing

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Ethical Consideration

Permission was obtained from authorities in El-Obeid International Hospital (ALdaman) to get access to the notified information.

Ethical Approval

The proposal has been granted approval by the Human Research Ethics Committee at MRCC. Approval Number: HREC0013/PMRCC.9/24.

Conflicts of Interest

The authors declare no conflicts of interest.

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