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ORIGINAL ARTICLE

Use of Micra AV in Patients with High-grade Atrioventricular Block in Hong Kong: A Single Center Experience

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Abstract

Background: **Micra AV leadless pacemaker provides an alternative to conventional DDDR pacemakers in patients with high-grade atrioventricular (AV) block. This study aimed to report the real-world single-center experience of using VDD leadless pacing (Micra AV) compared with conventional transvenous DDDR pacing in patients with high-grade AV block in Hong Kong.**

Methods: **A retrospective review of consecutive patients who underwent Micra AV between October 2020 and April 2022 were compared with patients with matched age and comorbidities who received conventional DDDR pacing between January 2017 and April 2022. Patients with intermittent or permanent high-grade AV block were included.**

Results: **The outcomes of 22 Micra AV patients were compared with 22 patients who received conventional DDDR pacemakers. The electrical parameters were stable during follow-up in 95.5% of patients who received Micra AV. AV synchrony was maintained in 76.2% and 77.8% of patients who received Micra AV at baseline and 6 months, respectively. The mean procedure time was significantly shorter in the Micra AV group than in the conventional group (40.0 ± 14.1 min vs. 71.6 ± 33.7 min) ($p < 0.001$), and the length of stay post-implantation of pacemaker in Micra AV group was also shorter (median 1 day vs. 7 days). ($p < 0.001$). There were no statistically significant differences in terms of complications and mortality.**

Conclusion: **Micra AV is a safe and effective alternative to conventional DDDR pacemakers for patients with intermittent or permanent high-grade AV block. The shorter procedure time and post-implantation hospital stay may also benefit patients and the healthcare systems.**

Keywords: AV block, Micra AV, DDDR pacemaker, AV synchrony

Introduction

Permanent pacing is the gold-standard treatment for patients with high-grade atrioventricular (AV) block and complete heart block that are not attributable to reversible or physiologic causes, irrespective of symptoms [1]. However, conventional transvenous pacemaker implantation is associated with complications related to pacing leads and subcutaneous pockets. To mitigate these complications, leadless pacemaker has been developed as an alternative [2]. The first-generation Micra (Micra VR, Medtronic, Minneapolis, MN, USA) has demonstrated its safety and reliability since its approval by the United States Food and Drug Administration in 2016 [3,4].

Current guidelines recommend leadless pacemaker as an alternative to transvenous pacemaker when upper extremity venous access is unavailable or when the risk of device pocket infection is particularly high (Class IIa), or as an alternative to standard single-lead ventricular pacing, taking life expectancy into consideration and using shared

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decision-making (Class IIb) [5]. In patients with AV block who require permanent pacing, however, guidelines recommend dual-chamber pacing over single-chamber ventricular pacing [1,5], limiting the use of Micra VR in this patient population.

Micra AV, which utilizes accelerometer-based sensing of atrial contraction [6], may be considered as an alternative for patients with advanced AV conduction abnormalities with preserved sinus node function, particularly in selected cases where the benefits of leadless pacing outweigh the potential benefits of 100% AV synchrony.

Real-world data on the use of Micra AV is primarily derived from prominent studies to date, including the Micra Atrial tRacking using a Ventricular accELerometer 2 (MARVEL-2) [7] and Accelerometer Sensing for Micra AV (AccelAV) [8]. The MARVEL-2 study demonstrated that the algorithm facilitated ≥70% AV synchrony at rest in 95% of the patients with complete AV block, while the AccelAV study showed an improved stroke volume and quality of life with accelerometer-based mechanical atrial sensing. However, results from other studies, such as the Longitudinal Coverage With Evidence Development Study on Micra AV Leadless Pacemakers (Micra AV CED study) and Micra AV Transcatheter Pacing System Post-Approval Registry (Micra AV PAS), are yet to be published.

Methods

Study design

This retrospective, non-randomized, observational study aimed to evaluate the safety and efficacy of Micra AV in patients with high-grade AV block in a single center in Hong Kong. The study included 22 consecutive patients with intermittent or permanent high-grade AV block pacing indications who underwent Micra AV implantation between October 2020 and April 2022. Historical data were retrieved from the Cardiac Implantable Electronic Devices (CIED) Registry of Yan Chai Hospital (YCH) between January 2017 and April 2022, which included 64 patients with conventional DDDR pacemakers. Among them, 22 patients were matched 1:1 using stratified matching based on age group (≥85 years old vs. <85 years old) and comorbidities using the Charlson Comorbidity Index, excluding age score.

Patients with known atrial fibrillation at baseline and other pacing indications, such as symptomatic bradycardia-tachycardia syndrome or sinus node dysfunction, were excluded from the study.

The study data, including demographics, comorbidities, pacing indications, procedure details, electrical parameters, and events, were retrieved from clinical notes and the electronic patient record (ePR) system.

Procedure for the implantation

Conventional DDDR pacemaker

The device was implanted according to the methods previously reported [9]. Transvenous access was performed via a percutaneous approach to the subclavian, cephalic, or axillary vein. A subcutaneous pacemaker pocket was created at the infraclavicular region, where the generator was implanted. Tine or screw-in leads were placed under fluoroscopy to the right atrium and ventricle.

Micra AV

The device was implanted using a 23-F internal diameter/27-F outer diameter introducer through the right femoral vein and the inferior vena cava, towards the right ventricle, using a steerable catheter. Micra AV was then anchored to the myocardium using nitinol tines. Device fixation was verified by the movement of at least two of four tines with adequate electrical measurement (pacing threshold <1.5V at pulse width of 0.24 ms). After the position was confirmed, the tether was cut, and the delivery system was removed. A figure-of-eight stitch was then used to achieve hemostasis at the access site and removed 6 hours after the procedure.

Outcomes

The primary objective of this study was to assess the safety and efficacy of Micra AV compared with conventional DDDR pacemakers in patients with high-grade AV block.

Efficacy outcomes were evaluated in terms of (1) procedural parameters, including procedural successful rate, procedural duration and post-procedure length of stay; (2) electrical performance, as measured by the ability to maintain a stable pacing capture threshold at implantation and during follow-up, defined as an increase of ≤1.5V at 0.24 ms from the time of implantation for Micra AV and an increase of ≤1V at a pulse width of 0.4 ms from the time of implantation for conventional DDDR pacemakers [10]; and (3) the performance of AV synchrony in Micra AV, estimated by device-collected %AM-VP [11] at baseline (1 week) and at 6 months.

Safety outcomes were evaluated in terms of freedom from system-related or procedure-related major complications at implantation until follow-up

at 6 months. Major complications were defined according to the same criteria used in the Micra IDE study [3] as (1) death, (2) permanent loss of device function as a result of mechanical or electrical dysfunction (e.g., deactivation), (3) hospitalization, (4) prolonged hospitalization by at least 48 hours, or (5) system revision.

Secondary outcomes included new-onset atrial fibrillation and heart failure-related and non-heart failure-related hospitalizations.

Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistics and Microsoft Excel. Categorical variables were presented as the number of patients (percentage) and were compared using Pearson's chi-square test or Fisher's Exact Test if any cell size was less than 5. Continuous variables were reported as mean ± standard deviation or median (interquartile range) depending on their distribution. The t-test and Mann–Whitney U test were used to compare parametric and non-parametric continuous data, respectively. A p-value of less than 0.05 was considered statistically significant. Survival time was defined as the interval from pacemaker implantation to death or the date of data collection. The Kaplan–Meier method was used to estimate the survival and event-free rate, and differences between groups were assessed using the log-rank and Breslow tests.

Results

Between 6th October 2020 and 30th April 2022, 22 patients with intermittent or permanent high-grade AV block underwent Micra AV pacemaker implantation (Fig. 1). Historical data was extracted from the CIED Registry of Yan Chai Hospital, which included 64 patients with conventional DDDR pacemakers implanted between January 2017 and April 2022. To compare outcomes between Micra AV and conventional DDDR pacemakers, 22 patients with Micra AV pacemakers were matched in a 1:1 ratio with patients from the DDDR group based on age (≥85-year-old vs. <85-year-old) and comorbidities (using the Charlson Comorbidity Index with age score excluded, categorized as 0, 1, or 2–4).

Patient characteristics

Table 1 summarizes the patient characteristics of the study population. The mean age of patients with Micra AV pacemakers was 84.14 ± 4.19 years, compared with 82.95 ± 4.87 years in patients with conventional DDDR pacemakers, with no statistically significant difference ($p = 0.435$). Among the patients with conventional DDDR pacemakers, 63.6% (N = 14) were male, compared with 54.5% (N = 12) in the Micra AV group.

The Charlson Comorbidity Index was used to measure the comorbidity burden, considering the presence and severity of several medical conditions. The mean Charlson Comorbidity Index (excluding age score) was 1.18 ± 1.22 in the Micra AV group, while that of the conventional DDDR group was 1.18 ± 1.18, with no statistically significant difference ($p = 0.990$).

The left ventricular ejection fraction (LVEF) was 57.82 ± 6.72% in the Micra AV group, while that of the conventional DDDR group was 66.14 ± 8.98% ($p = 0.004$). There was no statistically significant difference between the baseline renal function of both groups.

Outcomes

Efficacy outcomes

Both conventional pacemakers and Micra AV were successfully implanted in all patients. The mean procedure time was significantly shorter in the Micra AV group than in the conventional DDDR pacemaker group, with a mean procedure time of 40.0 ± 14.1 min for Micra AV and 71.6 ± 33.7 min for conventional DDDR pacemakers ($p < 0.001$).

The length of stay post-pacemaker implantation was also significantly shorter in the Micra AV group, with a median stay of 1 day compared to 7 days in the conventional DDDR pacemaker group ($p < 0.001$).

Electrical performance

The electrical measurements are presented in Table 2. Satisfactory electrical performance was achieved in 21 patients (95.5%) in both the DDDR and Micra AV groups, with a stable and low pacing capture threshold maintained at implantation until follow-up at 6 months. One patient in the DDDR group developed a raised right ventricular (RV) threshold from 0.8V at baseline to 2V (at pulse width of 0.40 ms) at 3 months post-implantation, while other parameters were stable. One patient in the Micra AV group had a high RV threshold since Day 2 post-operation, with readings of 1.25V, 2.75V, and 2.63V (at pulse width of 0.24 ms) at baseline, Day 2 post-operation, and Day 4 post-operation, respectively (see Fig. 2).

Maintenance of AV synchrony

Maintenance of AV synchrony was assessed in patients with Micra AV, and the mean %AM-VP was 77.27 ± 14.55 at baseline and 80.32 ± 13.00 at 6 months.

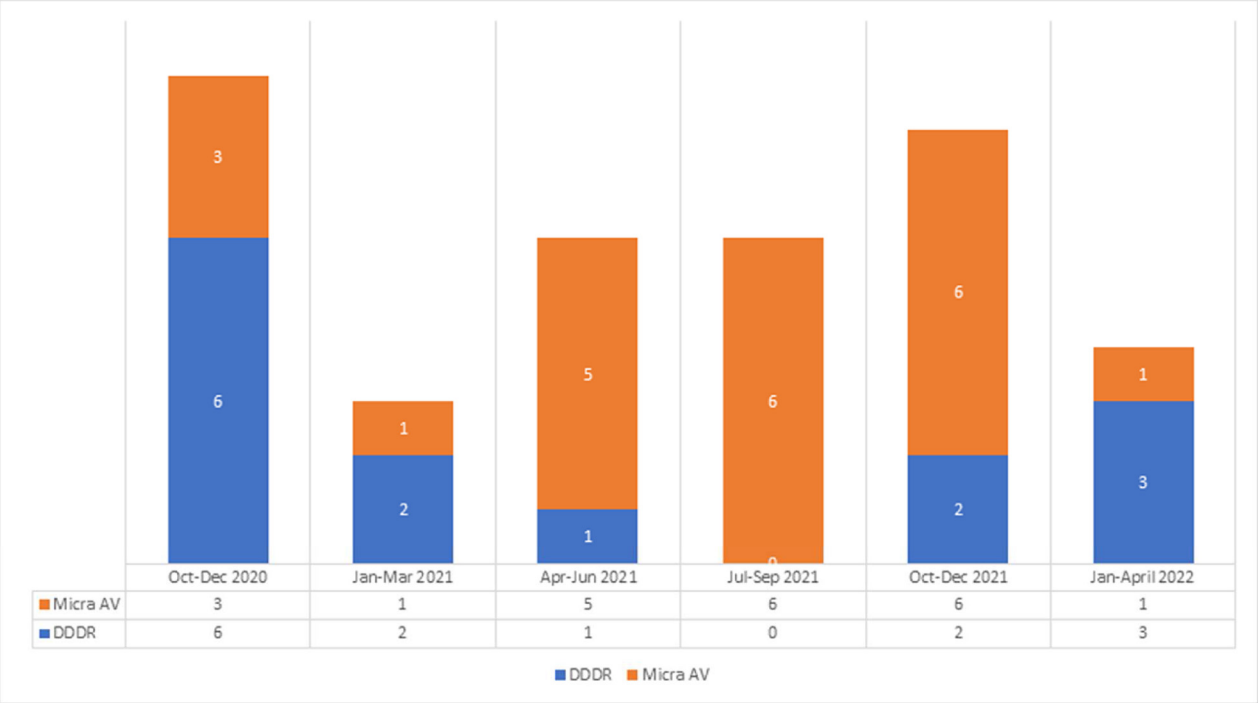

Fig. 1. Overview of DDDR and Micra AV implantation (YCH patients) from October 2020 to April 2022.

At baseline, 76.2% of the patients (16/21) achieved at least 70% AV synchrony, and this increased to 77.8% of the patients (14/18) at 6 months Fig. 3.

Safety outcomes

The safety outcomes were evaluated in terms of complication and mortality rate post-pacemaker procedure.

Complications

Within the first 2 weeks after the operation, 8 patients (36.4%) with Micra AV and 3 patients (13.6%) with conventional DDDR pacemakers experienced early complications not meeting the major criterion, mainly related to wound issues such as oozing, gapping, and bruising. One patient in the Micra AV group had groin wound erythema with swab culture yielded doubtful significance of Coagulase negative Staphylococci, which was resolved with a course of oral antibiotics. The patient had no fever and no systemic symptoms. No patients in the conventional DDDR group had wound infection. One patient with Micra AV developed a raised threshold since post-operation Day 2 up to 2.75V at pulse width of 0.24 ms, but did not require system revision or deactivation of the device. The patient was monitored in an outpatient setting, and the subsequent threshold during follow-up was stable at 2V–2.5V at pulse width of 0.24 ms. All patients mentioned above did not require hospitalization and hence were not adjudicated as major complications.

One patient (4.5%) with conventional DDDR had an early major complication due to dislodged atrial lead, requiring repositioning and prolonged hospitalization. The patient had repositioning of atrial lead on post-operation Day 6 and was discharged on Day 14 after pacemaker implantation.

For long-term complications within 6 months, one patient with conventional DDDR developed a raised RV threshold from 0.8V at baseline to 2V (at pulse width of 0.40 ms) at 3 months post-implantation, while other parameters were stable. The threshold was monitored and no hospitalization was required.

The Micra AV group had a higher complication rate than the conventional DDDR pacemaker group, primarily due to wound-related issues, although the difference was not statistically significant. Nevertheless, none of the complications resulted in major adverse events or required hospitalization.

The summary of major and non-major complications within 6 months in DDDR and Micra AV patients is presented in Fig. 4.

Mortality

Three patients (13.6%) with Micra AV and one patient (4.5%) with conventional DDDR died within 6 months after the operation, with two Micra AV

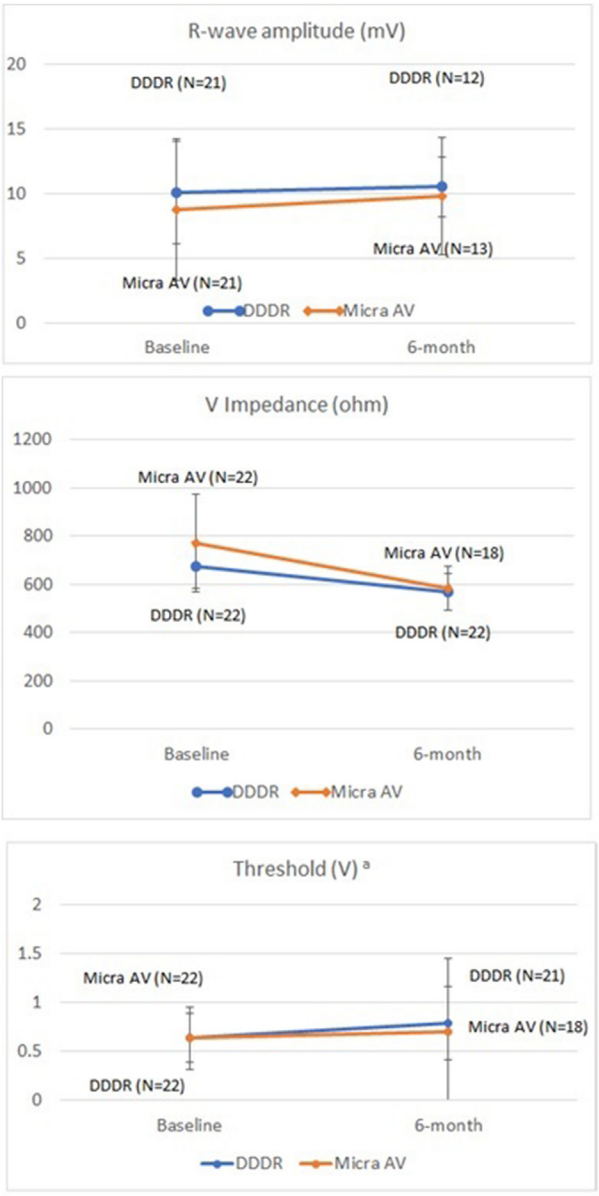

Fig. 2. Electrical perfomance at baseline and during follow-up at 6-month: a pacing threshold at median pulse width of 0.40 ms for DDDR and 0.24ms for Micra AV; DDDR, Dual-chamber Rate-modulated mode pacemaker.

patients died within 30 days post-operation. None of the deaths were considered procedure-related.

Two patients in the Micra AV group died of disseminated intravascular coagulopathy with extensive bleeding on Day 14 and 20, respectively (one with per-rectal bleeding and another with duodenal ulcer and psoas hematoma), and another patient was found collapsed in an aged-home and failed resuscitation on Day 67. One patient in the conventional DDDR group died of a chest infection on Day 156.

The 30-day and 6-month mortality rates did not significantly differ between the two groups ($p = 0.488$ and 0.607, respectively). No patients died of pacemaker-related cause. At the data collection date, 18 patients (81.8%) in the Micra AV group and 15 patients (68.2%) in the conventional DDDR groups survived. Overall, there was no statistically significant difference in survival when comparing both groups according to both the log-rank and Breslow tests (see Fig. 5).

Secondary outcomes

The secondary outcomes of the study include new-onset AF and hospitalization within 6 months post-implantation of pacemaker.

New onset AF at 6 months

Only one patient (4.5%) in the conventional DDDR pacemaker group was noted to have AF within 6 months of implantation, while no patients in the Micra AV group developed AF within the observation period. The difference was not statistically significant ($p = 1.000$).

Hospitalization at 6 months

12 patients (54.5%) with conventional DDDR pacemakers and 5 patients (22.7%) with Micra AV pacemakers had hospitalization within the first 6 months post-implantation, respectively ($p = 0.030$). The major difference was in the number of patients with non-heart failure-related causes of hospitalization. Among them, 11 patients (50%) with conventional DDDR pacemakers and 3 patients (13.6%) with Micra AV pacemakers had non-HF hospitalization within the first 6 months post-implantation, respectively. The difference was statistically significant ($p = 0.010$).

The causes of non-HF hospitalization in the conventional DDDR pacemaker group were varied, including tuberculosis foot osteomyelitis (1), hypoglycaemia (1), abdominal pain (1), fall with fracture neck of femur (1), metastatic lung cancer with cough and dyspnoea (1), acute retention of urine (1), chest pain (2), pneumonia (1), upper limb cellulitis (1) and eczema (1). The causes of non-HF hospitalization in the Micra AV group were dizziness (1) and pneumonia (2).

Only one patient (4.5%) with conventional DDDR pacemaker and two patients (9.1%) with Micra AV pacemakers developed heart failure symptoms that required hospitalization within 6 months. The difference was not statistically significant ($p = 1.000$).

Discussion

This study evaluated the efficacy and safety outcomes of Micra AV pacing in a cohort of 22 patients

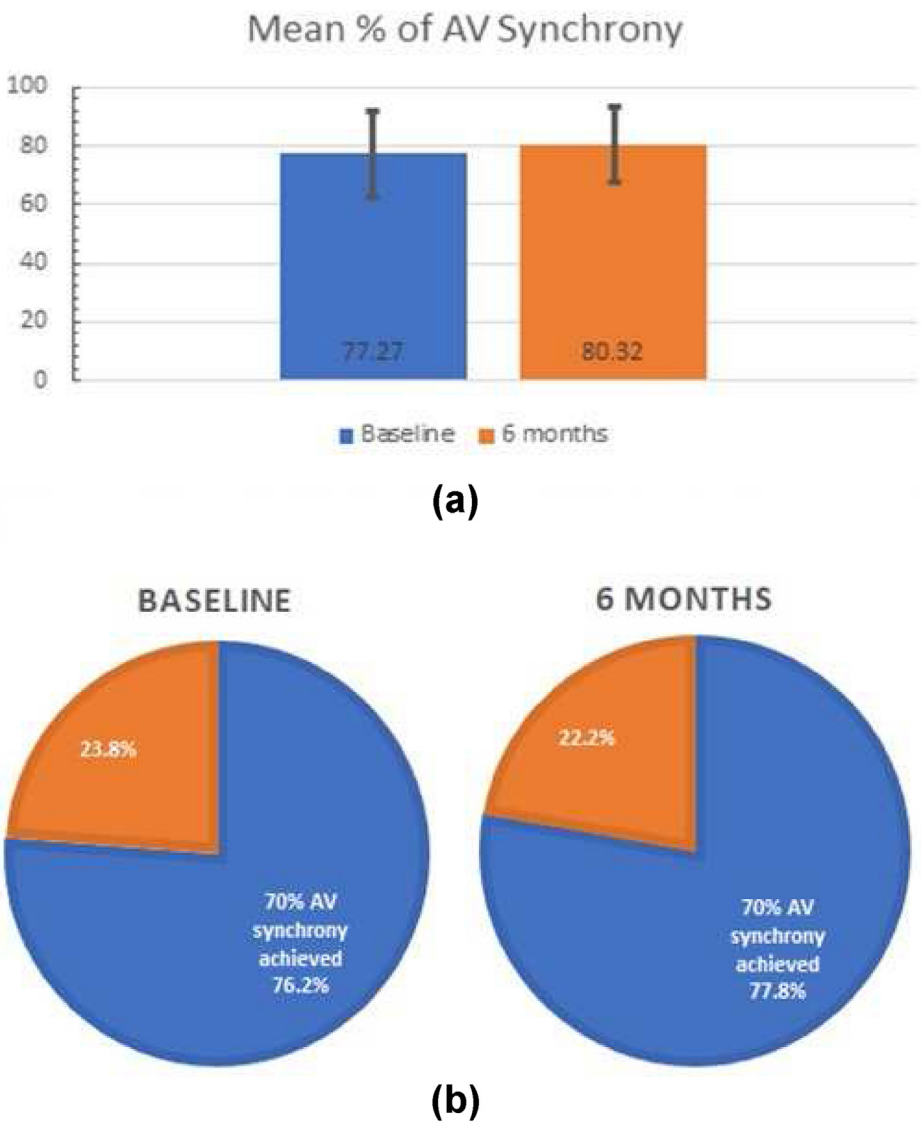

Fig. 3. Mean %AM-VP of Micra AV patients at baseline and 6 months from implantation. b. Percentage of Micra AV patients achieved at least 70% AV synchrony baseline and 6 months from implantation.

with intermittent or permanent high-grade AV block. The device was successfully implanted in all patients, and the 6-month follow-up assessed the outcomes of the device compared with historical data on conventional DDDR pacemaker implants. Our findings suggest that Micra AV pacing has several potential advantages over conventional DDDR pacing, including a shorter procedural time and hospital stay, without an increase in complications or mortality.

Patient selection

To minimize selection bias, stratified matching was performed to select the conventional DDDR pacemaker patients. Baseline characteristics, including age (in terms of age group ≥85 years old vs. <85 years old) and comorbidities (in terms of the Charlson Comorbidity Index excluding age score), were matched with the 22 patients with Micra AV. We used 85 years old as a cut-off in the age group as a previous study [12] reported that age ≥85 was one of the risk factors associated with cardiac injury related to the leadless pacemaker operation.

Our patients with Micra AV implanted had mean age of 84.14 years, which is higher than those observed in previous Micra studies (75.9 ± 10.9 in TPS [3] and 75.6 ± 13.5 in PAR [4]). Apart from the longer life expectancy in Hong Kong compared with counterparts in other parts of the world, one possible explanation is that relatively younger patients tend not to be offered leadless pacemakers, anticipating the need for multiple device implantations. Moreover, they are more physically active and require 100% AV synchrony. As a result, dual-

Table 1. Baseline patient characteristics

	DDDR	Micra AV	P-value
	N = 22	N = 22	
Age (year)	82.95 ± 4.87	84.14 ± 4.19	0.435
Male	14 (63.6%)	12 (54.5%)	0.54
Charlson Comorbidity Index (excluding age score)	1.18 ± 1.18	1.18 ± 1.22	0.99
Comorbidities			
Hypertension	17 (77.3%)	16 (72.7%)	0.728
Diabetes Mellitus	4 (18.2%)	6 (27.3%)	0.472
Hyperlipidemia	7 (31.8%)	7 (31.8%)	1
COPD	1 (4.5%)	2 (9.1%)	1
Myocardial Infarction	2 (9.1%)	1 (4.5%)	1
Peripheral Vascular Disease	0	0	Not applicable
Congestive Heart Failure	2 (9.1%)	2 (9.1%)	1
Atrial Fibrillation	0	0	Not applicable
Liver disease	0	0	Not applicable
Peptic Ulcer Disease	1 (4.5%)	3 (13.6%)	0.607
Connective Tissue Disease	0	0	Not applicable
Stroke/TIA	5 (22.7%)	2 (9.1%)	0.412
Solid Tumour	2 (9.1%)	2 (9.1%)	1
Leukaemia	0	0	Not applicable
Lymphoma	0	0	Not applicable
AIDS	0	0	Not applicable
Hemiplegia	0	0	Not applicable
Dementia	3 (13.6%)	2 (9.1%)	1
Renal insufficiency@	1 (4.5%)	1 (4.5%)	1
eGFR (CrCl)	61.95 ± 16.49	58.45 ± 18.63	0.513
LVEF (%)	66.14 ± 8.98	57.82 ± 6.72	0.004
Use of antiplatelet/anticoagulation			
Aspirin	8 (36.4%)	4 (18.2%)	0.176
Plavix	1 (4.5%)	0	1
DAPT	0	1 (4.5%)	1
Anticoagulation	0	0	Not applicable

Abbreviations: AIDS, Acquired Immunodeficiency Syndrome; AVB, Atrioventricular Block; CHB, Complete Heart Block; COPD, Chronic Obstructive Pulmonary Disease; CrCl, Creatinine Clearance; DAPT, dual antiplatelet therapy; eGFR, estimated Glomerular Filtration Rate; LVEF, left ventricular ejection fraction; TIA, Transient Ischaemic Attack.
@ Renal insufficiency is defined by a serum creatinine level ≥178 μmol/L.

chamber pacing would be preferred in this group of patients. This concurs with a prior study [13] showing that more sedentary patients with lower heart rates would be good candidates for leadless VDD pacing. In contrast, conventional transvenous systems may be considered for physically active patients or patients with high resting heart rates who require regular ventricular pacing. One limitation of the Micra AV algorithm is its inability to track atrial rate during tachycardia. When the sinus rate increases, the A3 and A4 signals merge, preventing appropriate sensing of the A4 signal by the device, leading to loss of AV synchrony.

Table 2. Electrical performance at baseline and during follow-up at 6-month

	DDDR	Micra AV	P-value
Threshold[a] (V)			
Baseline	0.63 ± 0.25 (N = 22)	0.63 ± 0.32 (N = 22)	0.39
6-month	0.79 ± 0.37 (N = 21)	0.70 ± 0.75 (N = 18)	0.003
R wave amplitude (mV)			
Baseline	10.10 ± 3.98 (N = 21)	8.76 ± 5.49 (N = 21)	0.128
6-month	10.53 ± 2.33 (N = 12)	9.79 ± 4.53 (N = 13)	0.613
Impedance (ohm)			
Baseline	677.14 ± 95.13 (N = 22)	770.00 ± 201.78 (N = 22)	0.06
6-month	569.14 ± 75.85 (N = 22)	584.44 ± 89.46 (N = 18)	0.561

[a] pacing threshold at median pulse width of 0.40 ms for DDDR and 0.24 ms for Micra AV.

Results

The results of the study are summarized in Table 3. Similar to previous studies about Micra VR, our study found that Micra AV pacing provides stable electrical performance and is non-inferior in safety outcomes. The pacing capture thresholds remained stable through follow-up in 95.5% of the Micra AV group patients, comparable to conventional DDDR pacemakers. One Micra AV group patient developed an increased threshold since Day 2 post-operation but was stable during follow-up and did

Table 3. Outcomes of patients with DDDR pacemaker vs. Micra AV

	DDDR	Micra AV	P-value
	N = 22	N = 22	
Primary Outcomes			
Procedure Time (mins)	71.6 ± 33.7	40.0 ± 14.1	<0.001
Length of stay post-pacemaker (Median [IQR], days)	7 [7,12.25]	1 [1,4]	<0.001
Safety Outcomes			
Early Complications (within 2 weeks)			
Major	1 (4.5%)	0	1
Non-major	3 (13.6%)	8 (36.2%)	0.082
Complications within 6 months			
Major	1 (4.5%)	0	1
Non-major	4 (18.2%)	8 (36.2%)	0.176
30-day mortality	0 (0%)	2 (9.1%)	0.488
6-month mortality	1 (4.5%)	3 (13.6%)	0.607
Secondary Outcomes			
New onset AF at 6 months	1 (4.5%)	0	1
Hospitalization at 6 months	12 (54.5%)	5 (22.7%)	0.03
HF-related	1 (4.5%)	2 (9.1%)	1
Non-HF related	11 (50%)	3 (13.6%)	0.01

Abbreviations: AF, Atrial fibrillation; HF, Heart Failure.

not need any system revision. There were no major complications that led to death or required revision or extraction of therapy, hospitalization, or prolonged hospitalization. There was no statistically significant difference in complications (at 2-week and 6-month) or mortality.

On the other hand, both the procedure time (40.0 ± 14.1 min vs. 71.6 ± 33.7 min) ($p < 0.001$) and length of stay post-pacemaker implantation (median 1 day vs. 7 days) ($p < 0.001$) were shorter in the Micra AV group. The shorter stay could be attributed to the minor surgical wound requiring less wound care in leadless pacemaker implantation. Also, there is no need for much body movement restriction post-implantation of leadless pacemakers, so earlier mobilization could be allowed, facilitating earlier discharge from the hospital. In previous experience [14], same-day discharge after leadless pacemaker implantation was demonstrated to be feasible and safe in appropriately selected individuals. The shorter procedure time and hospital stay observed in our study suggest that the Micra AV pacemaker may provide a less invasive and more efficient option for pacing in this population.

AV synchrony is one of the essential efficacy outcomes the study aimed to assess. This is a crucial aspect of pacemaker therapy for patients with high-grade AV block, as the maintenance of AV synchrony can help optimize cardiac function, improve

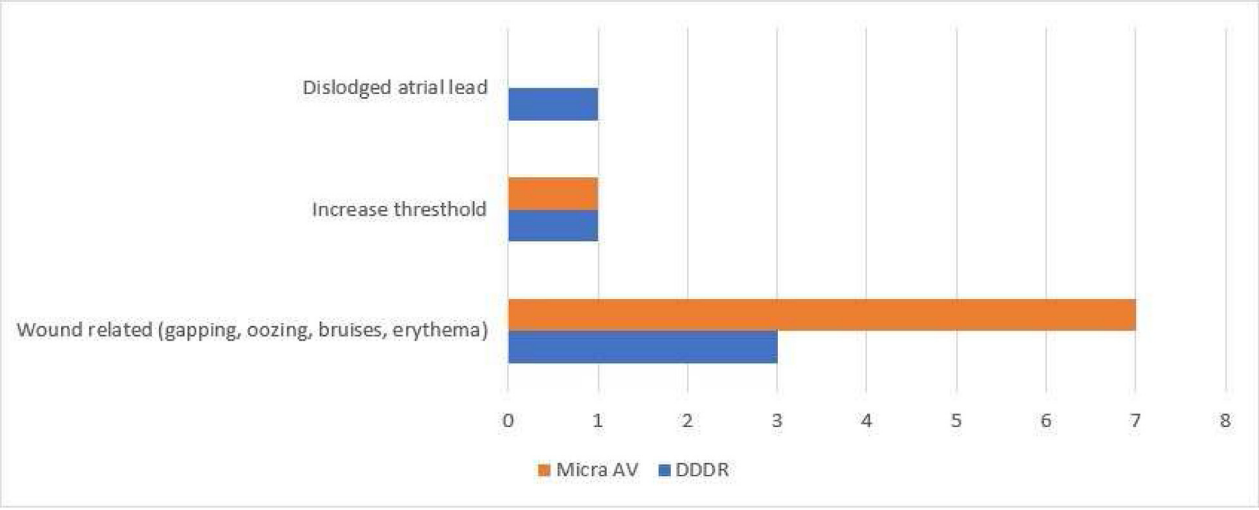

Fig. 4. List of major and non-major complications at 6 months.

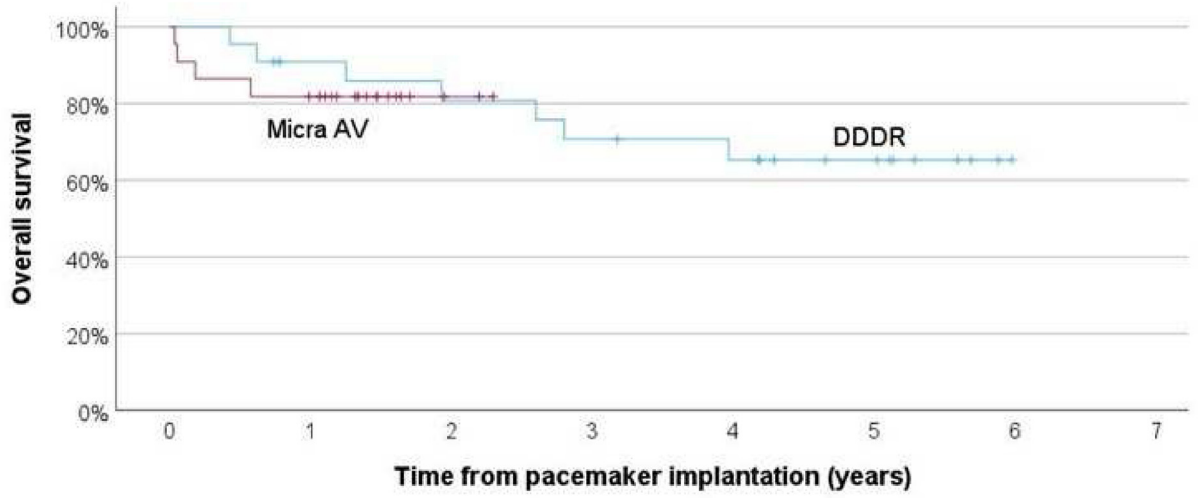

Fig. 5. Kaplan-Meier survival curve of patients in Micra AV vs. DDDR group.

cardiac output, and reduce the probability of pacemaker syndrome occurrence. The performance of AV synchrony was evaluated in this study in terms of mean %AM-VP. To facilitate comparison with other research studies, we used the same cut-off of ≥70% to define the threshold for adequate AV synchrony. At baseline and 6 months, 76.2% and 77.8% of the patients achieved at least 70% AV synchrony, respectively. The mean %AM-VP was maintained stably at 80.32 ± 13.00 at 6 months. The level of AV synchrony in this study, though lower than that in the MARVEL 2 clinical trial (95% of participants achieved mechanical atrial sensing resulting in AV-synchronous pacing of ≥70%), was comparable to other real-world data [15].

Despite the fact that 100% AV synchrony was not achieved, patients in the Micra AV group had no increased incidence of new-onset atrial fibrillation and hospitalization due to heart failure compared with conventional DDDR pacemaker counterparts.

Study limitations

One limitation of this study is the relatively small sample size. While stratified matching was used to minimize potential confounding variables, the small sample size may limit the generalizability of the study findings to larger populations.

Moreover, as a single-center retrospective review, there was no standardized protocol for implantation procedure and post-procedural monitoring and optimization during follow-up. The generalizability of results could be limited by different operators' experiences and practices, patient populations, and healthcare resources.

While an attempt was made to evaluate the significance of AV synchrony by looking at the secondary outcome of new-onset atrial fibrillation and hospitalization related to heart failure, other clinically significant impacts, such as patient-reported symptoms and quality of life, were not evaluated in this study. Also, identifying predictors of AV synchrony in Micra AV patients was out of the scope of this study.

Another limitation of the study is that Micra AV was compared with conventional DDDR pacemakers, in both of which, traditional right ventricular pacing was used. With the advancement of physiological pacing techniques such as left bundle branch pacing, further study may be needed to compare Micra AV with physiological pacing to evaluate the outcomes.

Longer-term data is lacking in this study, as the observation period for complications and mortality was only 6 months.

Conclusion

Micra AV is non-inferior to DDDR pacemakers in terms of clinical outcomes while offering potential advantages of shorter length of stay and procedure time. However, this study has some limitations, including its relatively small sample size and single-center retrospective design. Future studies could investigate the impact of quality of life and symptoms in patients with Micra AV implantation compared with DDDR pacemakers implantation and physiological pacing. Longer follow-up would be warranted to evaluate the long-term electrical stability, performance of AV synchrony, complications, and mortality.

In summary, Micra AV is a safe and effective alternative to conventional DDDR pacing in selected patients with intermittent or permanent high-grade AV block. The choice of pacing device should be individualized based on shared decision-making by healthcare providers and patients.

Ethical information

The study was approved by Kowloon West Cluster Research Ethics Committee (KWC-REC) of Hospital Authority in Hong Kong with reference number KW/EX-23-005(180-01).

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None reported.

Conflict of interest

The authors have no conflict of interest to disclose.

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