Initial experience with transvenous lead extraction of His bundle pacing leads

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INTRODUCTION

The use of conduction system pacing (CSP) is expanding globally in the treatment of patients with bradycardia, atrioventricular conduction disorders, and those requiring cardiac resynchronization therapy (CRT), through such techniques as His bundle-branch pacing (HBP) and left bundle-branch area pacing (LBBAP). The increase in the use of implantable devices with HBP and LBBAP has led to the first-ever recommendations for permanent pacing using HBP pacing [1, 2]. This growing interest in CSP, along with the rapidly expanding evidence base for CSP, is expected to result in a significant increase in the number of CSP patients in the coming years.

However, the long-term performance of CSP can be impacted by the learning curve of operators and anatomical challenges. In this population, HPB patients are more likely to suffer from high pacing thresholds leading to a higher likelihood of transvenous lead extraction (TLE). Furthermore, complications such as lead-dependent infective endocarditis (LDIE), local infections of the device pocket (LI), lead dysfunctions, and the presence of redundant/inactive leads can also contribute to an increased number of TLE procedures.

Currently, there is a lack of large data on TLE procedures of CSP lead extraction, particularly HBP leads in the adult population. Our study aimed to present the initial experience of performing TLE procedures in patients with HBP leads utilizing a non-stylet-driven Medtronic 3830 lead (MDT 3830, Medtronic Inc, Minneapolis, MN, US) from a tertiary center's perspective.

METHODS

A prospective analysis of the records included all patients with HBP leads who underwent TLE from October 2011 to February 2023. The patient inclusion criteria were the presence of an HBP lead and the need for TLE regardless of indication. The Research and Ethics Committee of Jagiellonian University approved the study protocol (KBET/259/B/2011), and written informed consent was obtained from all patients for using their anonymized data in the present study. The study protocol conformed with the Declaration of Helsinki and complied with the Good Clinical Practice guidelines.

In this study, patients whose HBP leads had been implanted for less than one year before the procedure were also included in the analysis. Data were collected from a prospectively maintained database comprising records on device implantation, follow-up on the device, medical information obtained from general cardiac centers during the index admissions for TLE, and data on 30-day complications after the procedure. We analyzed the data on the presence of non-functional/abandoned leads, age of extracted leads, fluoroscopy time, extraction techniques used during TLE, effectiveness of TLE, complete/incomplete removal for each lead targeted, and complications occurring during the intra-operative and 30-day post-operative period.

Table 1

Patient	Sex	Age, year	Pacing system	LVEF, %	Indication for TLE	Dwell time HIS pacing lead, months	Tools	Results of the TLE procedure	Fluoroscopy time, minutes
No 1	M	76.3	CRT-D HIS	24	Lead dysfunction	17.3	T	Full success	0.18
No 2	F	66.1	CRT-D HIS	35	Lead dysfunction	22.0	T	Full success	0.083
No 3	M	65.8	CRT-D HIS	50	Upgrade	10.9	CSF	Full success	6.42
No 4	M	79.7	CRT-P HIS	17	LDIE	6.9	T	Full success	0.1
No 5	M	73.1	CRT-D HIS	26	LDIE	7.8	T	Full success	0.05
No 6	M	66.5	CRT-D HIS	38	Local infection	15.1	T	Full success	0.1
No 7	M	61.2	CRT-D HIS	25	Local infection	17.0	T	Full success	0.05
No 8	M	68.3	CRT-D HIS	20	Upgrade	19.8	T	Full success	0.1
No 9	M	75.1	CRT-D HIS	35	Upgrade	43.3	C	Full success	2.88

Abbreviations: C, lead removal with polypropylene sheets; CRT-D HIS, cardiac resynchronization therapy with His bundle pacing; CSF, lead removal with polypropylene sheets combined with stabilizing the lead via femoral access; T, simple traction; LDIE, lead-dependent infective endocarditis; LVEF, left ventricular ejection fraction; TLE, transvenous lead extraction

The effectiveness of TLE procedures was defined according to the current Heart Rhythm Society (HRS) and European Heart Rhythm Association (EHRA) consensus [3, 4]. The description of the TLE procedure was presented in our earlier article [5].

Statistical analysis

Continuous variables were presented as median and interquartile range (IQR) or minimum and maximum values. Categorical variables were presented as counts and percentages.

RESULTS AND DISCUSSION

The study involved nine patients who met the inclusion criteria, one of whom was female, with a median (IQR) age of 68.3 (65.9–75.7) years and a range of 61–79 years. All patients had cardiac implantable electronic devices (CIED) with HBP using a non-*stylet*-driven Medtronic 3830 lead (MDT 3830, Medtronic Inc, Minneapolis, MN, US). Seven patients had CRT with HBP (HOT-CRT), and two patients had an ICD with HBP. All CIEDs were implanted for primary prevention on the left side of the chest. TLE was performed due to LDIE (2 patients), LI (2 patients), and non-infectious indications (5 patients). In patients with non-infectious indications, three patients required TLE due to an increase in their HBP threshold, and two patients with HOT-CRT and complete ipsilateral venous occlusion required additional placement of an atrial lead. In addition, 33.3% of patients had significant ipsilateral venous occlusion. The median (IQR) lead dwell time was 17.0 (9.3–20.9) months, and the majority of extracted CSP leads were over a year old.

The patients in our study had a high prevalence of comorbidities, including dyslipidemia (100%), atrial fibrillation (88.9%), ischemic heart disease (77.8%), hypertension (77.8%), diabetes (55.5%), history of myocardial infarction (55.5%), previous cardiac surgery (44.4%), and chronic kidney disease (44.4%).

TLE with the Medtronic 3830 lead was technically challenging due to its lumenless design, narrow caliber, cable-fixed exposed helix, and inability to use stylets. Furthermore, the high tensile strength of the Medtronic 3830 lead due to the presence of an inner cable and a non-retractable helix may pose a risk of myocardial avulsion [6, 7]. Nonetheless, the extraction efficacy of all targeted HBP leads was high and achieved 100%. Five leads were removed using simple traction, while four leads required more mechanical extraction tools, including Byrd dilators (Cook Medical). In two patients, an HBP lead was used to retrieve venous access due to complete ipsilateral venous occlusion, with stabilization of the HBP leads via a femoral approach with a Needle Eye Snare. The median (IQR) fluoroscopy time was 0.1 (0.07–1.53) minutes. The longest fluoroscopy times were recorded when HBP electrodes were used to regain venous access. There were no major or minor intra-procedural complications (Table 1).

While TLE procedures of CSP lead extraction are well documented in the pediatric population, there are limited data in the adult population [8]. The study by Vijayaraman et al. is the only report of retrospective analysis of 30 adult patients who underwent TLE of HBP leads, with a mean dwell time of 25 (18) months, which, in most cases, were successfully extracted with manual traction alone [9]. Additional data were derived from case descriptions such as our previous case study, where we reported a successful complex mechanical extraction of an HBP lead to retrieve venous access in an upgrade procedure [10].

TLE procedures, although safe, carry the risk of both major and minor complications, as demonstrated by Tajstra et al., who presented a TLE complication rate of approximately 5.6% in more than 800 patients. When determining the factors associated with TLE procedure complications, the authors showed that the presence of comorbidities such as prior dialysis, chronic kidney disease, and ventricular tachycardia were independent factors of higher risk of TLE-related in-hospital complications. Furthermore, heart failure and older age can independently affect 12-month mortality [11]. In the analyzed small population of HBP patients, the high percentage of effectiveness and safety of TLE procedures was achieved despite the high prevalence of comorbidities which, in our opinion, can be explained

by the short lead dwell time and the experience of the operators. However, it is reasonable to assume that with an increased lead dwell time, the profile of safety and complications of TLE procedures will be similar to large-scale studies.

An additional area of interest is the issue of performing TLE procedures involving HBP leads in patients with complex clinical situations. On this basis, as we described earlier, the implementation of HBP appeared to be an effective and safe pacing method in a heart transplant recipient [12]. Although we did not observe additional complications while performing TLE procedures in heart transplant recipients, managing malfunctioning or infected HBP leads is impaired by the lack of large-scale data on TLE procedures in this group of patients.

In conclusion, based on the analyzed study population, the TLE procedure appears to be safe and effective. However, to obtain more reliable assessment of its long-term effectiveness and safety in an expanding population of CSP patients, it is necessary to conduct a large multicenter prospective study.

Article information

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