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Implantable Loop Recorder as a Strategy Following Cardiovascular Implantable Electronic Device Extraction Without Reimplantation

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Abstract

Background: Limited data exists for outcomes in patients undergoing cardiovascular implantable electronic device (CIED) transvenous lead extraction (TLE) without clear indications for device reimplantation. The implantable loop recorder (ILR) may be an effective strategy for continuous monitoring in select individuals.

Objective: This retrospective analysis aims to investigate patients who have undergone ILR implant following TLE without CIED reimplantation.

Methods: Clinical data from consecutive patients who have undergone TLE with ILR implant and without CIED reimplantation from October 2016 to May 2020 at a single center were collected.

Results: Among 380 patients undergoing TLE, 28 (7.7%) underwent ILR placement without CIED reimplantation. TLE indications were systemic infection (n=13, 46.4%), pain at the site (n=8, 28.6%), device/lead malfunction (n=4, 14.2%), and other. Devices extracted included: dual-chamber and single-chamber pacemaker (n=14, 50%; n=4, 14.2%), dual-chamber implantable cardiac defibrillator (n=10; 35.7%), and cardiac-resynchronization therapy with defibrillator (n=1, 3.5%). Reasons for no reimplantation included no longer meeting CIED criteria (n= 14, 50%), patient preference (n=9, 32.1%), and no clear or inappropriate indication for initial CIED implantation (n= 5, 18%). During an average of 12.3 ± 13.1 months of follow-up, there were no lethal arrhythmias, and 4 (13.3%) patients underwent permanent pacemaker reimplantation due to symptomatic sinus bradycardia and atrioventricular block with syncope as discovered on

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ILR. Three patients died due to unknown causes (n=1), non-cardiac (n=1), and acute coronary syndrome (n=1).

Conclusions: In patients undergoing TLE without reimplantation, an ILR may be an effective monitoring strategy in patients at low risk for cardiac arrhythmia.

Keywords

Cardiac implantable electronic devices; device extraction; lead extraction; implantable loop recorder

Introduction

Permanent pacemakers (PPM), cardiac resynchronization therapy (CRT) and implantable cardiac defibrillators (ICD) confer important improvements in quality-of-life and life-sustaining therapy in select patients with heart disease. Increasing utilization of these devices is supported by the technical advances in monitoring and expansion of guideline indications [1, 2]. Partnered with an aging population and increasing need for cardiac implantable electronic devices (CIED), it is estimated that roughly 1.2 – 1.4 million devices are implanted on an annual basis worldwide with more than 300,000 new implants occurring every year in the United States alone, a significant rise from the early 2000s [3–7].

CIEDs are implanted with the intention for lifelong treatment, prevention, and monitoring; however, with CIED infections on the rise, percutaneous transvenous lead extraction (TLE) is becoming more frequent [8, 9]. Most risk factors for CIED infection are largely non-modifiable, therefore the decision for reimplantation must be carefully considered as re-infection and the morbidity of re-extraction is considered higher in this population [10, 11].

In certain clinical scenarios, such as high-grade AV block, severe ventricular arrhythmias, or high pacing needs, the decision for reimplantation is straight forward; however, in the absence of these indications, the decision for reimplantation may be unclear and risk of future event is difficult to predict. As no consistent guidelines exist for the monitoring of patients undergoing TLE without planned subsequent device reimplant, next steps are often guided by shared decision making between the patient and clinician, resulting in significant variability in clinical practice [12].

Long-term monitoring with an implantable loop recorder (ILR) may be a useful tool to aid in shared decision making and provide a more individualized risk assessment in certain groups of patients, particularly in those with a low risk of malignant cardiac arrhythmia. We aim to investigate the assess the outcomes of a strategy of ILR implantation in patients undergoing TLE without clear indications for CIED reimplantation.

Methods

Patient selection and study design

A retrospective chart review study was conducted in patients aged 18 years and older who underwent CIED TLE with placement of ILR at the University of California, San Diego

from January 2016 to December 2020. Patients were included if they had at least 1 lead successfully extracted and were alive at hospital discharge with at-least 1 remote monitoring transmission. Data was obtained via the electronic health record including patient demographic, comorbidities, CIED type, procedure details, and periprocedural outcomes. Additionally, ILR interrogations in the follow-up period were obtained. Institutional Review Board approval was obtained prior to data collection.

Statistical analysis

Descriptive statistics were primarily used. Mean and standard deviation were used to describe continuous variables. Counts and percentages were used to describe categorical variables. All statistical analyses were performed with IBM SPSS Statistics Version 28 (IBM Corp, Armonk, NY).

Results

Baseline characteristics

A total of 380 patients underwent lead extractions at the University of California San Diego from October 2016 to February 2021 with 30 patients (mean age of 59 years ± 17.1, 40% female) receiving ILR following CIED extraction, two patients died during index hospitalization and were not included in our study cohort. The average lead indwelling time was 75±62 months. Nearly two-thirds (64%) of the total extracted devices were pacemakers, including 14/28 (50%) dual chamber pacemakers and 4/28 (14.2%) single chamber pacemakers. Ten devices were ICDs, 9/10 (32.1%) dual chamber devices, 1/28 (3.5%) a single chamber ICD lead. One patient had a cardiac resynchronization therapy defibrillator (CRT-D).

Baseline characteristics are shown in table 1. There was a high prevalence of coronary artery disease (n=13, 43.4%) and hypertension (n=12, 40.4%). Less than half of the patients had a diagnosis of heart failure (n=6, 30%) and the average ejection fraction (EF) at the time of explant was greater than 50%.

Symptomatic sick sinus syndrome (SSS) was the most common indication for initial device placement (n=10, 35.7%), followed by primary prevention (n=6, 21.4%), symptomatic bradycardia (n= 5, 17.8%), secondary prevention for history of ventricular tachycardia (n=4, 13.3%), and high-grade/intermittent AV block (n=3, 10.7%). The CRT-D was placed for the indication of reduced EF and left bundle branch block (n=1, 3.33%).

Reason for CIED extraction

The most common reason for TLE was systemic infection or bacteremia meeting guideline criteria for extraction (n=13, 46.4%), chronic pocket site pain (n=8, 28.6%), device/lead failure (n=4, 14.2%), and other (n=3, 10.7%) as shown in Figure 1. A median number of 2 leads were extracted per person. Three patients underwent lead extractions of previously abandoned leads, one patient had five leads extracted. Two patients in this cohort had previously undergone TLE.

Procedural Outcomes

One patient (patient #21) suffered tricuspid valve injury and perforation during TLE due to severely calcified binding of leads to one another and significant vasculature fibrosis requiring sternotomy and valve repair. No other immediate complications from TLE in our cohort and all leads were successfully extracted.

Reimplantation deferment decision

Reasons for device reimplantation deferment as outlined in table 2 included: 1.) no longer meeting CIED criteria (n= 14, 50%), which consisted of history of symptomatic sinus node dysfunction or sinus bradycardia with low atrial pacing burden (n=8, 28.6%), recovered left ventricular ejection fraction (LVEF) (n=3, 10.7%), potentially resolved or misdiagnosed high grade AV block with minimal to no pacing needs (n=2, 7.1%), and definitive therapy following ventricular tachycardia (VT) ablation (n=1, 3.3%). 2.) Patient preference after shared decision making process (n=9, 32%), which consisted of prior symptomatic SSS or sinus bradycardia (n=4, 14.2%), primary prevention ICD indication with no events (n=3, 10.7%), AV block with moderate atrial pacing (n=1, 3.3%) and secondary prevention ICD with no VT during implantation (n=1, 3.3%). 3.) No clear initial indication at time of initial CIED implantation (n= 5, 18%), which consisted of those with asymptomatic bradycardia/no clear sinus node dysfunction (n=3, 10.7%) and presumed secondary prevention ICD with no VT on electrophysiology studies (EPS) or other rhythm detected (n=2, 7.1%).

Post-ILR Outcomes

Patients were implanted with ILR at the time of device explant, 14 received Linq (Medtronic), 12 received Confirm (St Jude Medical), and 4 received the BioMonitor (Biotronik). ILR remote transmissions were available in 100% of patients and were following for an average of 12.1 months ± 13.1. A total of 215 total ILR transmissions with an average of 7.2 ± 9.5 per patient were reviewed (Table 3). There were 35 triggered events which were associated with sinus tachycardia, atrial fibrillations, supraventricular tachycardias (SVT), Wenckebach, premature ventricular complexes (PVC). Non-triggered events included paroxysmal Atrial fibrillation (AF), SVT, AF with slow ventricular rates, premature atrial complexes (PAC)s, PVCs, sinus bradycardia, pauses while sleeping (4 seconds), SSS, pauses in waking hours associated with Wenckebach rhythm (Table 4). No ventricular tachycardias were observed.

CIEDs were reimplanted in 4/28 (14%) of our patients within 6 months of device extraction. ILR recordings revealed symptomatic sinus bradycardia with premature atrial complexes (n=1), and symptomatic multiple sinus pauses with syncope (n=2). One patient underwent implantation of primary prevention ICD but had no events on ILR recordings. Three were originally removed for CIED infection and one for atrial lead malfunction, all patients had minimal pacing needs. For two patients, reimplantation was deferred for further clarification of pacing need while they underwent definitive infectious disease therapy including completion of antibiotics; one patient wore a wearable cardiac defibrillator until reimplant. No patients suffered lethal arrhythmias or sudden cardiac death while ILR was in place. Death occurred in three patients, one from unknown cause, one in the setting of acute coronary syndrome and one from non-cardiac etiology. Two patients underwent elective ILR

removal at an average of five months from implantation for patient preference (n=1) and site discomfort (n=1) with no arrhythmias noted on interrogation.

Discussion

In patients without clear indication for CIED reimplantation who underwent TLE with a strategy of ILR implantation, we demonstrated several key findings. First, 28 (7.7%) patients did not have device reimplantation due to three broad categories: no longer meeting CIED criteria (n= 14, 50%), patient preference after shared decision making process (n=9, 32.1%), and no clear or inappropriate indication for initial CIED implantation (n= 5, 18%). Secondly, there were no sustained ventricular arrhythmias, high grade AV block, or sudden arrhythmic death as documented on ILR monitoring. Thirdly, three (10.7%) patients underwent device reimplantation due to significant conduction abnormality, including symptomatic sinus pauses (n=2) and syncope due to chronotropic incompetence (n=1). One patient underwent primary prevention ICD reimplantation after definitive surgical therapy for bacteremia. Taken together, this study suggests that in select patients who are deemed low risk for the need of CIED reimplantation following TLE may be safely monitored by an ILR long-term with avoidance of device reimplantation.

Patients undergoing TLE without device reimplantation are a distinct patient population where the competing risks of comorbidities and device-related issues must be weighed against the potential benefits of device reimplantation. In a study of 243 patients from a single center in Belgium, n=26 (10%) did not undergo reimplantation after TLE. Among this group, symptomatic bradyarrhythmias, excluding second degree and third-degree AV block, were the predominate indications for the initial implant. A large proportion were also thought to have a device implanted without clear indication (23.5%), an issue that has been noted in several other studies and mirrored in our own cohort [10, 12, 13]. Long-term outcomes among those with no device reimplantation are limited by heterogenous cohorts with disparate outcomes. In a study of 150 patients by Zsigmond et. al, 24% of patients did not undergo reimplantation with no difference in long-term survival, although no deaths were attributed to an arrhythmic cause. Lastly, a study involving two centers including our center with no overlapping patients, Al-Hijji et al. found 97/678 (14%) patients undergoing TLE did not undergo reimplantation mainly due to no longer meeting CIED requirements [12]. In follow-up, the risk of death was higher in the no reimplantation group, although only 1 of 31 was due to an arrhythmic cause. The remaining were due to ongoing device-related complications or comorbid conditions. While these prior studies may suggest those considered for no reimplantation have significant competing risk factors that may outweigh the benefits of a CIED, a valuable opportunity exists in all patients to revisit CIED indications at the time of TLE, including downgrade, upgrade, or in this case, no reimplantation. Indeed, the Heart Rhythm Society 2017 consensus statement on lead management during cardiovascular implantable electronic device replacement recommend careful review of indications prior to CIED reimplant including personalized stratification of risk and benefit for patients [3].

In our cohort, the decision to defer device reimplant was decided pre-procedurally in all patients after a shared decision-making process. For instance, patients thought to

no longer meet CIED criteria included those with prior diagnosed (or misdiagnosed) sinus node dysfunction or AV block that had no or very minimal pacing requirements along with an underlying sinus rhythm without evidence of significant conduction disease (normal PR interval and QRS duration). One such example is patient #13 who experienced transient peri-procedural AV block following TAVR placement or patient #3 who experienced symptomatic bradycardia while undergoing treatment for Graves' disease with pyridostigmine. Furthermore, these patients did not experience syncope during the duration of the device implant and those with symptomatic sinus bradycardia had no change in symptoms of fatigue following device placement. Those with recovered LVEF or prior VT at the time of extraction were thought to have a reversible condition, either with medical therapy or ablation, that was deemed low risk for future ventricular arrhythmic events. For some patients in our cohort, more immediate reimplantation was recommended, but ultimately deferred due to patient preference. Patient #22 required 63% atrial pacing at a rate of 70 during indwelling time, patients #19 and 20 deferred primary prevention reimplantation despite reduced LVEF at time of explant (Table 5). Lastly, while most of the decisions were influenced by existed clinical data, an electrophysiology study may prove valuable in those with unclear findings if no reimplantation is considered. For instance, patient 28 underwent an electrophysiology study that demonstrated a wide complex tachycardia due to atrioventricular nodal reentrant tachycardia with aberrancy with no inducible VT and device was subsequently extracted without reimplantation.

It is important to note that pre-procedural imaging or procedural findings of severe venous stenosis or occlusion, a common finding those referred for TLE, may influence the decision to defer to device reimplantation as maintaining venous access needs to be considered [14]. Particularly important to those undergoing TLE for non-infectious indications, maintaining ipsilateral access following TLE for immediate reimplantation in those with venous obstruction may be key to avoid the inability to regain access in the future and preserve contralateral access to allow for central access for other necessary medical procedures. Per our institution protocol, we obtain a preprocedural computed tomography scan on all patients and incorporate the findings into the shared decision-making process. No patients in our series demonstrated severe venous obstruction on preprocedural imaging or peri-procedurally, therefore the decision to defer implantation was largely based on overall clinical picture and objective data (i.e., infection, need for pacing, and initial indication) prior to implantation. In those with severe obstruction, immediate reimplantation following TLE via recaptured venous access may be favored if there are justified indications.

Certain challenging situations are worth expanding on. Specifically, three patients recovered LVEF no longer met primary prevention ICD criteria at the time of TLE. Management of recovered LVEF remains challenging as the risk of arrhythmias may not be completely mitigated, as expert opinion suggests there may be an unidentified subset of patients that may continue to benefit from ICD [13]. While observational studies have shown that those with recovered LVEF and ICD have a lower risk of adverse events in regard to mortality and hospitalizations as compared to those without persistently low LVEF, the risk of adverse events, including ICD shocks and recurrence of heart failure still remains, albeit low [15–18]. As no randomized trials are available to guide clinicians, expert consensus,

observational data, patient preference, and individual risk-assessment are needed to inform the patient in the shared-decision making process.

Lastly, we propose a novel use of ILR to study the long-term outcomes in patients with low or intermediate risk arrythmias to better inform risk and benefit discussions prior to CIED reimplantation, particularly those undergoing TLE for infection or unclear bradyarrhythmia indication. In the absence of clinical trial data and consensus statements, it remains critical to carefully select patients who are deemed low risk for future arrhythmic events for no device reimplantation. While we observed no arrhythmic deaths in our cohort, the use of ILR allowed us to identify 4 (13.3%) patients with bradyarrhythmias correlating with symptoms that ultimately underwent device reimplant. Long-term continuous data from an ILR monitoring post TLE without reimplantation may offer a safe compromise in these select patients. Further studies are needed to define sub-groups of patients in which ILR may be most beneficial or should be avoided.

Limitations

This is a retrospective single center descriptive analysis, and therefore no randomization was performed, or comparison groups were used. Our findings are limited by our small sample size which may limit generalizability to larger populations. Long-term ILR monitoring with interrogation and transmissions was heterogenous among the cohort, although this reflects clinical practice. The cause-specific mortality for one of the patients could not be determined.

Conclusion

In this retrospective series of patients, use of ILR may be an effective monitoring strategy for those undergoing CIED extraction without device reimplant in carefully selected patients.

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Disclosures/Conflict of Interest:

Dr. Birs, Dr. Darden, Dr. Eskander and Dr. Pollema have no disclosures to report. Dr. Ho has received grant support from the American Heart Association, National Institutes of Health and honoraria from Abbott, Boston Scientific, Biotronik, and Medtronic and owns equity in Vektor Inc. Dr. Birgersdotter-Green reports honoraria from Medtronic, Abbott, Biotronik, and Boston Scientific. Institutional Review Board approval was obtained prior to data collection. The data supporting the findings of this study are available within the article [and/or] its supplementary materials.

Abbreviations:

CIED	Cardiovascular Implantable Electronic Device
TLE	Transvenous Lead Extraction
ILR	Implantable Loop Recorder

PPM	Permanent Pacemaker
AV	atrioventricular
CRT	Cardiac Resynchronization Therapy
ICD	Implantable Cardiac Defibrillators
CRT-D	Cardiac Resynchronization Therapy Defibrillator
SSS	Sick Sinus Syndrome
SVT	Supraventricular tachycardias
PVC	Premature Ventricular Complex
AF	Atrial Fibrillation
AT	Atrial Tachycardia
IART	Intra-atrial Reentrant Tachycardia
PAC	Premature Atrial Complex
VT	Ventricular Tachycardia
EPS	Electrophysiology Studies
LVEF	Left Ventricular Ejection Fraction

Resources

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Key Findings

1. Use of ILR may be a safe and effective method for surveillance post CIED explantation
2. There may be a subgroup of low-risk patients who may benefit from remote monitoring prior to decision for reimplantation

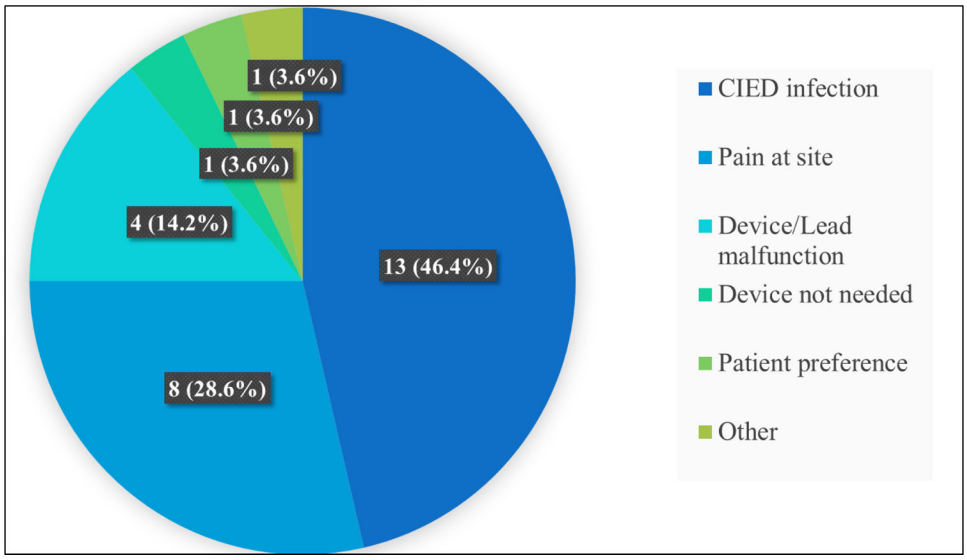

Figure 1:
Reason for CIED Extraction

Table 1:

Baseline Characteristics

Variable	Total (N= 28)
Demographic Data	
Age, years	59 (17.1)
Female sex	12 (40%)
Ejection fraction, %	56 (11.9)
Indwelling time, months	75 (62)
Comorbidities	
Coronary artery disease	13 (43.3%)
Hypertension	12 (40.4%)
Atrial Fibrillation/Flutter	7 (23.3%)
Heart failure	6 (20%)
Ischemic	3
Dilated	2
Hypertrophic	1
Valvular disease	6 (20%)
Chronic kidney disease	6 (20.0%)
Obesity	6 (20.0%)
Stroke/TIA	5 (16.7%)
Immunosuppressed	5 (16.7%)
Diabetes	4 (13.3%)
CIED type	
Pacemaker	18 (64.3%)
dual chamber	14
single chamber	4
ICD	10 (35.7%)
dual chamber	9
single chamber	1
CRT-D	1 (3.3%)
CIED indication	
Sick sinus syndrome	10 (35.7%)
Symptomatic bradycardia	5 (17.8%)
High-grade AV block	3 (10.7%)
Primary sudden death prevention	6 (21.4%)
Secondary sudden death prevention	4 (14.3%)

Values are mean (SD) or number of patients (%)

*VT and secondary prevention (n=4), Syncope and secondary prevention (n=2), CRT and primary prevention (n=1), Syncope and SSS (n=1), Syncope and Symptomatic Bradycardia (n=2).

Table 2:

Reasons for CIED deferment

		Total (n=28)	%
No longer meets CIED indication		**14**	**50%**
	SSS/SB with minimal or no pacing needs	8	
	Recovered EF, Primary prevention ICD	3	
	Resolved or misdiagnosed AV Block	2	
	VT ablation, treated	1	
Patient Preference		**9**	**32%**
	Sick sinus syndrome/sinus bradycardia	4	
	Primary prevention, reduced EF/HCM	3	
	Secondary ICD with no VT events	1	
	AV Block	1	
Never met CIED indication		**5**	**18%**
	Asymptomatic bradycardia, no clear SSS	3	
	Presumed VT, found to have AVNRT/no VT on EPS	2	

* Values are number of patients (%)

Table 3:

ILR utilization

Variable	Total, (SD)
ILR transmissions, total	215
Average, per person	7.2 (9.5)
Patient Triggered Events	35
Follow-up Time, months	12.3 (13.1)

* Values are mean (SD) or number of patients (%)

Table 4:

Post-ILR outcomes

Death	3 (10%)
Arrhythmogenic	0
ACS	1
Non-cardiac	1
Unknown	1
ILR Removal	2 (6.7%)
Avg time from explant, months	5
Reimplantation	4 (13.3%)
Symptomatic bradycardia/SSS	4
Follow up	
Followed at outside clinic	4 (13.3%)

* Values are mean (SD) or number of patients (%)

Table 5:

Summary Table

Patient #	Dwelling time	Age	Sex	Reason for Implant	Reason for Extraction	Justification for No Reimplant	Findings on ILR	Reimplant
No longer meeting criteria								
1	3400	40	M	SSS	Pain at site	Minimal pacing needs, <1%	AF, 5s vagal pause	N/A
2	3194	77	M	SSS	CIED infection with lead vegetations	No pacing needs	AT/SVT; PVCs/ PACs	N/A
3	659	66	M	SSS	Device malfunction: RA lead dislodgement; Chronic pain	Completed course of pyridostigmine, no pacing needs	Two 4s pauses, sleeping; AT	N/A
4	110	26	F	SSS	Chronic pain at site/Migration of Device	No pacing needs	Wenckebach, AT/SVT	N/A
5	354	21	F	SSS with Syncope	Patient preference	No pacing needs	Sinus bradycardia, PACs	N/A
6	3990	50	F	SSS with Syncope	Lead malfunction, chronic pacemaker pocket pain	No pacing needs	AF, tachy events, 1 brady event	N/A
7	4401	58	F	Symptomatic Bradycardia, Syncope	Chronic pocket pain	No pacing needs, asymptomatic	No events	N/A
8	3233	86	M	Symptomatic Bradycardia	CIED infection, recurrent E faecalis bacteremia	Minimal pacing needs, asymptomatic	AF, slow rates at night	N/A
9	3457	58	M	Primary Prevention, HFrEF	Breast cancer radiation, surgery	Recovered EF, no events	AF, PACs	N/A
10	5572	43	M	Primary Prevention, HFrEF	CIED infection, Device erosion	Recovered EF, no events	No events	N/A
11	6332	89	M	Primary Prevention, CRT-D, SSS	CIED infection and pocket erosion/ infection	Recovered EF, no events	1st degree AVB, 3s pause, AF	N/A
12	1100	67	M	High grade AVB	CIED infection with lead vegetations	Minimal pacing needs, <1%	No events	N/A
13	90	83	M	High grade AVB	Chronic pocket pain	Transient AVB post TAVR, recovered sinus rhythm	No events	N/A
14	2120	59	M	Secondary Prevention, Syncope/ Presumed VT	Device malfunction: High impedences and pacing thresholds	VT treated with ablation, no recurrence	SVT, 4 mins	N/A
Patient Preference								
15	1893	64	F	SSS	CIED infection, Enterrococus bacteremia	Ventricular pacing 33% at 70bpm	AF (91% burden)	N/A
16	2470	76	M	SSS	CIED infection. Staph Lugdunesnsis bacteremia	Atrial pacing 68% at 60bpm	No events	N/A

Patient #	Dwelling time	Age	Sex	Reason for Implant	Reason for Extraction	Justification for No Reimplant	Findings on ILR	Reimplant
17	1067	52	F	Symptomatic Bradycardia	Device malfunction: Atrial lead malfunction	Asmyptomatic, no pacing needs	Multiple sinus pauses, longest >6 sec	Yes
18	787	65	M	Symptomatic Bradycardia	CIED infection. Staph aureus Bacteremia	Asmyptomatic, no pacing needs	Syncope, chronotropic incompetence	Yes
19	2783	69	M	Primary Prevention, HFrEF	CIED infection. Staph aureus Bacteremia,	Reduced EF, surgery needed for definitive infection control	No events	Yes
20	1033	45	F	Primary Prevention, HFrEF	MRSA bacteremia, CIED infection. Lead vegetation	Reduced EF, cm going IV drug use	PVC, ST	N/A
21	6782	34	F	Primary Prevention, HCM and Syncope	Device malfunction: Increasing impedence	No VT, 1 inappropriate shock during exercise	SVT	N/A
22	1708	69	F	High grade AVB	CIED infection. Staph Bacteremia	Atrial pacing at 63%	Junctional rhythm, symptomatic bradycardia	Yes
23	3346	71	M	Seconday Prevention, Presumed VT	Strep pneumoniae bacteremia, CIED infection	No recurrence of VT	No events	N/A
No dear indication for initial CIED								
24	50	57	M	SSS	CIED infection, MRSA bactermia	No pacing needs	No events	N/A
25	2527	49	F	SSS	Pain at site	No pacing needs	No events	N/A
26	207	62	F	Symptomatic Bradycardia	Chronic pacemaker pocket pain	No pacing needs	AF <1%	N/A
27	1567	35	F	Seconday Prevention, Syncope/ Presumed VT	Pain and discomfort at site	No VT only runs of SVT seen	SVT, IART	N/A
28	207	67	M	Secondary Prevention, Syncope/ Presumed VT	No inducible VT on EPS (2020)	No VT, only runs of AVNRT and AF seen	AF, Atrial burden 3%	N/A

CIED = cardiovascular implantable electronic device; ILR = implantable loop recorder; SSS = sick sinus syndrome; AV block = atrioventricular block; VT = ventricular tachycardia, PAC = premature atrial complex; PVC = premature ventricular complex; AF = atrial fibrillation; SVT = supraventricular tachycardia