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Cardiovascular implantable electronic device lead removal in a resource-constrained setting: A single-center experience from India

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ABSTRACT

Background: Data from large-volume centers in developed countries, using dedicated tools, show a high success rate with a good safety record for the percutaneous lead removal procedure. However, there are constraints to replicate the results in a resource-poor setting and there is limited data from India.
Methods: We retrospectively analyzed lead removal procedures performed in our institution from 2008 to 2019.
Results: Seventy-five patients underwent percutaneous removal of 138 leads. Of these, 44 procedures and 80 leads qualified as extraction with a median dwell time of 52.1 (IQR 28.2–117.2) months. Overall, 33/44 (75.0%) procedures were successful and 65/80 (81.2%) leads were successfully extracted. Manual traction was successful in the extraction of 44/57 (77.2%) leads. All leads implanted less than 2.7 years could be removed with manual traction alone. Specialized tools were used in 23 leads and 21 (91.3%) of those could be successfully extracted. Inability to use dedicated tools was an independent predictor of procedural failure (adjusted OR 14.0; 95% CI 1.8–110.2; p-value 0.012). Right-sided implant (adjusted OR 12.6; 95% CI 1.3–119.5; p-value 0.027) was also independently associated with failure. There was 1 death (1.3%) and minor complications occurred in 6 (8.0%) patients.
Conclusions: In a resource-limited setting, percutaneous lead extraction of predominantly pacemaker leads by manual traction methods achieved success in extracting about three-fourths of the leads. Inability to use specialized tools was the main factor limiting success. The complication rate was low.

1. Introduction

The growing number of cardiovascular implantable electronic device (CIED) implantations has seen a concomitant increase in the indications for their removal. Percutaneous lead extraction, as opposed to surgical removal, has become the standard of care for the management of infected or dysfunctional CIED systems. In developed countries, large-volume centers with specialized lead extraction programs have evolved. Data from these centers, using dedicated tools, show a high success rate with a good safety record for the procedure [1,2]. Despite all the technical advances, percutaneous lead extraction remains a challenging and risky procedure. Data about lead management strategies from resource-constrained settings is limited. Given the prohibitive cost associated with these dedicated tools, reserving them for selected cases may be reasonable in countries like India. We report a single-center experience of non-laser assisted percutaneous lead removal procedures.

2. Methods

2.1. Study population

We retrospectively analyzed 75 lead removal procedures performed in our institution from 2008 to 2019. Patient data, device details, and follow-up data were collected from electronic medical records. Procedure details were collected from the detailed procedural notes written by the operator.

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2.2. Lead removal procedure

All patients had pre-procedure blood group typing and cross-matching done. When feasible, antiplatelet drugs and anticoagulants were stopped before the procedure. In cases where they could not be stopped safely, antiplatelets were continued through the procedure. Anticoagulants were stopped 2–3 days before the procedure and bridged with heparin or the procedure was done once the international normalized ratio (INR) was less than 2.0 without using heparin. Pacing-dependent patients who were not expected to receive immediate reimplantation were placed on a transjugular ventricular active-fixation lead connected to an external pulse generator. The choice to operate in the operating room (OR) or electrophysiology (EP) lab was at the discretion of the explanting physician. Regardless of the place of the procedure, thoracic-surgeons were always available on standby. Local anesthesia was used for leads with short dwell time while general anesthesia was used to extract longer dwelling leads.

A stepwise approach was used as described previously [3–7]. To summarize, after unscrewing and separating the device from the leads, manual lead traction with the aid of an implantation stylet was performed. If traction from the pocket resulted in a lead fracture or in case of a preexisting free-floating lead, a snare typically used for endovascular procedures (Goose Neck™ snare, Amplatz, Plymouth, Minnesota, USA) was inserted through a 6F catheter via the femoral route and lead retrieval was attempted. This snare, though not specifically designed for lead extraction, was used as an extension of manual traction for removal of retained lead fragments.

When available and not constrained by cost, the following types of dedicated extraction tools were used in various combinations according to the choice of the operator - (a) lead locking stylets (Liberator ®, Cook Medical, Bloomington, Indiana, USA, or LLD®, Spectranetics (a Philips company, San Diego, California, USA), (b) snaring device (Needle's Eye Snare®, Cook Medical), (c) telescoping sheaths (SlightRail™, Spectranetics), and (d) rotating mechanical dilator sheaths (Evolution®, Cook Medical, or TightRail™, Spectranetics).

Several procedural caveats apply while performing the extraction with dedicated tools. A skin incision directly over the site of lead's entrance into the vascular system and dissecting as close as possible to that site helped transmit the coaxial traction. The LLD was passed till the lead tip or to distal-most point possible to achieve effective traction. When manual traction with the lead stylet or LLD did not help, more advanced tools were used. It was made sure that the traction on the LLD was coaxial and controlled so as to ensure that the LLD did not retract. Continuous repeated application of the rotational cutting sheath mechanism was seldom required and waiting between applications while delivering forward counter pressure was more effective.

2.3. Reimplantation

When infection was the indication for CIED removal and there was no evidence of bacteremia, reimplantation was at the discretion of the physician depending on the adequacy of wound healing and urgency of reimplantation. In the case of endocarditis, at least 2 weeks of antibiotic therapy was administered and the blood cultures were negative before reimplantation.

In infected cases, implantation of a new CIED system was always advised. However, if the patient could not afford a new device and the old device had adequate battery life, it was reused. The leads were never reused. Explanted pulse generators were screened for any significant external damage and interrogated. Devices were washed with a detergent solution to remove particulate debris. They were packed as a double barrier package using commercially available sterilization pouches (Tyvek®, DuPont, Midland, Michigan, USA) and sterilized at least twice with either ethylene oxide (prior to 2017; EO-FCT, Andersen sterilizers, Haw River, North Carolina, USA) or low temperature hydrogen peroxide plasma sterilization (from 2017; STERRAD®, ASP (a Johnson & Johnson company),Irvine, California, USA). The last sterilization was done not more than 24 h before reimplantation. A separate consent explicitly stating the implantation of a refurbished device and the potentially higher risks, was taken.

2.4. Definitions

The terms related to lead removal have been defined previously in the expert consensus statements on lead extraction [7–9]. In brief, a procedure was called '*lead explantation*' when all the removed leads were implanted for less than one year and no special tools (other than implantation stylets) were used. A procedure was defined as *'lead extraction'* when at least one lead was implanted for more than one year or the procedure required the assistance of specialized equipment designed for lead removal. *'Complete success'* refers to the removal of all targeted leads and lead material without permanently disabling complications/procedure-related death. *'Clinical success'* was the removal of all targeted leads with retention of a small portion of the lead (<4 cm) that does not negatively impact the outcome goals. The procedure was considered a *'failure'* when neither complete nor clinical success could be achieved or a permanently disabling complication/procedure-related death ensued. In addition, for the purpose of this study, we defined '*manual lead removal*' as removal of leads with traction or using snares not typically designed for lead extraction.

2.5. Statistical analysis

Continuous variables were expressed as mean ± standard deviation and in case of skewed distribution, median with interquartile range (IQR) was used. Categorical variables were expressed as frequency and percentage. Means were compared with Student's t-test and categorical variables were compared with the Chi-square test. Non-parametric tests (Mann-Whitney U test and Fisher's exact test) were used when a variable had skewed distribution. Multivariable analysis was done using binary logistic regression by selecting variables with p-value < 0.200 on univariate analysis or if the variable was thought to be clinically relevant. Penalized logistic regression was used when the odds ratio could not be estimated due to empty cells or cells with low frequency, because of failure of the maximum likelihood estimate to converge. The point estimates were reported as odds ratio (OR) and 95% confidence interval (CI). A p-value of <0.05 was considered statistically significant. Statistical analysis was done with SPSS® software (Ver. 21.0, IBM, USA) and SAS® (Ver. 9.2, SAS Institute, USA).

3. Results

3.1. Patient characteristics

A total of 86 patients required CIED removal during the study period. Eleven patients underwent direct surgical removal due to other indications for surgery or the treating physician considered percutaneous removal very risky. Most of the surgical referrals were before the ready availability of extraction tools. The remaining 75 patients underwent percutaneous removal of 138 leads (average 1.8 leads per procedure). Majority of the leads (63.0%) were implanted elsewhere and referred to our institution for extraction.

The most common reason for device removal was infection in

68/75 (90.7%) patients. The baseline patient characteristics are summarized in Table .1 and the infection characteristics in Table 2. Most infections were confined to the pocket with only 4/68 (5.9%) having endocarditis. Cultures were negative in 29/68 (42.6%) of the cases. Coagulase-negative *Staphylococcus aureus* (CONS) was the most common organism (22.0%), followed by *Pseudomonas aeruginosa (10.3%)*, *Staphylococcus aureus* (7.4%), other gram-negative bacilli (7.4%), atypical mycobacteria (2.9%), *Candida* species (2.9%), and others (4.4%).

3.2. Lead and procedure characteristics

Removal of 138 leads was attempted. Six of the 138 (4.3%) were ICD leads and 68 (49.3%) were passive fixation leads. Seven leads (5.1%) were cut during earlier attempts at extraction before referral to our institution. The median dwell time was 22.1 (IQR 4.5–61.3) months. Eighty leads and 44 procedures qualified as extraction. Seventy of the 75 procedures (93.3%) were performed in the EP lab. The lead and procedure characteristics are summarized in Table .3.

3.3. Outcomes

Overall, 64/75 (85.3%) lead removal procedures were successful and 123/138 (89.1%) leads were removed. Analysis was done to 80 leads and 44 procedures that qualified as '*lead extractions*'. Complete success was achieved in 33/44 (75.0%) extraction procedures. When analyzed according to leads, 65/80 (81.2%) could be extracted successfully.

Manual traction (including use of a goose-neck snare in 3 cases) was successful in 16/25 (64.0%) of the extraction procedures. On lead wise analysis, manual traction alone was successful in extracting 44/57 (77.2%) leads. All leads with a dwell time less than 33 months could be removed with manual traction alone. Dedicated tools were used for extraction of 23 leads - traction tools (LLD and/or dedicated snares) in 9 and cutting sheaths (telescopic and/or rotational cutting sheaths) in 14 leads. When procedures with the use of dedicated tools were analyzed, 17/19 (89.5%) of the procedures were successful and 21/23 (91.3%) of the leads could be successfully extracted.

Multivariable analysis was performed only for pacing leads, as the ICD leads were few as compared to pacing leads and technical challenges of ICD implantation are different. Multivariable analysis was performed for predicting procedural failure by adding the following variables to the model - the inability to use dedicated tools, presence of passive fixation leads, right-sided implants, and dwell-time of the oldest lead (Table .4). After adjustment for other variables (Table .4), inability to use dedicated tools was the only significant predictor of procedural failure (adjusted OR 14.00; 95% CI 1.78–110.25; p-value 0.012).

Lead wise univariate analysis for the 75 pacing leads is summarized in Table .5. Multivariable analysis for predicting failure of lead extraction was performed by adding the following variables to the model - the inability to use dedicated tools, passive fixation leads, right-sided implants, and dwell-time. On multivariable analysis (Table .5), right-sided implants (adjusted OR 12.65; 95% CI 1.34–119.49; p-value 0.027), use of manual traction (adjusted OR 17.89; 95% CI 1.82–176.07; p-value 0.013), and dwell-time (adjusted OR 1.02; 95% CI 1.00–1.03; p-value 0.024) were significant.

Table 1
Baseline characteristics.

Number of patients	75
Number of leads	138
Age, yrs	62.6 ± 13.4
Male	55 (73.3)
Device type	
Pacemaker	66 (88.0)
ICD	3 (4.0)
CRT - P	3 (4.0)
CRT - D	3 (4.0)
Indication for implantation	
Sinus node dysfunction	21 (28.0)
AV block	42 (56.0)
LV dysfunction/heart failure	5 (6.7)
Others	7 (9.3)
Comorbid conditions	
Diabetes	24 (32.0)
Hypertension	36 (48.0)
Ischemic heart disease	9 (12.0)
Chronic kidney disease	5 (6.7)
Left ventricular dysfunction	10 (13.3)
Prosthetic valves	2 (2.7)
Prior CABG	2 (2.7)
Medications	
Any antithrombotic drugs	18 (24.0)
Antiplatelets	17 (22.7)
Anticoagulants	3 (4.0)
Last procedure	
Initial implant	60 (80.0)
Device change/revision/upgrade	15 (20.0)
Reason for device removal	
Infection/erosion	68 (90.7)
Lead dysfunction	6 (8.0)
Device upgrade	1 (1.3)

Note: Values are mean ± standard deviation or frequency (%).

3.4. Complications

Complications occurred in 7 (9.3%) patients. Six of them were minor complications not resulting in death or permanent disability - 4 patients had bleeding requiring a blood transfusion, 1 patient developed sepsis post-procedure and recovered with antibiotic therapy, and 1 patient developed deep vein thrombosis of the distal lower limb veins. No deaths occurred during the procedure, but one patient died due to massive pulmonary embolism 1 week after failed extraction. Twenty-seven patients (36.0%) did not have long-term (>1month) follow-up. Of the remaining, none of the patients had a complication after a median follow-up of 21.4 months (IQR 7.1 to 53.4).

3.5. Reimplantation

Fifty-five patients underwent reimplantation. Eighteen patients with infected devices underwent reimplantation of their own old device after resterilization. Two patients were lost to follow-up. There was no recurrence of infection in the remaining 16 patients after a median follow-up of 15.7 months (IQR 7.0–39.7 months).

4. Discussion

Many previous studies from large-volume centers in the developed countries have shown that percutaneous lead extraction has high success with low complication rates [1,2,10–12]. The high efficacy is in part due to access to dedicated extraction tools. Although there are a growing number of CIED implants in developing countries and an accompanying increase in the indications for their removal, data about the methods used and outcomes is lacking. We report a single-center experience in lead removal from India, highlighting the issues unique to the resource-constrained setting.

The key findings of the current study are (a) removal of CIED leads using manual traction and improvised snares was successful in extraction of 77.2% of the leads and 64.0% of the extraction procedures with good safety, (b) all leads with dwell time less than

Table 2
Infection characteristics (n = 68).

Type of infection	
Pocket infection/erosion	64 (94.1)
Infective endocarditis	4 (5.9)
Organisms	
Coagulase negative staphylococcus aureus	15 (22.0)
Staphylococcus aureus	5 (7.4)
Enterococcus sps.	2 (2.9)
Gram-negative enteric bacilli	5 (7.4)
Pseudomonas aeruginosa	7 (10.3)
Atypical mycobacteria	2 (2.9)
Candida sps.	2 (2.9)
Others	1 (1.5)
Culture-negative	29 (42.6)

Note: Values are frequency (%).

33 months (≈2.7 years) could be removed safely without resorting to special extraction tools, (c) reimplantation of a resterilized device was not associated with early recurrence of infection and can be judiciously considered in some cases, and (d) extraction in EP lab was safe in appropriately selected patients, with surgical back-up.

Manual traction has been reported to have a low success rate in previous studies, between 15 and 30% [10–12]. However, in those studies operators had access to specialized tools and a probable lower threshold to use them. The success rate with manual traction in this series is comparable to the study published by de Bie et al. which used predominantly manual traction (77.2% in our study with a median lead dwell time of 4.3 years V 75.7% in the study by de Bie et al. in the subgroup with dwell time >2.6 years) [13]. However, lead locking device was used in some cases in that study [13]. In the current study, among cases where specialized tools were used, the success was close to 90%. It is unclear at what point during the procedure manual traction should be considered unsuccessful and changed to another method. This varies between operators and will very likely to depend on their experience. However, when constrained by the availability of other tools, experienced operators are likely to exhaust all tricks during manual traction before considering it unsuccessful. This illustrates the fact that the major limitation to lead extraction in the developing world is the inability to use dedicated tools in all patients, mainly due to financial constraints. This was an independent predictor of procedural failure in our study.

Right-sided implants were more difficult to extract and were independently associated with failure in this study. We speculate that due to an almost 90^0angle between right subclavian vein and the superior vena cava, force transmission of manual traction may be poor. Also, the cutting sheaths designed for extraction are not very flexible and difficult to maneuver from the right side. However, this was not previously reported in other series that used dedicated tools, indicating that this is probably a factor unique to manual extraction.

Another problem encountered was the practice of cutting the leads flush with the pectoral fascia. This is done sometimes with an expectancy of healing, which was almost never the case in our experience. The biofilm of infecting organism frequently extends along the lead into deeper tissues, so eradication of infection is very unlikely just by cutting the lead flush. Although not analyzed statistically in this study due to the small number, in all cases it made the procedure more difficult. A cut lead poses several risks. First, it can retract into deeper tissues, or worse still, can retract into vascular space with the risk of dissemination of what was a localized infection. Second, lumen of a cut lead can be compromised due to tissue ingrowth, precluding the use of lead locking devices. Third, the short working length can make application of traction difficult.

Table 3
Lead and procedure characteristics.

	Total leads removed (n = 138)	Explantation (n = 58)	Extraction (n = 80)	p- value[a]
Lead type				
Atrial pacing leads	50 (36.2)	23 (39.7)	27 (33.7)	–
Ventricular pacing leads	75 (54.3)	32 (55.2)	43 (53.7)	–
VDD pacing leads	1 (0.7)	0 (0)	1 (1.2)	–
Coronary sinus leads	6 (4.3)	2 (3.4)	4 (5.0)	–
Single coil ICD leads	2 (1.4)	0 (0)	2 (2.5)	–
Dual coil ICD leads	4 (2.9)	1 (1.7)	3 (3.8)	–
Lead fixation				
Active	70 (50.7)	37 (63.8)	33 (41.2)	0.009
Passive	68 (49.3)	21 (36.2)	47 (58.8)	–
Unipolar leads	3 (2.2)	1 (1.7)	2 (2.5)	0.758
Vascular access for the leads				
Subclavian/axillary	125 (90.6)	52 (89.7)	73 (91.2)	0.752
Cephalic	13 (9.4)	6 (10.3)	7 (8.8)	–
Cut leads	7 (5.1)	0 (0)	7 (8.8)	0.021
Side of the implant				
Left side	79 (57.2)	37 (63.8)	42 (52.5)	0.186
Right side	59 (42.8)	21 (36.2)	38 (47.5)	–
Dwell time, months	22.1 (4.5–61.3)	3.9 (2.9–8.6)	52.1 (28.2–117.2)	–
Place of explantation				
Electrophysiology lab	128 (92.8)	55 (94.8)	73 (91.2)	0.424
Operating room	10 (7.2)	3 (5.2)	7 (8.8)	–
Technique of explantation				
Manual traction only	115 (83.3)	58 (100.0)	57 (71.2)	–
Traction tools (Lead locking device and/or snare)	9 (6.5)	–	9 (11.2)	–
Cutting sheaths	14 (10.1)	–	14 (17.5)	–
Successful removal				
Success	123 (89.1)	58 (100.0)	65 (81.2)	<0.001
Total removal	121 (87.7)	58 (100.0)	63 (78.8)	–
Partial removal (<4 cm remnant left)	2 (1.4)	0 (0)	2 (2.5)	–

Note: Values are frequency (%) or median (25th percentile - 75th percentile).
– Not applicable or not analyzed.
[a] Comparison between explantation and extraction groups.

Table 4
Predictors of failure of pacemaker extraction procedures (n = 39)[a].

	Failure (n = 11)	Success (n = 28)	p-value	Univariate OR (95% CI)	p-value	Adjusted OR[c] (95% CI)	p-value[c]
Age, years	61.1 ± 18.0	65.8 ± 11.6	0.338	–	–	–	–
Male sex	9 (81.9)	21 (75.0)	1.000	–	–	–	–
Comorbid conditions							
Diabetes mellitus	2 (18.2)	12 (42.9)	0.266	–	–	–	–
Hypertension	6 (54.5)	14 (50.0)	0.798	–	–	–	–
Chronic kidney disease	0 (0)	2 (7.1)	0.918	–	–	–	–
Ischemic heart disease	1 (9.1)	4 (14.3)	1.000	–	–	–	–
Prior open heart surgery	1 (9.1)	1 (3.6)	0.490	–	–	–	–
Left ventricular dysfunction[b]	0 (0)	5 (17.9)	0.644	–	–	–	–
Procedure characteristics							
Procedure in the EP lab	11 (100.0)	25 (89.3)	0.644	–	–	–	–
Use of manual traction only (unable to use special tools)	9 (81.8)	14 (50.0)	0.086	4.50 (0.82–24.68)[b]	0.083[b]	14.00 (1.78–110.25)	0.012
Device characteristics							
Presence of passive leads[b]	11 (100.0)	18 (64.3)	0.059	13.00 (0.60–280.53)	0.101	6.57 (0.22–199.54)	0.280
Presence of cut lead	3 (27.3)	3 (10.7)	0.323	–	–	–	–
Right-sided implants	10 (90.9)	13 (46.4)	0.014	11.54 (1.30–102.65)	0.028	7.05 (0.74–67.20)	0.090
Dwell time of the oldest lead, months	117.2 (80.3–173.8)	41.4 (21.9–99.8)	0.003	1.02 (1.00–1.03)	0.022	1.01 (1.00–1.02)	0.210

Note: Values are mean ± standard deviation, frequency (%) or median (25th percentile - 75th percentile).
– Not applicable or not included in the multivariable model.
[a] ICD leads were not included in multivariable analysis.
[b] Penalized simple logistic regression was performed.
[c] Penalized multiple logistic regression was performed.

Table 5
Lead characteristics predicting failure of extraction (n = 75)[a].

	Failure (n = 15)	Success (n = 60)	p-value	Univariate OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Venous access site							
Subclavian/axillary	13 (86.7)	55 (91.7)	0.622	–	–	–	–
Cephalic	2 (13.3)	5 (8.3)	–	–	–	–	–
Use of manual traction only (unable to use special tools)	13(86.7)	42(70.0)	0.192	2.79 (0.57–13.63)	0.206	17.89 (1.82–176.07)	0.013
Passive fixation leads	14 (93.3)	33 (55.0)	0.006	11.46 (1.42–92.75)	0.022	7.40 (0.72–75.52)	0.091
Right-sided implants	14 (93.3)	24 (40.0)	<0.001	21.00 (2.59–170.37)	0.004	12.65(1.34–119.49)	0.027
Dwell time, months	117.2 (80.3–162.6)	46.9 (26.3–93.1)	<0.001	1.02 (1.01–1.03)	0.002	1.02(1.00–1.03)	0.024

Note: Values are mean ± standard deviation, frequency (%) or median (25th percentile - 75th percentile).
– Not applicable or not included in multivariable analysis.
[a] ICD leads were not included in multivariable analysis.

Considering the futility to control infection and the challenges it poses during extraction, cutting of the leads should be strongly discouraged.

So, when feasible, it would be prudent to plan an extraction procedure with specialized tools available at hand when there are right-sided implants, cut leads and leads with long dwell time.

Most procedures were performed in the EP lab with surgical backup. The safety of performing extractions in the EP lab was previously reported [14]. The arguments for extraction in the EP lab are that patients with massive bleeding are not more likely to be rescued in the operating room and performing every procedure in OR is impractical [14]. Even in the developed world, two-thirds of the procedures are performed in the EP lab [14]. The safety in this study was comparable to other large series [10,11,13]. However, there were lower number of ICD leads and dwell times were relatively short in this study. Short of a hybrid lab or a quick response surgical team, it is our opinion to perform at least the highest risk procedures in the operating room.

Reuse of CIEDs, especially after infection, is an ethical grey area because of the manufacturers' labeling of the devices as single-use and the potential for device malfunction. It is, however, an inevitable reality in many cases in the developing world due to financial constraints. Reuse of CIEDs has been previously reported to be safe and not associated with higher rates of infection or device malfunction [15–17]. In our series, we did not find any recurrence of infection or device malfunction.

Guidelines from professional societies recommend transvenous extraction to be performed in centers with high volumes where thoracic surgery back-up is available and by operators with adequate experience [8,9]. However, such centers are very few in the developing world. The first step towards the evolution of such centers would be reporting of outcomes and sharing data towards establishing a registry. There is no standardized approach or recommendation for the selection of extraction tool or technique of extraction. The available tools are, in most cases, prohibitively expensive. So, there is a need for adapting improvised techniques to a resource-constrained setting and reporting such techniques.

4.1. Limitations

Being a retrospective single-center study with a relatively small sample size, there are limitations to its generalizability. Nevertheless, to our knowledge, this is the first case series about percutaneous lead removal from India. Inability to use specialized tools in all patients significantly decreases the success rate. However, this is the real scenario in most cases in India. The number of ICD leads in this series is small - reflecting the overall lower number of ICDs implanted.

5. Conclusions

In a resource-limited setting, percutaneous lead extraction of

predominantly pacemaker leads, by manual traction methods achieved success in extracting three-fourths of the leads and all leads implanted less than 2.7 years could be removed with manual traction alone. The complications of lead removal were low. Inability to use specialized tools due to financial constraints was the main factor responsible for failure and it would be wise to plan a lead extraction of a right-sided implants, cut leads and leads with long dwell times with dedicated tools available at hand.

Declaration of competing interest

The authors declare no conflict of interest for this study.

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