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Capping oder Extraction: Berücksichtigen wir die Zukunft des Patienten ausreichend?

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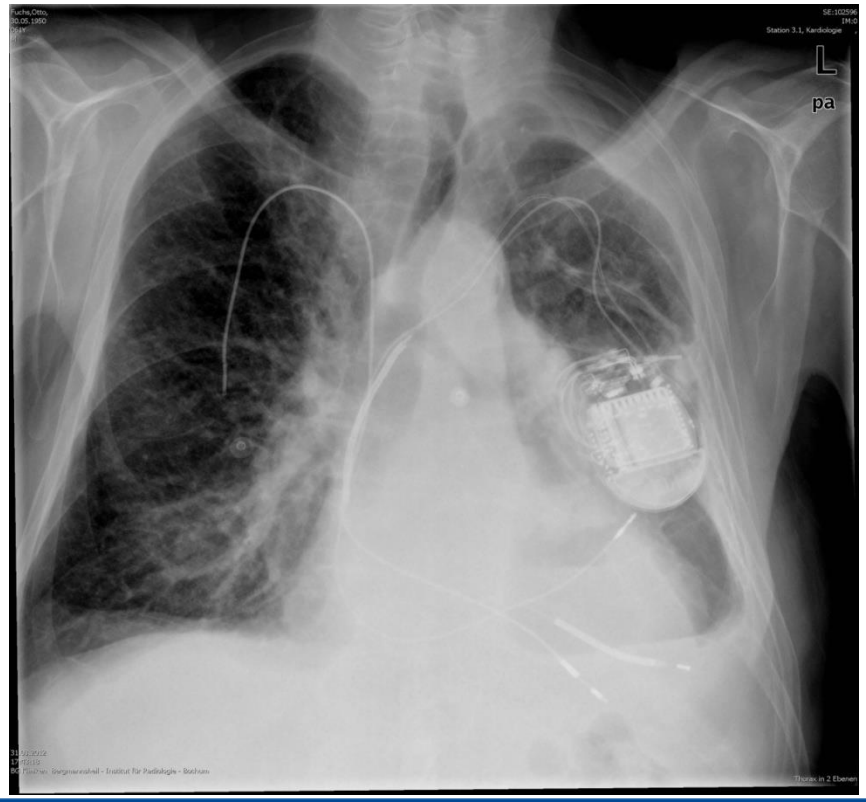
Medtronic, Abbott, Boston Scientific, Impulse Dynamics, Spectranetics, Biotronik

3 Elektroden im RV – alle defekt!

Duo coil im RV von links
stillgelegte SM Elektrode links
abgeschnittene Elektrode rechts



Need for lead extraction/removal – a European perspective

More Cardiovascular Implantable Electronic Devices (CIED) - due to improving recognition of clinical need and wider indications
More Leads - CRT devices, upgrades and a higher proportion of dual vs. single-chamber devices
More generator and lead changes - as life expectancy has risen, so have the number of generator and lead changes despite advances in technology
More recalls - Product advisories are inevitable despite overall improvements in reliability and have led to surges in extraction

Table I Estimated need for transvenous lead extraction

New implants /million/ year	Prevalence of infection (%)	Prevalence of extraction (%)	Extractions/ million/year
500	1–4	1.5–6	7.5–30
1000	1–4	1.5–6	15–60
1500	1–4	1.5–6	22.5–90
2000	1–4	1.5–6	30–120

• Great variabilities in different studies due to:

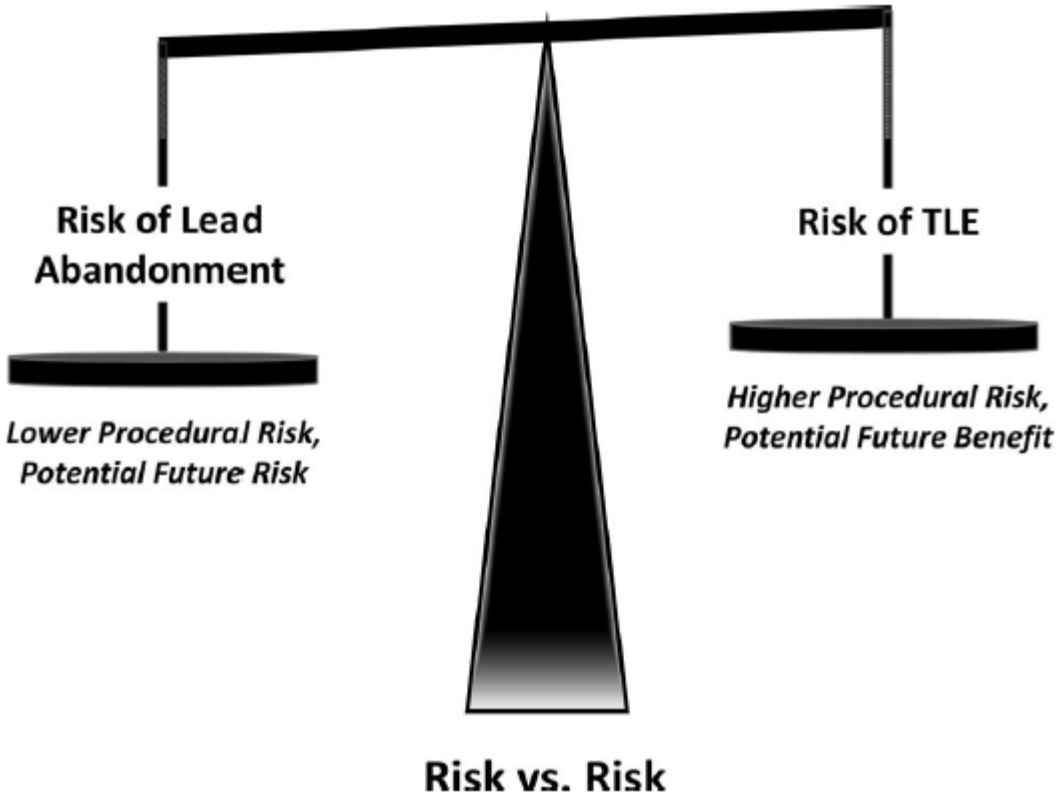
- PM vs ICDs
- Superficial infection vs device infection
- Length of FU
- Location of device
- Transvenous vs epicardial leads
- Comcomitant cardiac surgery

Zunahme der notwendigen Sondenextraktionen

- Erweiterte Indikationen in der Device Therapie
- Älter werdende Patienten = ältere Elektroden
- Zunehmende Anzahl an Up-grades, mehr Elektroden
- Recalls der Industrie (defekte/problembehaftete Elektroden)
- Gefäßverschlüsse, Stenosen, Thrombosen
- Elektrodenlast erhöht / Anzahl der Elektroden nimmt zu
- Infektionen, Taschen- und Systeminfektionen,

Should They Stay or Should They Go? Current Controversies in Lead Extraction

When Less Is More



Maytin and Epstein, Circ Arrhythm Electrophysiol. 2010;3:413-424

Cap or Extract ?

- Short-term risks associated with lead extraction have been established and can be quantified based upon patient characteristics, operator volume, institution, and registry data.[1-3]

- Lead extraction's long-term benefits have not been quantified, so are difficult to estimate and discuss with patients.

1. Wilkoff BL. PLEXES. *J Am Coll Cardiol*. 1999;33:1671-6.
2. Wazni O. LExICon. *J Am Coll Cardiol*. 2010;55:579-86.
3. Byrd CL. *Pacing Clin Electrophysiol*. 2002;25:804-8.

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Heart Rhythm Society SM

Summary of Expert Consensus Statement for CLINICIANS

2017 HRS Expert Consensus Statement on Cardiovascular Implantable Electronic Device Lead Management and Extraction

ESC European Society of Cardiology

Europace (2018) **00**, 1–11
doi:10.1093/europace/euy050

EHRA CONSENSUS STATEMENT

2018 EHRA expert consensus statement on lead extraction: recommendations on definitions, endpoints, research trial design, and data collection requirements for clinical scientific studies and registries: endorsed by APHRS/HRS/LAHRS

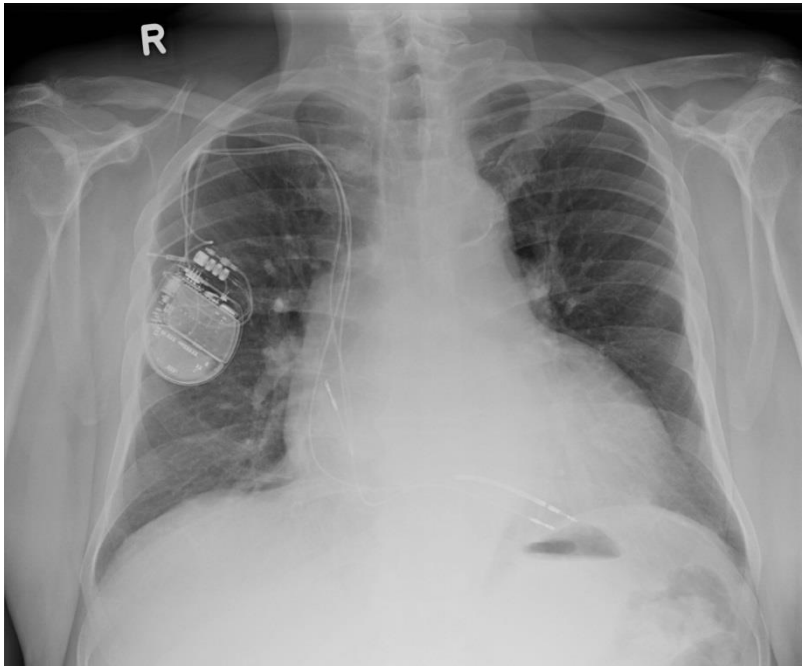
Estimates: 1.2–1.4 million CIEDs are implanted annually worldwide !

Questions on lead management arise in several situations:

- when changes in a patient's clinical condition make a different functionality more or less important
- if a lead becomes non-functional
- if the presence of a lead is thought to interfere with the patient's optimal treatment.

Existing Cardiovascular Implantable Electronic Device Lead Management

Leaving the lead in a condition that will permit future extraction and prevents retraction into the vessel is recommended for any abandoned lead. (COR I; LOE C-EO)
Careful consideration with the patient on the decision on whether to abandon or remove a lead is recommended before starting the procedure. The risks and benefits of each course of action should be discussed, and any decision should take the patient's preference, comorbidities, future vascular access, and available programming options into account. (COR I; LOE C-EO)
Lead abandonment or removal can be a useful treatment strategy if a lead becomes clinically unnecessary or nonfunctional. (COR IIa; LOE B-NR)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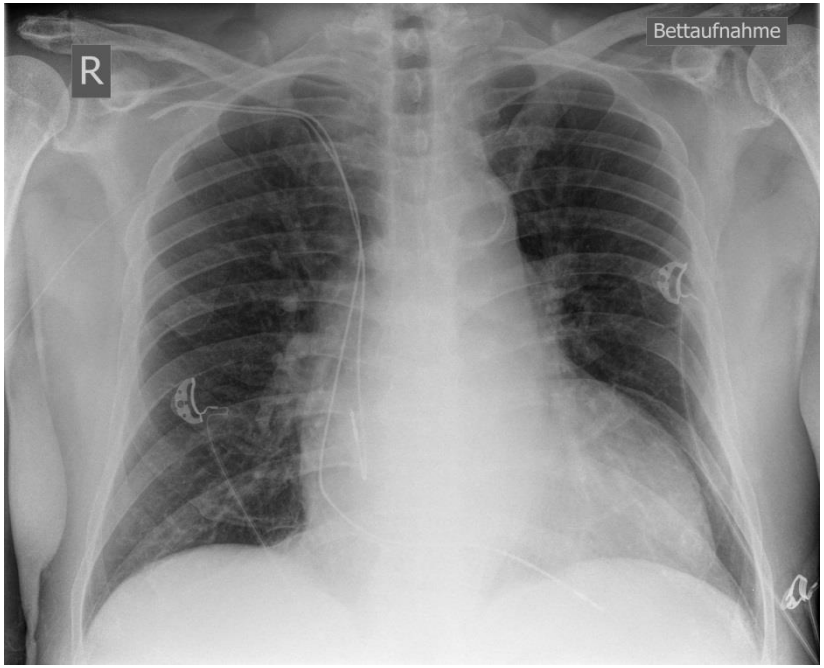
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Bettaufnahme

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Infections

- Currently, infection accounts for approximately two-thirds of all extractions
- Lead revisions and generator changes carry a greater risk of infection than new implants
- The incidence of both infectious and non-infectious cases appears to be rising
- **All leads should be extracted if the indication is infection**
- However, residual lead tips or conductor coils, in the absence of insulating materials, rarely prevent full recovery from a CIED infection

Indikation: Infektion - Keimspektrum

Summary of the microbiology of implantable cardiac electronic device infection

Pathogen (number of studies reporting this pathogen)	Range in studies using patients as the denominator	Range in studies using isolates as the denominator
CoNS (17)	10%[a]–68%	42%–77%
Staphylococcus aureus (16)	24%–59%	10%–30%
Gram-negative bacilli (11)	1%–17%	6%–11%
Enterococcus spp. (6)	5%–6%[b]	0.4%–10%[b]
Streptococcus spp. (5)	4%–6%[b]	3%–10%[b]
Propionibacterium spp. (3)	—	0.8%–8%
Fungi (5)	0.5%–2%	0.4%–1.4%

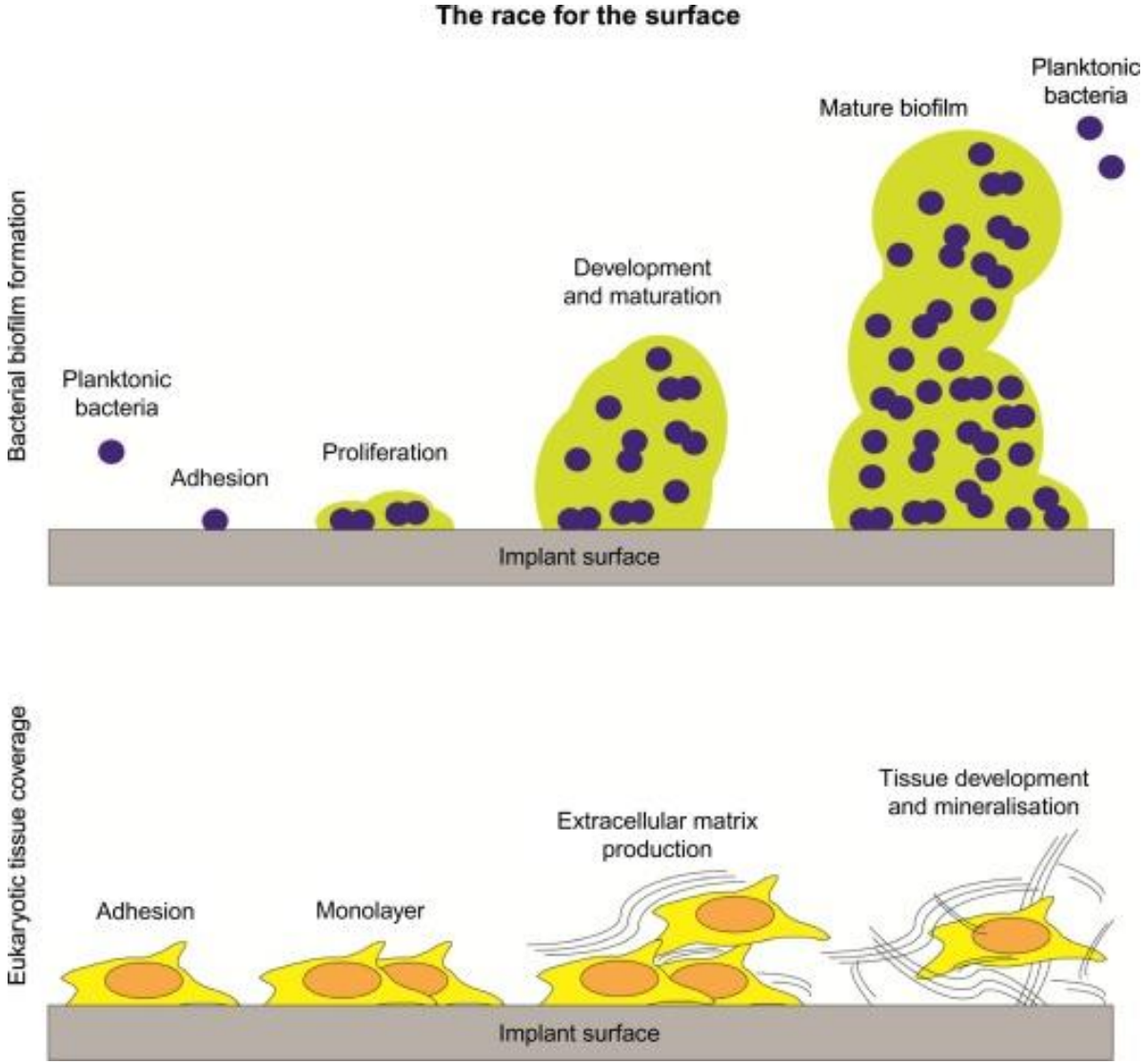
[a] This study only used blood cultures and had high culture negativity (49%).

[b] This study reported *Streptococcus* and *Enterococcus* spp. together.

Sandoe et al. **Guidelines for the diagnosis, prevention and management of implantable cardiac electronic device infection. Report of a joint Working Party project on behalf of the British Society for Antimicrobial Chemotherapy (BSAC, host organization), British Heart Rhythm Society (BHRS), British Cardiovascular Society (BCS), British Heart Valve Society (BHVS) and British Society for Echocardiography (BSE).**

J Antimicrob Chemother. 2015 70(2):325-59.

„Der Kampf um die Oberfläche“



Odekerken et al. 2013

Schwierige Eradikation

sheil
ersitätsklinikum

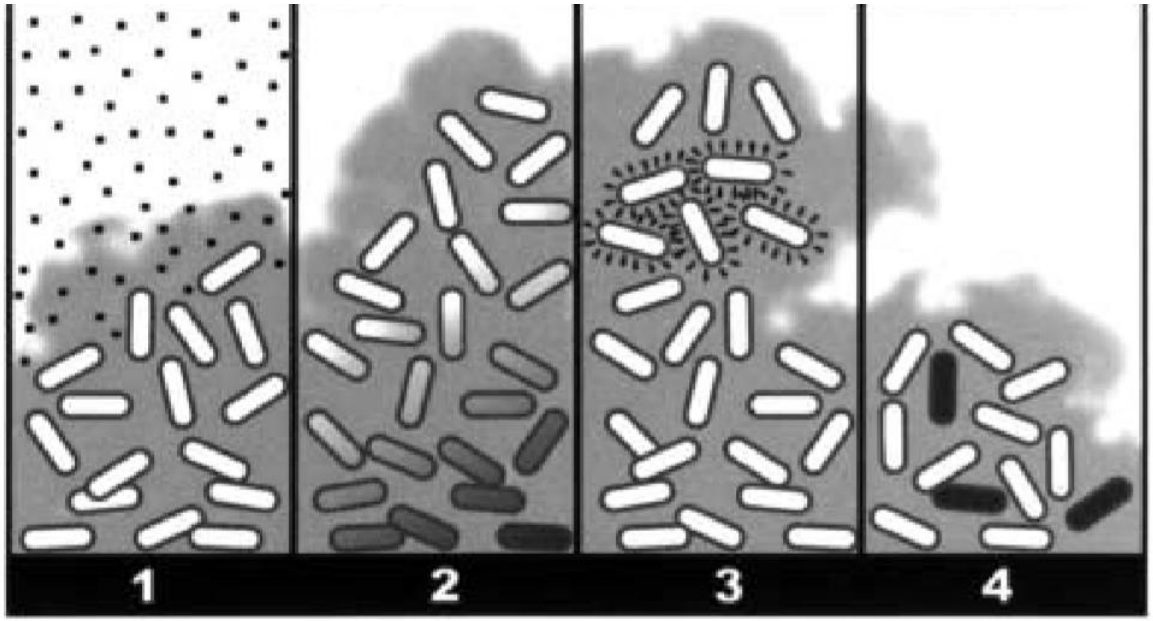
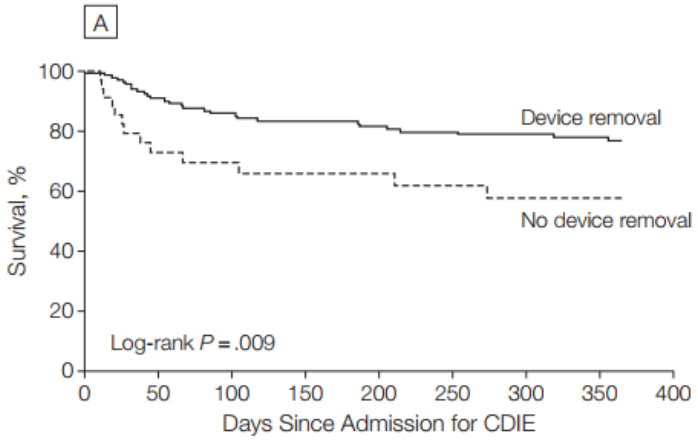


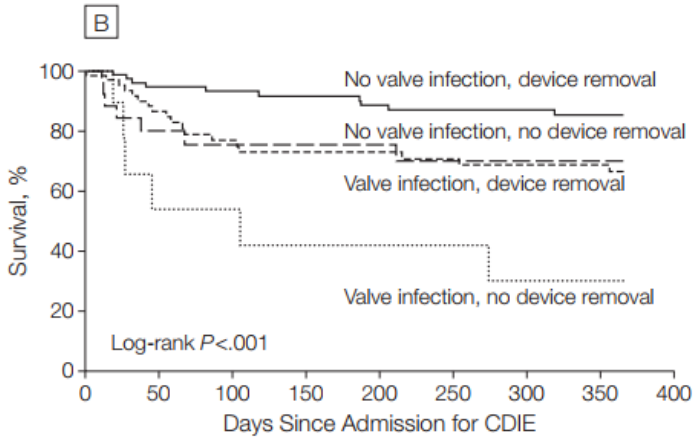
Fig. 1. Four hypothesized biofilm resistance mechanisms. *1* – The antibiotic (squares) penetrates slowly or incompletely; *2* – a concentration gradient of a metabolic substrate or product leads to zones of slow or non-growing bacteria (shaded cells); *3* – an adaptive stress response is expressed by some of the cells (marked cells); *4* – a small fraction of the cells differentiate into a highly protected persister state (dark cells).

Stewart et al. 2002 Int. J. Med. Microbiol. 292, 107±113

Mortality of infective endocarditis involving implantable cardiac devices



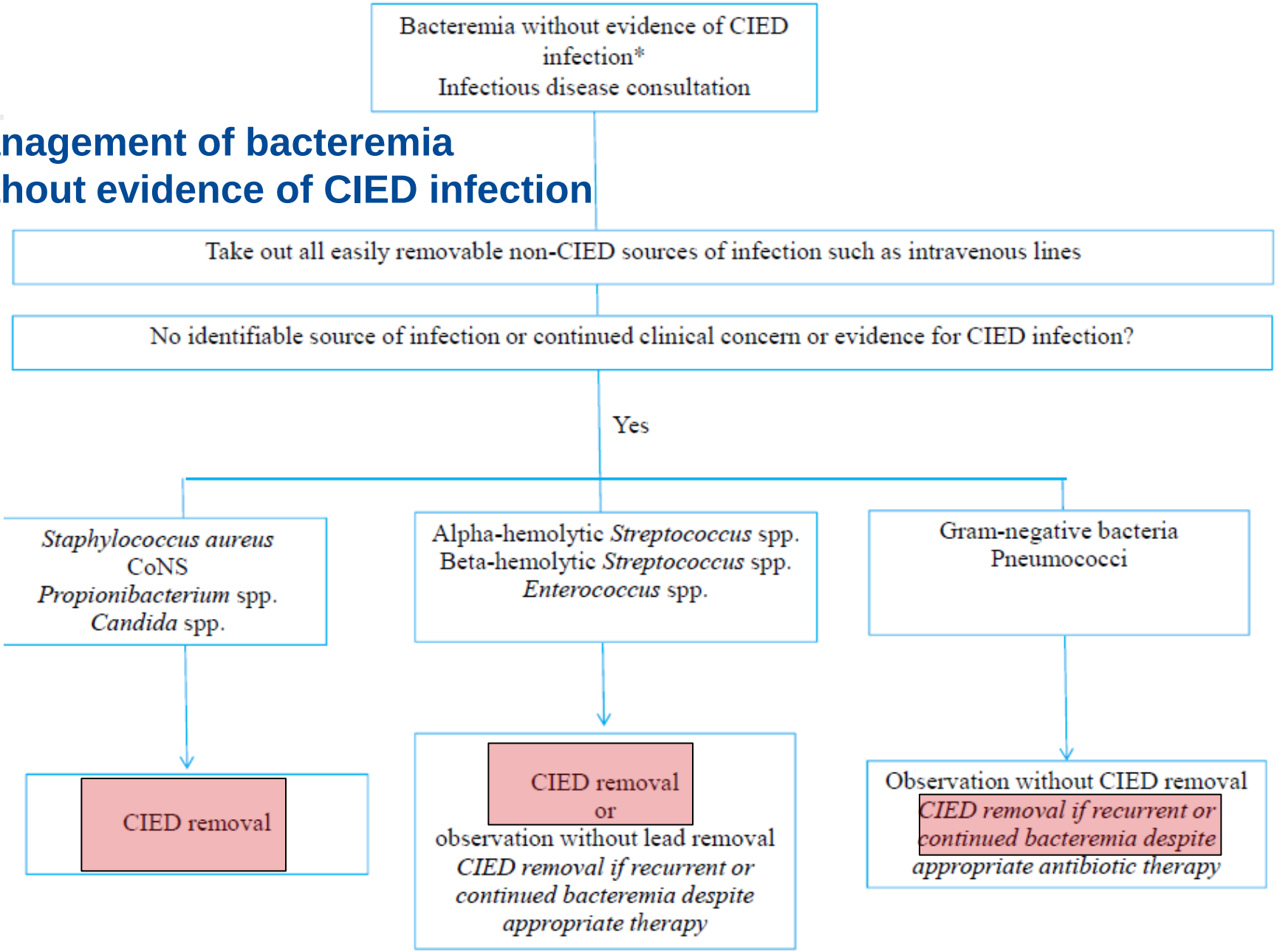
No. at risk								
Device removal	141	112	98	94	92	87	84	80
No device removal	34	22	19	17	16	14	13	12



No. at risk								
No valve infection								
Device removal	79	66	61	59	57	54	53	50
No device removal	25	18	15	14	13	11	11	10
Valve infection								
Device removal	62	46	37	35	35	33	31	30
No device removal	9	4	4	3	3	3	2	2

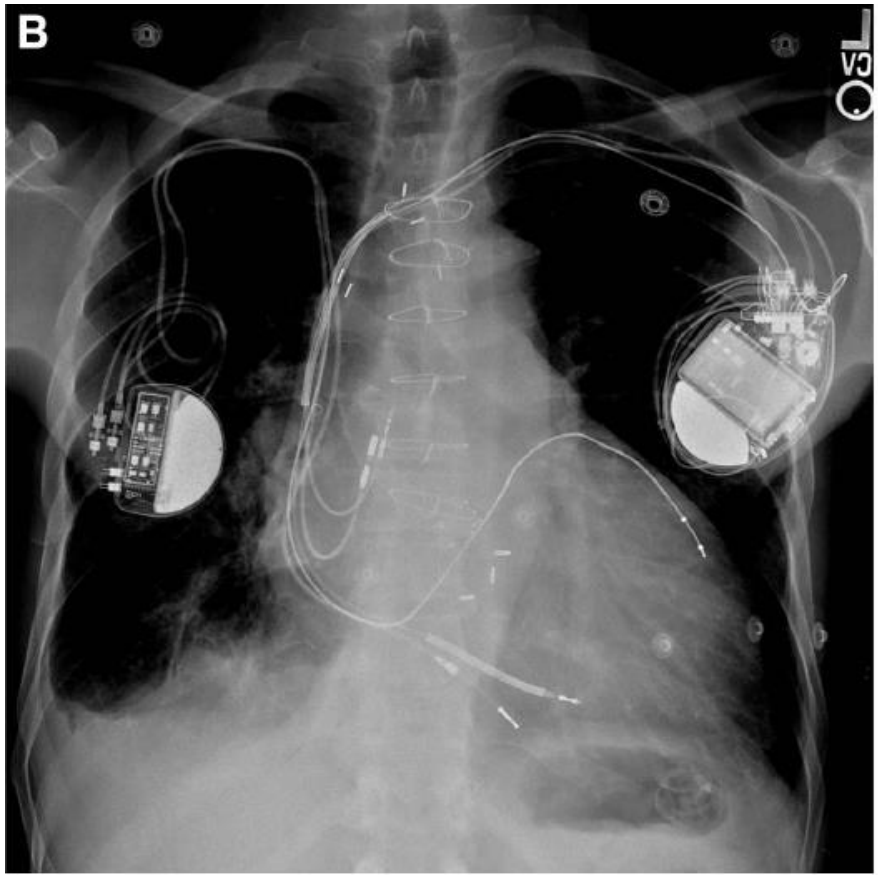
Athan E et al. Clinical characteristics and outcome of infective endocarditis involving implantable cardiac devices. JAMA. 2012 307(16):1727-35.

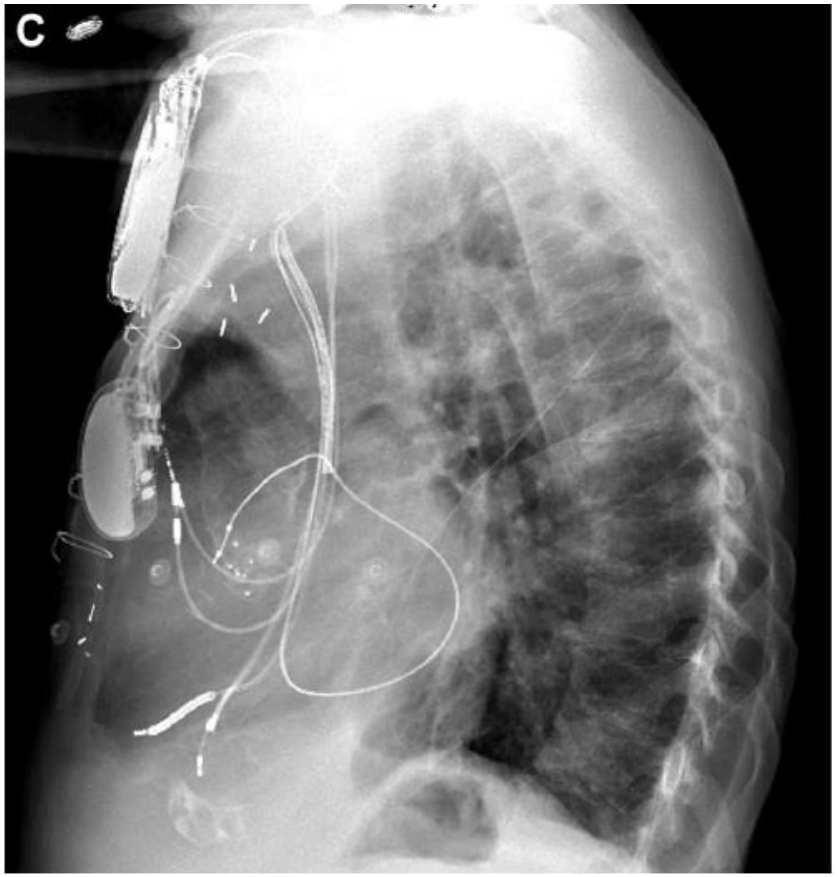
Management of bacteremia without evidence of CIED infection



Kusumoto et al., 2018, DOI: 10.1016/j.hrthm.2017.09.001

Inappropriate inhibition of pacing due to lead-lead interaction

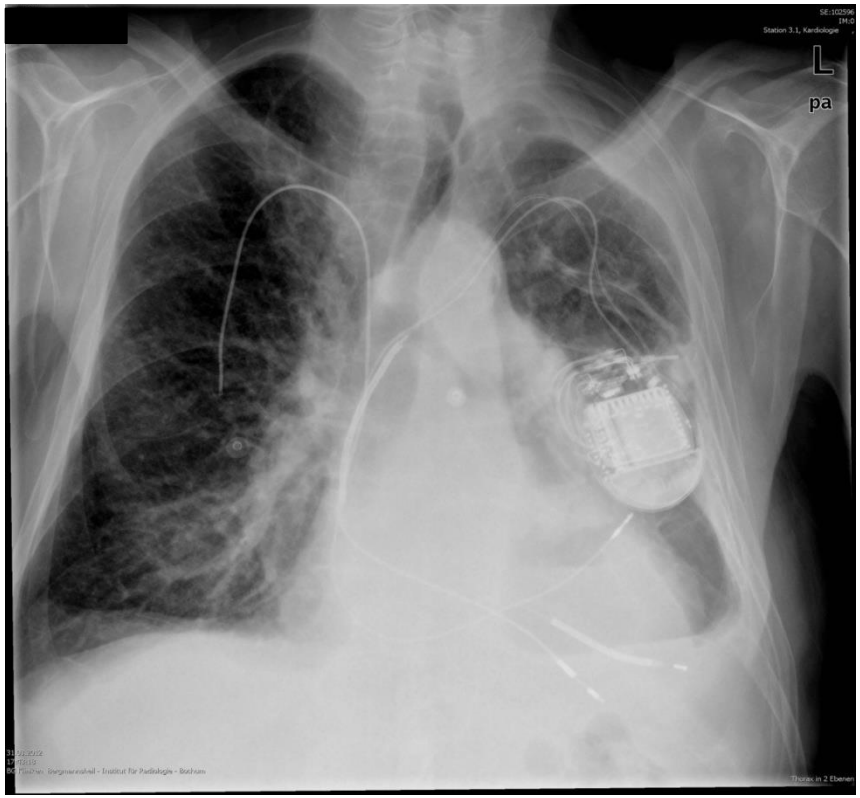




Maytin and Epstein, Circ Arrhythm Electrophysiol. 2010;3:413-424

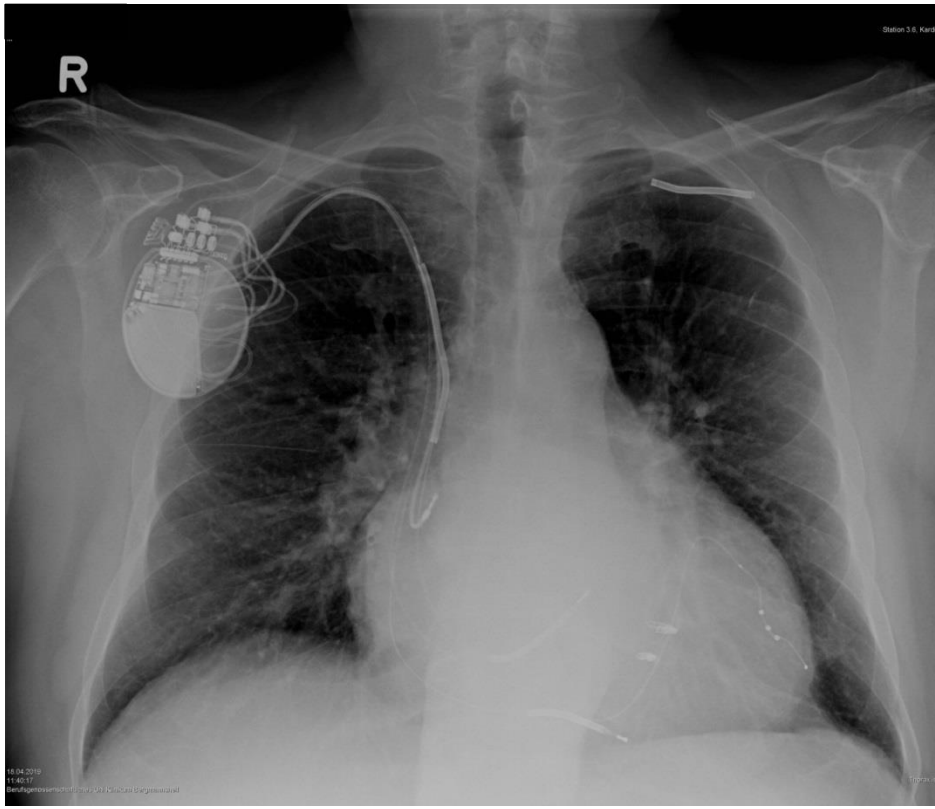
3 Elektroden im RV – alle defekt!

- Duo coil im RV von links
- stillgelegte SM Elektrode links
- abgeschnittene Elektrode rechts



Fragmente nach Extraktion wegen Infektion!

- coil in der v. subclavia links
- abgerissene Elektrode im RV
- CRT mit defekter Duocoil von rechts
- Mitraclip



The role of transvenous lead extraction in the management of redundant or malfunctioning pacemaker and defibrillator leads post ELECTRa

Why Extract a Nonfunctional Lead ?

- chronic Pain
- Thrombosis/Vascular Issues/venous access issues
- life-threatening arrhythmias secondary to retained leads
- more than 4 leads on one side or more than 5 leads through the SVC
- abandoned lead that interferes with the operation of a CIED system (detection and/or defibrillation)
- to facilitate access to MRI
- normally functioning non-recalled pacing or defibrillation leads for selected patients after a shared decision-making process
- multiple leads may worsen TR?
- Because multiple leads make future extraction more risky
- *Multiple leads increase risk of infection*
- *Abandoned leads increase risk of infection (11% vs. 2%)*

Kusumoto et al., Heart Rhythm Society 2017; Sidhu et al., Europace (2018) 0, 1–8

Factors Associated with Extraction Procedure Complications and Longer-Term Mortality

Factor	Associated risk
Age	1.05-fold ↑ mortality
Female sex	4.5-fold ↑ risk of major complications
Low body mass index (<25 kg/m^2)	1.8-fold ↑ risk of 30-day mortality ↑ no. of procedure-related complications
History of cerebrovascular accident	2-fold ↑ risk of major complications
Severe LV dysfunction	2-fold ↑ risk of major complications
Advanced HF	1.3- to 8.5-fold ↑ risk of 30-day mortality 3-fold ↑ 1-year mortality
Renal dysfunction	ESRD: 4.8-fold ↑ risk of 30-day mortality Cr ≥2.0: ↑ in-hospital mortality and 2-fold ↑ risk of 1-year mortality
Diabetes mellitus	↑ in-hospital mortality 1.71-fold ↑ mortality
Platelet	Low platelet count: 1.7-fold ↑ risk of major complications
Coagulopathy	Elevated INR: 2.7-fold ↑ risk of major complications and 1.3-fold ↑ risk of 30-day mortality Anticoagulant use: 1.8-fold ↑ 1-year mortality
Anemia	3.3-fold ↑ risk of 30-day mortality
Number of leads extracted	3.5-fold ↑ risk of any complication 1.6-fold ↑ long-term mortality
Presence of dual-coil ICD	2.7-fold ↑ risk of 30-day mortality
Extraction for infection	2.7- to 30-fold ↑ risk of 30-day mortality 5- to 9.7-fold ↑ 1-year mortality CRP >72 mg/L associated with ↑ 30-day mortality 3.52-fold ↑ mortality

Extraction Procedure-Related Complications

	Incidence, %
Major	0.19%–1.80%
Death[64]	0.19%–1.20%
Cardiac avulsion	0.19%–0.96%
Vascular laceration	0.16%–0.41%
Respiratory arrest	0.20%
Cerebrovascular accident	0.07%–0.08%
Pericardial effusion requiring intervention	0.23%–0.59%
Hemothorax requiring intervention	0.07%–0.20%
Cardiac arrest	0.07%
Thromboembolism requiring intervention	0.07%
Flail tricuspid valve leaflet requiring intervention	0.03%
Massive pulmonary embolism	0.08%

Kusumoto et al., Heart Rhythm Society 2017

Extraction Procedure-Related Complications

Minor[64,216,246,247,287,307]	0.60%–6.20%
Pericardial effusion without intervention	0.07%–0.16%
Hematoma requiring evacuation[64,216,287]	0.90%–1.60%
Venous thrombosis requiring medical intervention[64,216]	0.10%–0.21%
Vascular repair at venous entry site[64,216,246]	0.07%–0.13%
Migrated lead fragment without sequelae[64]	0.20%
Bleeding requiring blood transfusion[64,246,287]	0.08%–1.00%
AV fistula requiring intervention[64]	0.16%
Coronary sinus dissection[64]	0.13%
Pneumothorax requiring chest tube[287]	1.10%
Worsening tricuspid valve function[287]	0.32%–0.59%
Pulmonary embolism[246]	0.24%–0.59%

ELECTRa Study – Mortality and complications

Table 2 **Outcomes: patients, procedure, and leads**

Patients outcomes	All patients (*N* = 3510)
Clinical success, *N*/Total *N* (%), [95% CI]	3395/3510 (96.7) [96.1–97.3]
Complications, *N*/Total *N* (%), [95% CI]	
Procedure related major complications including deaths	58/3510 (1.7) [1.3–2.1]
Intra-procedural	37/3510 (1.1) [0.7–1.5]
Post-procedural	21/3510 (0.6) [0.4–0.9]
Details of procedure related major complications including deaths, *N*/Total *N* (%), [95% CI]	
Procedure related deaths[a]	17/3510 (0.5) [0.3–0.8]
Intra-procedural	9/3510 (0.3) [0.1–0.5]
Post-procedural	8/3510 (0.2) [0.1–0.5]
All cause in-hospital major complications including deaths, *N*/Total *N* (%), [95% CI]	
All cause major complications	95/3510 (2.7) [2.2–3.3]
All cause deaths	50/3510 (1.4) [1.1–1.9]

1.7 %

2.7 %

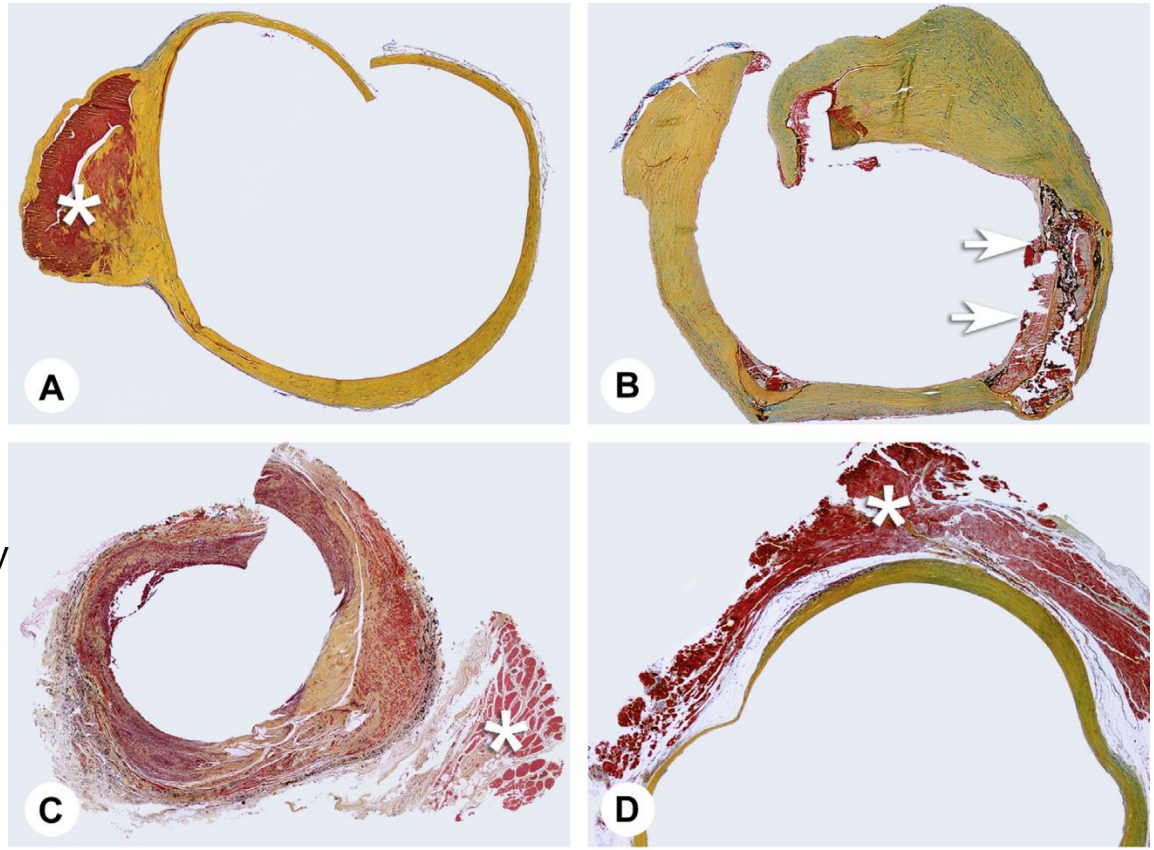
Bongiorni et al. *EHJ* 2017; 38: 2995-3005

Unrecognized venous injuries after cardiac implantable electronic device transvenous lead extraction

histologic examination of fibrous cuffs surrounding cardiac implantable electronic device leads

861 leads (585 pacemaker and 272 defibrillator leads) extracted from 461 patients, median lead age of 2546 days

thin rim of dense fibrous tissue with attached organizing thrombus stained in red (asterisk).



Calcification (arrows) is common in the fibrous cuffs

granulation tissue surrounding the empty Space

segment of skeletal muscle (asterisk)

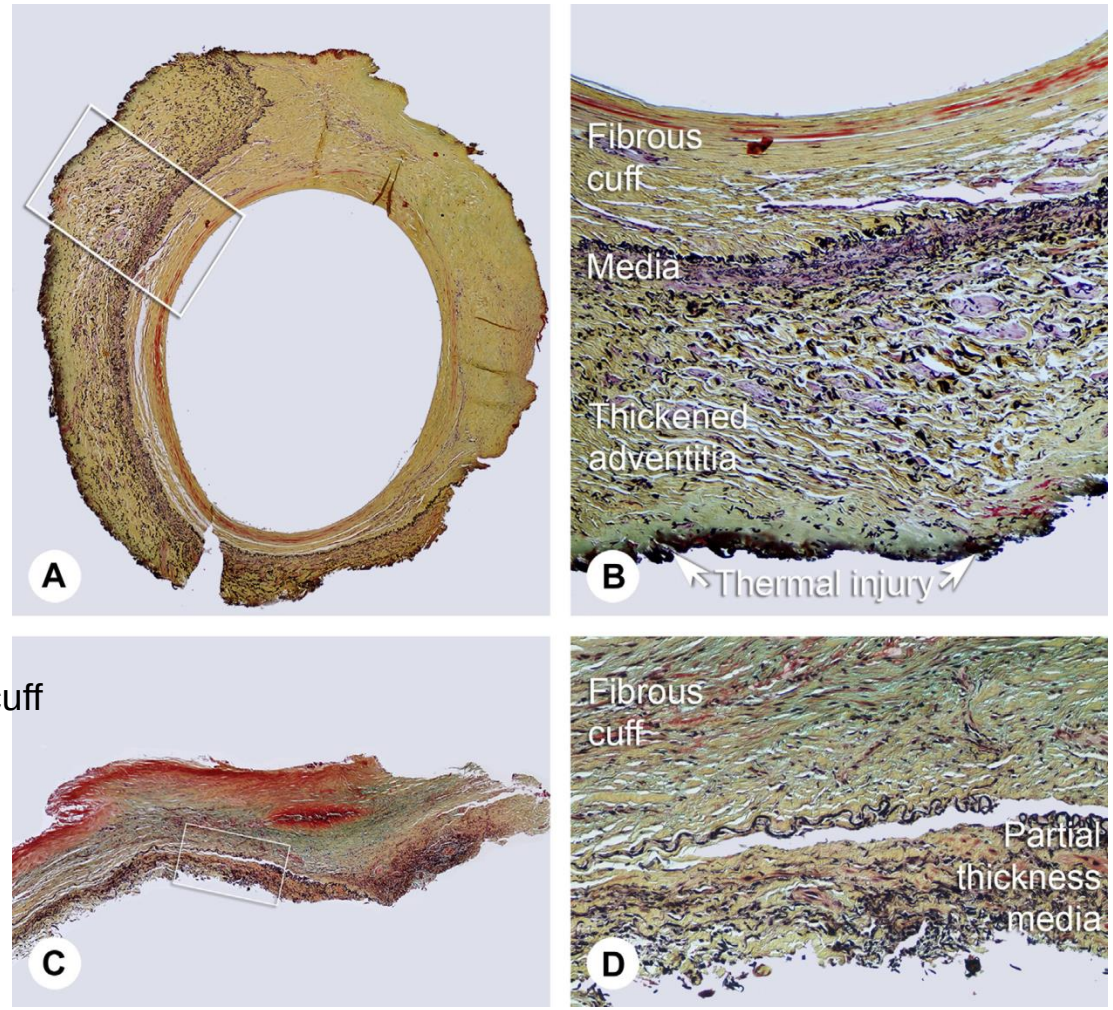
focally surrounded by myocardial tissue

9.3% of leads showed segments of vein, most of which were transmural (venous tissue including adventitia). Only 5 catastrophic complications (1.1%) occurred that required emergent surgical intervention

Histology of vein injury associated with lead extraction

high-resolution

fibrous cuff



secondary to thermal injury

A segment of fibrous cuff has an attached partial thickness of vein wall

the portion of the fibrous cuff adherent to the vein is very thin

Lead and procedural characteristics

	No evidence of any cardiovascular injury (n = 708)	Evidence of any cardiovascular injury (n = 153)	*P* value*
Lead type			<.001
Pace/sense	519 (73.7)	66 (43.1)	
Defibrillator†	185 (26.3)	87 (56.9)	
Age of leads, d, median (IQR)	2324.0 (1162.0–3669.0)	3171.0 (2420.0–3900.0)	.002
Use of laser extraction	445 (62.9)	140 (91.5)	<.001
Procedural complications	14 (2.0)	6 (3.9)	.26
Reason for lead extraction			<.001‡
Infection	433 (61.3)	74 (48.7)	
Lead failure	185 (26.2)	66 (43.4)	
Device upgrade	36 (5.1)	6 (4.0)	
Venous access	25 (3.5)	4 (2.6)	
Other	27 (3.8)	2 (1.3)	
Prior open heart surgery	262 (34)	56 (37)	.56

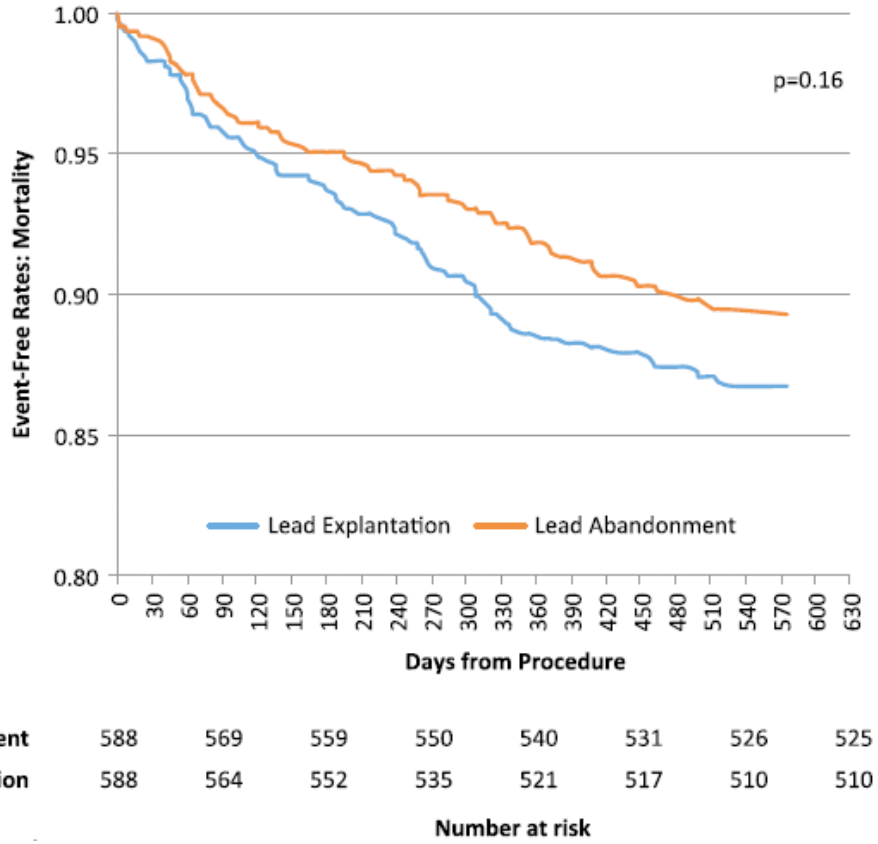
Multivariable prediction model for vein injury

Covariates	Odds ratio (95% confidence interval)	*P* value
Defibrillator vs pace/sense lead	2.02 (1.20–3.50)	.009
Age of leads (log transformed)	1.75 (1.11–2.97)	.024
Use of laser extraction	5.69 (2.13–19.99)	.002
Hypertension	2.47 (1.37–4.77)	.004
Diabetes	0.48 (0.24–0.90)	.026

Outcomes One Year after ICD Lead Abandonment versus Explantation for Unused or Malfunctioning Leads: A Report from the NCDR® (National Cardiovascular Data Registry)

Short-Term Outcomes from Linked NCDR Cohort

Mortality

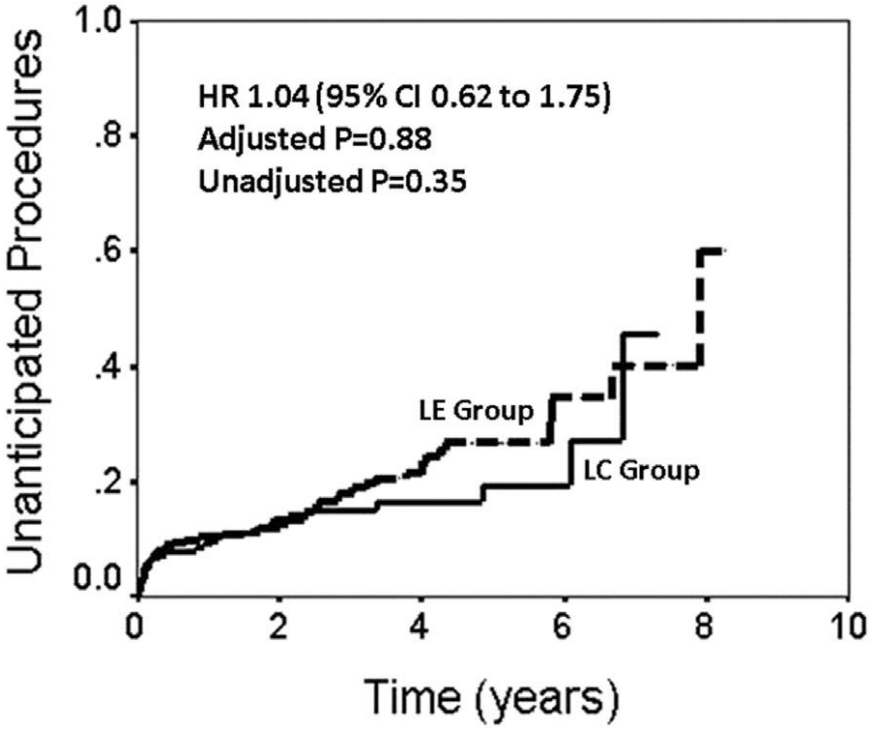


patients undergoing removal of an unused/malfunctioning ICD lead had slightly higher in-hospital complications and deaths than those with a lead abandonment strategy

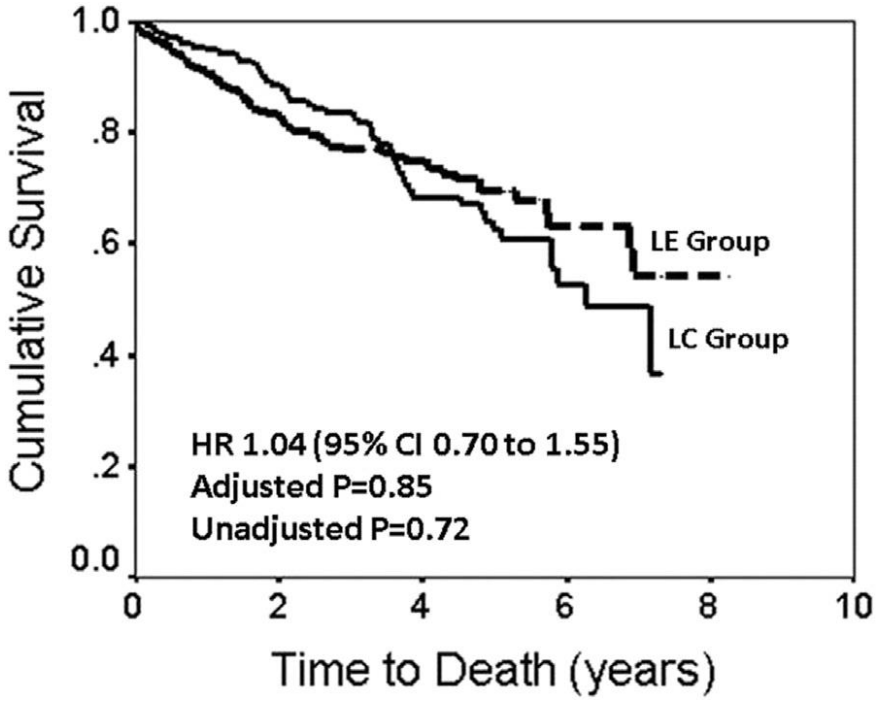
Zeitler E. Circ Arrhythm Electrophysiol. 2016;9:e003953

Extracting Versus Abandoning Sterile Pacemaker and Defibrillator Leads

LE (n=296) or LC (n=192) from 2006 to 2012
infectious indications were excluded



Nelson-Aalen-cumulative hazard curves comparing the rates of unanticipated CIED-related procedures



Kaplan-Meier curves comparing the overall survival

Conclusion: lead revision strategy is influenced by operator extraction experience and dwell time of leads. Author found no difference in outcomes between the 2 strategies.

Procedural outcomes and long-term survival associated with lead extraction in patients with abandoned leads

Baseline characterristics

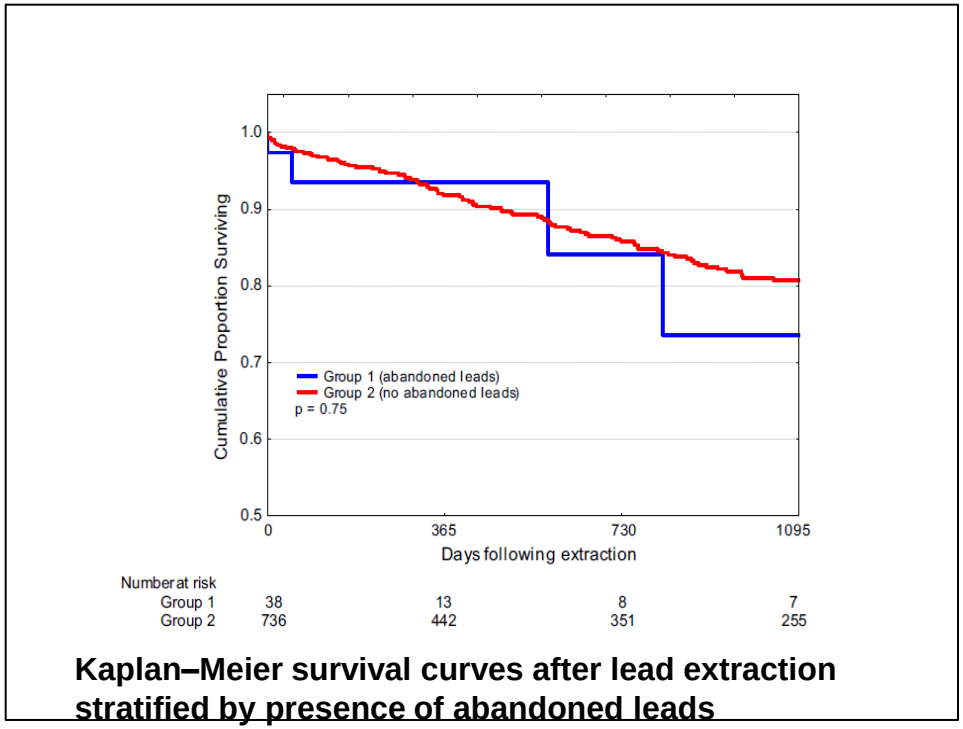
abandoned leads	Group 1 (n = 38)	Group 2 (n = 736)	*P* value
Age (years)	63.5 ± 14.4	61.6 ± 16.3	.640
Male	26 (68.4)	483 (65.6)	.861
Left ventricle ejection fraction (%)	41.6 ± 17.9	36.4 ± 16.7	.163
Coronary artery disease	18 (47.4)	297 (40.4)	.402
Hypertension	22 (57.9)	466 (63.3)	.496
Diabetes mellitus	11 (28.9)	213 (28.9)	1
Chronic kidney disease*	13 (34.2)	143 (19.4)	.037
Device type			
Implantable cardioverter–defibrillator	32 (84.2)	511 (69.4)	.068
Cardiac resynchronization therapy	11 (28.9)	117 (15.9)	.043
Dwell time of oldest extracted lead (years)	7.6 ± 4.9	5.6 ± 4.4	.017
Indication for extraction			
Infection	29 (76.3)	243 (33.0)	<.001
Lead malfunction	6 (15.8)	372 (50.5)	<.001

Procedural characteristics and outcomes

	Group 1 (n = 38)	Group 2 (n = 736)	*P* value
Simple traction*	1 (2.8)	49 (9.4)	.238
Locking stylet*	35 (97.2)	474 (90.5)	.237
Powered sheaths*			
Laser	24 (66.7)	321 (61.3)	.597
Mechanical	4 (11.1)	106 (20.2)	.276
Femoral approach*	7 (19.4)	31 (5.9)	.007
Complete procedural success	35 (92.1)	699 (95.0)	.439
Clinical success	35 (92.1)	717 (97.4)	.088
Death or major procedural complications	1 (2.6)	9 (1.2)	.397
Periprocedural death	1 (2.6)	5 (0.7)	.261

Procedural outcomes and long-term survival associated with lead extraction in patients with abandoned leads

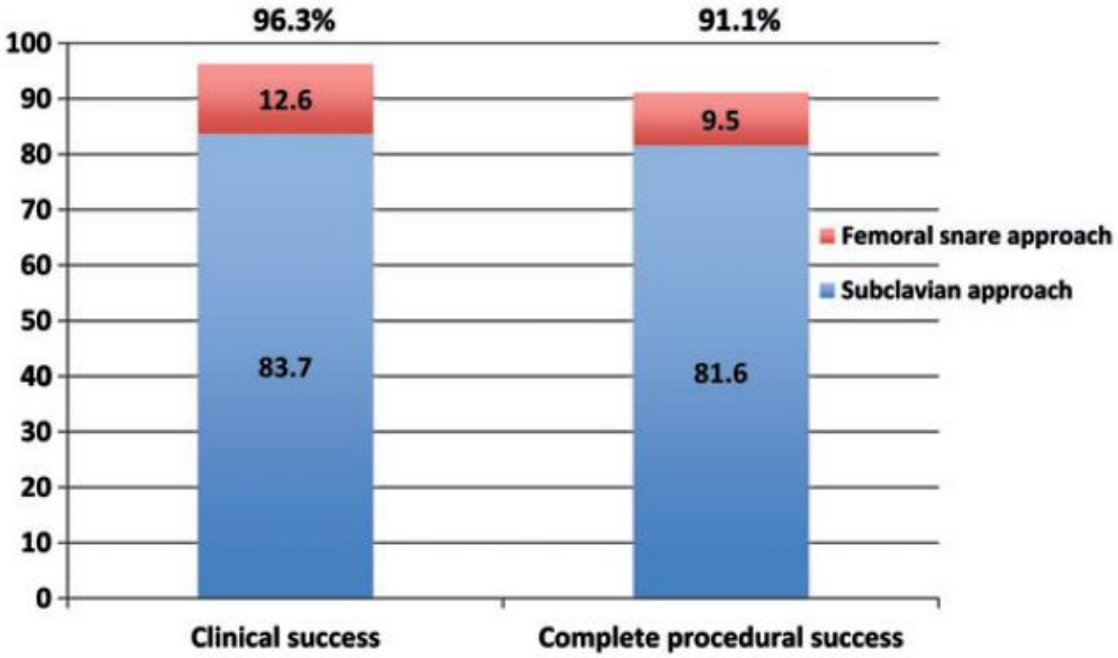
Survival



Kaplan–Meier survival curves after lead extraction stratified by presence of abandoned leads

- Complete procedural success rates were similar (92.1% in group 1 vs 95.0% in group 2; P =0.439
- trend toward lower clinical success in group 1 (92.1% vs 97.4%; P =0.088), primarily due to failure to remove all hardware in the setting of infection.
- Major procedural complication rates were similar (2.6% in group 1 vs 1.2% in group 2; P =0.397),
- long-term survival (mean follow-up 2.3 ± 2.2 years).

Impact of a femoral snare approach as a bailout procedure on success rates in lead extractions



n = 114 pats.
TLE = 190 leads

Success and complication rates

	All leads (*n* = 190)	Femoral snare approach (*n* = 28)
Clinical success	96.3% (*n* = 183)	85.7% (*n* = 24) (first-line: 100.0%; bailout: 80.0%)
Complete procedural success	91.1% (*n* = 173)	64.3% (*n* = 18) (first-line: 87.5%; bailout: 55.0%)
Major complications	*n* = 2	*n* = 1
Minor complications	*n* = 4	*n* = 0

Starck CT, et al., Interactive CardioVascular and Thoracic Surgery 18 (2014) 551–555

Circulation

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ORIGINAL RESEARCH ARTICLE

Outcomes Associated with Extraction versus Capping and Abandoning Pacing and Defibrillator Leads

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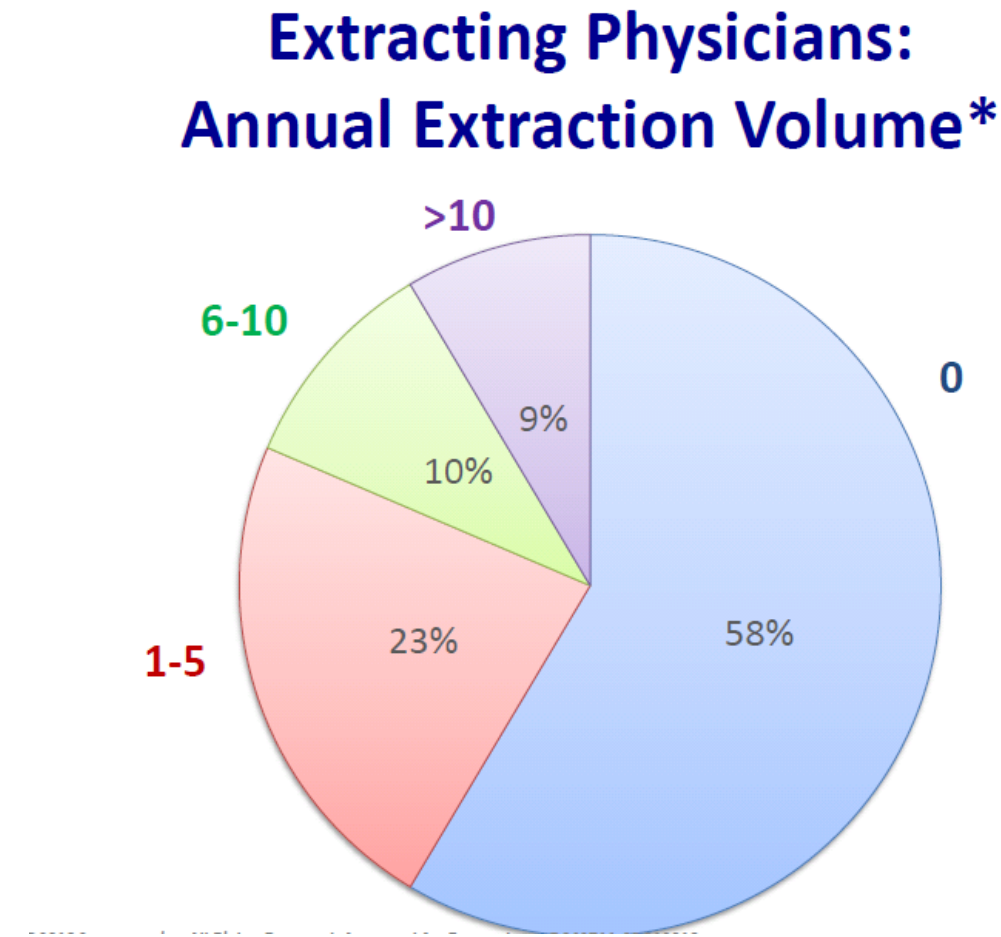
Baseline Characteristics: Device Data & Treating Physician

Using the 5% Medicare sample

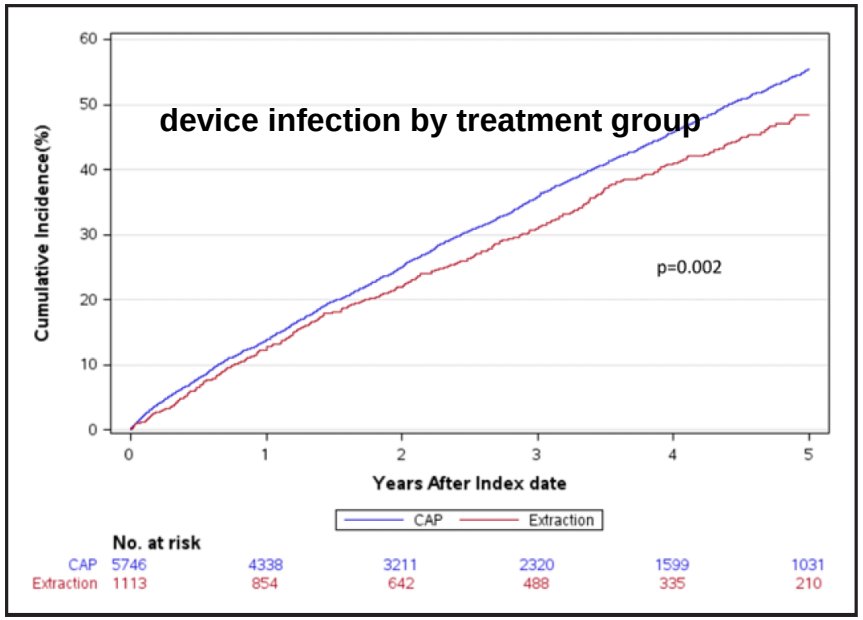
	Cap and Abandon (N=5,746)	Extract (N=1,113)	p-value
Device Data			
Pacing lead	4,832 (84.1%)	914 (82.1%)	0.10
ICD lead	3,410 (59.3%)	659 (59.2%)	0.93
Lead Dwell Time (years), Median (IQR)	4.0 (2.0-5.0)	3.0 (1.0-4.0)	<0.0001
Physician Specialty			<0.0001
Surgery	230 (4.0%)	82 (7.4%)	
Cardiologist	4,580 (79.7%)	845 (75.9%)	
Other	936 (16.3%)	186 (16.7%)	
Yearly Practice Extraction Volume*			<0.0001
0	3,161 (55.0%)	- - --	
1-5	2,328 (40.5%)	939 (84.4%)	
6-10	204 (3.6%)	107 (9.6%)	
>10	53 (0.9%)	60 (5.4%)	

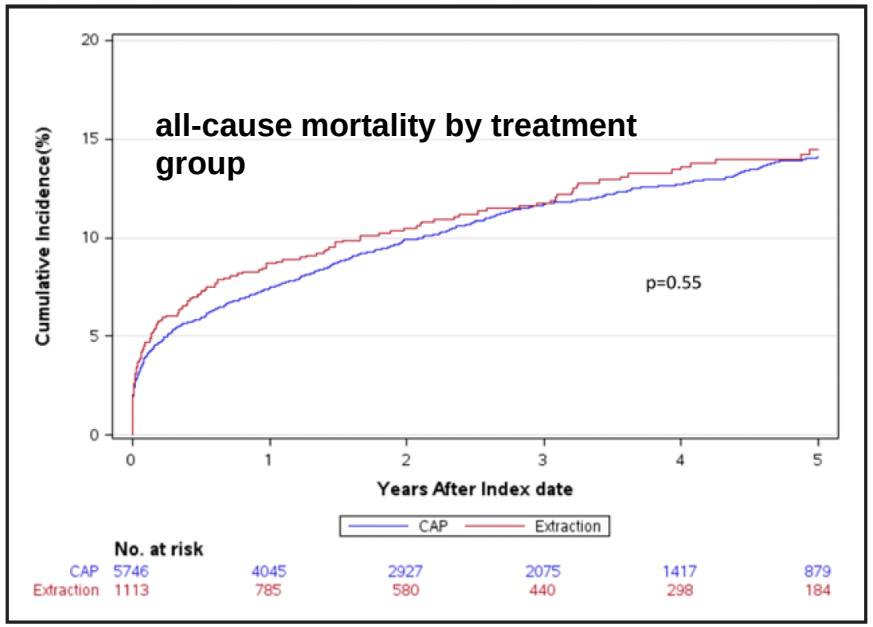
Outcomes Associated With Extraction Versus Capping and Abandoning Pacing and Defibrillator Leads



Pokorney SD, et al., Circulation. 2017;136:1387–1395

Outcomes Associated With Extraction Versus Capping and Abandoning Pacing and Defibrillator Leads





-Extraction patients tended to be younger (median, 78 versus 79 years; P<0.0001),
-were less likely to be male (65% versus 68%; P=0.05),
-had shorter lead dwell time (median, 3.0 versus 4.0 years; P<0.0001)
-and fewer comorbidities.

Cardiac Implantable Electronic Device Infections

Added Complexity and Suboptimal Outcomes With Previously Abandoned Leads

TABLE 3 Procedural Profiles and Outcomes of Extraction of Infected Leads in Patients With or Without Previously Abandoned Leads in Place

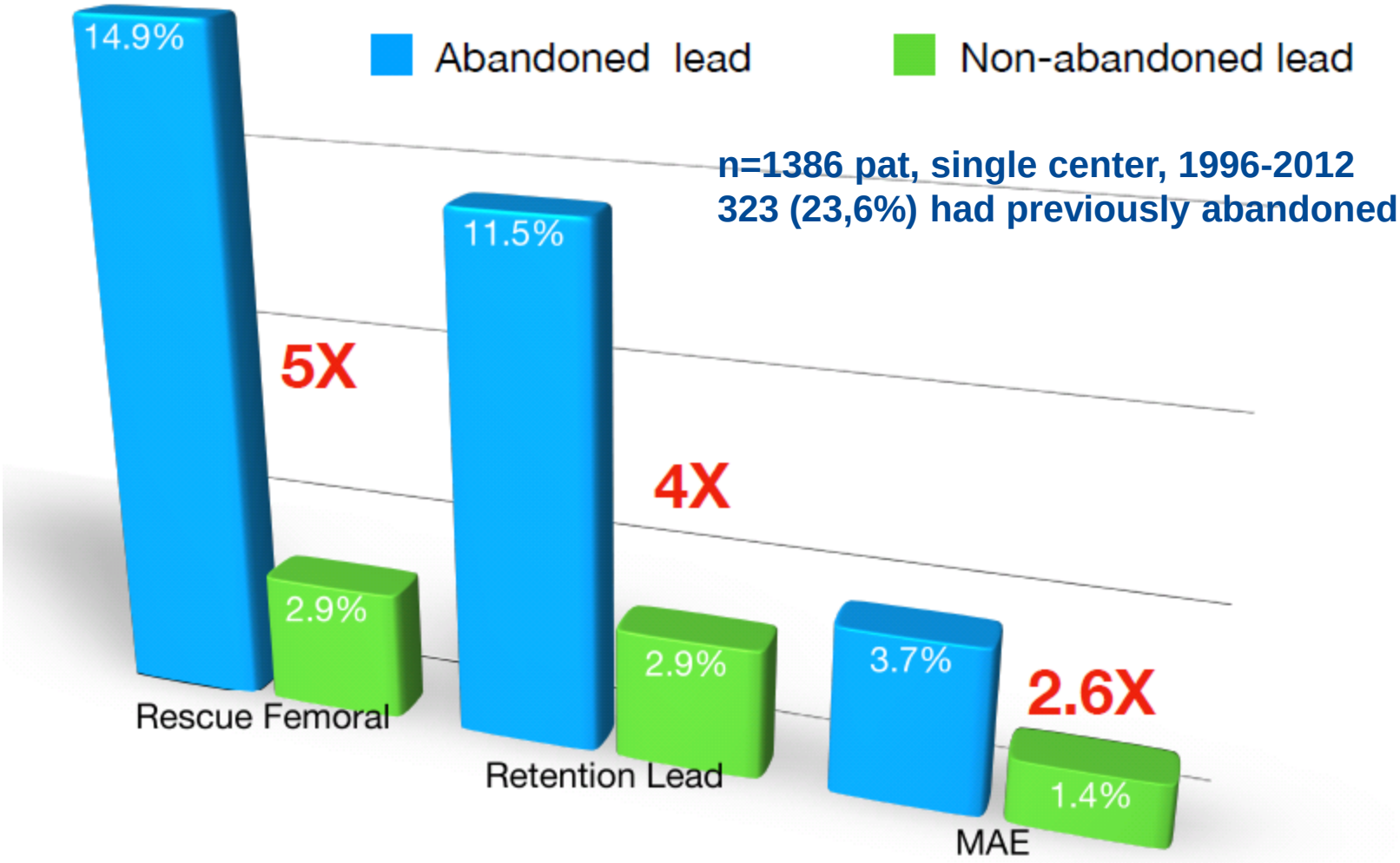
	Patients With Abandoned Leads Group 1 (n = 323)	Patients Without Abandoned Leads Group 2 (n = 1,063)	p Value
Procedural profiles			
Procedure duration, min	170 (130–220)	115 (85–155)	<0.0001
Fluoroscopy time, min	13.2 (7.7–24.8)	6.6 (3.2–13)	<0.0001
Specialized tools required	94.4	81.8	<0.0001
Locking stylets	91.6	80.6	<0.0001
Laser sheaths	83.3	67.9	<0.0001
Dilator sheaths	16.7	11.7	0.02
Electrosurgical sheath	4.0	6.2	0.10
Evolution	4.0	2.2	0.07
Rescue femoral workstation	14.9	2.9	<0.0001
Snare	19.2	4.2	<0.0001
Procedural outcomes			
Failure to achieve primary endpoint*	13.0	3.7	<0.0001
Lead material retention	11.5	2.9	<0.0001

TABLE 4 Complications of Transvenous Extraction of Infected Leads in Patients With or Without Previously Abandoned Leads in Place

	Patients With Abandoned Leads Group 1 (n = 323)	Patients Without Abandoned Leads Group 2 (n = 1,063)	p Value
Any complication	11.5	5.6	0.0007
Major complication	3.7	1.4	0.01
Minor complication	7.7	4.4	0.02
Hypoxemia	0.6	0.4	0.60
Hypercarbia	0.6	0	0.02
Respiratory arrest	2.2	0.5	0.009
Pneumothorax	0	0.09	0.50
Hemothorax	0.3	0.4	0.90
Pulmonary embolus	0.6	0.3	0.40

CONCLUSIONS: Previously abandoned leads complicate the management of cardiac device infections, leading to worse clinical outcomes

More Difficult extractions and worse outcomes



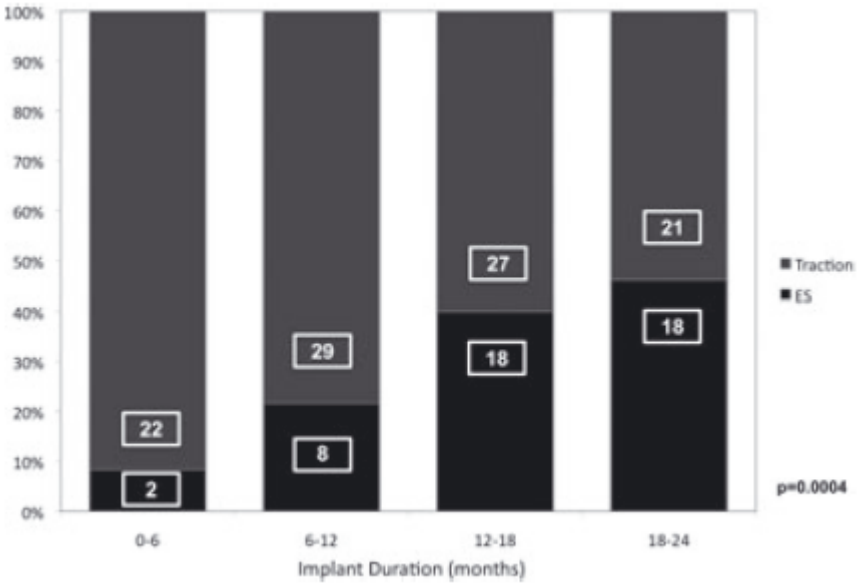
n=1386 pat, single center, 1996-2012
323 (23,6%) had previously abandoned leads

Hussein A, JACC: Clinical Electrophysiology Jan 2017, 3 (1) 1-9

Lead Implant Duration Does Not Always Predict Ease of Extraction: Extraction Sheath May Be Required at < 1 Year

Procedural Characteristics

Characteristic	Traction (n = 99)	ES (n = 46)	P-Value
TLE indication			0.007
Systemic infection	23%	15%	
Local infection	37%	17%	
Lead malfunction	18%	46%	
Device upgrade	14%	11%	
Other	8%	11%	
Implant duration (months)	11.7 ± 6.5	16.3 ± 5.1	<0.0001
No. of leads removed	1.8 ± 0.8	1.4 ± 0.6	0.001
Complete success	97.9%	97.8%	1.00
Clinical success	100%	100%	1.00
Major complications	0%	±0%	1.00
Minor complications	1.0%	4.4%	0.24

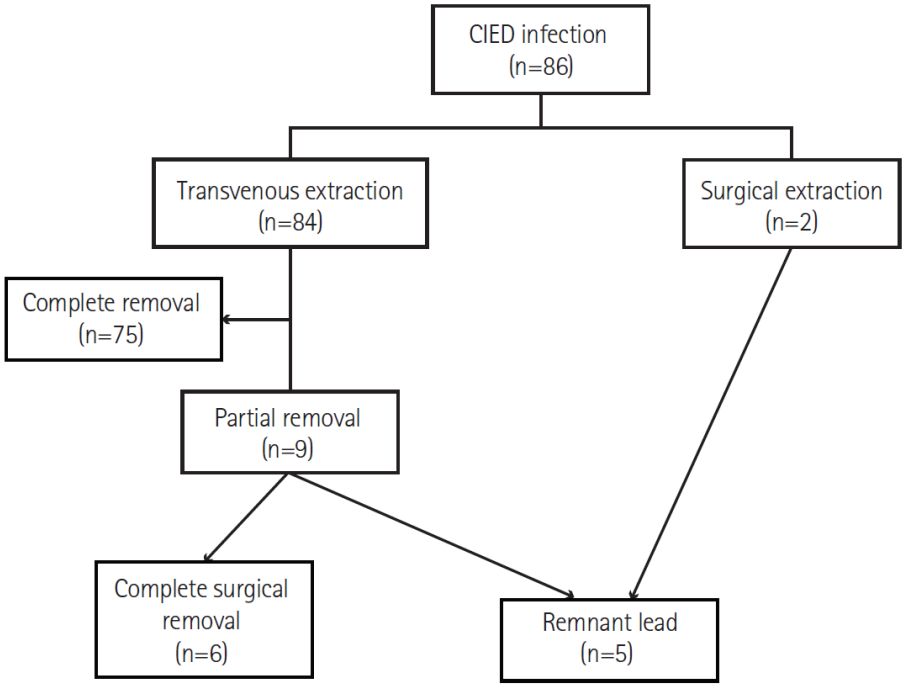


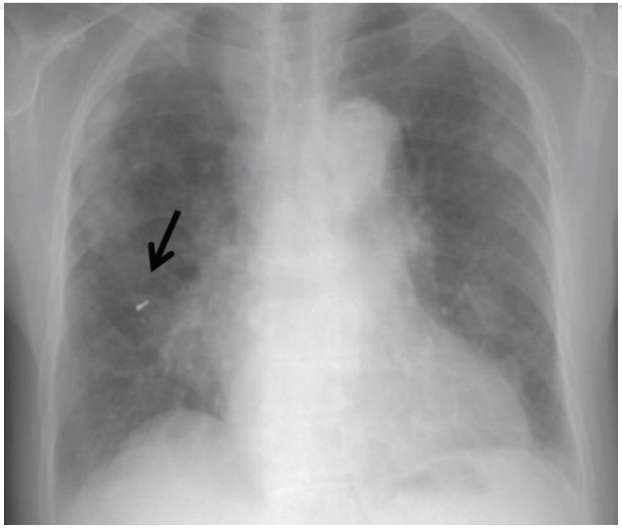
The need for extraction sheaths increased significantly over time.

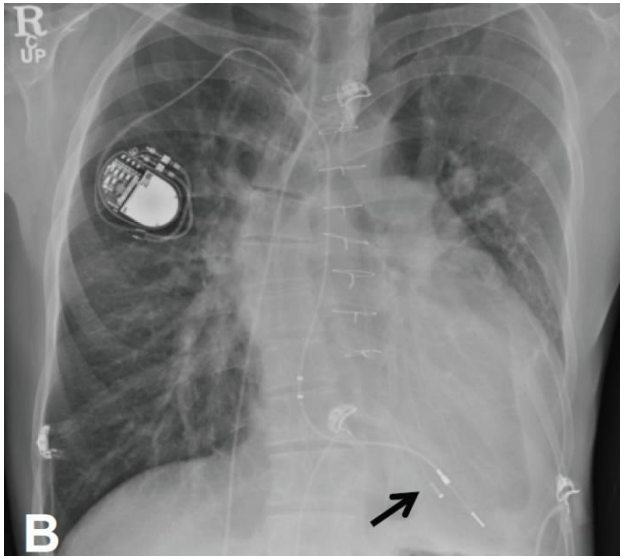
Predictors:
age, number of leads, implant duration, ICD leads

MAYTIN M, at al., PACE 2011; 34:1615–1620

Remnant Pacemaker Lead Tips after Lead Extractions in Pacemaker Infections







Kim D, et al., Korean Circ J 2016;46(4):569-573

ELECTRa- study

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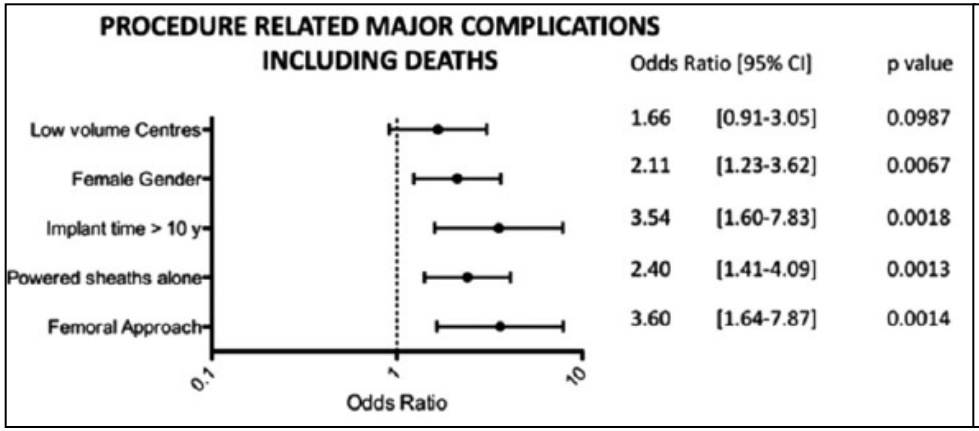
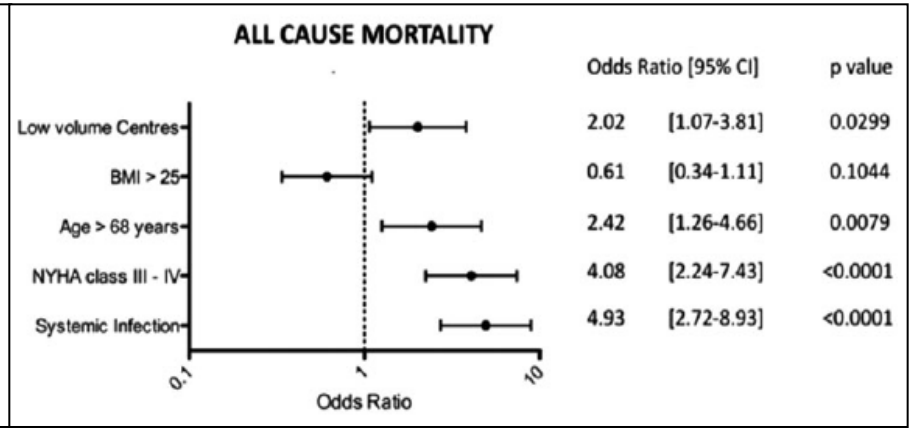
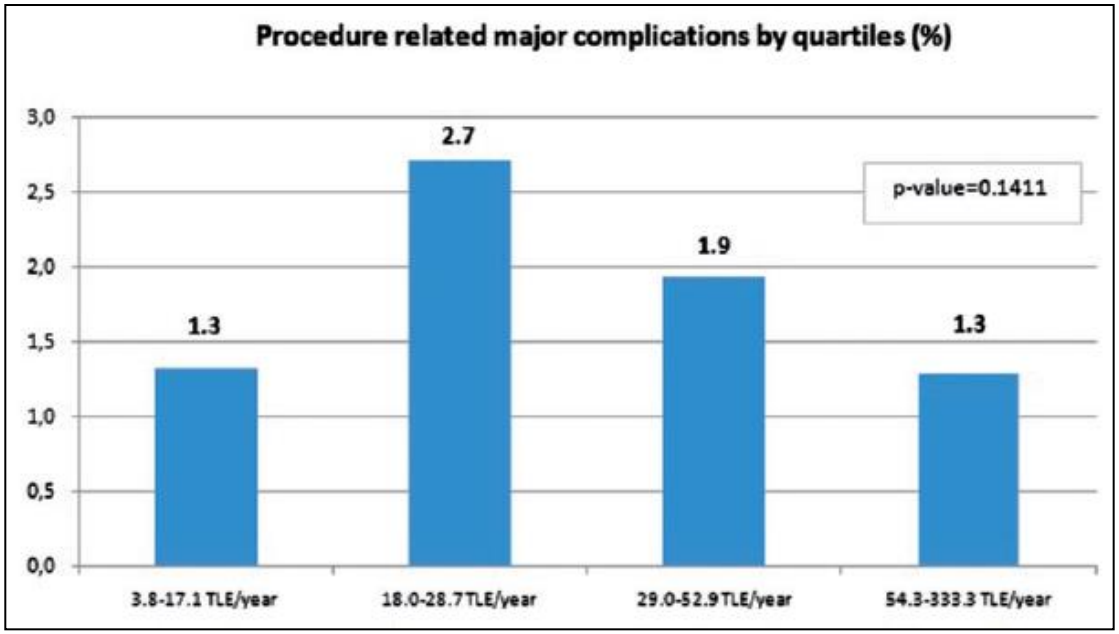






Bongiorni MG, et al., European Heart Journal 2017, 1–11 doi:10.1093/eurheartj/ehx080

Procedural outcomes associated with transvenous lead extraction in patients with abandoned leads: an ESC-EHRA ELECTRa Registry Sub-Analysis

n=3510 pat- at time of extraction
Patients with abandoned leads (N=422)
Patients without abandoned leads (N=3088)

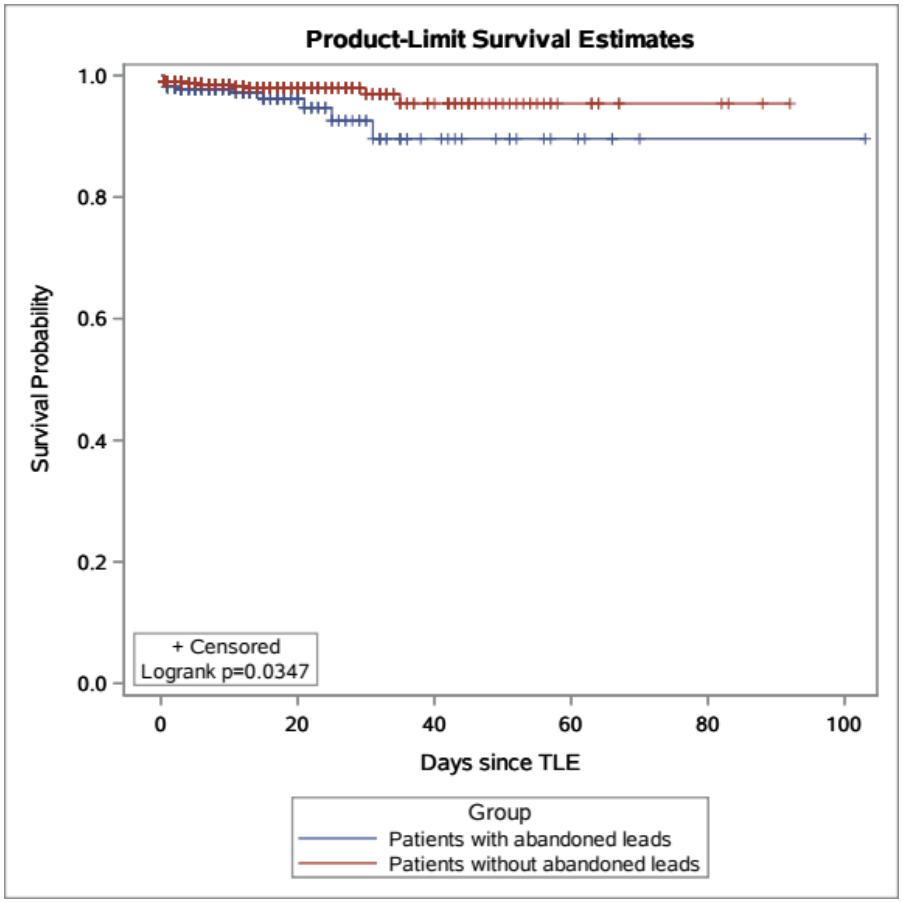
Variables	Total (*N* = 3510)	Patients with abandoned leads (*N* = 422)	Patients without abandoned leads (*N* = 3088)	*P*-value
Age (years), median (IQR)	68.00 (57.00–76.00)	70.00 (60.00–77.00)	67.00 (57.00–76.00)	0.0170
Male gender, *n/N* (%)	2539/3510 (72.34)	319/422 (75.59)	2220/3088 (71.89)	0.1108
Body mass index (kg/m^2), median (IQR)	26.10 (23.50–29.30)	26.50 (24.20–29.10)	26.10 (23.50–29.30)	0.1750
LVEF (%), median (IQR)	50.00 (33.00–60.00)	45.00 (32.00–56.00)	50.00 (33.00–60.00)	0.0719
NYHA Class III–IV, *n/N* (%)	486/3472 (14.00)	68/418 (16.27)	418/3054 (13.69)	0.1537
Coronary artery disease, *n/N* (%)	1375/3482 (39.49)	175/419 (41.77)	1200/3063 (39.18)	0.3092
Valvular heart disease, *n/N* (%)	514/3500 (14.69)	76/422 (18.01)	438/3078 (14.23)	0.0396
Dilated cardiomyopathy, *n/N* (%)	917/3492 (26.26)	116/420 (27.62)	801/3072 (26.07)	0.4997
Previous sternotomy, *n/N* (%)	596/3504 (17.01)	89/422 (21.09)	507/3082 (16.45)	0.0173
Hypertension, *n/N* (%)	1888/3478 (54.28)	222/419 (52.98)	1666/3059 (54.46)	0.5687
Diabetes mellitus, *n/N* (%)	781/3487 (22.40)	99/419 (23.63)	682/3068 (22.23)	0.5196
Chronic heart failure, *n/N* (%)	1557/3488 (44.64)	196/419 (46.78)	1361/3069 (44.35)	0.3476
Chronic kidney disease, *n/N* (%)	613/3493 (17.55)	87/419 (20.76)	526/3074 (17.11)	0.0652
Chronic obstructive pulmonary disease, *n/N* (%)	297/3483 (8.53)	37/417 (8.87)	260/3066 (8.48)	0.7875
ICD, *n/N* (%)	1655/3510 (47.15)	221/422 (52.37)	1434/3088 (46.44)	0.0220
CRT-D, *n/N* (%)	606/1655 (36.62)	102/221 (46.15)	504/1434 (35.15)	0.0109
Pacemakers	1848/3510 (52.65)	194/422 (45.97)	1654/3088 (53.56)	0.0033
CRT-P, *n/N* (%)	127/1848 (6.87)	6/194 (3.09)	121/1654 (7.32)	0.0052
Number of total leads (class) ≥3, *n/N* (%)	987/3509 (28.13)	326/422 (77.25)	661/3087 (21.41)	<0.0001
Number of leads from both left and right side, *n/N* (%)	179/3509 (5.10)	60/422 (14.22)	119/3087 (3.85)	<0.0001
Vegetations (where TEE/TTE were performed), *n/N* (%)	578/3510 (16.47)	104/422 (24.64)	474/3088 (15.35)	<0.0001

Procedural outcomes associated with transvenous lead extraction in patients with abandoned leads: an ESC-EHRA ELECTRa (European Lead Extraction ConTRolled) Registry Sub-Analysis.

3508 TLE procedures,
- 422 patients (12.0%)
had abandoned leads

- Pat were older
- more likely to have ICD devices
- procedure related major complications (3.3% vs 1.4%, p=0.0123) were higher
- dwelling time was longer
- Procedural success rate and clinical success (p<0.0001) were lower

Conclusions: Previously abandoned leads at the time of TLE were associated with increased procedural complexity, clinical failure and major complication.



Kaplan-Meier freedom of clinical failure and procedure related complications including deaths in patients with vs without abandoned leads

Zusammenfassung

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Die Zukunft des Patienten ist wichtig und bei der Indikationsstellung zu beachten?

- Häufigkeit an redundanten und nicht funktionierenden Sonden nimmt zu: Sie sollten eine Indikation zur Extraktion sein
- Stillgelegte oder gekappte Elektroden erhöhen das Operationsrisiko und die Komplikationsrate bei notwendiger zukünftiger Extraktion
- Elektive Extraktion von funktionslosen Sonden zeigt ein geringeres Risiko der Device-Infektion nach 5 Jahren
- Einbeziehung des Patientenwunsches in die Diskussion (shared decision-making process)
- Trotz Gefäßverletzungen insgesamt geringe Komplikationsrate
- Fazit: Elektroden sollten möglichst nicht stillgelegt werden sondern entfernt werden