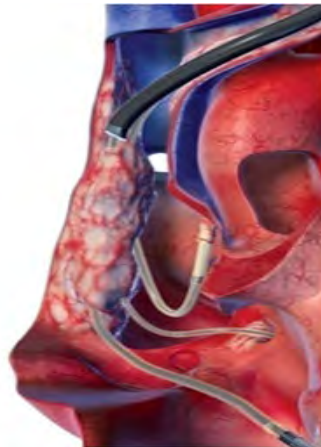
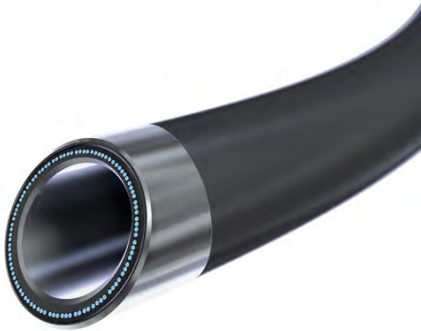


„Wenn es zur Komplikation kommt – vorbereitet auf allen Ebenen?“

Simon Pecha

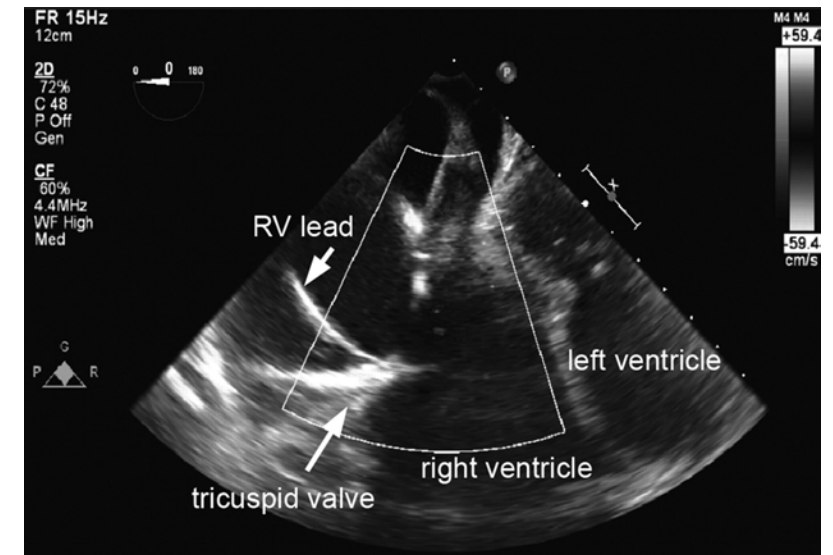
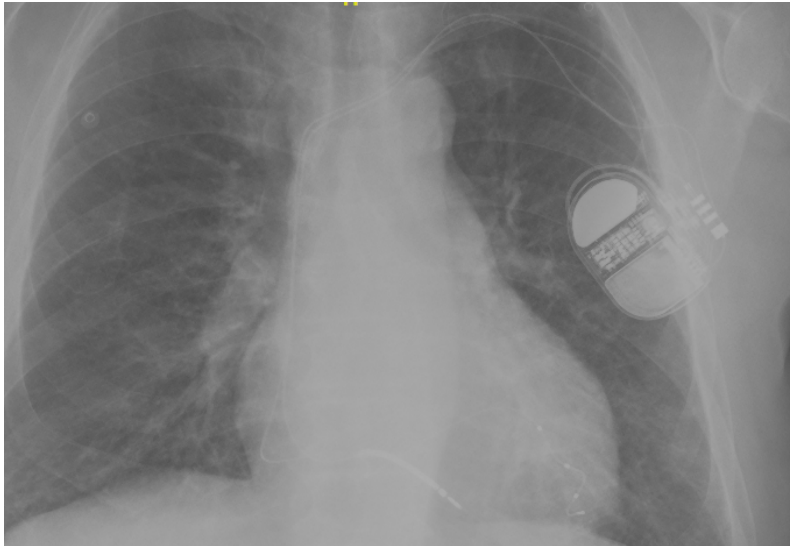
- Preoperative planning of a Lead extraction procedure
- Lead extraction-perioperative considerations



- **Diagnostics:** Chest X-ray, Venography, Transthoracic echo (Transesophageal echo), CT?
- **Leads:** Number, age, location, fixation, broken leads?, previous extraction attempts?
- **Device interrogation:** Lead dysfunction? Pacemaker dependency?
- Blood group checked and packed RBCs in the OR (Cell Saver available)
- Anticoagulation Management

# Pre-OP Diagnostics

- Chest X-ray, Venography, Transthoracic echo (Transesophageal echo), CT?





# Pre-OP CT Scan

- Do we need a preoperative CT scan?



Europace  
doi:10.1093/europace/euw074

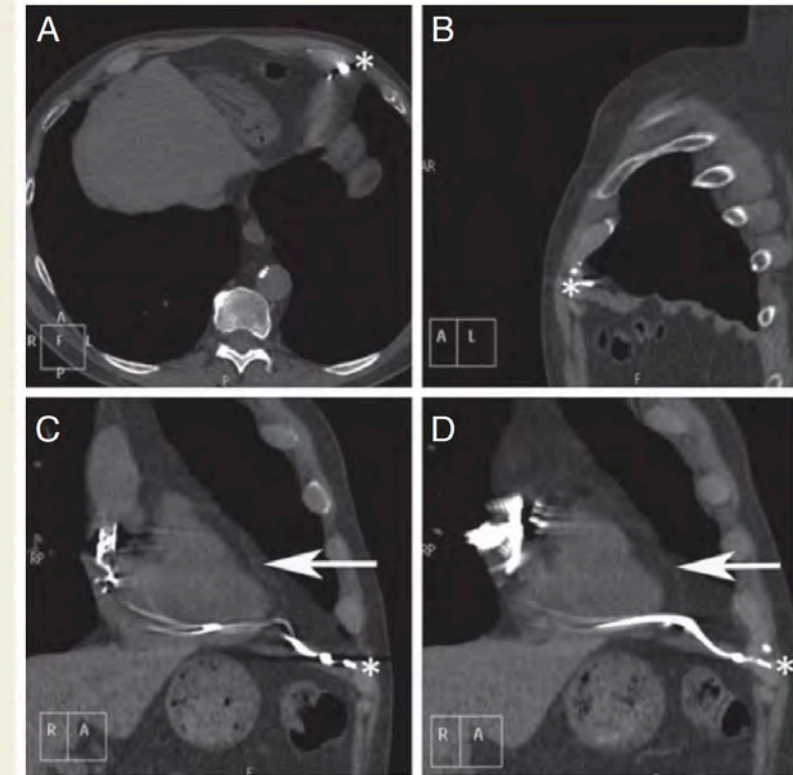
CLINICAL

**Table 2** Diagnostic accuracy of imaging modalities in suspected cardiac perforation

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy <sup>a</sup> (%)
CXR (visualized perforation only)	27.8	94.4	83.3	56.7	61.1
CXR (visualized perforation or displaced lead or left-sided pleural effusion)	61.1	88.9	84.6	69.6	75
TTE (visualized Perforation only)	41.2	84.2	70	61.5	62.7
TTE (visualized perforation or both pleural and pericardial effusions)	47	84.2	72.7	64	65.6
CT	100	85.7	87.5	100	92.9

CXR, chest radiography; TTE, transthoracic echocardiography; CT, computed tomography; PPV, positive predictive value; NPV, negative predictive value.

<sup>a</sup>Calculated assuming prevalence of 0.5 as per the sample.



Rebecca Preston<sup>3</sup>,

## Conclusion

In the setting of cardiac perforation, CT is the imaging modality of choice. Transvenous lead extraction can be recommended as a safe, efficacious, and versatile intervention.



ORIGINAL - DEVICES

## Clinical significance of incidentally detected lead perforations by computed tomography

Prerana Bhatia MD✉, Tommy Chiou BS, Emma Svennberg MD, PhD, Swapnil Khoche MD, Kathleen Jacobs MD, Travis Pollema DO, Victor Pretorius MBChB, Ulrika Birgersdotter-Green MD

- A total of 143 patients and 348 leads were assessed
- The finding of lead perforation from CT was correlated with findings from peri-procedural transesophageal echocardiography (TEE) and outcomes of the lead extraction procedure

## Conclusions

: Incidental delayed lead perforations detected by CT are common and do not correlate with significant TEE findings or adverse peri-procedural outcomes in patients undergoing lead extraction. Larger studies are needed to further characterize the frequency and safety of these findings.

## Results

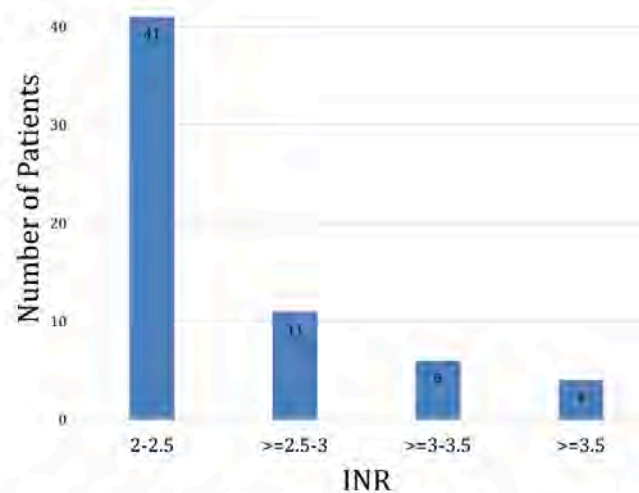
- Lead perforations (including perforations  $< 5$  mm and  $\geq 5$  mm) were detected in 66 (46%) patients and 73 (21%) leads.
- Lead perforation  $\geq 5$  mm were less common and detected in 13 (9%) of patients and 14 (4%) of leads.
- There was no significant difference in the rates of peri-procedural death, cardiac avulsion, cardiac tamponade or post-extraction  
nts with and



CLINICAL | VOLUME 15, ISSUE 12, P1777-1781, DECEMBER 01, 2018

### Transvenous lead extraction during uninterrupted warfarin therapy: Feasibility and outcomes

Qi Zheng, MD, MHS • Melanie Maytin, MD, FHRS • Roy M. John, MD, PhD, FHRS •  
Ammar M. Killu, MBBS • Laurence M. Epstein, MD, FHRS



**Figure 1** Distribution of INR range. A total of 62 patients underwent transvenous lead extraction during uninterrupted warfarin therapy with therapeutic INR (mean  $2.5 \pm 0.5$ ; range 2.0 to 4.5). INR = international normalized ratio.

**Table 5** Procedural outcomes

Total no. of leads attempted to be extracted	116
Total no. of leads extracted	114
Complete success	98.3%
Clinical success	98.3%
Procedure-related complications	
Femoral vein tear requiring surgical repair	1
Pericardial effusion resolved spontaneously	1
Deaths	1
Total no. of perioperative transfusions required	0
Total no. of anticoagulation reversing agents required	0

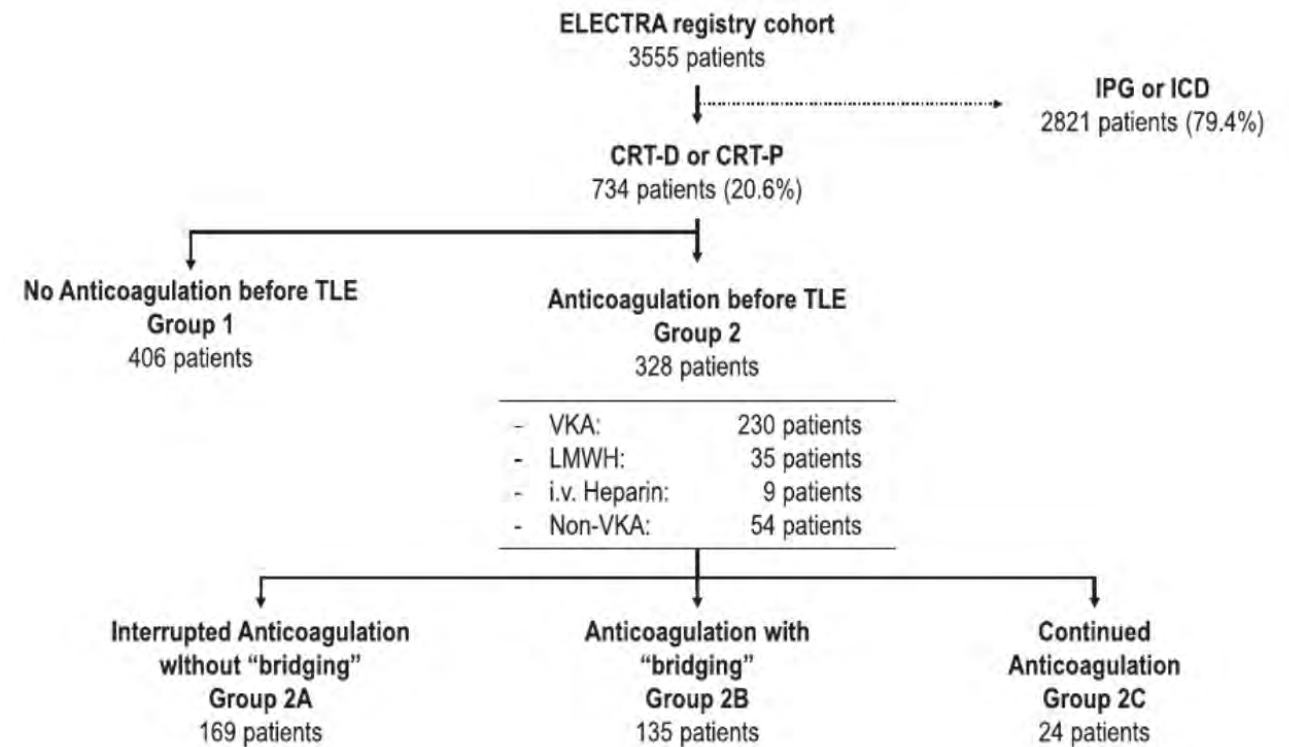
**CONCLUSION** TLE during uninterrupted warfarin therapy with therapeutic INR may be considered in patients at high risk for thromboembolism if performed by experienced operators at high-volume centers.

ORIGINAL ARTICLE

WILEY

## Impact of anticoagulation therapy on outcomes in patients with cardiac implantable resynchronization devices undergoing transvenous lead extraction: A substudy of the ESC-EHRA EORP ELECTRa (European Lead Extraction ConTRolled) Registry

François Regoli MD, PhD<sup>1</sup> | Angelo Auricchio MD, PhD<sup>1</sup> | Andrea Di Cori MD<sup>2</sup> |  
 Luca Segreti MD<sup>2</sup> | Carina Blomström-Lunqvist MD, PhD<sup>3</sup> | Christian Butter MD<sup>4</sup> |  
 Jean-Claude Deharo MD<sup>5</sup> | Charles Kennergren MD<sup>6</sup> | Andrzej Kutarski MD, PhD<sup>7</sup> |  
 Cecile Laroche<sup>8</sup> | Valery Zalevskiy MD<sup>9</sup> | Giovanni Luzzi MD<sup>10</sup> | Oscar Cano MD<sup>11</sup> |  
 Marcin Grabowski MD<sup>12</sup> | Christopher Rinaldi MD, MG<sup>13</sup> | Maria Grazia Bongiorno MD<sup>2</sup>





## Anticoagulation during Lead extraction

**TABLE 3** Comparison of minor complications between the “bridging” and the other two periprocedural anticoagulation strategies

	AC interrupted & continued (N = 193)	AC «Bridging» (N = 135)	P
<b>MINOR- Total</b>	9 (4.7)	16 (11.9)	<b>0.020</b>
Intraprocedural	3 (1.6)	0	0.271
Arrhythmia	1	0	1.000
Blood transfusion	2	0	0.514

**Conclusion:** CRT patients treated with TLE under AC were more compromised but did not present more major complications compared to patients without AC. More minor complications were associated with “bridging” AC regimen.

Pneumothorax req. chest tube	0	0	1.000
Pulmonary embolism not req. surgery	0	1	0.412
Other	1	0	1.000
<b>Total minor bleeding</b>	7 (3.6)	11 (8.1)	<b>0.088</b>
<b>Total minor thromboembolism</b>	0	5 (3.7)	<b>0.011</b>

# Empfehlungen zur Sondenextraktion – Gemeinsame Empfehlungen der Deutschen Gesellschaft für Kardiologie (DGK) und der Deutschen Gesellschaft für Thorax-, Herz- und Gefäßchirurgie (DGTHG)

## Personelle Voraussetzungen

Roland R. Tilz<sup>1,2,14</sup> · Ralph Bosch<sup>3,13</sup> · Christian Butter<sup>4</sup> · Karl-Heinz Kuck<sup>1,14</sup> ·  
Sergio Richter<sup>5</sup> · Philipp Sommer<sup>6</sup> · Samer Hakmi<sup>7</sup> · Thorsten Hanke<sup>8</sup> · Michael Knaut<sup>9</sup> ·  
Christoph Starck<sup>10,11</sup> · Heiko Burger<sup>12</sup>

<b>Tab. 7</b> Übereinstimmende EHRA/HRS/DGK/DGTHG-Empfehlungen für Mindestanforderungen zur Sondenextraktion an Untersucher und Zentrum			
	<b>Mindestanzahl an extra- hierten Elektroden/Jahr</b>	<b>Mindestanzahl an Prozeduren/Jahr</b>	<b>Zusatzanforderungen</b>
Qualifizierter Operator	20	15	Umfassende Qualifikation in Device-Implantationen (DGK-Zusatzqualifikation „Spezielle Rhythmologie – Aktive Herzrhythmusim- plantate“ oder DGTHG-Zertifikat „HSM-, ICD- und CRT-Therapie – Modul 3“ oder EHRA-Zertifikat „EHRA Certified Cardiac Device Specialist – Level 2“)
Supervisor	–	30	Kumulativ > 75 Sondenextraktionen
Zentrum	20	15	Mindestens 1 qualifizierter Untersucher/Supervisor
<i>EHRA</i> European Heart Rhythm Association, <i>HRS</i> Heart Rhythm Society, <i>DGK</i> Deutsche Gesellschaft für Kardiologie, <i>DGTHG</i> Deutsche Gesellschaft für Thorax-, Herz- und Gefäßchirurgie, <i>HSM</i> Herzschrittmacher, <i>ICD</i> Implantierbarer Kardioverter-Defibrillator, <i>CRT</i> kardiale Resynchronisationstherapie			



## Empfehlungen zur Sondenextraktion – Gemeinsame Empfehlungen der Deutschen Gesellschaft für Kardiologie (DGK) und der Deutschen Gesellschaft für Thorax-, Herz- und Gefäßchirurgie (DGTHG)

Roland R. Tilz<sup>1,2,14</sup> · Ralph Bosch<sup>3,13</sup> · Christian Butter<sup>4</sup> · Karl-Heinz Kuck<sup>1,14</sup> · Sergio Richter<sup>5</sup> · Philipp Sommer<sup>6</sup> · Samer Hakmi<sup>7</sup> · Thorsten Hanke<sup>8</sup> · Michael Knaut<sup>9</sup> · Christoph Starck<sup>10,11</sup> · Heiko Burger<sup>12</sup>

Extraktions-Risiko	Elektroden-Charakteristika	Extraktions-Tools	Patienten-Charakteristika <sup>#</sup>	Extraktions-Setting
<b>Niedriges Risiko (Gruppe A)</b>	<ul style="list-style-type: none"> <li>Elektrodenalter &lt;1 Jahr</li> <li>Alle Elektrodentypen (ausgenommen aktiv fixierte Koronarsinus-Elektroden*)</li> <li>Fehlender Nachweis einer Endokarditis/Endoplastitis</li> </ul>	<ul style="list-style-type: none"> <li>Stylets</li> <li>Locking stylets</li> <li>Nur Zugangsweg von Implantationsstelle</li> </ul>	<ul style="list-style-type: none"> <li>Alle Patienten (<u>Ausnahme</u>: Bei ausgeprägter Tascheninfektion / -perforation Sondenextraktion nur in Zentren mit Expertise in der Wundbehandlung)</li> </ul>	<ul style="list-style-type: none"> <li>KL, HOP, OP</li> <li>Herzchirurgie im Haus nicht erforderlich</li> <li>LVo+HVo-Zentren</li> <li>Flache AnSed</li> </ul>
<b>Mittleres Risiko (Gruppe B)</b>	<ul style="list-style-type: none"> <li>Elektrodenalter 1-5 Jahre</li> <li>Schrittmacherelektroden mit aktiver Fixierung</li> <li>&lt;3 Elektroden</li> <li>Fehlender Nachweis einer Endokarditis/Endoplastitis</li> </ul>	<ul style="list-style-type: none"> <li>Stylets</li> <li>Locking stylets</li> <li>Non-powered dilator sheaths</li> <li>Rotational mechanical sheaths</li> <li>Nur Zugangsweg von Implantationsstelle</li> </ul>	<ul style="list-style-type: none"> <li>Patienten <u>ohne</u> schwere kardiovaskuläre Begleiterkrankungen (hochgradig eingeschränkte LVEF; schwere Herz- oder Niereninsuffizienz; schwere Gerinnungsstörung)</li> <li>Keine (oder pausierte) orale Antikoagulation</li> </ul>	<ul style="list-style-type: none"> <li>KL, HOP, OP</li> <li>Herzchirurgie im Haus erforderlich</li> <li>LVo+HVo-Zentren</li> <li>Tiefe AnSed, VN (+TEE)</li> </ul>
<b>Hohes Risiko (Gruppe C)</b>	<ul style="list-style-type: none"> <li>Elektrodenalter 1-10 Jahre</li> <li>Alle Elektrodentypen (ausgenommen aktiv fixierte Koronarsinus-Elektroden*)</li> <li>≥3 Elektroden</li> <li>Perforierte Elektroden</li> <li>Defekte/abgerissene Elektroden nach frustanem Extraktionsversuch</li> <li>Positiver Nachweis einer Endokarditis/Endoplastitis</li> <li>Vegetationen ≤2 cm oder &gt;2 cm ohne Nachweis einer Rechtsherzinsuffizienz</li> <li>Vorausgegangene Sternotomie(n)</li> </ul>	<ul style="list-style-type: none"> <li>Stylets</li> <li>Locking stylets</li> <li>Non-powered dilator sheaths</li> <li>Rotational mechanical sheaths</li> <li>Femoral/jugular snare tools</li> <li>Alle Extraktions-Zugangswege</li> </ul>	<ul style="list-style-type: none"> <li>Patienten mit schweren kardiovaskulären Begleiterkrankungen (hochgradig eingeschränkte LVEF; schwere Herz- oder Niereninsuffizienz; schwere Gerinnungsstörung)</li> <li>Orale Antikoagulation</li> <li>Subclavia-/Anonyma-Verschluss</li> </ul>	<ul style="list-style-type: none"> <li>KL, HOP, OP</li> <li>Herzchirurgie im Haus erforderlich</li> <li>Herzchirurgie unmittelbar verfügbar</li> <li>Bevorzugt im HOP/OP mit Herzchirurgie</li> <li>Bevorzugt HVo-Zentrum</li> <li>Bevorzugt VN+TEE, ggf. tiefe AnSed</li> </ul>
<b>Sehr hohes Risiko (Gruppe D)</b>	<ul style="list-style-type: none"> <li>Elektrodenalter &gt;10 Jahre</li> <li>Implantation vor 30. Lebensjahr</li> <li>Elektroden im linken Atrium/Ventrikel</li> <li>Risiko-Elektroden: dual-coil ICD-Elektroden mit passiver Fixierung; externalisierte Sondenleiter; aktiv fixierte Koronarsinus-Elektroden</li> <li>Vegetationen &gt;2 cm mit Nachweis einer Rechtsherzinsuffizienz und/oder Lungenembolie</li> <li>Vorausgegangene Sternotomie(n)</li> </ul>	<ul style="list-style-type: none"> <li>Stylent</li> <li>Locking stylets</li> <li>Non-powered dilator sheaths</li> <li>Rotational mechanical sheaths</li> <li>Femoral/jugular snare tools</li> <li>Powered Laser sheath*</li> <li>Alle Extraktions-Zugangswege</li> </ul>	<ul style="list-style-type: none"> <li>Patienten mit schweren kardiovaskulären Begleiterkrankungen (hochgradig eingeschränkte LVEF; schwere Herz- oder Niereninsuffizienz; schwere Gerinnungsstörung) im kardiogenen/septischen Schock</li> <li>Linksventrikuläres Assist-Device</li> <li>EMAH-Patienten mit komplexer Anatomie ± operativer Korrektur</li> <li>Indikation zum TK-Ersatz bei präoperativ hochgradiger TI oder TK-Endokarditis</li> </ul>	<ul style="list-style-type: none"> <li>HOP, OP</li> <li>Herzchirurgie im Haus erforderlich</li> <li>Im HOP/OP mit Herzchirurgie (Ausnahme: Im HKL mit Herzchirurgie nur in sehr erfahrenen HVo-Zentren)</li> <li>Bevorzugt HVo-Zentren</li> <li>Bevorzugt VN+TEE, ggf. tiefe AnSed</li> </ul>

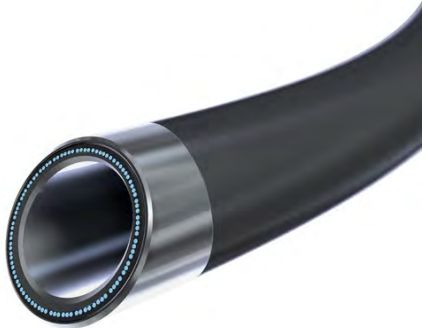


- Hybrid-OR
- Cardiac Surgeon and Cardiologist, Cardiac Anesthesiologist
- General anesthesia
- Invasive arterial blood pressure monitoring
- Transesophageal Echo (Pericardial/Pleural effusion)
- All patients need to be prepared for emergent sternotomy
- Heart-lung machine needs to be prepared in the OR
- Cell Saver available
- 4 F sheaths A. femoralis and 6F sheaths V. femoralis (Pigtail)
- Bridge occlusion balloon for SVC occlusion (available in OR)



## Tools for Lead extraction

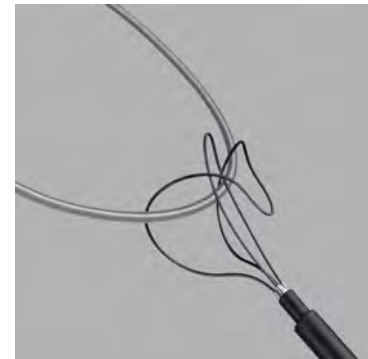
### Laser sheaths



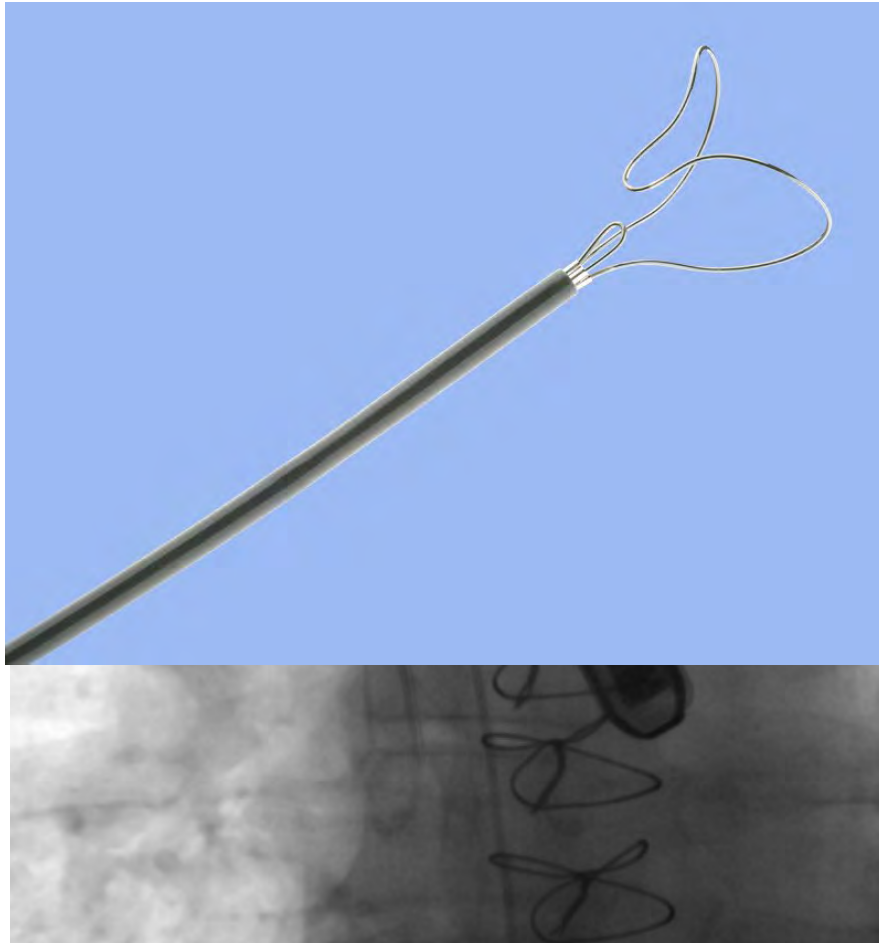
### Mechanical rotational sheaths



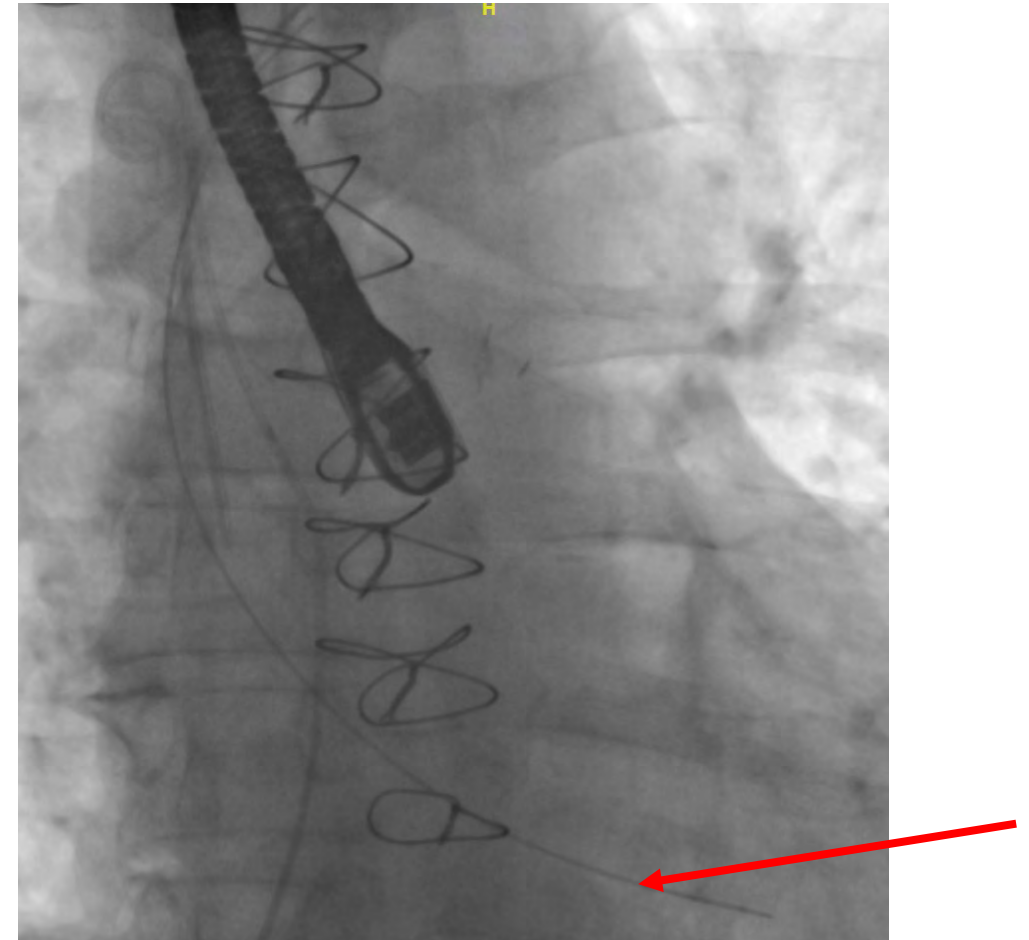
### Snares



## Lead extraction in a patient after Heart Transplantation



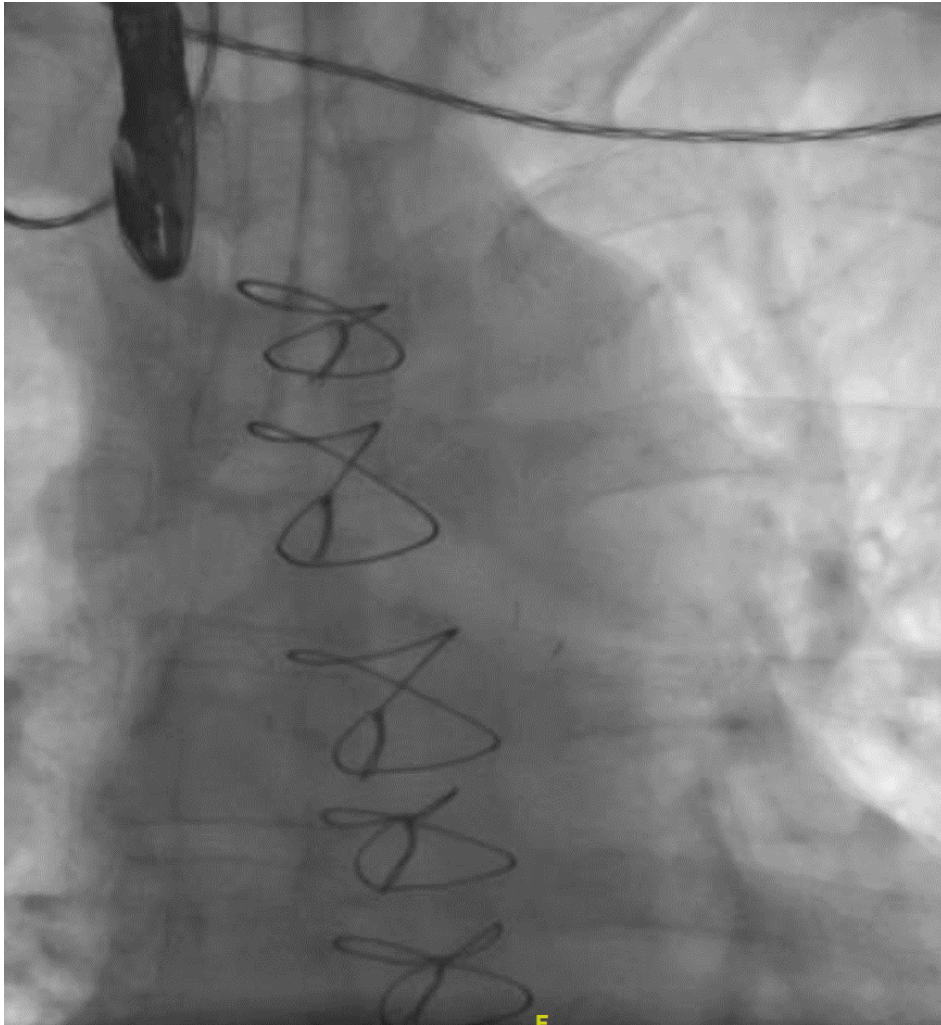
- Insertion of an LLD EZ in RV ICD lead



- Bail-out: Femoral snaring of the lead (Needle Eye Snare)



## Lead extraction in a patient after Heart transplantation





# GermAn Laser Lead Extraction Registry

n = 2524	n	%
Mechanical	106	4.2
Snare	32	1.3
Mechanical & Snare	18	0.7
Mechanical & Other	3	0.1
Snare & Other	2	0.1
Other	7	0.3

In 6.7% of cases additional extraction tools were used



# GermAn Laser Lead Extraction Registry

Clinical procedural Success rate

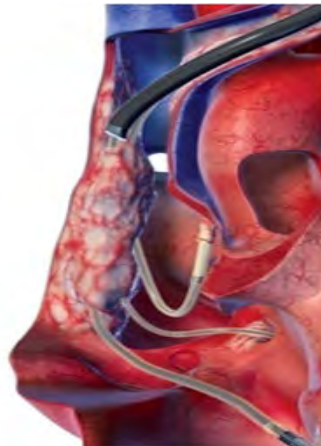
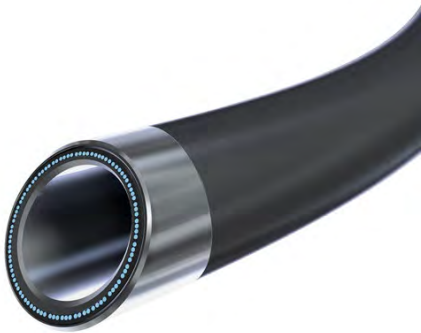
<b>n = 2524</b>	<b>n</b>	<b>%</b>
<b>Laser sheaths only</b>	2354	<b>93.3</b>
<b>Laser sheaths combined with other tools</b>	116	<b>97.86</b>
<b>Failure</b>	54	<b>2.14</b>

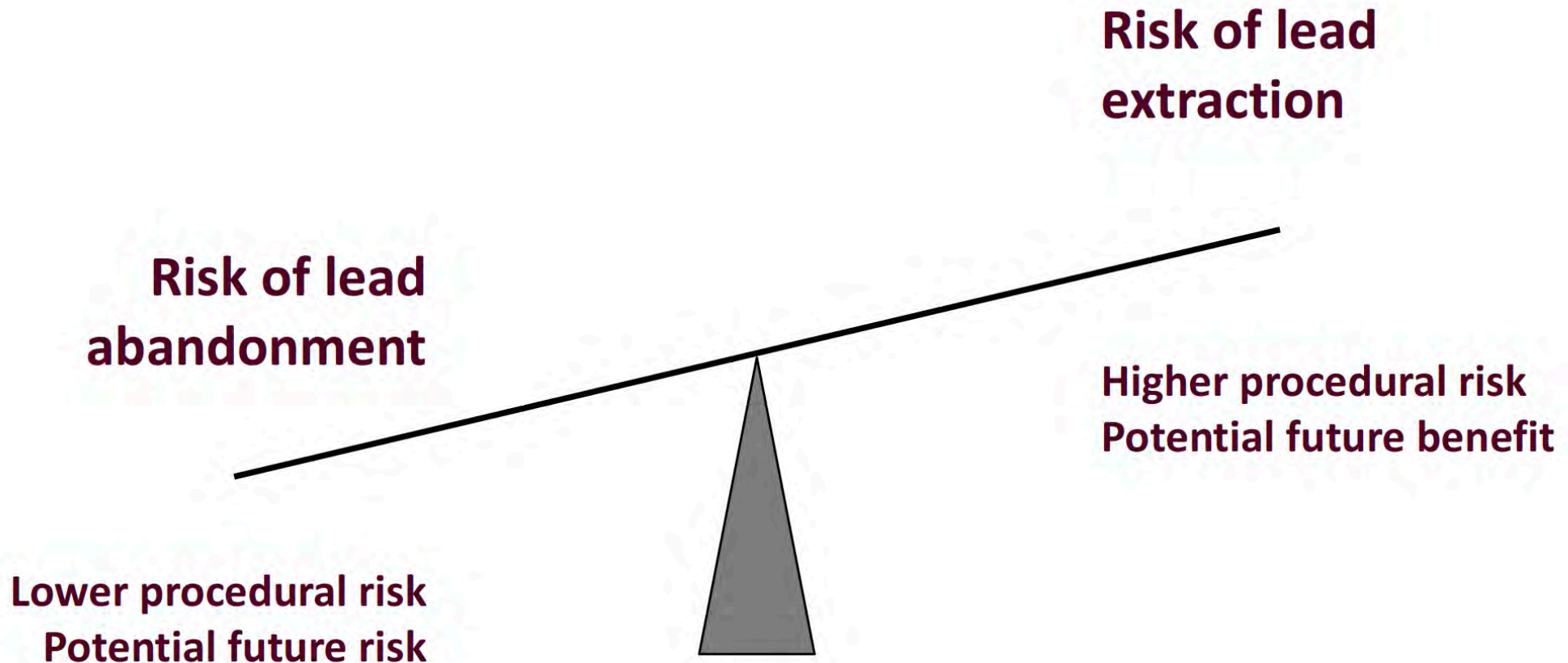
- Multi-tool strategy increases the overall clinical success rate



- Preoperative planning of a Lead extraction procedure

- Lead extraction-perioperative considerations





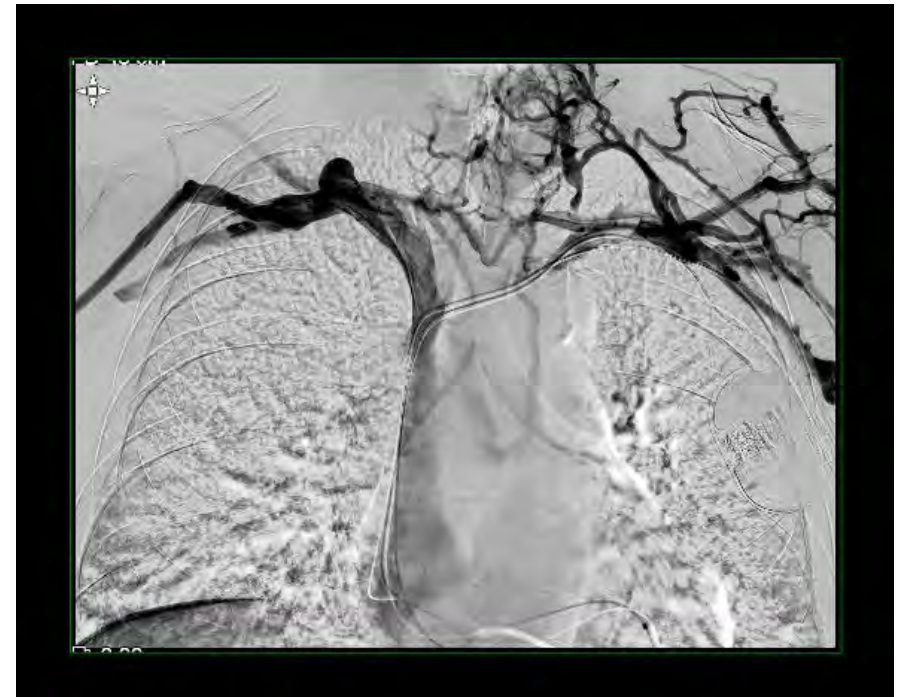
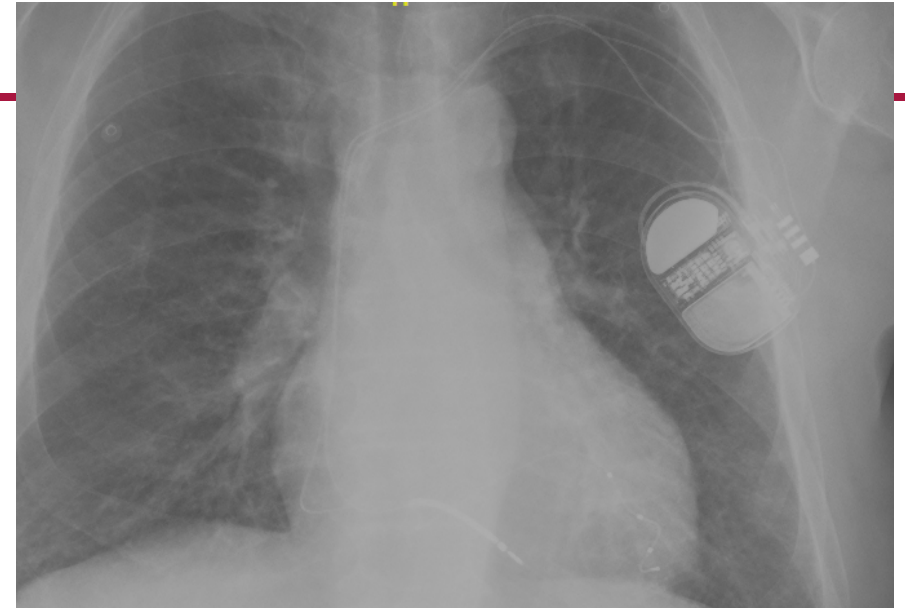
**Risk versus Risk**

## Patient history

- 61 years old male patient with ICM and Afib
- CRT-D Implantation (RV- and LV Lead) from left side in 2016
- Lead revision with new Implantation of an RV Lead 2019
- Pacemaker dependency, LVEF 27%
- Stenosis of left- subclavian- and occlusion of innominate vein

## Now:

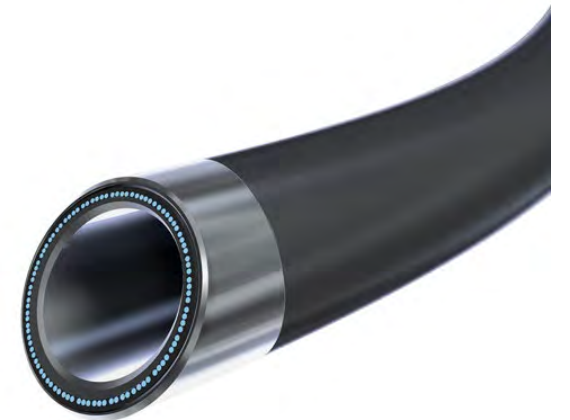
Presenting with Oversensing of RV-Lead and LV-lead with increased pacing threshold





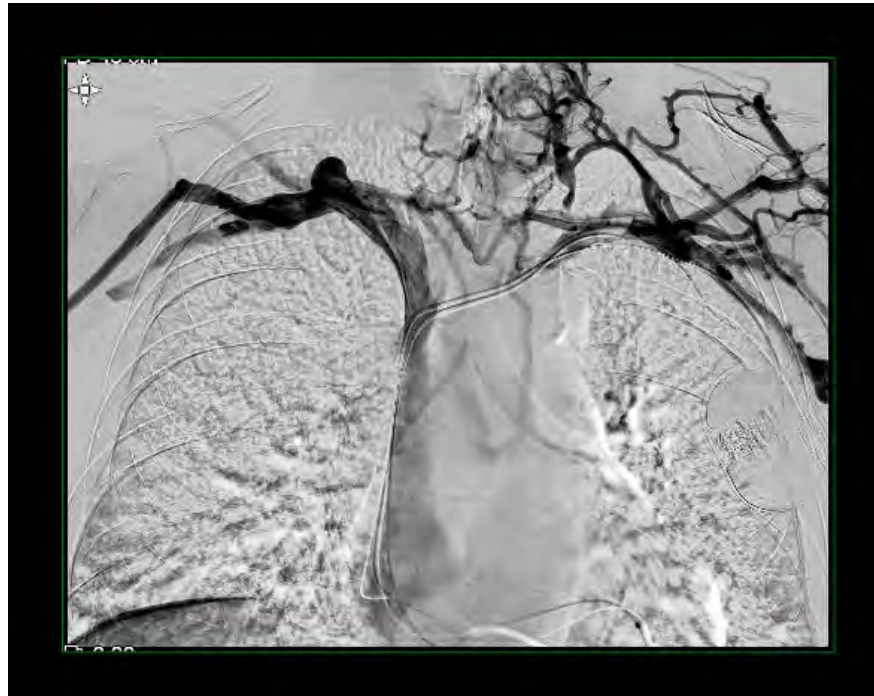
## Operative Strategy:

- Laser lead extraction of the RV-ICD and LV lead (16F GlideLight Laser sheaths)
- Transvenous new implantation of an RV- and LV lead from the ipsilateral side



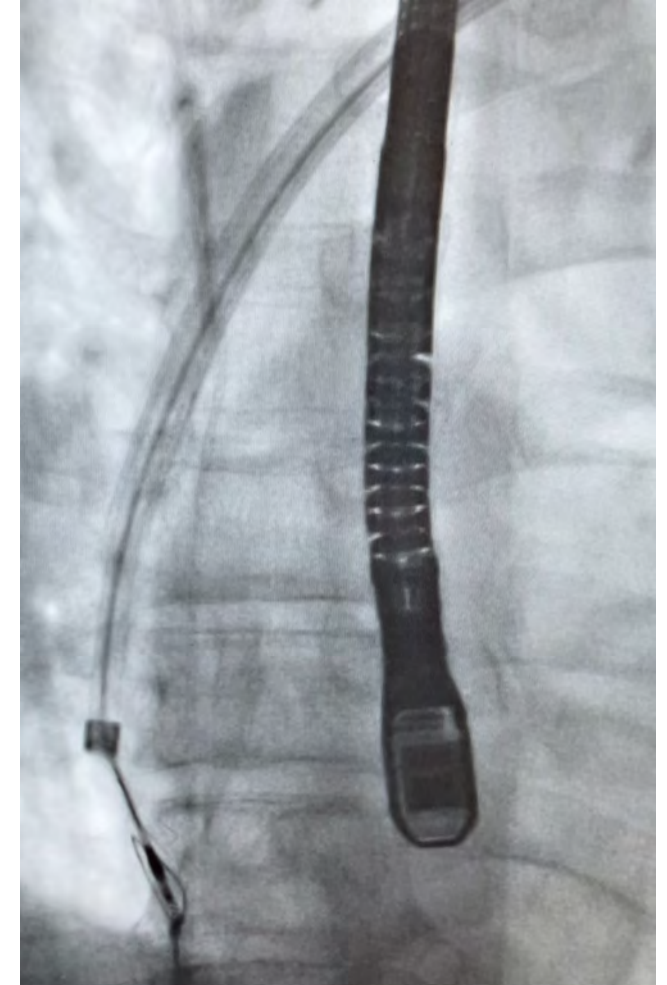
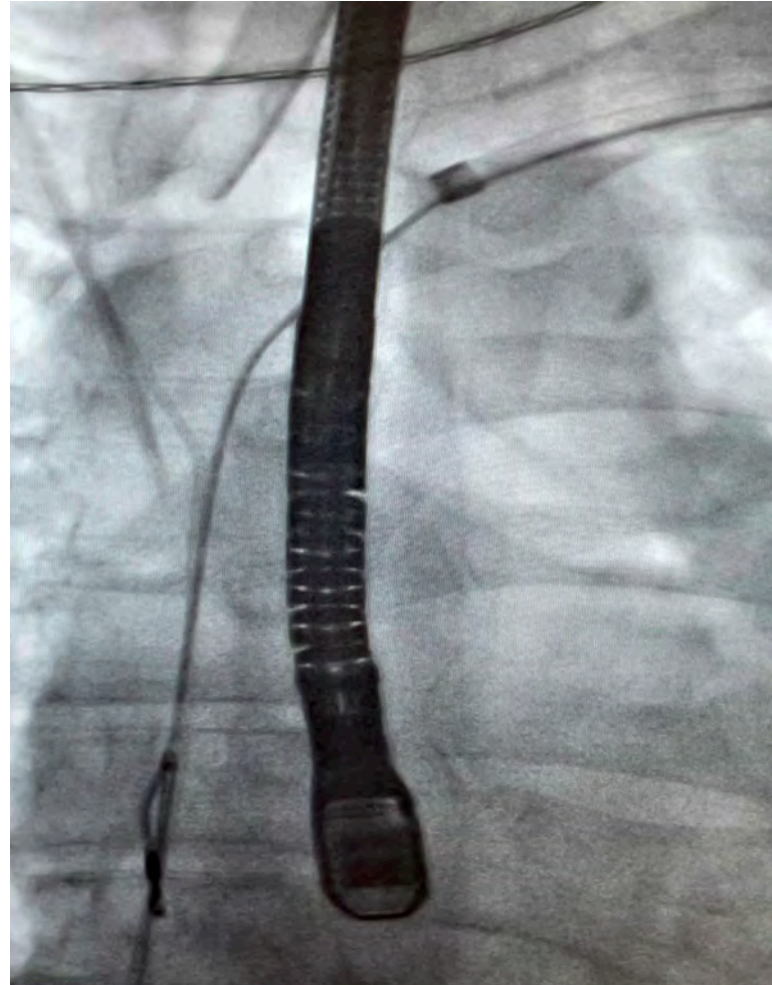
## Procedure:

- Ipsilateral Laser recanalization of the left subclavian- and innominate vein (16F laser sheath)
- Preserving venous return from contralateral side in a young patient by avoiding contralateral lead implantation

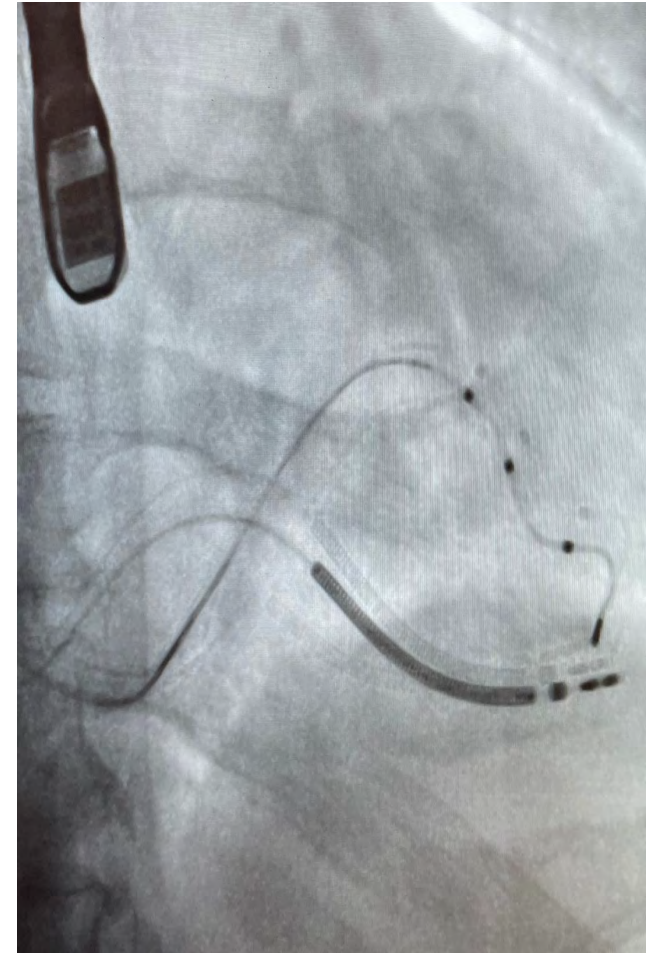
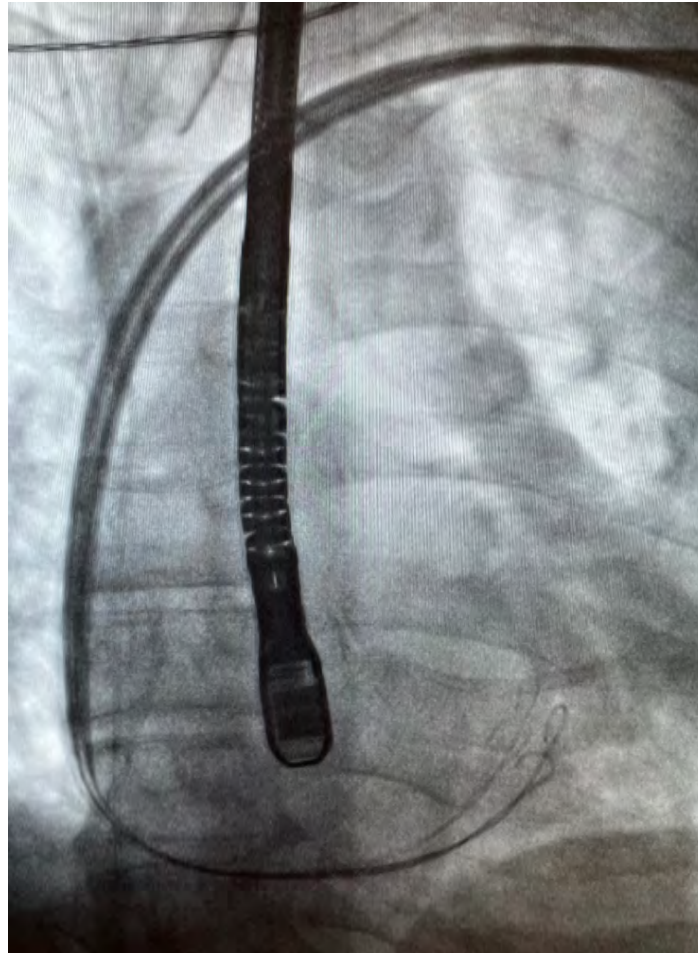
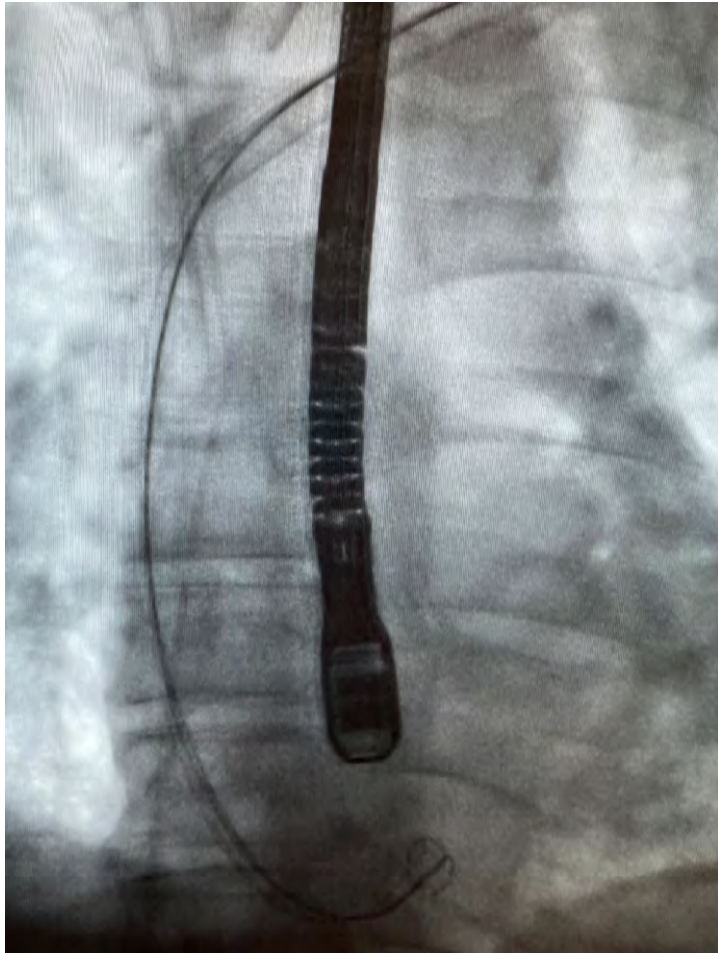


# Case presentation

- LV-lead could be removed with manual traction (LLD), RV lead dislodged from RV after beginning of Laser lead extraction





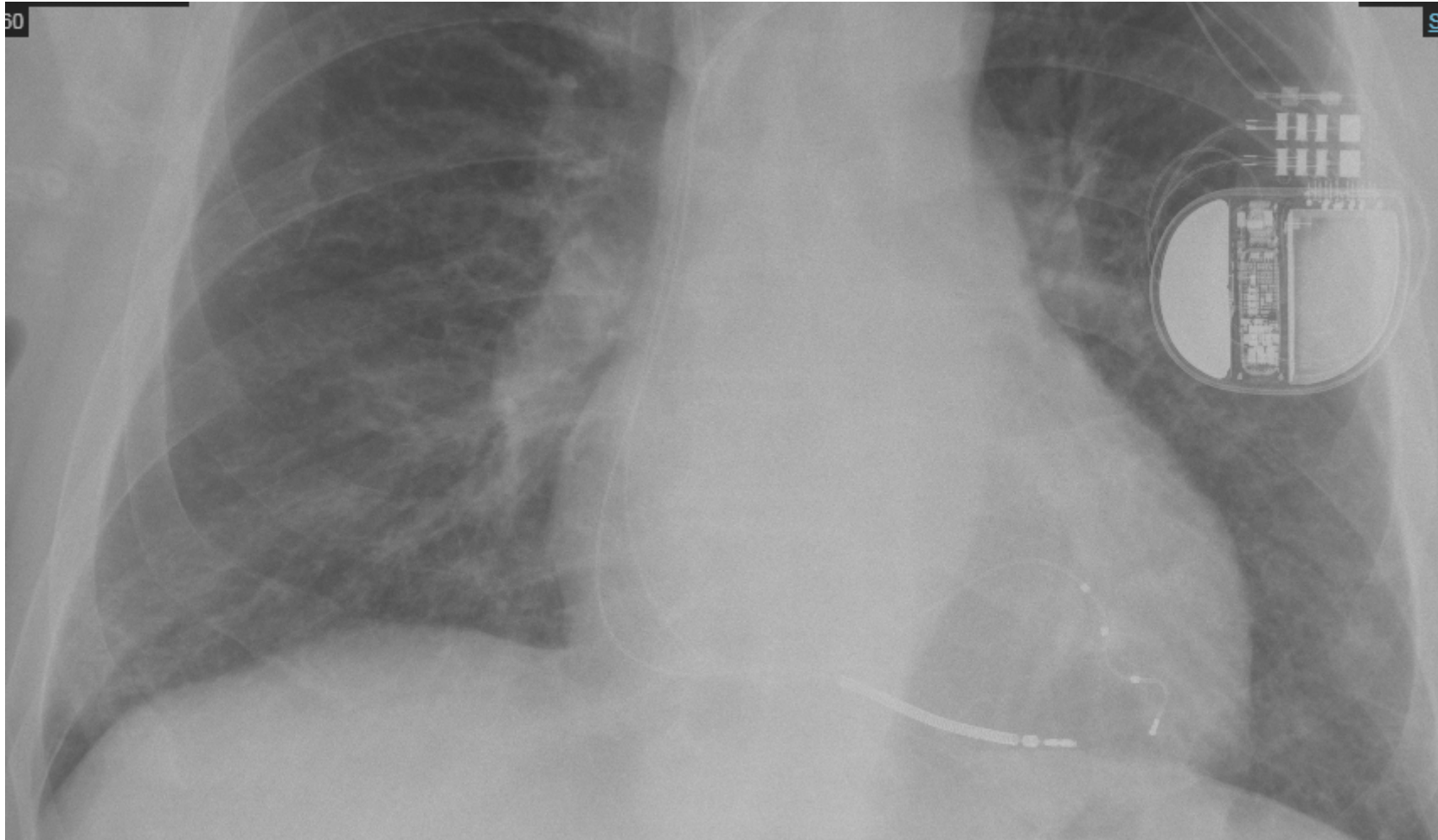


Insertion of 2 wires through 16 F Laser sheath, followed by 2 peel-away sheath  
Implantation of a single-coil RV-ICD lead and an LV lead

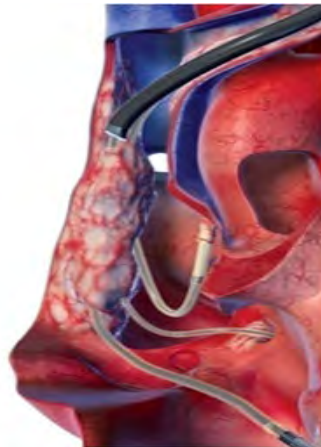
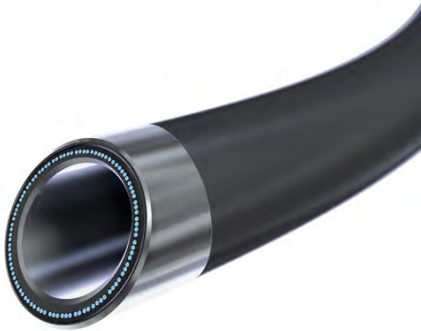


# Case presentation

## Postoperative Chest-X-Ray

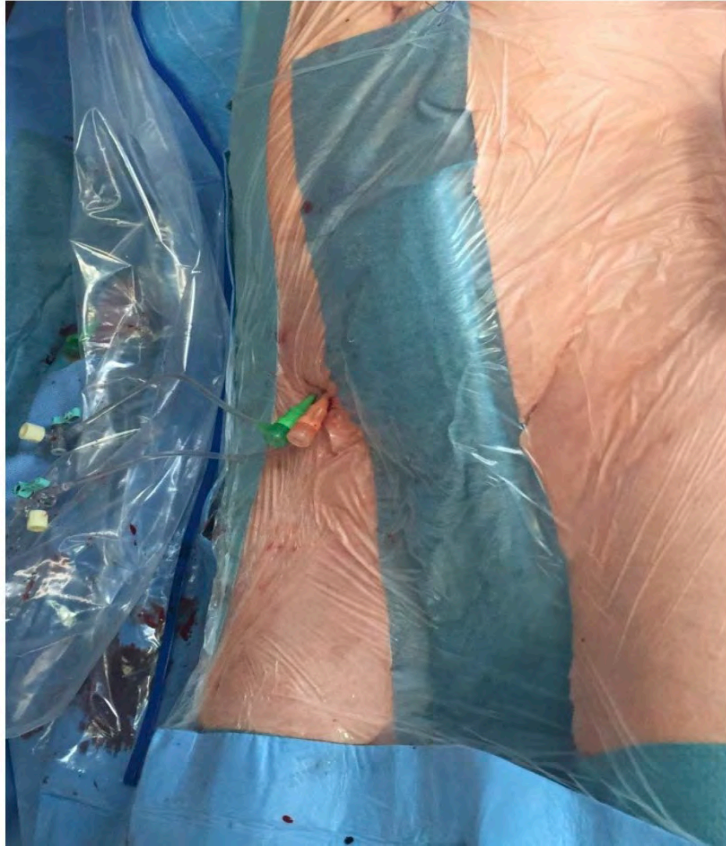


- **Lead Extraction-perioperative Work-up**



# Femoral arterial sheaths

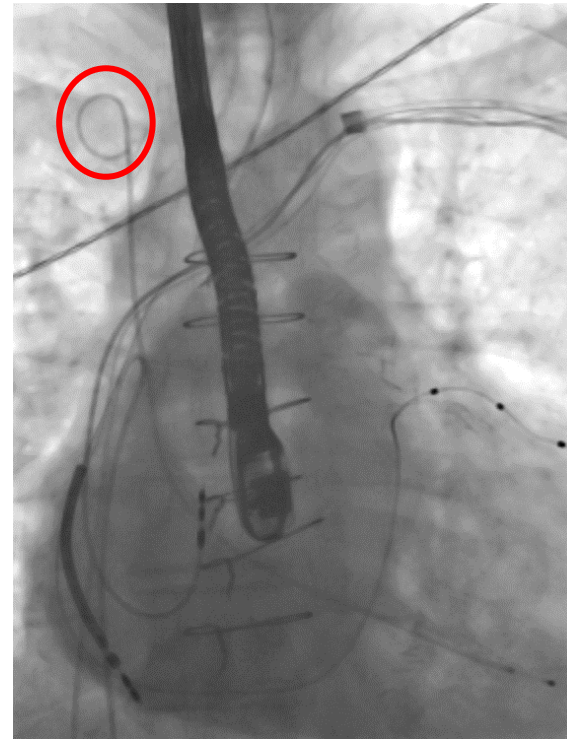
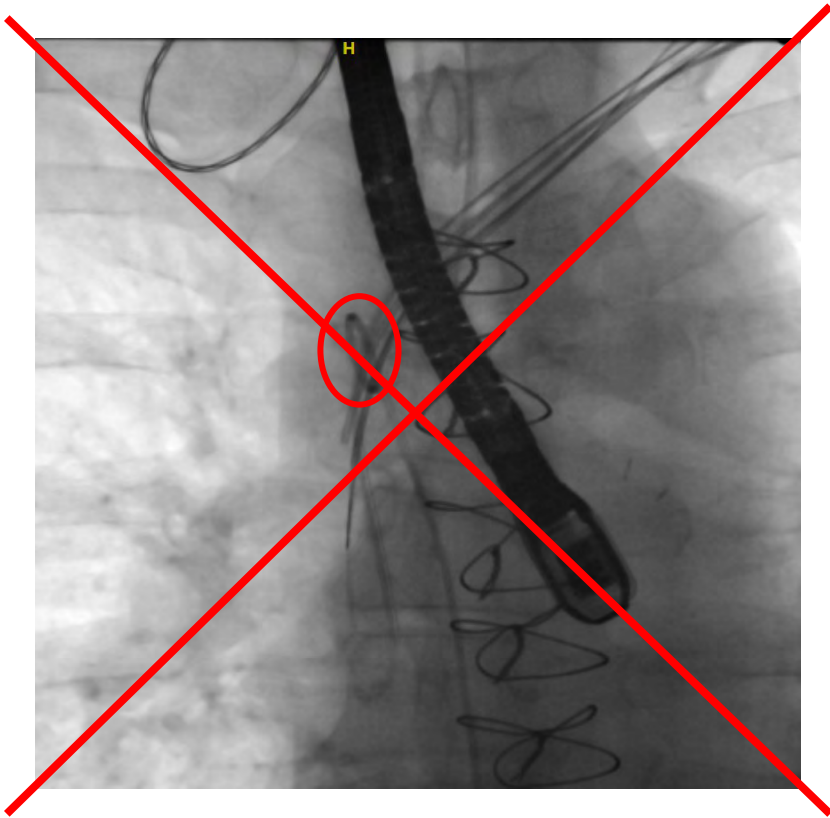
- 4F arterial sheaths, 6 F venous sheaths, Pigtail, Pacemaker (in PM dependent patients)





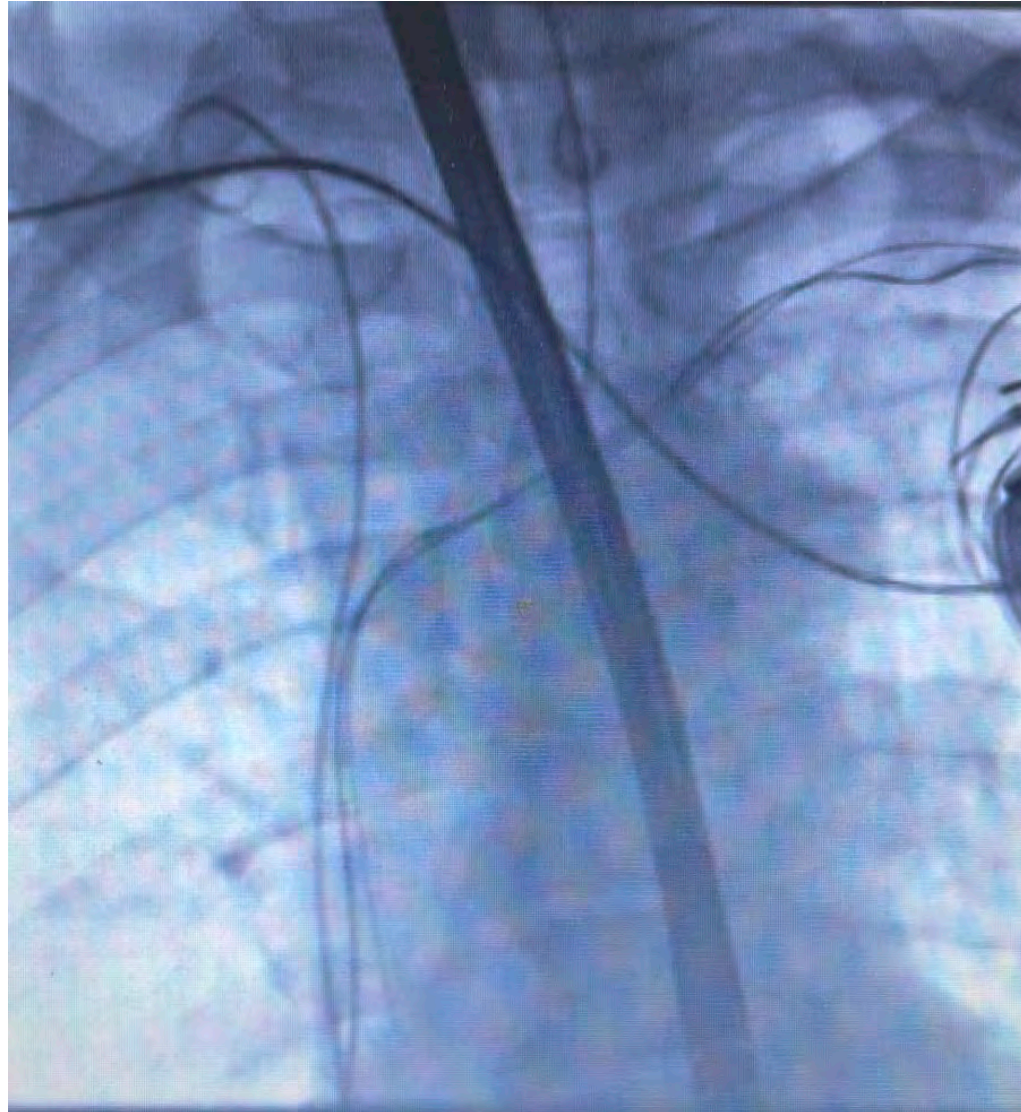
# Pigtail

- Pigtail can be used for venography (suspected tear/perforation)
- Pigtail can be exchanged for a stiff wire to insert a bridge balloon in case of SVC perforation



- Bring the tip of your pigtail up to the internal jugular or right subclavian vein (you need to be above the location of a potential SVC tear)

# Intraoperative Venography

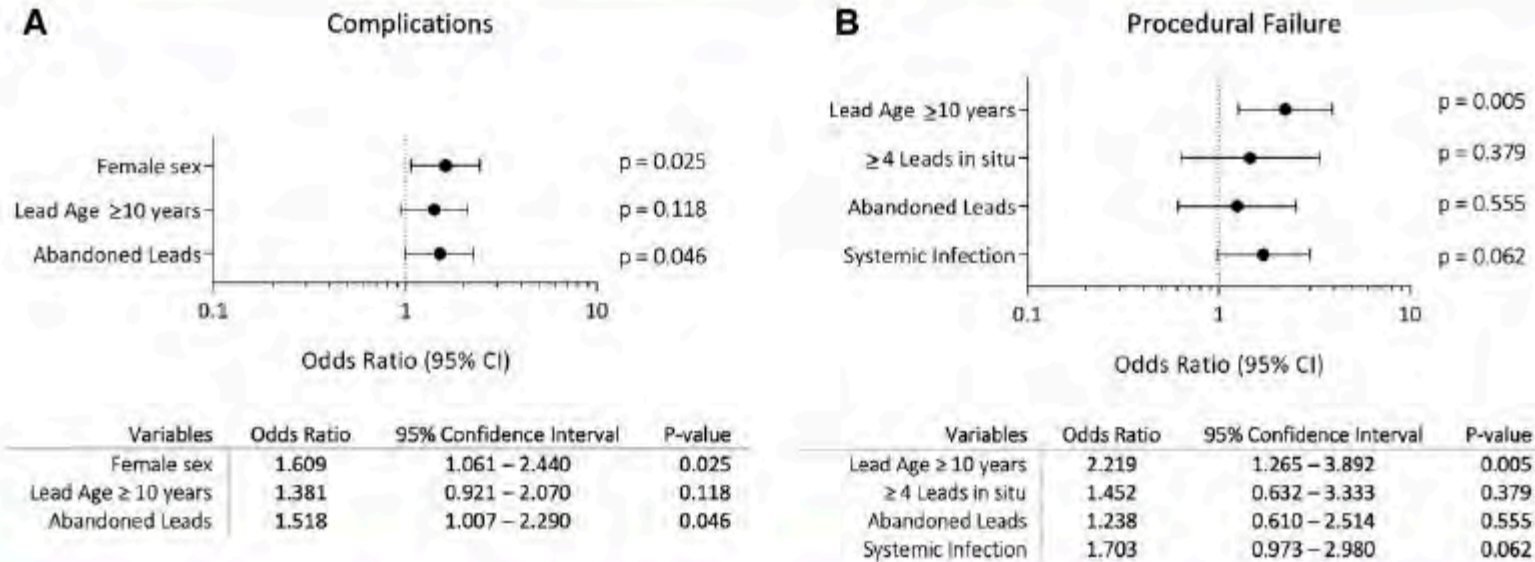


- Can be repeated in case of hemodynamic instability with suspected perforation

### Graphical Abstract

## The GermAn Laser Lead Extraction Registry: GALLERY

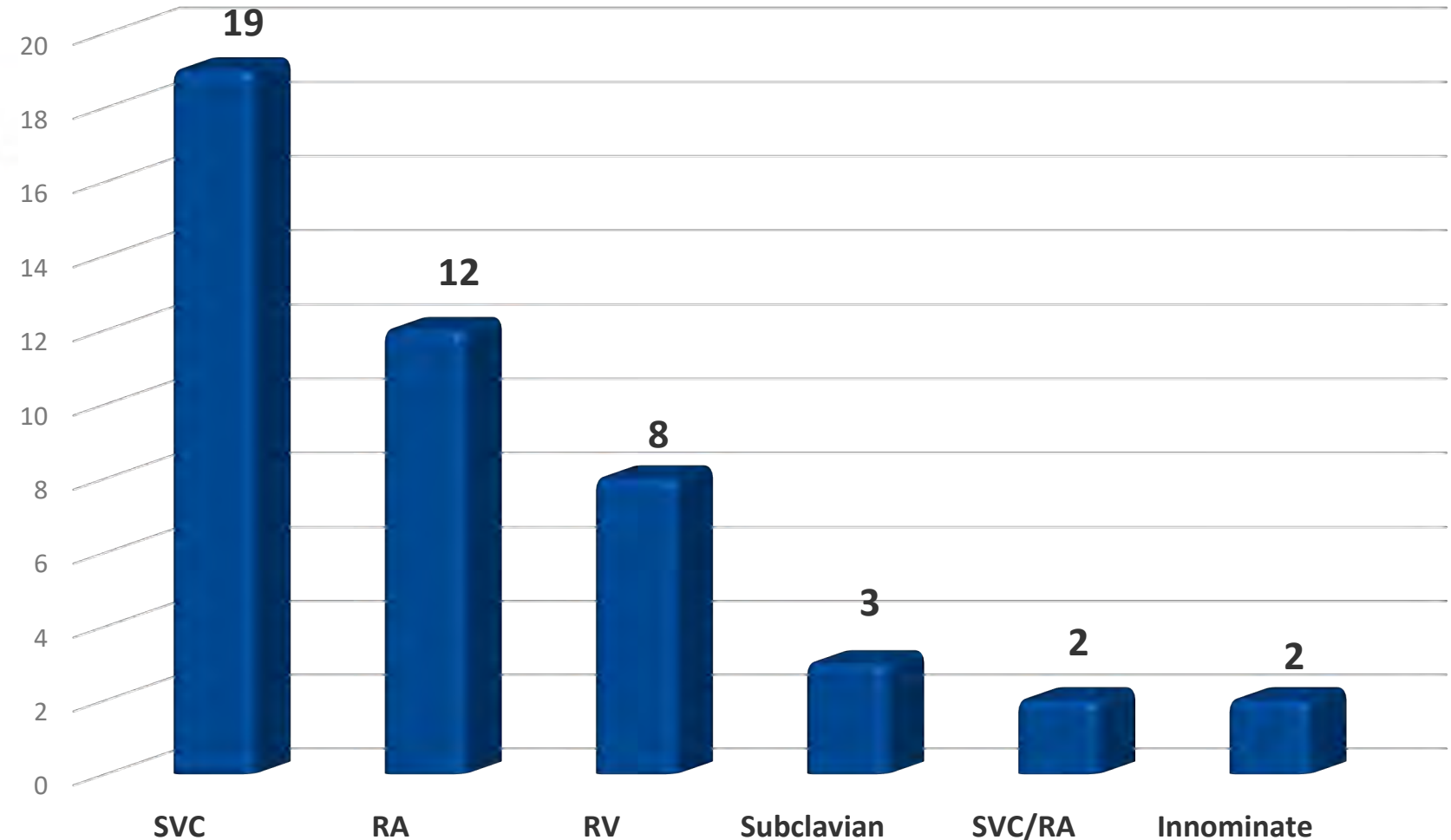
**GALLERY** is a retrospective industry independent registry.  
This registry is the largest Laser lead extraction database including **2524** patient from **24** German centers.



**Figure 2** Multivariate logistic regression analysis to identify independent predictors for overall complications (A) and procedural failure (B) in patients undergoing transvenous lead extraction. A P-value of <0.05 was considered statistically significant. Variables that reached statistical significance in univariate analysis (not shown) were used as predictors for multivariate analysis. CI, confidence interval.



## Location of Vascular/cardiac tears (n=46)

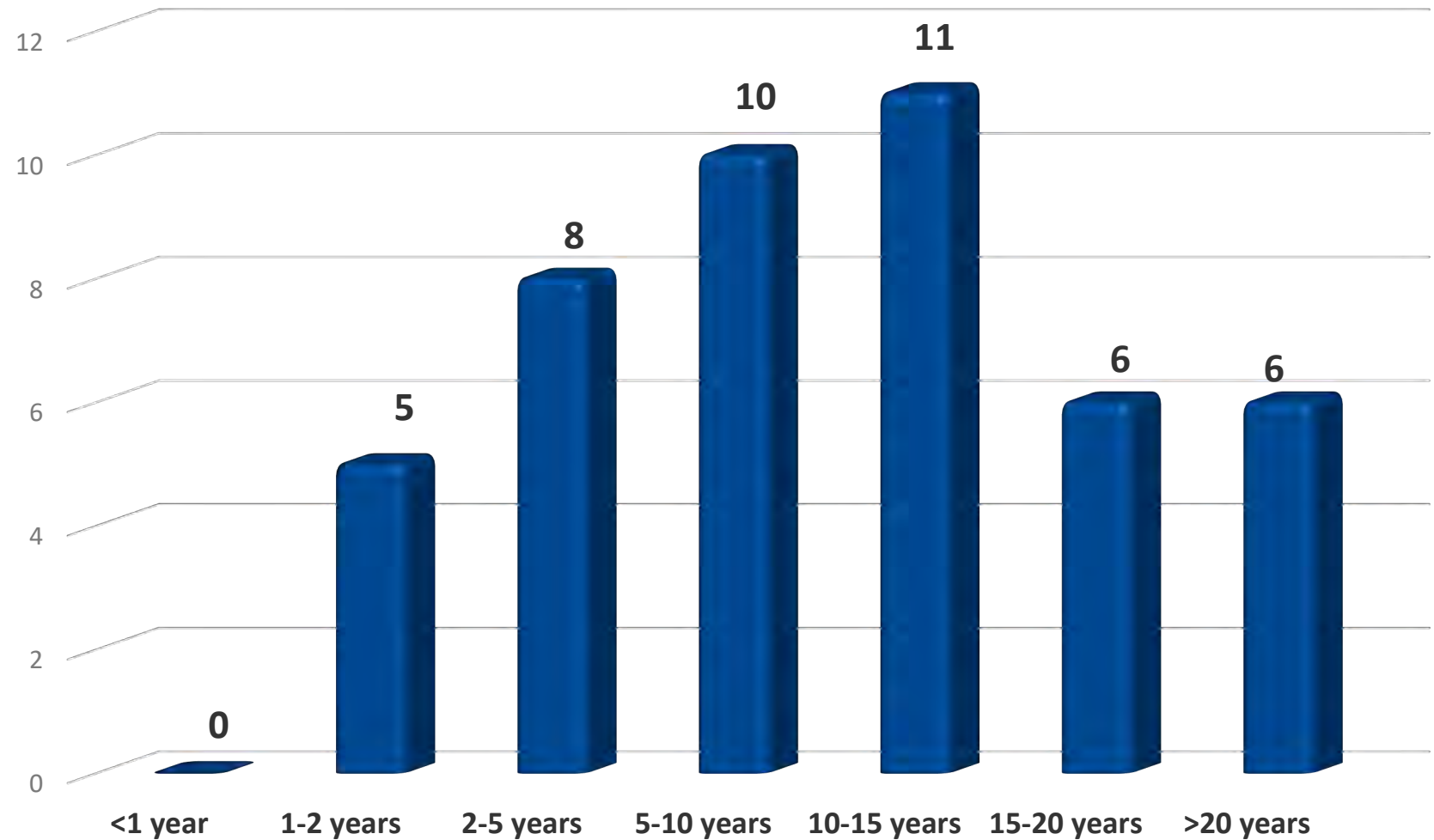


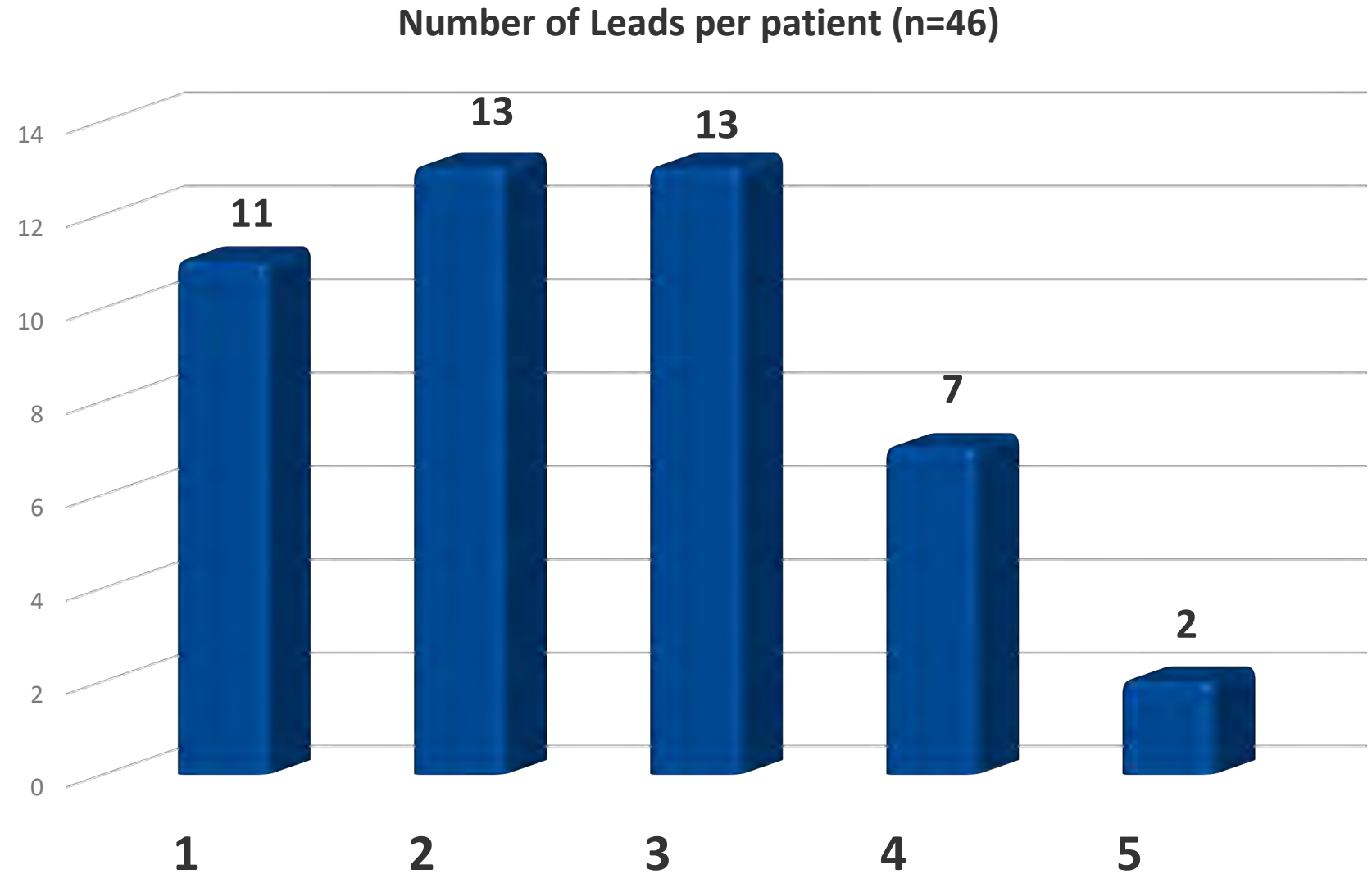
## The GermAn Laser Lead Extraction GallerY: GALLERY

Simon Pecha<sup>1\*</sup>†, Heiko Burger<sup>2†</sup>, Da-Un Chung<sup>3</sup>, Viviane Möller<sup>4</sup>,  
Tomas Madej<sup>5</sup>, Alaa Maali<sup>6</sup>, Brigitte Osswald<sup>7</sup>, Raffaele De Simone<sup>8</sup>,  
Nadeja Monsefi<sup>9</sup>, Virgilijus Ziaukas<sup>10</sup>, Stefan Erler<sup>11</sup>, Hamdi Elfarra<sup>12</sup>,  
Mathias Pertheil<sup>13</sup>, Mahmoud S. Wehbe<sup>10</sup>, Naser Ghaffari<sup>14</sup>, Tim Sandhaus<sup>15</sup>,  
Henning Busk<sup>16</sup>, Jan D. Schmitto<sup>17</sup>, Volker Bärsch<sup>18</sup>, Jerry Easo<sup>19</sup>, Marc Albert<sup>20</sup>,  
Hendrik Treede<sup>21</sup>, Herbert Nägele<sup>22</sup>, Dieter Zenker<sup>23</sup>, Yasser Hegazy<sup>24</sup>,  
Donja Ahmadi<sup>1</sup>, Nele Gessler<sup>3</sup>, Wolfgang Ehrlich<sup>2</sup>, Gabriele Romano<sup>8</sup>,  
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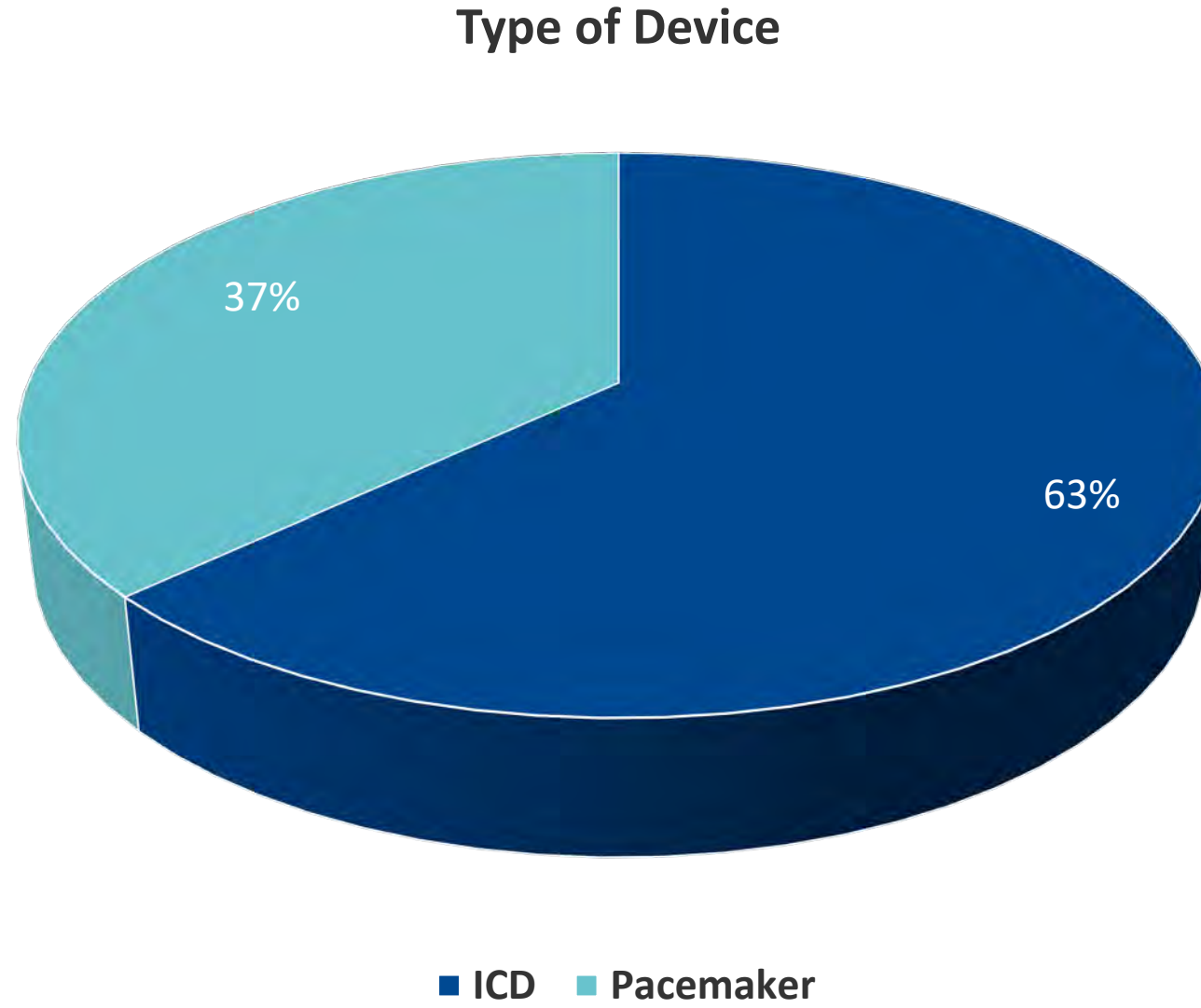
Lead age in patients with Vascular tears (n=46)





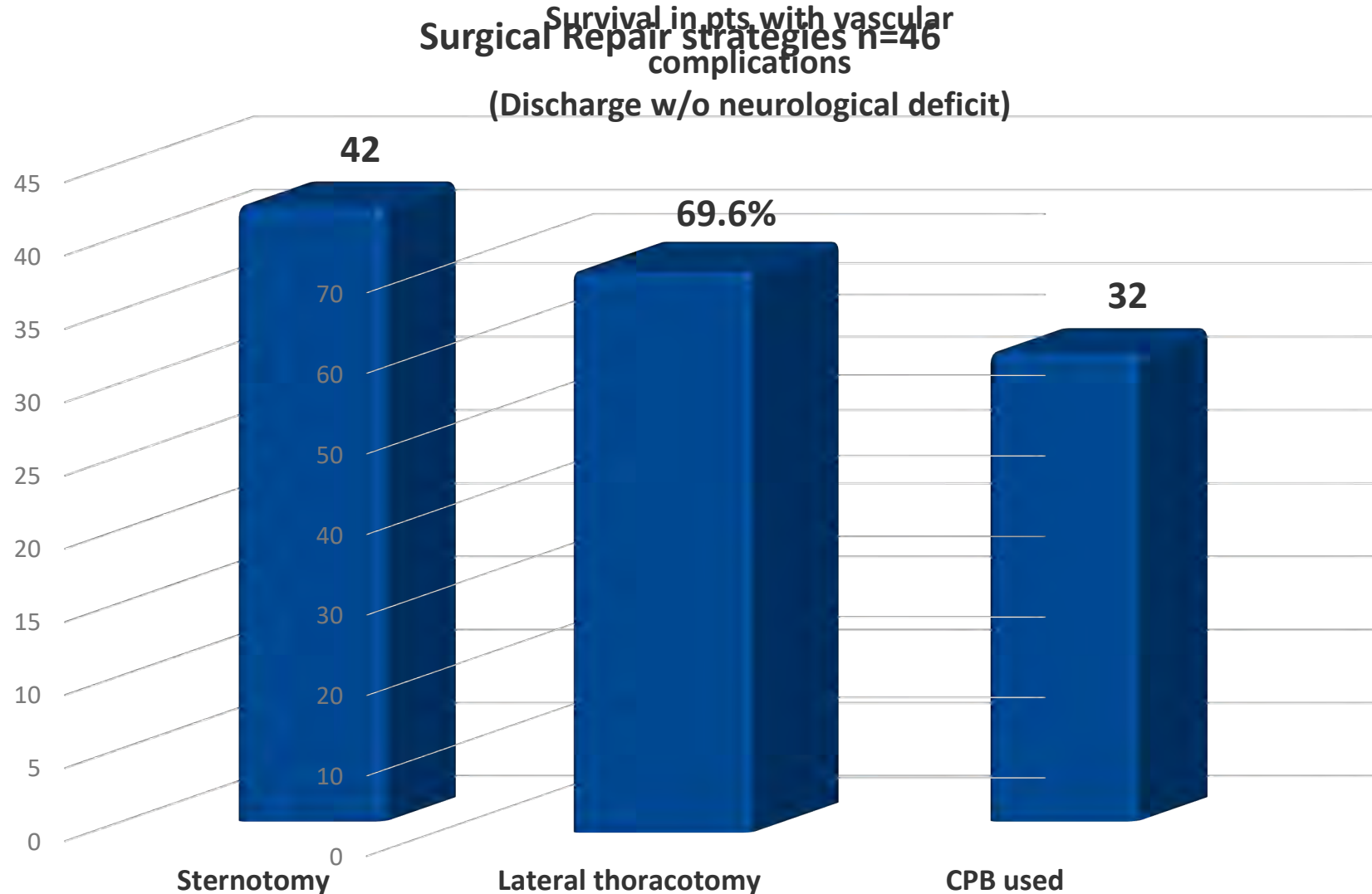
- 43% of patients had abandoned leads, 18 % had previous extraction attempts





## The GermAn Laser Lead Extraction GallerY: GALLERY

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Out of these 46 patients, 69.6% were rescued by emergent surgical management and were discharged without neurological or functional deficit

# Empfehlungen zur Sondenextraktion – Gemeinsame Empfehlungen der Deutschen Gesellschaft für Kardiologie (DGK) und der Deutschen Gesellschaft für Thorax-, Herz- und Gefäßchirurgie (DGTHG)

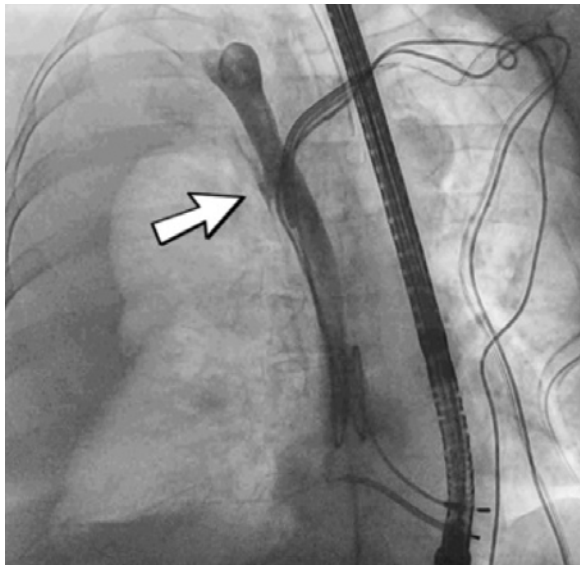
Roland R. Tilz<sup>1,2,14</sup> · Ralph Bosch<sup>3,13</sup> · Christian Butter<sup>4</sup> · Karl-Heinz Kuck<sup>1,14</sup> · Sergio Richter<sup>5</sup> · Philipp Sommer<sup>6</sup> · Samer Hakmi<sup>7</sup> · Thorsten Hanke<sup>8</sup> · Michael Knaut<sup>9</sup> · Christoph Starck<sup>10,11</sup> · Heiko Burger<sup>12</sup>

Extraktions-Risiko	Elektroden-Charakteristika	Extraktions-Tools	Patienten-Charakteristika <sup>#</sup>	Extraktions-Setting
<b>Niedriges Risiko (Gruppe A)</b>	<ul style="list-style-type: none"> <li>Elektrodenalter &lt;1 Jahr</li> <li>Alle Elektrodentypen (ausgenommen aktiv fixierte Koronarsinus-Elektroden*)</li> <li>Fehlender Nachweis einer Endokarditis/Endoplastitis</li> </ul>	<ul style="list-style-type: none"> <li>Stylets</li> <li>Locking stylets</li> <li>Nur Zugangsweg von Implantationsstelle</li> </ul>	<ul style="list-style-type: none"> <li>Alle Patienten (<u>Ausnahme</u>: Bei ausgeprägter Tascheninfektion / -perforation Sondenextraktion nur in Zentren mit Expertise in der Wundbehandlung)</li> </ul>	<ul style="list-style-type: none"> <li>KL, HOP, OP</li> <li>Herzchirurgie im Haus nicht erforderlich</li> <li>LVo+HVo-Zentren</li> <li>Flache AnSed</li> </ul>
<b>Mittleres Risiko (Gruppe B)</b>	<ul style="list-style-type: none"> <li>Elektrodenalter 1-5 Jahre</li> <li>Schrittmacherelektroden mit aktiver Fixierung</li> <li>&lt;3 Elektroden</li> <li>Fehlender Nachweis einer Endokarditis/Endoplastitis</li> </ul>	<ul style="list-style-type: none"> <li>Stylets</li> <li>Locking stylets</li> <li>Non-powered dilator sheaths</li> <li>Rotational mechanical sheaths</li> <li>Nur Zugangsweg von Implantationsstelle</li> </ul>	<ul style="list-style-type: none"> <li>Patienten <u>ohne</u> schwere kardiovaskuläre Begleiterkrankungen (hochgradig eingeschränkte LVEF; schwere Herz- oder Niereninsuffizienz; schwere Gerinnungsstörung)</li> <li>Keine (oder pausierte) orale Antikoagulation</li> </ul>	<ul style="list-style-type: none"> <li>KL, HOP, OP</li> <li>Herzchirurgie im Haus erforderlich</li> <li>LVo+HVo-Zentren</li> <li>Tiefe AnSed, VN (+TEE)</li> </ul>
<b>Hohes Risiko (Gruppe C)</b>	<ul style="list-style-type: none"> <li>Elektrodenalter 1-10 Jahre</li> <li>Alle Elektrodentypen (ausgenommen aktiv fixierte Koronarsinus-Elektroden*)</li> <li>≥3 Elektroden</li> <li>Perforierte Elektroden</li> <li>Defekte/abgerissene Elektroden nach frustriertem Extraktionsversuch</li> <li>Positiver Nachweis einer Endokarditis/Endoplastitis</li> <li>Vegetationen ≤2 cm oder &gt;2 cm ohne Nachweis einer Rechtsherzinsuffizienz</li> <li>Vorausgegangene Sternotomie(n)</li> </ul>	<ul style="list-style-type: none"> <li>Stylets</li> <li>Locking stylets</li> <li>Non-powered dilator sheaths</li> <li>Rotational mechanical sheaths</li> <li>Femoral/jugular snare tools</li> <li>Alle Extraktions-Zugangswege</li> </ul>	<ul style="list-style-type: none"> <li>Patienten mit schweren kardiovaskulären Begleiterkrankungen (hochgradig eingeschränkte LVEF; schwere Herz- oder Niereninsuffizienz; schwere Gerinnungsstörung)</li> <li>Orale Antikoagulation</li> <li>Subclavia-/Anonymia-Verschluss</li> </ul>	<ul style="list-style-type: none"> <li>KL, HOP, OP</li> <li>Herzchirurgie im Haus erforderlich</li> <li>Herzchirurgie unmittelbar verfügbar</li> <li>Bevorzugt im HOP/OP mit Herzchirurgie</li> <li>Bevorzugt HVo-Zentrum</li> <li>Bevorzugt VN+TEE, ggf. tiefe AnSed</li> </ul>
<b>Sehr hohes Risiko (Gruppe D)</b>	<ul style="list-style-type: none"> <li>Elektrodenalter &gt;10 Jahre</li> <li>Implantation vor 30. Lebensjahr</li> <li>Elektroden im linken Atrium/Ventrikel</li> <li>Risiko-Elektroden: dual-coil ICD-Elektroden mit passiver Fixierung; externalisierte Sondenleiter; aktiv fixierte Koronarsinus-Elektroden</li> <li>Vegetationen &gt;2 cm mit Nachweis einer Rechtsherzinsuffizienz und/oder Lungenembolie</li> <li>Vorausgegangene Sternotomie(n)</li> </ul>	<ul style="list-style-type: none"> <li>Stylent</li> <li>Locking stylets</li> <li>Non-powered dilator sheaths</li> <li>Rotational mechanical sheaths</li> <li>Femoral/jugular snare tools</li> <li>Powered Laser sheath*</li> <li>Alle Extraktions-Zugangswege</li> </ul>	<ul style="list-style-type: none"> <li>Patienten mit schweren kardiovaskulären Begleiterkrankungen (hochgradig eingeschränkte LVEF; schwere Herz- oder Niereninsuffizienz; schwere Gerinnungsstörung) im kardiogenen/septischen Schock</li> <li>Linksventrikuläres Assist-Device</li> <li>EMAH-Patienten mit komplexer Anatomie ± operativer Korrektur</li> <li>Indikation zum TK-Ersatz bei präoperativ hochgradiger TI oder TK-Endokarditis</li> </ul>	<ul style="list-style-type: none"> <li>HOP, OP</li> <li>Herzchirurgie im Haus erforderlich</li> <li>Im HOP/OP mit Herzchirurgie (Ausnahme: Im HKL mit Herzchirurgie nur in sehr erfahrenen HVo-Zentren)</li> <li>Bevorzugt HVo-Zentren</li> <li>Bevorzugt VN+TEE, ggf. tiefe AnSed</li> </ul>

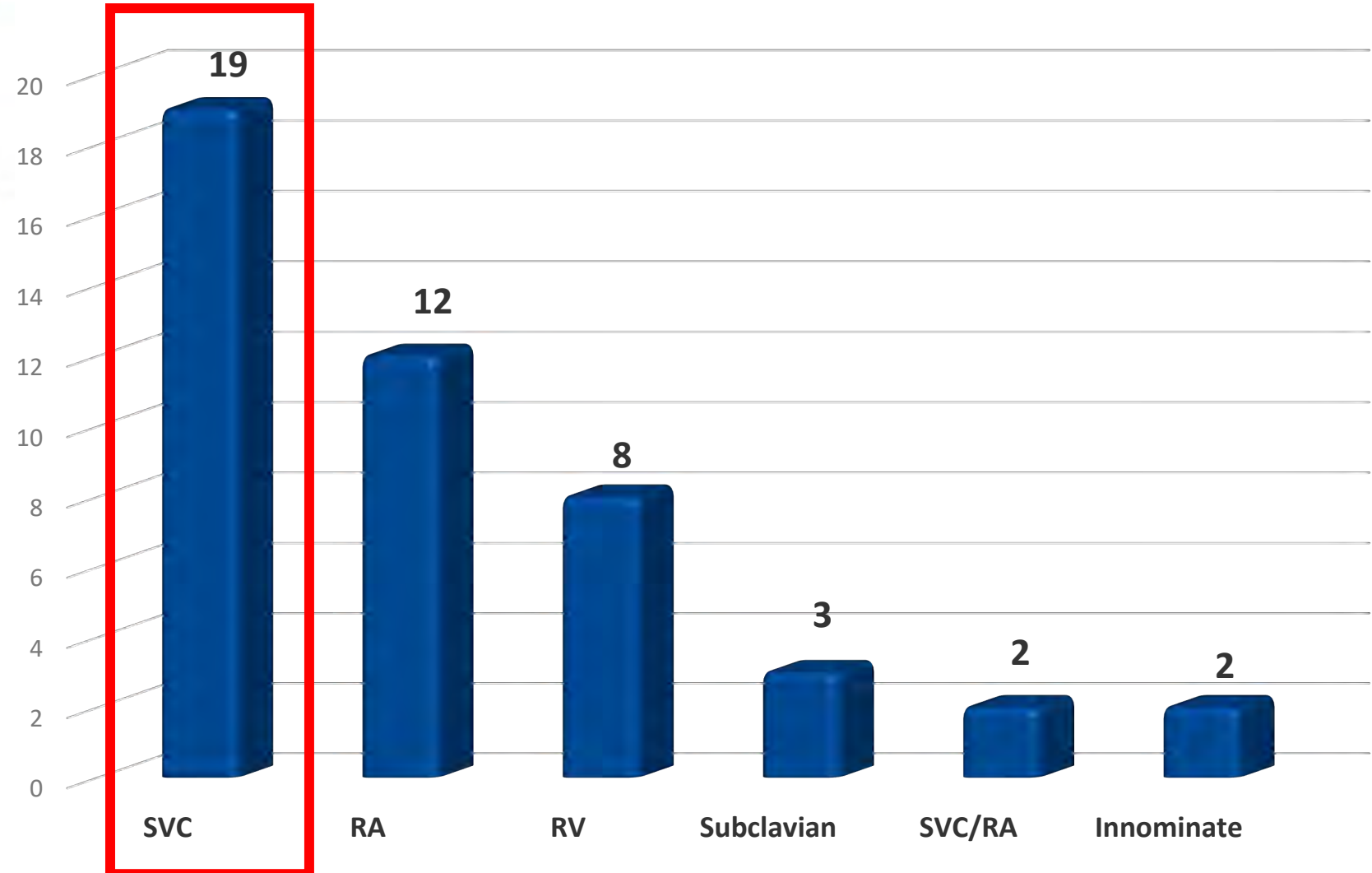


## The GermAn Laser Lead Extraction GallerY: GALLERY

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## Location of Vascular/cardiac tears (n=46)



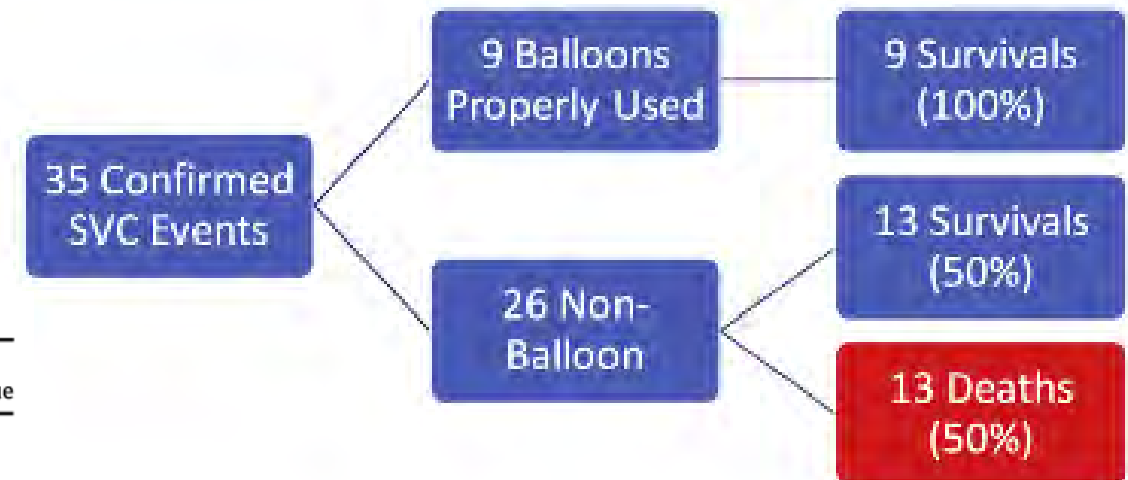
## Compliant endovascular balloon reduces the lethality of superior vena cava tears during transvenous lead extractions

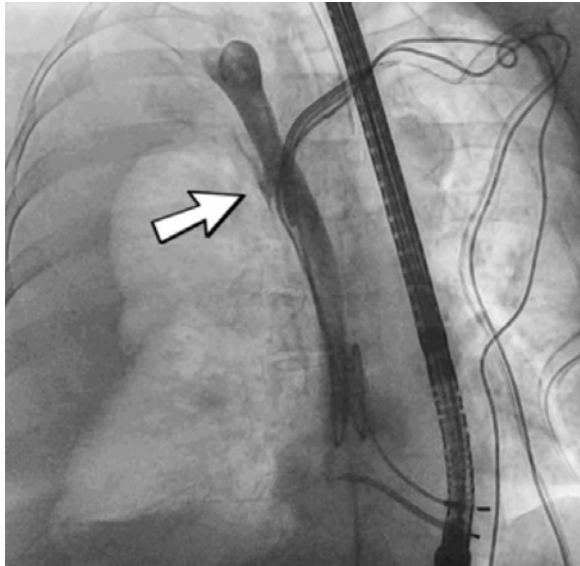
Ryan Azarrafiy, BA,<sup>\*</sup> Darren C. Tsang, BS,<sup>\*</sup> Thomas A. Boyle, BS,<sup>\*</sup>  
Bruce L. Wilkoff, MD, FHRS,<sup>†</sup> Roger G. Carrillo, MD, MBA, FHRS<sup>\*</sup>

From the <sup>\*</sup>Department of Surgery, Division of Cardiothoracic Surgery, University of Miami Miller School of Medicine, Miami, Florida, and <sup>†</sup>Department of Cardiovascular Medicine, Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, Cleveland, Ohio.

**Table 1** Patient demographics and outcomes

Characteristic	All SVC lacerations (n = 35)	Balloon cohort (n = 9)	No balloon or improper usage cohort (n = 26)	P value
Age, years	60.2 (± 14.5)	58.3 (± 13.5)	60.8 (± 14.6)	.323
Gender, female	19 (54.3)	7 (77.8)	12 (46.2)	.135
Device type	23 (65.7) ICD 11 (31.4) PPM 1 (2.9) CRTD	5 (55.6) ICD 4 (44.4) PPM 0 (0) CRTD	18 (69.2) ICD 7 (26.9) PPM 1 (4.4) CRTD	.686 .416 1.000
Indication for extraction	11 (33.3) infectious 22 (66.7) noninfectious 2 unavailable	3 (33.3) infectious 6 (66.7) noninfectious	8 (33.3) infectious 16 (66.7) noninfectious 2 unavailable	1.000 1.000
Extraction tools	34 (97.1) laser sheaths 1 (2.9) mechanical sheath	9 (100) laser sheaths	25 (96.2) laser sheaths 1 (3.8) mechanical sheath	1.000
Lead dwell time, years	9.62 (± 3.9)	10.6 (± 2.6)	9.3 (± 4.2)	.852
Discharged alive	22 (62.9)	9 (100)	13 (50.0)	.013





- Median lead age 96 months (16-360)
- 74% female patients
- None of the patients had prior cardiac surgery
- ICD leads 79%
- 9 out of 15 (60%) ICD patients had Dual Coil leads
- Sternotomy rate 100%
- CPB used in 84% of cases

**→ Survival rate 58%**



## Benefits of routine prophylactic femoral access during transvenous lead extraction

Da-Un Chung, MD,<sup>\*1</sup> Lisa Müller, BSc,<sup>†1</sup> Timm Ubben, MD,<sup>\*</sup> Yalin Yildirim, MD,<sup>†</sup> Johannes Petersen, MD,<sup>†</sup> Christoph Sinning, MD,<sup>‡</sup> Liesa Castro, MD,<sup>§</sup> Till Joscha Demal, MD,<sup>†</sup> Lukas Kaiser, MD,<sup>\*</sup> Nils Gosau, MD,<sup>\*</sup> Hermann Reichenspurner, MD, PhD,<sup>†</sup> Stephan Willems, MD,<sup>\*</sup> Simon Pecha, MD,<sup>†1</sup> Samer Hakmi, MD<sup>\*1</sup>

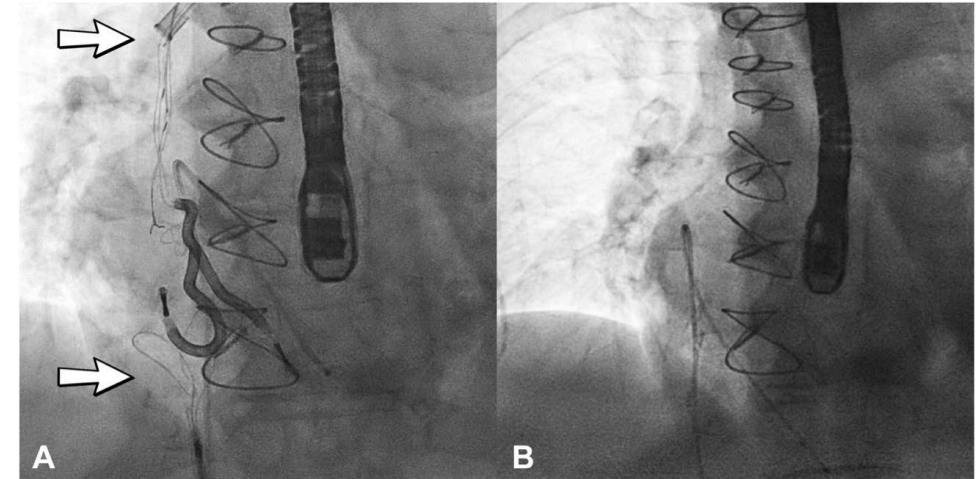
**Table 4** Actively engaged femoral sheaths (n = 26)

Emergency temporary pacing for sudden asystole	3 (11.5)
Snare for broken/damaged lead fragments	10 (38.5)
Diagnostic venography for lacerations	3 (11.5)
Balloon angioplasty for SVC stenosis/occlusion	3 (11.5)
Prophylactic balloon placement for high-risk TLE	6 (23.1)
MCS/ECMO for hemodynamic collapse	1 (3.9)

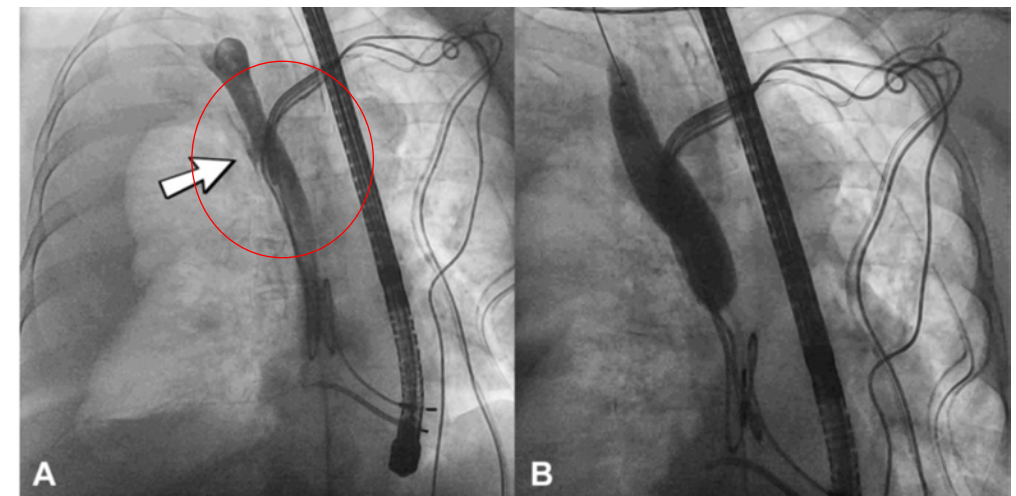
Values are given as n (%).

ECMO = extracorporeal membrane oxygenation; MCS = mechanical circulatory support; SVC = superior vena cava; TLE = transvenous lead extraction.

### • Femoral Snaring



- A) Venography confirming SVC Perforation
- B) Bridge Occlusion Balloon



- **Essential pre-op diagnostics:**  
Chest X-ray, TTE (TEE), PM interrogation, Venography (in complex cases),  
(CT in cases with suspected perforation)
- **Anticoagulation Management**  
No need for heparin bridging in pts. on anticoagulation (aim for low therapeutic INR)
- **Expect the unexpected:**  
Always have a Plan B (Different extraction tools, subclavian and femoral approach...)
- **Lead extraction is a Team approach**  
(Electrophysiologist, Cardiac Surgeon, OR Nurse, Cardiac Anesthesiologist)
- **Be prepared for complications**  
The essential step in complication management is excellent preoperative preparation



# Thank you for your attention !



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