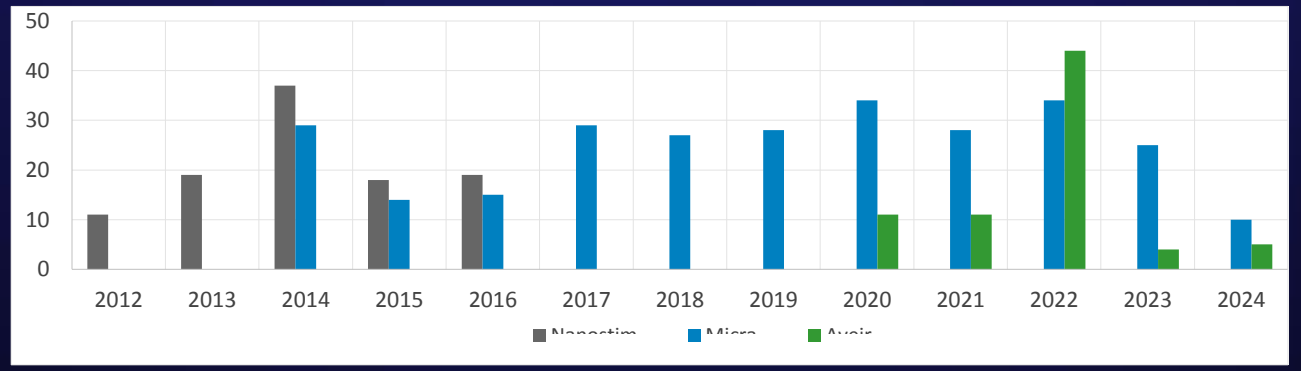
Trancatheter Retrieval of the Chronically Implanted Leadless Tines - based Pacemaker

Neužil P, Petrů J., Chovanec M.,Šedivá L.,Janotka M., Hála P., Chudiak B., Tousek M.,Funasako M.,Brada J., Mudroch M.,Mráček M.,Baroch J.

Kardiocentrum Nemocnice Na Homolce Praha

Leadless stimulace v NNH

	Leadless pacing v NNH: 2012 - 2024
Σ	**491** **Nanostim 104, Micra TPS 273(VR 249, AV 24), Aveir 113 (VR 35, AR 2, DR 2x38), Modular ATP(Empower) 1**
Věk	70,5 (20 – 92) let
Muži	311 (64%)
Úspěšnost	99%
Stimulační parametry	Stim.práh: < 1 V / 0,25- 0,4 ms Velikost vlny R: 4,6 – 20 mV
Jiná než VVI stim.	**8x (2 x leadless + WiCS, 6 x leadless + S-ICD)**
Komplikace	**0,8 % (4x dislokace)** **0,2 % revize třísla, infekce, 1x perforace**



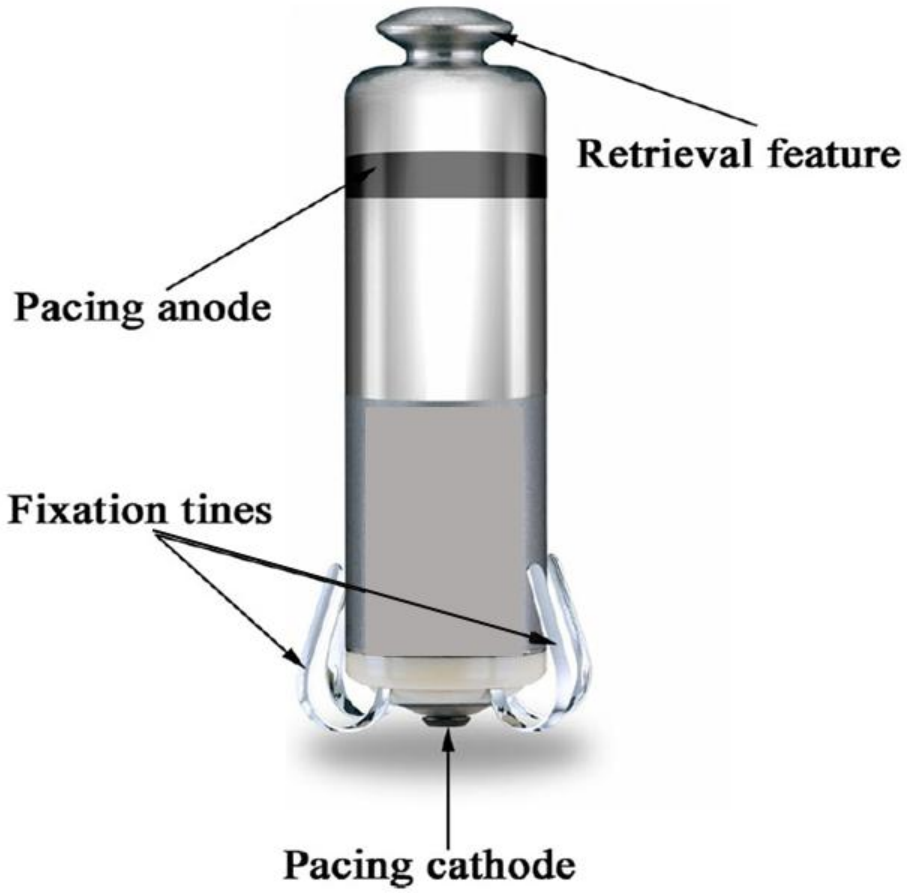
NNH: unikátní zkušenosti jednoho centra

	Leadless pacing v NNH: 2012 - 2023
Σ	**448** **Micra TPS 256, Micra AV 23, Nanostim 103, Aveir VR 28, Aveir DR 38**
Věk	**70,5 (20 – 90) let**
Muži	**235 (56,5%)**
Úspěšnost	**99%**
Stimulační parametry	**Stim.práh: < 1,5 V / 0,25ms Velikost vlny R: 8 – 20 mV**
Jiná než VVI stim.	**4x (2 x leadless + WiCS, 2 x leadless + S-ICD)**
Komplikace	**0,9% 4 dislokace** **0,2% 1 srdeční tamponáda** **0 % revize třísla, infekce, smrt**

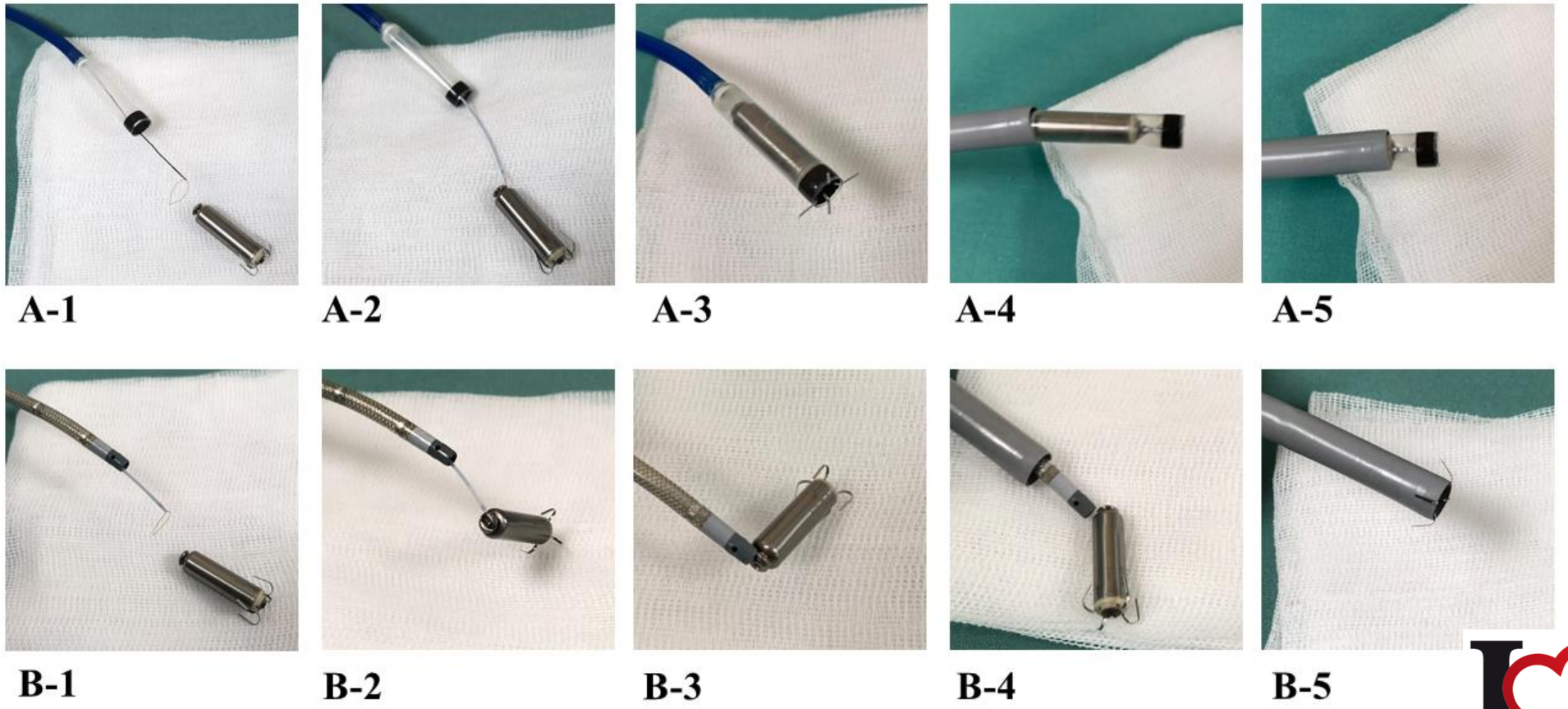
KardioCentrum

NA HOMOLCE HOSPITAL

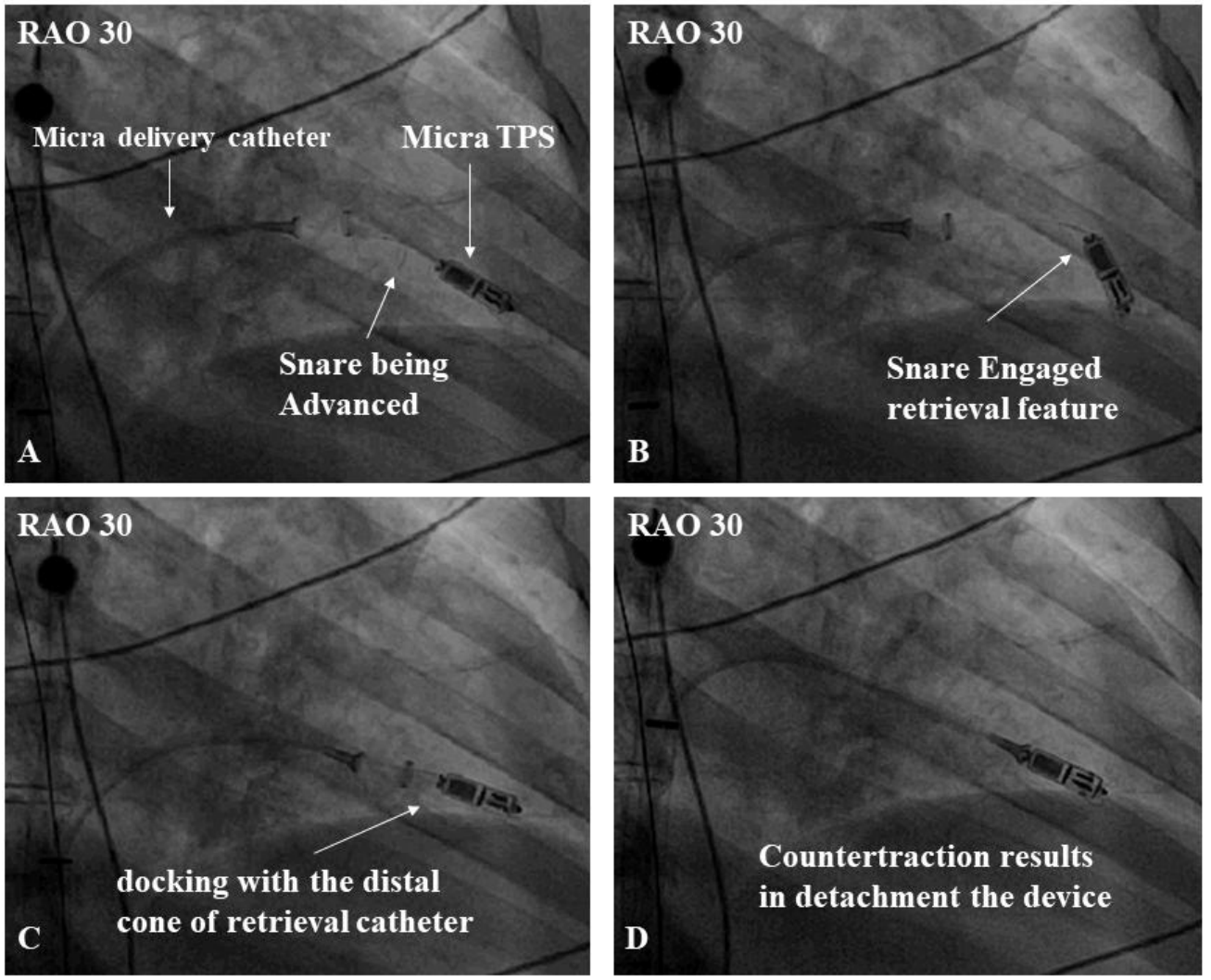
Princip adaptované Extrakce MICRA TPS



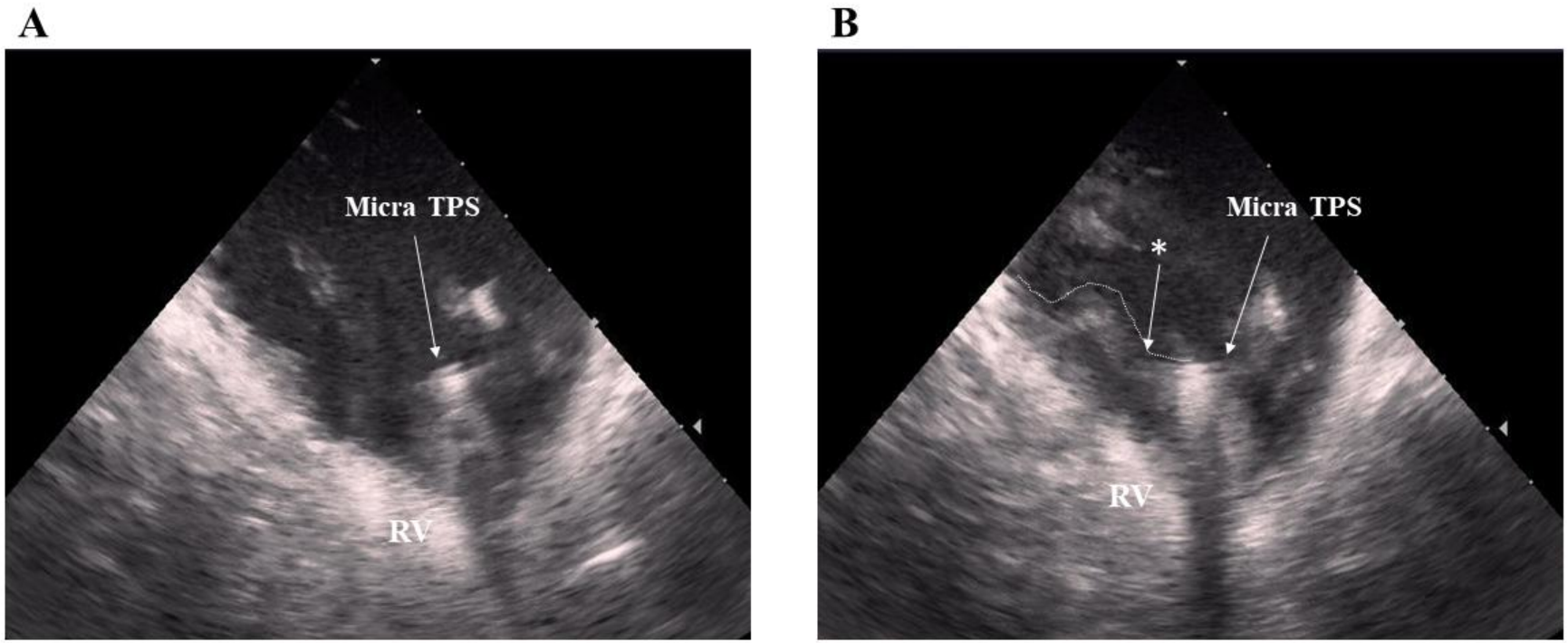
Princip adaptované Extrakce MICRA TPS



Princip adaptované Extrakce MICRA TPS



ICE monitorace Extrakce MICRA TPS



Minami K/Neuzil P et al: JACC Case Rep. 2020 Nov 18;2:2249-2252

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Case Presentation

1.st world MICRA TPS retrieval – battery failure

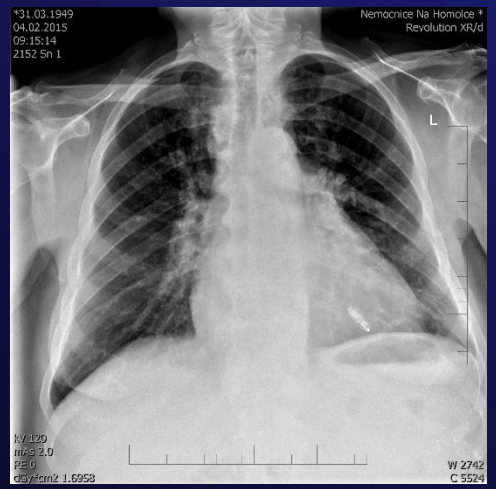
- 65 year old male
- Medical history:
  - Permanent Afib slow response , CHA_2DS_2 VASc score 4
  - TPS MICRA Medtronic implantation in February 2015
  - Arterial hypertension
  - Hyperlipidemia
  - Diabetes mellitus type 2
  - COPD, moderate PA hypertension, borderline RV diameter
  - Stroke (cardioembolic etiology) 2004 and 2014
  - St.p. polypectomy for adenoma of colon in 2011

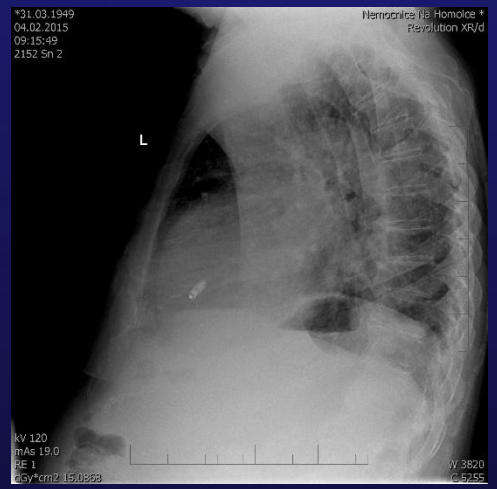
- Medications: warfarin, furosemid, kalium chloratum, ramipril, losartan, rosuvastatin, metformin, allopurinol

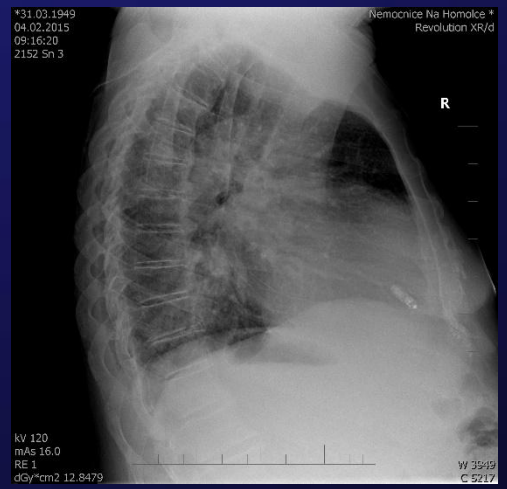
Case Presentation

1.st world MICRA TPS retrieval – battery failure

- TPS MICRA implanted February 3rd ,2015
- Difficult RV apex approach that required multiple repositions of the Micra device
- Next day follow up:
  - Increase of threshold (~3,5 V) with preserved sensing and impedance parameters
  - Transthoracic echocardiography and chest X-ray was performed with no sign of perforation or device displacement
  - Adequate energy output was set and prednison therapy was iniciated







- Patient discharged : early follow-up was scheduled in Pacemaker clinic

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Hospital na Homolce

Case Presentation

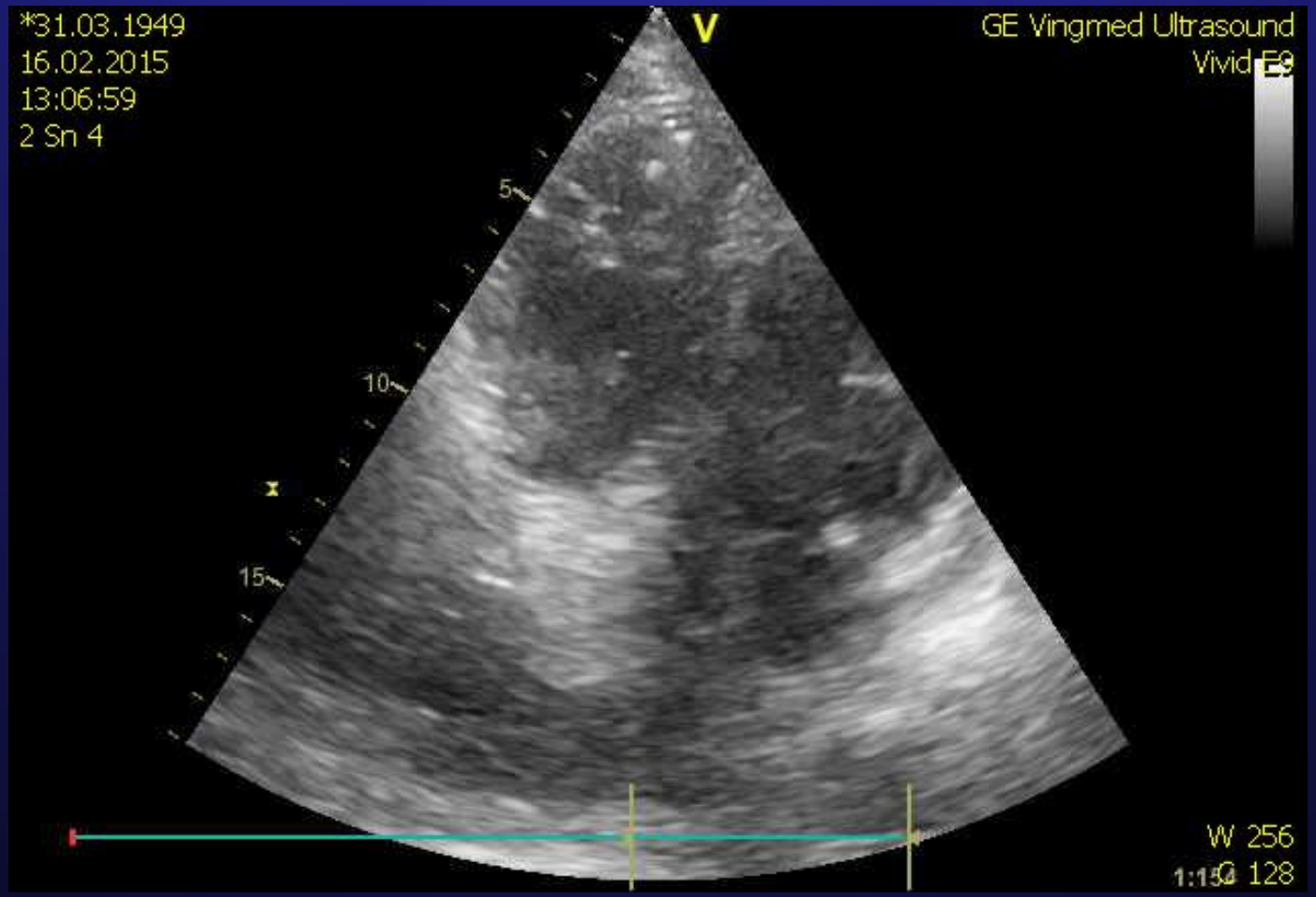
1.st world MICRA TPS retrieval – battery failure

- 1st month:
  - Patient still in good condition
  - Improvement of pacing treshold: 4,38-3,38V/0,24ms
  - RV capture management activation, output set on 5V
- 3rd month:
  - Mild worsening of patients conditions – lower extremities fatigue, initial swelling
  - Increasing of pacing treshold – no capture on 3,63V/0,24ms
  - RV capture management set off, pulse width set back on 1,0 ms with output of 5V → still irregular capture on lower rate → capture only in rate over 110/min
- 6th month:
  - General worsening with swelling, ascites
  - Pacing threshold still high
  - Intermittent capture 5,0 V/0,24 ms
  - Holter monitoring
- Follow-up in 9/2015 and 2/2016 (12 months)
  - No improvement loss of capture detected by ECG monitor, Battery capacity - ERI
  - Decision for TPS Micra retrieval: **March 15th ,2016**

KardioCentrum NA HOMOLCE HOSPITAL

Case Presentation

1.st world MICRA TPS retrieval – battery failure



Echocardiography focused on RV

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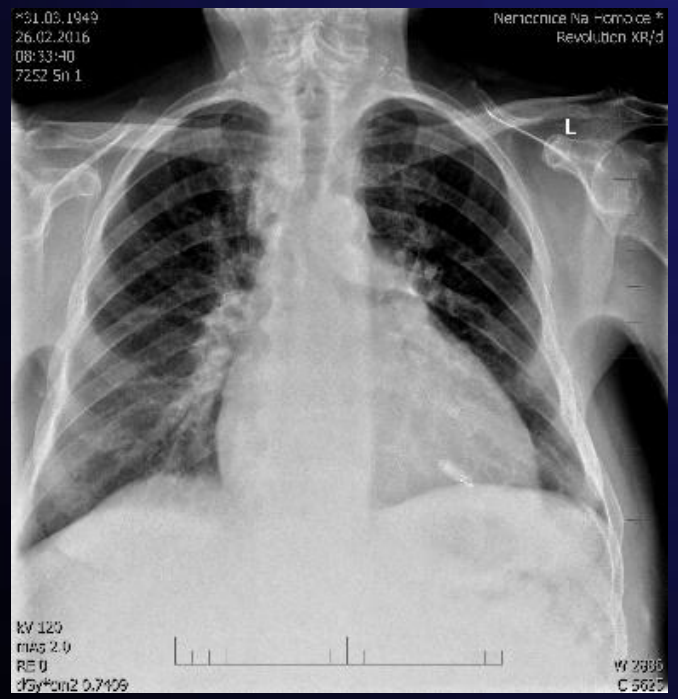
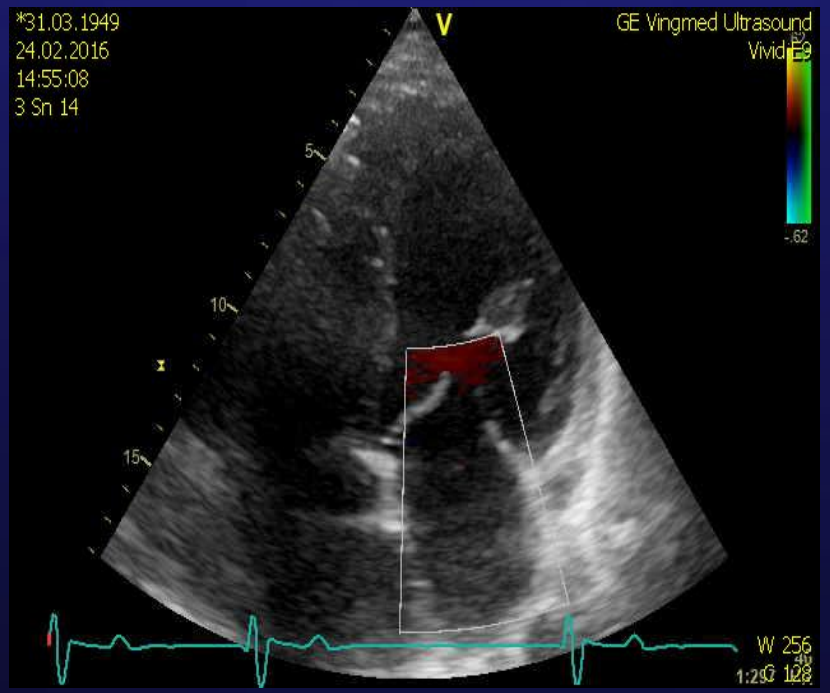
Case Presentation

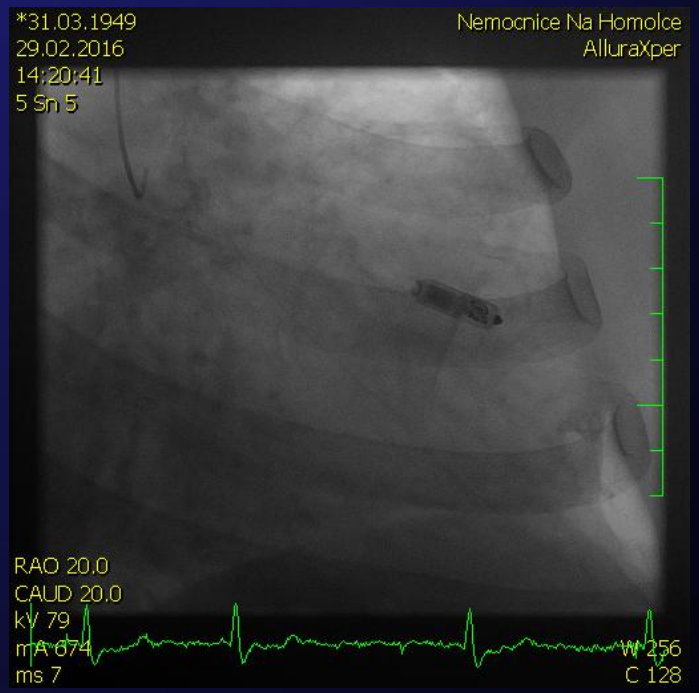
1.st world MICRA TPS retrieval – battery failure

TTE: Pulmonary hypertension with RV and RA dilation
No significant valve disease

CT AG and VP scan: Excluded pulmonary embolism
Coronary angio: Minimal atherosclerotic changes







Case Presentation

1.st world MICRA TPS retrieval – battery failure

Retrieval after 395 days

KARDIOCENTRUM

HOSPITAL NA HOMOLCE

Case Presentation

1.st world MICRA TPS retrieval – battery failure

Retrieval after 395 days

Minami K,Petrů J,Neuzil P J. Clinical Cardiol Cardiovascular Interv. 2021; 4(6); Doi:10.31579/2641-0419/138

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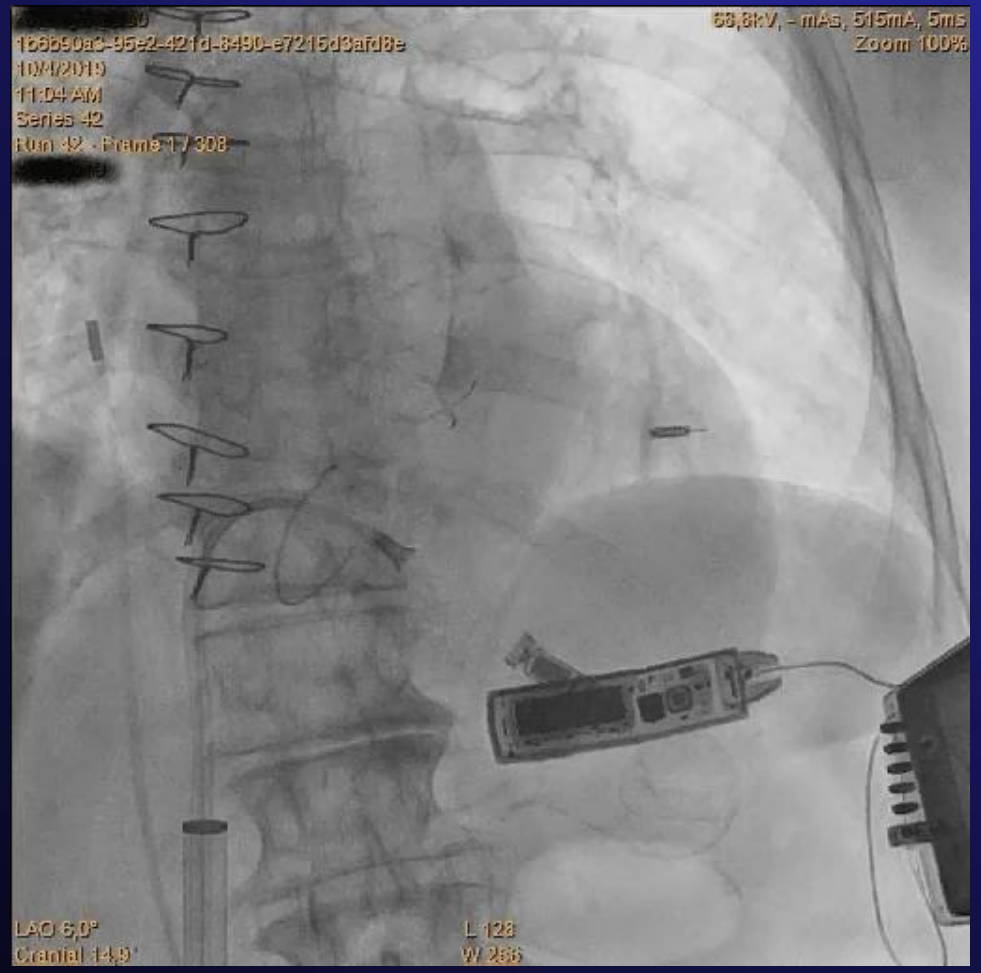
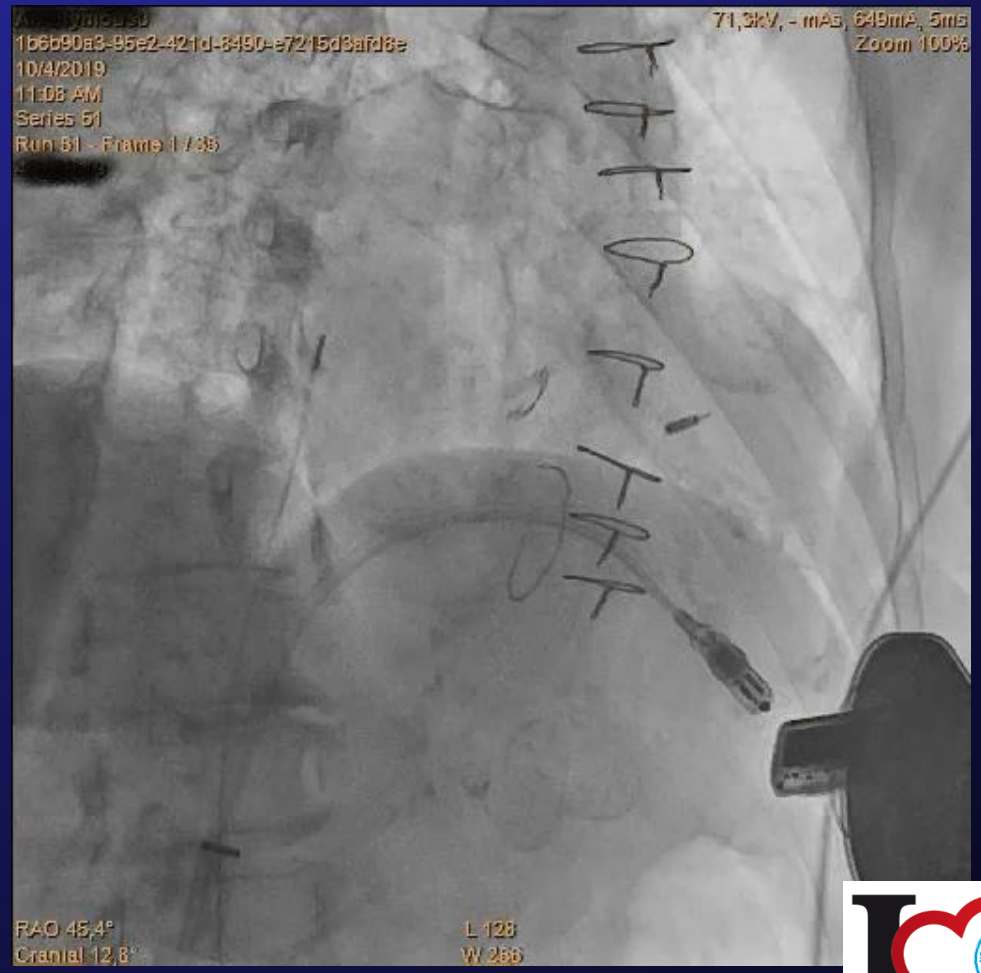
HOSPITAL NA HOMOLCE

Case Presentation

MICRA TPS retrieval in WICS CRT Patient





Minami K/Neuzil P et al: JACC Case Rep. 2020 Nov 18;2:2249-2252

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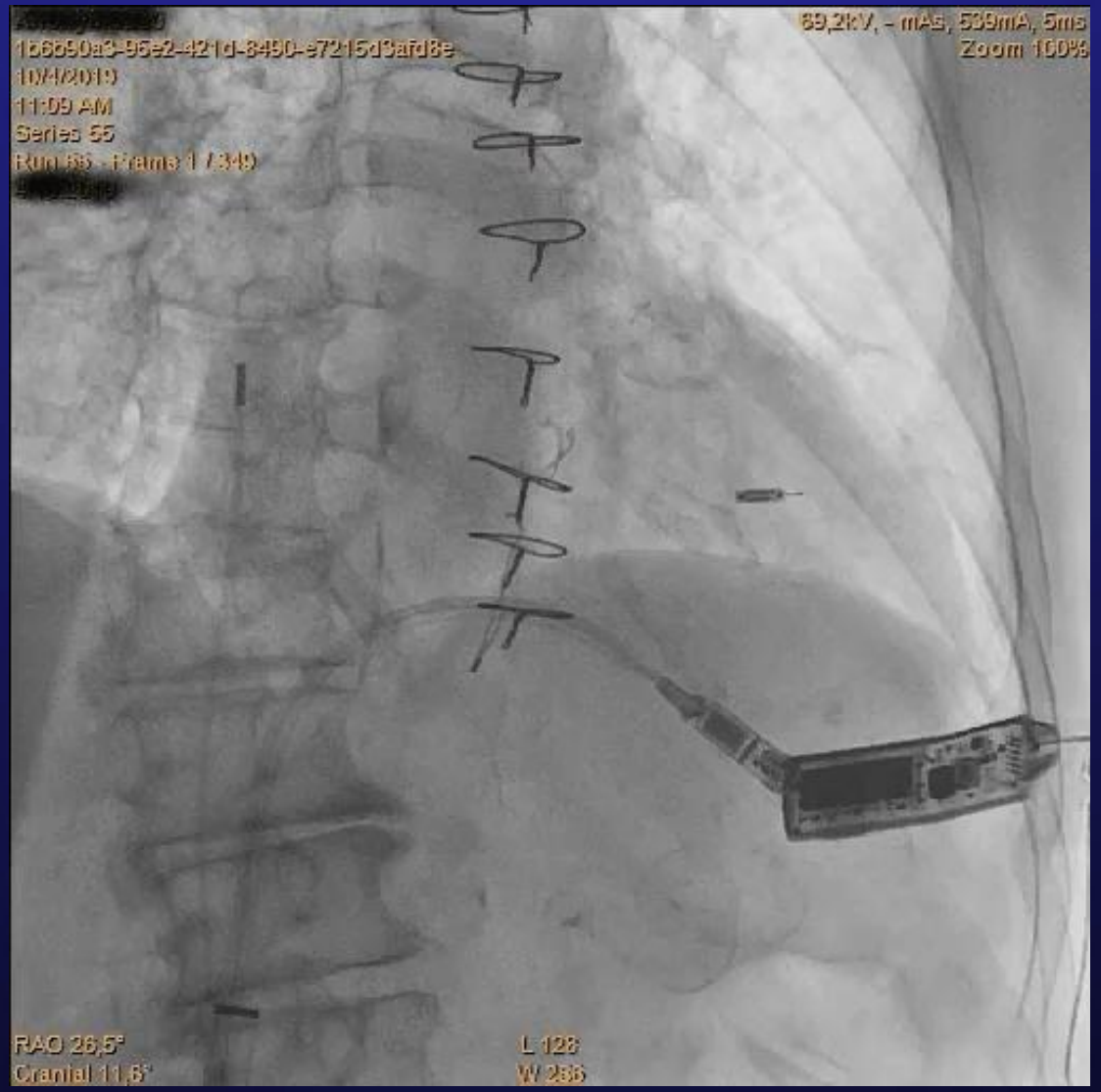
Case Presentation

MICRA TPS retrieval in WICS CRT Patient



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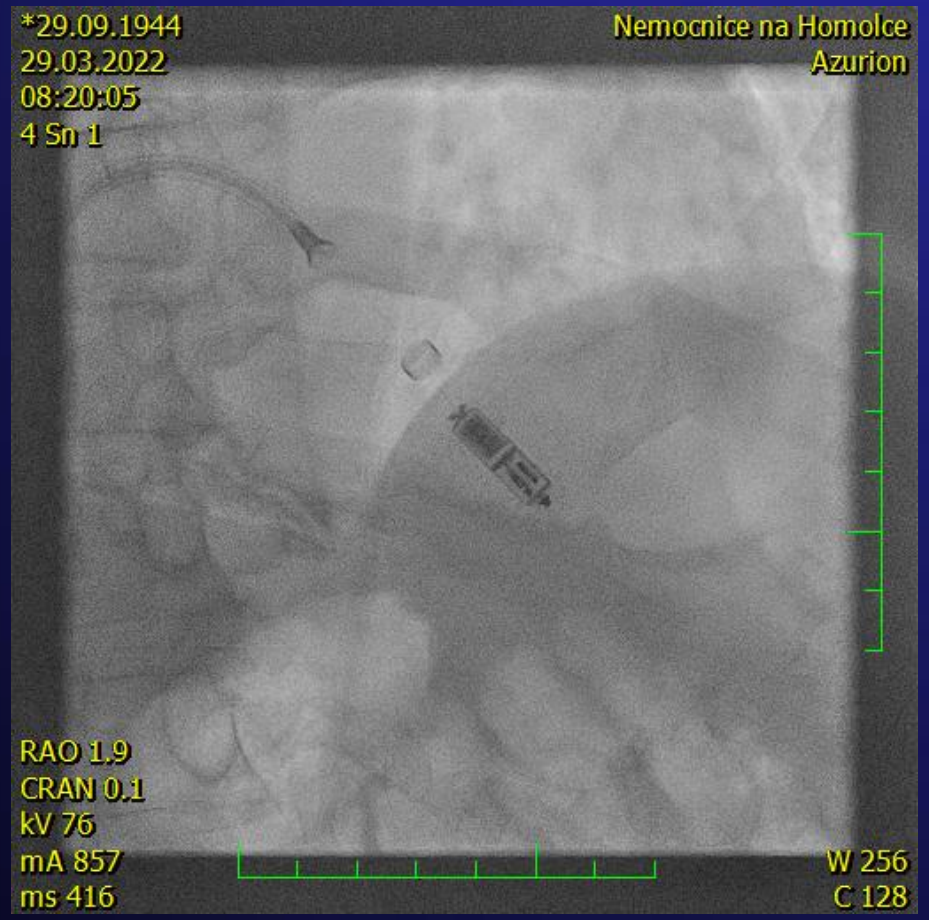
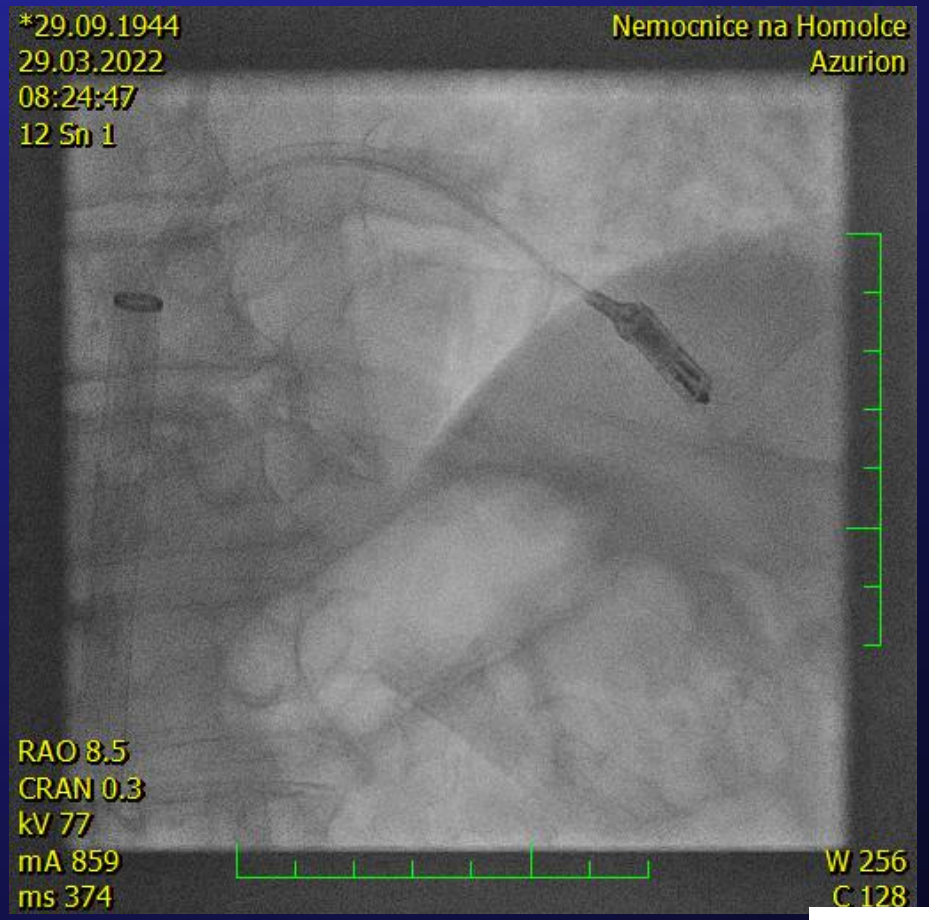
Extrakce MICRA TPS

~ 7 let po primoimplantaci





19.2.2014 implantace MICRA leadless KS

29.3.2022 extrakce a reimplantace nového leadless KS Micra VR

KardioCentrum

Nemocnice na Homolce Hospital

Extrakce MICRA TPS

~ 7 let po primoimplantaci

Delivery katetr se zavedenou kličkou – Ø 7 mm → kontratrakcí uvolnění kotev (10 min.)

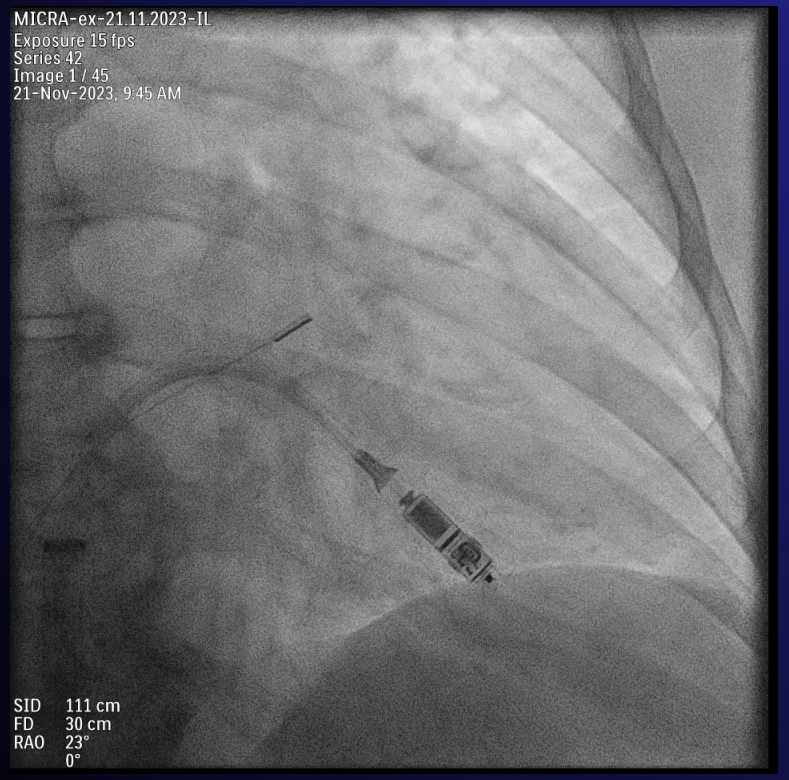
Nekomplikovaná re-implantace nového přístroje Micra VR - excelentní parametry

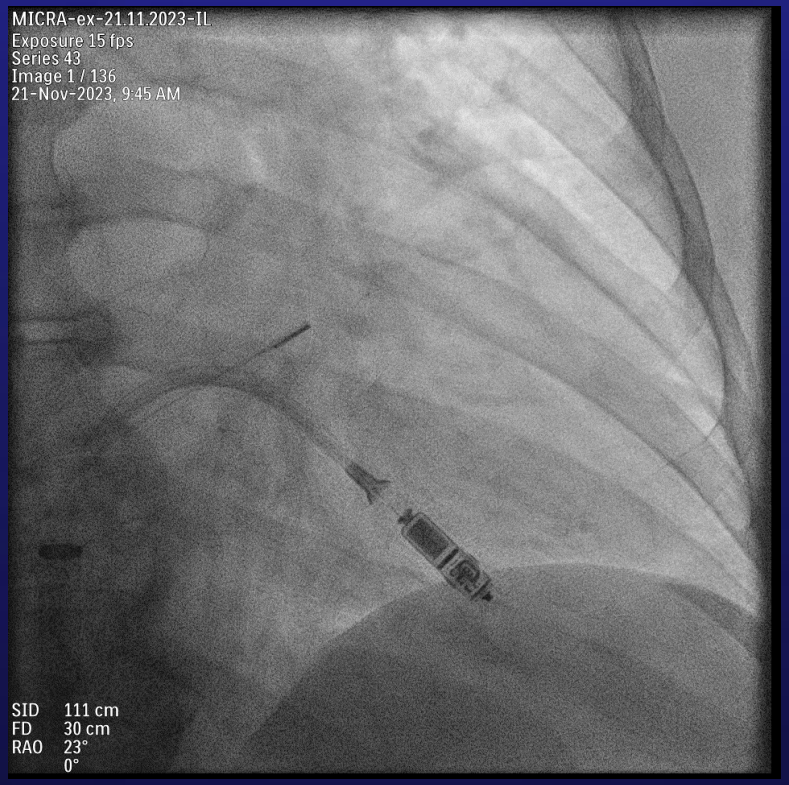
KardioCentrum

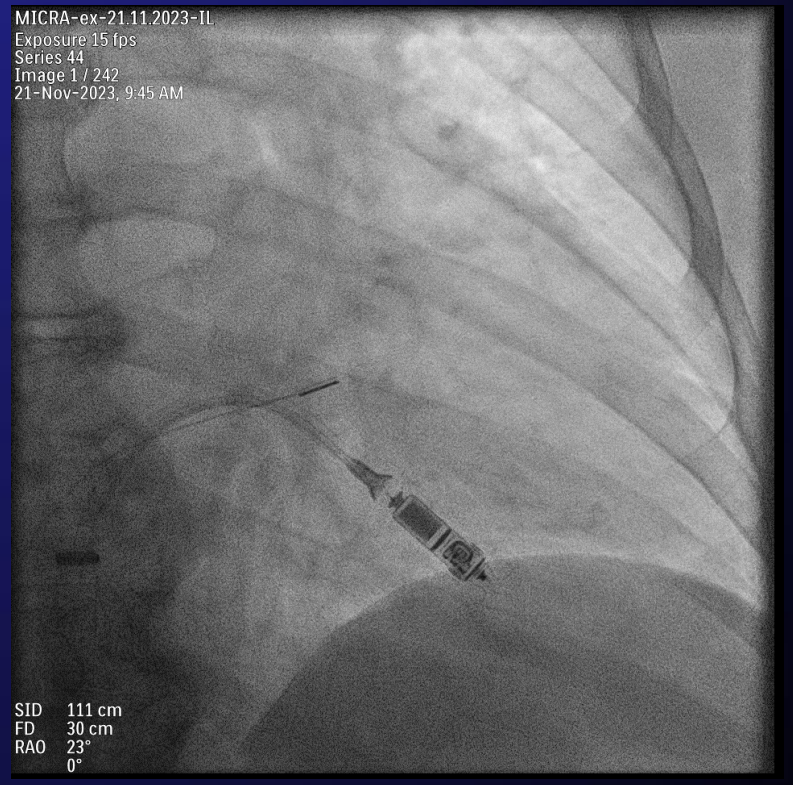
Nemocnice na Homolce Hospital

Extrakce MICRA TPS

~ 9 let po primoimplantaci







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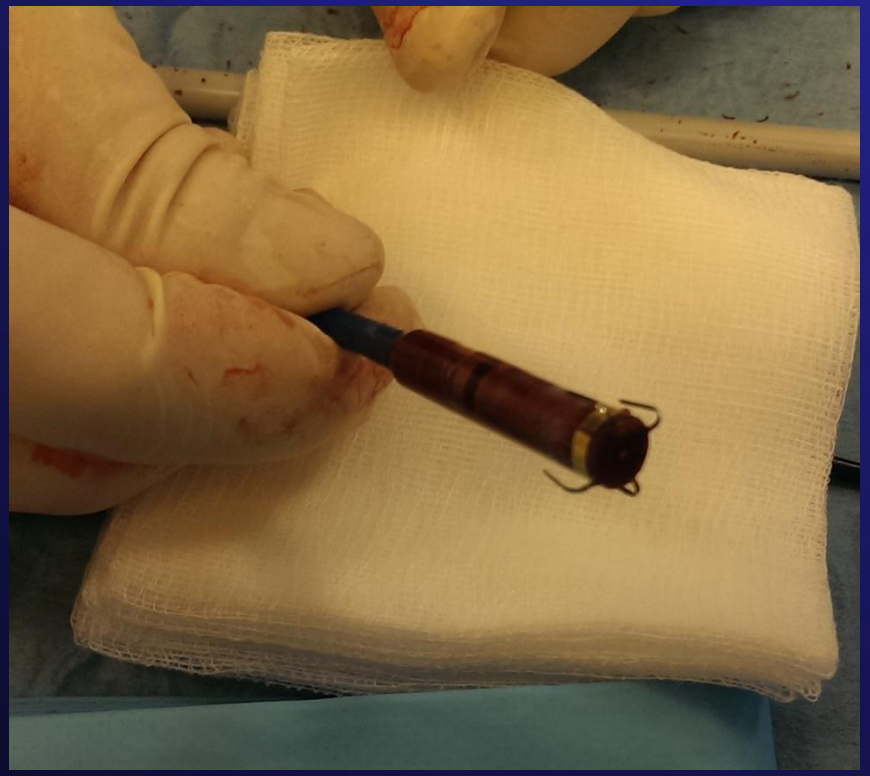
Extrakce MICRA TPS

~ 9 let po primoimplantaci



MICRA PO EXTRAKCI:

Minimální tkáňové srůsty kolem vlastní kapsle přístroje

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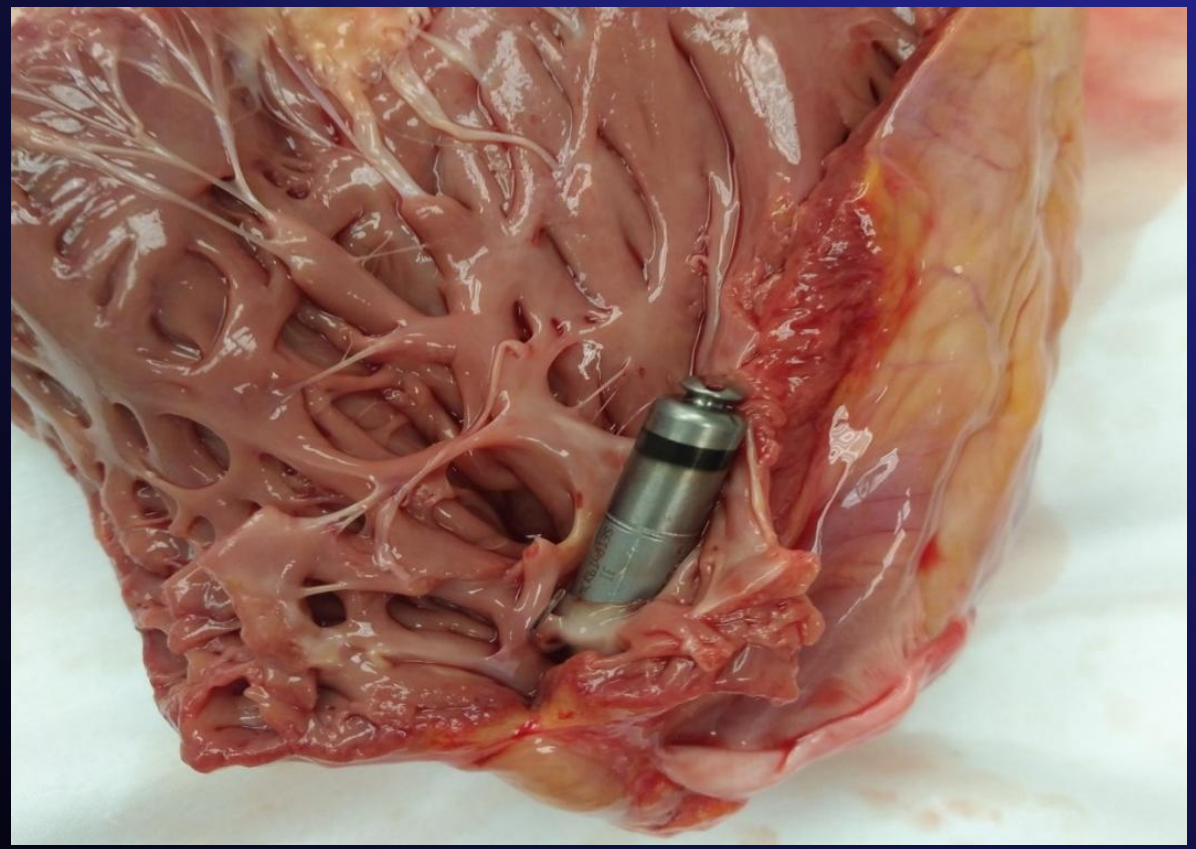
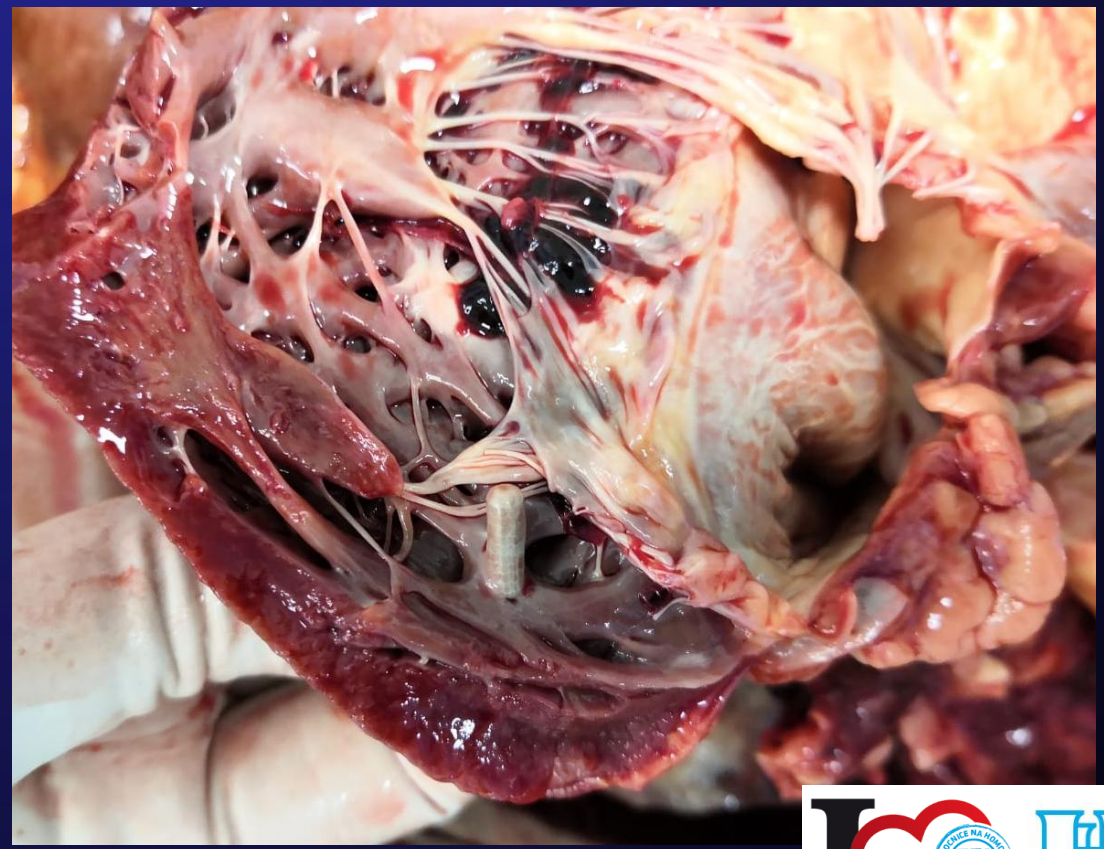
Hospital na Homolce

Autopsy of Micra TPS and WiSE

Both Devices 2 years after implantation





Extrakce Leadless Homolka

- Celkem byla extrakce provedena u **61 nemocných** s leadless stimulací
- **52 Nanostim LCP, 9 Micra TPS, 1 Aveir VR, 1 Aveir AR.**
- Průměrný věk nemocných byl **72,5± 17 let**
- Průměrná doba od implantace **1496 ± 482 dní**
- Úspěšnost extrakce LCP Nanostim (47/51 = **92%**)
- Úspěšnost extrakce Micra TPS (7/8 = **87,5**%)
- Oba dva Aveir VR/AR byly extrahovány po několika měsících..
- Nový system leadless KS byl implantován u většiny nemocných **(n 58 = 90%)** v jedné době po provedené extrakci.

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ÚSPĚŠNOST EXTRAKCE MICRA TPS

	VĚK (roky)	M/Ž	Doba od impl. (dny)	Čas skia (minuty)	ÚSPĚCH	Indikace	Reimpl.
1	82	M	280	37	ANO	BATERIE	MICRA
2	54	M	777	21	ANO	PM SYN.	DDD
3	66	Ž	406	13	ANO	< EF LK	CRT-D
4	46	M	287	49	NE	< EF LK	CRT-D
5	79	M	1219	15	ANO	BATERIE	MICRA
6	49	Ž	360	12	ANO	PM SYN.	DDD
7	36	Ž	2959	6	ANO	BATERIE	MICRA
8	62	M	956	14	ANO	< EF LK	CRT-P
Ø	59±15		905,5±426	39,3± 12			

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ZÁVĚRY

- Extrakce dlouhodobě implantovaného systému leadless MICRA TPS je schůdná a bezpečná i při adaptovaném použití „of label“ systému, který není původně určen k provádění extrakce
- Reimplantace nového MICRA TPS leadless kardiostimulátoru je efektivní
- Naše vlastní zkušenosti vedou ke zdokonalení techniky námi metodiky extrakce
- Extrakce MICRA TPS by měla být z klinického pohledu zvažována a je otázkou, zda má být zahájen vývoj nové metody extrakce

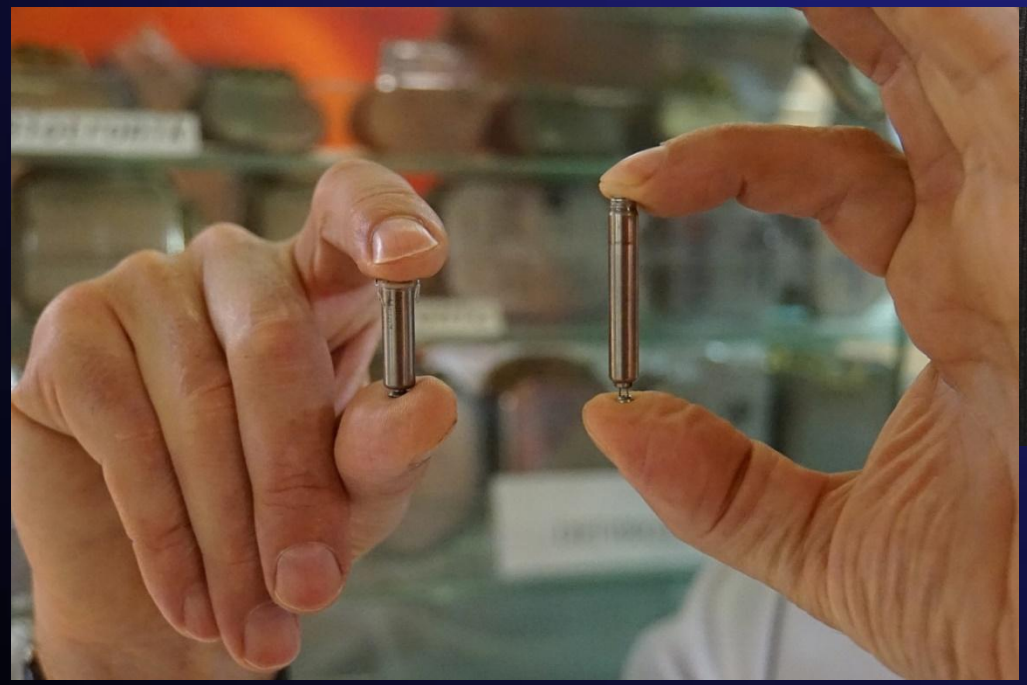
KARDIOCENTRUM NA HOMOLCE HOSPITAL

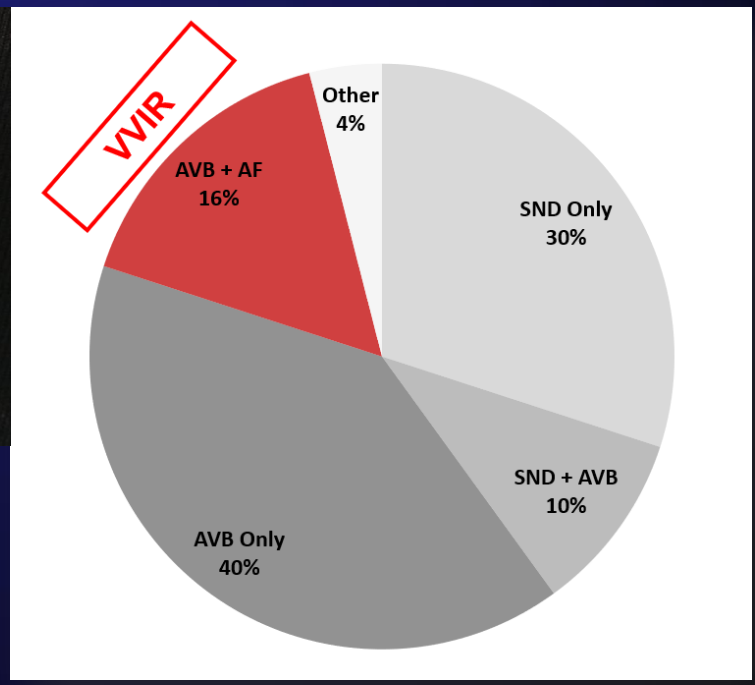
Konflikt zájmů

- Konzultant & podpora výzkumného grantu:

  - Abbott Inc.
  - Medtronic Inc.
  - EBR Inc.
  - Boston Scientific Inc.
  - Cairdac Inc.

10 LET PO PRVNÍ IMPLANTACI
NENÍ
LEADLESS KARDIOSTIMULACE
SVÉBYTNOU PLATFORMOU





Reddy V/Knops R/Sperzel J/Neuzil P Circul 2014 129;1466-71

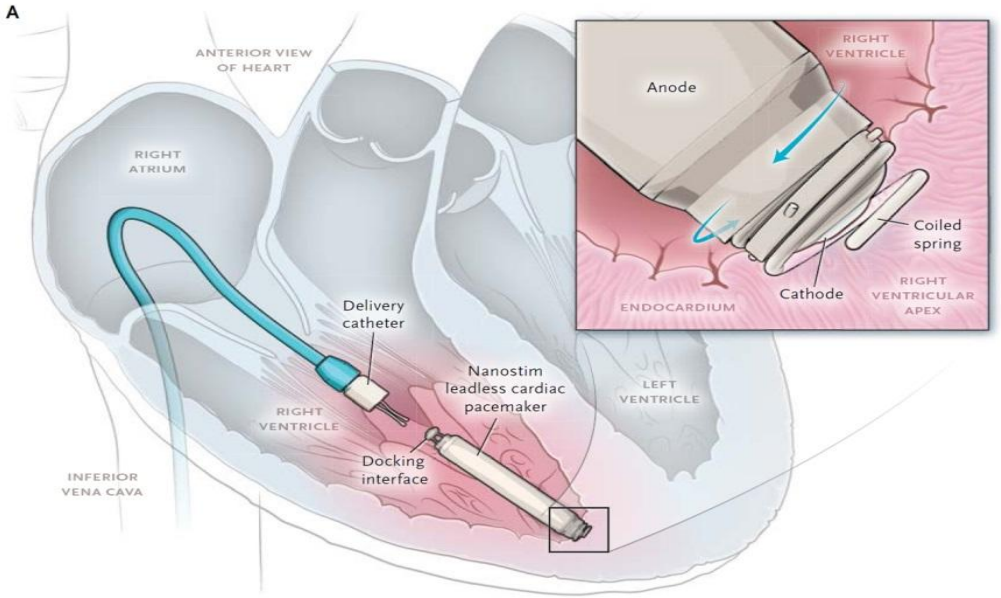
„LEADLESS"_EVIDENCE BASED MEDICINE

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Percutaneous Implantation of an Entirely Intracardiac Leadless Pacemaker

Vivek Y. Reddy, M.D., Derek V. Exner, M.D., M.P.H., Daniel J. Cantillon, M.D., Rahul Doshi, M.D., T. Jared Bunch, M.D., Gery F. Tomassoni, M.D., Paul A. Friedman, M.D., N.A. Mark Estes, III, M.D., John Ip, M.D., Imran Niazi, M.D., Kenneth Plunkitt, M.D., Rajesh Banker, M.D., James Porterfield, M.D., James E. Ip, M.D., and Srinivas R. Dukkipati, M.D., for the LEADLESS II Study Investigators*



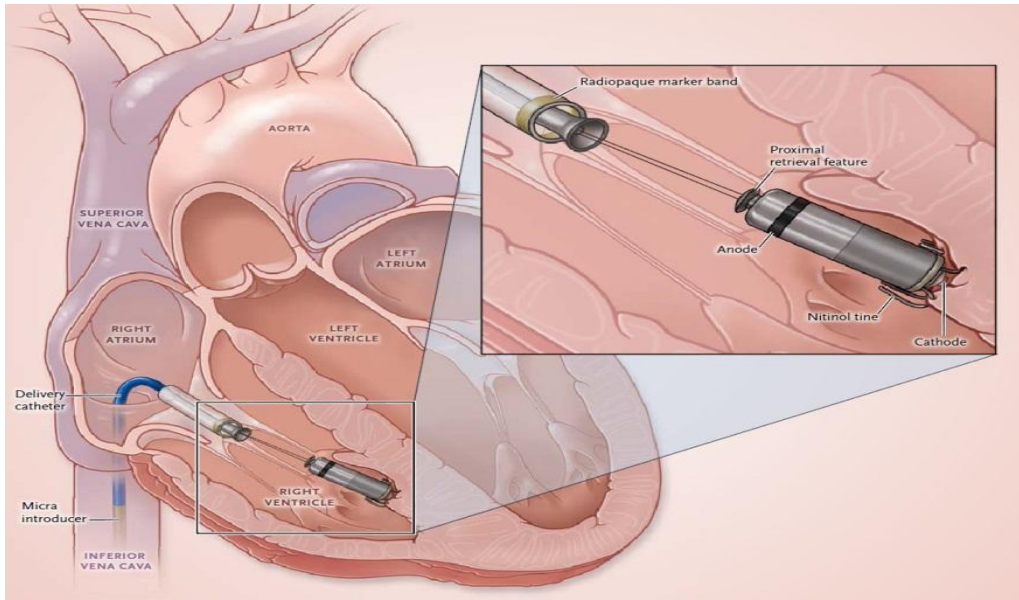
Reddy VY et al: NEJM 2015, Sept 17, 373: 1127.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Leadless Intracardiac Transcatheter Pacing System

Dwight Reynolds, M.D., Gabor Z. Duray, M.D., Ph.D., Razali Omar, M.D., Kyoko Soejima, M.D., Petr Neuzil, M.D., Shu Zhang, M.D., Calambur Narasimhan, M.D., Clemens Steinwender, M.D., Josep Brugada, M.D., Ph.D., Michael Lloyd, M.D., Paul R. Roberts, M.D., Venkata Sagi, M.D., John Hummel, M.D., Maria Grazia Bongiorni, M.D., Reinoud E. Knops, M.D., Christopher R. Ellis, M.D., Charles C. Gornick, M.D., Matthew A. Bernabei, M.D., Verla Laager, M.A., Kurt Stromberg, M.S., Eric R. Williams, B.S., J. Harrison Hudnall, B.S., and Philippe Ritter, M.D., for the Micra Transcatheter Pacing Study Group*



Reynolds D et al: NEJM 2016, Feb 11 : 535.

Hlavní výzvy „leadless“ technologie

- Fixation Technology
  - Superior holding force
- Increased electronic packaging density
- Novel power sources
- Ultra low power circuitry
- Electrode-tissue interface; low, stable pacing thresholds
- VVIRw/Hysteresis
- Inherently MRI compatible

- Communication systems:
  - Inter-device (intrabody)
- Atrial Component for DDD:
  - Fixation and stability
- Catheter based acute/chronic retrieval
- Additional chambers
  - Leadless PM for LV
- Integrated S-ICD/Leadless system for pacing and ATP

KardioCentrum

Hospital na Homolce

Nemocnice Na Homolce: zkušenosti jednoho centra

	Leadless pacing v NNH: 2012 - 2021
Σ	**448** **Micra TPS 256, Micra AV 23, Nanostim 103, Aveir VR 28, Aveir DR 38**
Věk	70,5 (20 – 90) let
Muži	235 (56,5%)
Úspěšnost	99%
Stimulační parametry	Stim.práh: < 1,5 V / 0,25ms Velikost vlny R: 8 – 20 mV
Jiná než VVI stim.	**4x (2 x leadless + WiCS, 2 x leadless + S-ICD)**
Komplikace	**0,9% 4 dislokace** **0,2% 1 srdeční tamponáda** **0 % revize třísla, infekce, smrt**

KardioCentrum

Hospital na Homolce

Kazuistika

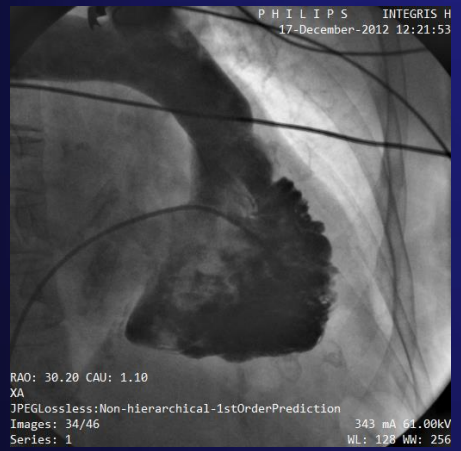
- 84 letá žena, BMI 21.6, long-standing perzistentní FiS (CHA2DS2-VASc 4), antikoagulace Pradaxa (2 x 150 mg)

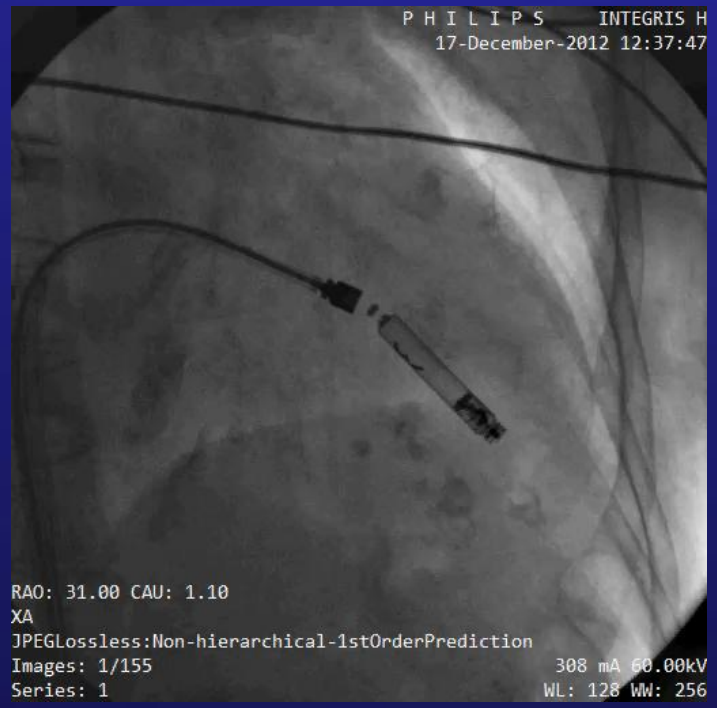
- Nanostim LCP (St Jude Medical Inc) implantace: Prosinec 17,2012, s optimálními elektrickými parametry.
  Stabilní během kontrol až do listopadu 2021, kdy nebylo možné LCP načíst – indikace : status baterie EOL.

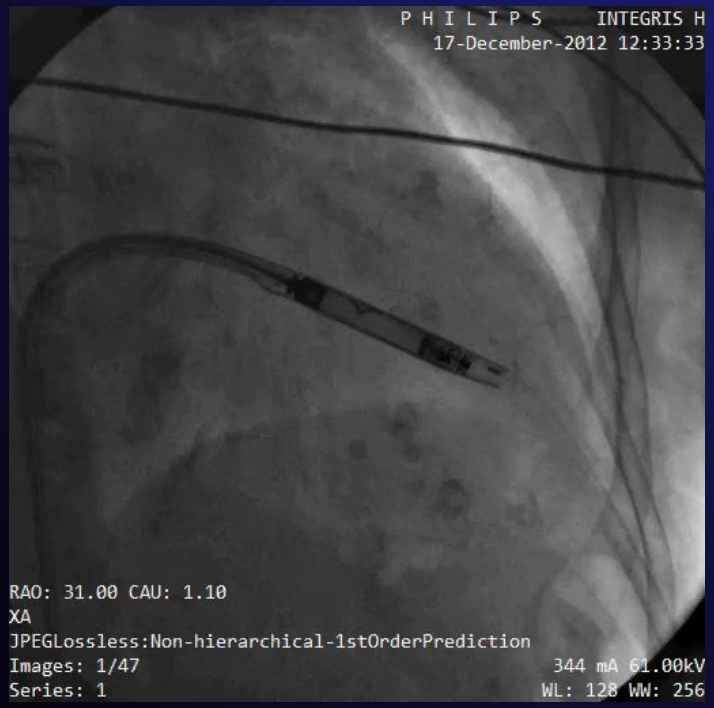
- Po měsíci od poslední kontroly byla přijata k provedení extrakce LCP.
  Kontrolní RTG skiaskopie zachovaný pohyb implantovaného LCP: „swinging movement“ fenomén predikce úspěšné extrakce

Kazuistika

Implantace Nanostim LCP 17.12.2012





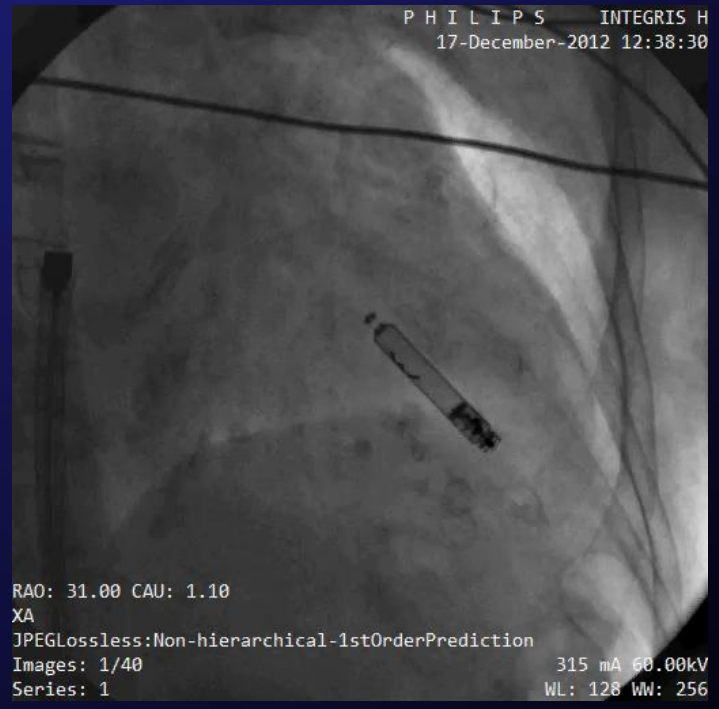


Akutní stim. práh 0.5 V @ 0.4ms

Impedance 500 Ohm

Amplituda R vlny 7.5 mV

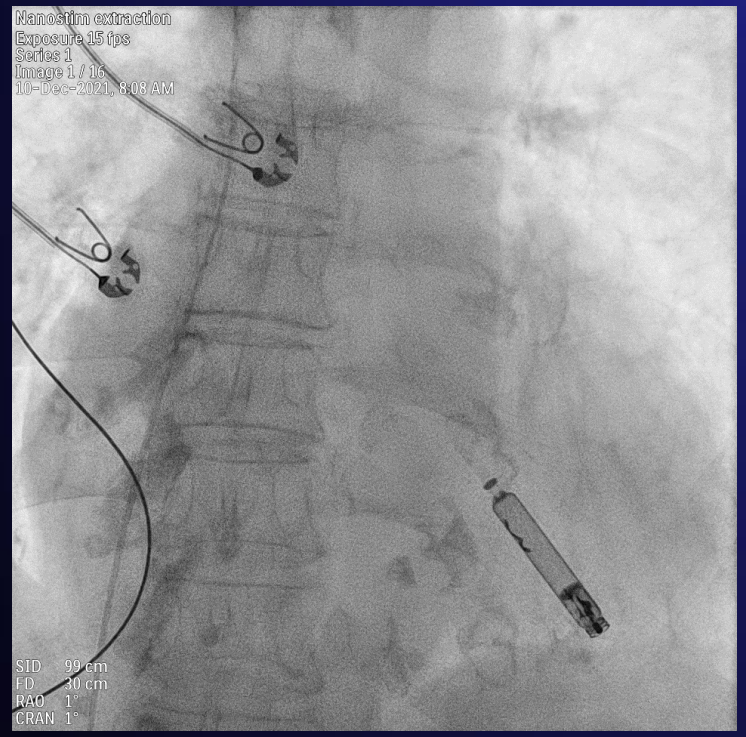
Bez komplikací

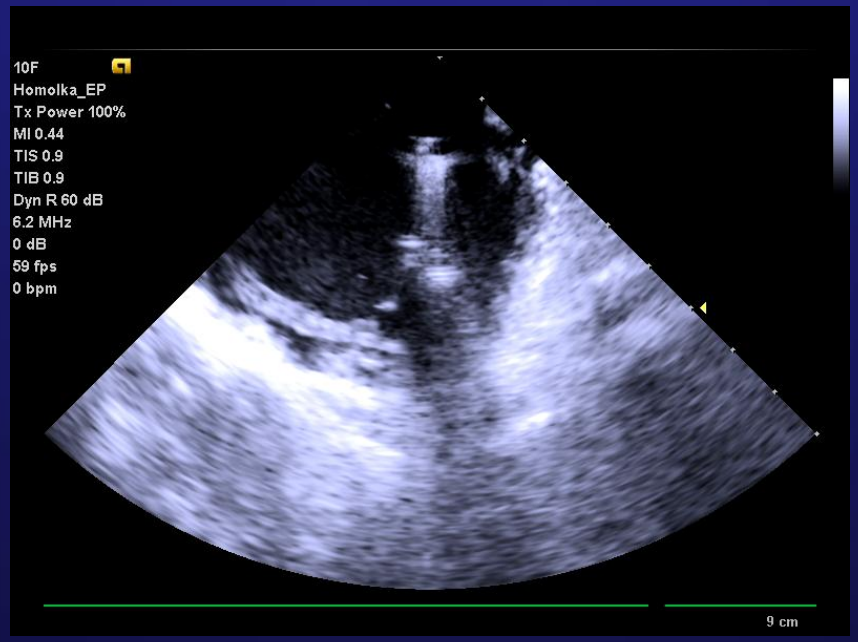


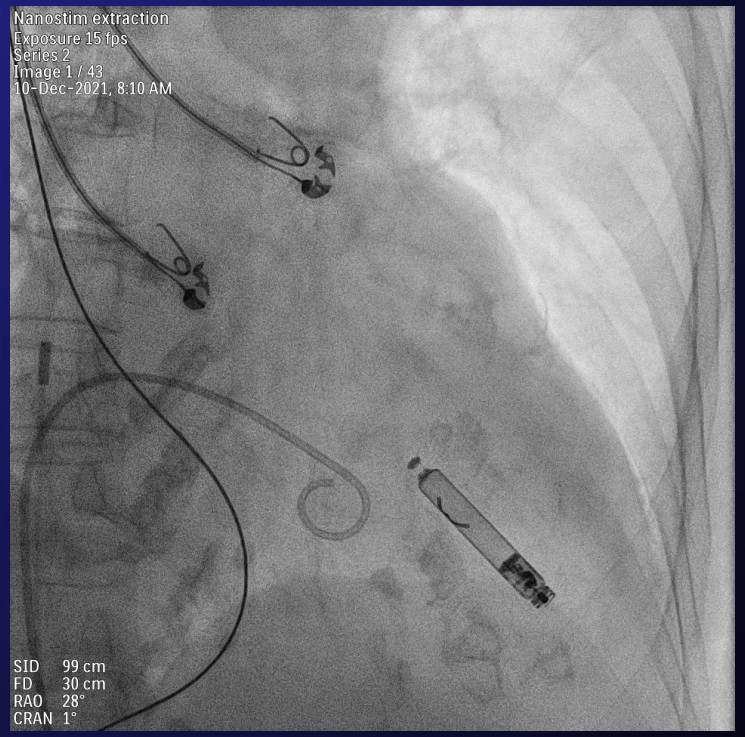
Kazuistika

Extrakce Nanostim LCP 10.12.2021

10.12.2021, 08:08





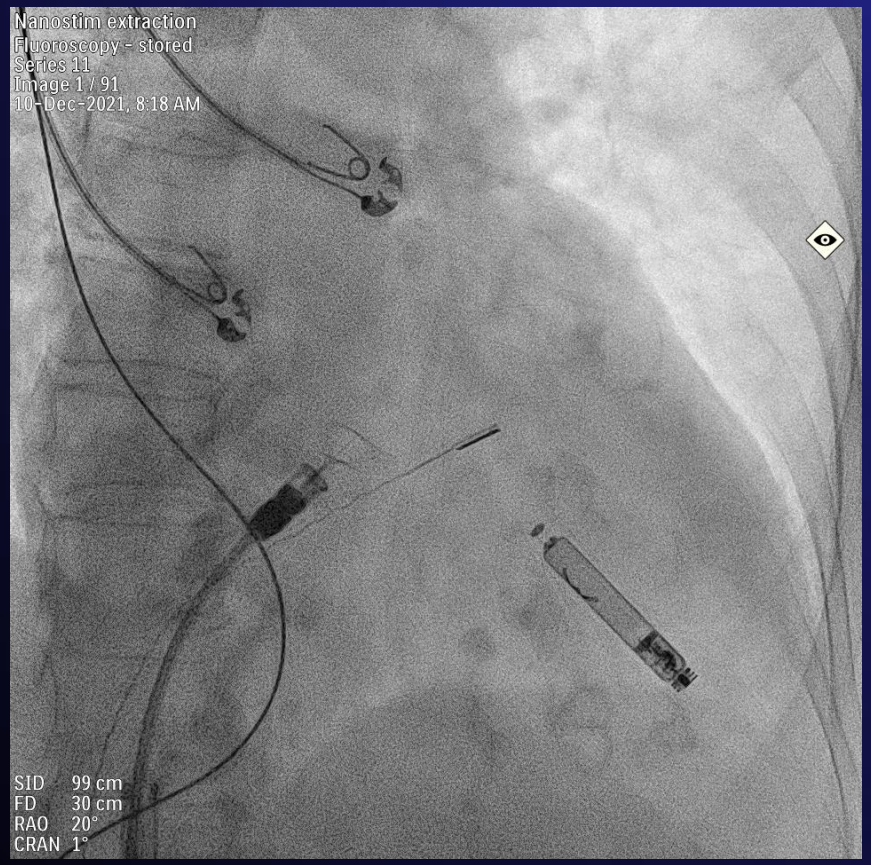


„Swinging „LP pohyb indikuje dobrou predikci úspěšná extrakce Nanostim LCP , aplikace kontrastní látky prakticky vylučuje adheze s okolní tkání

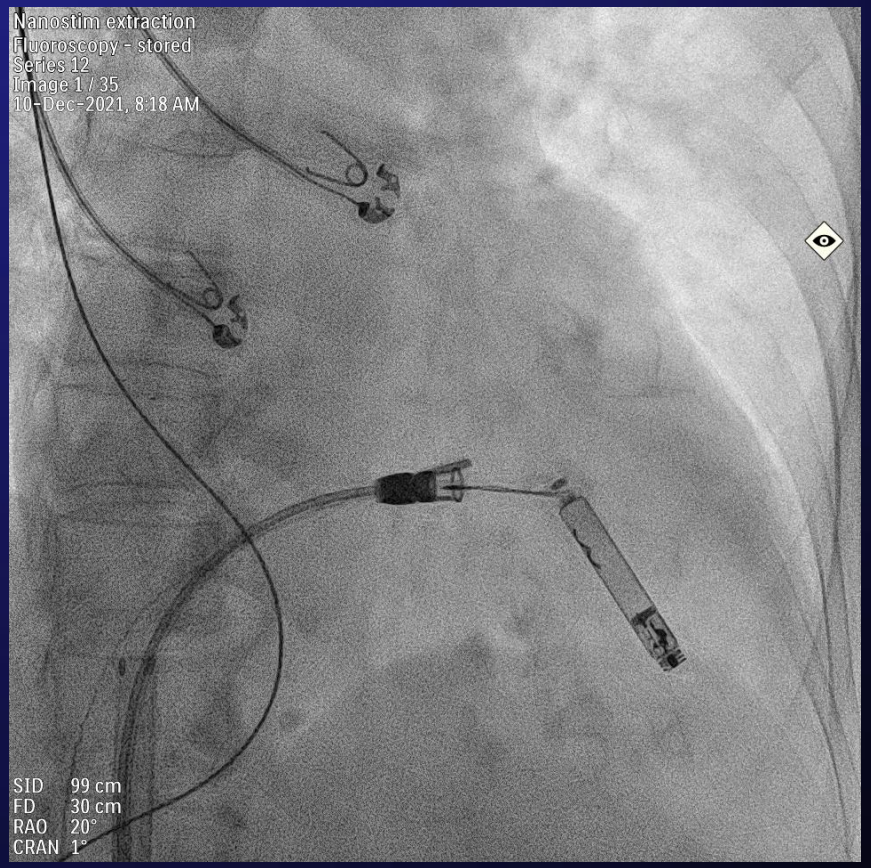
Kazuistika

Extrakce Nanostim LCP 10.12.2021

Tri-Loop High Torque retrieval katetr
CAPTURE 10.12.2021, 08:18



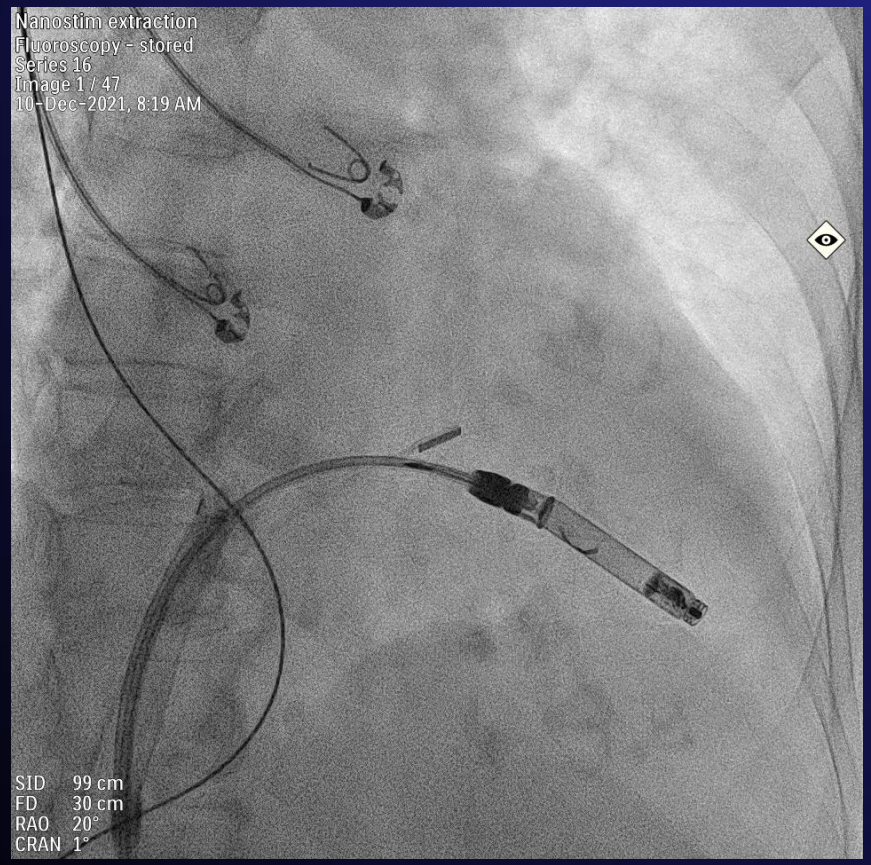
Tri-Loop High Torque retrieval katetr
DOCKING 10.12.2021, 08:18



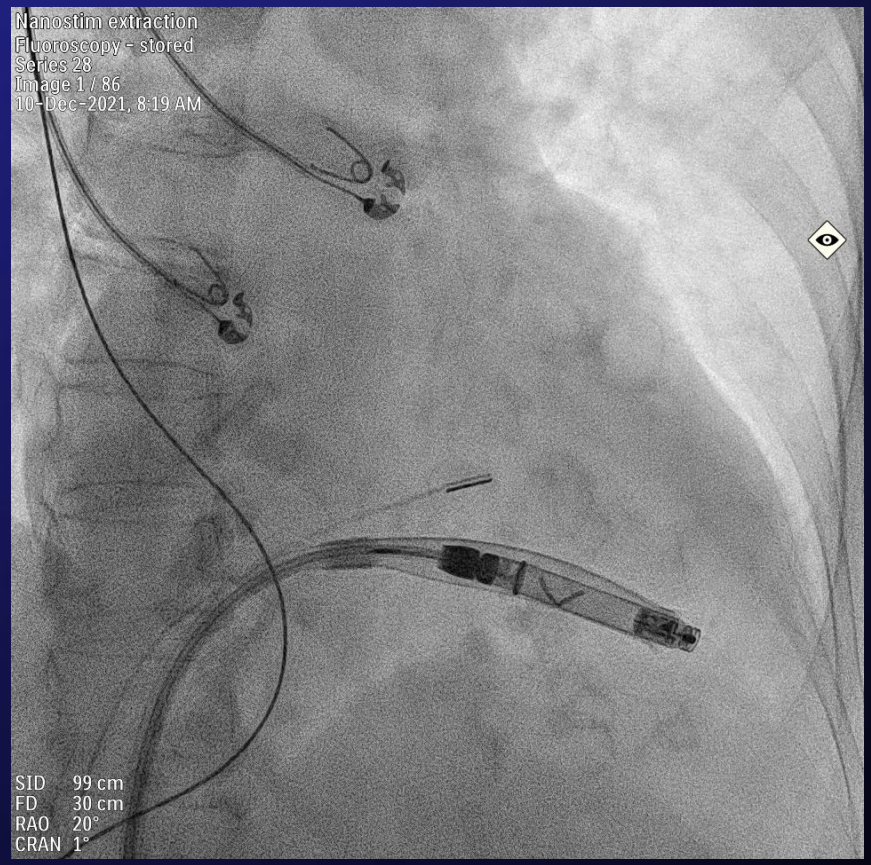
Kazuistika

Extrakce Nanostim LCP 10.12.2021

„Sleeve“ volný průchod
OVER LCP 10.12.2021, 08:19



Rotace a uvolnění Nanostim LCP
10.12.2021, 08:19



Kazuistika

Extrakce Nanostim LCP 10.12.2021

After Nanostim LCP retrieval:

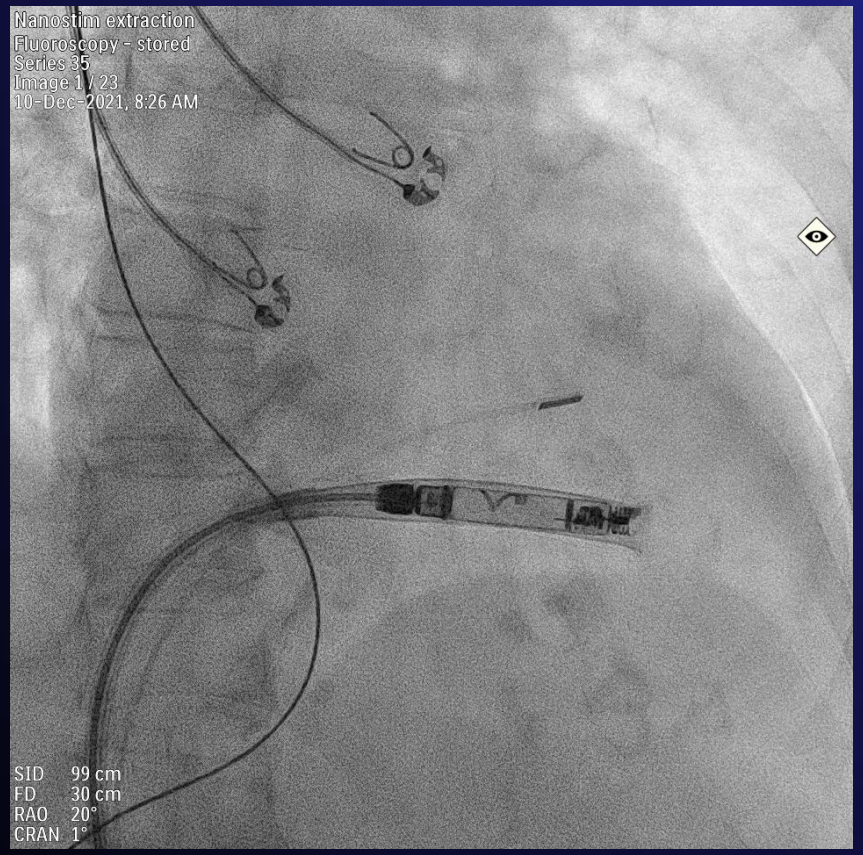
Minimum tissue remnants on LP device body

No signs of tissue on the fixation knob and screw as well

Kazuistika

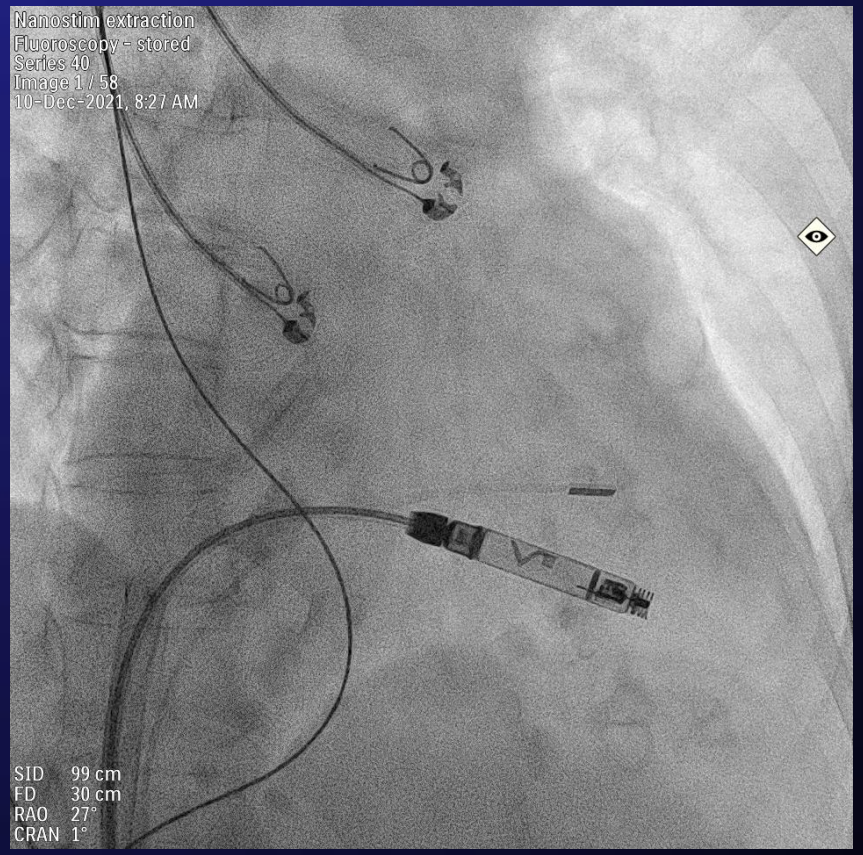
Implantace Aveir VR 10.12.2021

Zavedení přes TCH do PK
AVEIR VR 10.12.2021, 08:26



Aveir VR:
Vícečetná repozice nového LP
Aveir VR v různých místech PK

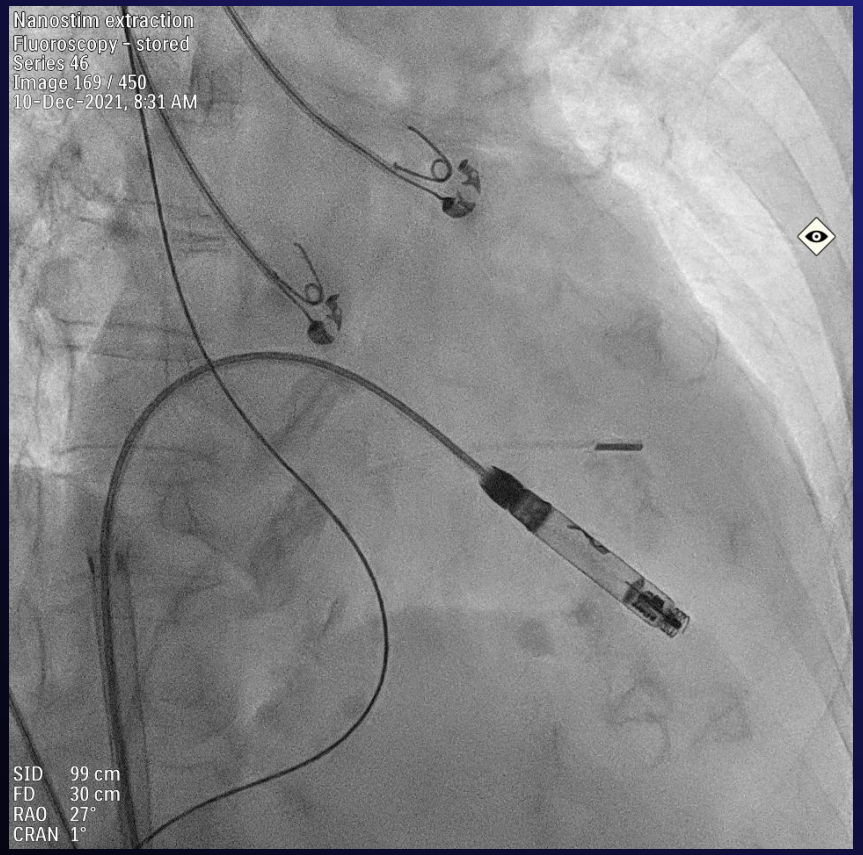
Repozice AV rámci PK
AVEIR VR 10.12-2021, 08:27



Kazuistika

Implantace Aveir VR 10.12.2021

Fixace AVEIR VR v PK pomalá rotace
10.12.2021, 08:31



Aveir VR:
Jednoduchá implantace

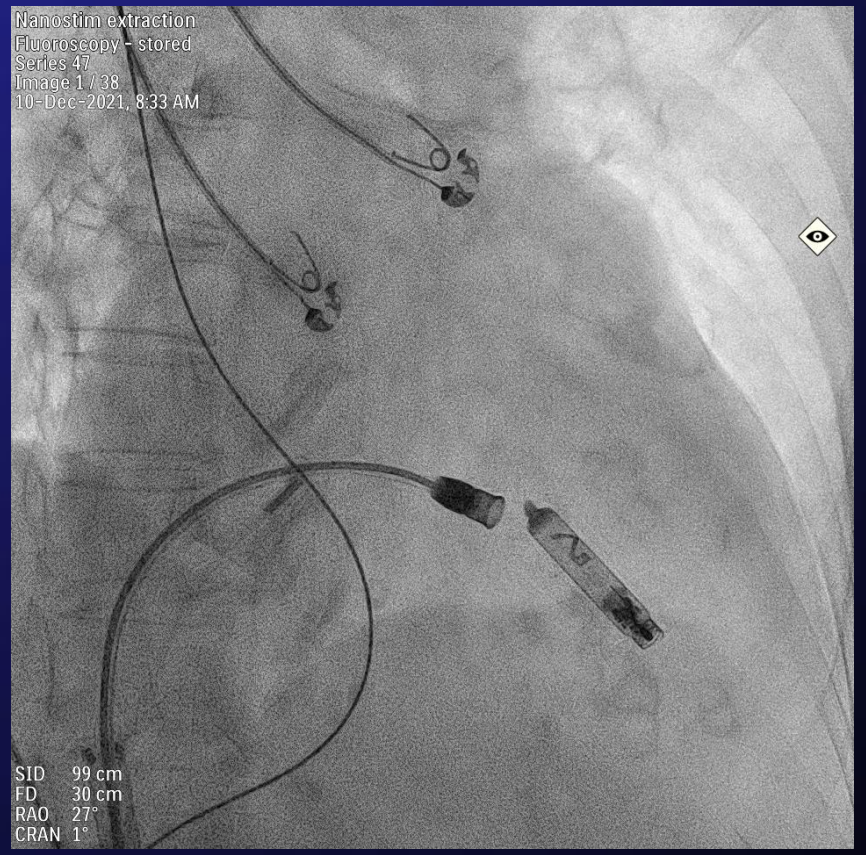
Vyšší akutní prahové hodnoty:

2,5 V/0,4 ms

Po čekací době 4 minuty:

1,0 V/0,4 ms
Impedance 630 Ω
R vlna 9 mV

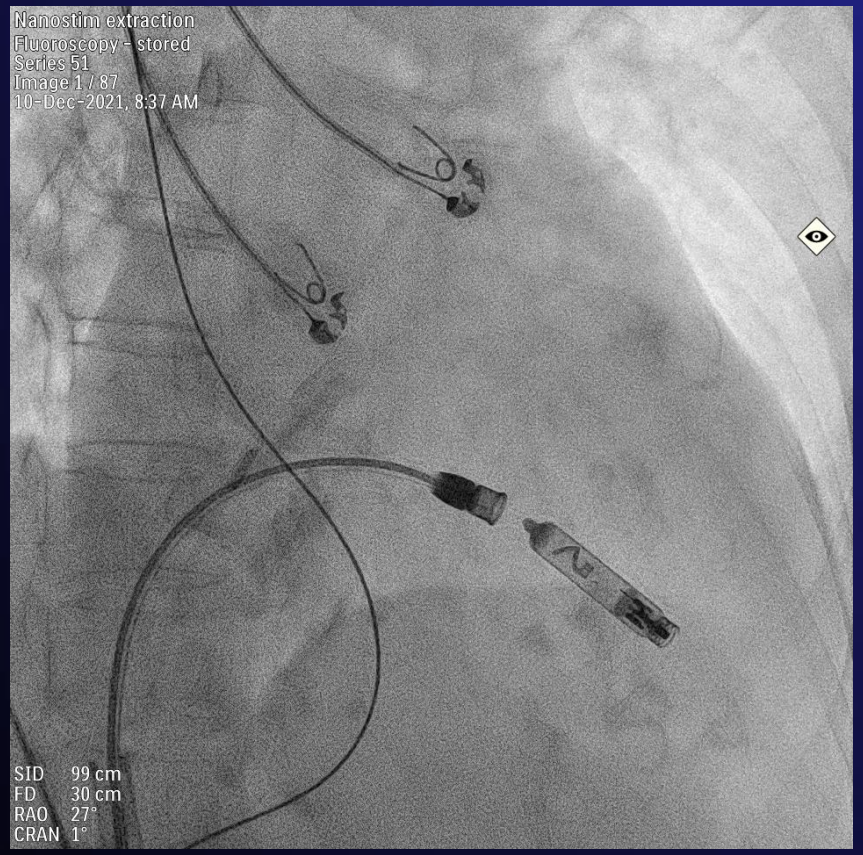
Test stability
AVEIR VR 10.12.2021, 08:33



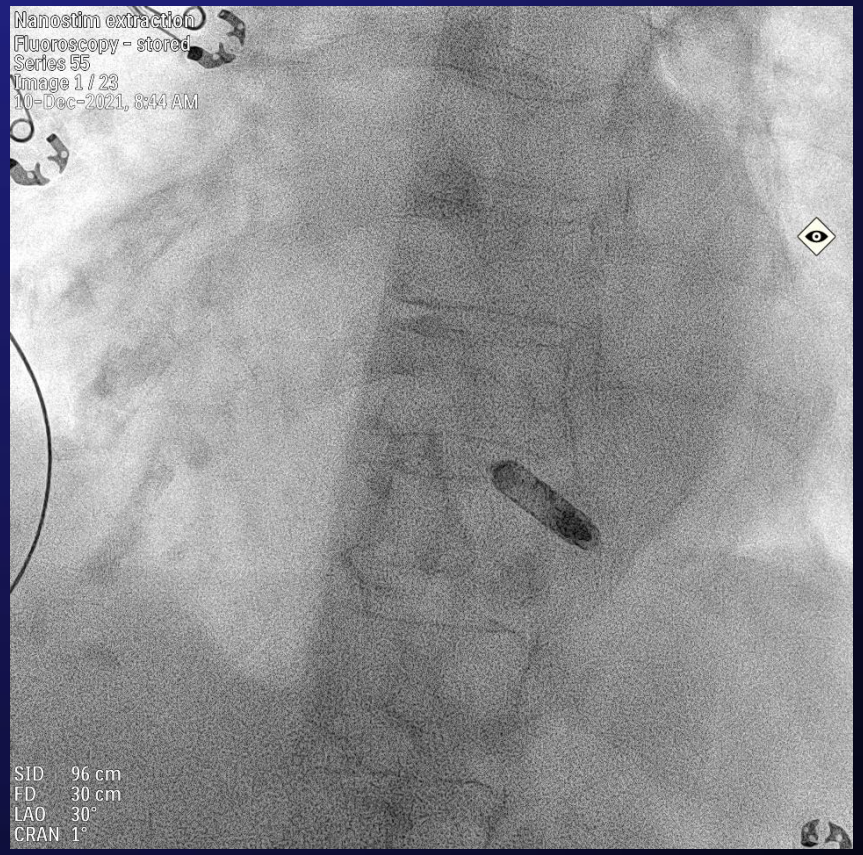
Kazuistika

Implantace Aveir VR 10.12.2021

Konečná poloha a uvolnění
AVEIR VR 10.12.2021, 08:37

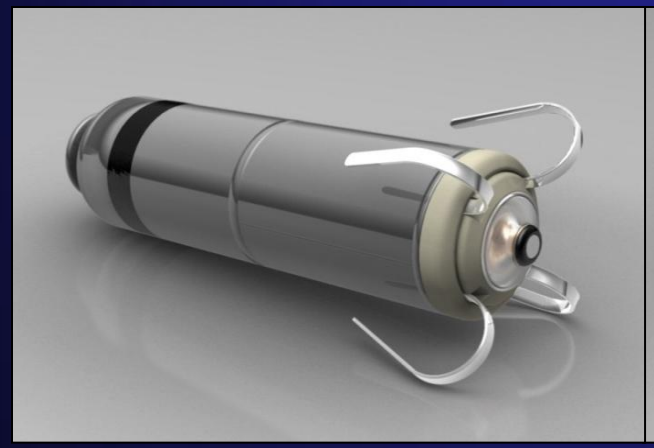


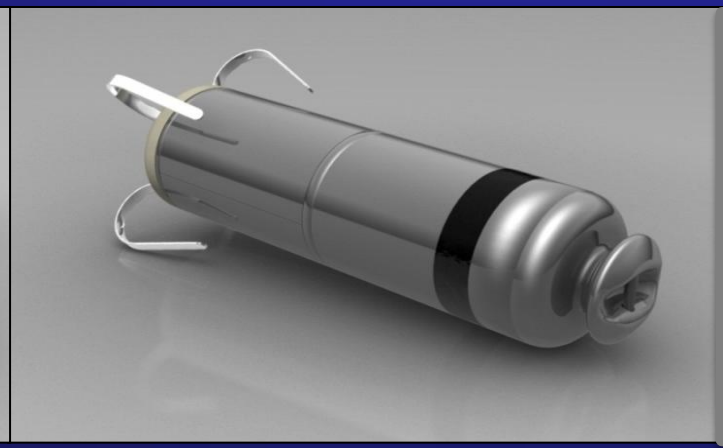
Finální pozice před překladem ze sálu
AVEIR VR 10.12.2021, 08:44



Fyziologická jednodutinová stimulace

Micra AV : od VVI k DDD





- MICRA AV = VVIR →VDD(R)
- Identical volume : 0.75ml
- Weight: 2g
- Lenght: 24mm
- Width: 20Fr
- Bipolar Pacing (17mm)

Micra Atrial TRacking Using a Ventricular AccELerometer Study *(MARVEL)* *NCT03157297*

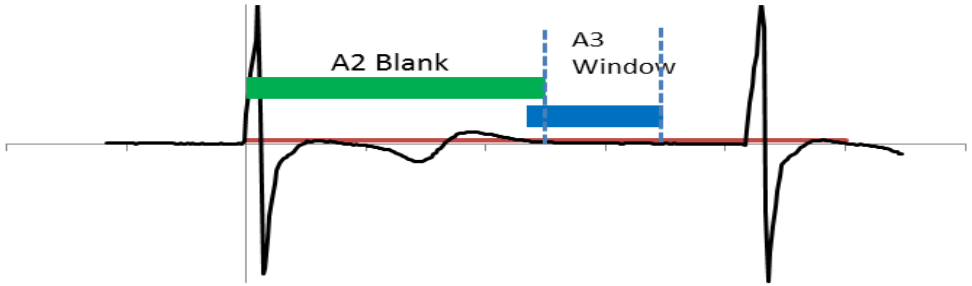
Primary Endpoint :

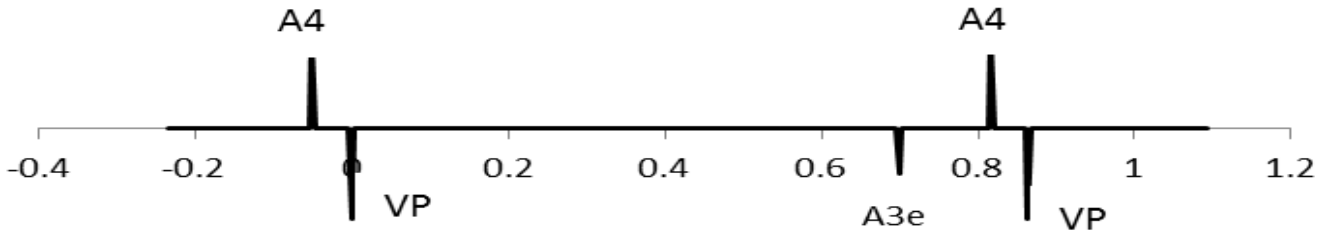
Synchronisation of ventricular pacing to reach = VDD

3 preexisting accelometers : atrial activity detection based on tricuspid valve movement detection – in concert with P wave detection on ECG

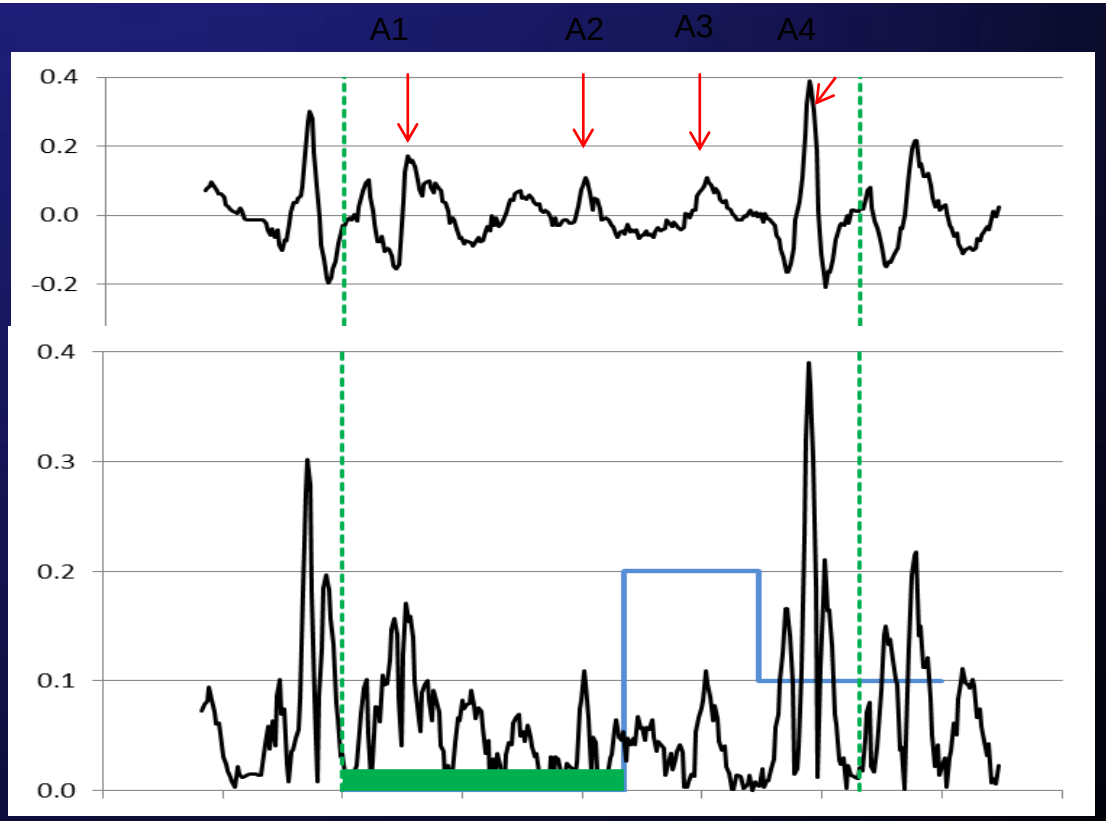
Micra AV : VDD mode

Detekce pohybu cípů TCH





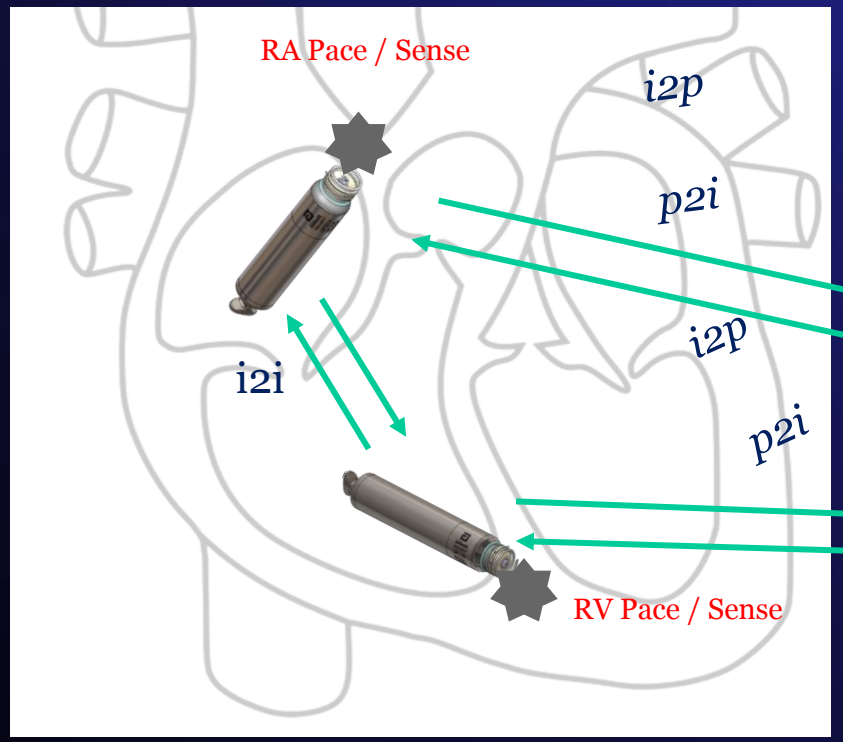
- „High pass“ filtr accelerometer (5-10Hz) – 3 x→ 360°
- Usměrňovací filtr
- Blanking after ventricle activity
- Blanking or increasing threshold post T- wave detection to erase A3 false detection
  - Measurement → hardware
    Blanking → firmware
- A4 wave detection as the first wave ovecross the filter thresholds
  - Typical 0.10-0.15g

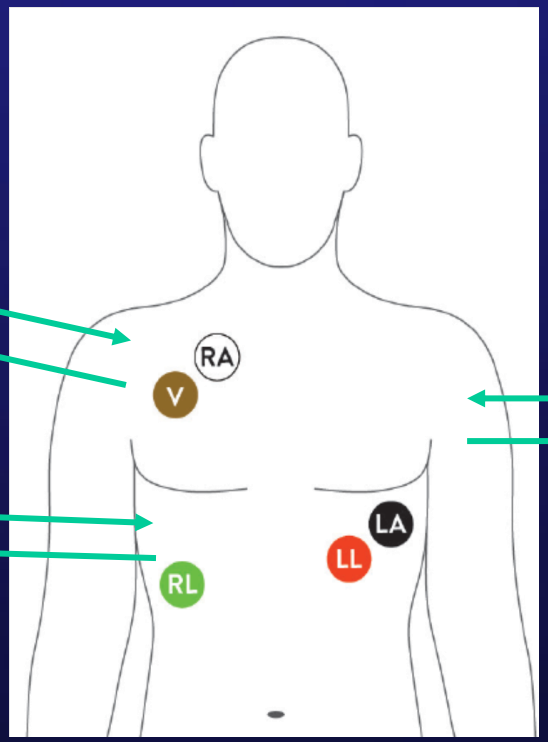


Dvoudutinový leadless Aveir DR

vzájemná komunikace „i2i“ (implant to implant)

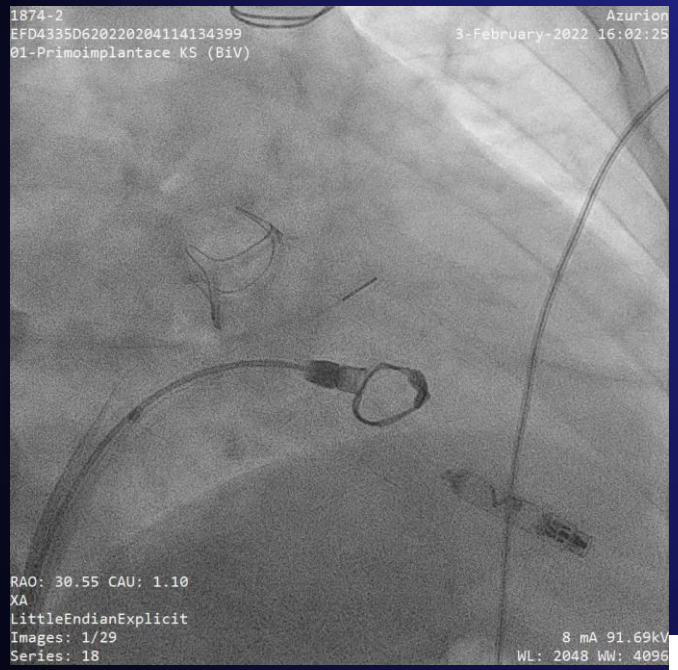
- **Kondukční komunikace** – využívá vodivé vlastnosti tkání a krve; vysílání/přijímání vysokofrekv. el. signálů (uA, pA), výkon v rámci uW … minimální spotřeba energie

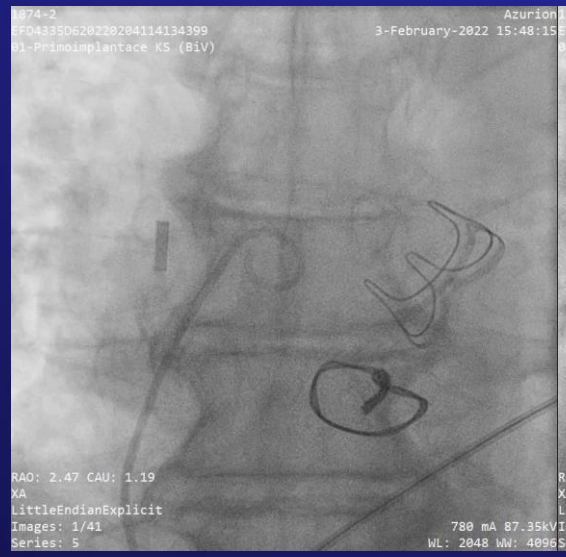


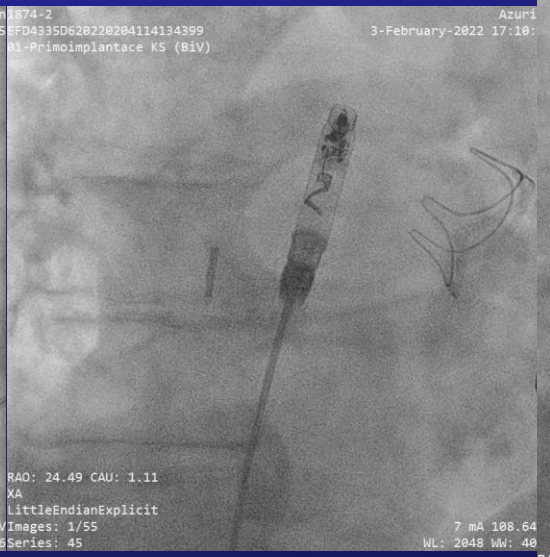


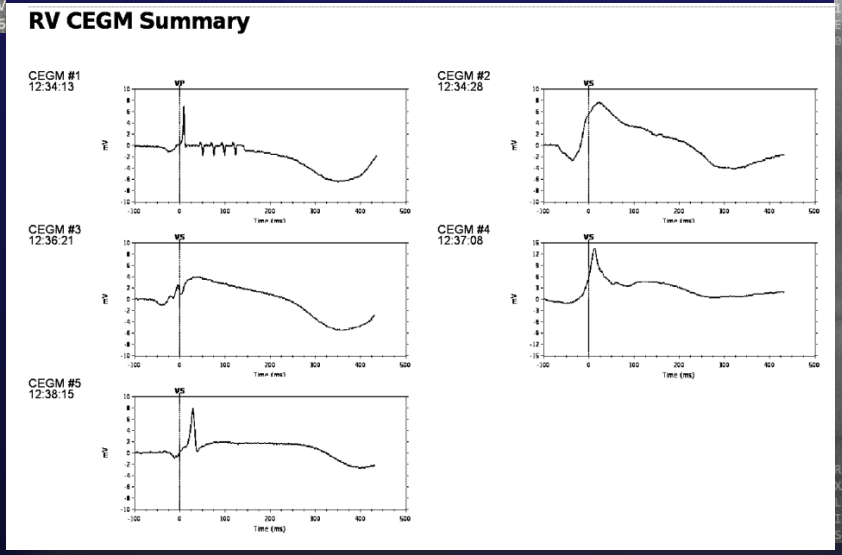
Dvoudutinový leadless Aveir DR

implantace komorové a síňové komponenty



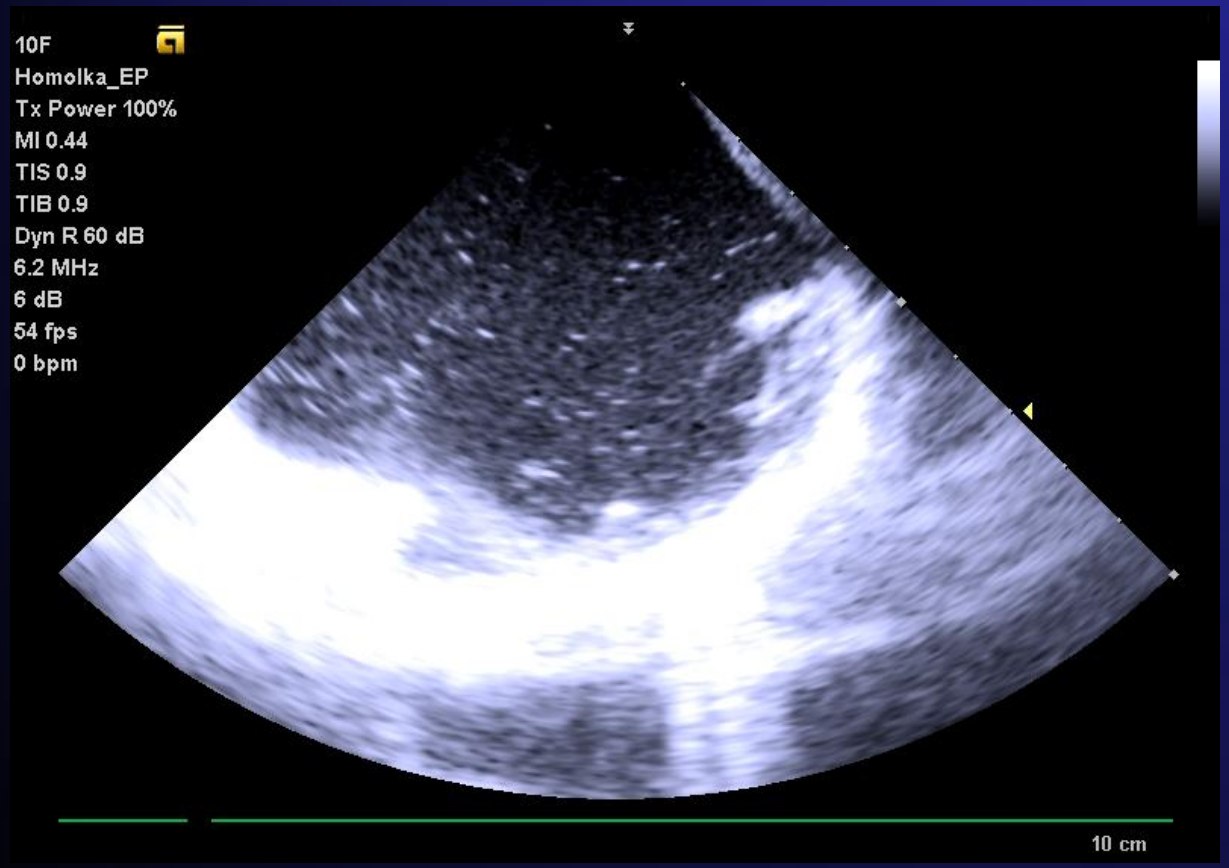


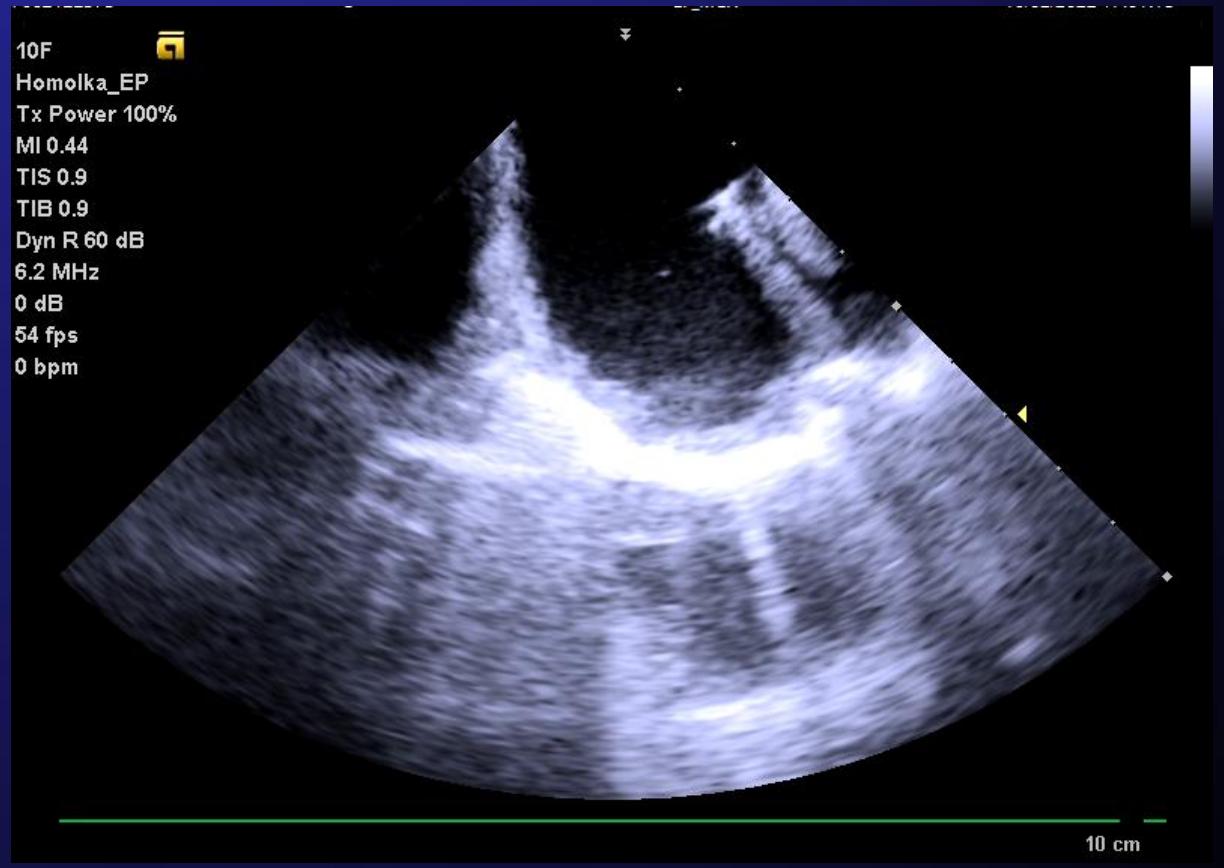




Dvoudutinový leadless Aveir DR

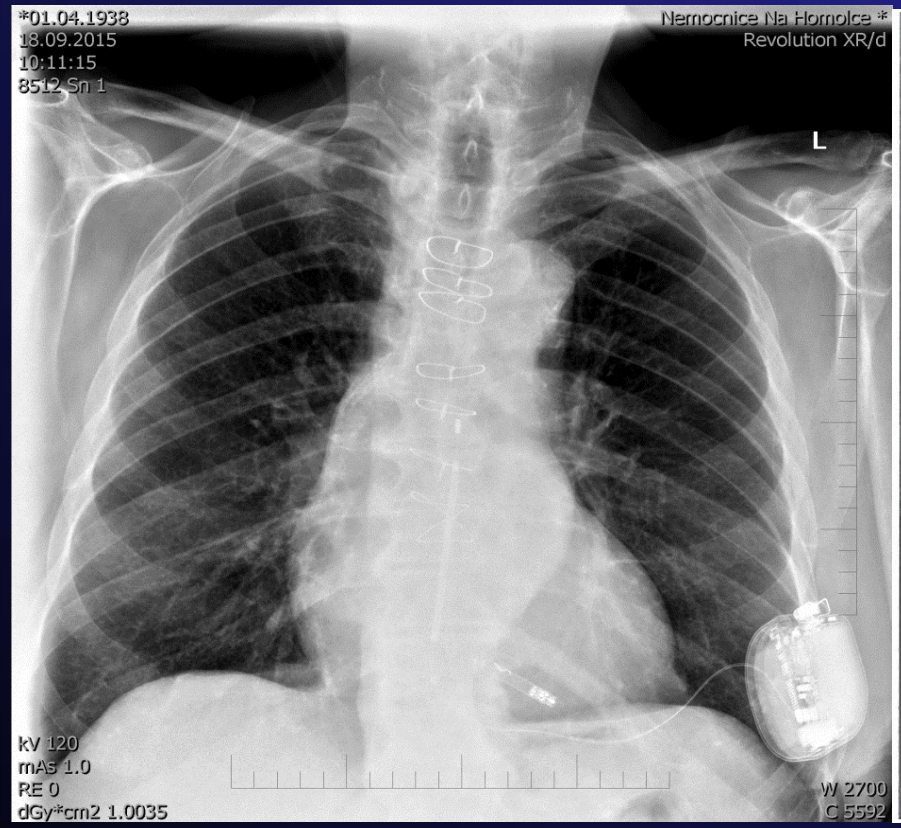
implantace síňového Aveir - ICE

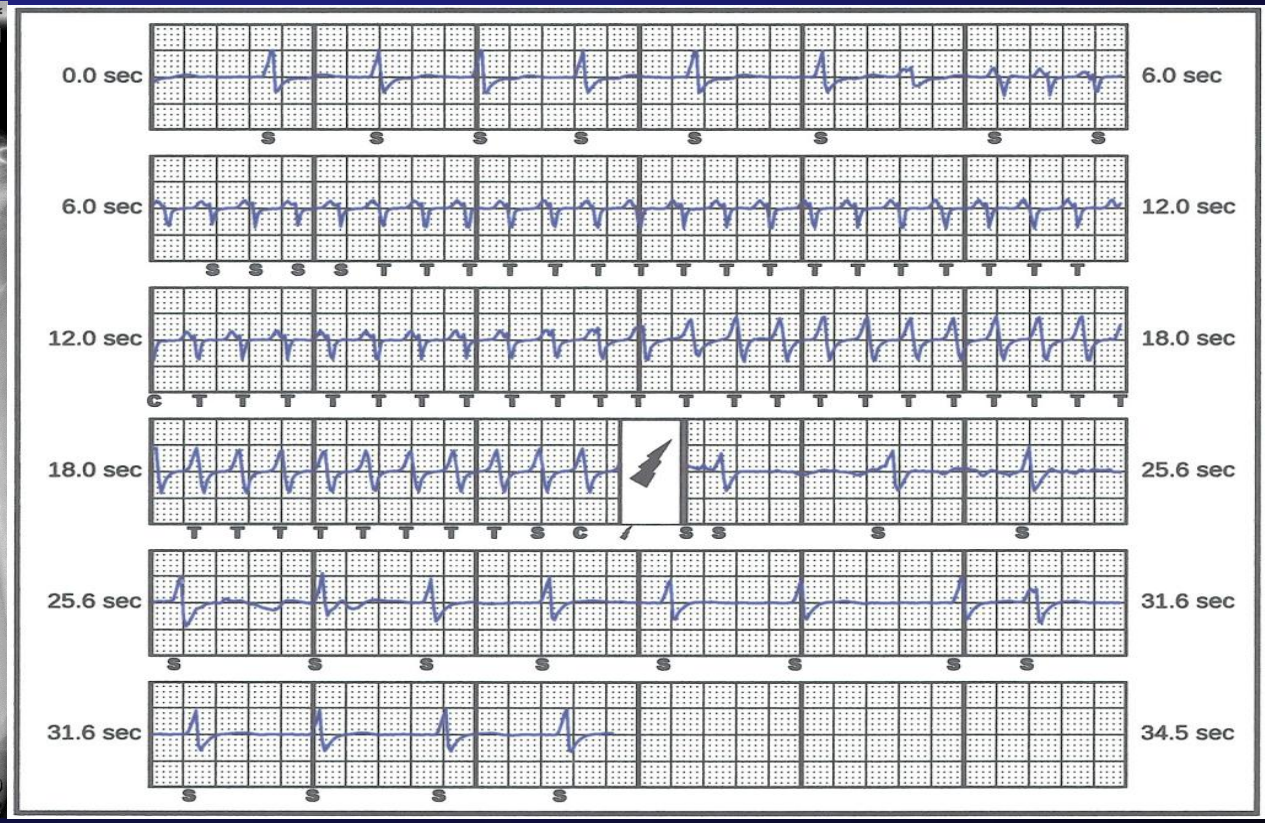




Leadless pacing & S-ICD
(no inter-device comunication)

81 y/o/m
CAD – CABG 2002
Long-standing Persistent AF, LCP implantant 2012
Incessant VT 2014 , LV EF 35%, S-ICD 2015, VT Catheter Ablation 2015





Leadless brady & ATP & S-ICD

Implantable Devices

EMPOWER™ Modular Pacing System
EMBLEM™ Family of S-ICDs

Programmers

Model 3200 S-ICD Programmer

Next Generation
BSC 3300 LATITUDE
Programming System

EMPOWER™ Details

32.1 mm x 6 mm
0.8 cc

Active fixation talons
Tether / Snare port

EMPOWER™ Delivery and Retrieval

Preloaded delivery catheter with extendable inner catheter

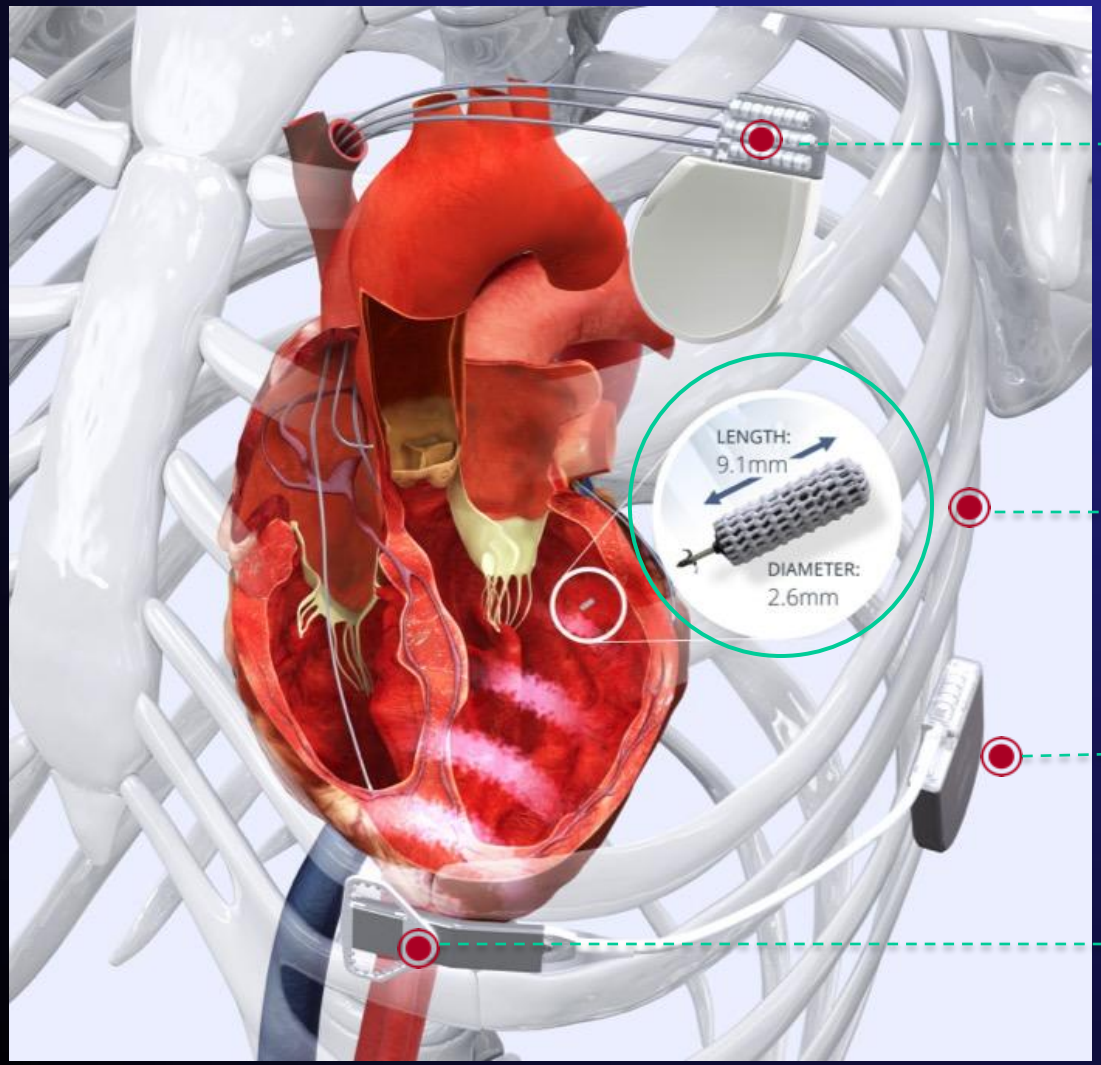
Dedicated retrieval system with single & tri-loop snares

Dedicated delivery and retrieval catheters

*mCRM™ Systems, EMBLEM™ S-ICD mCRM™ functionality, and EMPOWER™ Modular Pacing Systems are in development and not approved for sale in any geography.

WiSE CRT System

Hlavní součásti a princip „wireless“ stimulace



CO-IMPLANT DEVICE

Co-implanted pacemaker, ICD or CRT paces the right ventricle.

RECEIVER ELECTRODE

Implanted onto the endocardium, the receiver electrode converts ultrasound energy into electrical energy to pace the left ventricle.

BATTERY

Implanted subcutaneously on the left mid axillary line, powers the transmitter.

TRANSMITTER

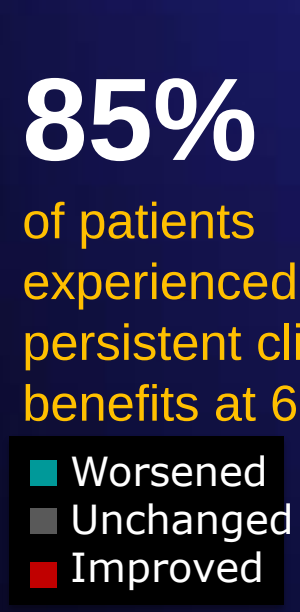
Phased array ultrasound transmitter is implanted sub-muscular over a cardiac echo window. Synchronizes with an RV pacing pulse to transmit ultrasound energy to the receiver electrode to provide Bi-V endocardial pacing.

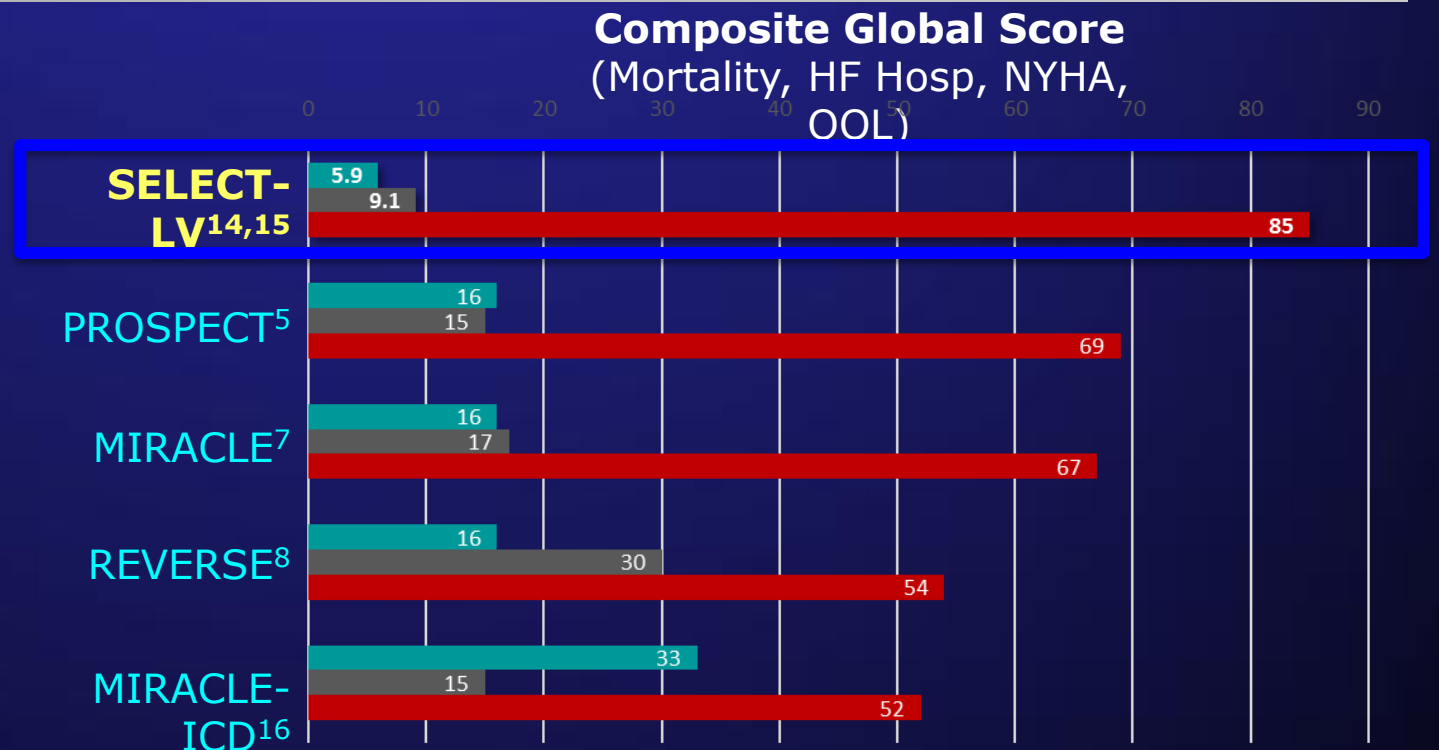
Studie SELECT-LV :
Hlavní výsledky

The SELECT-LV study showed sustained cardiovascular improvement for complex CRT patients treated with the WiSE System

85%

of patients experienced persistent clinical benefits at 6-months





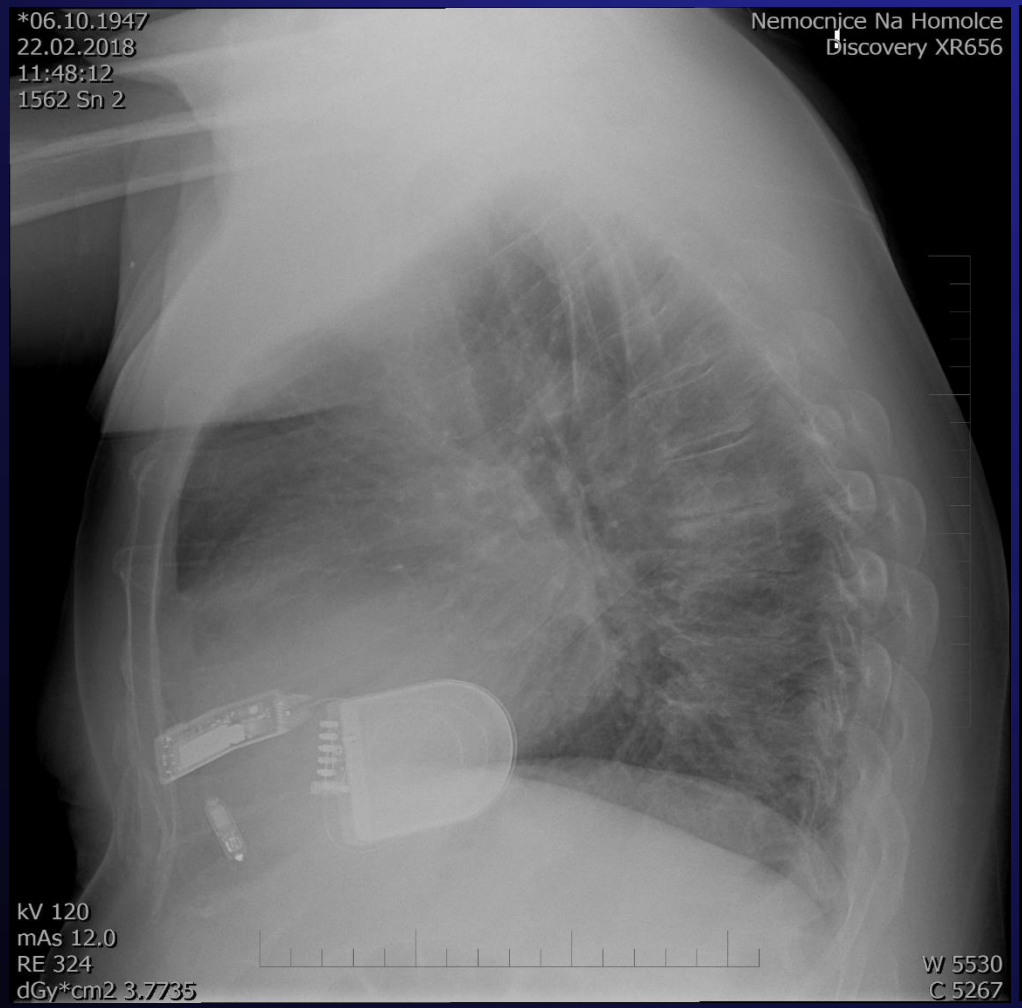
This pts group had previously failed conventional CRT

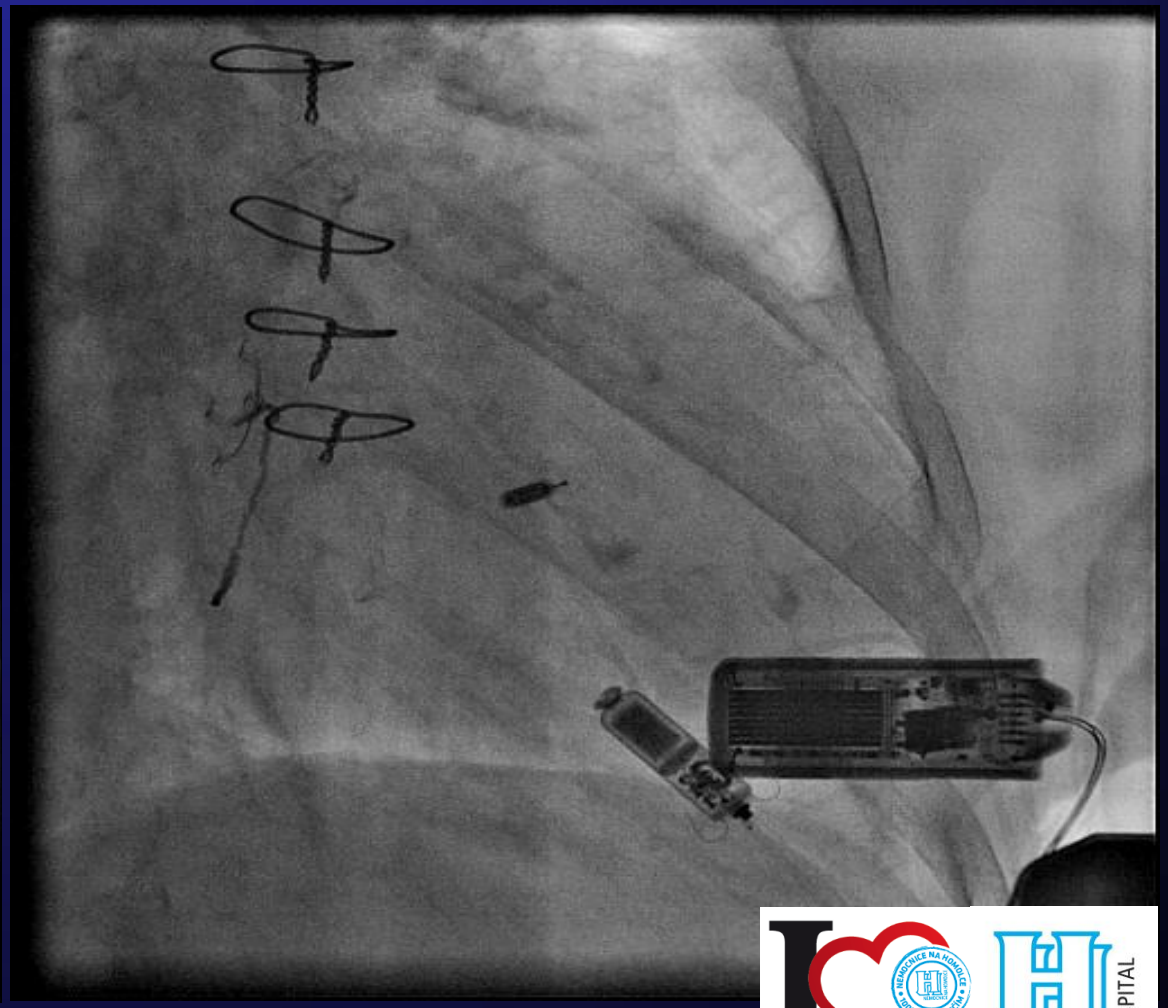
Reddy VY/Neuzil P/Riahi S: JACC 2017;*69:2119-2129*

KARDIOCENTRUM NA HOMOLCE HOSPITAL

Kompletní leadles-wireless CRT systém

Micra TPS + WiSE





Carabelli A/Neuzil P/ DefayeP: *Europace 2021;23:740-747*

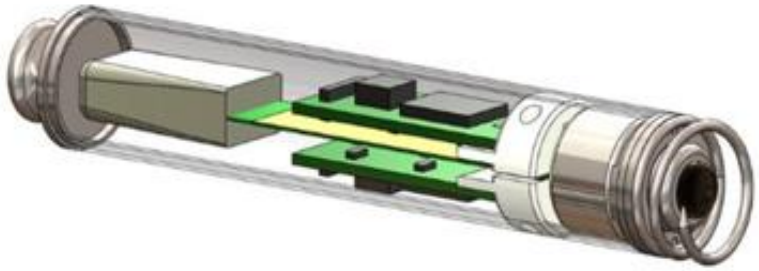
KARDIOCENTRUM

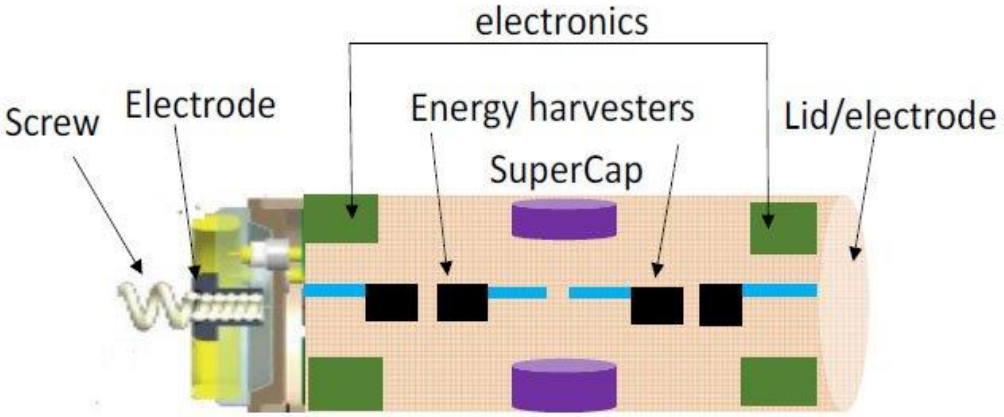
NA HOMOLCE HOSPITAL

Nová technologie baterií

„harvesting“ energie

- Kardiokinetika jako zdroj energie pro stimulaci:





Parameters	Micra (Medtronic)	ALPS
Polarity	bipolar	bipolar
Pacing modes	VVIR (single-ch)	VVIR / DDDR
Rate modulation	3D accelerometer	3D accelerometer
Energy supply	Lithium iodine battery	Piezoelectric energy harvester
Estimated longevity (ISO)	5 y	> 20y
Size (D x L) mm	6,7 x 26	6,5 x 30
Fixation mechanism	Tines	Helix + torque limiter
Delivery	Femoral catheter access	Femoral catheter access
Other features	Hourly/daily based pacing threshold verification	Beat to beat capture verification
		Automatic sensing adaptation
		Holter episode for EGM + Acceleration
		Daily/weekly Home-monitor transmission

Piezoelectric energy harvester for pacemaker application: a comparative study - IOPscience

Kdy indikovat Leadless kardiostimulátor

- V případě opakovaných infekčních komplikací spojených s transvenózními KS systémy a to i bez ohledu na základní rytmus (FiS/SSS/SR s AVB)

- Implantace LP (*MICRA VVI/AV) i v případě probíhajícího septického stavu*
- Implantace LP *(MICRA VVI/AV) v případě rizika akutní komplikace*
  subklaviální punkce, okluze SVC či obliterace centrálního žilního systému

- *Fibrilace síní (LP VVI)* - *vysoce aktivní pacient s rizikem porušení transvenózně zaváděné elektrody*
  chabé podkoží s rizikem vývoje dekubitu
  trikuspidální plastika či MVR
  riziko poškození trikuspidální chlopně

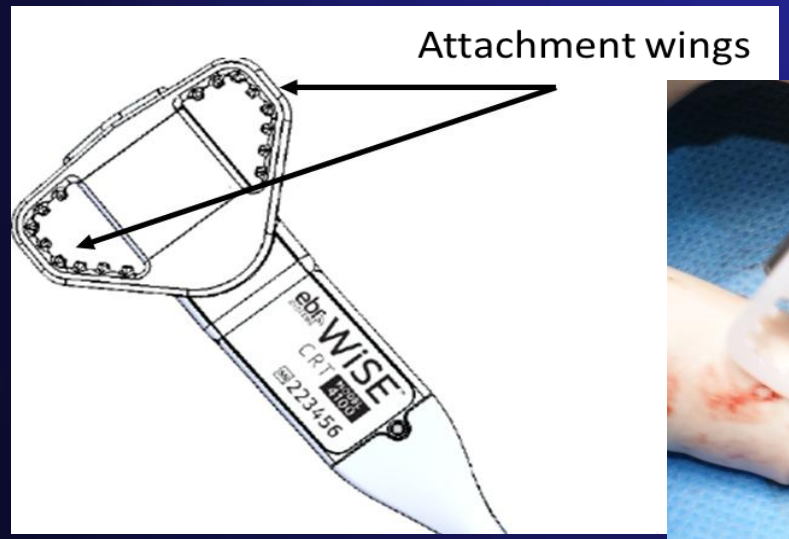
PRAGUE HOMOLKA Hope:

LEADLESS PLATFORM FOR ALL:

COMING SOON

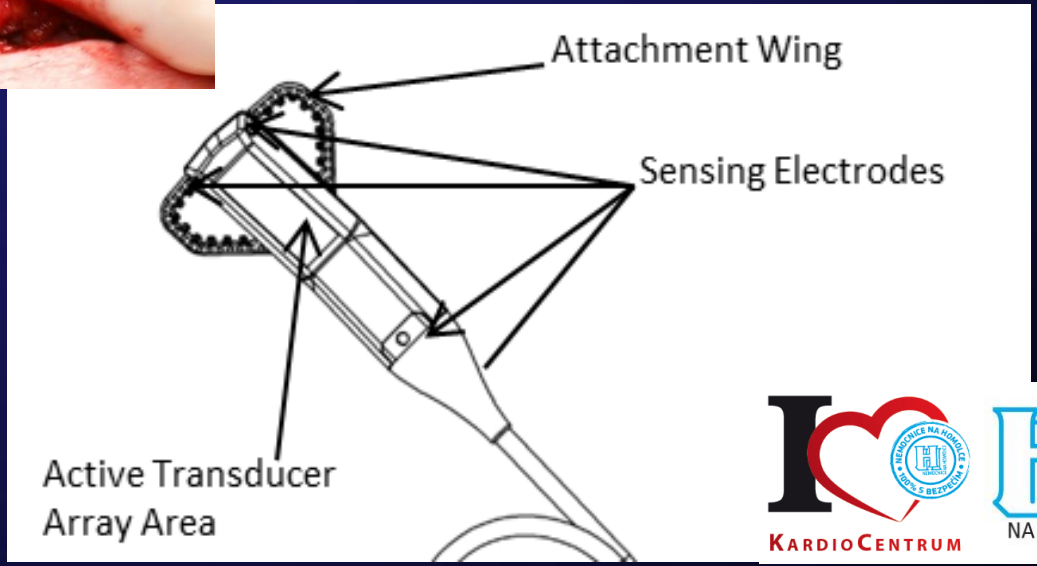
WiSE CRT System

Ultrazvukový transmiter



- Detects co-implant RV Pulse
  - Uses sensing electrodes
  - Discriminates RV pulse using pulse-width
  - Compatible with any co-implant / RV lead

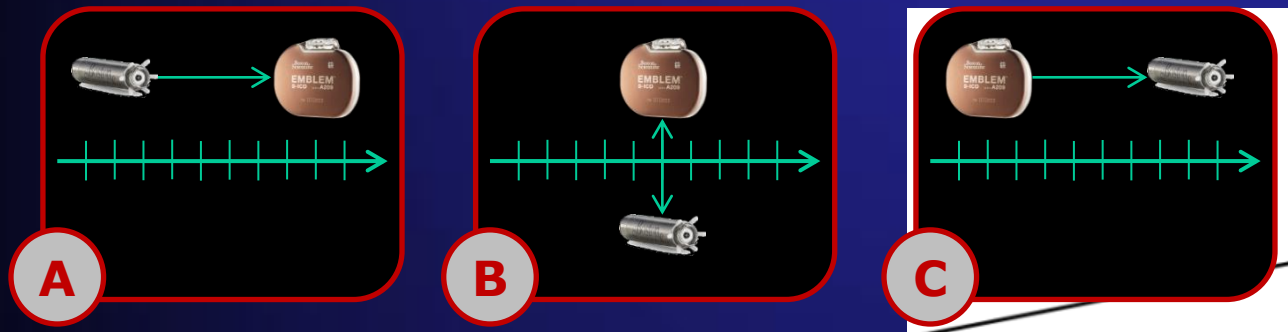
- Focuses and Steers Ultrasound Beam
  - Targeted beam improves power transfer efficiency
  - “Find” the RE (typ 3ms, max 10ms)
  - Send Pacing Pulse energy to RE location

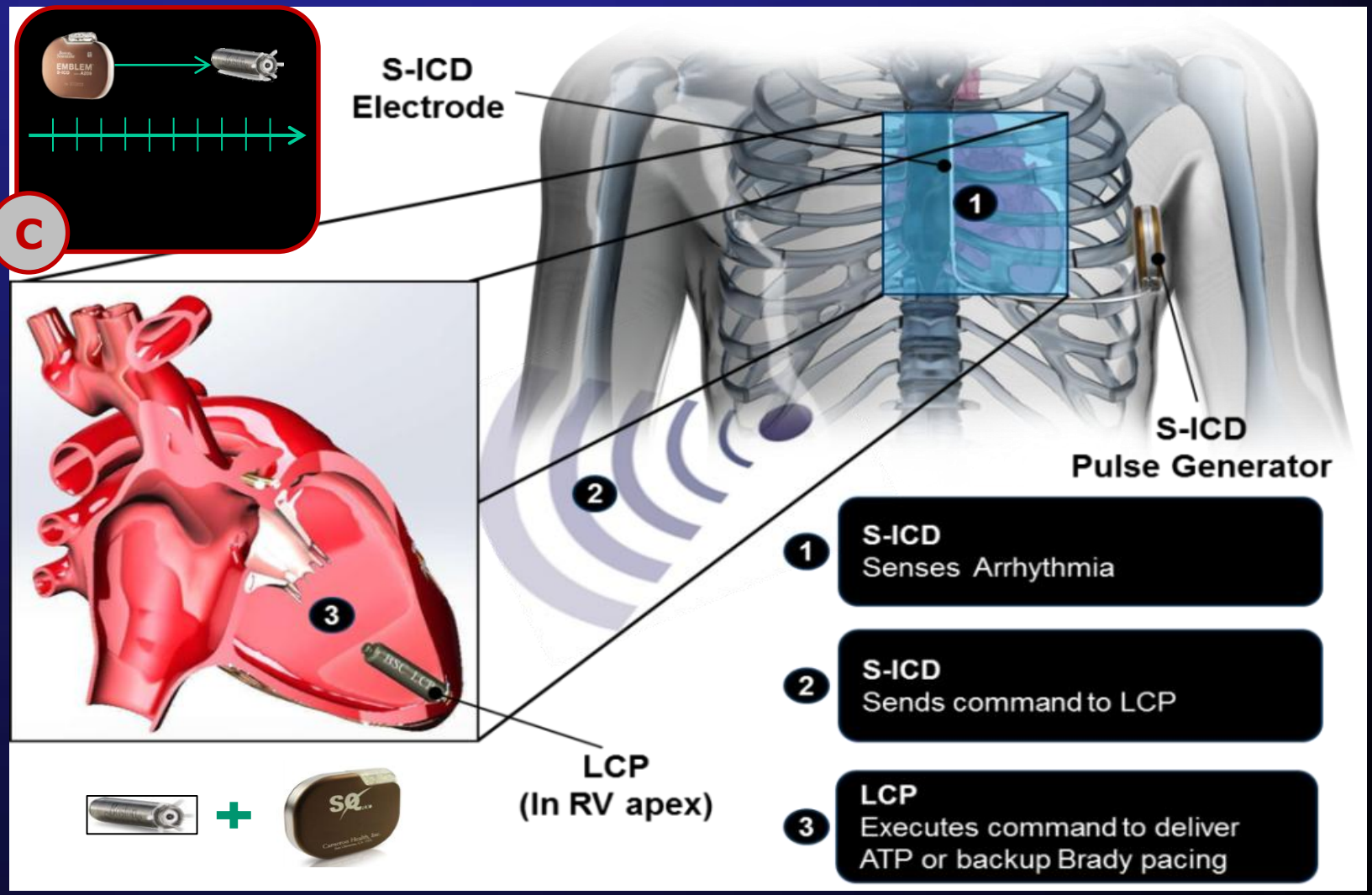


KARDIOCENTRUM

HOSPITAL NA HOMOLCE

Leadless brady & ATP & S-ICD





KardioCentrum

Hospital na Homolce

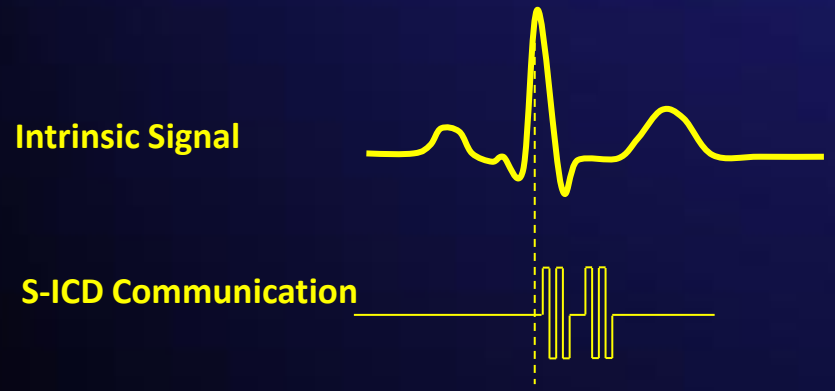
mCRM™ mechanizmus komunikace : Modular

EMPOWER™ Modular Pacing System
- VVIR leadless pacemaker with 8+ years longevity @100% pacing
- ATP activated by mCRM™ enabled S-ICD

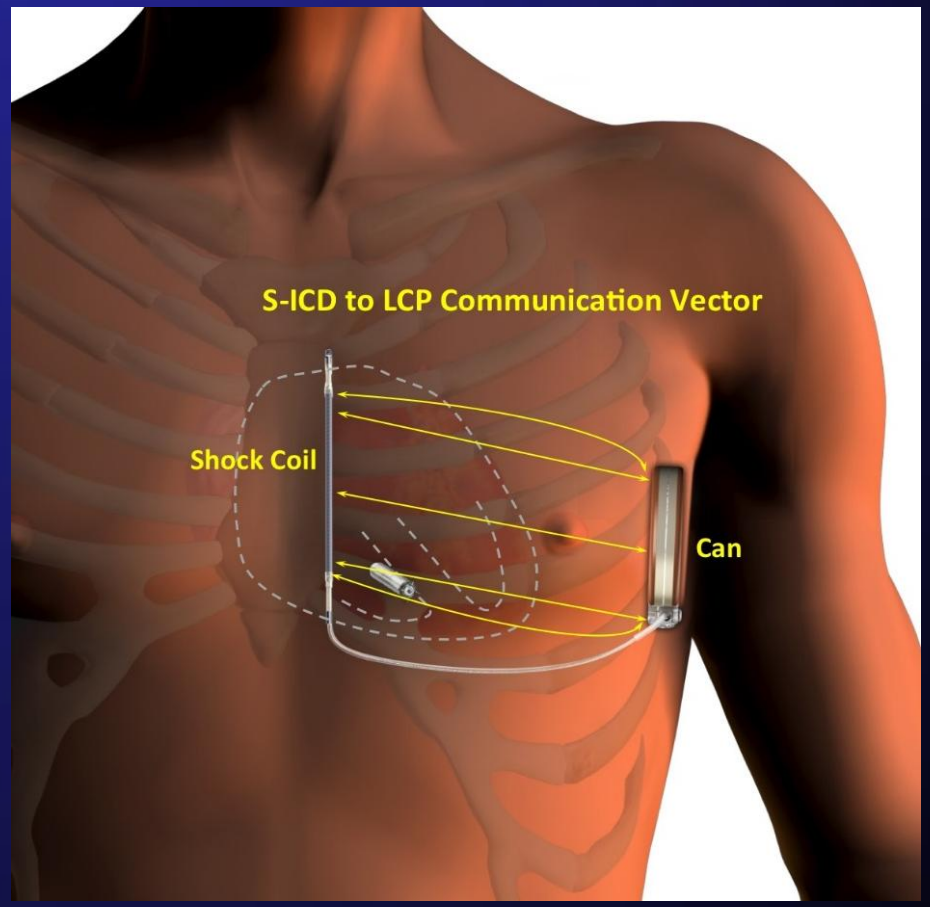
mCRM Enabled EMBLEM™ S-ICDs
- Insight Algorithms with SMART Pass technology
- Up to 3 attempts of ATP in Conditional Zone
- QuickConvert in the Shock Zone

mCRM Compatibility
- EMPOWER™ MPS is designed so that all EMBLEM™ S-ICDs are capable of mCRM™ upgrade to benefit from modular therapy and TruATP™

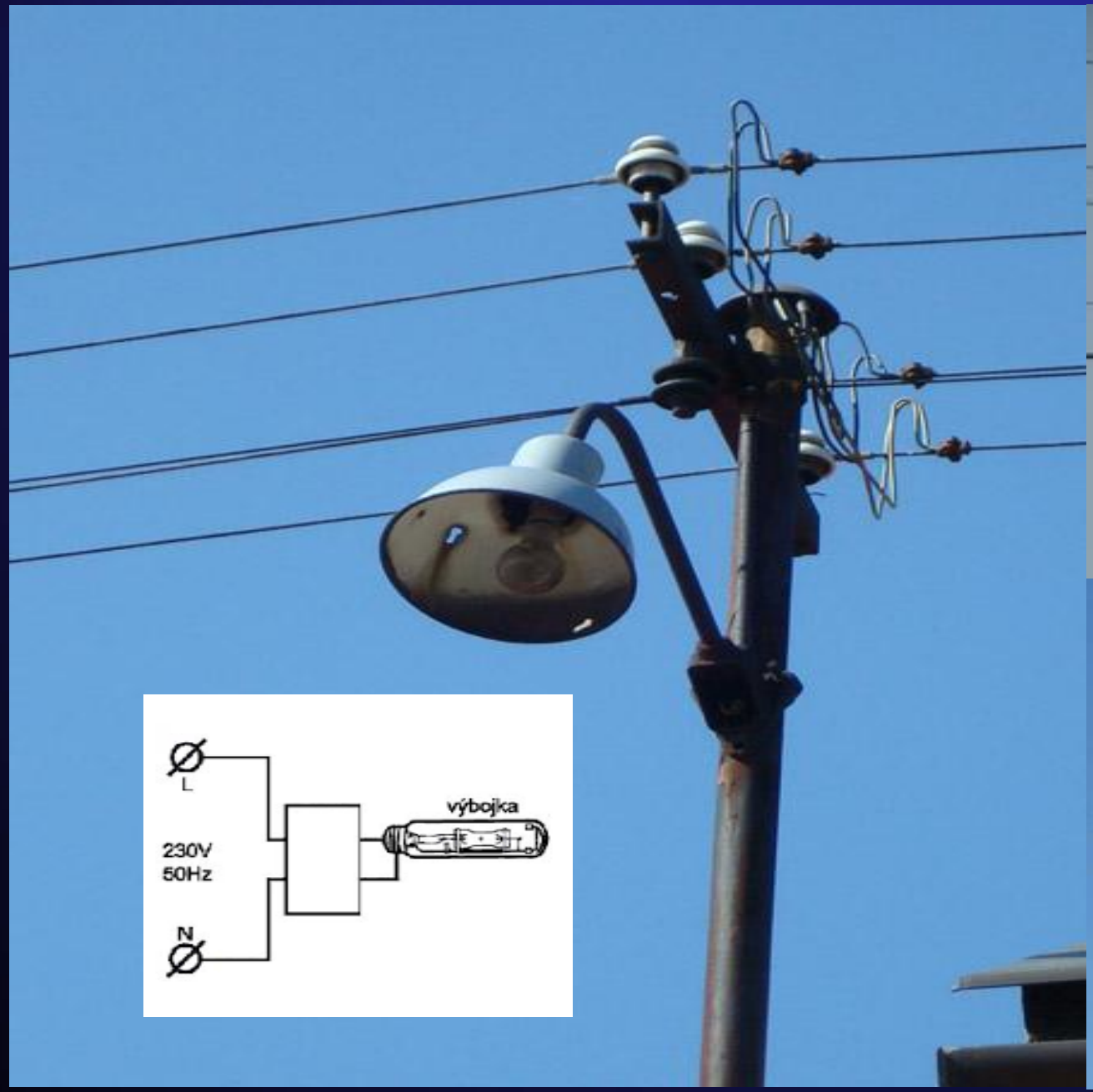
mCRM™ Communication
- Conducted telemetry signals sent from S-ICD
- Negligible battery impact on EMBLEM™ or EMPOWER™



- **Coupled to R-wave**
- **Voltage and pulse width similar to existing lead impedance measurement**
- **Built-in redundancy**



KardioCentrum NA HOMOLCE HOSPITAL



KARDIOCENTRUM

NA HOMOLCE HOSPITAL

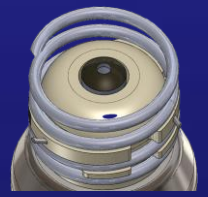
Design goals, subject to change

Nanostim Leadless dvoudutinová stimulace

Nový systém AVEIR™ — Implantace In-Vivo

AVEIR™ IMPLANTAČNÍ & EXTRAKČNÍ SYSTÉM

AVEIR™ Leadless STIMULÁTOR



AVEIR™ KOMUNIKACE MERLIN PCS

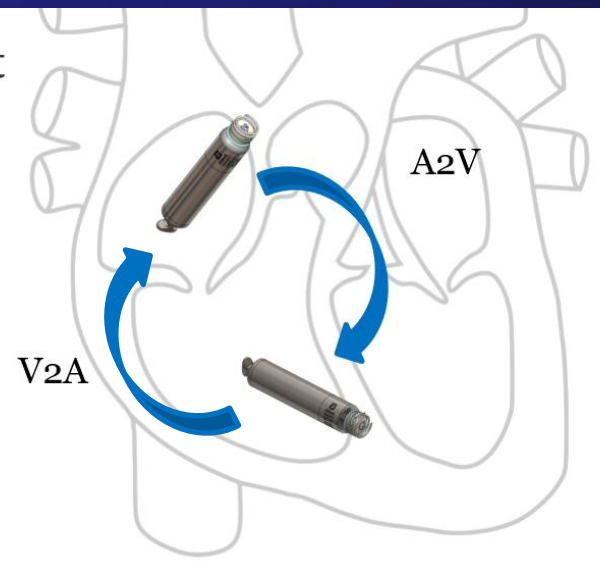
Vzájemná komunikace – i2i ("implant to implant")

- i2i komunikace se zahajuje každou elektrickou srdeční aktivitou

i2i communication repeats for **every cardiac event**

- Atrial to ventricular (A2V)
- Ventricular to atrial (V2A)

Occurs immediately before paced or following sensed event



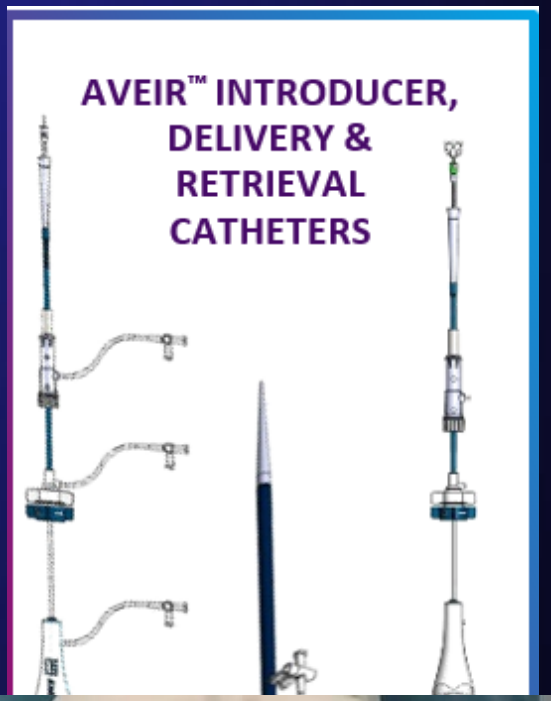
Example: A to V i2i prior to Ap

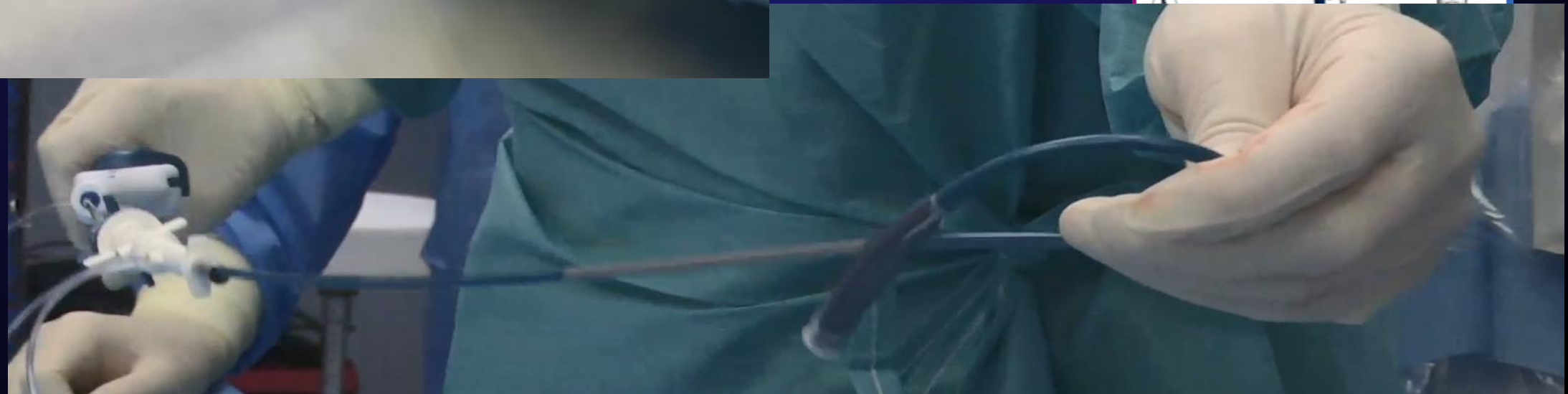
Example: V to A i2i after to Vs

Abbott

Dvoudutinový leadless Aveir DR

zavaděcí katetr

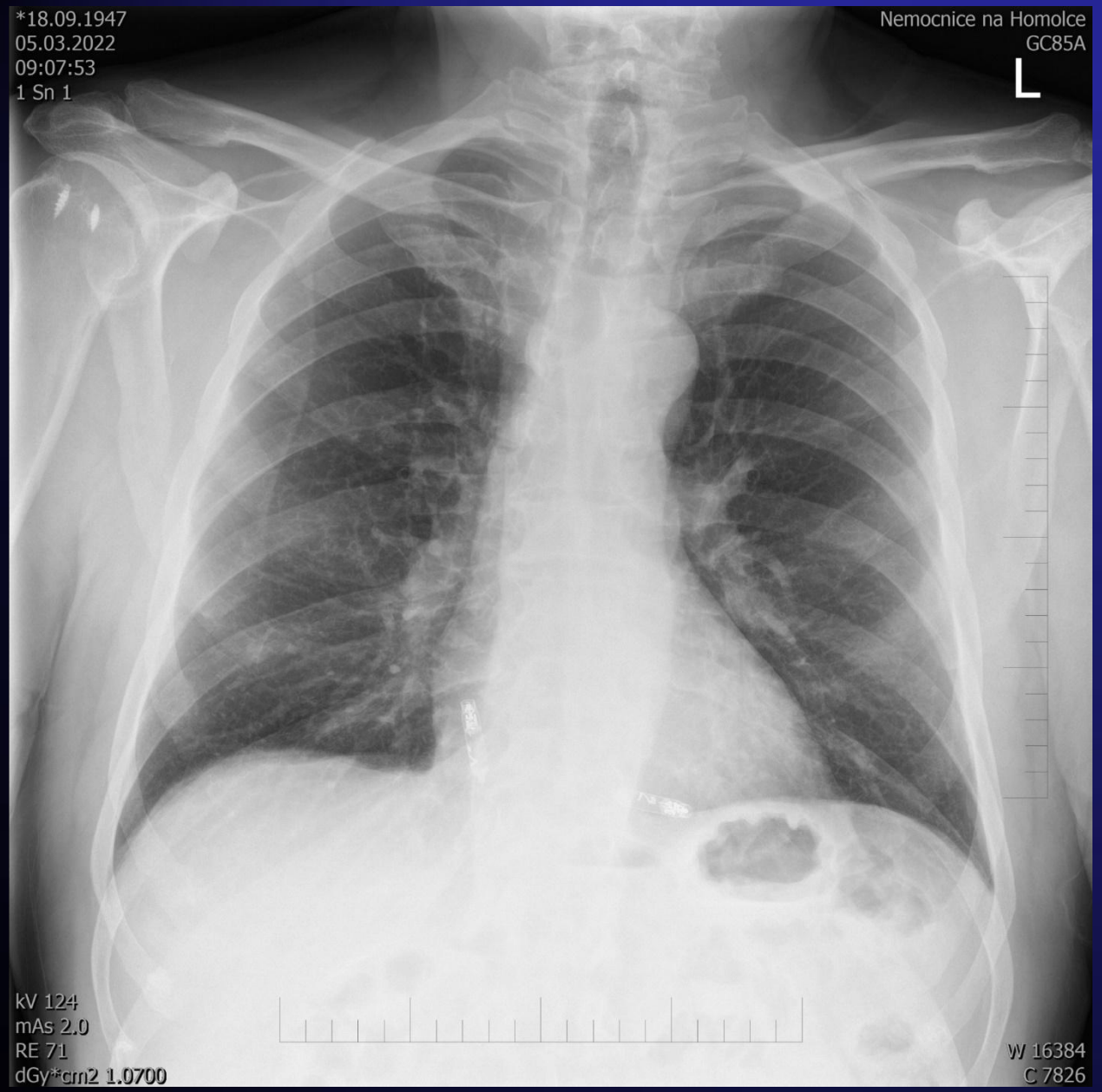


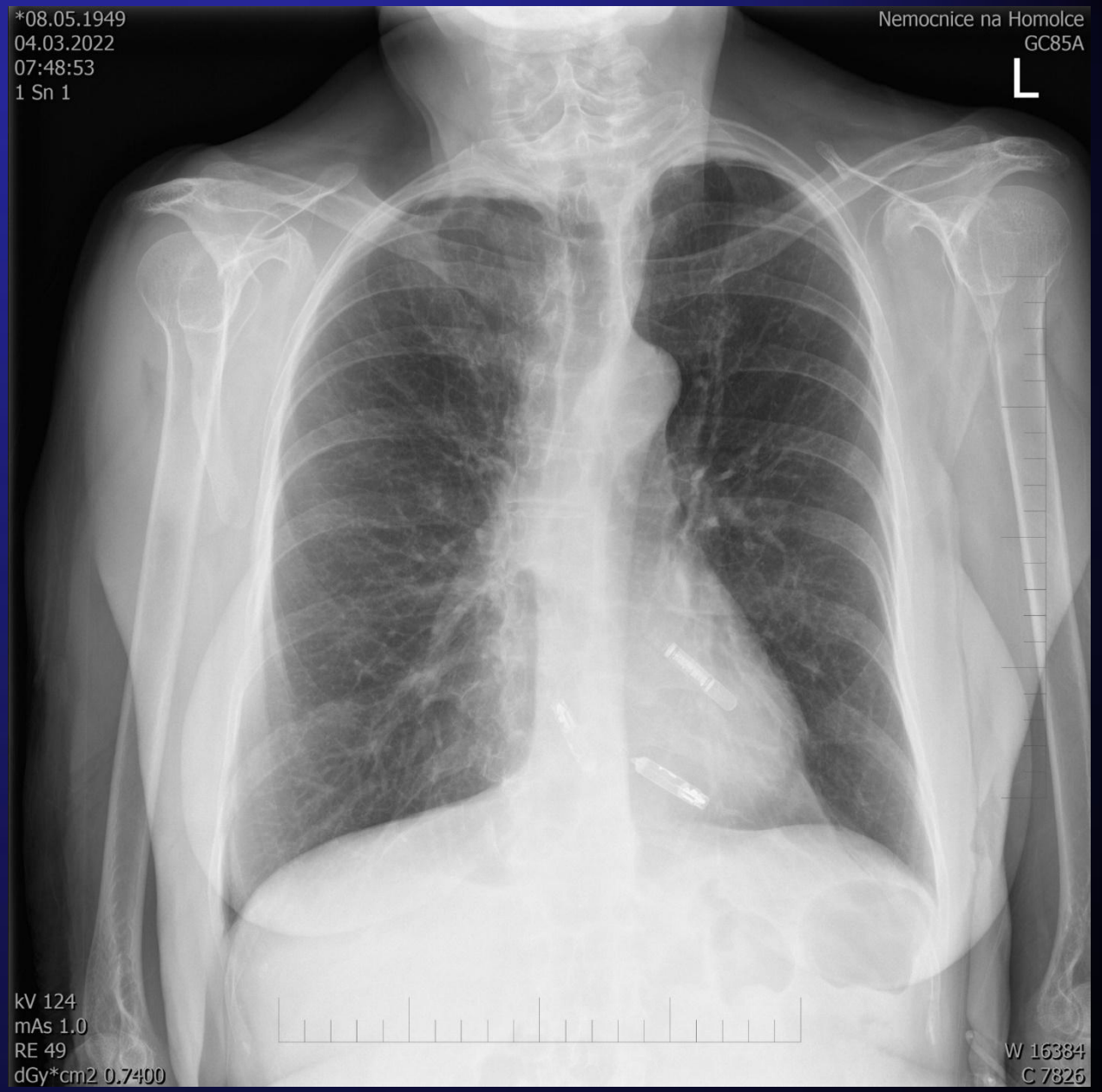


Soubor pacientů (1. implantace 3.2.2022)

n	**17**
pohlaví	12 mužů/ 5 žen
Ø věk (roky)	70,3 (35–83)
Indikace SSS/AV blok	8/9
BMI	29,1 ± 4,1

- analgosedace
- femorální přístup
- skiaskopická kontrola + ICE


*18.09.1947
05.03.2022
09:07:53
1 Sn 1
Nemocnice na Homolce
GC85A
L
kV 124
mAs 2.0
RE 71
dGy*cm2 1.0700
W 16384
C 7826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04.03.2022
07:48:53
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GC85A
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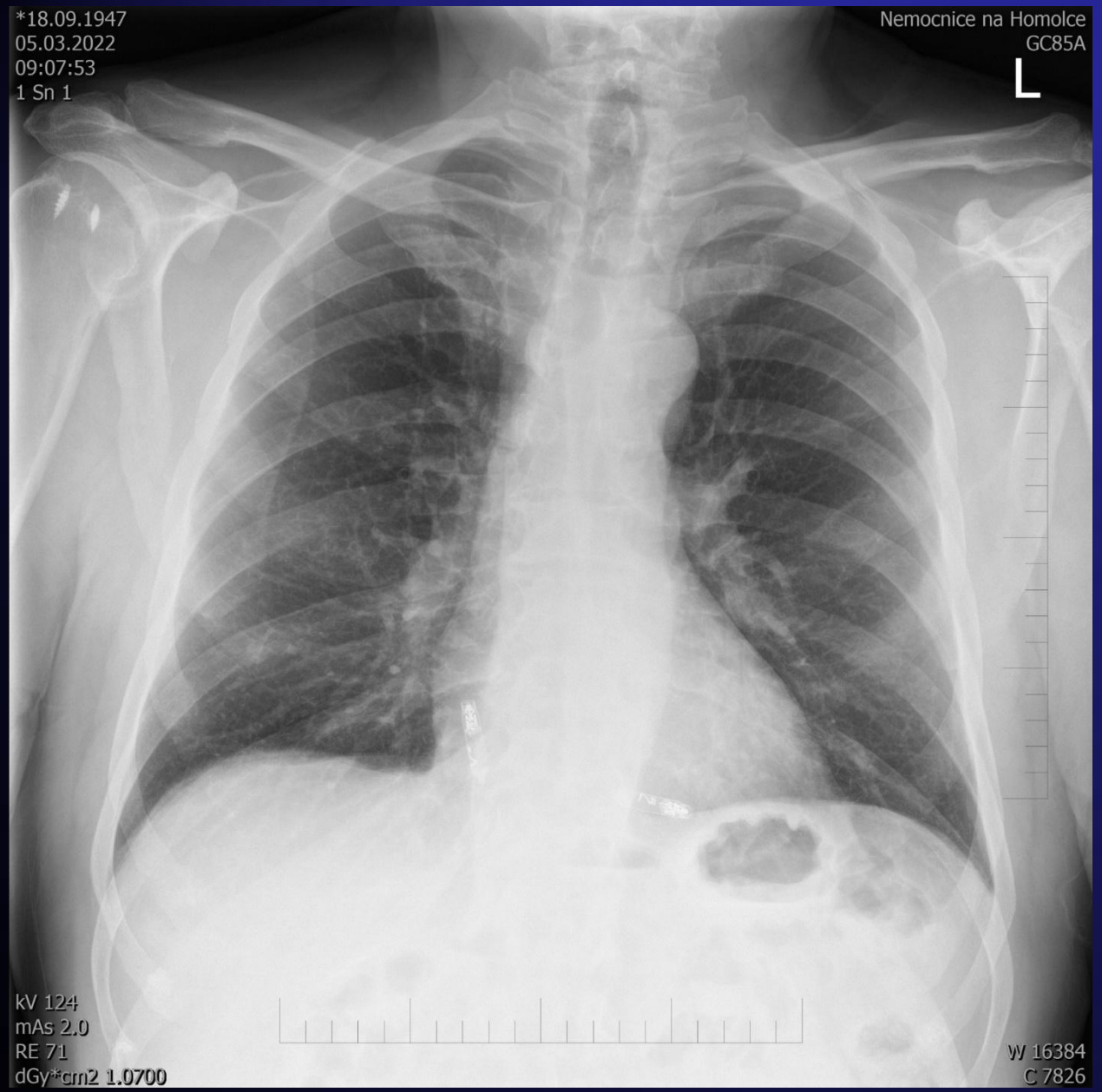
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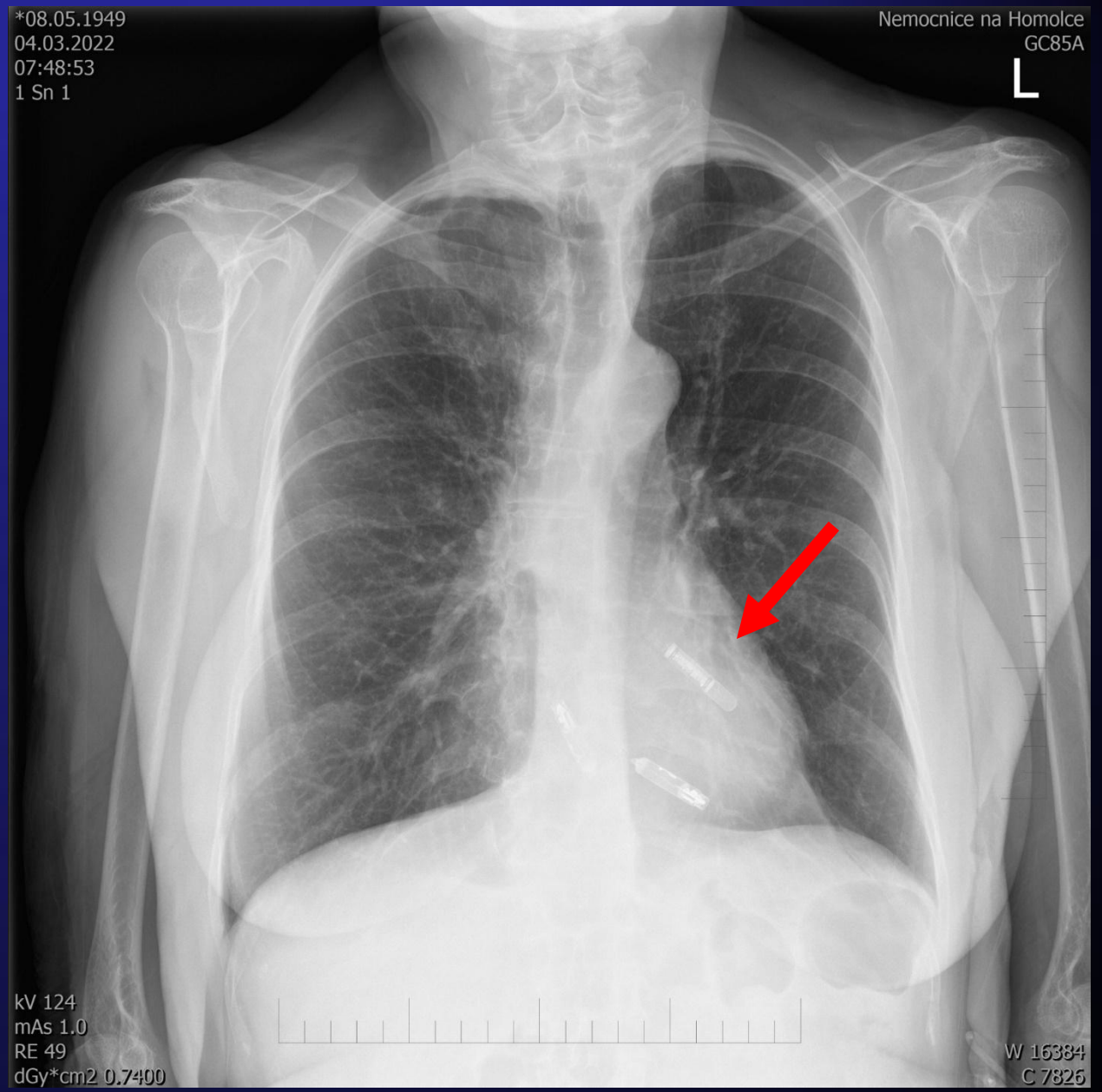
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04.03.2022
07:48:53
1 Sn 1
Nemocnice na Homolce
GC85A
L
kV 124
mAs 1.0
RE 49
dGy*cm2 0.7400
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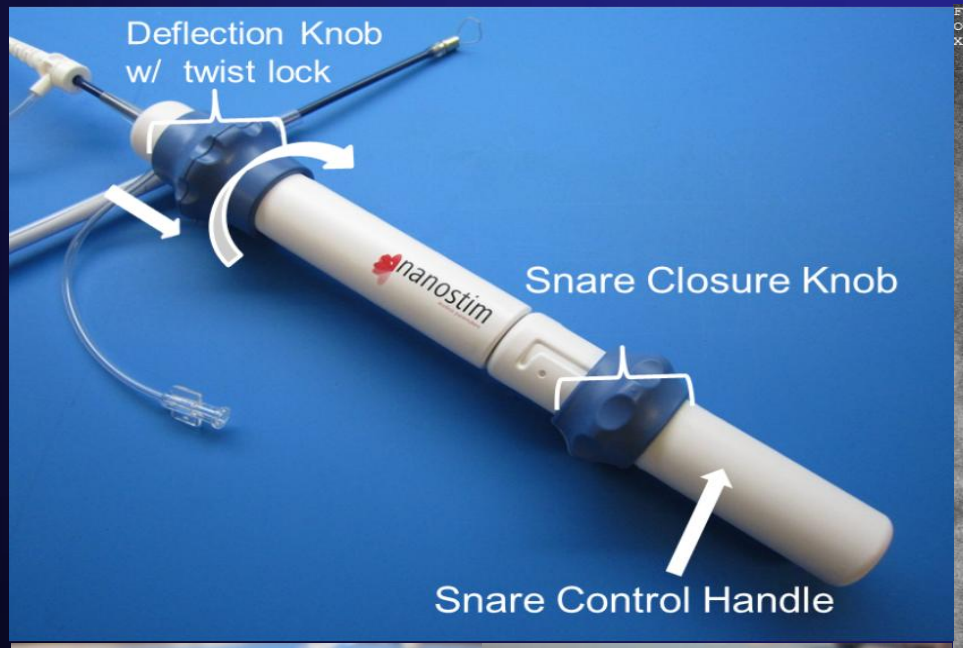
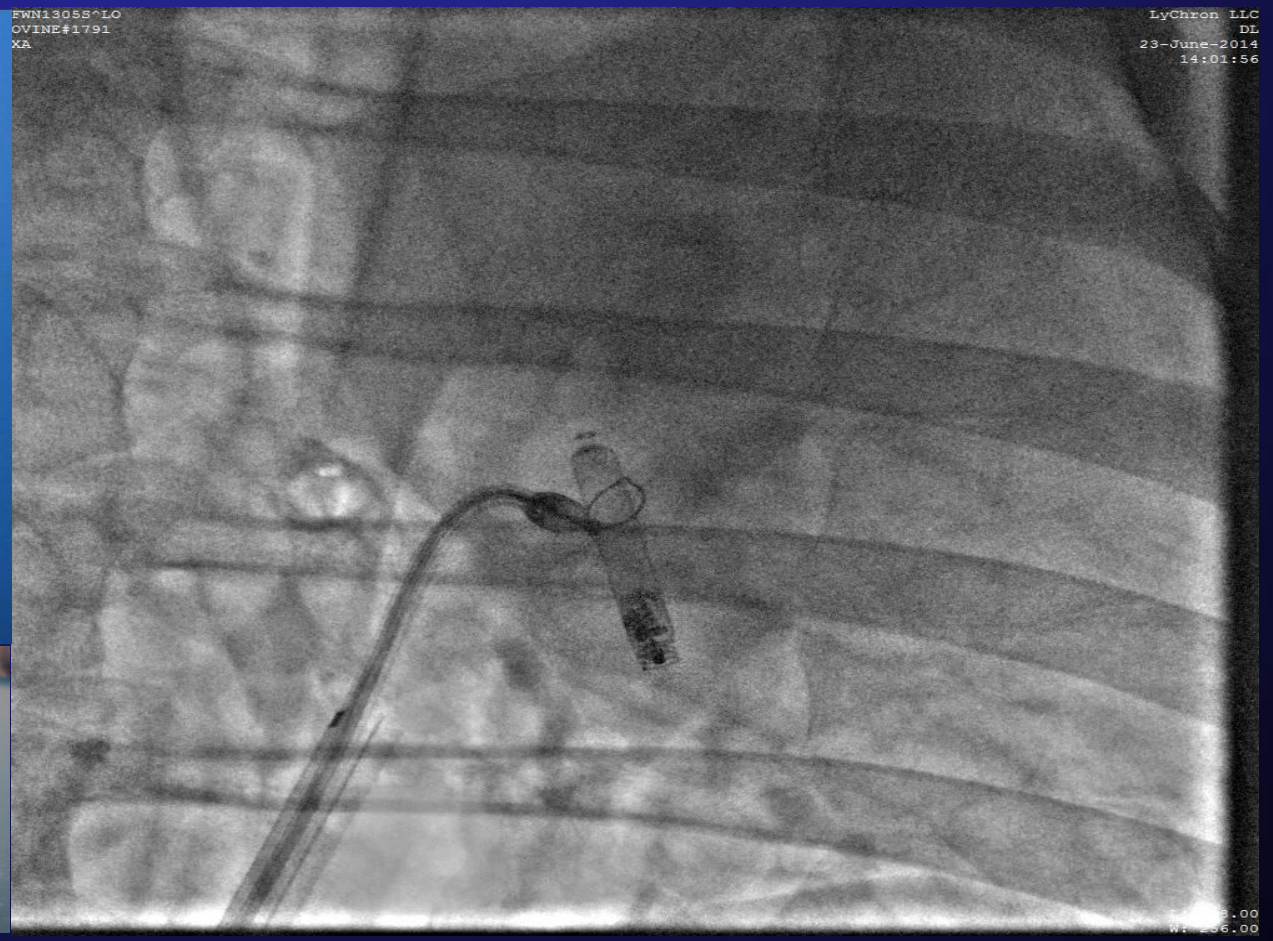
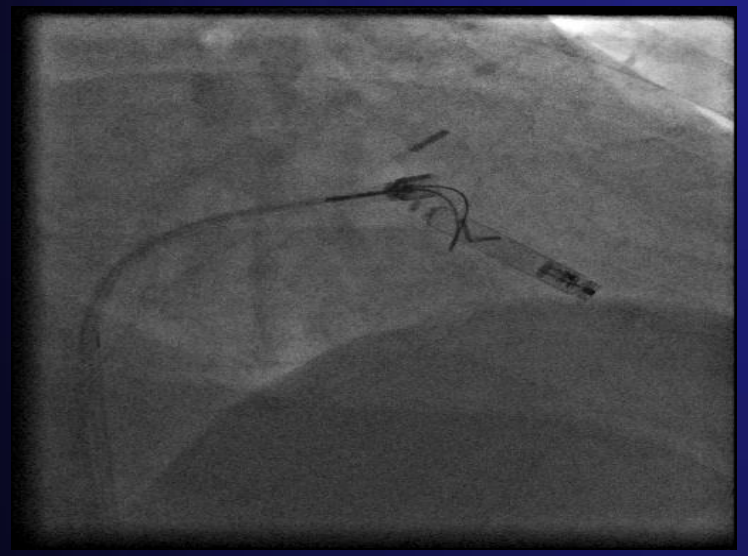
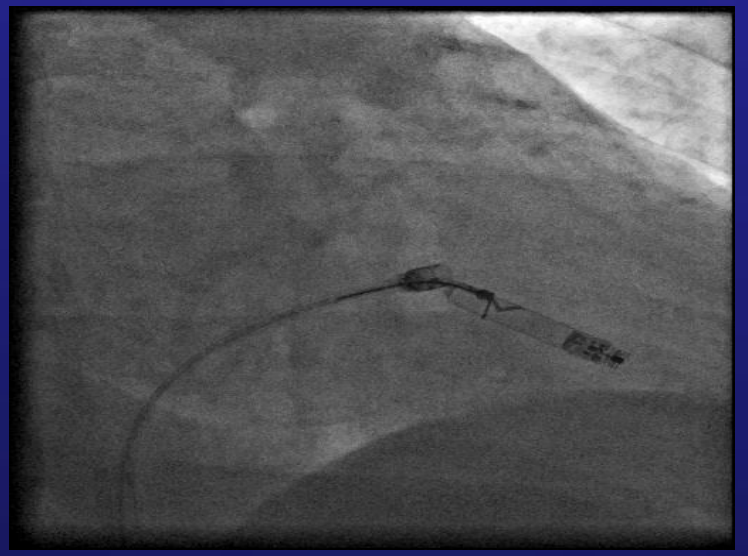
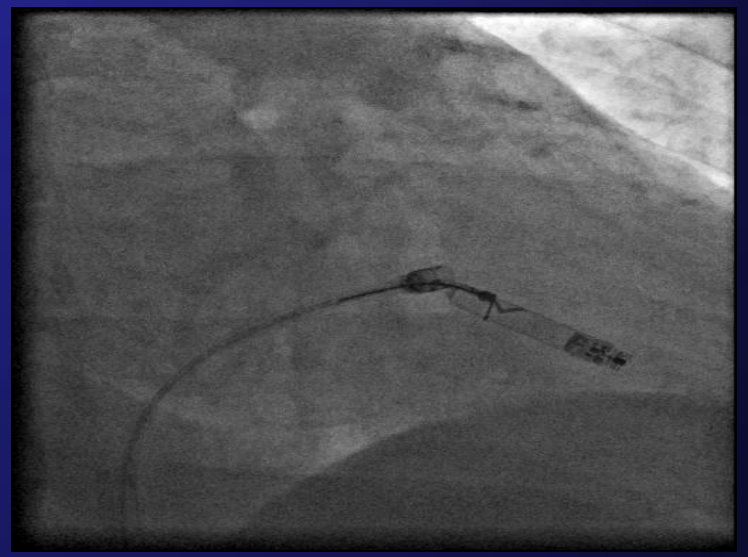
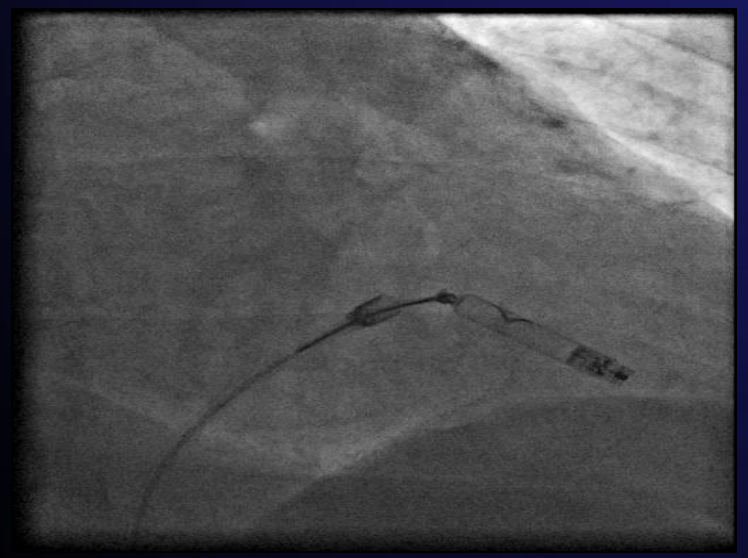
Retrieval Device for Nanostim LCP

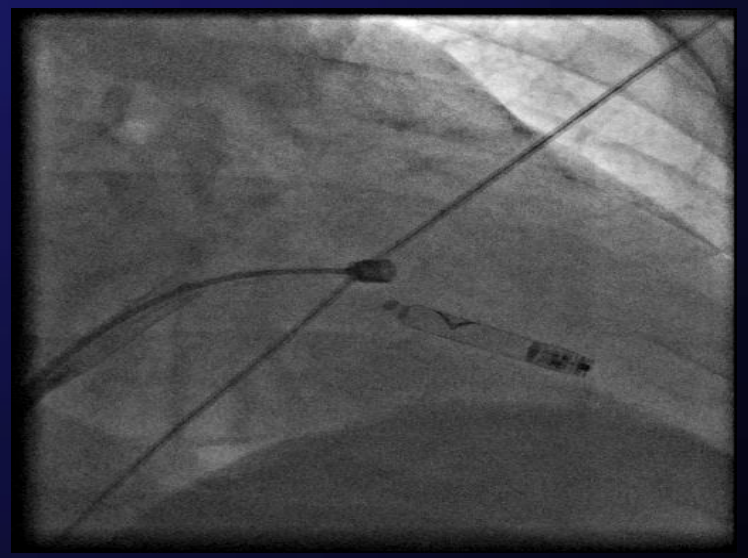




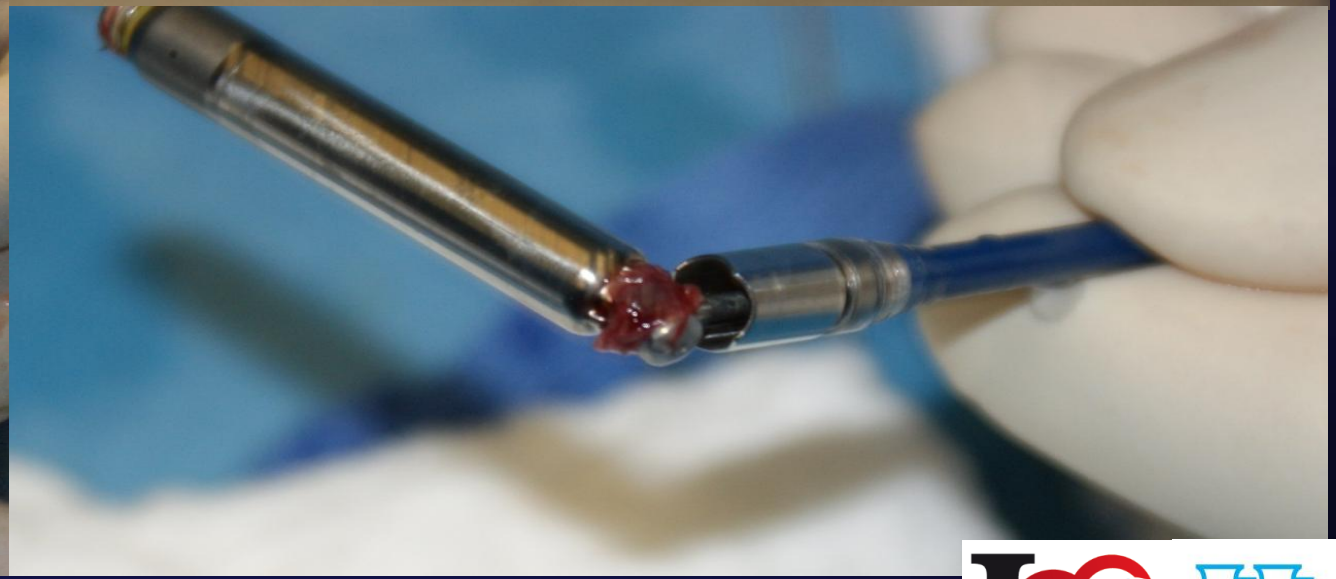
Sperzel J, et al *Europace*. 2013; 15(Suppl 2):860.

Retrieval Nanostim LCP 6 years after First Implant



Retrieval Nanostim LCP: Device Inspection



Retrieval MICRA TPS 1 year + 30 days after First Implant

Retrieval MICRA TPS 1 year + 30 days after First Implant

KardioCentrum

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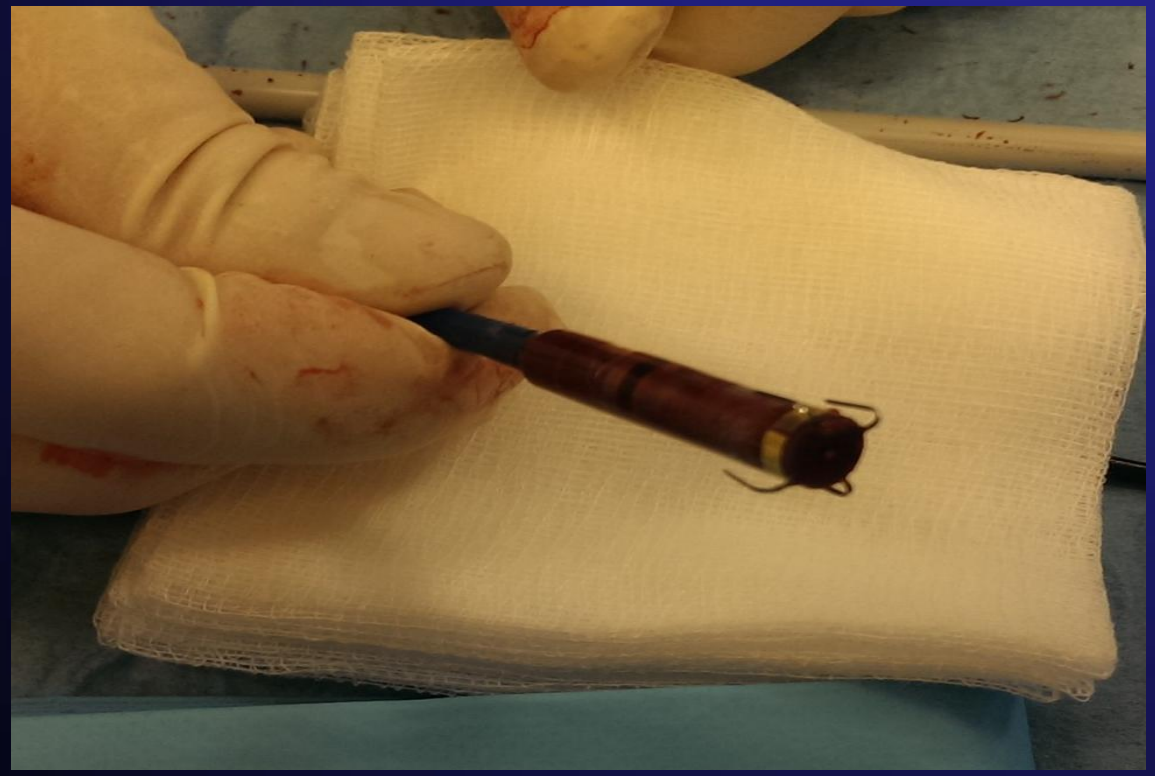
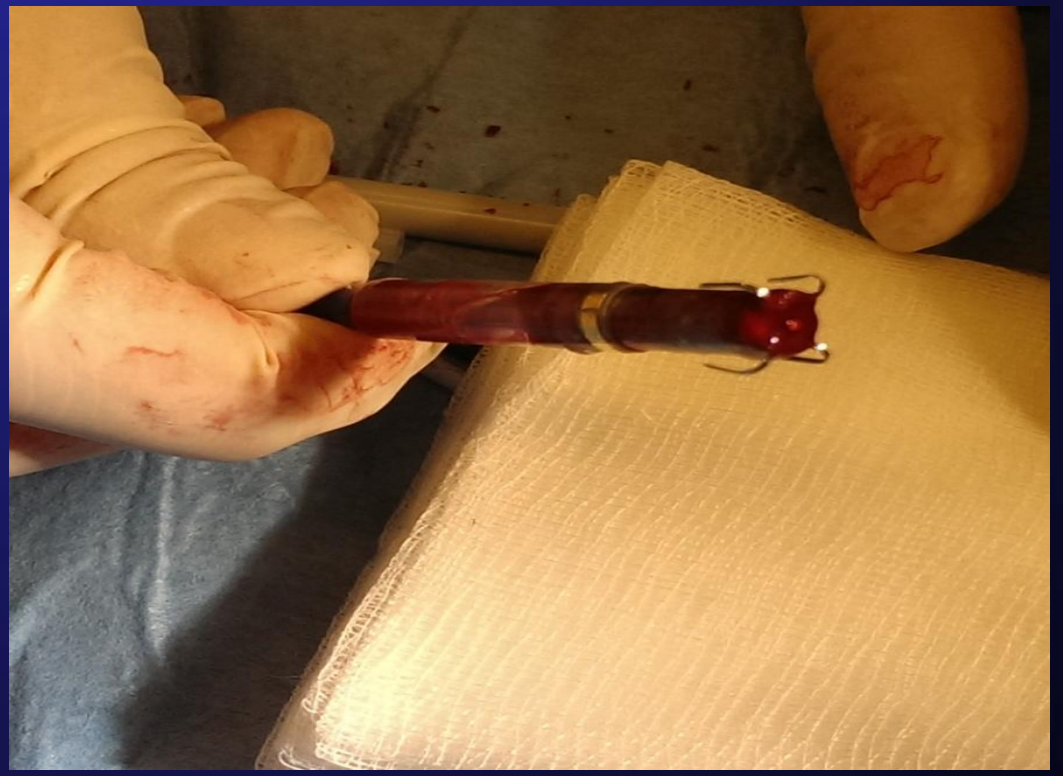
Retrieval MICRA TPS 1 year + 30 days after First Implant



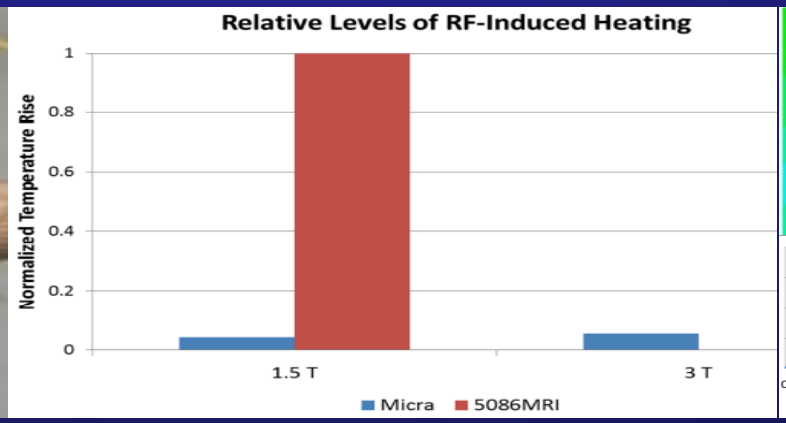


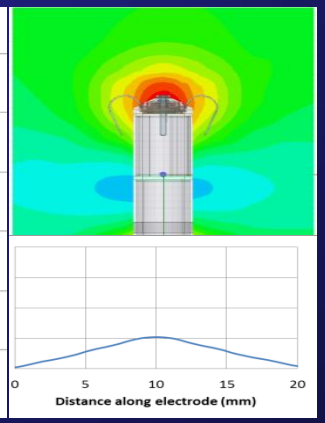
Micra after retrieval:

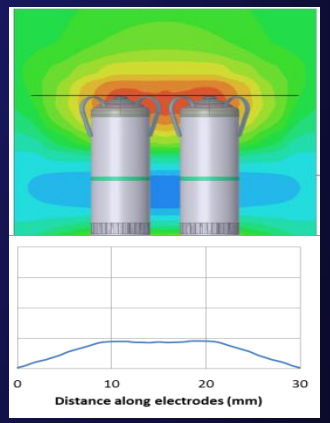
A) In the cup of the delivery catheter
B) Free with talons out with thin tissue layer on the device

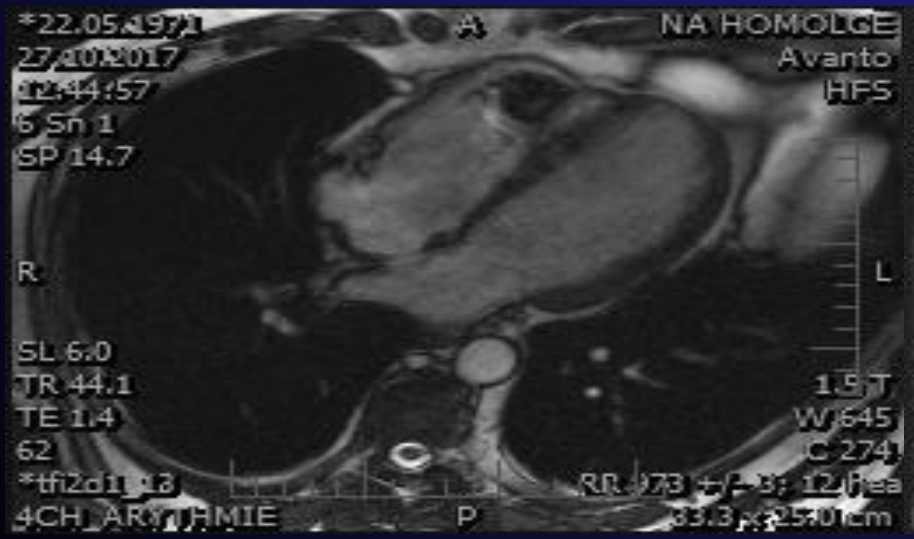
Micra TPS : MRI expose

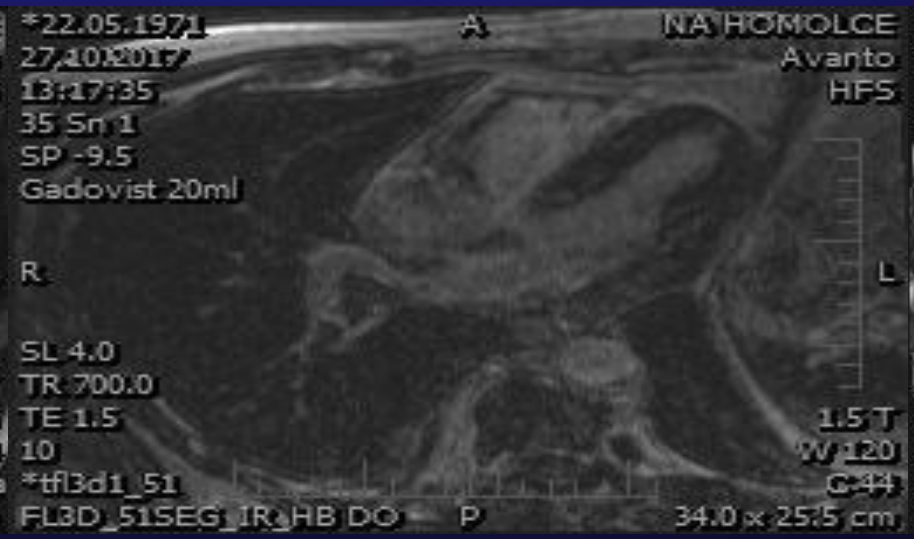
5086 MRI: 2 W/kg, Micra 4 W/kg Phantom: Temperaturfe increase < 0.4 ˚C v 99% 1.5T and 3T











Nanostim & Micra Retrieval: Homolka Experiences

- (**NANOSTIM**) 68/77 successful retrieval (90.4%)
- Retrieval Failed = 9
  - LP „docking button“ not reached/fracture = 6
  - Detachment of docking button = 3

- Retrieval Success
  - Since Implant: < 1 y: 86%;1–2 yrs: 93%; >2 yrs: 90%

- Homolka data
  - **Nanostim: 37 (29 preliminary battery failure) 21 M/12 W (2 – 7 years)**
    33 (89%) successful retrieval !!!

  - **Micra: 6 (2 battery preliminary discharged) 4M/2W (7 months – 2 yrs)**
    5 (83%) successful retrieval !!!

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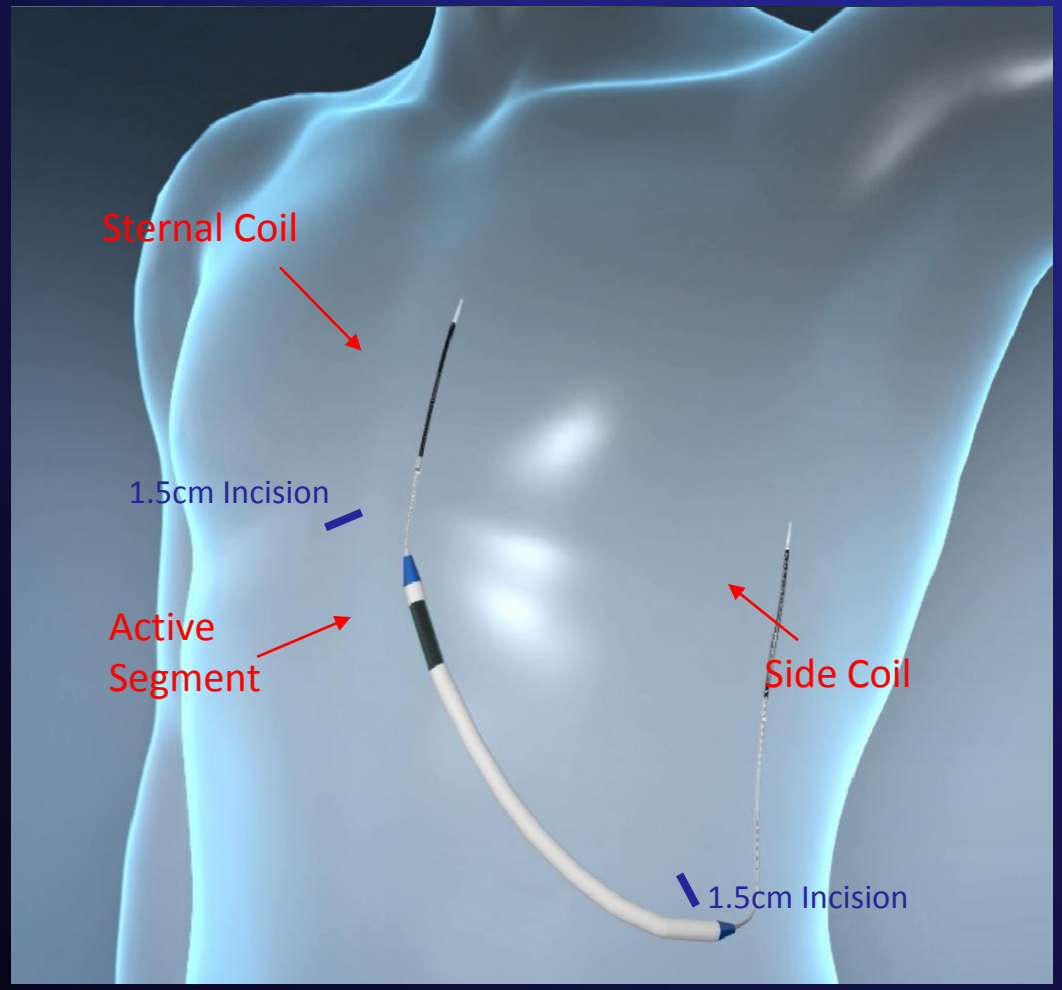
Implantable Subcutaneous String Defibrillator (ISSD)

Basic Concept



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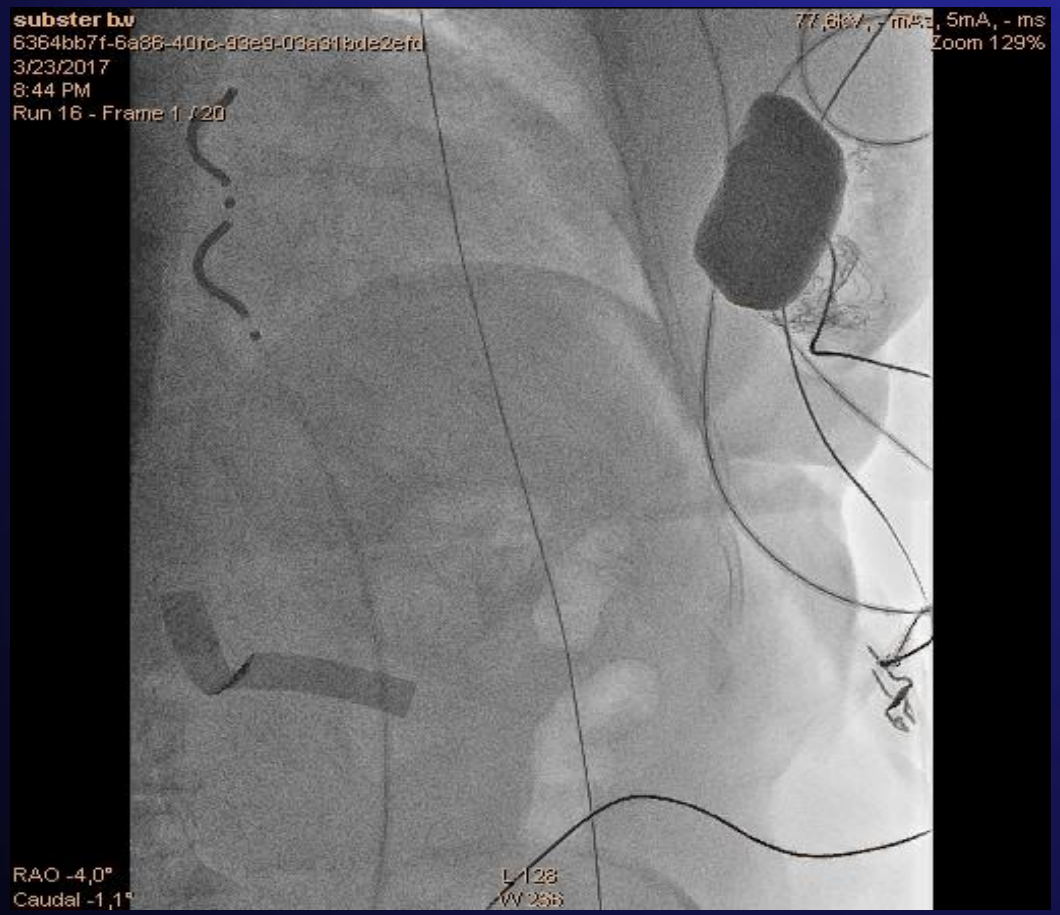
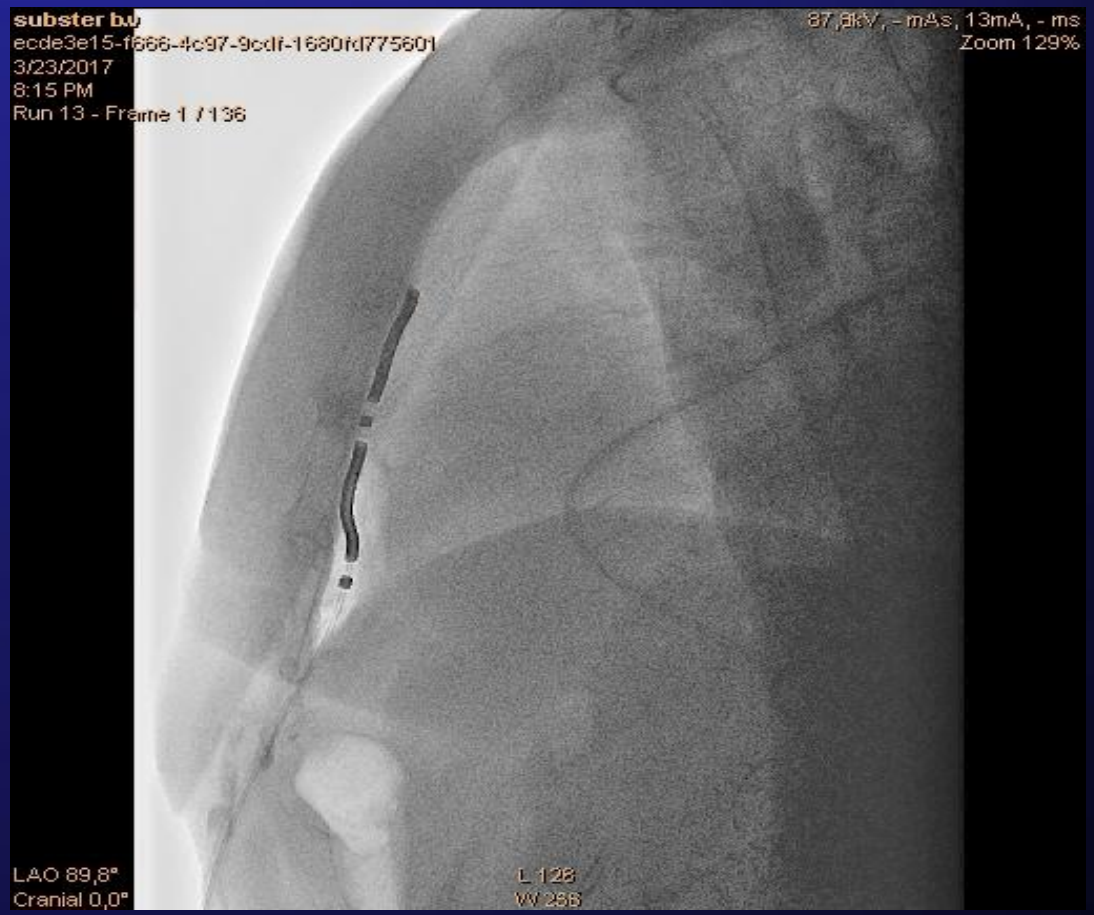
Pacing and Defibrillation Performance of Mediastinal vs Subcutaneous Electrodes: *ASD 2 Trial*





Study demonstrated the ability to pace, sense, and defibrillate using a lead designed specifically for the substernal space.

Boersma LVA,Merkely B, Neuzil P et al: JACC EP 2019;2:186

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Leadless dvoudutinová stimulace

Nový systém AVEIR™

Changes to the LP docking button from “Flexible Cables” to “Fixed Post”

Updated battery chemistry tested to 72◦C confirming chemistry stability

Changes to the LP length :

42.3 mm to 38.0 mm

& diameter from: **18F to 19.5F**

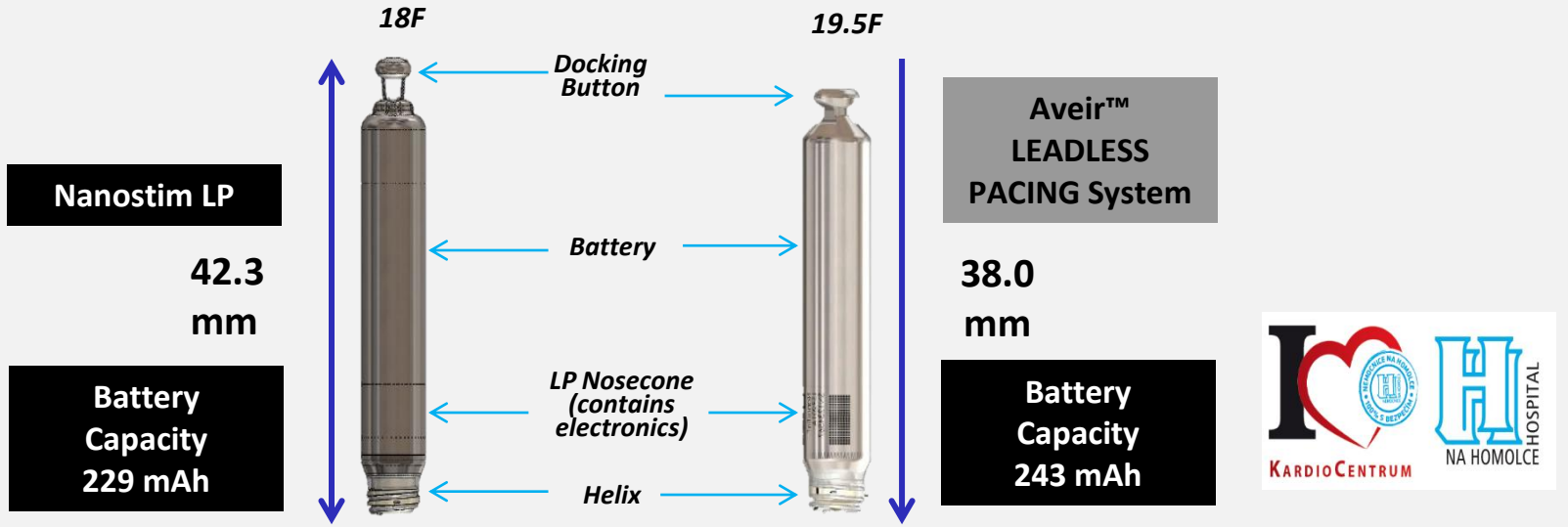
Updates to the LP electronic components while preserving the functionality of the device

Changes to the LP helix to provide additional mitigation to the risk of perforation and helix damage occurring during implant, repositioning or retrieval.

Increased battery capacity: 229 to 243 mAh

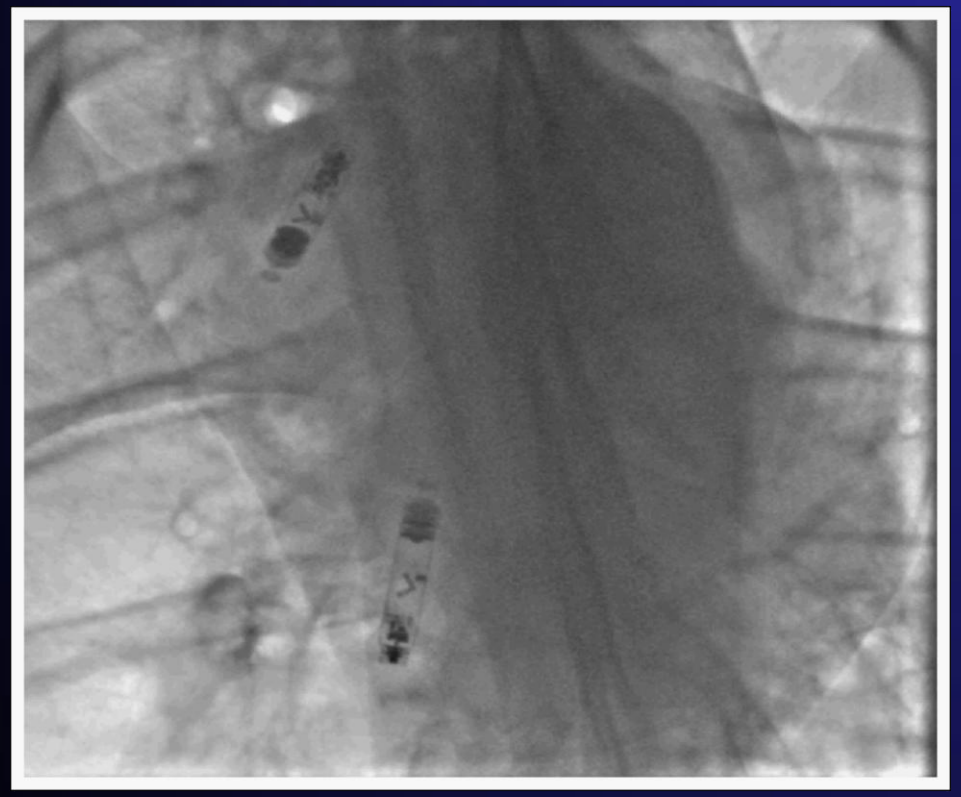
Loadable catheter

Upgradeable to DR*



Dvoudutinová „leadless“ technologie

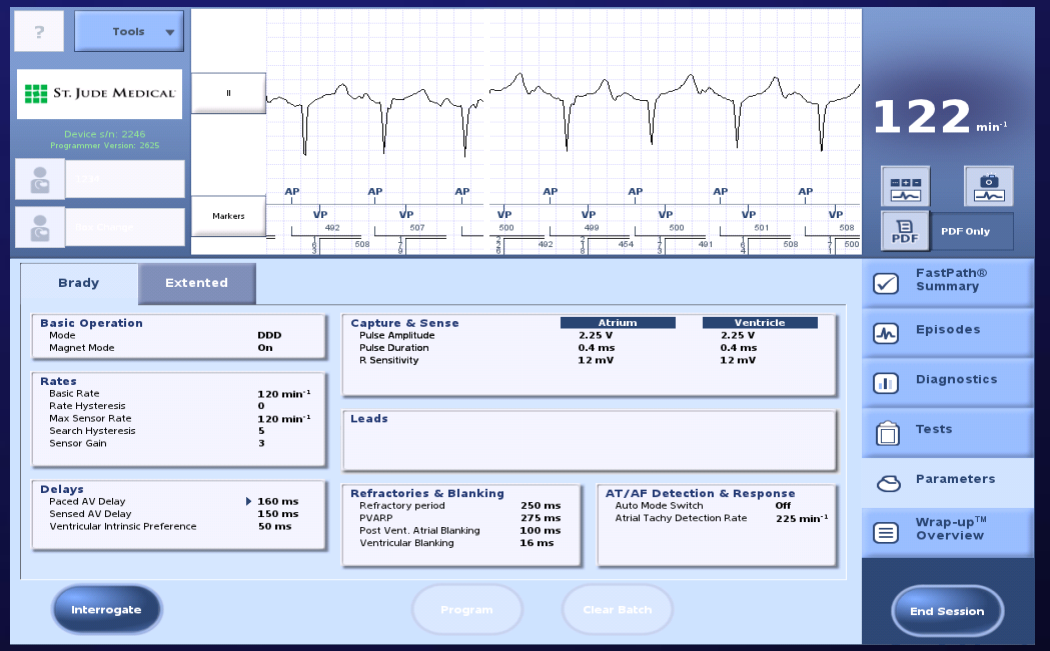
AP



Preklinická implantace DDDR

Develop leadless dual chamber pacemakers that:

- *Can be safely implanted into the RA and RV*
- *Beat-to-beat communication with an AV delay*
- *Provide dual chamber functionality DDD(R) PM*
- *Retrievable and upgradeable*



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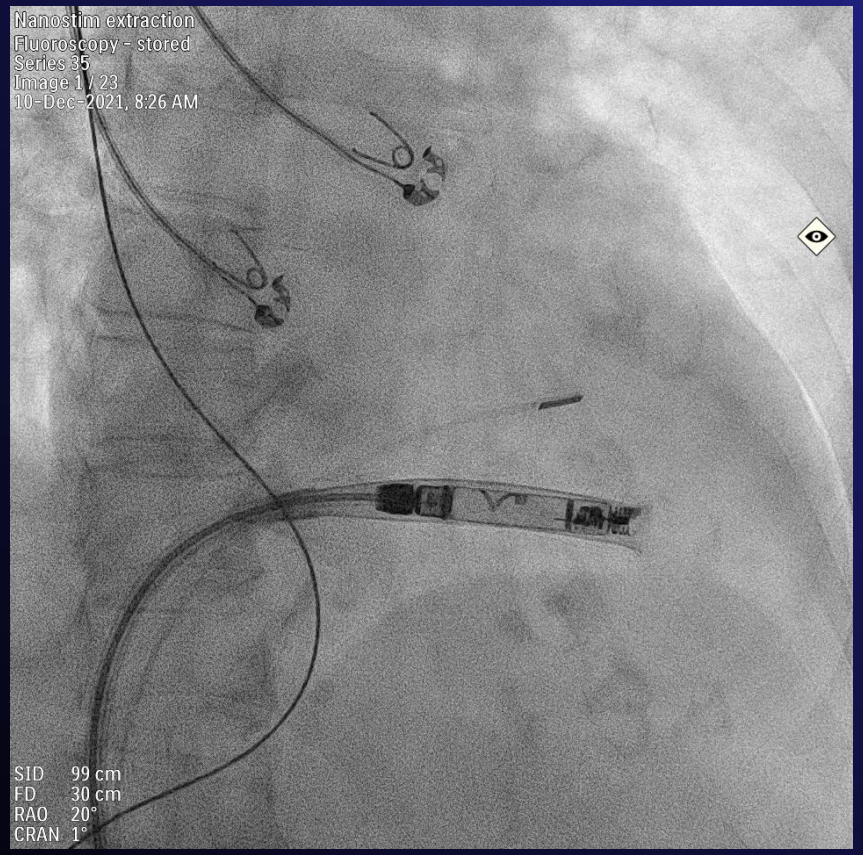
Kazuistika

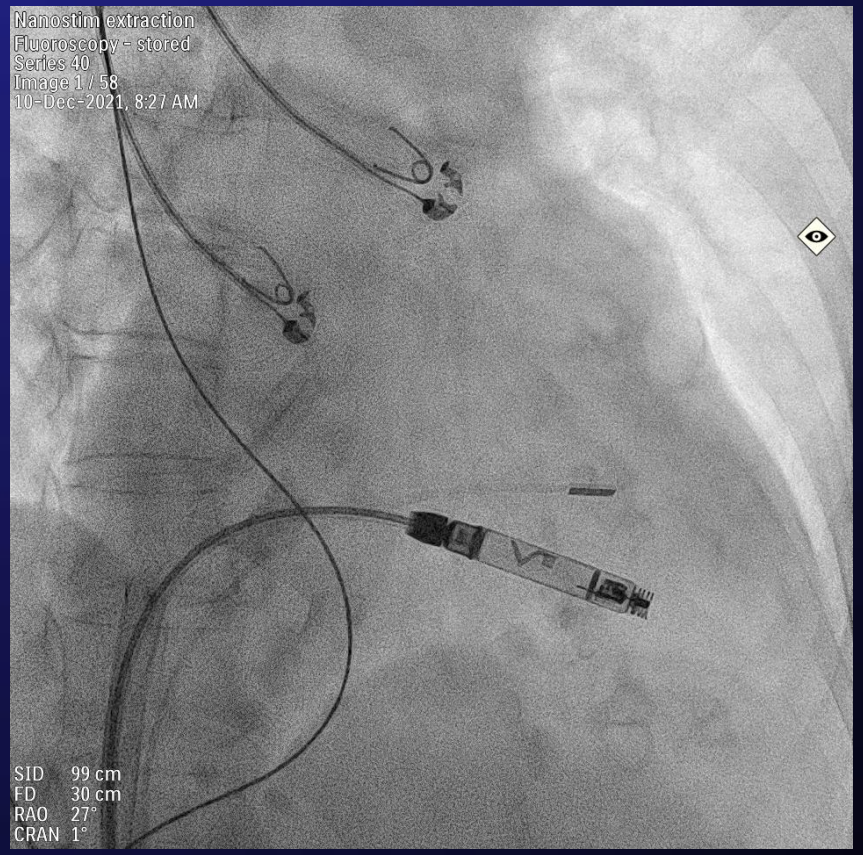
Aveir VR Implantace 12/2021

Positioning new
AVEIR VR Dec 10, 08:26



Aveir VR:
We tried to get different position with new LP

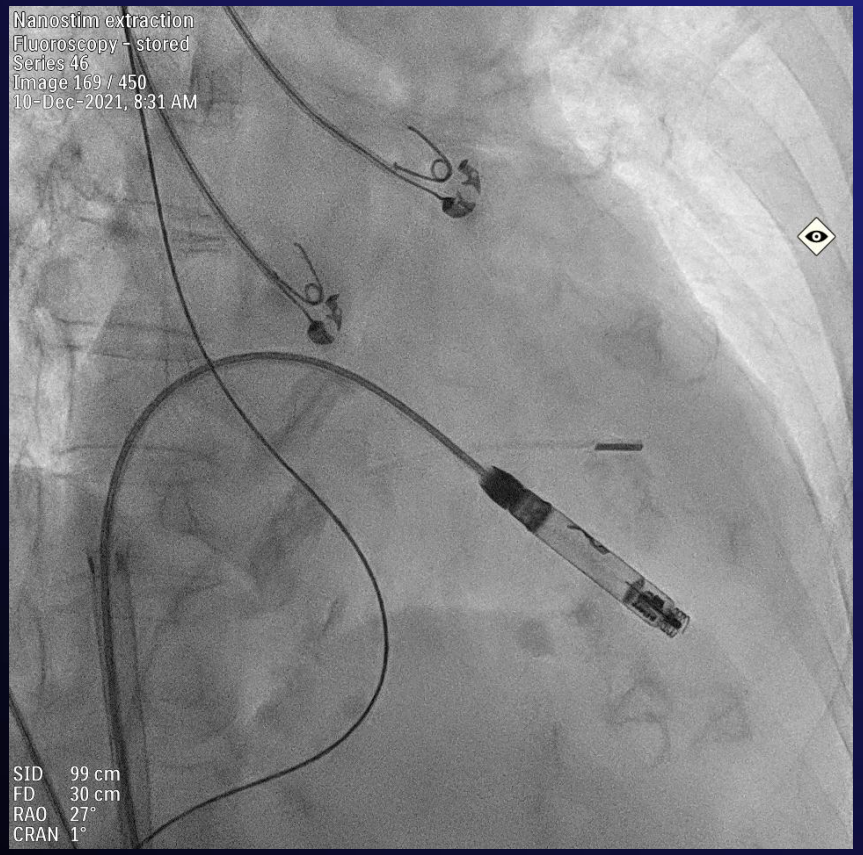
Re-positioning new
AVEIR VR Dec 10, 08:27



Kazuistika

Aveir VR Implantace 12/2021

Fixation by slow rotation
AVEIR VR Dec 10, 08:31



Aveir VR:
Easy to implant

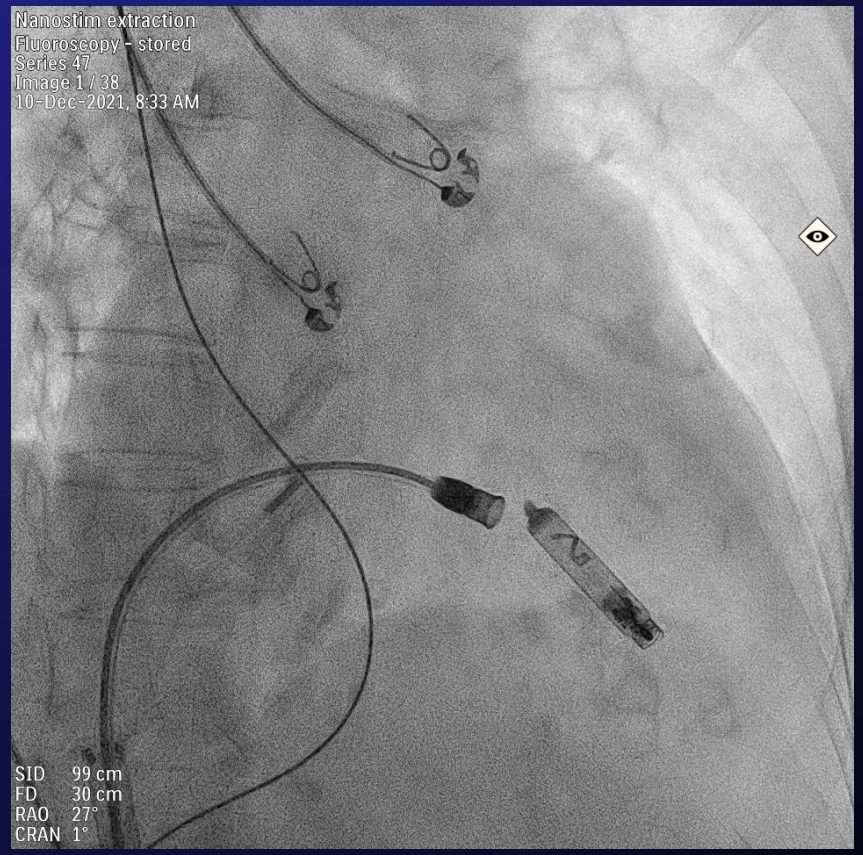
Higher acute thresholds:

2,5 V/0,4 ms

Waiting period 4 minutes:

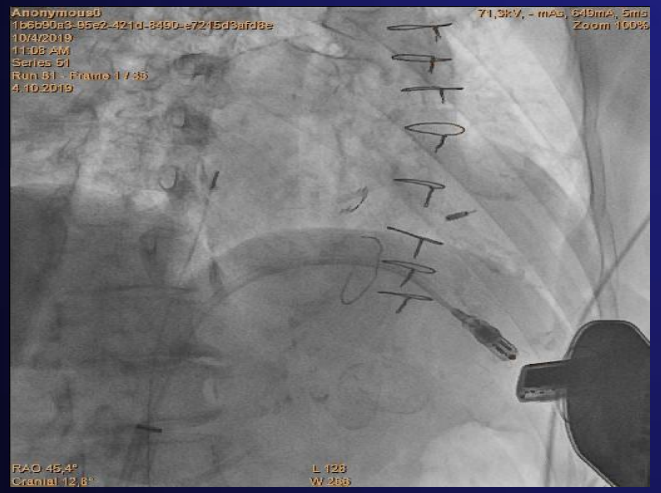
1,0 V/0,4 ms
Impedance 630 Ω
R wave 9 mV

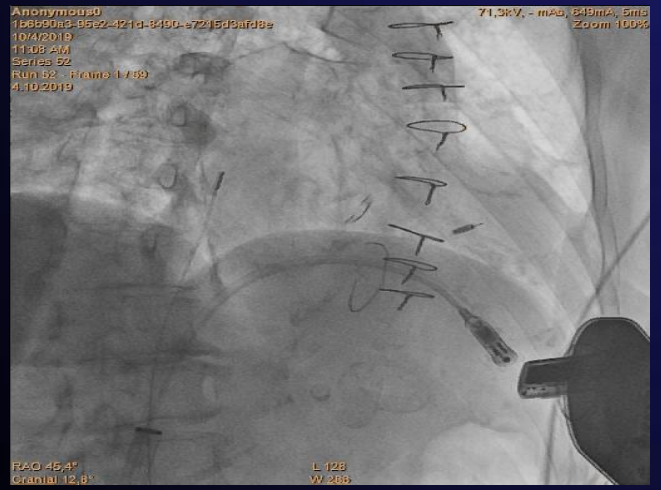
Stability test
AVEIR VR Dec 10, 08:33

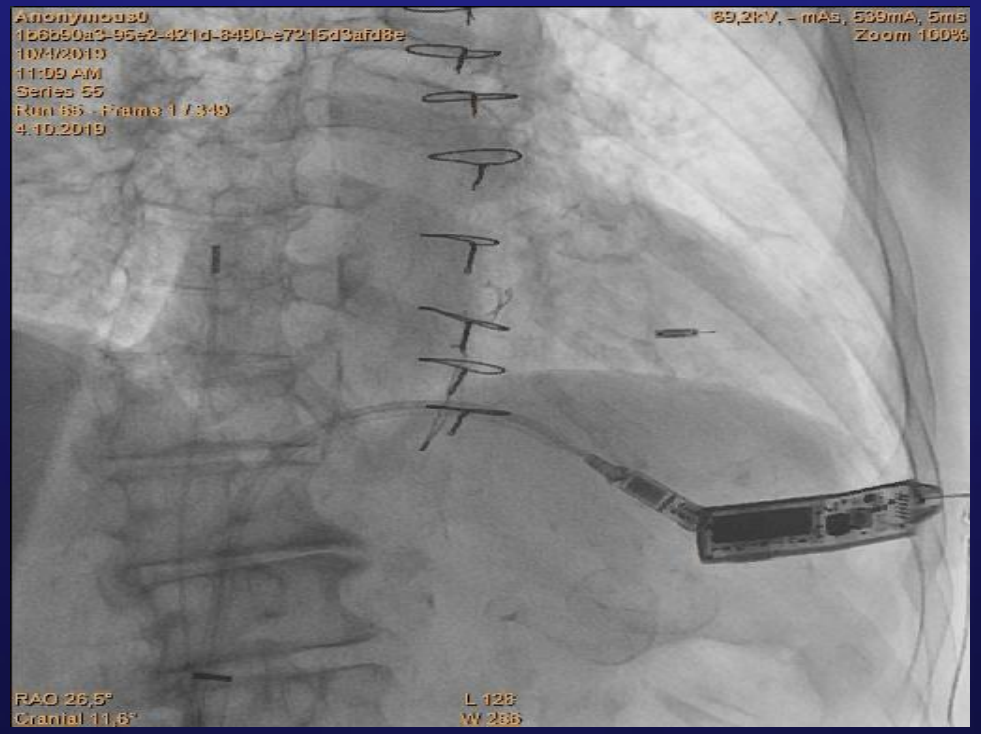


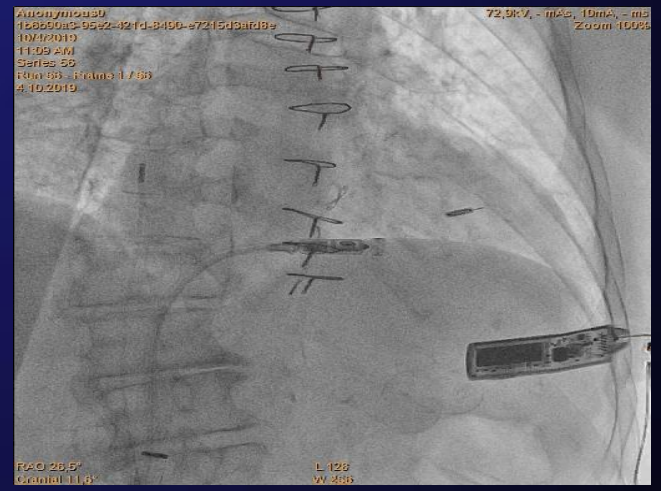
Case Presentation

TPS Micra Retrieval 1251 days









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