

Telemonitoring a prevence hospitalizace pacientů se srdečním selháním

Filip Málek

XXVIII. výroční konference ČASS

Brno 2025



KARDIOLOGICKÁ KLINIKA
1. LÉKAŘSKÉ FAKULTY UNIVERZITY KARLOVY A NEMOCNICE NA HOMOLCI

Obsah sdělení

- Telemonitoring u srdečního selhání
- Parametry pro vzdálenou monitoraci
- Vědecké poznatky
- Využití v praxi

Možnost vzdálené monitorace pacientů se srdečním selháním

- Telefon, E-mail , Skype, WhatsApp
- Elektronická monitorace TK a hmotnosti
- Implantabilní záznamník (Reveal)
- CIED – ICD, CRT
- Multiparametrické senzory – Future Cardia
- Hrudní impedance – CRT (OptiVol)
- Tlakové senzory – CardioMems
- Senzor v DDŽ

Monitorace fyzikálních a biometrických parametrů v ambulanci srdečního selhání AmbSS

- Telemonitoring změny zdravotního stavu
 - Telefon, E-mail , Skype, WhatsApp (sestra AmbSS)
- Telemonitoring biometrických parametrů
 - viz výše + elektronická monitorace TK a hmotnosti (AmbSS, klinický výzkum)
- Telemonitoring poruch srdečního rytmu
 - implantabilní záznamník



Telemonitoring pomocí CIED

- Studie s různým plánem a různými parametry

openheart Remote monitoring in patients with heart failure with cardiac implantable electronic devices: a systematic review and meta-analysis

Michael J McGee^{1,2}, Max Ray², Stephn C Briennes², Shanathan Srittharan², Andrew J Boyle^{2,3}, Nicholas Jackson², James W Leitch², Aaron L Sverdlow^{2,3}

J Innov Cardiac Rhythm Manage. 2021;12(8):4621-4624

DOI: 10.19102/icrm.2021.120802

REMOTE MONITORING

ORIGINAL RESEARCH

Impact of Remote Monitoring on Hospitalizations for Heart Failure: A Five-year Single-center Experience

JONATHAN ROSMAN, MD, FACC, FHRS,^{1,2} MURRAY ROSENBAUM, MD, FACC, FHRS,^{1,2} ERIC BERKOWITZ, MD, FACC, FHRS,^{1,2} and E. MARTIN KLOOSTERMAN, MD, FACC, FHRS^{1,2}

¹Cardiac Arrhythmia Service, Boca Raton Regional Hospital, Delray Medical Center, Boca Raton, FL, USA
²Department of Clinical Biomedical Sciences, FAU Medical School, Boca Raton, FL, USA

ESC
European Society of Cardiology
Europe (2022) 24, 256–267
doi:10.1093/eurpub/ckab160

CLINICAL RESEARCH
Remote CIED monitoring

Remote monitoring data from cardiac implantable electronic devices predicts all-cause mortality

Fozia Zahir Ahmed^{1,2†}, Camilla Sammut-Powell^{1†}, Chun Shing Kwok^{1,4,5}, Tricia Tay¹, Manish Motwani^{1,2}, Glen P. Martin¹, and Joanne K. Taylor^{3,6*}

¹Division of Cardiovascular Sciences, Faculty of Biology, Medicine and Health, University of Manchester, Manchester, UK; ²Department of Cardiology, Manchester University Hospitals NHS Foundation Trust, Oxford Rd, Manchester, UK; ³Division of Population Health and Data Sciences, Faculty of Biology, Medicine and Health, University of Manchester, Manchester Academic Health Science Centre, Manchester, UK; ⁴School of Primary, Community and Social Care, Keele University, Stoke-on-Trent, UK; and ⁵Department of Cardiology, University Hospital of Northumbria NHS Trust, Newcastle, UK

Received 1 December 2020; editorial decision 17 April 2021; online published ahead of print 3 October 2021

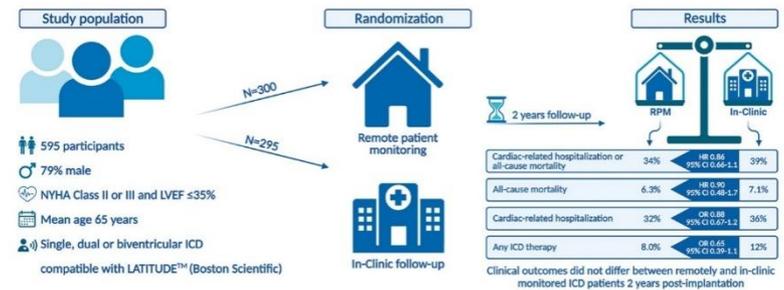
Aims To determine if remotely monitored physiological data from cardiac implantable electronic devices (CIEDs) can be used to identify patients at high risk of mortality.

Methods and results This study evaluated whether a risk score based on CIED physiological data (Trigge-Heart Failure Risk Status, Trigge-HFRS; previously validated to predict heart failure (HF) events) can identify patients at high risk of death. Four hundred and thirty-nine adults with CIEDs were prospectively enrolled. Primary observed outcome was all-cause mortality (median follow-up 702 days). Several physiological parameters (including heart rate profile, atrial fibrillation/tachycardia (AF/AT) burden, ventricular rate during AT/AF, physical activity, thoracic impedance, therapies for ventricular tachycardia/fibrillation) were continuously monitored by CIEDs and dynamically combined to produce a Trigge-HFRS every 24 h. According to transmission parameters were categorized into 'high-risk' or 'lower high-risk' groups. During follow-up, 285 patients (63%) had a high-risk episode and 40 patients (14%) died (50 in high-risk group; 10 in lower high-risk group). Significantly more cardiovascular deaths were observed in the high-risk group, with mortality rates across groups of high vs. never-high 10.3% vs. <4.0%, $P = 0.03$. Experiencing any high-risk episode was associated with a substantially increased risk of death [odds ratio (OR): 3.07, 95% confidence interval (CI): 1.57–6.28, $P = 0.002$]. Furthermore, each high-risk episode ≥ 14 consecutive days was associated with increased odds of death (OR: 1.26, 95% CI: 1.06–1.48, $P = 0.006$).

Conclusion Remote monitoring data from CIEDs can be used to identify patients at higher risk of all-cause mortality as well as HF events. Distinct from other prognostic scores, this approach is automated and continuously updated.

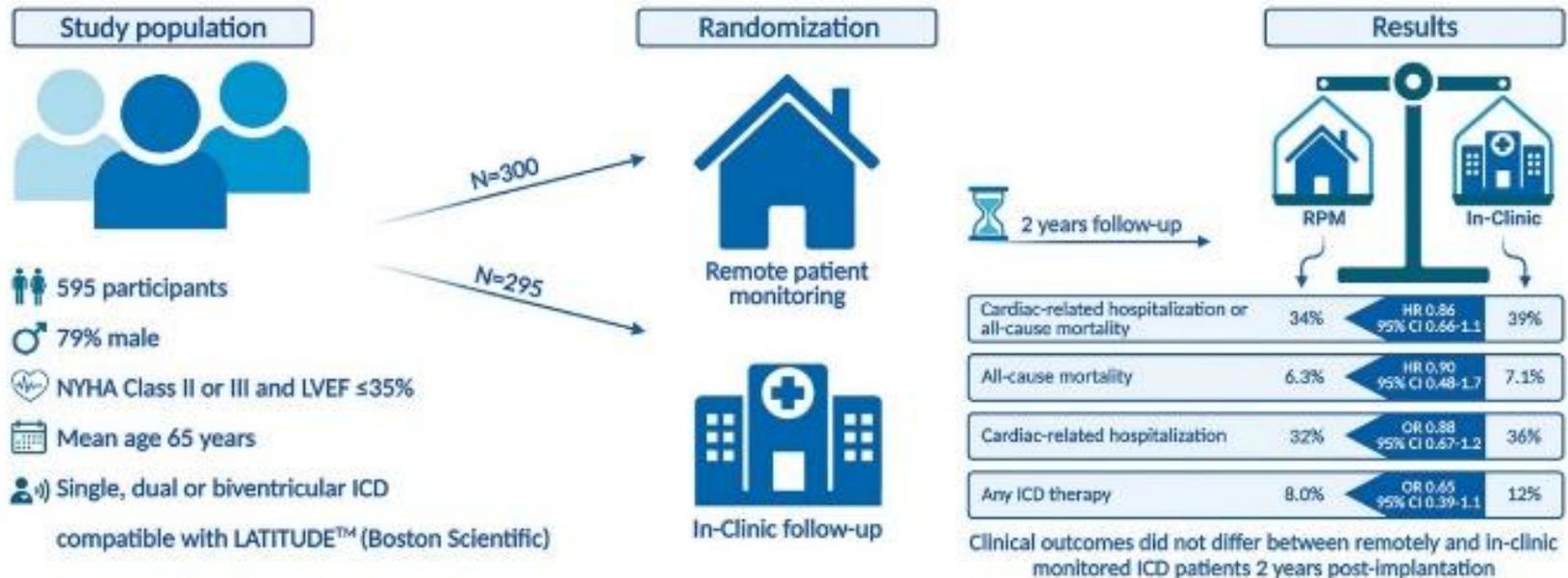
Keywords Cardiac resynchronization • Defibrillators • Prognosis • Risk score • Mortality • Remote monitoring

Effect of remote monitoring on clinical outcomes in European heart failure patients with an implantable cardioverter-defibrillator: secondary results of the REMOTE-CIED randomized trial



Studie REMOTE-CIED (cardiac implantable electronic devices)

Effect of remote monitoring on clinical outcomes in European heart failure patients with an implantable cardioverter-defibrillator: secondary results of the REMOTE-CIED randomized trial

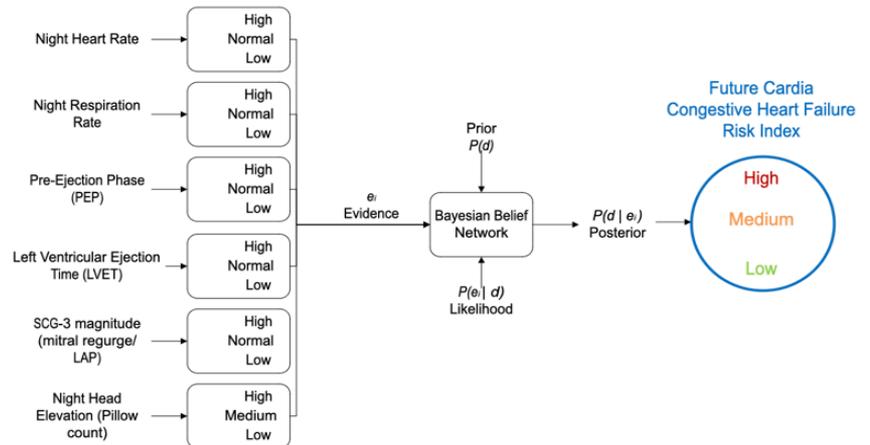
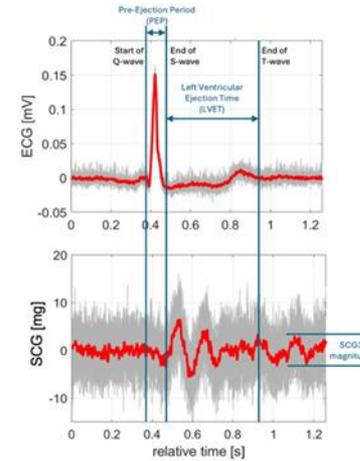
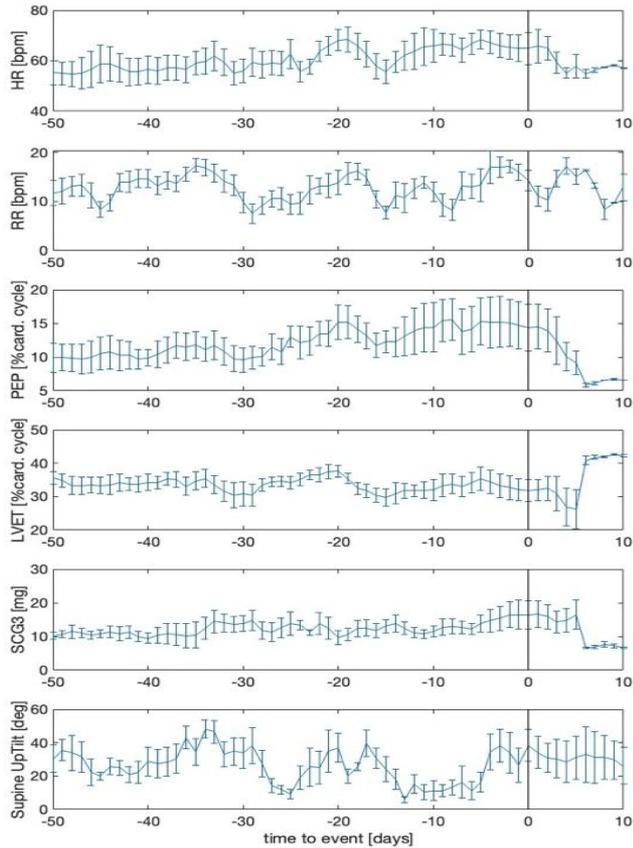


Více parametrický impantabilní monitor Future Cardia



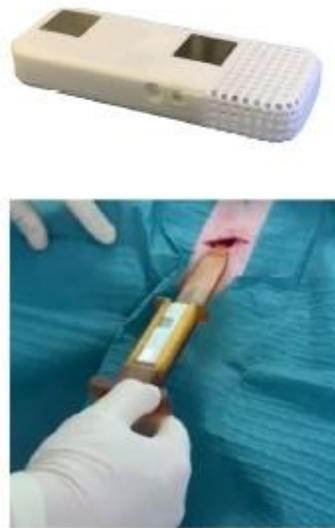
HR – heart rate, RR – respiration rate, PEP – Pre-ejection Period, LVET – Left Ventricular Ejection Time, SCG3 – third wave of the SCG (seismocardiography), upper body tilt angle (Supine Uptilt)

Implantabilní monitor Future Cardia

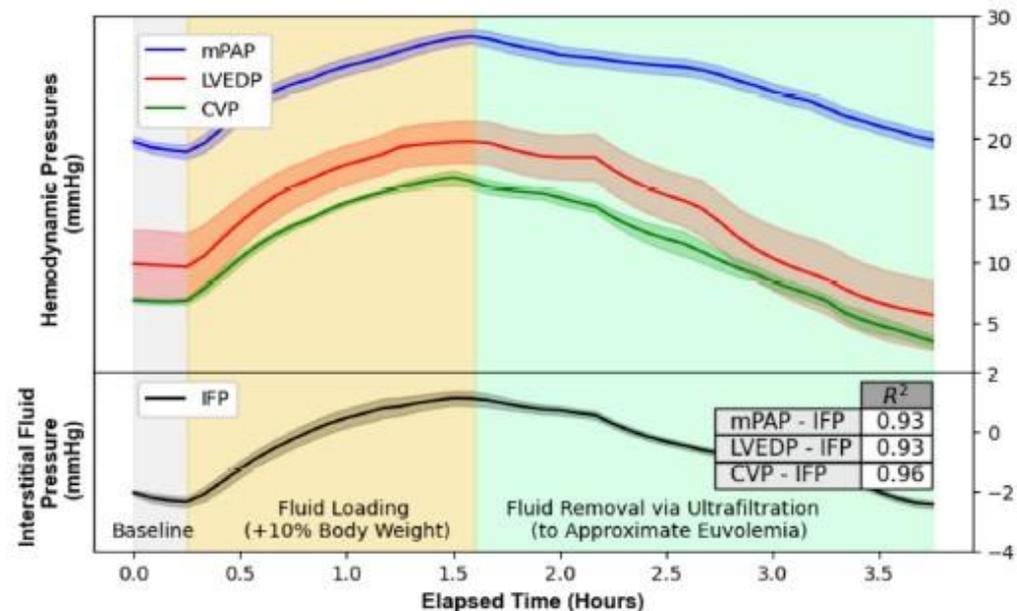


Implantabilní senzor pro monitoraci IFP (tlak intersticiální tekutiny)

A IFPx Subcutaneous Multiparameter Sensor and Insertion Procedure



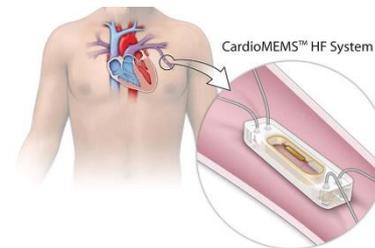
B Relationship of Interstitial Fluid Pressure (IFP) and Hemodynamic Pressures



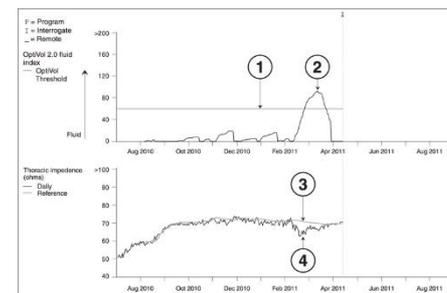
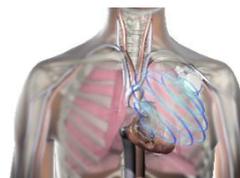
(A) The IFPx sensor is inserted subcutaneously in a 5-minute procedure in an office-based setting under local anesthesia. The IFPx sensor measures interstitial fluid pressure (IFP), heart rate, activity, sleep incline, respiratory rate, and more. (B) Pilot data (5-minute rolling mean and SD, representative data, thoracic location) showing the relationship between IFP and hemodynamic pressures in a porcine model of acute fluid-overloaded heart failure. CVP = central venous pressure; LVEDP = left ventricular end diastolic pressure; mPAP = mean pulmonary artery pressure.

Možnosti monitorace volémie pacientů s HF

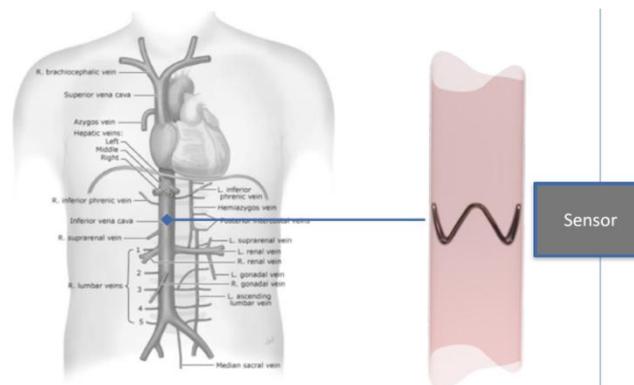
- CardioMems – senzor v plicnici



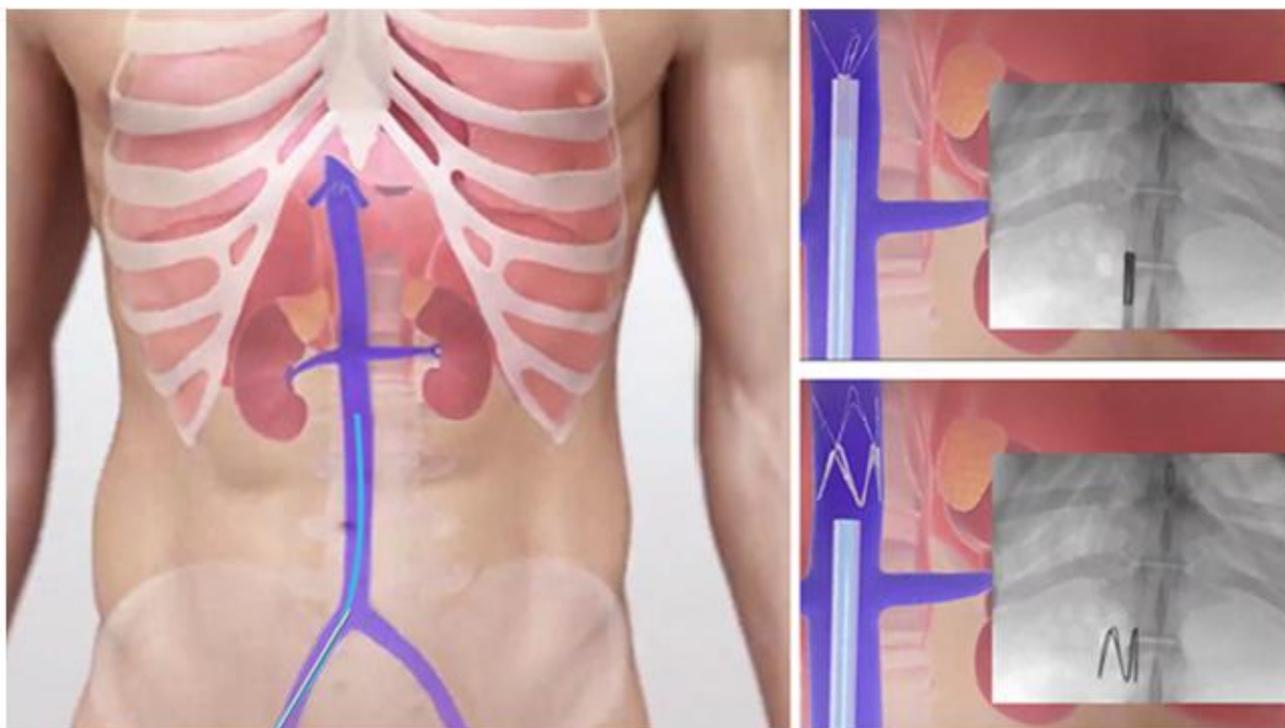
- OptiVol – hrudní impedance (CRT)



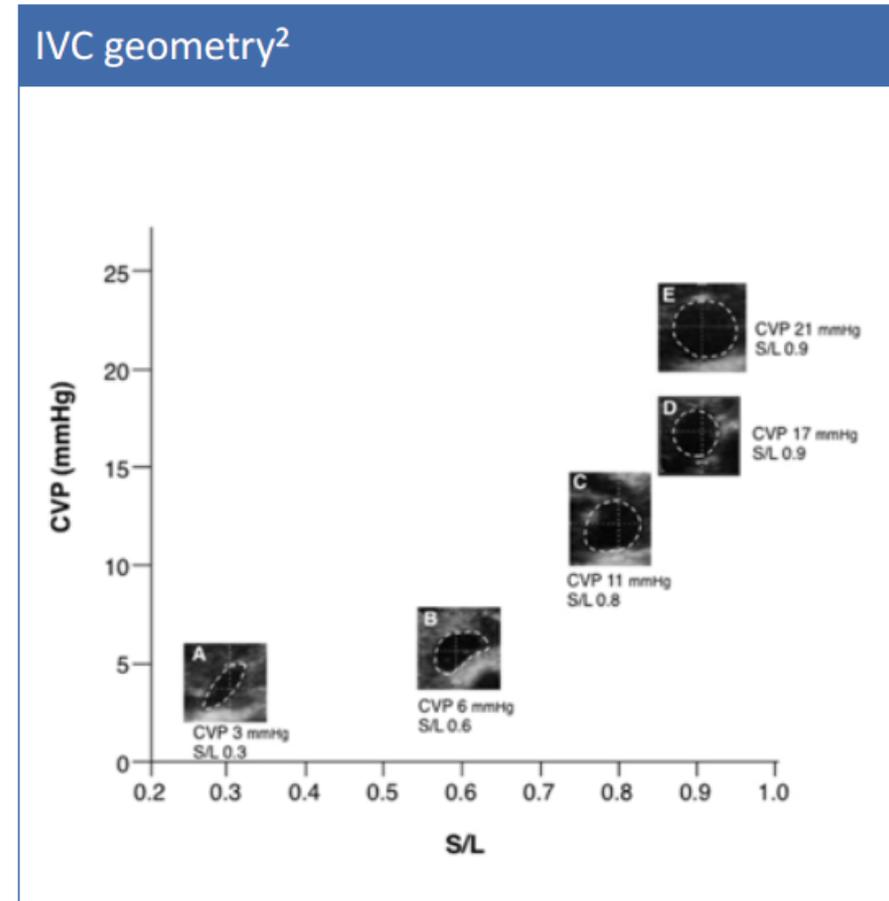
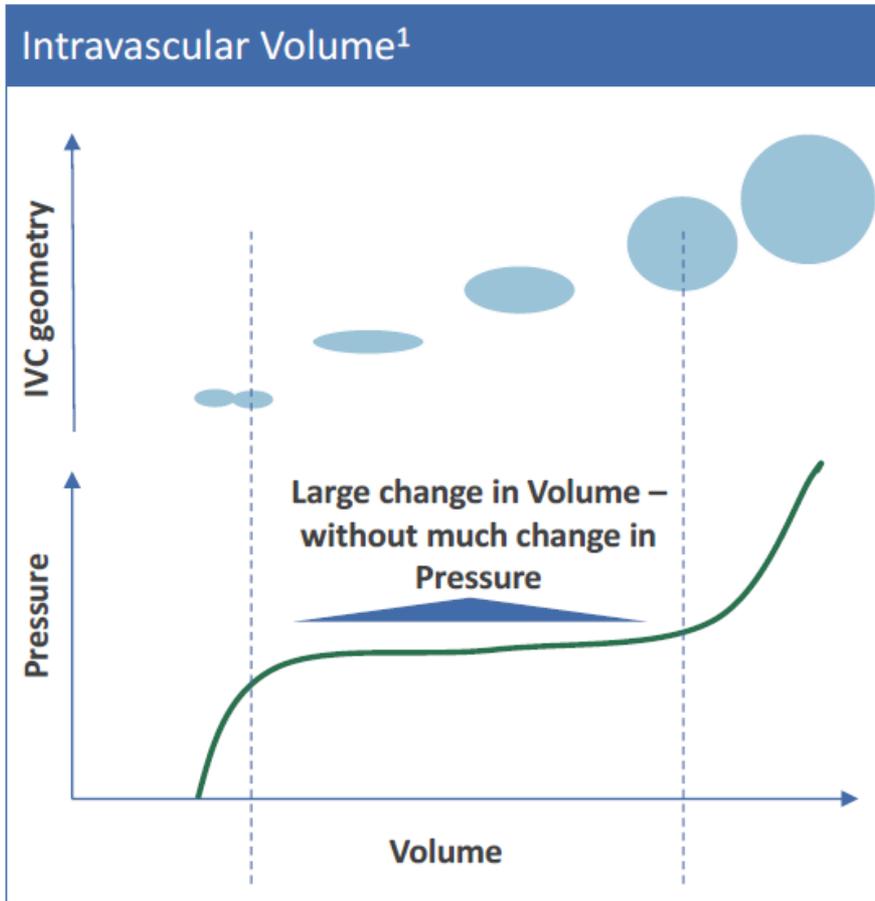
- Senzor v IVC (FIRE I)
- rozměr a kolapsibilita IVC



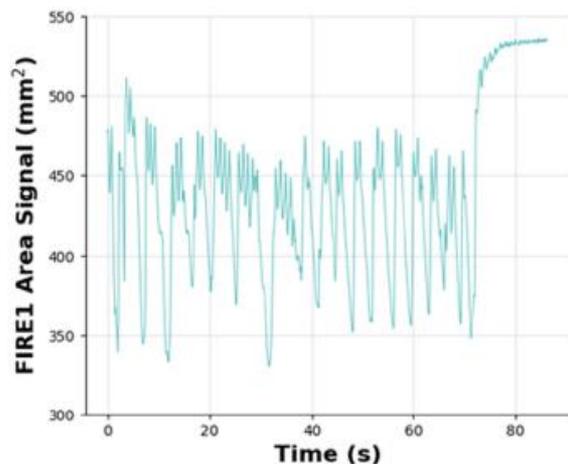
Implantabilní senzor v DDŽ



Dynamické změny morfologie IVC předcházejí rozvoji systémové kongesce



Telemonitorace plochy a kolapsibility DDŽ

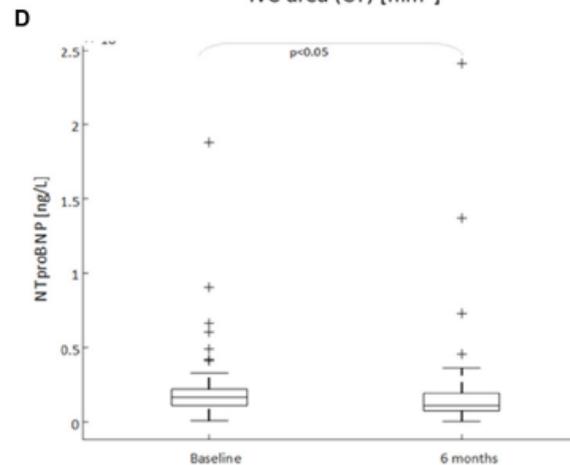
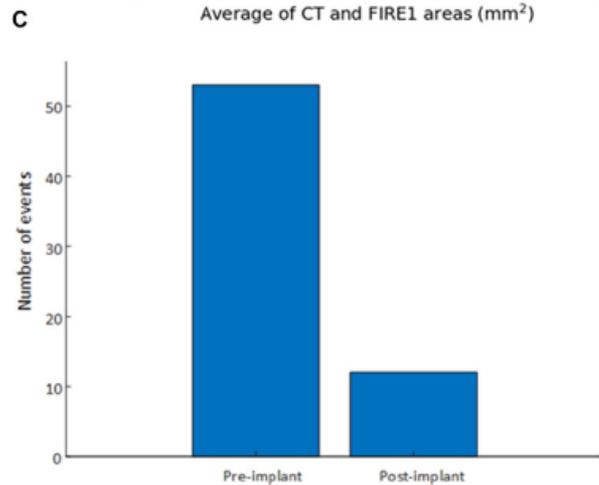
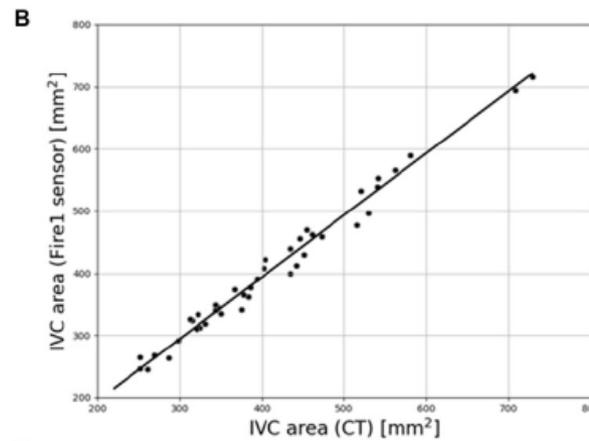
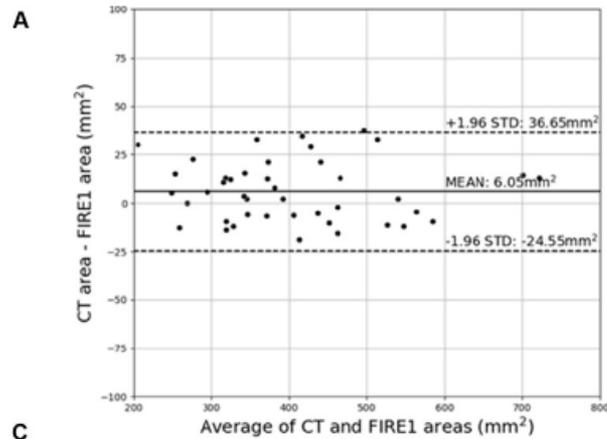


Daily IVC Area and Collapsibility



Prioritized IVC metrics over time per patient

Vědecké poznatky – studie FUTURE HF



JACC: HEART FAILURE
© 2023 THE AUTHOR(S). PUBLISHED BY ELSEVIER ON BEHALF OF THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION. THIS IS AN OPEN ACCESS ARTICLE UNDER THE CC BY-NC-ND LICENSE (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

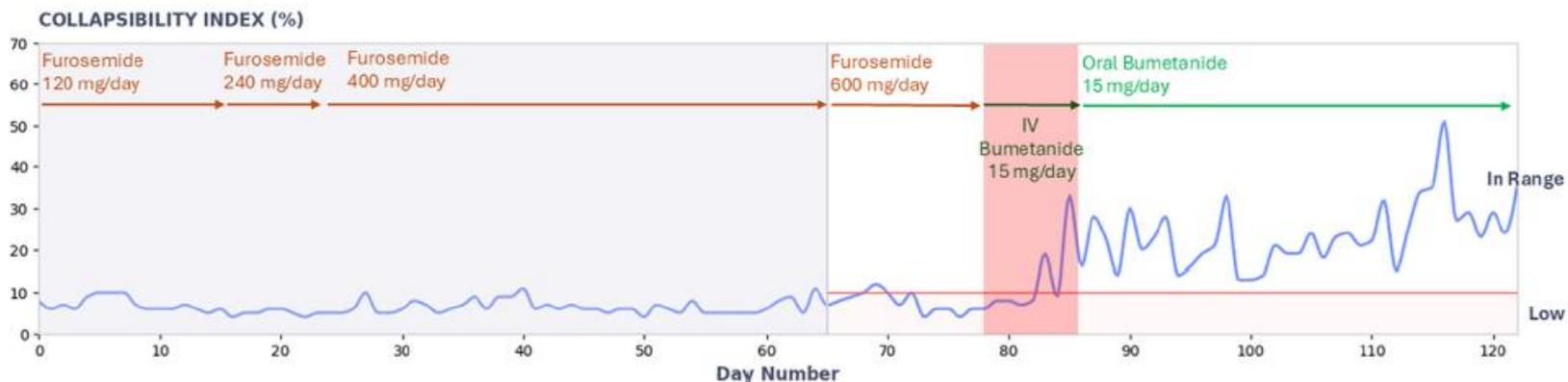
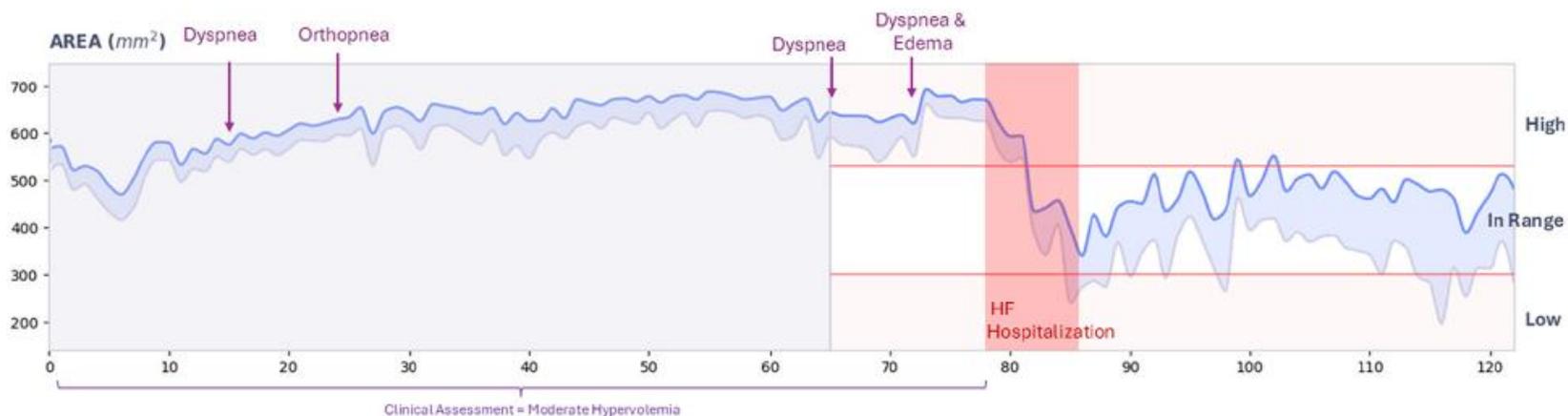
VOL ■ NO ■ 2023

ORIGINAL RESEARCH

First-in-Human Implantable Inferior Vena Cava Sensor for Remote Care in Heart Failure

FUTURE-HF

Praktické využití telemonitorace signálu v DDŽ



JACC: HEART FAILURE
© 2023 THE AUTHOR(S), PUBLISHED BY ELSEVIER ON BEHALF OF THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION. THIS IS AN OPEN ACCESS ARTICLE UNDER THE CC BY-NC-ND LICENSE (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

VOLUME 11 • NUMBER 1 • 2023

ORIGINAL RESEARCH

First-in-Human Implantable Inferior Vena Cava Sensor for Remote Care in Heart Failure
FUTURE-HF

Závěry

- Telemonitoring patří k základním principům komplexní péče o pacienty s ChSS, úloha AmbSS a sester specialistek v AmbSS
- Vzdálená monitorace pomocí CIED není lepší než standardní kontroly předpovědi rizika úmrtí a HF hospitalizací
- Budoucností je využití implantabilních multiparametrických senzorů
- Změny volémie je možné hodnotit pomocí senzoru v DDŽ ještě před vzestupem CŽT a předpovědět riziko klinické deteriorace
- Vzdálená monitorace pomocí senzoru v DDŽ umožňuje reagovat na změny volémie a intervenovat je

Děkuji vám za pozornost



KARDIOLOGICKÁ KLINIKA
1. LÉKAŘSKÉ FAKULTY UNIVERZITY KARLOVY A NEMOCNICE NA HOMOLCE