Možnosti prevencie infekcií asociovaných s CIED.

Národný ústav srdcových a cievnych chorôb, a.s.

P.Margitfalvi [1], Kardiologická klinika SZU, Oddelenie arytmií a kardiostimulácie NUSCH Bratislava a.s.[1],

XVI. České a Slovenské Sympózium o Arytmiách a Kardiostimulácii

11-13. November 2018, hotel Clarion, Ostrava, ČR

Úvod

- Celosvetovo i na Slovensku sa počty implantácií CIED zvyšujú
- Veľká rôznorodosť CIED (KS, ICD, CRT, CCM implantabilné monitory, S-ICD, leadless stimul.)
- Infekcie stúpajú viac,akoby sme očakávali
- Máme priestor na zlepšenie???

Radostné stránky implantológie

Tienisté stránky implantológie

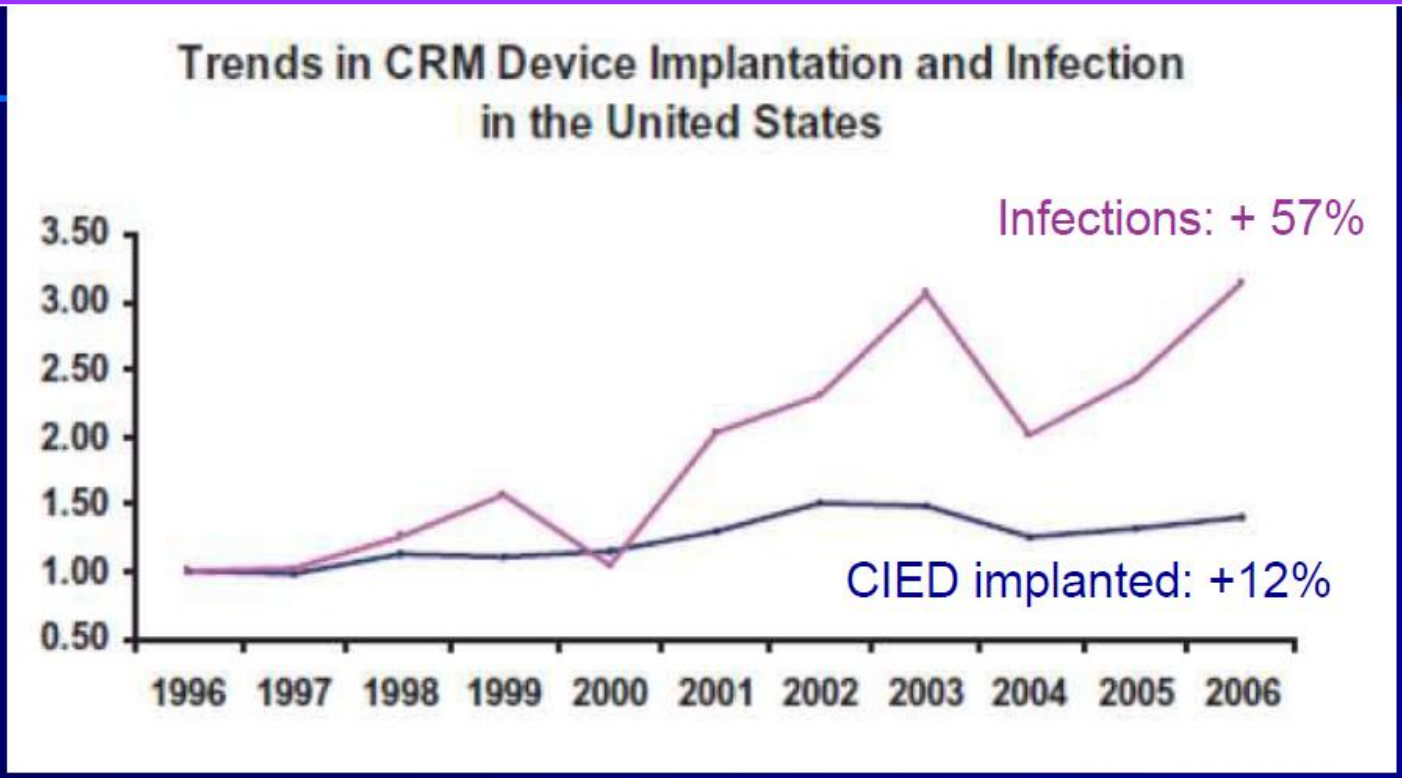









Vzostup infekcií CRDM v USA za 10 rokov/ 1996-2006



Infekcie stúpajú rýchlejšie ako počty implantácii

... možné vysvetlenie tejto epidémie- implantujú sa starší,polymorbídni pacienti,viac komplexných procedúr, revízií,upgradeov,rezistencia mikroorg

A Voigt et al, PACE 2010; 33:414–419

Rizikové faktory asociované s infekciou CIED

Patient-Related Factors	Procedure-Related Factors	Device-Related Factors
Age >60 y	Lack of antibiotic prophylaxis	Defibrillator (vs pacemaker)
Male sex	Device replacement/revision	Dual chamber (vs single chamber)
Chronic obstructive pulmonary disease	Early reintervention	Biventricular device
Congestive heart failure	Procedure duration	Abdominal pocket
Diabetes	Operator experience	Epicardial leads
Renal disease (dialysis)	Postimplant hematoma	
Steroid use		
Prior infection		
Presence of a central venous catheter		
Anticoagulant use		
Preoperative fever		

Aljabri K et al. Card Electrophysiol Clin 2018;10:153

Europace (2015) 17, 767–777
doi:10.1093/europace/euv053

REVIEW
Pacing and resynchronization therapy

Risk factors for cardiac implantable electronic device infection: a systematic review and meta-analysis

Konstantinos A. Polyzos[1,2], Athanasios A. Konstantelias[1], and Matthew E. Falagas[1,3,4]*

[1]Alfa Institute of Biomedical Sciences (AIBS), 9 Neapoleos Street, 151 23 Marousi, Athens, Greece; [2]Atherosclerosis Research Unit, Center for Molecular Medicine, Department of Medicine, Karolinska Institutet, Stockholm, Sweden; [3]Department of Medicine – Infectious Diseases, Iaso General Hospital, Athens, Greece; and [4]Department of Medicine, Tufts University School of Medicine, Boston, MA, USA

Received 9 December 2014; accepted after revision 13 February 2015

Table 1 Characteristics of the included studies (prospective studies)

Study ID	Totals (*n*)	Male (%)	Age (yrs)[a]	Follow-up (mo)[b]	Infection rate (%)[c]	Identified risk factors[d]
Muers 1981[34]	431	NR	70	22.8 (9–40)	2.1	Lack of antibiotic prophylaxis
Ramsdale 1984[35]	500	50	72	3–12	4.2 (0.6)	–
Bluhm 1984[28]	100	51	73	1–43	8	Lack of antibiotic prophylaxis
Bluhm 1986[29]	106	54	75	14 (7–35)	0	–
Glieca 1987[31]	200	66	66	NR	6	Lack of antibiotic prophylaxis
Mueller 1990[46]	333	57	73	16	0.9	–
Bru 1991[38]	209	53	70	(1–36)	1.4	–
Lüninghake 1993[32]	302	NR	NR	(12–48)	5	–
Mounsey 1994[33]	656	55	74	19 (9–26)	2	Lack of antibiotic prophylaxis; reintervention; procedure duration; inexperienced operator
Chauhan 1994[39]	2019	56	NR	1.5	0.8	Temporary pacing
Aggarwal 1995[36]	1059	51	75	2	1.8 (0.9)	Temporary pacing wire
Kron 2003[42]	539	79	65	27	2.6 (2)	Lack of antibiotic prophylaxis; abdominal pocket
Bertaglia 2006[37]	852	56	77	25.6	1.8 (0.7)	Generator replacement; male sex; shorter procedure duration
Klug 2007[e,40]	6134	60	73	12	0.7	Lack of antibiotic prophylaxis*; temporary pacing*; re-intervention*; fever within 24 h before implantation*; device replacement*
Oliveira 2009[30]	649	47	64	6	2 (1.4)	Lack of antibiotic prophylaxis*; procedure duration; haematoma*; generator replacement
Romeyer-Bouchard 2010[47]	303	81.5	70	31	4.3	Reintervention*; procedure duration*; haemodialysis*; haematoma; ICD device type*; lead dislodgement
Krahn 2011[41]	1081	82	66	1.5	2.6 (1.7)	Haematoma
Metais 2011[45]	304	69	70	12	2.3	Reintervention; anticoagulant/antiplatelet drug use; history of contralateral implant
Landolina 2011[43]	3253	80	67	Median: 18	1/100 pt-yrs	Generator replacement*; COPD*
MacFadden 2012[44]	5213	79	65	12	1.9 (1)	–
Uslan 2012[48]	1744	68	70	6	1.3 (0.8)	Abdominal pocket; haematoma

Table 2 Characteristics of the included studies (retrospective studies)

Study ID	Totals (*n*)	Male (%)	Age (yrs)[a]	Follow-up (mo)[b]	Infection rate (%)[c]	Identified risk factors[d]
Case–control studies						
Bloom 2006[11]	4856	77	67	NR	1.6	Generator replacement*; diabetes mellitus; renal insufficiency*; oral anticoagulants*; CHF*; male sex*; age
Sohail 2007[16]	12 799	76	63	39	0.23	Lack of antibiotic prophylaxis*; device replacement/upgrade; CVC; malignancy; corticosteroids*; history of device infection; number of device-related procedures (>2); number of leads (>2)*
Marschall 2007[52]	116	63	62	NR	16.4	Device replacement/revision; abdominal pocket
Lekkerkerker 2008[51]	3410	73	60.5	NR	2.2	Device replacement/revision*; diabetes mellitus; renal insufficiency*; elevated serum Cr; oral anticoagulants*
Gould 2008[49]	451	72	67	12	4 (2.2)	Consultant operator
Nery 2010[53]	2417	67	68.5	NR	1 (0.9)	Generator replacement*; lead dislodgement; dual/triple-chamber device*
Sohail 2011[15]	204	81	Median: 65.5	44.4	NA	Temporary pacing; haematoma; haemodialysis; COPD*; history of device infection; chronic skin disorders; number of device-related procedures (≥3); duration of hospital-stay (≥2 d)*; Charlson index (≥4); epicardial lead*; any post-operative complication*
Raad 2012[54]	72	72	70	NR	NA	Generator/lead replacement; haematoma; dual-chamber device; history of device infection; post-procedural trauma
Herce 2013[50]	2868	60	73	NR	1.2	Reintervention; diabetes mellitus*; dual-chamber device*; heart disease*; simultaneous invasive procedure
Retrospective cohorts						
Rao 1974[72]	401	55.4	NR	NR	0.75	–
Mugica 1977[70]	2016	NR	NR		2	Lack of antibiotic prophylaxis
Hartstein 1978[65]	298	59.8	72	NR	3	Use of drains
Wunderly 1990[77]	263	NR	NR	19	3	–
Trappe 1995[76]	335	91	56	22	3.9	Epicardial lead placement
Spinler 1998[12]	171	80	61	(15.6–102)	4.5	Diabetes mellitus*
Smith 1998[74]	1831	78	63	NR	1.2	Presence of subcutaneous defibrillation patch*
Harcombe 1998[64]	2621	59	74	NR	0.7	Device replacement
Kiviniemi 1999[68]	446	41	72	27 (0–72)	1.8	–
Higgins 2000[66]	174	84.5	69	NR	1.7	Device upgrade to dual chamber
Mela 2001[69]	1406	NR	NR	35	1.2	Abdominal pocket
Wiegand 2004[13]	3164	58	72	3	0.3	ICD device type
Al-Khatib 2005[55]	9854	78	>65	3	1.1	Operator experience*
Gil 2006[63]	423	86	60	NR	2.4	Abdominal pocket; two-stage surgery; subcostal approach of lead placement; trauma at pocket; decubitus ulcer
Catanchin 2007[59]	1481	56	Median: 75	Median: 29.3	1.6	Male sex; number of prior procedures (>1)
Dasgupta 2007[62]	164	71	65	NR	3 (1.8)	–
Ito 2009[78]	71	80	58	37.6	1.4	–
Pakarinen 2010[71]	567	51	72	3	1.9 (1.2)	Reintervention; temporary pacing
Cengiz 2010[60]	890	57	Range: 18–104	34.8	2.5	Lack of antibiotic prophylaxis*; generator replacement*; haematoma; anticoagulants; corticosteroids; CVC*; age*
Borleffs 2010[58]	3161	80	62	38	1.2/100 ICD-yrs	Device (generator/lead) replacement
Margey 2010[e,14]	3105	69	Median: 69	NR	1.3	CRT device*; number of leads (>2); screening time

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Table 2 ***Continued***

Study ID	Totals (*n*)	Male (%)	Age (yrs)[a]	Follow-up (mo)[b]	Infection rate (%)[c]	Identified risk factors[d]
Bloom 2011[57]	624	68	70	1.9	0.5	–
Johansen 2011[f,67]	56 657	54	Median: 76	NR	7.14/1000 PPM-yrs	Lack of antibiotic prophylaxis*; device replacement; dual-chamber device; male sex*; younger age (20–49 yrs)*; implantation during the early yrs of study*; procedure complexity; number of prior procedures*; indication (AV block)
Charytan 2011[61]	9528	70	64.5	16.8	4.2/100 pt-yrs	COPD; age; black race (vs. caucasian); dialysis modality (vs. haemodialysis)*; recent infection*; cerebrovascular accident/TIA*; GI bleeding
Tompkins 2011[75]	1440	65	65	2	0.5	Renal insufficiency; end-stage renal disease
Lyman 2011[81]	38 992	77	66	3	1.2	–
Armaganijan 2012[56]	4814	57	76	61.2	NR	–
Schuchert 2013[73]	402	79	68	12	1.2	–
Peterson 2013[80]	32 034	74	74	3	0.7	–
Palmisano 2013[79]	2671	57	74	Median: 27	1.1	Generator replacement/system upgrade*; CRT device*

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REVIEW
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Table 3 Variables identified as significant risk factors for CIED infection in at least two studies[a]

	Prospective studies (*n*)		Case–control studies (*n*)		Retrospective cohorts (*n*)	
	Univariate	Multivariate	Univariate	Multivariate	Univariate	Multivariate
Host-related factors						
Age			1[11]		3[60,61,67]	3[14,60,67]
Male sex	1[37]		1[11]	1[11]	2[59,67]	1[67]
Diabetes mellitus			3[11,50,51]	1[50]	1[12]	1[12]
Renal insufficiency			2[11,51]	2[11,51]	1[75]	
ESRD/dialysis	1[47]	1[47]	1[15]		1[75]	
COPD	1[43]	1[43]	1[15]	1[15]	1[61]	
Anticoagulants	1[45]		2[11,51]	2[11,51]	1[60]	
Corticosteroids			1[16]	1[16]	1[60]	
CVC			1[16]		1[60]	1[60]
History of device infection			3[15,16,54]			
Implant site trauma			1[54]		1[63]	
Procedure-related factors						
Lack of antibiotic prophylaxis	7[28,30,31,33,34,40,42]	2[30,40]	1[16]	1[16]	3[60,67,70]	2[60,67]
Device replacement/revision	3[30,37,43]	2[40,43]	6[11,16,51–54]	3[11,51,53]	6[58,60,64,66,67,79]	2[60,79]
Reintervention	5[31,33,40,45,47]	2[40,47]	1[50]		1[71]	
No. of prior device-related procedures			2[15,16]		2[59,67]	1[67]
Temporary pacing	3[36,39,40]	1[40]	1[15]		1[71]	
Procedure duration	4[30,33,37,47]	1[47]				
Operator experience	1[33]		1[49]		1[55]	1[55]
Lead dislodgement	1[47]		1[53]			
Post-op haematoma	5[30,31,41,47,48]	1[30]	2[15,54]		1[60]	
Device-related factors						
ICD device	1[47]	1[47]			1[13]	
CRT					2[14,79]	2[14,79]
Dual-chamber system			2[50,54]	1[50]	1[67]	
No. of leads			1[16]	1[16]	1[14]	
Abdominal pocket	2[42,48]		1[52]		2[63,69]	
Epicardial leads			1[15]	1[15]	1[76]	

Faktory:
Modifikovateľné
Nemodifikovateľné

Europace (2015) 17, 767–777
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Modifikovateľné a nemodifikovateľné rizikové faktory

Modifiable risk factors	Non-modifiable risk factors
(1) Colonization with *S. aureus*	(1) Age
(2) Optimization of comorbid conditions such as DM, CHF, CKD	(2) Comorbid conditions (DM, CHF, CKD, Malignancy)
(3) Chronic steroid therapy	(3) Temporary pacing lead before permanent device implantation
(4) Skin antisepsis prior to procedure	(4) History of multiple device-related procedures
(5) Preoperative antibiotic prophylaxis	(5) History of CIED infection
(6) Antibiotic impregnated envelope	(6) Presence of >2 electrode leads
(7) Peri-procedure anticoagulation	(7) Recent device manipulation
(8) Central venous catheter aspotential source of bacteremia	(8) Presence of epicardial leads
(9) Experience level of device implanter	(9) Chronic skin conditions (psoriasis, dermatitis)
(10) Presence of abandoned leads	(10) Autoimmune diseases requiring Immunosuppressive therapy

CHF: congestive heart failure; CIED: cardiac implantable electronic device; CKD: chronic kidney disease; DM: diabetes mellitus.

EXPERT REVIEW OF MEDICAL DEVICES, 2017
VOL. 14, NO. 5, 371–381
https://doi.org/10.1080/17434440.2017.1322506

Riziko infekcie u pacientov s CIED

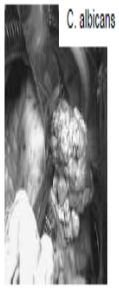
- Pacemaker 1% after 1 year
- ICD 1.7% after 6 months
- CRT 9.5% after 2 yrs

- 2-4 fold risk after device replacement or upgrades

- Mortality lead extraction: 0.3-0.8%

- Delayed device removal 3-fold increase in 1 year mortality

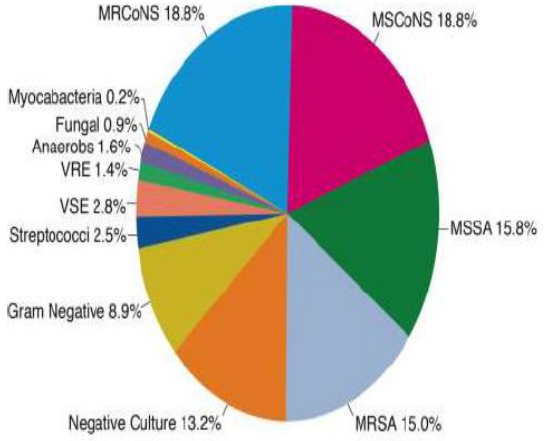
- Conservative therapy 7-fold increase in 30-day mortality



Poznaj svojho nepriateľa

Microbiology in 816 patients who underwent CIED extraction for infection at Cleveland Clinic between 2000-2011

MRSA = methicillin-resistant *Staphylococcus aureus*; MSSA = methicillin-sensitive *Staphylococcus aureus*; MRCoNS = methicillin-resistant coagulase-negative staphylococcus; MSCoNS = methicillin-sensitive coagulase-negative *Staphylococcus*; VRE = vancomycin-resistant *Enterococcus* species; VSE = vancomycin-sensitive *Enterococcus* species.



Nielsen JC et al. Eur Heart J 2015;36:2484
Sekiguchi Y. J Arrhyth 2016;32:293
Margery R et al. Europace 2010; 12:64-70

Princípy prevencie infekcií

6 článkov v reťazci prenosu infekcie

4 oblasti záujmu

Hygiena rúk

Chirurgické nástroje

Antiseptická Príprava kože

Enviromentálny manažment

Prevencia komplikácií CIED

CAVE

Výber optimálneho kandidáta na implantáciu

- Odporúčania na implantácie KS, ICD a CRT 2013,2015,2016

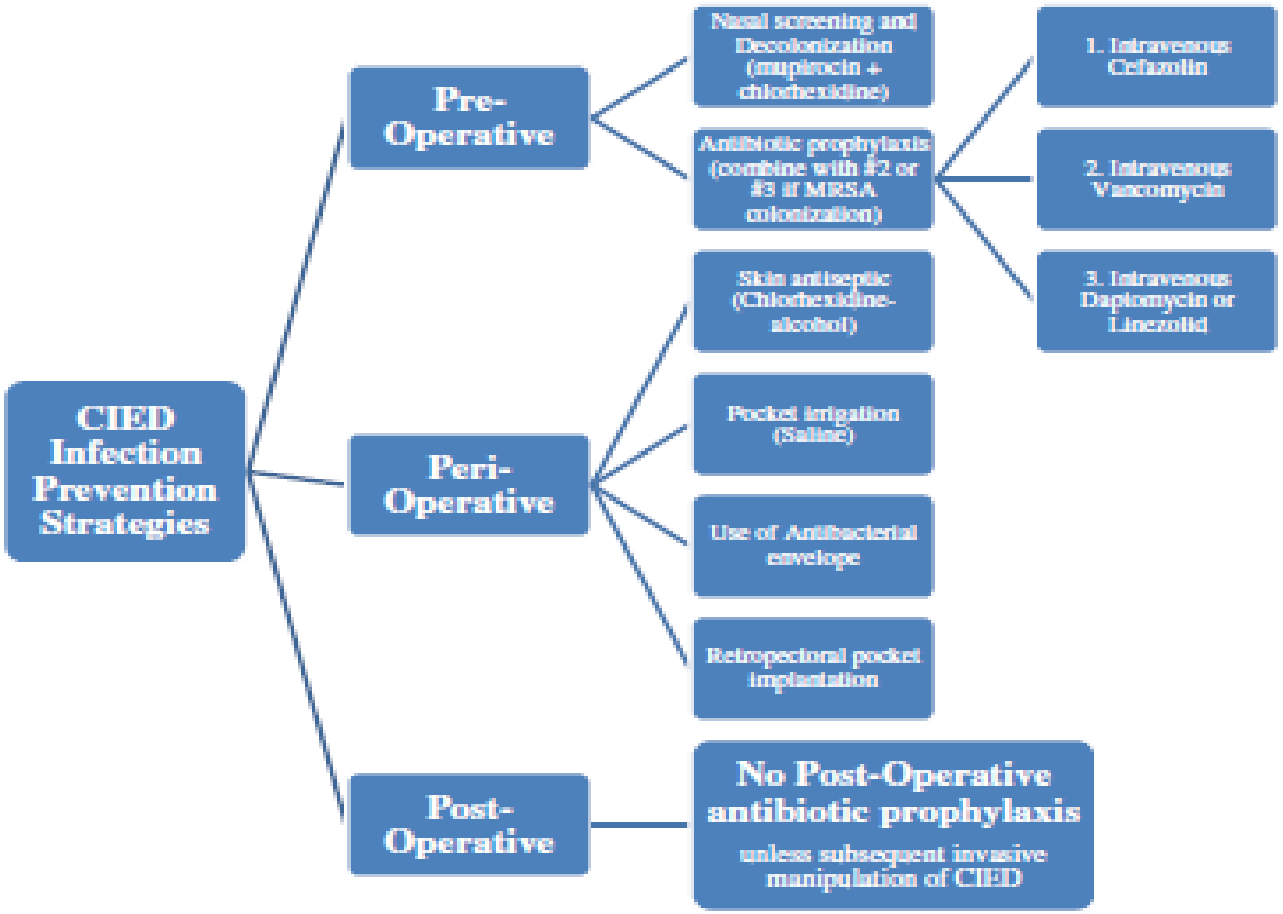
Memento

Je implantácia vôbec potrebná?

Indikácia, selekcia pacienta, optimálne načasovanie...

12-55% pacientov po extrakciách nebolo reimplantovaných!!!

Preventívne stratégia na minimalizáciu infekcií



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Prevencia komplikácií CIED

Čo urobiť preimplantačne?

- Optimálny výber pacienta,posúdenie individuálnej miery rizika a benefitu
- Indikácia ? Optimalizácia typu CIED (veľkosť,tvar, komplexnosť...)
- CAVE: dočasná KS (minimalizácia trvania, špička ad K+C)
- CAVE: zápalový sy, febrility, subfebrility (odložiť výkon!!!)
- Preliečenie kožných afekcií a ulcerácií (dostať všetko pod kontrolu)
- Konštitúcia, BMI, žilová kresba, známky SZ, CVK, ochlpenie v mieste op.
- Predchádzajúce jazvy v mieste op., tumor ....,hygiena pac.!!! +oholenie op.poľa
- Kontrola medikácie- osobitne antitrombotiká a antikoagulanciá

Prevencia komplikácií CIED

Čo urobiť perimplantačne?

- „režim operačky“ na implantačnej sále (minimalizácia osôb a pohybu na op)
- ATB profylaxia
- Správna technika rúškovania pacienta, inštitucionálny protokol! (chlorhexidín versus povidon-iodine)
- trvanie výkonu (implantačný čas čo najkratší)
- hemostáza
- správna chir. technika (irigácia kapsy-ATB/antiseptiká/FR-bez dôkazov) (kapsulektomia nie!!!)
- Používanie zdvojenia rukavíc (funguje na redukciu infekcií)
- Redukcia „hardware“

Aké antiseptikum?

ORIGINAL ARTICLE

Chlorhexidine–Alcohol versus Povidone–Iodine for Surgical-Site Antisepsis

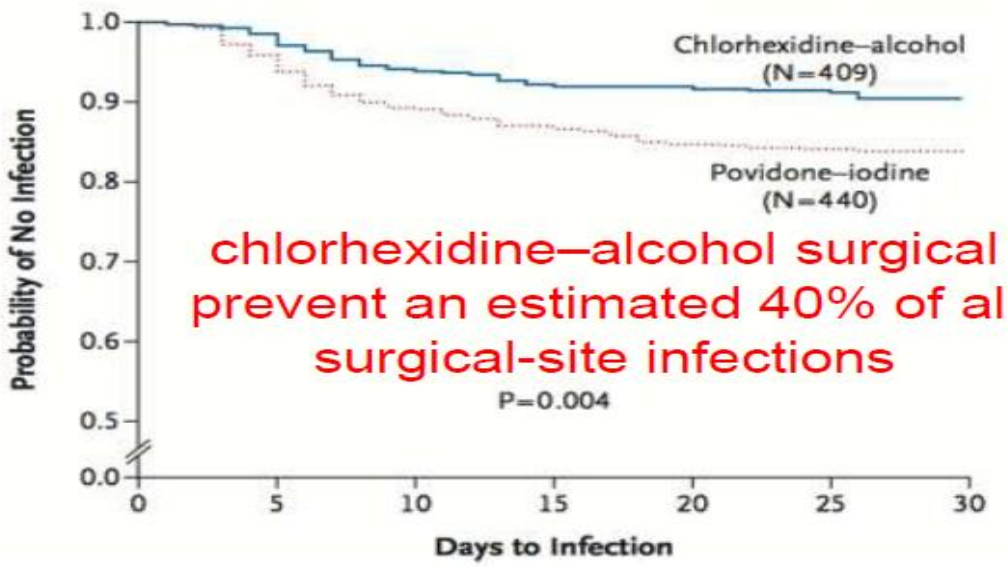

Figure 2. Kaplan–Meier Curves for Freedom from Surgical-Site Infection (Intention-to-Treat Population).

Patients who received chlorhexidine–alcohol were significantly more likely to remain free from surgical-site infection than were those who received povidone–iodine (P=0.004 by the log-rank test). In the chlorhexidine–alcohol group, 39 patients had events (9.5%) and data from 370 patients (90.5%) were censored; in the povidone–iodine group, 71 patients had events (16.1%) and data from 369 patients (83.9%) were censored.

Darouiche et al

NEJM 2010

Príprava kože: Chlorhexidín vs povidone iodine

- On 4/30/2010 The use of Chlorhexidine in the EP lab was discontinued and we started using Betadine
- Did that affect our CIED infection rate?

Reviewed all device procedures 1 year before and 1 year after 4/30/2010

- **Conclusion**

In one large cohort of patients undergoing CIED procedures, the antiseptic agent used for skin preparation (chlorhexidine-alcohol vs povidone-iodine) was not associated with increased risk of developing CIED infection.

The Impact of Changing Antiseptic Skin Preparation Agent used for Cardiac Implantable Electronic Device (CIED) Procedures on the Risk of Infection

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MUHAMMAD HAMMADAH, M.D.,* AMY HSU, M.S.,‡ OUSSAMA WAZNI, M.D.,‡
BRUCE L. WILKOFF, M.D.,‡ and KHALDOUN G. TARAKJI, M.D., M.P.H.‡
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Qintar, Wazni, Wilkoff, Tarakji. *PACE*. 2015 38 240

Skin preparation: Chlorhexidine-Alcohol vs Povidone-Iodine

- 1,326 consecutive patients undergoing CIED
  - 2010: 648 povidone-iodine
  - 2011: 678 alcoholic povidone iodine
- Follow up 26 months
- 32 CIED infection (2.4%)
- No significant difference between 2 agents

CLINICAL RESEARCH

Preoperative skin antiseptics for prevention of cardiac implantable electronic device infections: a historical-controlled interventional trial comparing aqueous against alcoholic povidone-iodine solutions

Antoine Da Costa[1]*, Claire Tulane[1], Virginie Dauphinot[1], Jérémy Terreaux[1], Cécile Romeyer-Bouchard[1], Alexie Gate-Martinet[1], Marie Levallois[1], and Karl Isaaz[1]

Správna chirurgická technika

Guideline for Prevention of Surgical Site Infection, 1999

Alicia J. Mangram, MD; Teresa C. Horan, MPH, CIC; Michele L. Pearson, MD; Leah Christine Silver, BS; William R. Jarvis, MD; The Hospital Infection Control Practices Advisory Committee

- Gentle traction
- Effective hemostasis
- Removal of devitalized tissues
- Obliteration of dead space
- Irrigation of tissues with saline to avoid excessive drying
- Use of fine, non-absorbed monofilament suture material
- Judicious use of closed suction drains
- Wound closure without tension

From Altemeier, et al. 1984.[54]
SSIs = surgical site infections.

AJIC
Volume 27, Number 2

ATB a antiseptiká predchádzajú infekciám pri impl. CIED

Metaanalýza 15 štúdií- 3970 pacientov

Study or Subgroup	PSA + antiseptic Events	Total	Antiseptic Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bluhm 1984	1	50	7	50	22.9%	0.14 [0.02, 1.12]
Bluhm 1986	0	50	0	52		Not estimable
De Oliveira 2009	2	314	11	335	43.2%	0.19 [0.04, 0.87]
Glieca 1987	0	100	12	100	12.3%	0.04 [0.00, 0.67]
Lüninghake 1993	0	136	1	106	9.5%	0.26 [0.01, 6.33]
Mounsey 1994	0	224	9	249	12.1%	0.06 [0.00, 1.00]
Total (95% CI)		874		892	100.0%	0.13 [0.05, 0.36]
Total events	3		40			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.57$, df = 4 (P = 0.81); $I^2 = 0\%$

Test for overall effect: Z = 4.02 (P < 0.0001)

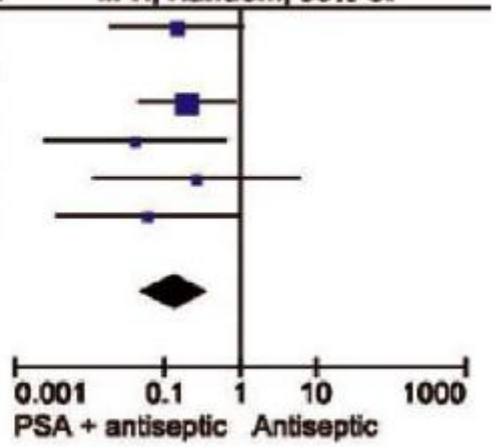


Figure 3. *Forest plot of risk ratio for infections: PSA plus antiseptics versus antiseptics.*

PACE 2012; 00: 1-13

ATB profylaxia

Pre-operative Antibiotics Prevent Infection

Meta analysis	Antibiotics	Controls
No. of Patients	1011	1012
Infections	5 (0.5%)	37 (3.7%)

p=0.005

Brazil Controlled Trial 2009	Cefazolin 1g	Controls
No. of Patients	314	335
Infected	2 (0.64%)	11 (3.28%)
Superficial	0	4
Pocket	2	7
Systemic	1	4

p=0.016

Infected patients
- longer procedures
- more pocket haematomas
- replacements (10/13)

Da Costa et al Circulation 1998; 97:1796
De Oliveira et al Circ Arrhythm Electrophysiol 2009;2:29-34

Prevencia komplikácií CIED

Čo urobiť počas FU

- Redukuj počet výmen !!!

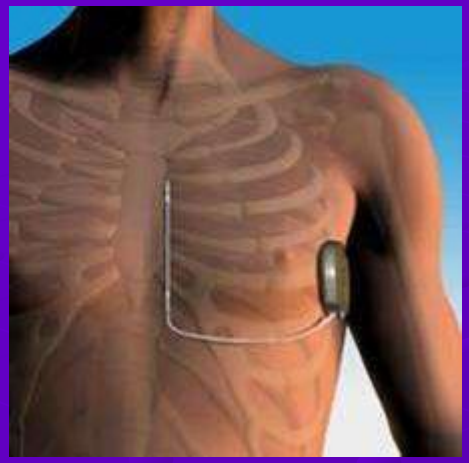
  Optimalizácia životnosti

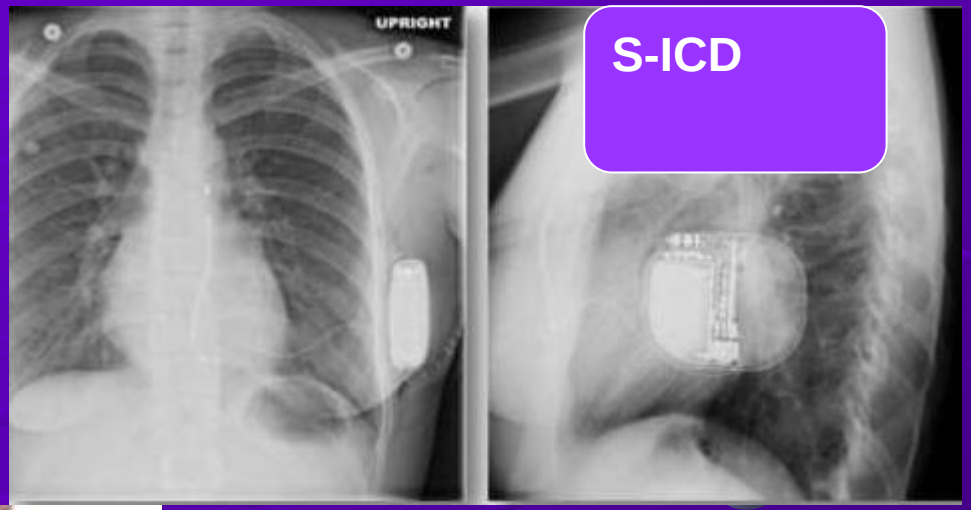
- Upgrade len ak je nevyhnutný !!!

- Prevencia neskorých/meta inf.!!!

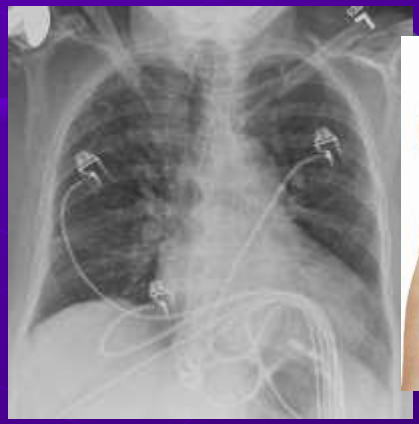
  Dôsledné preliečenie všetkých afekcií a infekcií

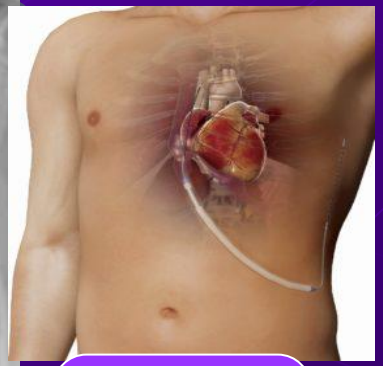
Alternatívy CIED





S-ICD

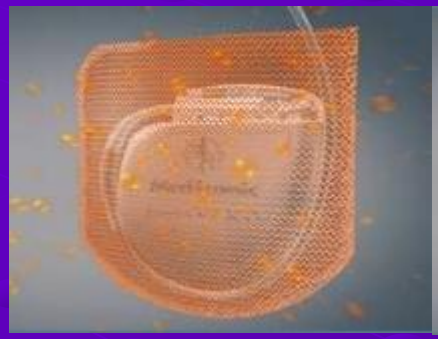




Strunový defibrilá-tor

Bezelektródový-leadless systém

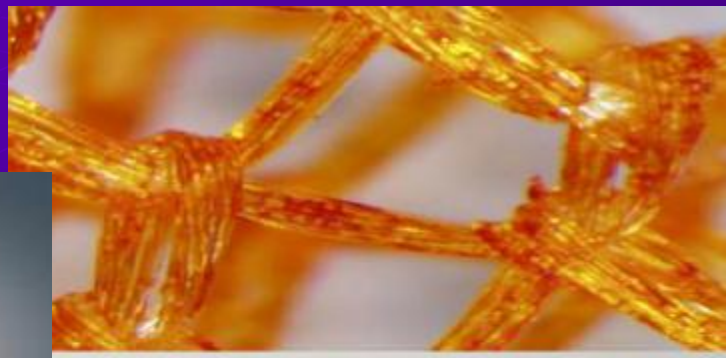
TYRX™ Antibiotická obálka

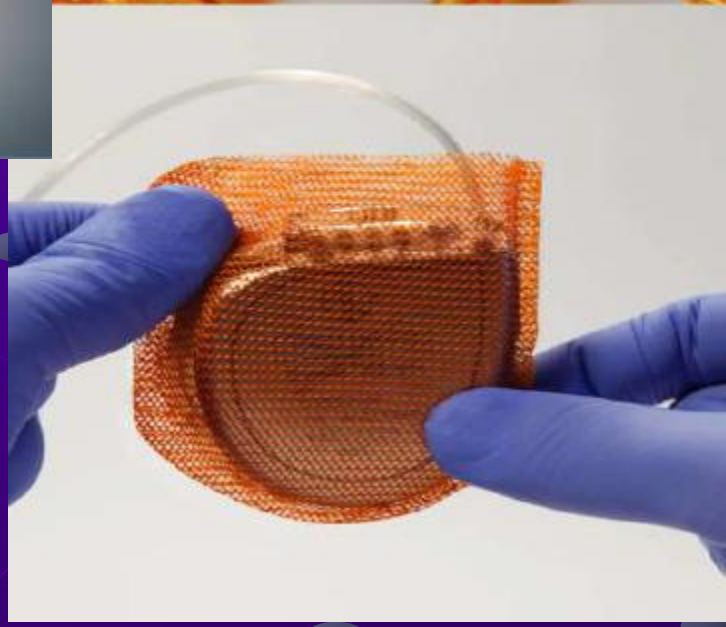


Obálka pri implantácii

4 týždne po

9 týždňov po





World-wide Randomized Antibiotic Envelope CIED Infection PrevenTion Trial (WRAP-IT)

- Randomized, prospective, multi center, international, single blinded post market study
- Target population:
  1. CIED replacement of upgrade (PPM, CRT-P, ICD, CRT-D)
  2. De novo CRT
- About 7,000 patients
- Randomized 1:1 (envelope vs no envelope)

Tarakji KG, Mittal S, Kennergren C, Corey R, Poole J, Stromberg K, Lexcen DR, Wilkoff BL. Worldwide Randomized Antibiotic EnveloPe Infection PrevenTion Trial (WRAP-IT). Am Heart J 2016;180:12–21.

Prevention of Arrhythmia Device Infection (PADIT)

- Prospective, randomized, unblinded cluster crossover clinical trial
- 11,000 patients (Secondary procedures)
- Sites (not patients) are randomized into 2 strategies for preoperative antibiotic
  - Conventional: Single preop dose of Cefazolin (or vancomycin for penicillin-allergic patients)
  - Incremental:
    - Single preop dose of Cefazolin **AND** Vancomycin (In patients allergic to Penicillin, vancomycin alone)
    - Intraoperative bacitracin pocket wash
    - 2 Days postop antibiotics (Cefalexin or Cephadroxil (or Clindamycin in penicillin allergic patient)

Závery

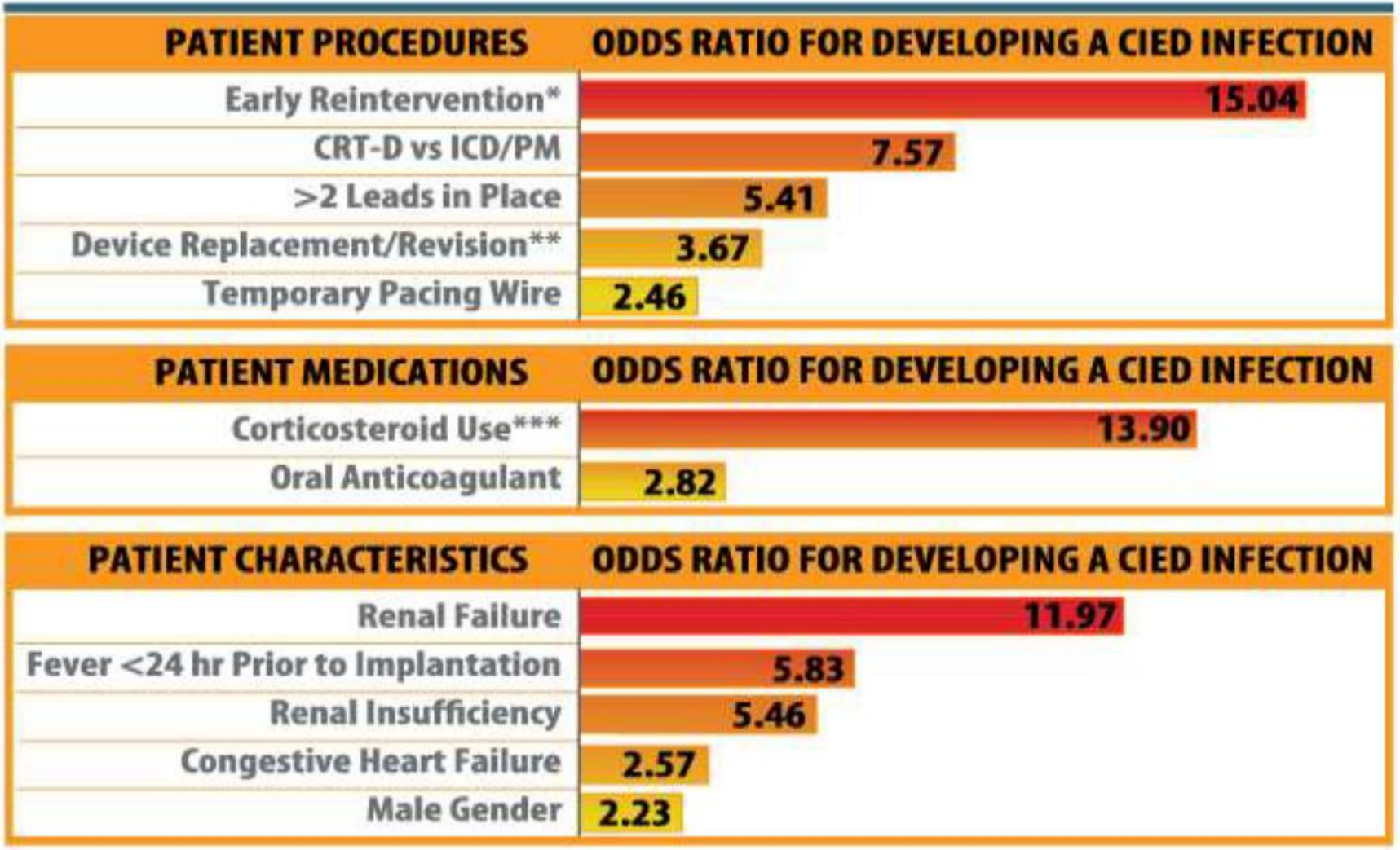
- Infekčné komplikácie CIED nie sú zriedkavé a sú na vzostupe. Prevencia začína pred rozhodnutím implantovať CIED!!!

- Prevencia je dôležitá a závisí od výberu harvéru, techniky, op.teamu. Treba zodpovedať otázky: -
  - otázka indikácie
  - otázka načasovania
  - otázka pripravenosti pac.
  - zdravá kapsa /chir.technika/
  - ATB profylaxia

- Pri každej implantácii myslieť na event. budúcu EXTRAKCIU!!!

- Nové postupy / TYRX, PADIT, Leadless KS, S-ICD .../

Aké sú riziká pre vznik infekcie?



Klug D et al. Circulation 2007;116(12):1349-1355. - Lekkerkerker JC et al. Heart 2009;95(9):715-720. Margey R et al. Europace 2010;12(1):64-70. - Sohail MR et al. Clin Infect Dis. 2007;45(2):166-173. Bloom H et al. Pacing Clinical Electrophysiology 2006;29(2):142-145.