IV Congreso

SEICAV
Sociedad Española de Infecciones Cardiovasculares

Infecciones en pacientes con dispositivos de asistencia ventricular: *opciones de profilaxis y tratamiento antibiótico*

Santander, Viernes, 30 de Octubre 2015. 16:20-16:40

Patricia Muñoz

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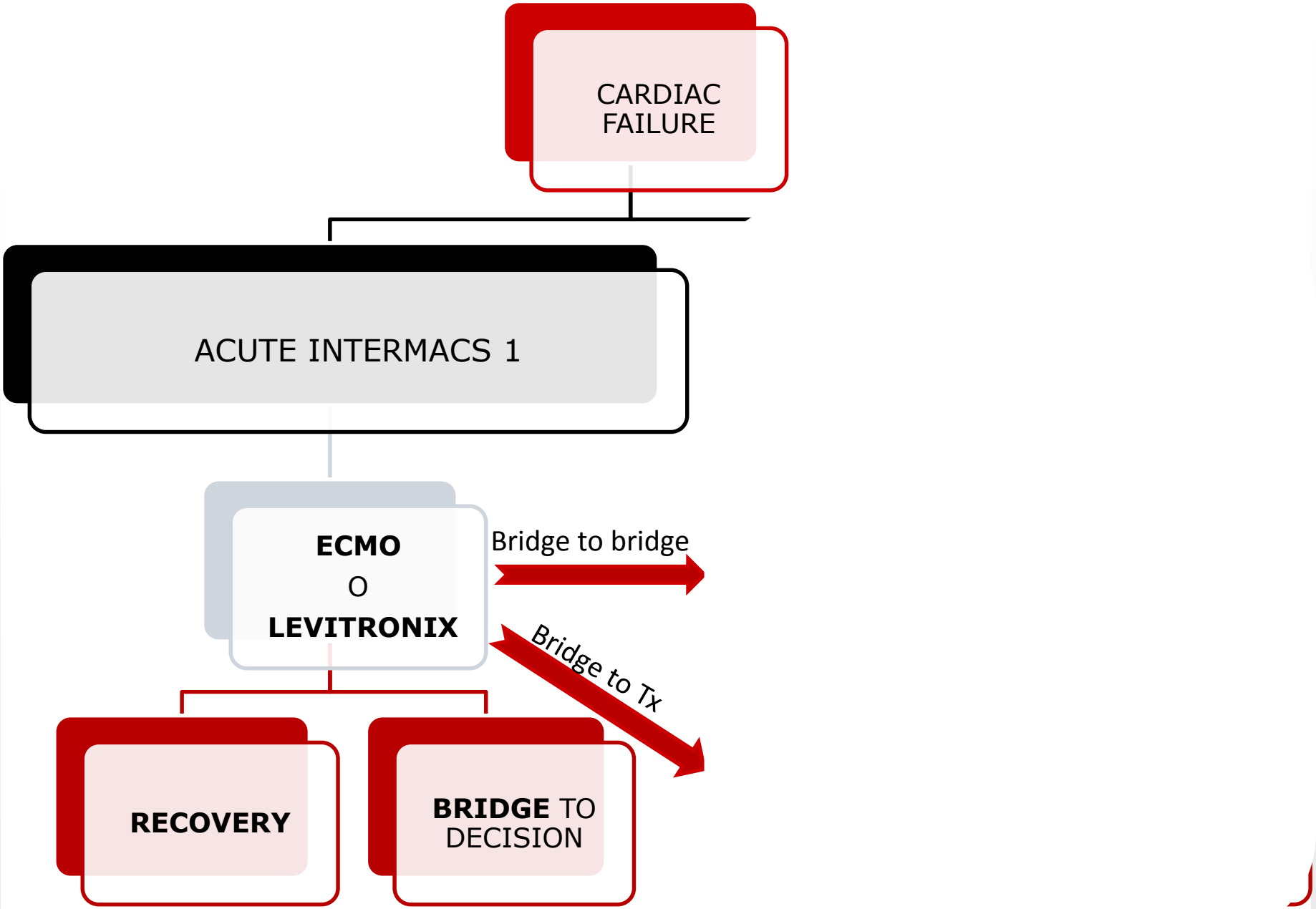
Madrid

IGM

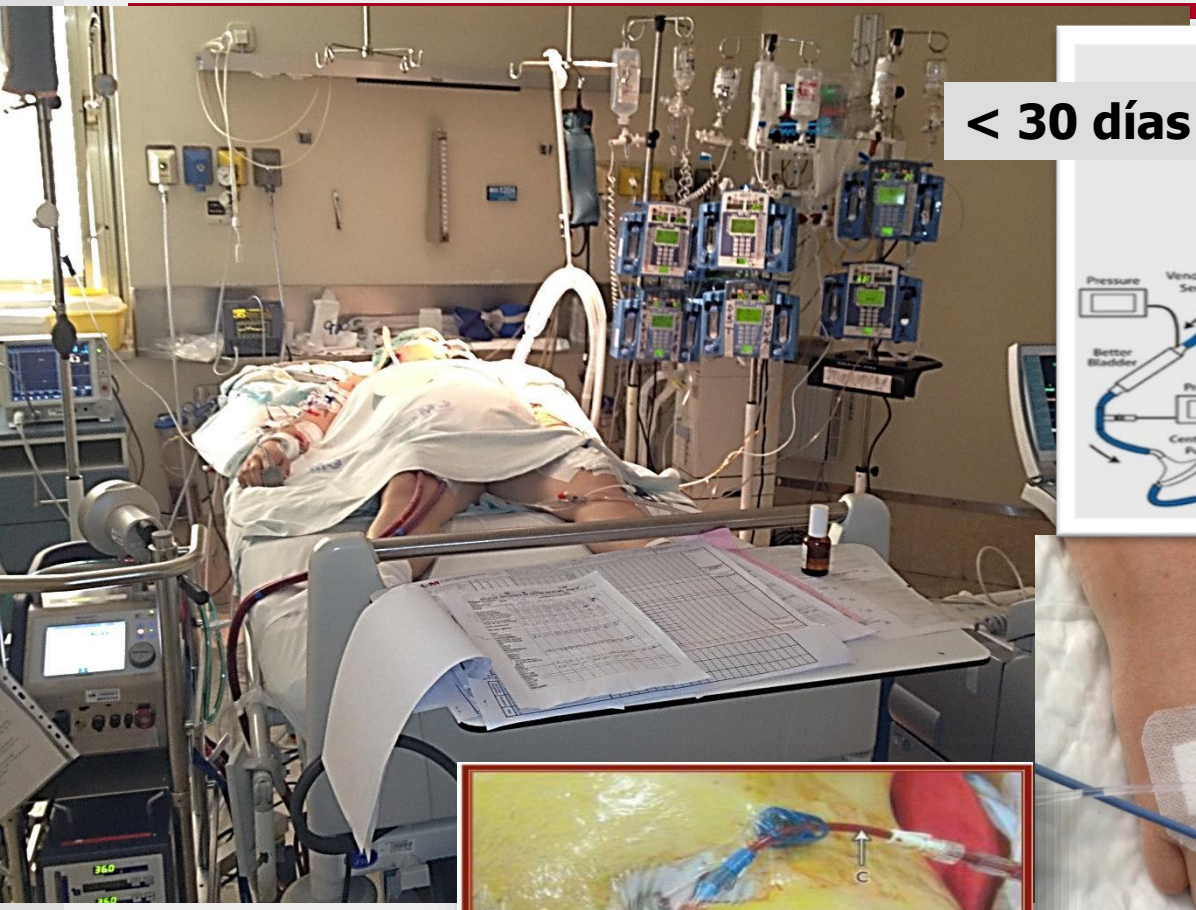
Dispositivos asistencia ventricular

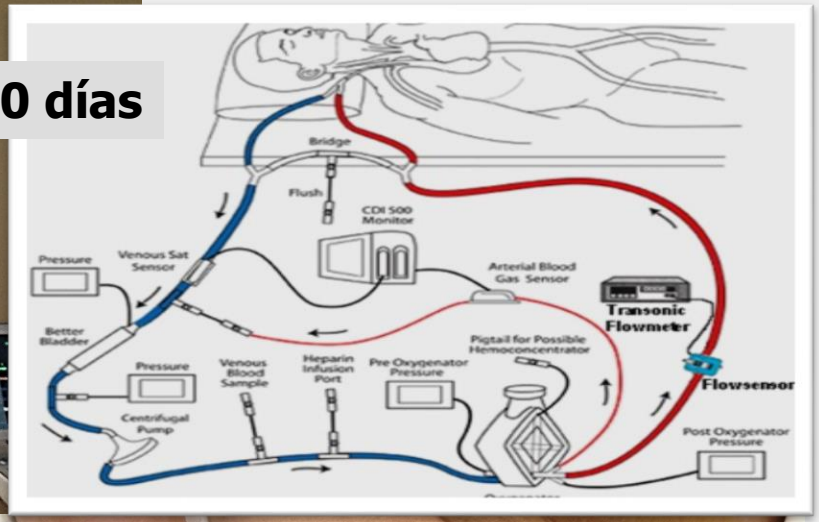
1. ***De que hablamos cuando hablamos de "asistencias ventriculares"?***
2. Infecciones?
3. Tratamiento?
4. Profilaxis?

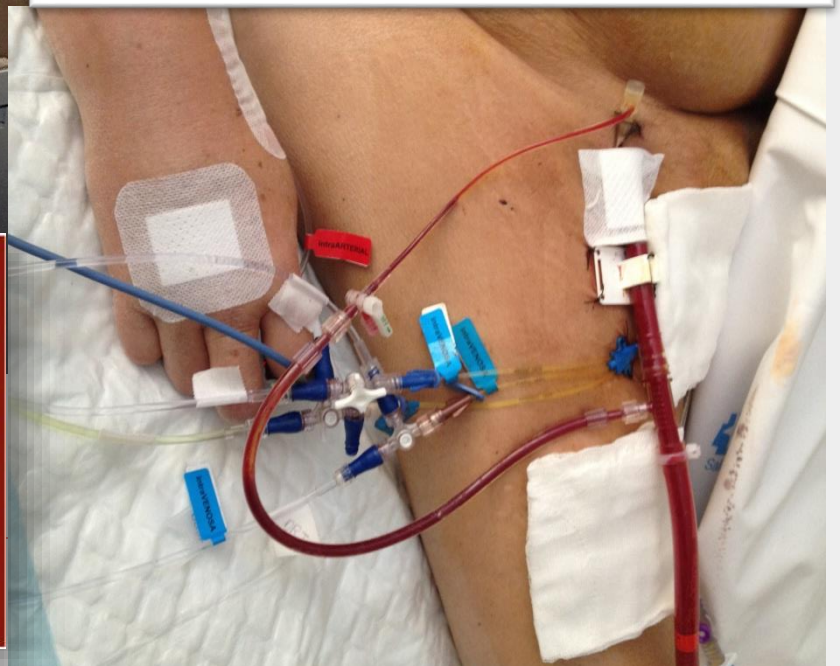

CARDIAC FAILURE
ACUTE INTERMACS 1
ECMO
O
LEVITRONIX
Bridge to bridge
Bridge to Tx
RECOVERY
BRIDGE TO DECISION

ECMO (extracorporeal membrane oxygenation (2000 € por set)

< 30 días







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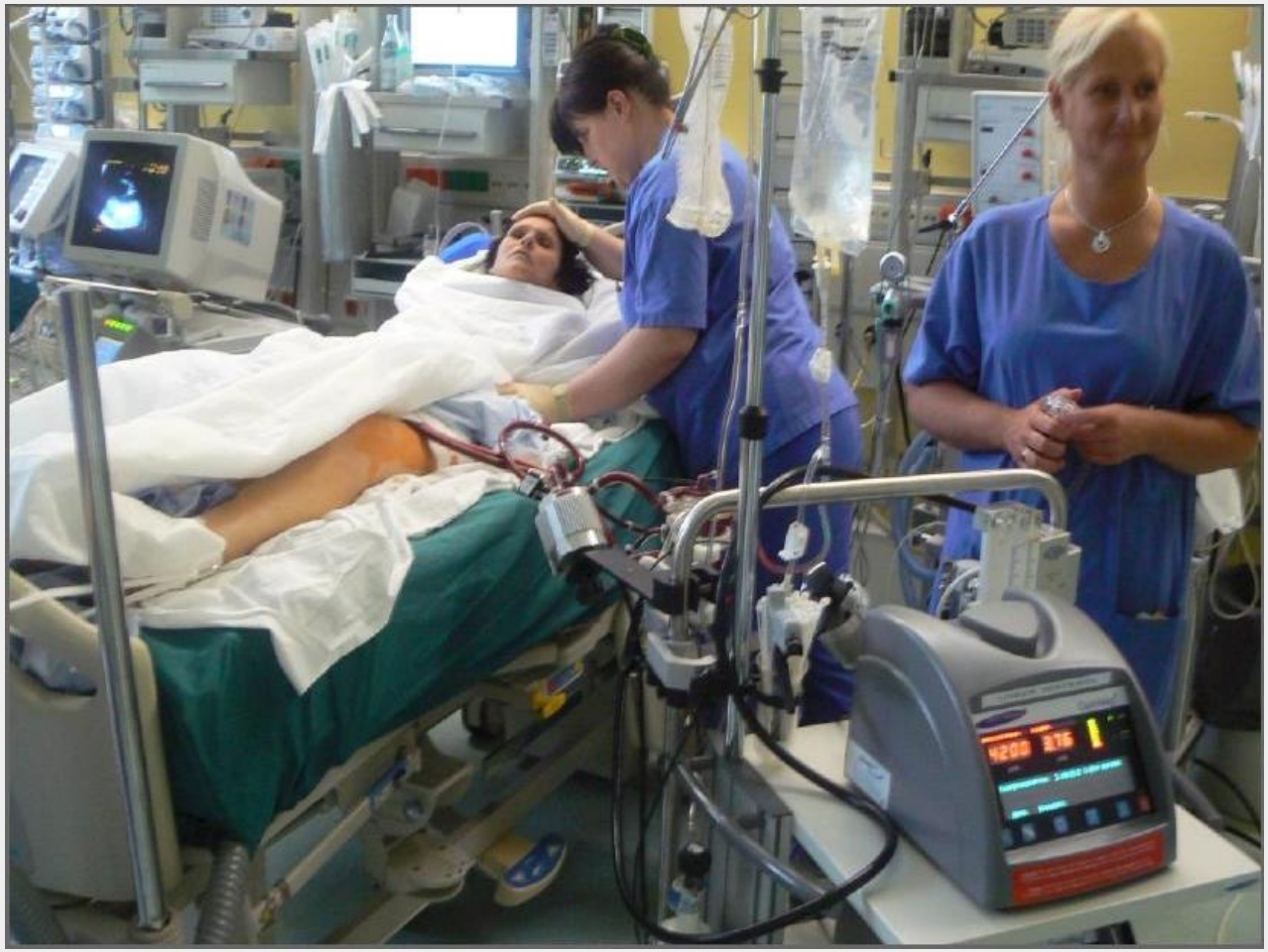
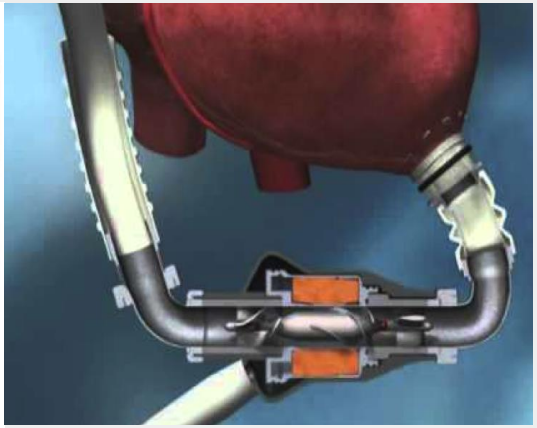
LEVITRONIX
(~7-10.000 €)

- < 60 d
- Cánulas esternotomía AD-AP y/o VI-Aorta, tubuladuras, bomba centrífuga
- Extubado y movilizable



Asistencias de larga duración aprobadas FDA

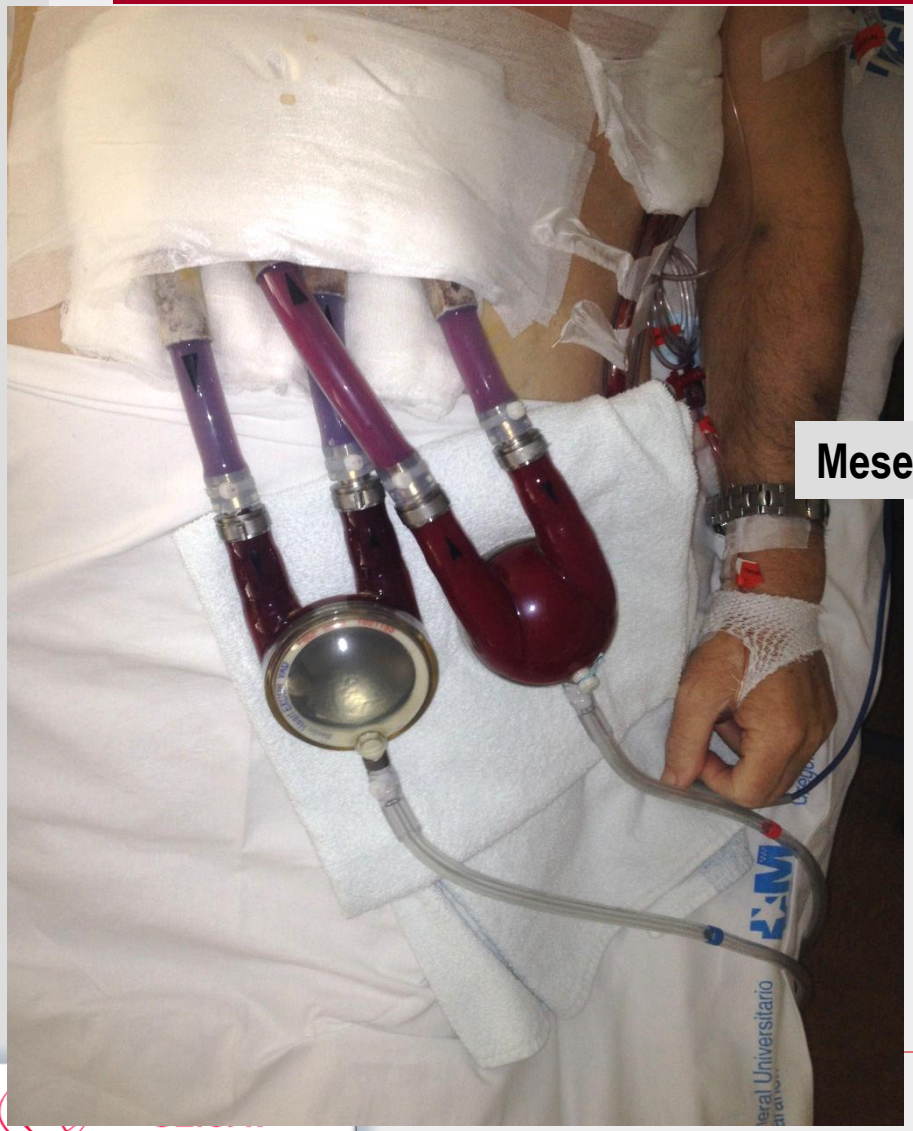
Type	Device
Durable devices	
Continuous flow	Thoratec HeartMate II
	HeartWare HVAD
	MicroMed DeBakey Child VA
Pulsatile extracorporeal	Thoratec PVAD
	Berlin Heart EXCOR
Pulsatile intracorporeal	HeartMate IP
	HeartMate VE
	HeartMate XVE
	Thoratec IVAD
	Novacor PC
	Novacor PCq
Total artificial heart	SynCardia CardioWest
	AbioCor TAH



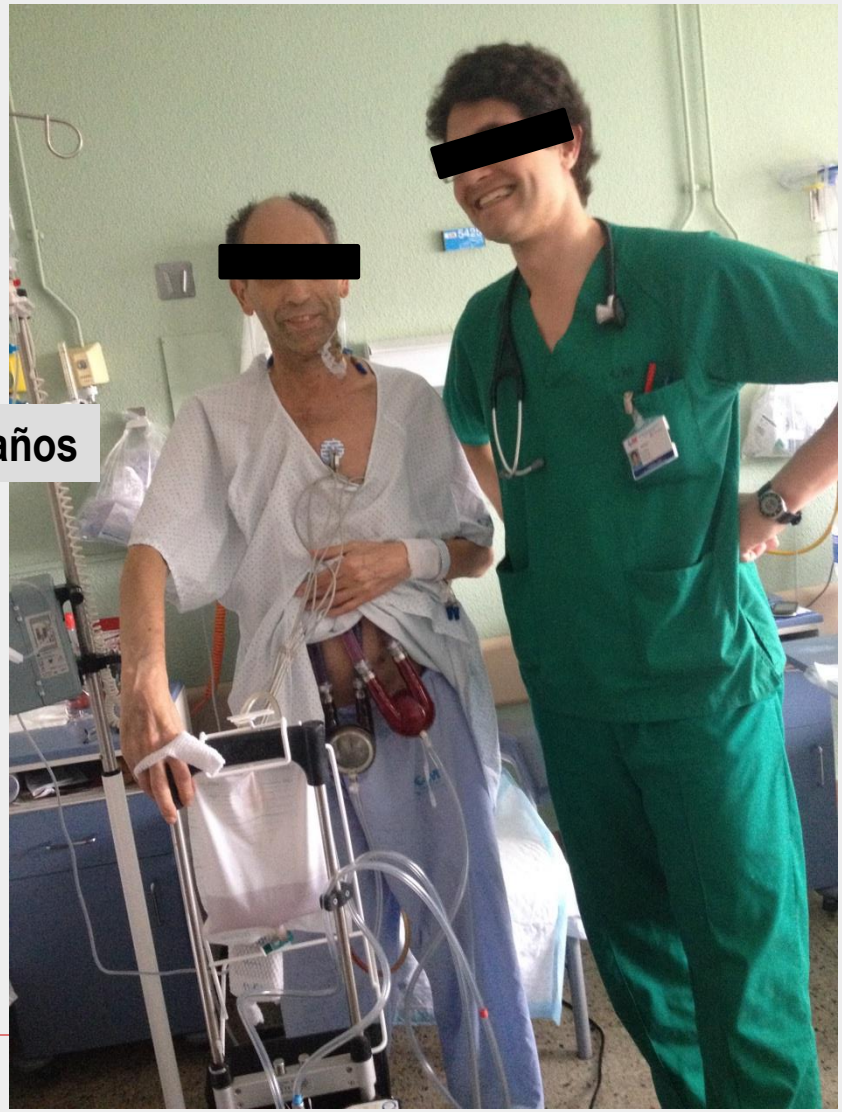
HeartMate II

Berlin Heart EXCOR

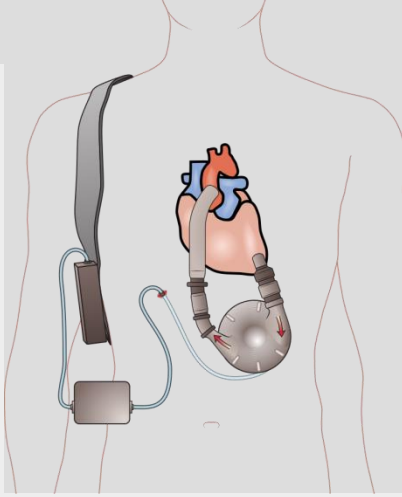
Berlin Heart (~20.000 € cada ventrículo)



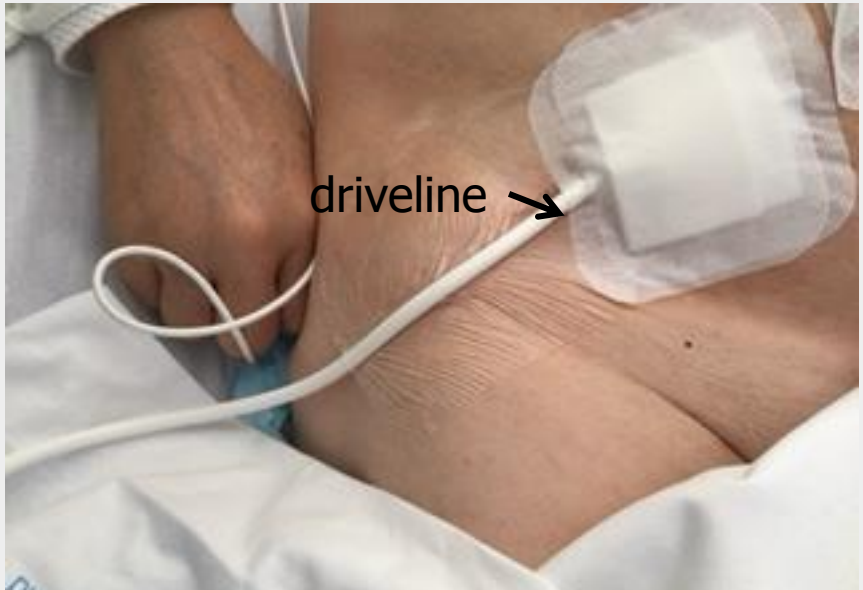
Meses-2 años



Heartmate II (~100.000 €)

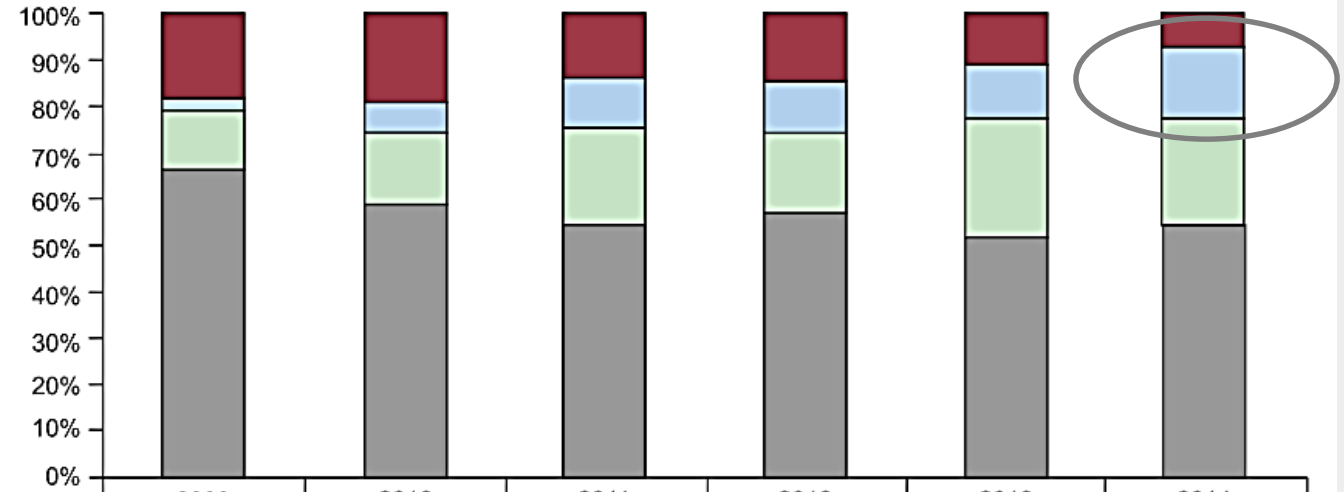


Años



Ojo, La mayoría de artículos se refieren a este tipo de asistencias, pero en España aún son muy raras

Spanish Heart Transplantation Registry
26th Official Report (1984-2014)



	2009	2010	2011	2012	2013	2014
DAV pulsátil	18,2	18,5	13,2	13,8	10,7	6,5
DAV continua	2,0	7,4	11,0	11,5	12,4	15,7
ECMO	13,1	14,8	20,9	17,2	24,8	23,1
Balón	66,7	59,3	54,9	57,5	52,1	54,6

- En 2014, se usó una asistencia temporal en el **18.8% de los TXC (50/266)**
- Las asistencias de flujo continuo: 2,0% en 2009 y **15,7% en 2014 (~8)**
- El peor pronóstico: TXC urgente en **ECMO** (usarlo sólo como **puente a decisión**)

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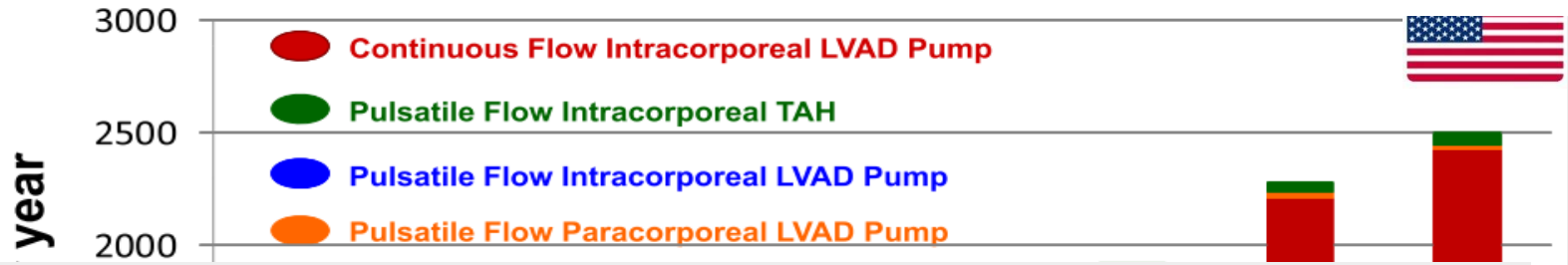
González-Vilches. Rev Esp Cardiol 2015

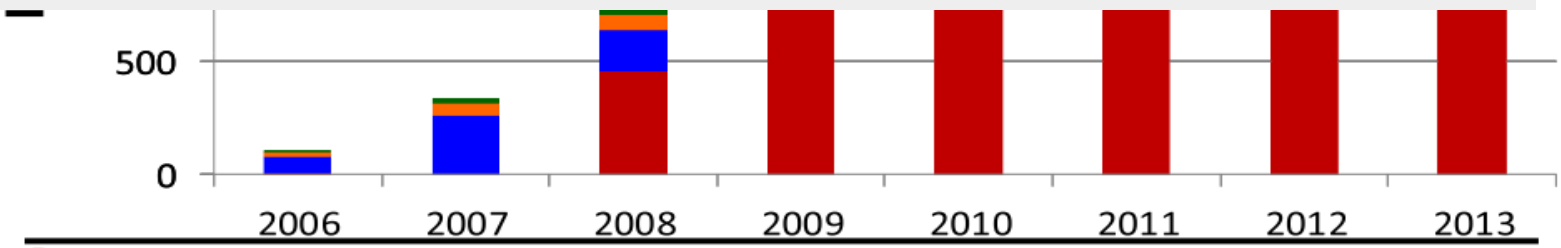
Uso de asistencias USA

Survival
- 1yr: 80%
- 2 yrs: 70%



Destination therapy:
(ineligible for Tx: age, renal failure, COPD, ...)

15% → 42%



	2006	2007	2008	2009	2010	2011	2012	2013
Cont Intra Pump	1	0	459	866	1581	1838	2207	2420
Puls Intra TAH	1	22	30	24	29	26	41	66
Puls Intra Pump	78	260	180	54	13	2	0	0
Puls Para Pump	18	56	71	66	29	54	30	20

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J Heart Lung Transplant 2014;33:555 – 564

Dispositivos asistencia ventricular

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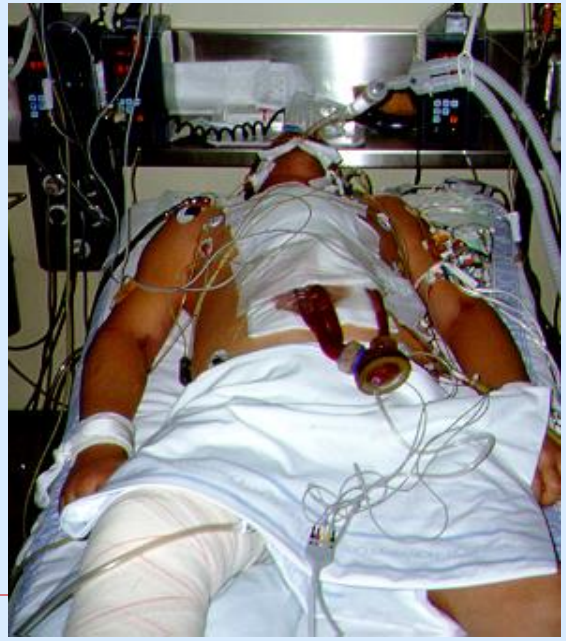

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NIH Public Access
Author Manuscript
J Am Coll Cardiol. Author manuscript; available in PMC 2015 July 29.

Published in final edited form as:
J Am Coll Cardiol. 2014 July 29; 64(4): 372–381. doi:10.1016/j.jacc.2014.04.052.

MANAGEMENT PRACTICES AND MAJOR INFECTIONS AFTER CARDIAC SURGERY

Annetine C. Gelijns, PhD[*], Alan J. Moskowitz, MD[*], Michael A. Acker, MD[†], Michael

5,158 cardiac surgery patients

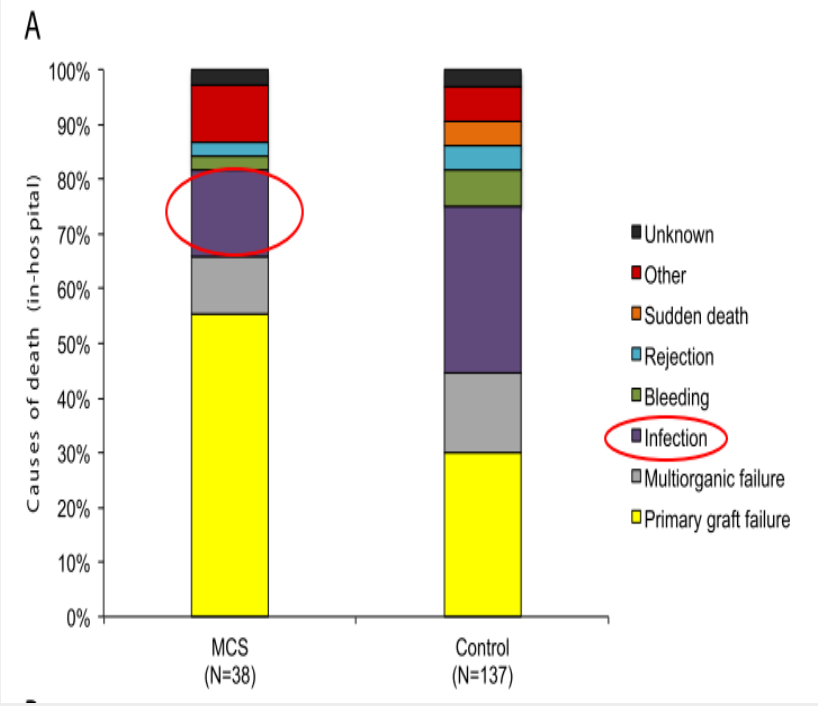
Baseline and Procedure Characteristics Associated With Infection

Baseline Variable	HR (95% CI)	*P* Value
COPD (yes/no)	1.66 (1.21, 2.26)	0.002
Heart failure (yes/no)	1.47 (1.11, 1.95)	0.007
Corticosteroids (yes/no)	1.91 (1.19, 3.05)	0.007
Creatinine, mg/dL	1.15 (1.08, 1.22)	<.001
Hemoglobin, g/dL	0.90 (0.84, 0.97)	0.008
LVAD/Tx (yes/no)	2.89 (1.86, 4.50)	<.001
Open sternum (yes/no)	6.35 (2.62, 15.38)	<.001
Duration of surgery (hours)	1.31 (1.21, 1.41)	<.001

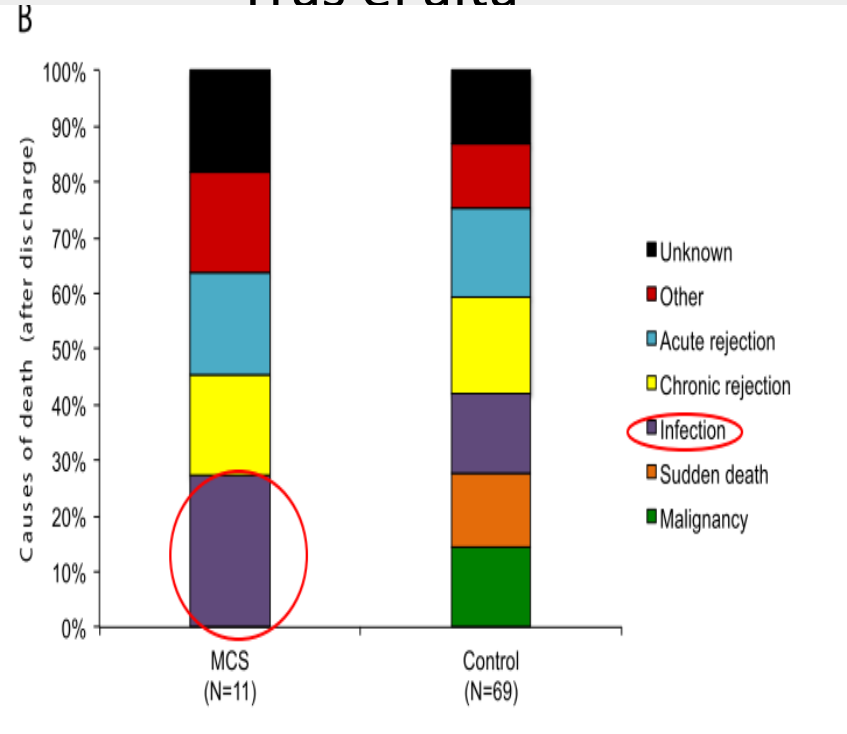
Mortalidad en TXC urgentes (> si precisó AV)

Mayor mortalidad global (OR 1.75, 95% CI 1.05–2.91) y mortalidad postrasplante (aHR 1.60, 95% CI 1.15–2.23).

Intrahospitalaria



Tras el alta



NO factor independiente de mortalidad

E. Barge Internat J Cardiol 176 (2014) 86–93

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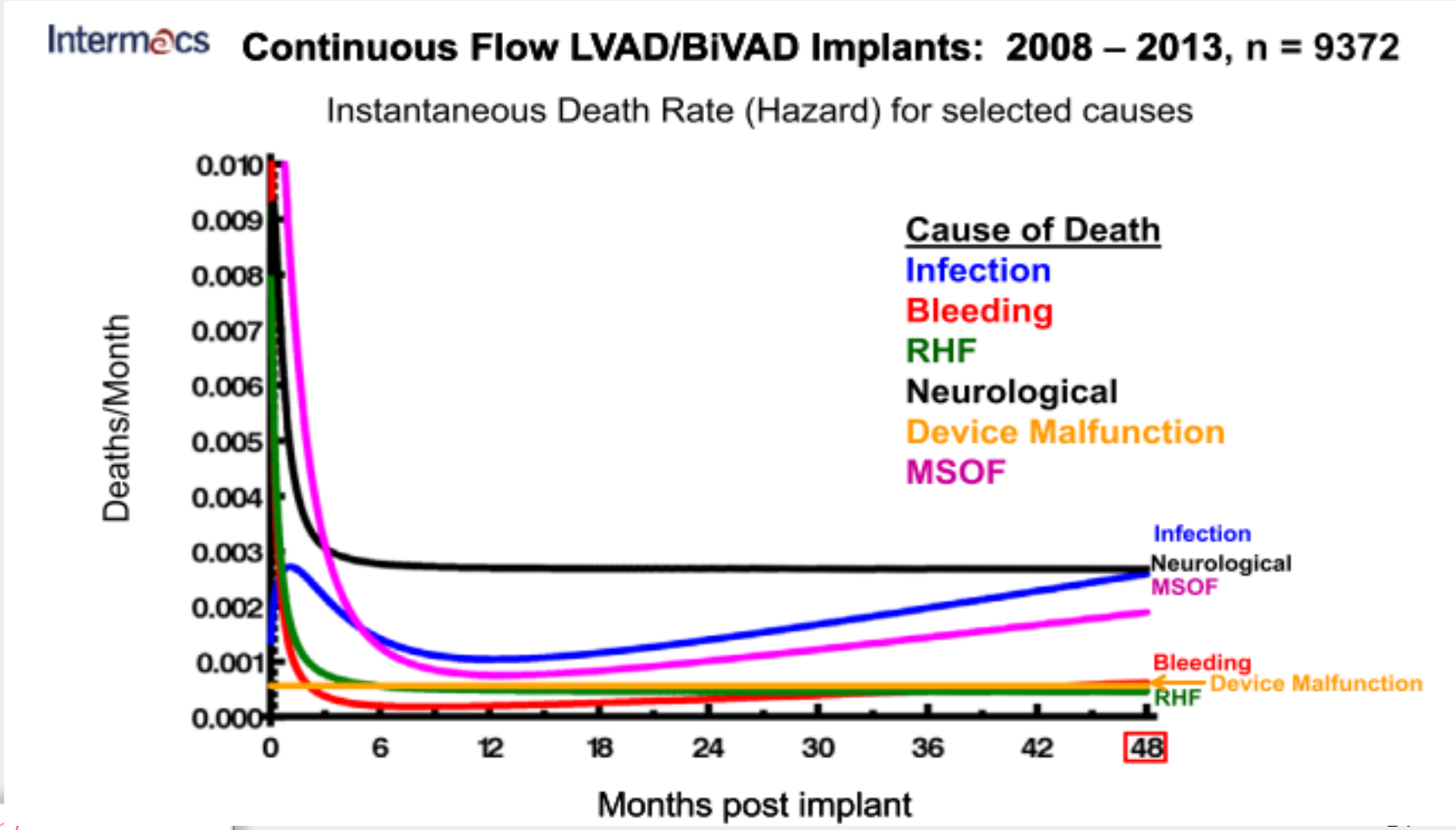
Sixth INTERMACS annual report: A 10,000-patient database

James K. Kirklin, MD,[a] David C. Naftel, PhD,[a] Francis D. Pagani, MD, PhD,[b] Robert L. Kormos, MD,[c] Lynne W. Stevenson, MD,[d] Elizabeth D. Blume, MD,[e] Marissa A. Miller, DVM, MPH,[f] J. Timothy Baldwin, PhD,[f] and James B. Young, MD[g]



J Heart Lung Transplant 2014;33:555 – 564

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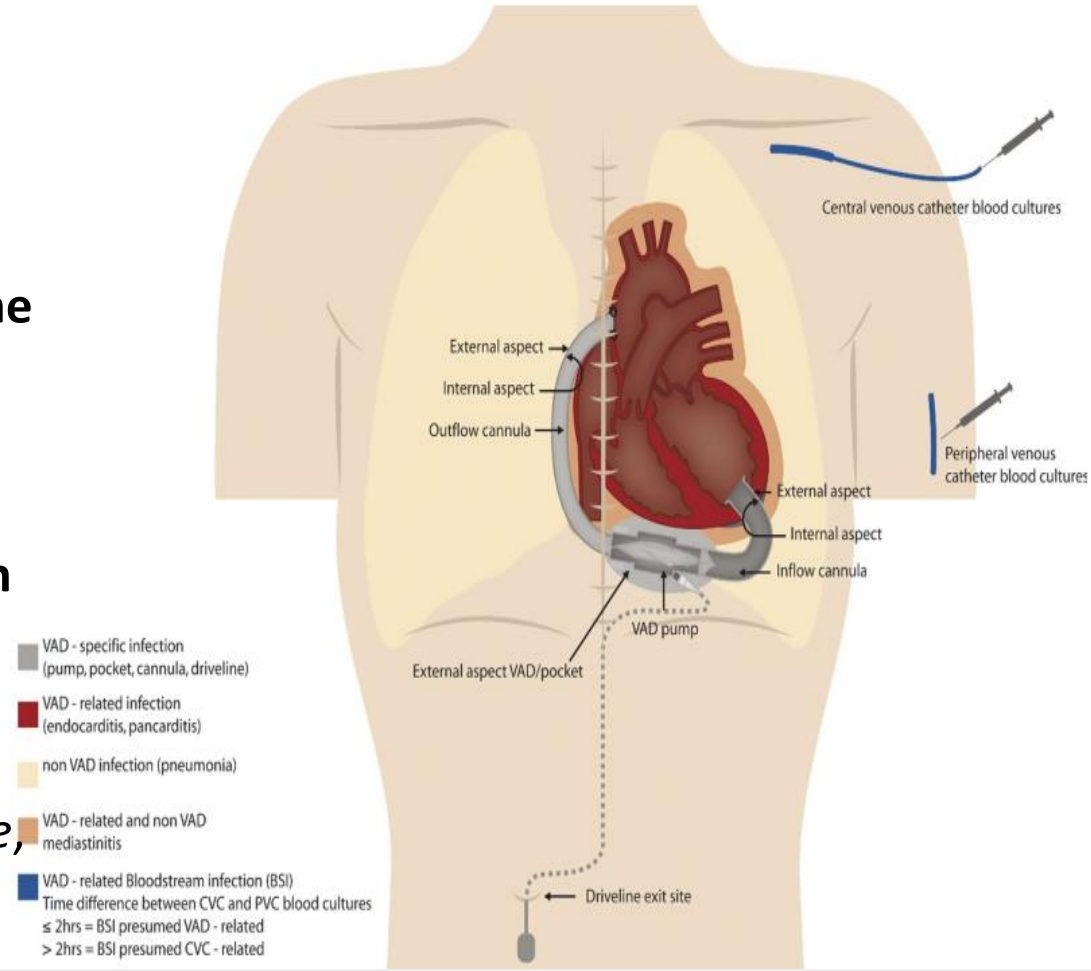
Working formulation for the standardization of definitions of infections in patients using ventricular assist devices

Margaret M. Hannan, MD[l], Shahid Husain, MD,[b] Frauke Mattner, MD,[c] Lara Danziger-Isakov, MD,[d] Richard J. Drew, MB,[a] G. Ralph Corey, MD,[e] Stephan Schueler, MD, PhD,[g] William L. Holman, MD,[h] Leo P. Lawler, MD,[a] Steve M. Gordon, MD,[d] Niall G. Mahon, MD,[a] John M. Herre, MD,[f] Kate Gould, MB,[g] Jose G. Montoya, MD,[i] Robert F. Padera, MD, PhD,[j] Robert L. Kormos, MD,[k] John V. Conte, MD,[l] and Martha L. Mooney, MD[e]

- **VAD-specific infections**
  - Do not occur in other pts
  - Related to hardware
    - **Pump, cannula, pocket &percutaneous driveline**
- **VAD-related infections**
  - Can occur without VAD
    - **IE, BSI, mediastinitis, sternal wound infection**
    - Specific considerations in pts with VADs
- **Non-VAD infections**
  - LRT, cholecystitis, *C. difficile*, UTI



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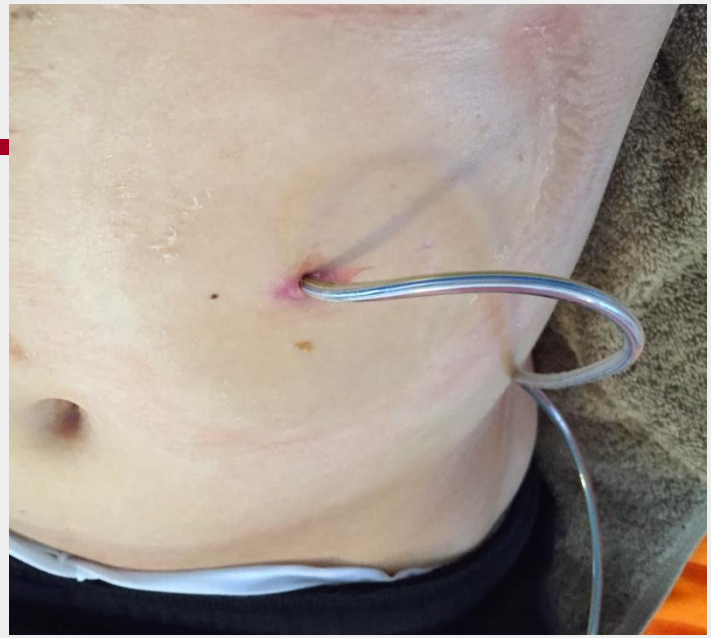
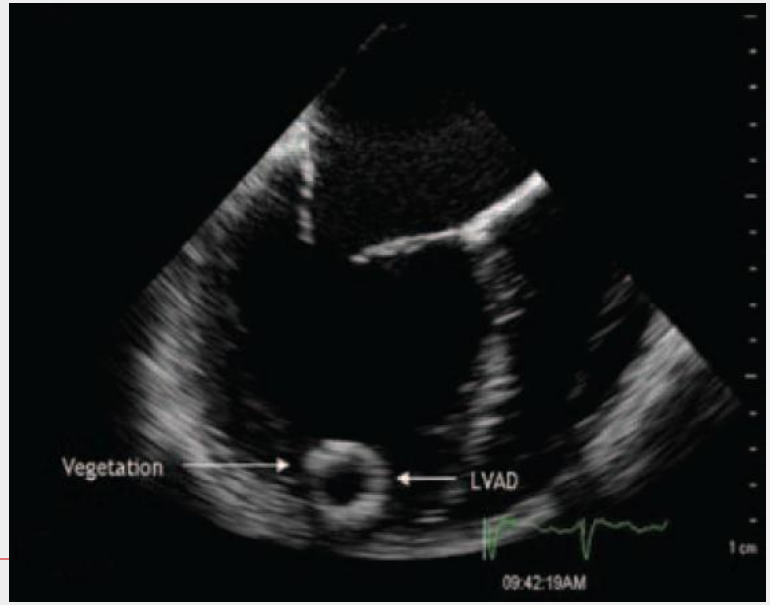
Journal of Heart and Lung Transplantation 2011

- **Driveline**: inf tejidos blandos que rodean la salida (eritema, calor, exudado)
- **Bolsillo**: inf. cavidad que contiene la bomba de la asistencia
- **Endocarditis**: evidencia clínica de inf en la bomba y/o cánula + vegetación o fenómenos vasculares (Duke modificados)
- **Inf Bomba/cánula**: lo previo, pero si no se logra ver vegetación





Clinical presentation: UNSPECIFIC

- Fever 14/25 (56%)
- Leukocytosis 7/25 (28%)
- [illegible]
- [illegible]
- [illegible]
- Mechanical problems
  - Inlet obstruction, outflow rupture
- Bacteremia

Siempre hay que sacar hemocultivos!!

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Sivaratnam et al. ASAIO Journal 2002; Argenziano JHLT 1997; Simon D. CID 2005

Clinical Manifestations and Management of Left Ventricular Assist Device–Associated Infections

Objetivo del estudio: Manifestaciones clínicas y terapia de infecciones relacionadas con los dispositivos de asistencia ventricular con flujo continuo.

Campus de la Clínica Mayo entre 2005 y 2011

Incidencia: 110 infecciones en 78 pacientes **(32% de la cohorte)**

Tipo asistencia: Heartmate II (94%)

Indicación: 62% destino final

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Nienaber et al. CID 2013; 57:1438-48

Clinical Manifestations and Management of Left Ventricular Assist Device–Associated Infections

LVADI clasificadas según los criterios ISHLT

TOTAL 32.8%

	Infection Type	Cases per 100 Person-Years of LVAD Support (95% CI)	
Infecciones Endovasculares (41)	Endocarditis	1.6 (.5–3.8)	
	Pump and/or cannula infection	4.9 (2.7–8.0)	
	Bloodstream infection		24%
	VAD related	7.5 (4.7–11.2)	
	Non–VAD related	6.8 (4.2–10.4)	
	CVC related	3.3 (1.6–6.0)	
	CVC associated	1.6 (.5–3.8)	
Infecciones locales (37)	Pocket infection	2.3 (.9–4.7)	
	Driveline infection	15.0 (10.9–20.0)	47%
	CIED infection	1.6 (.5–3.8)	
	Mediastinitis, VAD related	2.0 (.7–4.2)	

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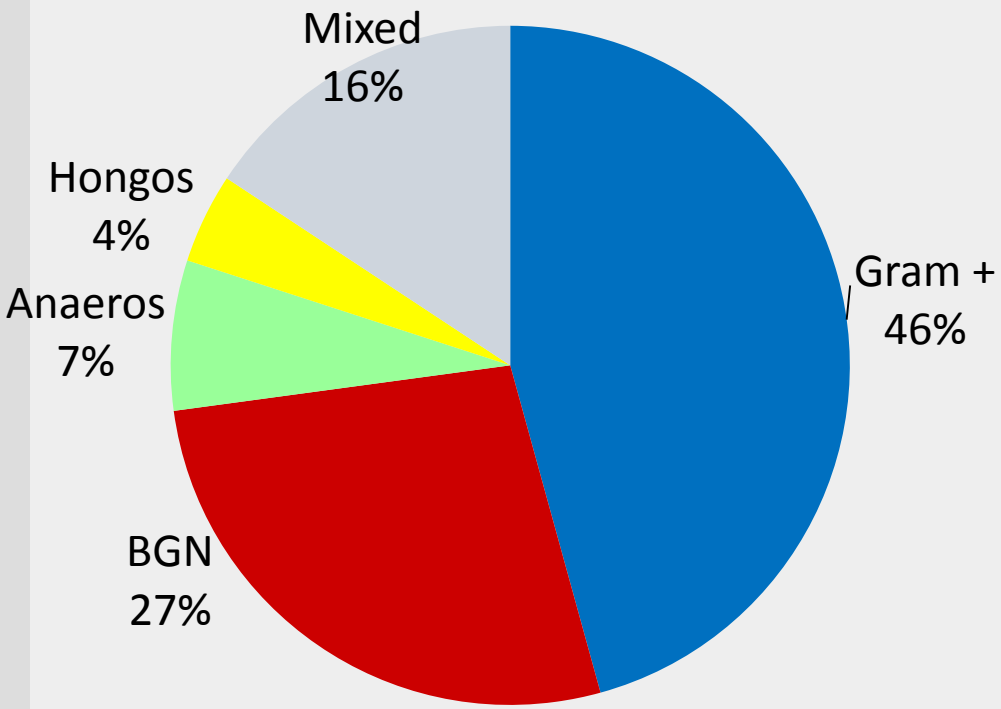
Nienaber et al. CID 2013; 57:1438-48

Etiología



- Gram negativos
  - + destination therapy
  - > Charlson
  - Abs al implante
  - BSIs **NO relacionadas** LVAD
- Gram positivos
  - BSI relacionadas asistencia
  - **> necesidad tto supresor**

La distribución de los microorganismos entre las infecciones endo-vasculares y locales ha sido similar

Nienaber et al. CID 2013; 57:1438-48

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Device Related Features and Clinical Manifestations

✓ 21 % de los pac. con **infección activa** al momento del implante

	Total (n=78)	Endovascular (n=41)	Local (n=37)
Time to infection onset, m	4.4 (1-13.5)	**1.6** (0.3-7.3)	7.1 (3-19.8)*
Fever	37 (48)	30 (73)	**7 (19)***
Met SIRS criteria	19 (25)	16 (39)	3 (8)*
Leucocitosis	39 (51)	29 (71)	10 (29)*
Creatinine level, mg/dl	1.2 (0.9-1.5)	1.4 (1.2-1.9)	1 (0.9-1.2)
Albumin level < 3.5 mg/dl	17 /57 (30)	14/31 (45)	3/26 (12)
Driveline trauma	**12 (16)**	**4 (10)**	**8 (24)**

✓ **Los 12 pts que sufrieron trauma en la driveline, se infectaron**

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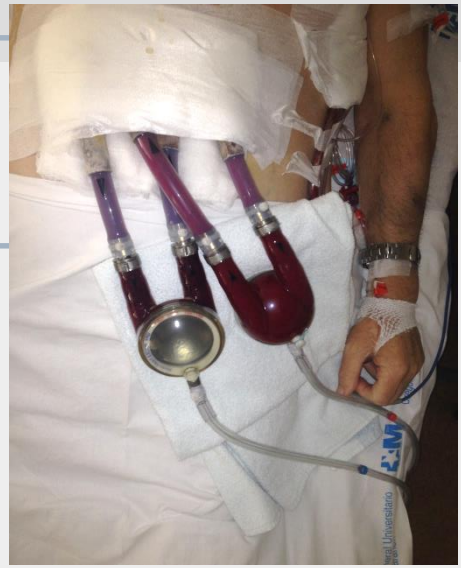
Nienaber et al. CID 2013; 57:1438-48

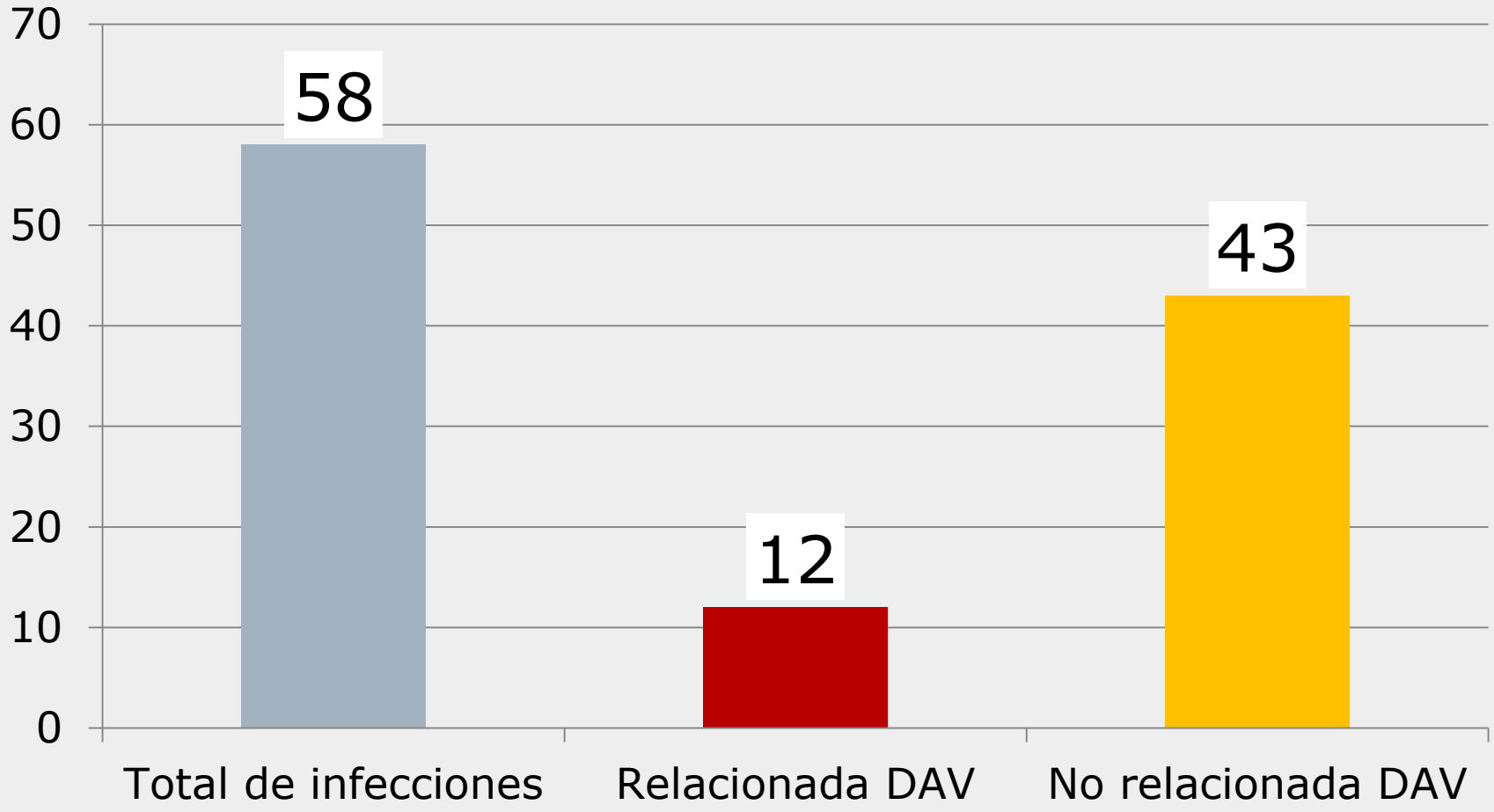
Infecciones en BERLIN HEART EXCOR



	Portador MO MR
PACIENTE 1	***Pseudomonas* Multi-R**
PACIENTE 2	***E. faecium* Vanco R**
PACIENTE 3	**SAMR** **E. coli BLEE**
PACIENTE 4	***Klebsiella* BLEE**
PACIENTE 5	***Klebsiella* BLEE**
PACIENTE 6	***Klebsiella* BLEE**
PACIENTE 7	***Klebsiella* BLEE**
PACIENTE 8	**No colonizado :)**
PACIENTE 9	**SAMS**
PACIENTE 10	**SAMS**

- 10 pacientes
- Profilaxis: 8 cefazolina, 2 Vanco+Meronem
- Colonizados patógenos resistentes

Infecciones Berlin Heart
Infección: 10/10 pacientes (media 5,8/pte)



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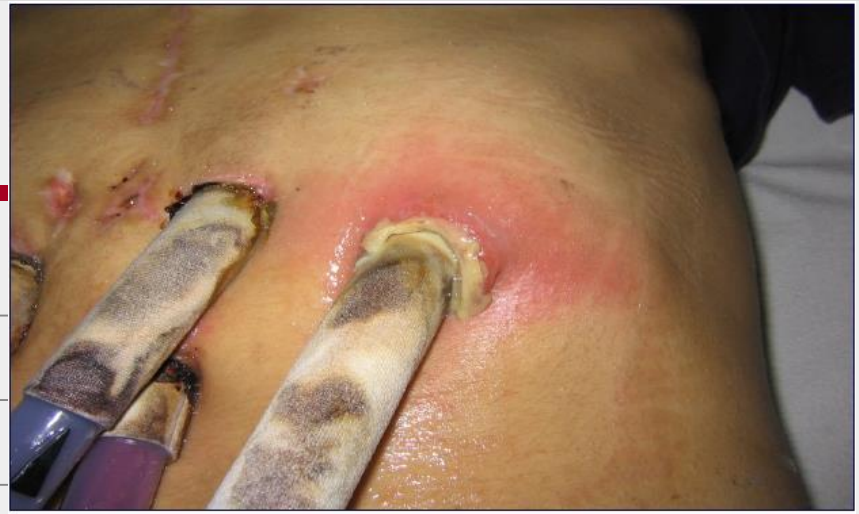
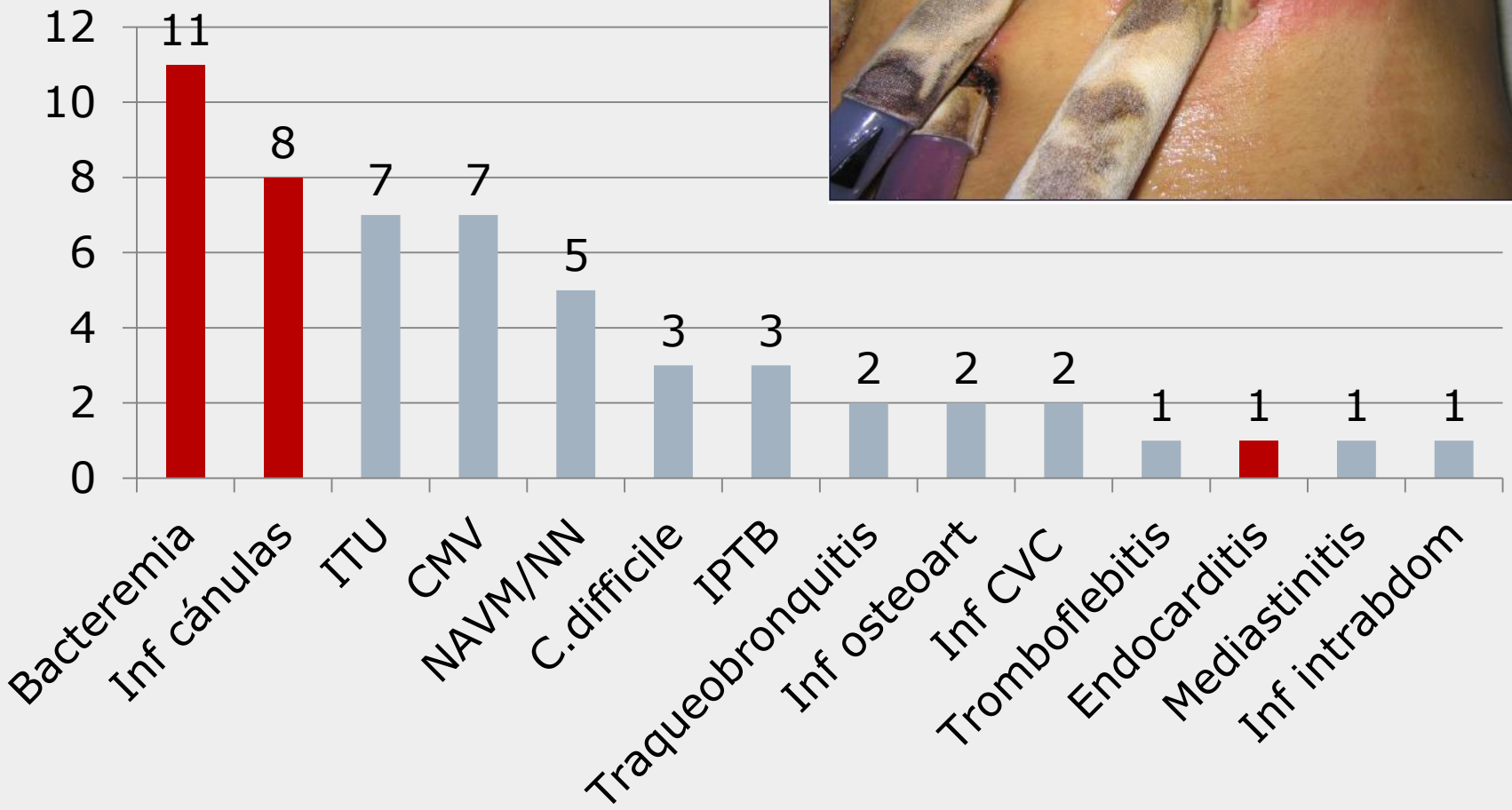
Datos no publicados. Hospital General Universitario Gregorio Marañón

Tipo de infecciones





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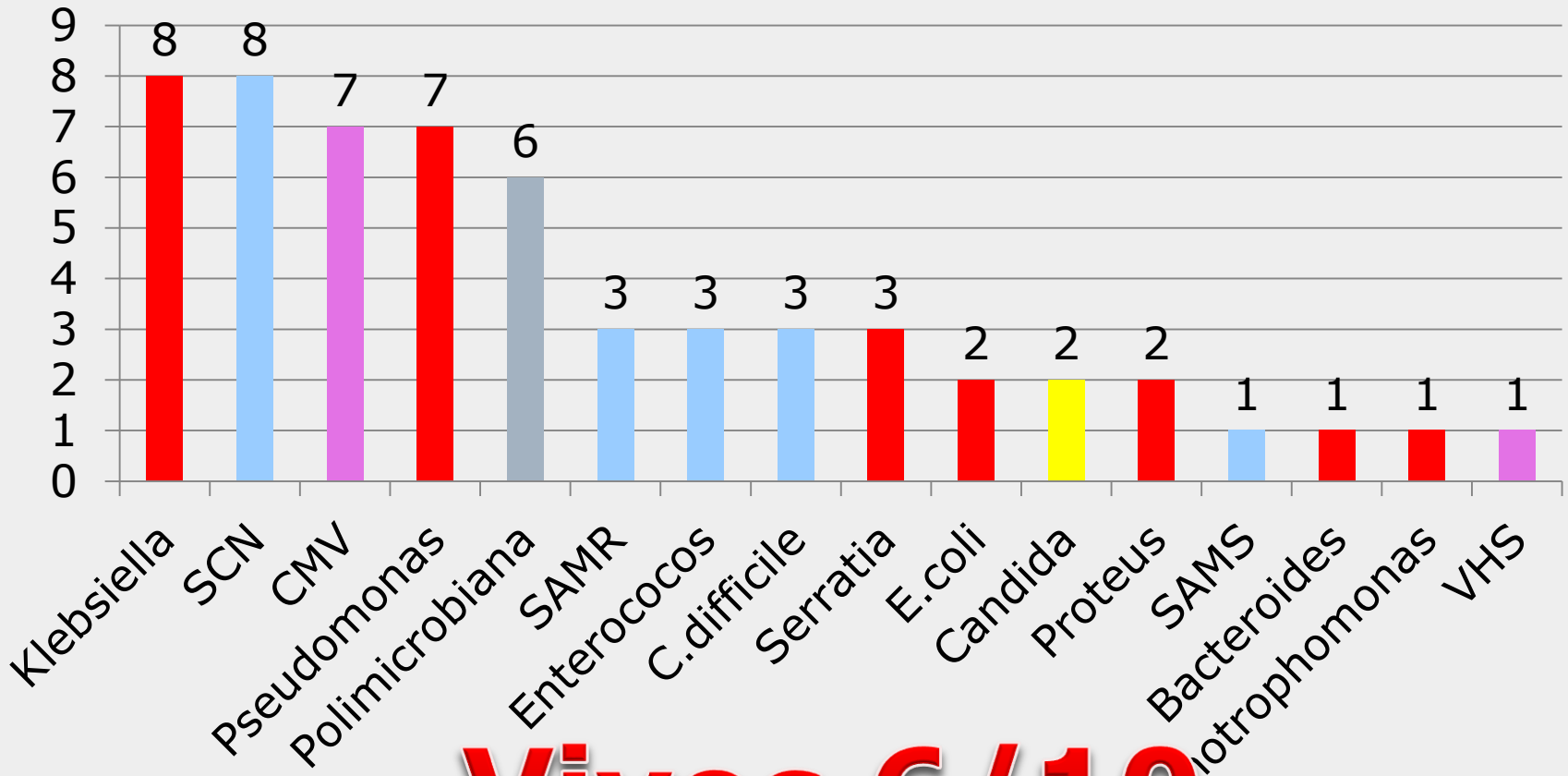
Datos no publicados. Hospital General Universitario Gregorio Marañón

Microorganismos causales



Vivos 6/10

Datos no publicados. Hospital General Universitario Gregorio Marañón

Heart, Lung and Circulation (2014) **23**, 234–241
1443-9506/04/$36.00
http://dx.doi.org/10.1016/j.hlc.2013.09.008

ORIGINAL ARTICLE

Bacteraemia in Ventricular Assist Devices: A Common Complication that Need Not Affect Clinical Outcomes

Franklin L. Rosenfeldt, MD, FRACS[a*], Lachlan J. Kwa, ME

- 170 devices in 148 pts (Novacor 12; Thoratec 100, Ventrassist 36)
- 21 Bi-Ventricular and 127 LVAD
- **Bacteremia 45%!!** (median time **45 days**)

Table 1 Prophylaxis and Treatment of Infections.

Antibiotic prophylaxis	
1990–2002	
48 h perioperative	Cephazolin 2 g or vancomycin 1 g IV
2003–2009	
Pre-operative	Rifampacin 600 mg
Intra-operative	Vancomycin 500 mg + gentamicin 320 mg + fluconazole 200 mg
Post-operative	Fluconazole 200 mg 5 days
Wound care	
All devices	Daily dressing change with aseptic povidone iodine/chlorhexidine wash of drivelines
Ventrassist	Medihoney antibacterial gel applied to drivelines weekly Shower with driveline cover, triclosan 3% wash after shower
Antibiotic therapy	
Diagnosis of bacteraemia	Initial empirical antibiotic therapy
Culture and antibiogram	Directed antibiotic therapy
Other measures	
IV cannulae	Optimal care and early removal
Collections	Prompt surgical drainage of collections at device and drivelines

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Dispositivos de asistencia ventricular

1. Que son?
2. Infecciones
3. **Tratamiento**
4. Prevención?

Dificultades de tratamiento

Challenges

The greatest challenge that hinders our efforts is difficulty in determining the extent of infection in patients with driveline infection (driveline versus device). Although a computed tomographic scan was used in this process, unless an obvious fluid collection is present around the left ventricular assist device, the infection status of the device is difficult to determine. In many

- Ademas…..

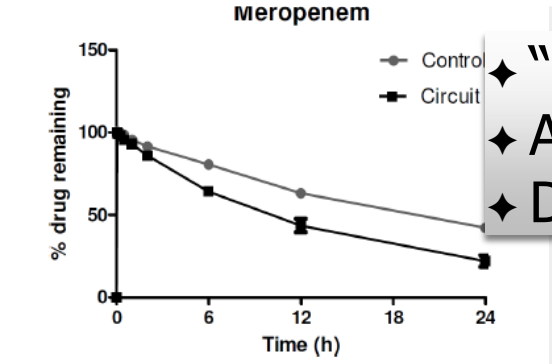
Dificultades de tratamiento

- Disfunción de la **respuesta inmune**
- Reducida **biodisponibilidad de los fármacos** en el lugar de la infección por poca vascularización
- **Interacciones** medicamentosas
- Imposibilidad de **retirar el material extraño** infectado (biofilm)
- Frecuentemente **cursos largos** de Abs con armamentario limitado

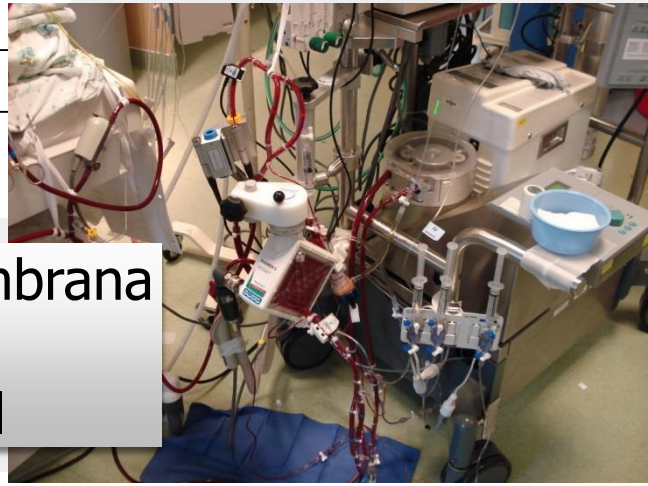
Sequestration of drugs in the circuit may lead to therapeutic failure during extracorporeal membrane oxygenation

Shekar *et al. Critical Care* 2012, **16**:R194

Kiran Shekar[1*], Jason A Roberts[2], Charles I Mcdonald[1], Stephanie Fisquet[1], Adrian G Barnett[3], Daniel V Mullany[1], Sussan Ghassabian[4], Steven C Wallis[2], Yoke L Fung[1], Maree T Smith[4] and John F Fraser[1]



- "Secuestro" del F en la membrana
- Aumento del Vd
- Disminución/Aumento del Cl



Intensive Care Med (2007) 33:1018–1024
DOI 10.1007/s00134-007-0606-2

PEDIATRIC ORIGINAL

Nilesh M. Mehta
David R. Halwick
Brenda L. Dodson
John E. Thompson
John H. Arnold

Potential drug sequestration during extracorporeal membrane oxygenation: results from an ex vivo experiment

- **Dramatic sequestration of voriconazole (up to ≥ 70%) in the ECMO circuit**
- **Loss of 15.4% of ampicillin, 21% of cefazolin**
- **31.4% of fosphenytoin**
- **53.3%of heparin and 100% of fentanyl**
- **Meropenem 42%**

De Rosa FG. Int J Antimicrob Agents 2013

SEICAV
Sociedad Española de Infecciones Cardiovasculares

¿Que características influirán en estos cambios?

Fármaco

- Tamaño de la molécula
- Grado de ionización a pH fisiológico
- UPP
- Liposolubilidad

ECMO

- Tipo de bomba (centrifugación/rodillo)
- Composición de la membrana
- Composición del tubo

Paciente

- Hemodilución
- Sangrado y transfusiones
- Disfunción orgánica
- Técnicas de depuración extrarrenal

SEICAV
Sociedad Española de Infecciones Cardiovasculares

Shekar K, Altered antibiotic pharmacokinetics during extracorporeal membrane oxygenation: cause for concern? JAC 2013

Tratamiento antimicrobiano pacientes en ECMO:

- Muchas publicaciones sobre variabilidad parámetros PK en pacientes con ECMO (la mayoría *case reports).*
- Distintos efectos en diferentes fármacos
- Posibilidad fallo terapéutico
- Siempre que sea posible monitorizar los niveles del fármaco y tratar de individualizar las dosis
- Valorar infusiones extendidas en beta lactámicos
- Necesitamos más datos

ISHLT guidelines

- **Medical therapy**
  - No recommendations on
    - Drugs of choice
    - Duration
- **Surgical**
  - Need to establish the site of infection
  - Debridement or device replacement?
- Recurrence 38%

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Sociedad Española de Infecciones Cardiovasculares

Moazami N. Ann thorac Surg 2013; Sharma V. Ann Thorac Surg 2012; Sharma V. Ann Thorac Surg 2012

Tratamiento infecciones asistencias ventriculares

- Duración media del tto. **28 días**
- **42%** tratamiento supresor (hasta muerte, retirada de la asistencia o limitación de esfuerzos) si sospecha de afectación de la asistencia
- 76% de los pacientes **NO cirugía**
  - **14% desbridamiento quirúrgico** con mantenimiento del dispositivo
  - **3 pacientes retirada del dispositivo**
- **29% experimentaron recidiva** (29% (8/28) con tto. crónico Vs 11% (5/45) sin tto. crónico)
- **Mortalidad** a 2 años: 43%. Tx en 43% de los 30 candidatos

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Sociedad Española de Infecciones Cardiovasculares

Nienaber et al. CID 2013; 57:1438-48

Clinical Manifestations and Management of Left Ventricular Assist Device–Associated Infections

Variable		Total (n = 78)	Endovascular (n = 41)	Local (n = 37)
Antibiotic therapy duration, d[a]				
Overall	n = 76	28.0 (14.5–42.5)	33.0 (15.5–42.5)	23.5 (13.0–44.0)
Parenteral antibiotics (primarily)[a]	n = 53	36.0 (17.0–49.0)	34.5 (16.0–43.0)	39.0 (26.0–132.0)
Oral antibiotics (primarily)[a]	n = 23	14.0 (10.0–24.0)	15.5 (14.0–17.0)	14.0 (10.0–24.0)
Receipt of suppressive oral antimicrobials		29 (37)	16 (39)	13 (35)
Receipt of suppressive parenteral antimicrobials[b]		4 (5)	2 (5)	2 (5)
Surgical management	n = 76			
None		58 (76)	33 (80)	25 (71)
Bedside debridement		3 (4)	1 (2)	2 (6)
Intraoperative debridement with device retention		10 (13)	4 (10)	6 (17)
LVAD removal		3 (4)	1 (2)	2 (6)
Other[c]		2 (3)	2 (5)	0 (0)
Duration of LVAD support follow-up, y		1.6 ± 1.1	1.3 ± 0.8	2.0 ± 1.2
Death at 2-y follow-up[d]		25 (40)	19 (53)	6 (26)
Heart transplantation at 2-y follow-up (among bridge-to-transplant patients[d]	n = 30	10 (47)	5 (40)	5 (55)

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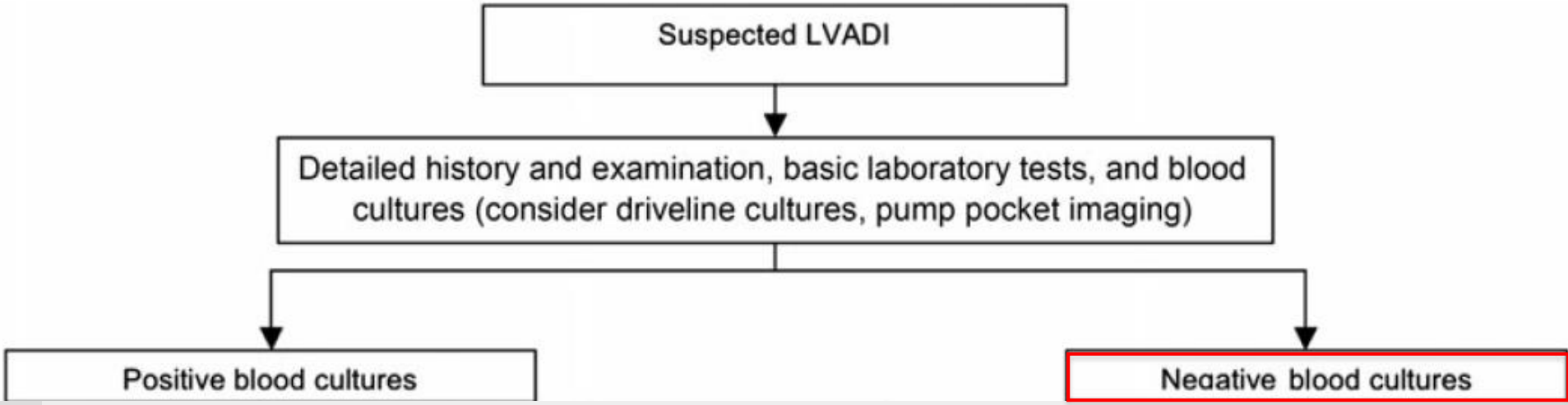
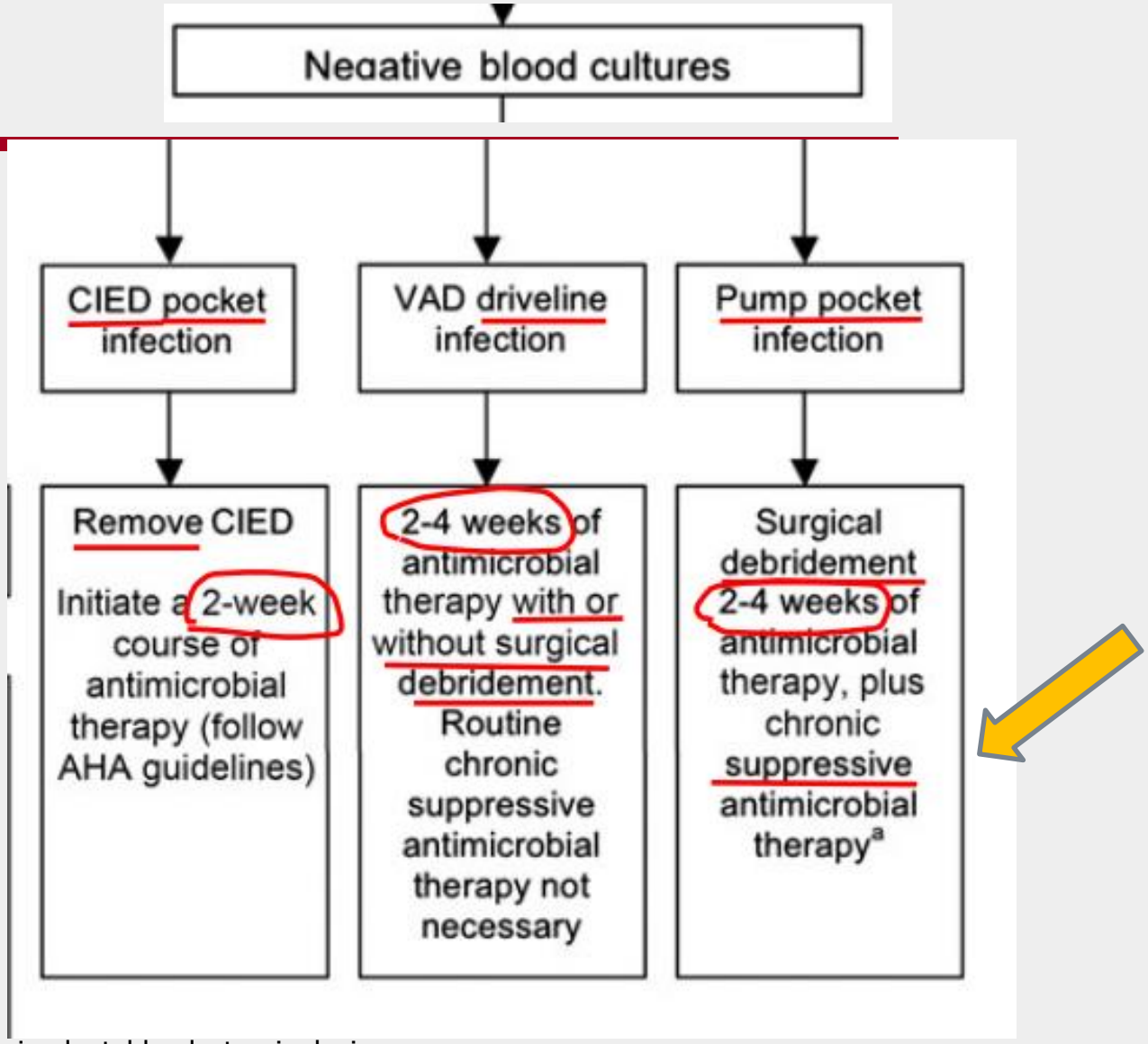
Sociedad Española de Infecciones Cardiovasculares

Nienaber et al. CID 2013; 57:1438-48

Propuesta de algoritmo



Nienaber et al. CID 2013; 57:1438-48



CIED, cardiovascular implantable electronic device

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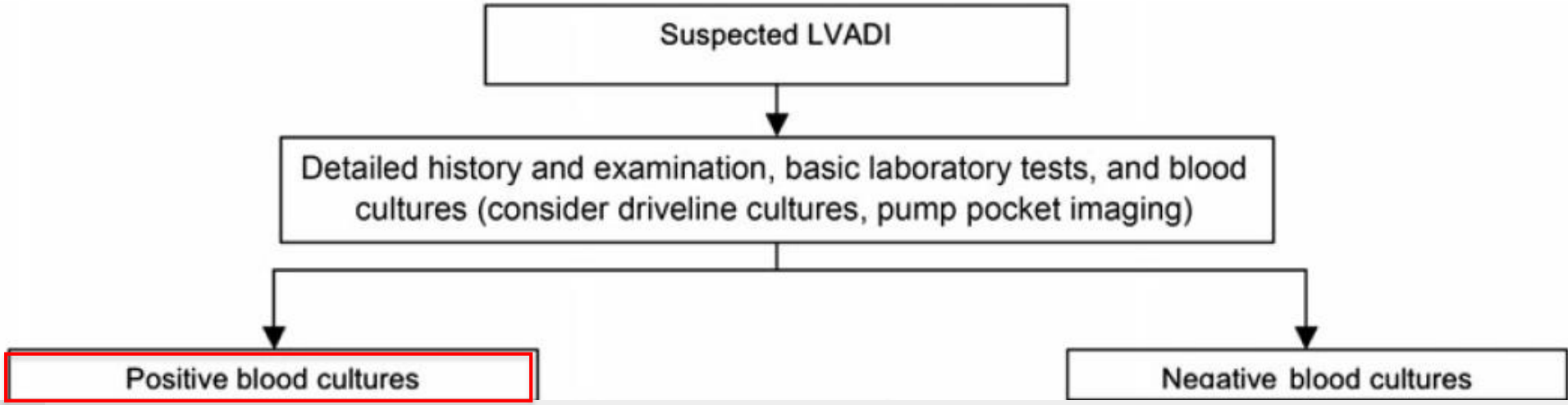
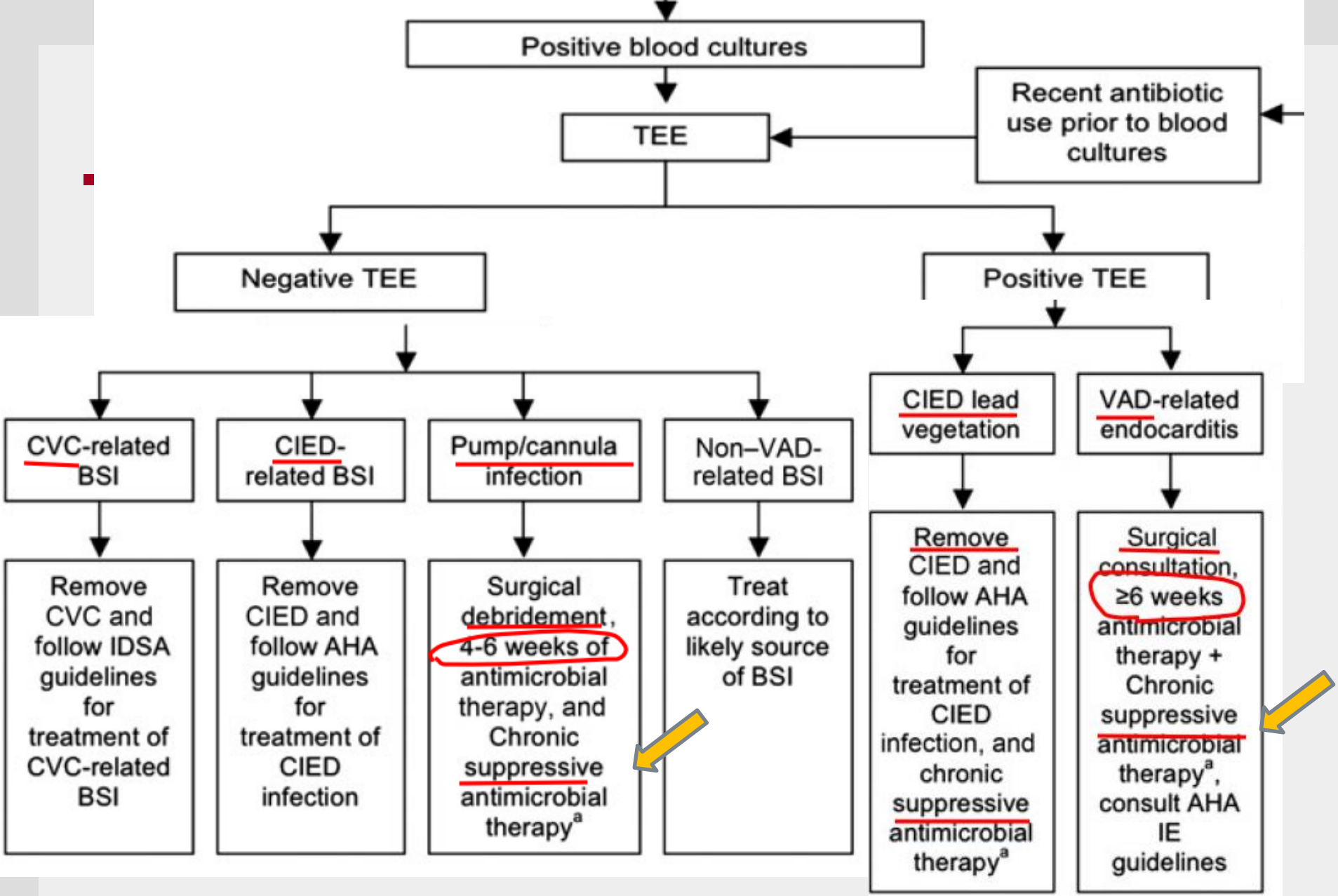
Nienaber et al. CID 2013; 57:1438-48

Recomendaciones



Nienaber et al. CID 2013; 57:1438-48



SEICAV
Sociedad Española de Infecciones Cardiovasculares

Nienaber et al. CID 2013; 57:1438-48

Clinical Outcomes Associated With Chronic Antimicrobial Suppression Therapy in Patients With Continuous-Flow Left Ventricular Assist Devices

*†Douglas L. Jennings, ‡Anuvrat Chopra,

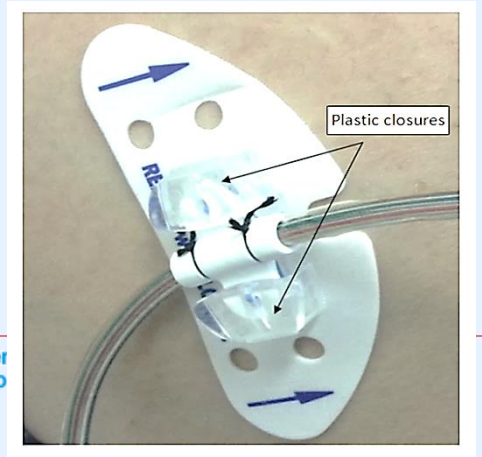
- **Chronic Abs** (after 6 wks of IV Therapy): 16/140 (**11.5%**) with DEVICE-RELATED infection
- SXT 37.5%, drivelines infections (69%)
- **Failure** (clinical deterioration needing switch to IV or to other IV Ab, elevation to status 1A of tx list due to infection or device/driveline exchange or death): 5/16- **31% after a mean of 175 days of therapy (10-598)**
- Sobreinfecciones, AEs y *C. difficile*

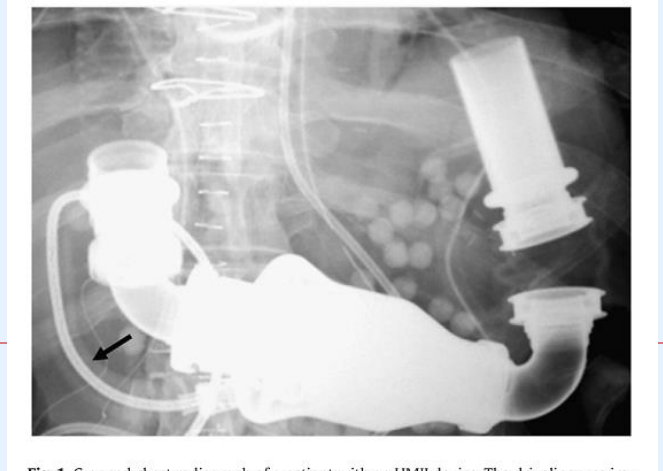
Jennings DL. Artif Organs 2014; 38

DAV

1. Que son?
2. Infecciones?
3. Manejo?
4. ***Prevención?***

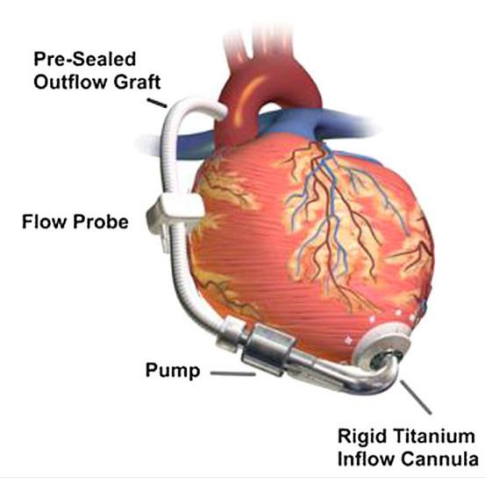
Antimicrobianos
Otras actuaciones

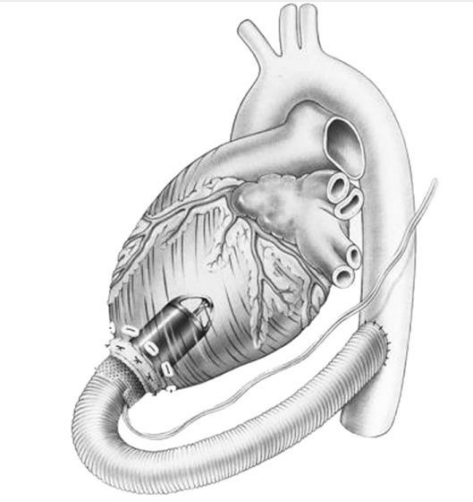




Prevention. No clinical trials

- **Colonization screening** before surgery
- Maximum **surgical prevention** strategies
  - Operating room traffic, HEPA filters
  - Wrapping the pump and drivelines in Ab pads?? Wrapping the pump omentum?
  - Tunneling driveline contralateral to pump pocket
  - Occlusive dressing of driveline exit
  - Chlorhexidine bathing
- **Postoperative infection prevention**
  - Extubation, pulmonary toilet
  - Removal of catheters
  - Nutrition…..
- **Prophylactic antibiotics**





Frequency of driveline exit-site dressing change

Left ventricular assist device driveline infection and the frequency of dressing change in hospitalized patients

Lisa Wus, DNP, CRNP, PCCN-CMC [a,*], MaryLou Manning, PhD, CRNP, CIC, FAAN [b], John W.C. Entwistle III, MD, PhD [c]

[a] *Thomas Jefferson University Hospital, 111 South 11th Street, Suite 5480N, Philadelphia, PA 19107, USA*
[b] *Thomas Jefferson University, Jefferson School of Nursing, 901 Walnut Street, Suite 814, Philadelphia, PA 19107, USA*
[c] *Division of Cardiothoracic Surgery, Department of Surgery, Thomas Jefferson University, 1025 Walnut Street, Suite 607 College Building, Philadelphia, PA 19107, USA*

- Retrospectivo. 2008-2013: 68 pacientes con Heartmate II NO infecciones del driveline
- **No diferencias entre cambios diarios, cada tres dias o cada semana**.

Heart Lung. 2015 May-Jun;44(3):225-9

The Evidence Base for Prophylactic Antibiotics in Patients Receiving ECMO

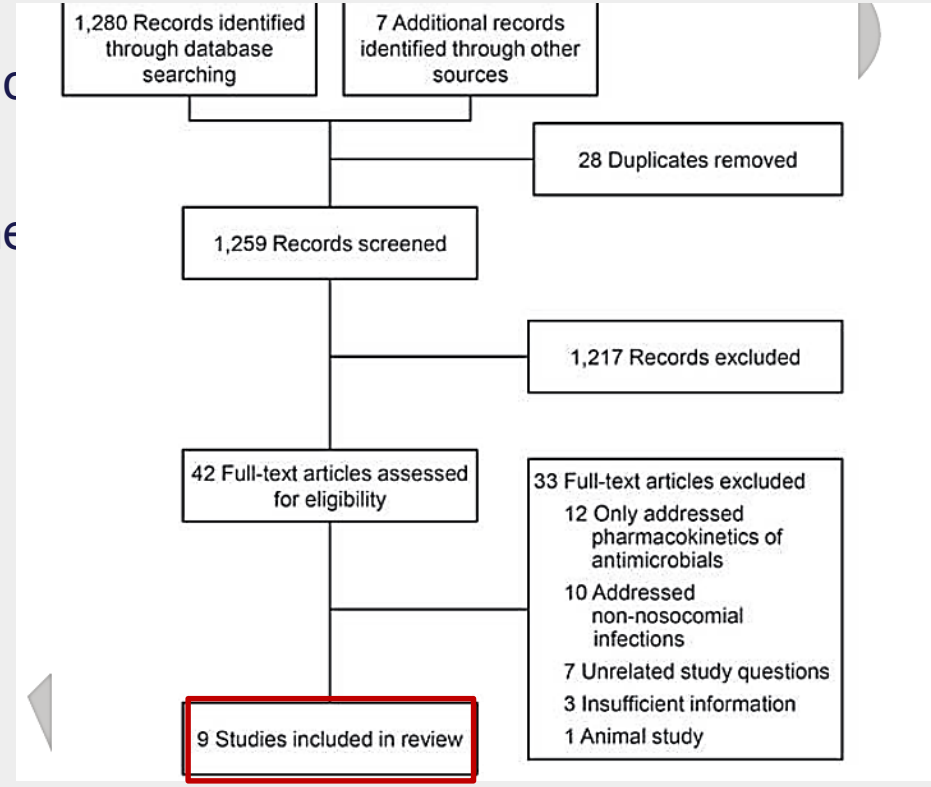
AIM OF THE SYSTEMATIC REVIEW:

- Evaluate the evidence for the use o antibiotic prophylaxis in patients receiving extracorporeal membrane oxygenation (ECMO) therapy

PROPHYLACTIC DRUG USED varied substantially!

No relationship was observed regarding incidence between studies using prophylaxis or not

Consider if <u>open chest</u>



O'Horo JC. ASAIO Journal Ahead of Print
DOI: 10.1097/MAT.0000000000000287

ASAIO Journal 2013

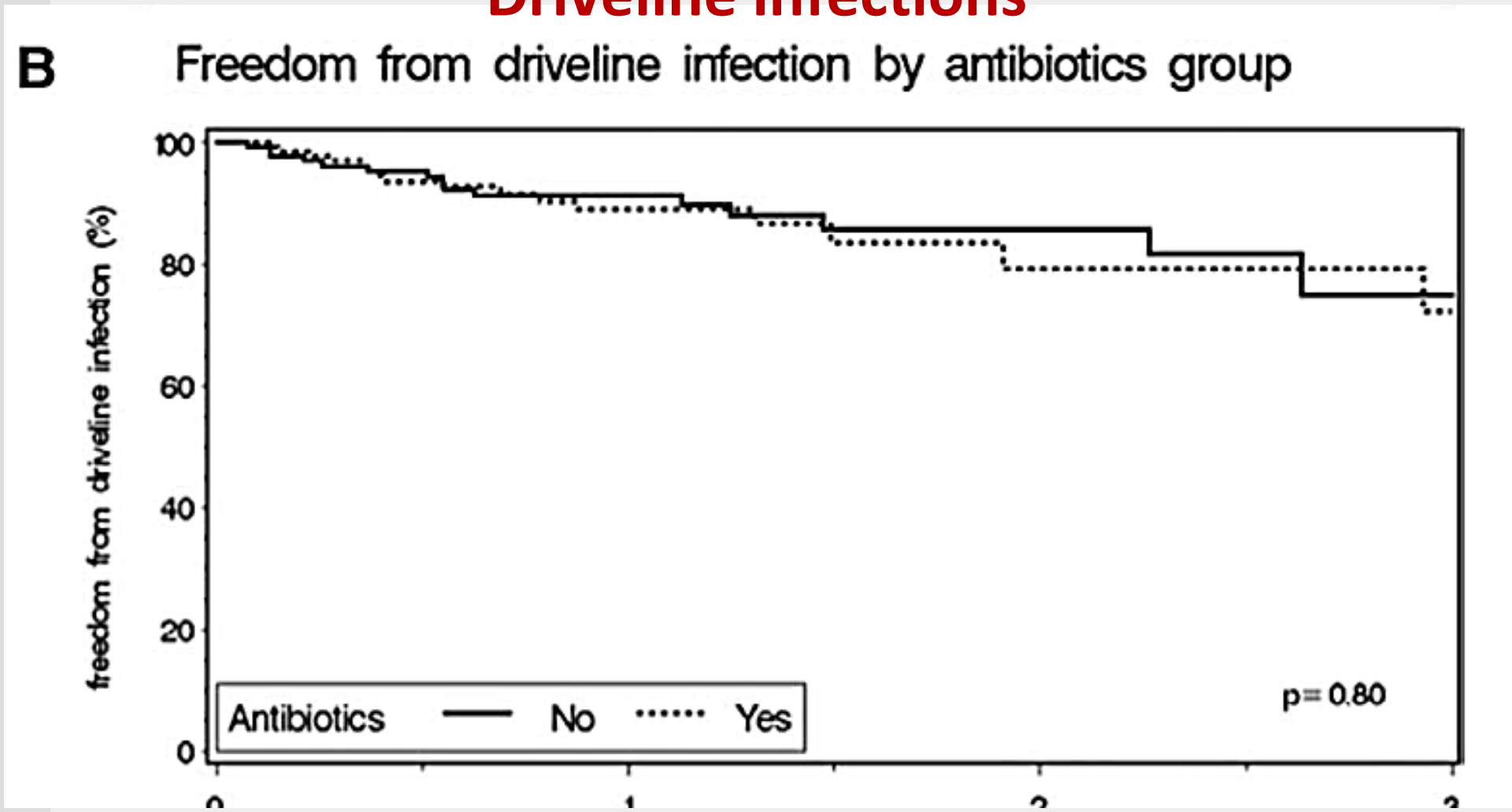
Prevention of Percutaneous Driveline Infection After Left Ventricular Assist Device Implantation: Prophylactic Antibiotics Are Not Necessary

John M. Stulak,* Simon Maltais,† Jennifer Cowger,‡ Lyle D. Joyce,* Richard C. Daly,* Soon J. Park,* Keith D. Aaronson,‡ and Francis D. Pagani‡

- Comparacion de la incidencia de infecciones en dos grupos:
  - 141 pacientes en la clínica Mayo con Heartmate: Limpieza estéril, recambios estériles de los apósitos y **NO antibióticos** salvo perioperatorio
  - 144 pacientes en la Michigan University: Lo mismo PERO **CON ANTIBIÓTICOS**

ASAIO J. 2013 Nov-Dec;59(6):570-4

Driveline infections

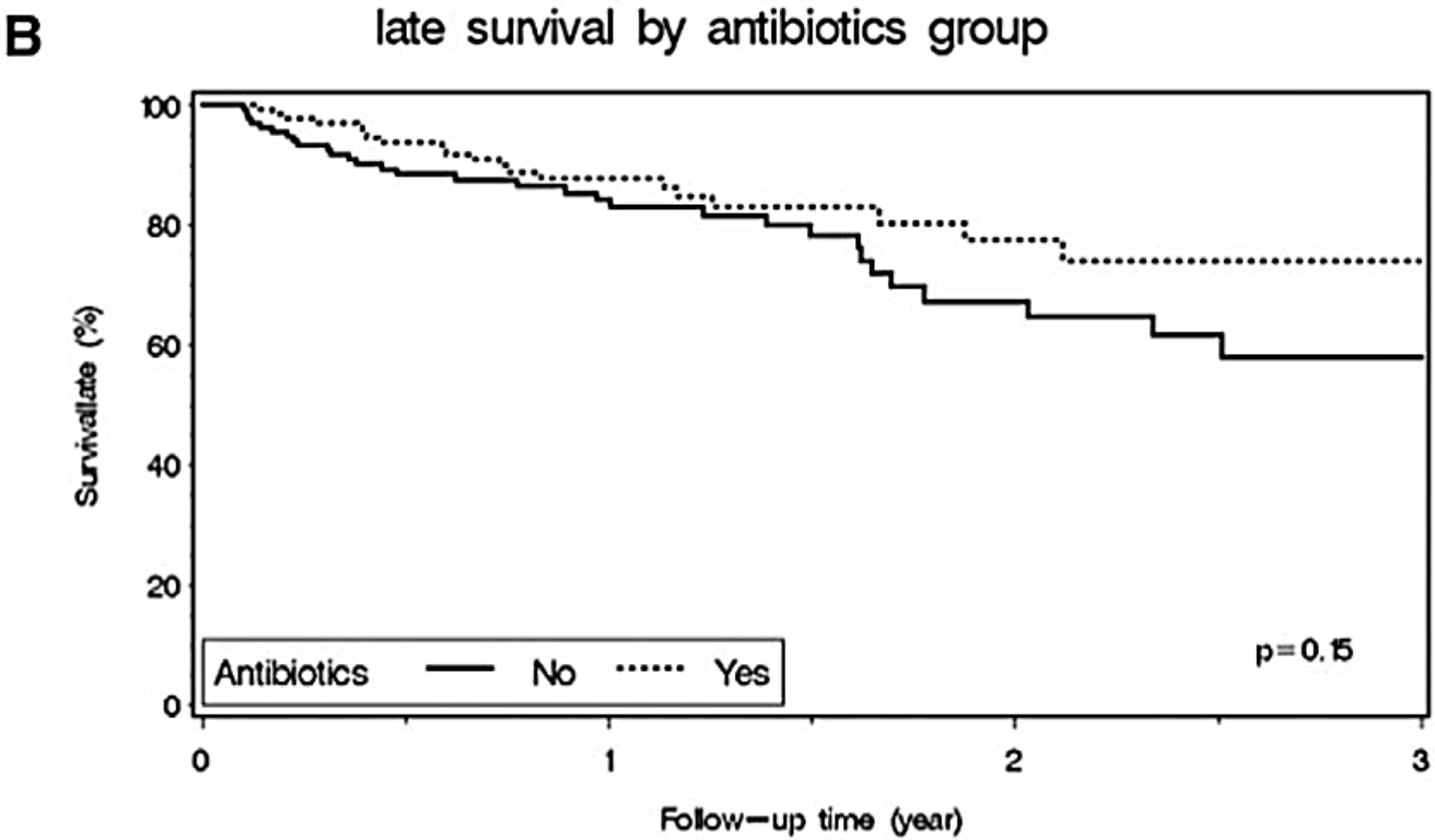


Hospital General Universitario Gregorio Marañón

SaludMadrid
Comunidad de Madrid

ASAIO J. 2013 Nov-Dec;59(6):570-4

Survival



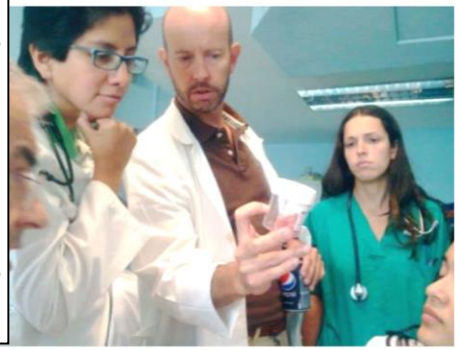
ASAIO J. 2013 Nov-Dec;59(6):570-4

En resumen

- A pesar de los avances, las infecciones continúan causando importante morbi-mortalidad, tanto a corto, como a largo plazo
- El diagnóstico de la profundidad de la infección sigue siendo complicado en la vida real
- Necesitamos más datos para establecer los esquemas terapéuticos médicos y quirúrgicos así como la duración óptima del tratamiento
- No hay evidencia de que sea necesario administrar pautas profilácticas de gran espectro
- La protección frente a los microtraumas en el driveline es esencial, y se están desarrollando mecanismos para evitarlos
- Pacientes con gran carga emocional para todos y que necesitan ser manejados en equipo y probablemente con protocolos nacionales.

Grupo de Apoyo al Manejo de las Asistencias Ventriculares (GAMAV)

- **Cardiología:** Yago Sousa, Eduardo Zataraín, Francisco Fernández-Avilés
- **Cirugía Cardiaca:** Manuel Ruíz, Gregorio Cuerpo, Hugo Abella, Juan Fco del Cañizo, Ángel Pinto.
- **Anestesia:** Javier Hortal, José Maria Barrio, Alejandro Garrido
- **Inmunología:** Elisabeth Sarmiento
- **Microbiología:** Patricia Muñoz, Maricela Valerio, Alia Eworo, Emilio Bouza



Muchas gracias!!

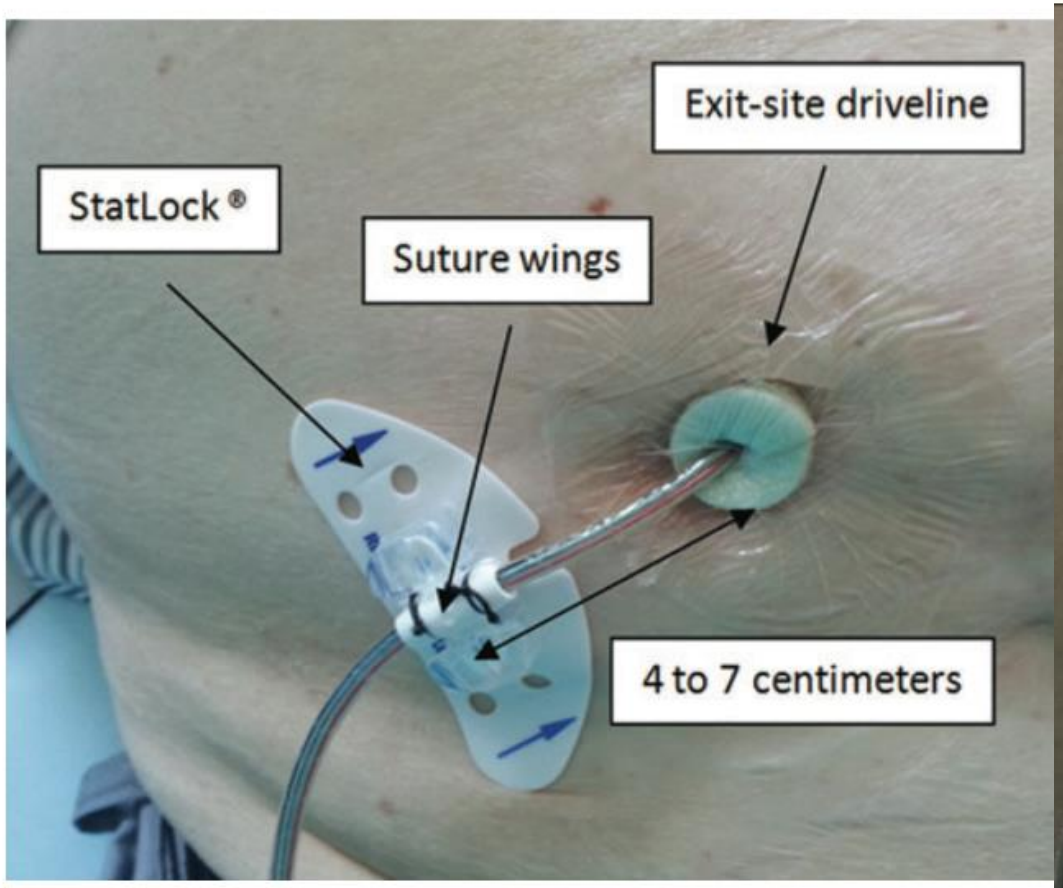
SaludMadrid
Comunidad de Madrid

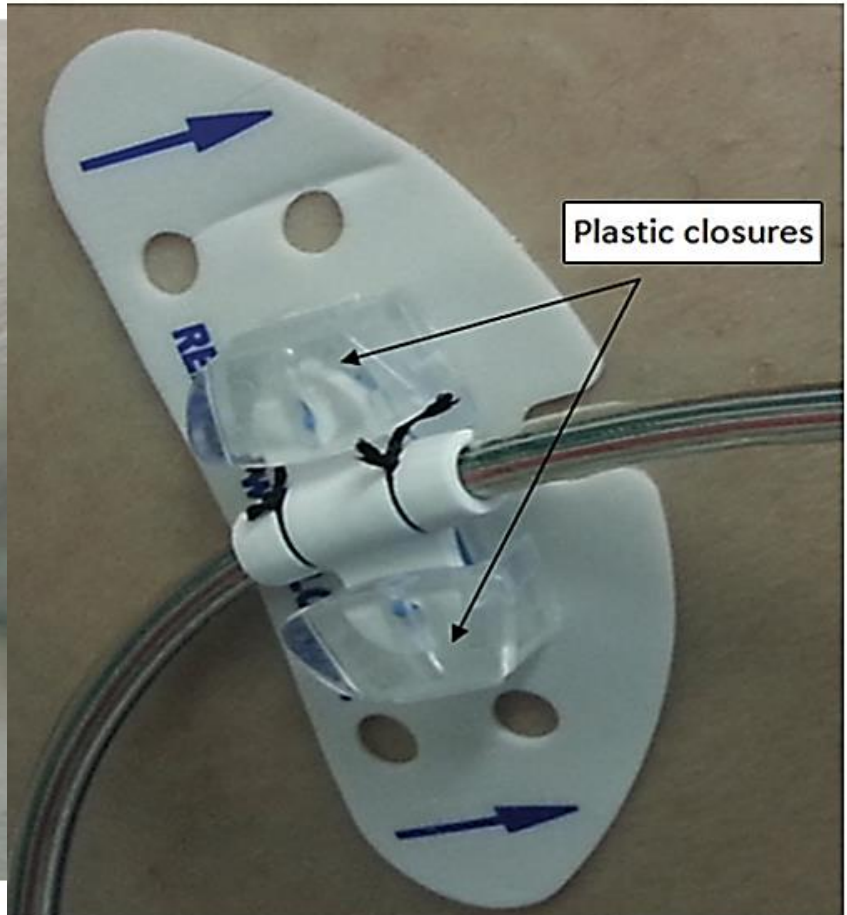
Interactive CardioVascular and Thoracic Surgery 18 (2014) 415–417
doi:10.1093/icvts/ivt549 Advance Access publication 14 January 2014

A simple device to secure ventricular assist device driveline and prevent exit-site infection

Andrea Baronetto[a,*], Paolo Centofanti[a], Matteo Attisani[a], Davide Ricci[a], Baudolino Mussa[b], Roger Devotini[a], Erika Simonato[a] and Mauro Rinaldi[a]

[a] Division of Cardiac Surgery, San Giovanni Battista Hospital 'Molinette', University of Turin, Turin, Italy





Reduction in driveline infection rates: Results from the HeartMate II Multicenter Driveline Silicone Skin Interface (SSI) Registry

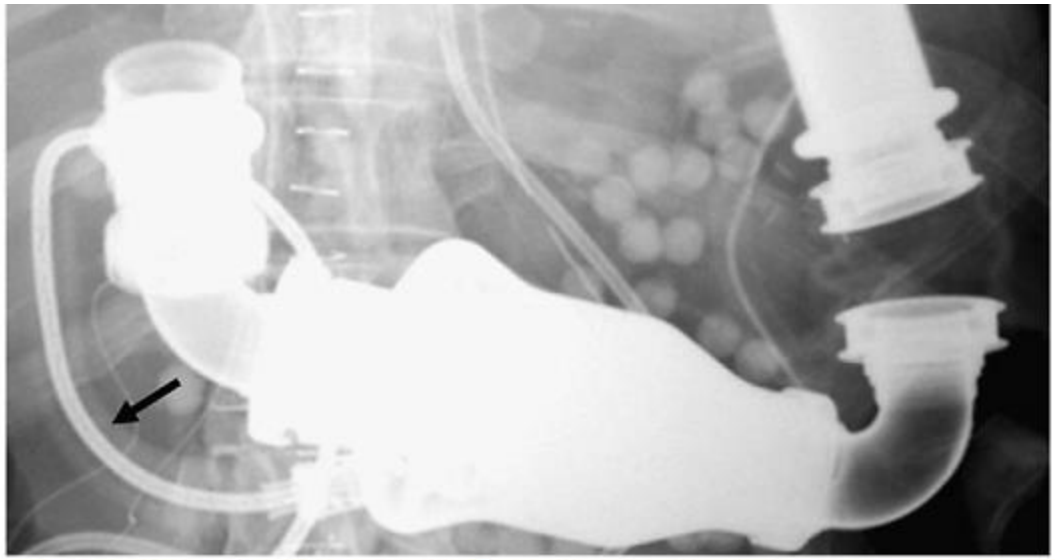
David Dean, MD,[a] Faouzi Kallel, PhD,[b] Gregory A. Ewald, MD,[c]
Antony Tatooles, MD,[d] Brett C. Sheridan, MD,[e] Robert J. Brewer, MD,
Christian Caldeira, MD,[g] David J. Farrar, PhD,[b] and Shahab A. Akhter
on Behalf of the SSI Registry Investigators

- Comparación infección de driveline y VAD en HeartMate II
  - 200 (2009 – 2012) driveline tunelizado
  - 201 (2007 y 2009) técnica clásica

JHLT 2015

Comparing velour versus silicone interfaces at the driveline exit site of HeartMate II devices: infection rates, histopathology, and ultrastructural aspects

Sean P McCandless [a,1], Ian D Ledford [a,1], Nathan O Mason [a], Rami Alharethi [c], Brad Y Rasmusson [d], Deborah Budge [c], Sandi L Stoker [a], Stephen E Clayson [b], John R Doty [b], George E Thomsen [d], William T Caine [b], Abdallah G Kfoury [c], Bruce B Reid [b], Dylan V Miller [e,*]



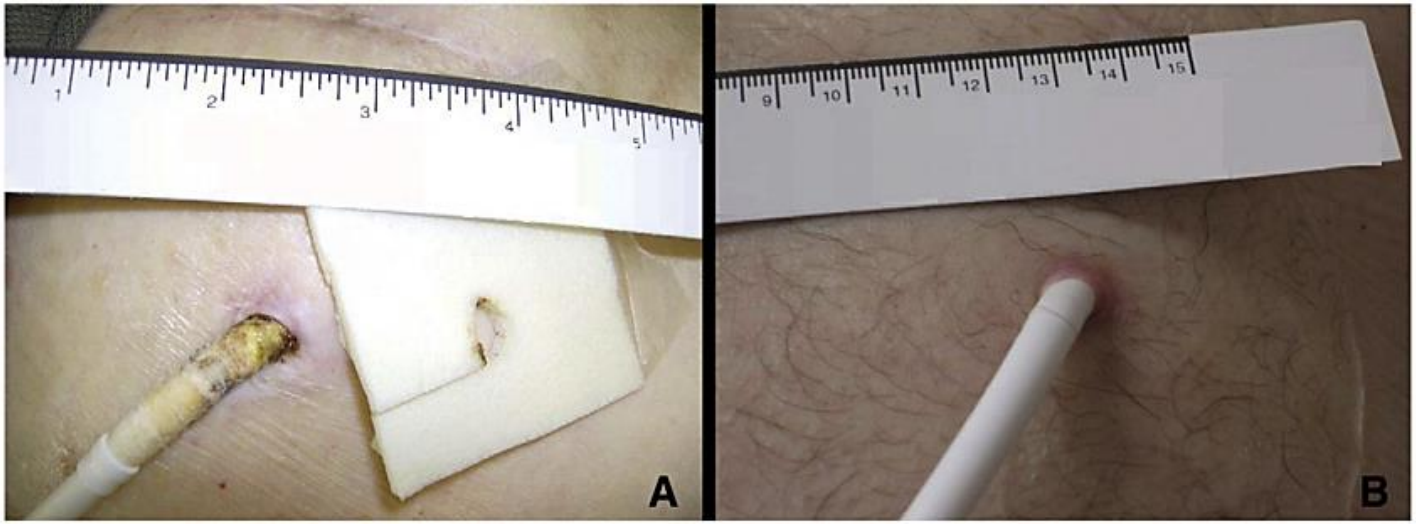


Fig. 2. Photographs showing typical fully incorporated velour and silicone DLES with velour (A) and smooth silicone (B) interfaces. Notice bloody material adhered to the velour sheath. The silicone DLES is free of debris, and skin is cleanly adhered to the driveline. Both photographs show the DLES at similar stages of wound healing.

Infección driveline