19:10 – 19:30 h **Infecciones en dispositivos de asistencia ventricular**

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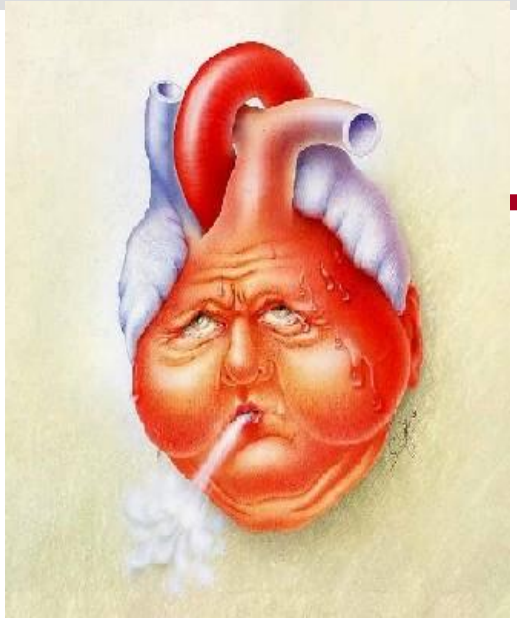
Universidad Complutense de Madrid

CIBERES

Sociedad Madrileña Microbiología Clínica

Dispositivos asistencia ventricular

1. **Asistencias ventriculares**
2. Infecciones DAV
3. Manejo



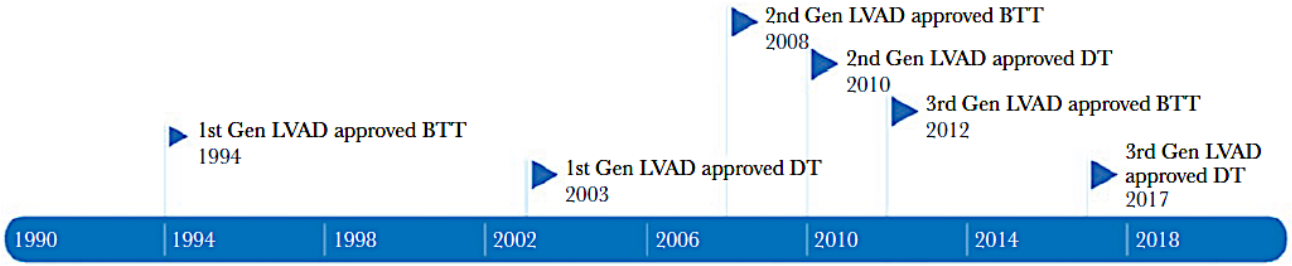
Importancia del problema

>6.5 millones con ICC en USA

TxC 3.551 en 2019 en USA

Rápido aumento de soportes circulatorios mecánicos

Soporte agudo *(recuperación, Puente a Tx o a decision)*
Soporte crónico- *destination therapy*



Generation	Details	Examples
First	Pulsatile flow through bioprosthetic valves; pump pocket in the peritoneal cavity	HeartMate XVE Novacor
Second	Continuous flow with either axial or centrifugal pumps; smaller pump with simplified components	HeartMate II (HMII, axial pump) VentrAssist (centrifugal pump)
Third	Magnetically suspended centrifugal rotor eliminates metal bearings	HeartWare (HVAD) HeartMate 3 (HM3)

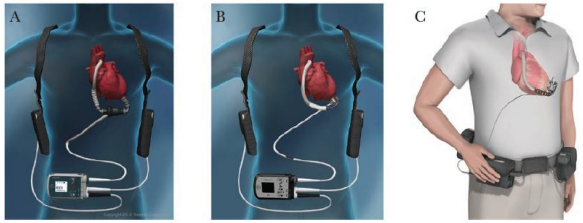


Figure 2. Most frequently encountered LVADs currently in use in the United States: (A) HeartMate II, (B) HeartMate III, and (C) HeartWare HVAD. Images of H and HeartMate 3 are reproduced with permission from Abbott. Image of HeartWare is reproduced with permission from Medtronic, Inc.

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Zinoviev R. Open Forum Infectious Diseases 2020; ;7(5):ofaa124

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STS-INTERMACS 2020 ANNUAL REPORT

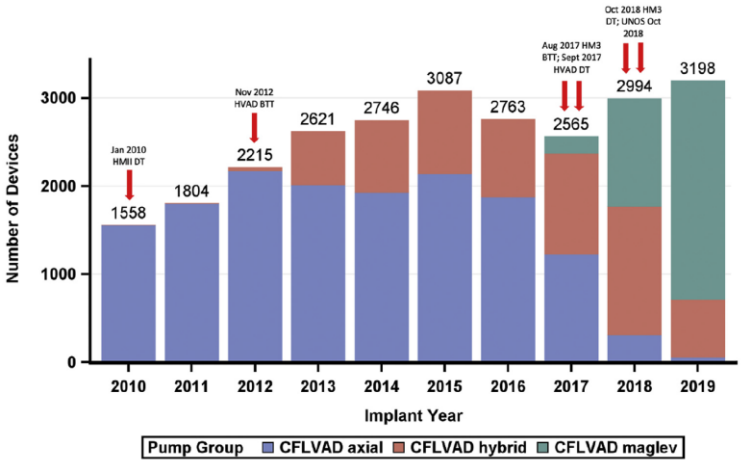
Recent Trends

- ↑ Implant volumes (2019 highest annual)
- ↑ African-American (27% in 2015-2019 era)
- ↑ temporary MCS (36.8% in 2015-2019 era)
- ↑ INTERMACS Profiles 1-2 (50% in 2019)
- ↑ Destination Therapy (73% in 2019)
- ↑ MagLev Technology (77% in 2019)

25,551 patients undergoing primary isolated CF-LVAD implantation between 2010-2019

Axial Flow Pump	Centrifugal Full Magnetic Levitation	Centrifugal Hybrid Levitation
N= 15,084	N=3,902	N=6,565

B



Contemporary Outcomes

- Improved 1- and 2-year survival: 82.3% and 73.1%
- Major bleeding and infection are the leading adverse events
- Incident stroke ↓ to 12.7% at 1-year
- Readmission rates remain high: 38.6% at 90 days and 72.2% at 12 months
- Withdrawal of care represents a rising cause of death

THE ANNALS OF THORACIC SURGERY
Official Journal of The Society of Thoracic Surgeons and the Southern Thoracic Surgical Association

Molina et al
@annalsthorsurg #TSSMN
#VisualAbstract #AnnalsImages

Ann Thorac Surg 2021;111:778-92

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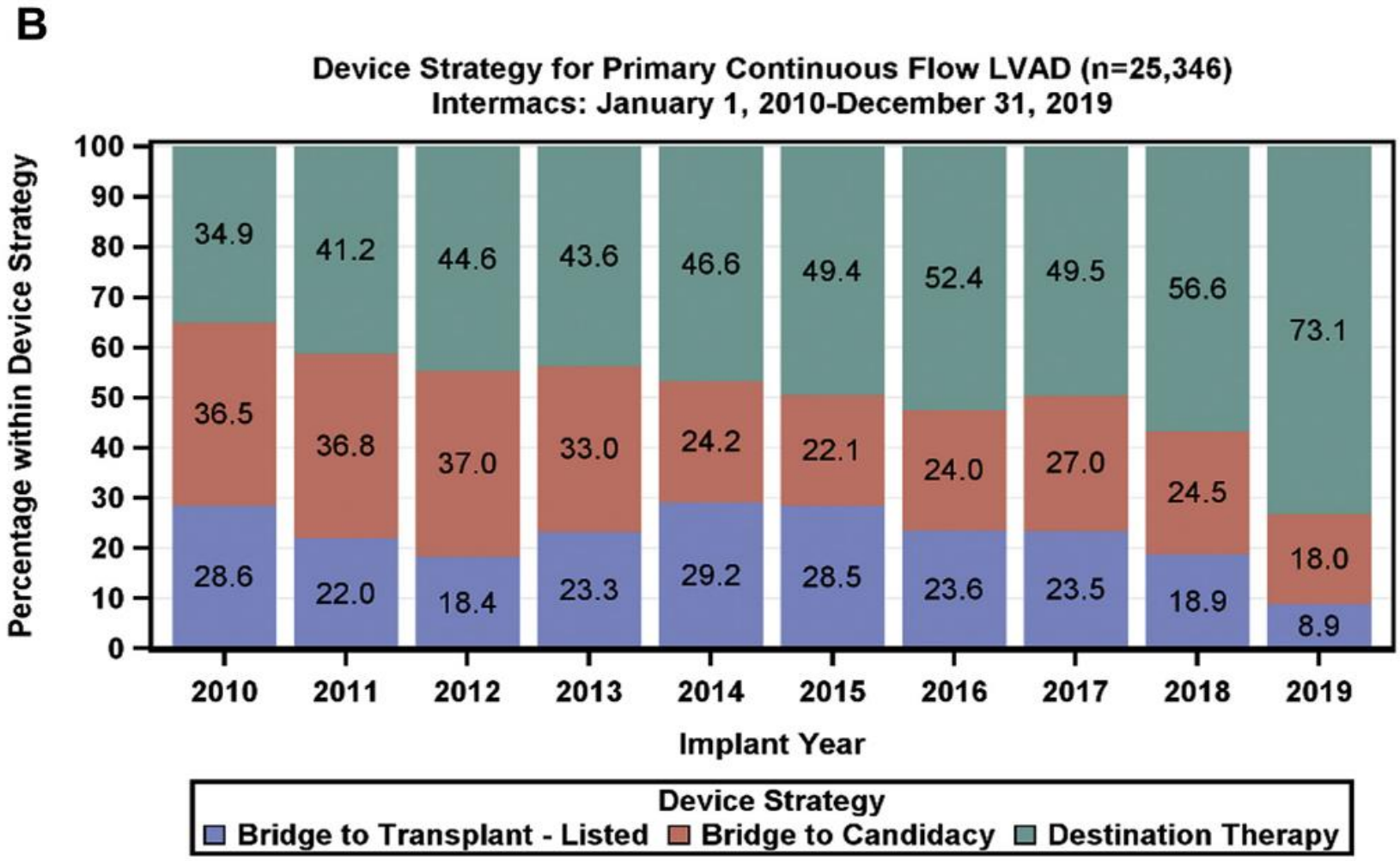

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Ann Thorac Surg 2021;111:778-92

Inserción percutánea!!!!

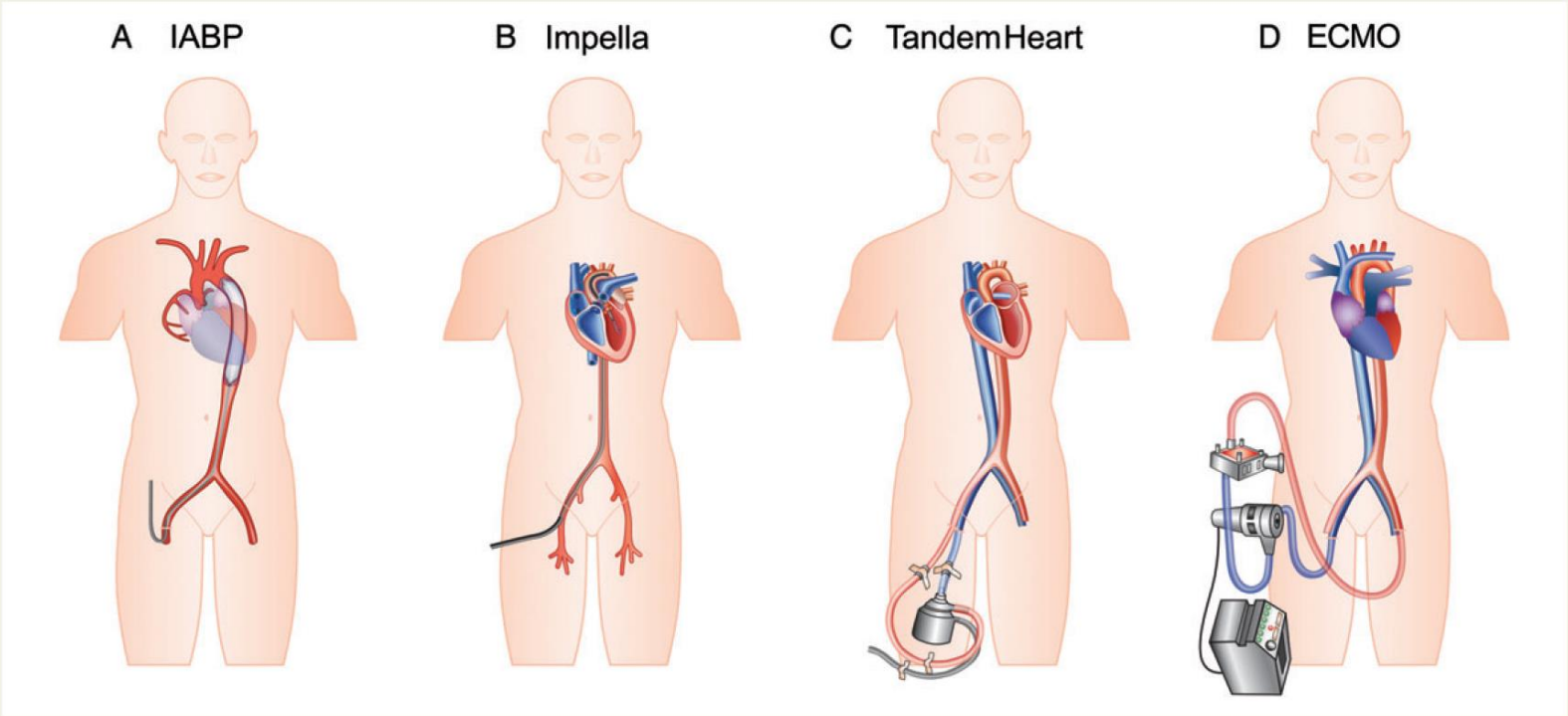
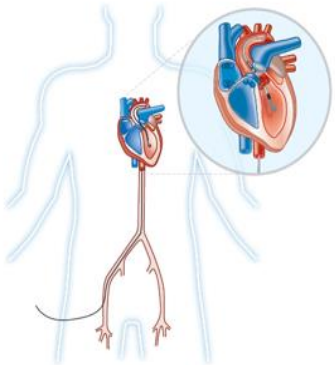
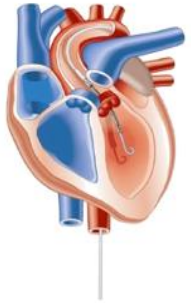


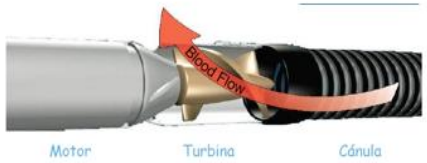
Figure 3 Percutaneous assist devices in cardiogenic shock. (*A*) Intra-aortic balloon counterpulsation; (*B*) Impella® pump; (*C*) TandemHeartT™; (*D*) extracorporeal membrane oxygenation (ECMO). Modified from Thiele *et al.*[30]

Curr Opin Cardiol 2020, 35:145 – 149

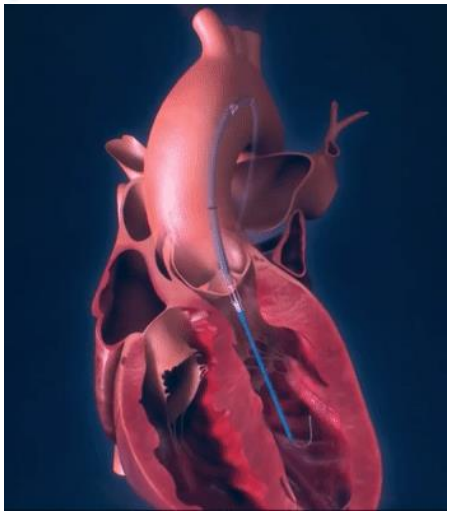
IMPELLA







- Asistencia inserción periférica, percutánea o Qx
- Catéter con bomba microaxial, colocación intraventricular (D o I).
- Flujo continuo (similitudes con HeartMate).
- 5-30 días de soporte



CENTRIMAG: CARACTERÍSTICAS

· Asistencia para-corpórea implante Qx

· Bomba centrífuga de Levitación Magnética.

-- Rotor flota y rota en un campo magnético

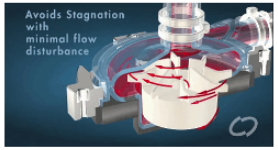
-- No contacto con las paredes.

-- Ausencia de ejes y conectores.

-- Mínima fricción y generación de calor.

-- Minimización de áreas de estancamiento y turbulencia.

-> Disminución de Hemólisis y Trombosis.



ECMO-VA

>> COMPONENTES:

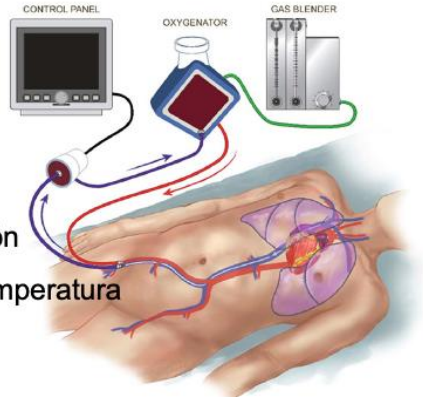
· Cánulas

· Tubuladuras

· Bomba centrífuga

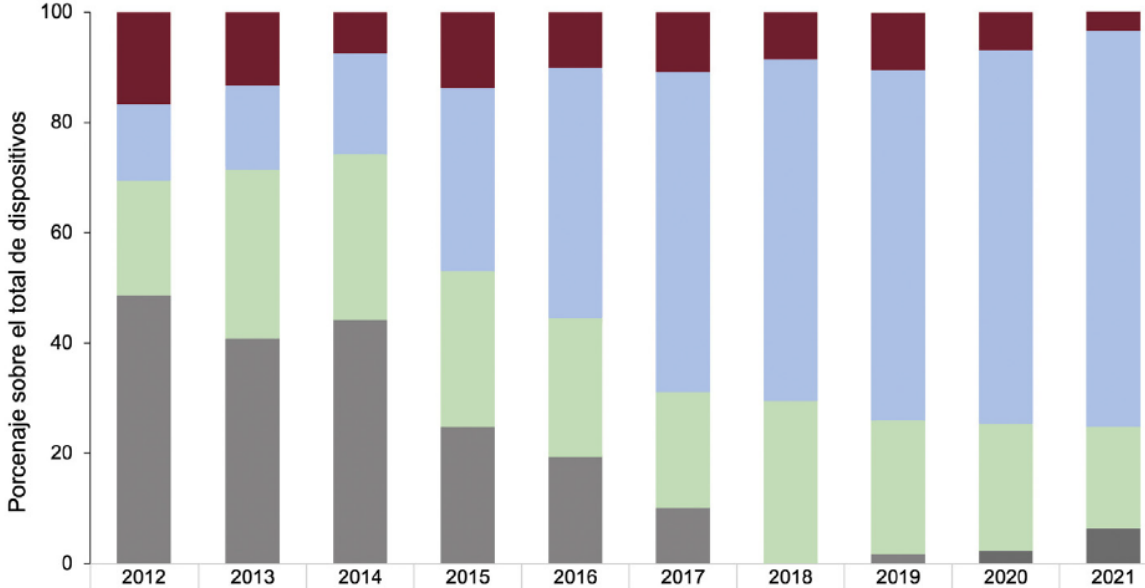
· Membrana de oxigenación

· Sistema de control de temperatura



GENTILEZA DE IAGO SOUSA
Cardiología HGUGM

Spanish Heart Transplantation Registry
33rd Official Report (1984-2021)



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
DAV pulsátil	16,7	13,3	7,5	13,7	10,1	10,9	8,5	10,4	6,9	3,5
DAV continuo	13,9	15,3	18,3	33,3	45,4	58,0	62,0	63,5	67,8	71,9
ECMO	20,8	30,6	30,1	28,2	25,2	21,0	29,5	24,3	23,0	18,4
Balón	48,6	40,8	44,1	24,8	19,3	10,1	0,0	1,7	2,3	6,4

- En 2014, asistencia temporal en **18.8% de los TXC (50/266)**
- 2018-2020: **38,4%**
- Incremento asistencia ventricular de tipo continuo (71,9%)

González-Vilches. Rev Esp Cardiol 2022; 75(11):926–935

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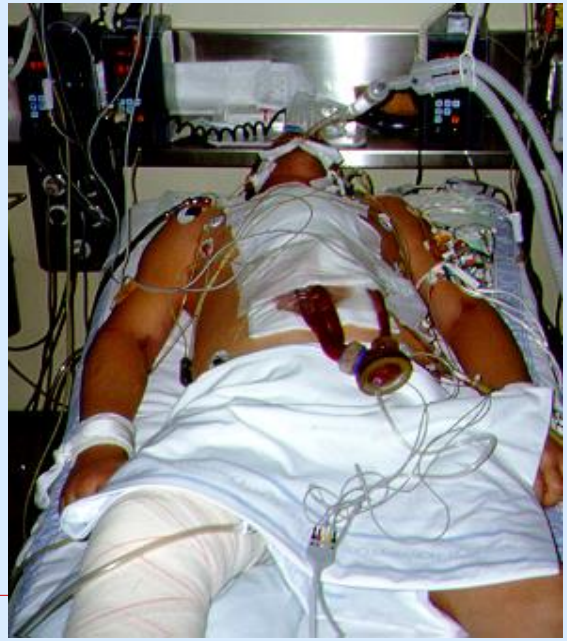
Dispositivos asistencia ventricular

1. Dispositivos asistencia ventricular
2. ***Infecciones DAV***
3. Manejo



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Open Forum Infectious Diseases
REVIEW ARTICLE

In Full Flow: Left Ventricular Assist Device Infections in the Modern Era

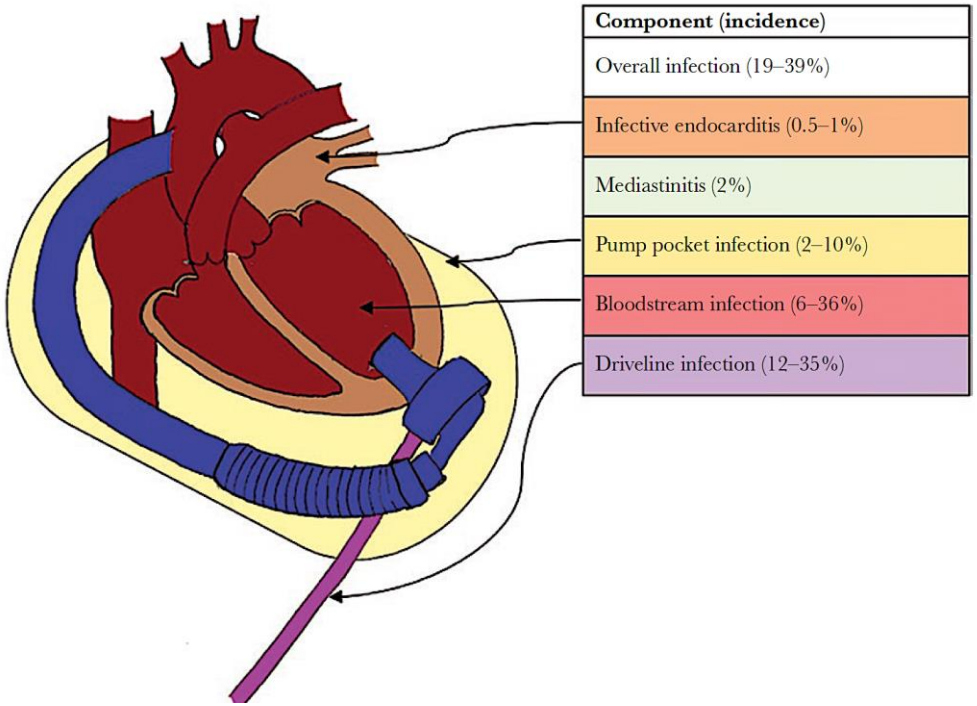
Radoslav Zinoviev,[1] Christopher K. Lippincott,[2] Sara C. Keller,[3] and Nisha A. Gilotra[4]

Infection most common LVAD complication

1/6 pts LVAD-related infection 1st yr

7-10% all LVAD-related deaths in 1st yr

and 15% of LVAD deaths thereafter



Zinoviev R. Open Forum Infectious Diseases 2020; ;7(5):ofaa124

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TABLE 2 Adverse Events in 14,607 Patients on Isolated Continuous-Flow Left Ventricular Assist Device Support (January 1, 2015-December 31,2019) With Follow-up Through June 30, 2020

Event	Period[a]	Event Count	CF LVAD AE Rate[b]	Patient Count	Patient %
Major infection	Early	4573	1.349	3382	23.2
	Late	8824	0.440	4654	31.9
Device-related infection	Early	1131	0.334	1015	6.9
	Late	2618	0.130	1817	12.4
Device-specific infection	Early	538	0.159	503	3.4
	Late	3302	0.165	2126	14.6
Nondevice infection	Early	3398	1.002	2625	18.0
	Late	4165	0.208	2697	18.5

TABLE 3 Causes of Death Comparison by Era for Patients on Isolated Left Ventricular Assist Device Support

Primary Cause of Death	Era 2010-2014[a] (n = 10,944)	Era 2015-2019[a] (n = 14,607)
Bleeding	84 (1.9)	80 (2.0)
Circulatory other	308 (7.0)	251 (6.3)
Device malfunction	171 (3.9)	55 (1.4)
Heart failure	519 (11.8)	496 (12.5)
Major infection	376 (8.5)	225 (5.7)
Multisystem organ failure	617 (14.0)	654 (16.4)
Neurologic dysfunction	845 (19.1)	622 (15.6)
Other	578 (13.1)	606 (15.2)
Respiratory	281 (6.4)	200 (5.0)
Sudden death	199 (4.5)	116 (2.9)
Withdrawal of support	437 (9.9)	677 (17.0)

[a]$P < .0001$ for all comparisons.

Major infection **leading to death** declined from 8.5% to 5.7%.

Ann Thorac Surg 2021;111:778-92

Cuando

The Society of Thoracic Surgeons Intermacs 2020 Annual Report

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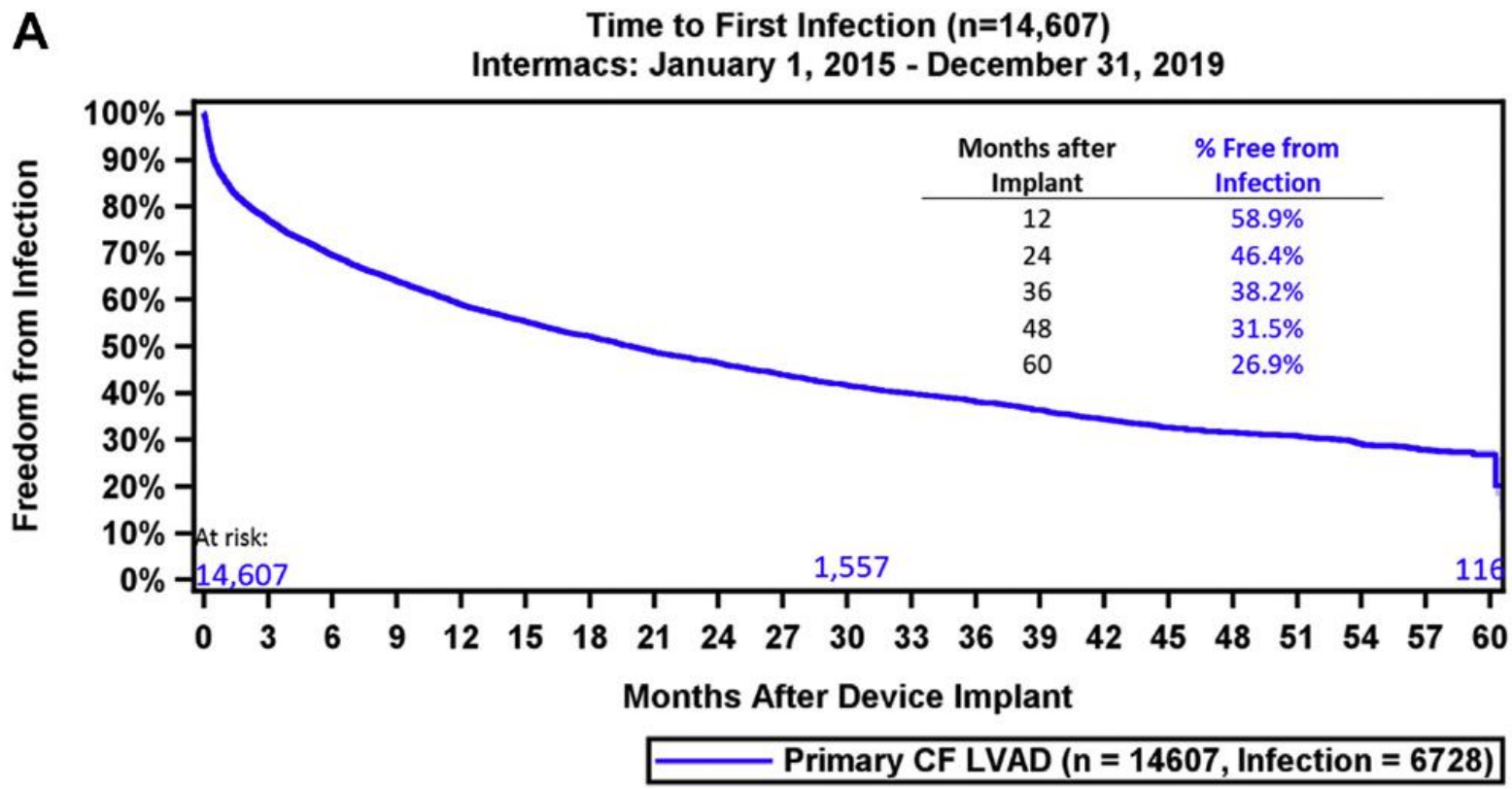

Shaded areas indicate 70% confidence limits
p (log-rank) = N/A
Event: Infection (censored at death,tx,cess. of supp)

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Ann Thorac Surg 2021;111:778-92

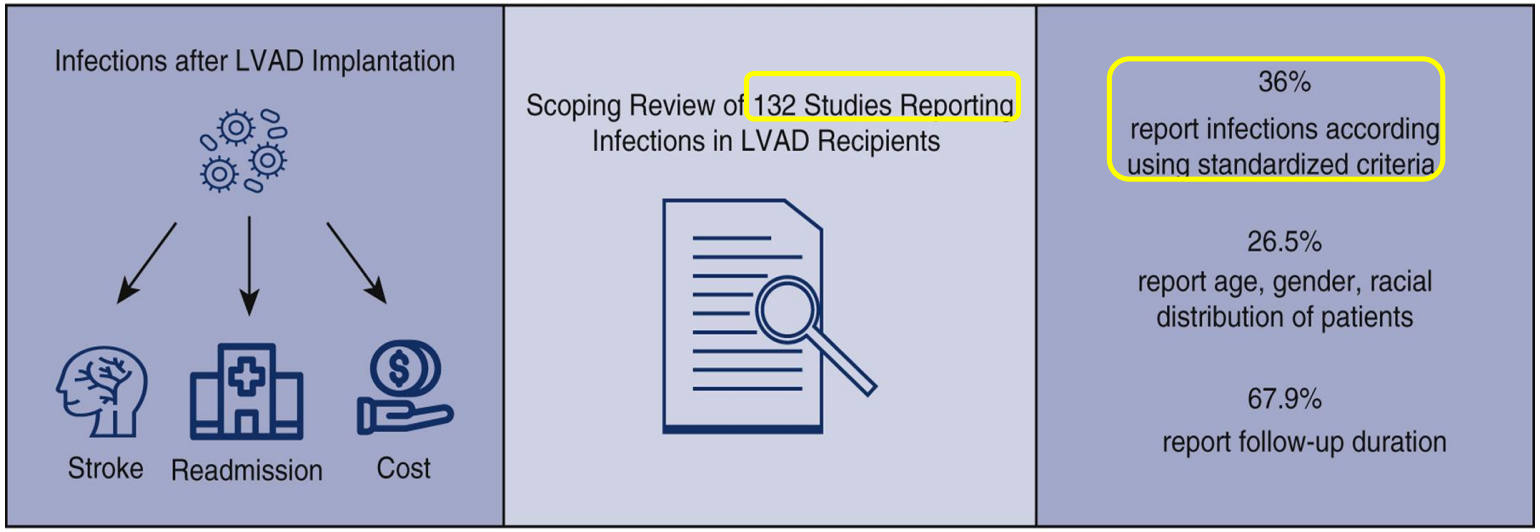
Definiciones

Rates and types of infections in left ventricular assist device recipients: A scoping review

Check for updates

Michael Pienta, MD, MS,[a] Supriya Shore, MBBS, MSc, MSc,[b] Francis D. Pagani, MD, PhD,[a] and Donald S. Likosky, PhD,[a] on behalf of the Michigan Congestive Heart Failure Investigators*

Rates and Types of Infection in Left Ventricular Assist Device Recipients: A Scoping Review



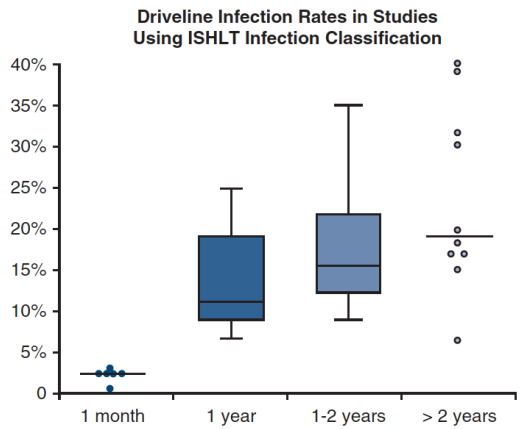
To advance the scientific rigor of investigations into infections after LVAD implantation, future studies should use standardized infection definitions and meet minimum reporitng guidelines

LVAD: Left ventricular Assist Device

Pienta M. JTCVS Open 2021;8:405-11

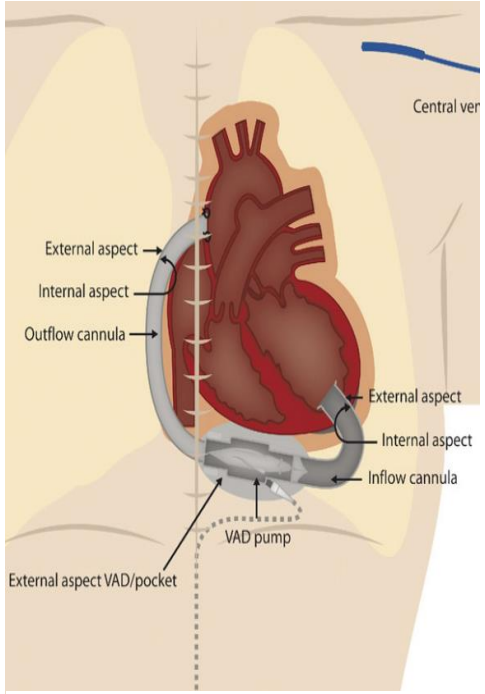
VAD specific infections- Review

- **Driveline infections** (92 studies)
  - 0-2.6% first 30 d
  - 5-56% first 6 m
  - 7-71% 1 yr
  - **7-65%** 2 yrs



- **Pocket infections** (20 studies)
  - 0% first 30 d
  - 0-2% first 6 m
  - 0.4-10% 1 yr
  - **0-7.7%** 2 yrs

- **Pump infections** (3 studies)
  - **2-13%** follow-up 8.5m to 3.5 yrs



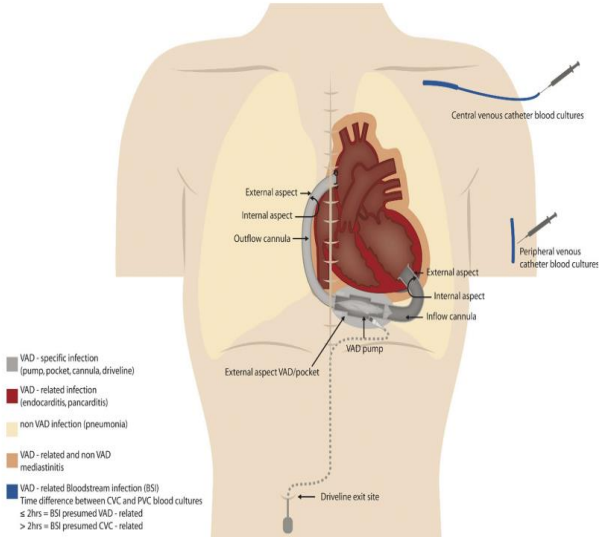
- **VAD specific Pump - Infection**
- **Inflow** (ventricle) and **outflow** (cardiovascular system) **cannula**
- **Pump pocket** (intraperitoneal, within left V, Pericardial sack)
- **Percutaneous driveline**
  - Superficial or deep
  - Proven, probable, possible
- **Suture lines**

Pienta M. JTCVS Open 2021;8:405-11

VAD Related infections- Review

- **BSI infections** (54 studies)
  - 2.6-10% first 30 d
  - 5-20% first 6 m
  - **3-27%** 1yr
- **Mediastinitis** (6 studies)
  - 0.5-22%
- **Infective endocarditis** (2 studies)
  - 0.5-2%

- **VAD-related infections**
  - Can occur without VAD
    - **IE, BSI, mediastinitis, sternal wound infection**
    - Specific considerations in pts with VADs



Pienta M. JTCVS Open 2021;8:405-11

Non-LVAD Related infections- Review

- **Pneumonia** (11 studies)
  - 2-22%
- **Urinary tract infection** (6 studies)
  - 3-32%
- **Sepsis** (5 studies)
  - 0.5-2%

Only 23 studies reported specific pathogens, most common ***S. aureus*** (17 studies) and **P. aeruginosa** (11 studies)

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Pienta M. JTCVS Open 2021;8:405-11

Microbiology of LVAD infections

Etiología

S. aureus 14-56%; CNS 7-56%, *P. aeruginosa* 3-28%

Table 1. Frequency of Bacterial (A) and Fungal (B) Pathogens in LVAD Infections as Percentage of Bacterial and Fungal Infections, Respectively

A, Reported Frequency of Bacterial Organisms Among Patients With Bacterial LVAD Infections				
Bacterial Pathogen	Reported Frequency, %			
	DLI	PPI	IE	BSI
Staphylococcus aureus	10–43	8–22	20–25	33
MSSA	4–30	11–25	8–21	0
MRSA	44–56	21	0	14
Unspecified				
Coagulase-negative *Staphylococcus*	7–29	17–50	21–40	33–56
Enterococci	5–15	11–26	8–29	8–17
Corynebacterium	2–14	2	8–20	0
Pseudomonas aeruginosa	4–28	3–25	17–20	3
Klebsiella species	2–13	5–7	7–8	5
Escherichia coli	1–4	5–11	0	0

B, Reported Frequency of Fungal Organisms Among Patients With Fungal LVAD Infections	
Fungal Pathogen	Reported Frequency, %
Candida albicans	28–45
C. glabrata	14–23
C. kruseii	14–19
Other *Candida* species	13
Aspergillus species	28

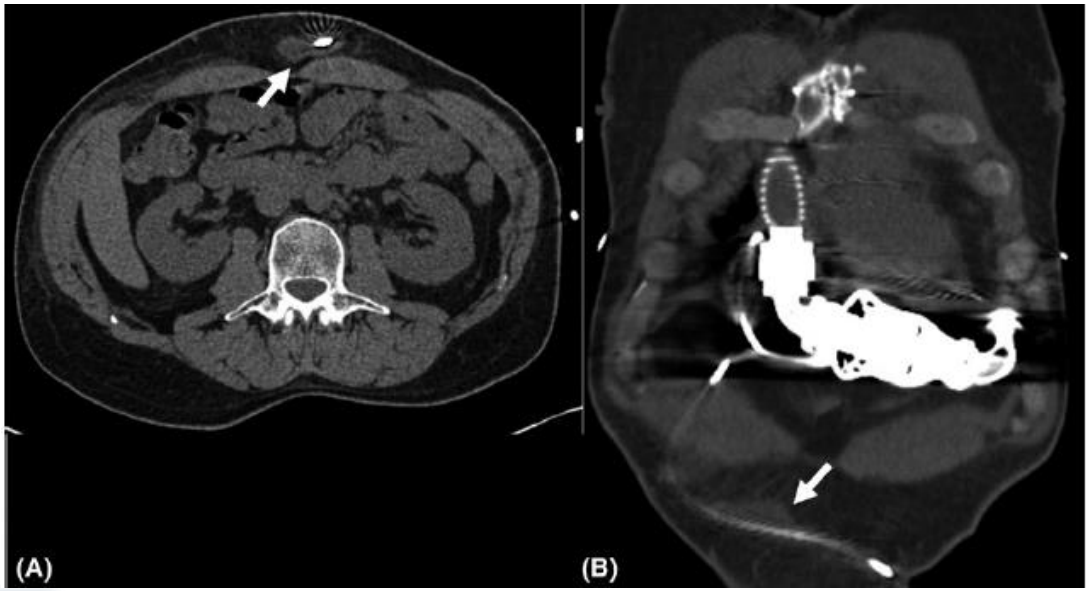
Data are listed as a range between the lowest and highest reported frequencies per pathogen [6, 7, 9, 11, 14, 23, 26, 28, 29].

Abbreviations: BSI, bloodstream infection; DLI, driveline infection; IE, infective endocarditis; LVAD, left ventricular assist device; MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-sensitive *Staphylococcus aureus*; PPI, pump pocket infection.

Zinoviev R. Open Forum Infectious Diseases 2020; ;7(5):ofaa124

Mycobacterium abscessus Left Ventricle Assist Device Driveline Infections: An Emerging Pathogen?

- First 2 cases of *M. abscessus* driveline infection.
- Both had persistent infection despite of aggressive antibiotic treatment and local debridement, and **only improved after removal** of the devices.



Nunez JD. Transpl Infect Dis. 2018;20:e12957

Contemporary Left Ventricular Assist Device Outcomes in an Aging Population

An STS INTERMACS Analysis

Ancianos

Dominic Emerson, MD,[a] Joanna Chikwe, MD,[a] Pedro Catarino, MD,[a] Mohamed Hassanein, MD, PHD,[a] Luqin Deng, PHD,[b] Ryan S. Cantor, PHD,[b] Amy Roach, MD,[a] Robert Cole, MD,[a] Fardad Esmailian, MD,[a] Jon Kobashigawa, MD,[a] Jaime Moriguchi, MD,[a] James K. Kirklin, MD[b]

Rehospitalization 12.7-16.6/100 patient-months

Bleeding 2.8-4.1 and infection 3.3-4.2/100 patient-months

TABLE 3 Adverse Event Rates Early and Later After LVAD Implantation Stratified by Age at Time of Implantation

	Events per 100 Patient-Months			*P* Value		
Adverse Event	A Age <65 y (n = 16,808)	B Age 65-75 y (n = 6,418)	C Age >75 y (n =1,182)	A vs B	B vs C	A vs C
Early, within 3 months of LVAD implantation						
All bleeding	11.1	18.0	17.9	<0.01	0.90	<0.01
Gastrointestinal bleeding	4.9	9.3	8.7	<0.01	0.35	<0.01
Stroke	2.0	2.5	2.2	<0.01	0.32	0.47
Device malfunction or thrombosis	2.6	2.1	1.9	<0.01	0.50	0.02
Infection	10.8	13.5	14.3	<0.01	0.22	<0.01
Rehospitalization	19.0	20.2	19.1	<0.01	0.19	0.95
Late adverse events, after 3 months of LVAD implantation						
All bleeding	2.8	4.1	3.8	<0.01	0.02	<0.01
Gastrointestinal bleeding	1.9	3.2	2.9	<0.01	0.07	<0.01
Stroke	0.8	0.7	0.5	<0.01	<0.01	<0.01
Device malfunction or thrombosis	1.9	1.4	1.0	<0.01	<0.01	<0.01
Infection	4.2	3.5	3.3	<0.01	0.09	<0.01
Rehospitalization	16.6	14.6	12.7	<0.01	<0.01	<0.01

LVAD = left ventricular assist device.

https://doi.org/10.1016/j.jacc.2021.06.035

Infections in children with left ventricular assist device

Niños

Semra Şen[1] | Zülal Ülger[2] | Zümrüt Şahbudak Bal[1] | Mustafa Özbaran[3]

- Edad media 12 años. Turquía
- 22/27 (**82%**) 80 infecciones
- 7 muertes, todos con infección

TABLE 2 Distribution of infectious episodes in infected patients

VAD-specific infection episodes (n = 22; 27.5%)	
Driveline infection	22
Pump pocket infection	0
VAD-related infection episodes (n = 31; 38.75%)	
Bloodstream infection	17
CVC-associated bloodstream infection	6
Sternal wound infections (including osteomyelitis)	8
Non-VAD infection episodes (n = 27; 33.75%)	
Pneumonia/Ventilator associated pneumonia	4/9
Urinary tract infection	10
Other	4
Total infection episodes (n = 80, 100%)	

TABLE 3 Microorganisms isolated from all sites

Microorganism	No.	Percent (%)
Gram-positive microorganisms (n = 38) (60.32%)		
Methicillin-susceptible Staphylococcus aureus	20	31.75
Coagulase-negative Staphylococcus	8	12.69
Methicillin-resistant Staphylococcus aureus	5	7.93
Enterococcus faecium	2	3.17
Vancomycin-resistant enterococci	2	3.17
Nocardia	1	1.58
Gram-negative microorganism (n = 20) (31.75%)		
Pseudomonas aeroginusae	5	7.93
Acinetobacter baumanii	5	7.93
Klebsiella pneumonia	3	4.76
Stenotrophomonas maltophilia	3	4.76
ESBL E Coli	2	3.17
Proteus mirabilis	1	1.58
Elizabethkingea meningoceptica	1	1.58
Fungal isolates (n = 5) (7.93%)		
Candida glabrata	2	3.17
Candida parapsilosis	1	1.58
Candida pelliculosa	1	1.58
Candida tropicalis	1	1.58
	63	100%

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Sen S. Transpl Infect Dis. 2020;22:e13439

Infections in patients after Berlin Heart® EXCOR assist device implantation

Patricia Muñoz[1,2,3,4] | Maricela Valerio[1,2] | Víctor Vásquez[1] | Jesús Velásquez-Rodríguez[5] | Iago Sousa[5] | Eduardo Zatarain[5] | José María Barrio[6] | Manuel Ruiz[7] | Gregorio Cuerpo[7] | Hugo Rodríguez-Abella[7] | Javier Hortal[6] | Emilio Bouza[1,2,3,4] | on behalf of the "Grupo de Apoyo al Manejo de las Asistencias Ventriculares" (GAMAV)*

HGUGM

- Infection **13/15 PTS** (27 episodes). 11 HT (3 relapses)

VAD specific infections	3 (11.1)
Cannula infections	
Staphylococcus aureus	1 (3.7)
E.coli	1 (3.7)
P.aeruginosa	1 (3.7)
VAD-related infections	7 (25.9)
Mediastinitis	2 (7.4)
S.epidermidis	1
S.aureus and *S.epidermidis*	1
Bloodstream infections	3 (11.1)
E.faecalis	2
P.mirabilis	1
Catheter-related BSI	2 (7.4)
Coagulase-negative *Staphylococcus*	1
K.pneumoniae+E. coli	1

Infections not related to VAD	17 (62.9)
Urinary tract infections	5 (20.8)
K.pneumoniae	2
E.coli	1
S.marcescens	1
P.aeruginosa and *S.marcescens*	1
CMV diseases	4 (14.8)
Lower respiratory tract infections	3 (11.1)
S.aureus	1
K.pneumoniae	1
Polymicrobial	1
C.difficile associated diarrhea	3 (11.1)
Catheter related infection	1 (3.7)
Candida albicans	1
Prosthetic Joint Infection	1 (3.7)
S.aureus	1

Munoz P. Transpl Infect Dis. 2018;20:e12936.

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Sociedad Española de Infecciones Cardiovasculares

INFECCIONES NOSOCOMIALES EN PACIENTES CON ECMO EN UNA UNIDAD CORONARIA

Simone Mornese[1], Maricela Valerio[1,3], Iago Sousa-Casasnovas[2], Alicia Galar[1,3], María Olmedo[1,3], Carolina Devesa-Cordero[2], Ana Alvarez-Uria[1,3], Manuel Martínez-Selles[2], Emilio Bouza[1,3], Francisco Fernández-Avilés[2,3], Patricia Muñoz[1,3].

69 pacientes

30.4% colonizados previamente
14.5% infección antes del ECMO

42% infección tras el ECMO

No infecciosas: trombopenia (50.7%), hipoxemia (47.8%), hemorragia (29.9%) e insuficiencia renal aguda (29.4%).

Mortalidad durante ECMO 39.1%.

Mortalidad hospitalaria 46.4%

Mortalidad relacionada a infección 5.8%.

Tipo de infección / microorganismo n=33 (en 29 pacientes)	
Colonización de la cánula del ECMO	2 (2.9)
Infección durante ECMO	29 (42)
Neumonía asociada a ventilación mecánica	n=19 (57.6%)
- SAMS	3
- SAMR	1
- *Acinetobacter baumanni*	1
- *Serratia marcescens*	1
- *Burkholderia cepacia*	1
- *Enterobacter cloacae*	1
- *Enterobacter aerogenes*	1
- *Proteus mirabilis*	1
- *Klebsiella pneumoniae*	2
- No aislamiento microbiológico	7
Traqueobronquitis	3 (9.1%)
- *Enterobacter aerogenes*	2
- *Stenotrophomonas maltophilia*	1
Bacteriemias	3 (9.1%)
- *Pseudomonas aeruginosa*	1
- SCN	2
IPPTB	3 (9.1%)
- *Morganella*	1
- *Enterococcus faecalis*	1
- SCN	1
Reactivación CMV	3 (9.1%)
Infección intraabdominal	1
Infección por *Clostridium difficile*	1

Mornese S, et al. submitted.

INFECCIONES NOSOCOMIALES EN PACIENTES CON ECMO EN UNA UNIDAD CORONARIA

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- **análisis univariable** los **factores de riesgo** asociados con **infección** fueron:

  - ✓ Enfermedad cardíaca pre-existente (93.1% vs. 62.5%, p=0.004)
  - ✓ Cr sérica elevada antes del ECMO (mediana 1.2 vs. 0.9, p=0.027)
  - ✓ Días en ECMO (7.2 vs 5.7, p=0.05)
  - ✓ ICTUS tras la colocación del ECMO (13.8% vs. 0%, p=0.031).

- **análisis multivariable**: **días en ECMO** (OR 1.14, IC 95% 1.01-1.30, p=0.029).

Mornese S, et al. submitted.

INFECCIONES NOSOCOMIALES EN PACIENTES CON ECMO EN UNA UNIDAD CORONARIA

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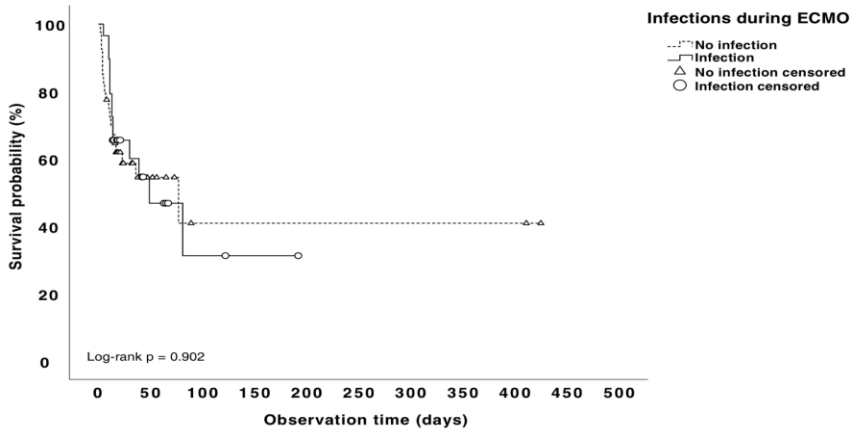
FR MORTALIDAD

- **Análisis univariable** para **factores de riesgo de mortalidad**
  - ✓ Cr sérica basal elevada (1.24 en quienes murieron vs. 0.93 en quienes sobrevivieron, p=0.006)
  - ✓ ICTUS tras ECMO (4% vs. 0%, p=0.047)
  - ✓ Enfermedad renal aguda tras ECMO (53.1% vs. 8.3%, p=0.0001)
  - ✓ Transfusiones durante ECMO (62.5% vs. 37.8%, p=0.055)
  - ✓ Acidosis láctica tras ECMO (6.3 vs. 5.0, p=0.001)

- **Análisis multivariable**
  - **Acidosis láctica** tras el ECMO (OR 2.08, IC 95% 1.19-3.62, p=0.009)
  - **Deterioro renal** (Cr) tras instaurar el ECMO (OR 13.35, IC 95% 1.43-124.8, p=0.023).



Los pacientes que desarrollaban infección tenían una menor supervivencia aunque la diferencia no fue estadísticamente significativa.

Mornese S, et al. submitted.

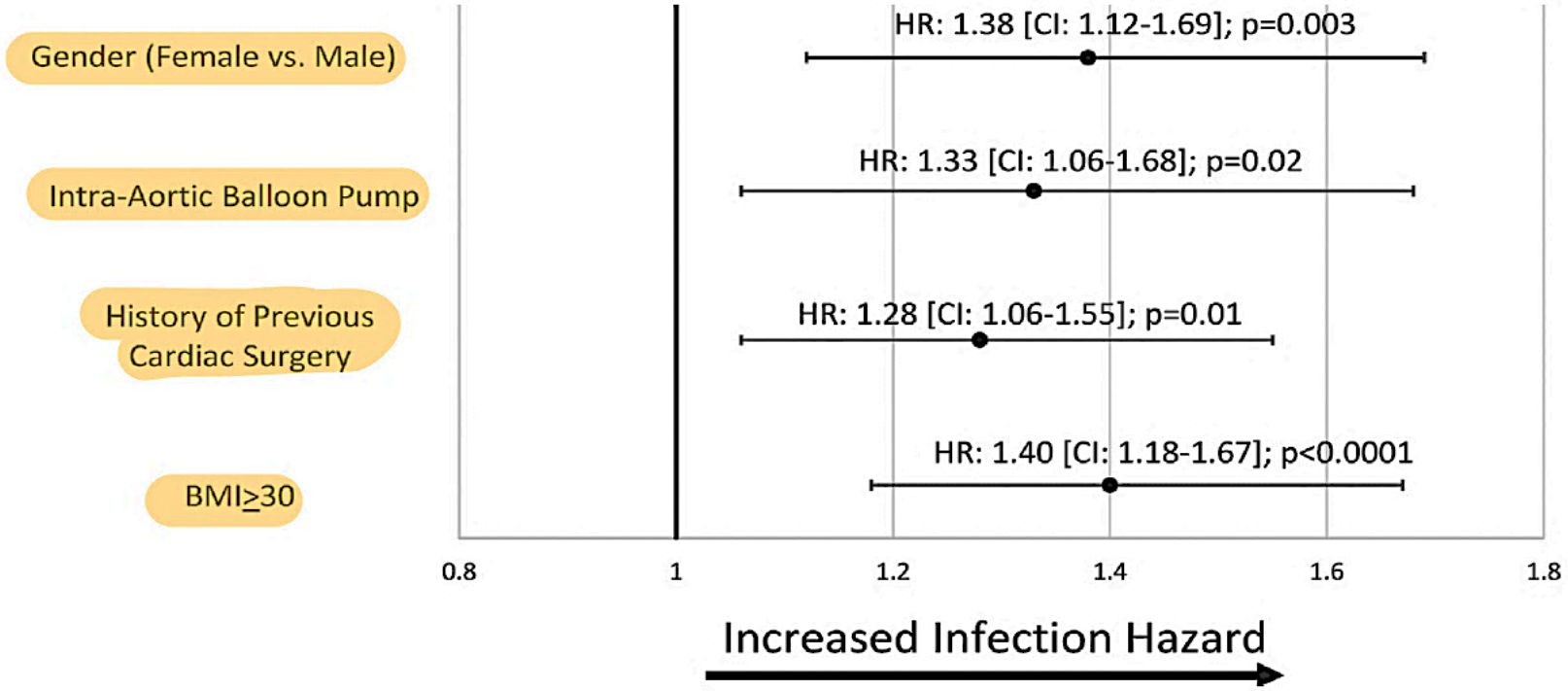
F. riesgo

Risk factors for infection. Momentum 3 trial

1,213 pts (634 HM3 and 579 HMII). Major **infection at 2 yrs 58% and 56%**

Most infections do not affect the pump or driveline, occur in the first 6 months and are bacterial

50% will recur



Patel CB. J Heart Lung Transplant 2020;39:774–781

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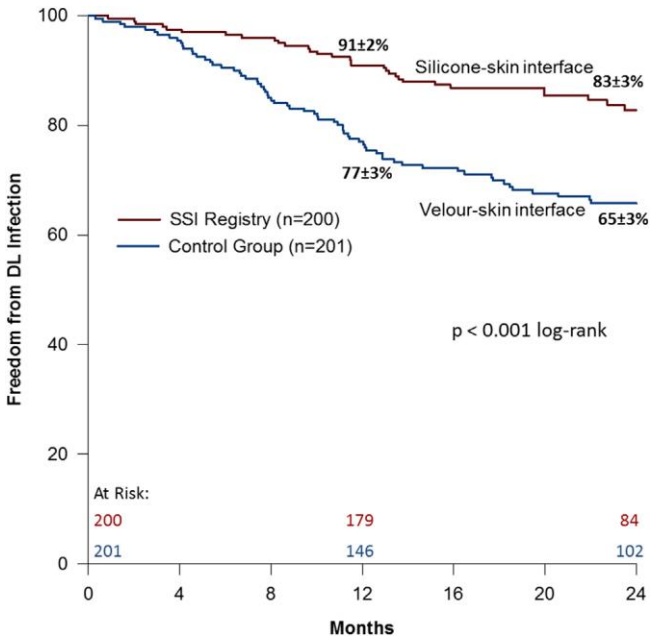
Non-patient factors associated with infections in LVAD recipients: A scoping review

43 published studies in order to identify **modifiable Risk Factors**

- **increasing center experience**
- **establishing a silicone-skin interface at the driveline exit site**



J HeartLungTransplant2015;34:781–789

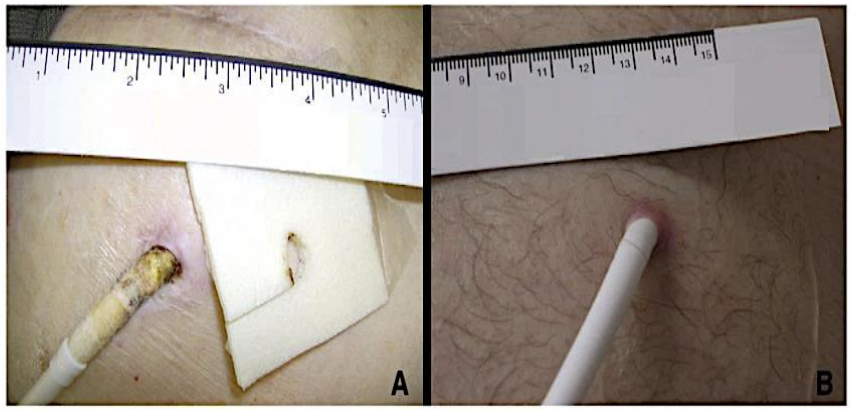


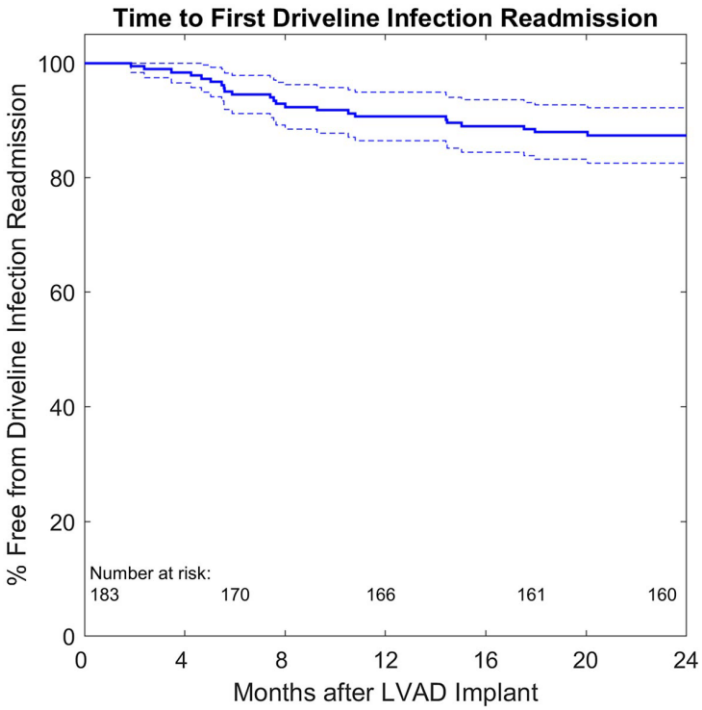
Fig. 2. Photographs showing typical fully incorporated velour and silicone DLES with velour (A) and smooth silicone (B) interfaces. Notice bloody material adhered to the velour sheath. The silicone DLES is free of debris, and skin is cleanly adhered to the driveline. Both photographs show the DLES at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

Shore S. JHLT 2022;41:1–16

Reingresos por infección del driveline

Reingresos

- 2 years postimplant
  - 183 LVAD (43 HeartMate II , 29 HeartMate 3, 111 HVAD) 2013 -17
- **12.6% readmitted for DLI**, 14.8% DLI treated in the outpatient
  - Higher with HM3
  - 52% *S. aureus*, 16% *P. aeruginosa*
  - CRP, WBC, and fibrinogen higher in readmitted pts 1-3 months before
- **No effect on mortality**



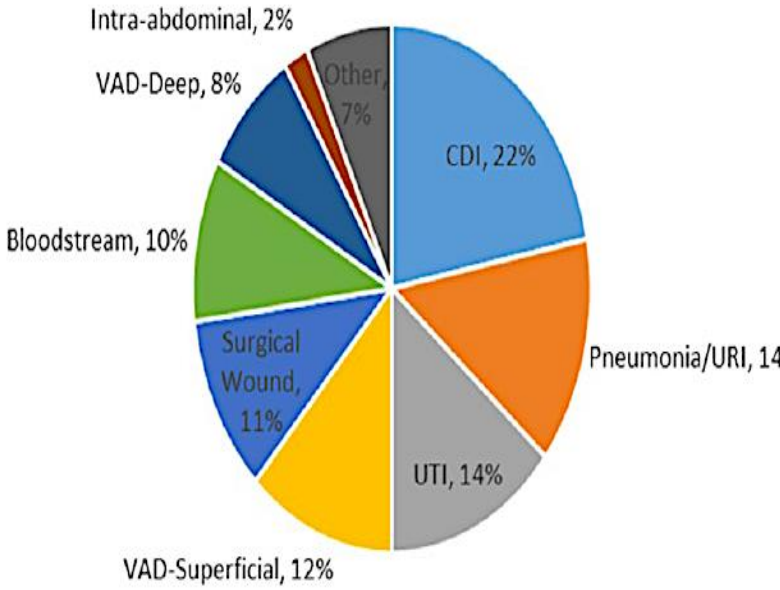
Schlöglhofer T. Artificial Organs. 2021;45:464–472

The impact of infection among left ventricular assist device recipients on post-transplantation outcomes: A retrospective review

Txc

- 74 TxC tras LVAD multicéntrico (2007-12)
- 62% inf pre TXC y 24% específicas de la AV

- **Infectados**
  - Menos tiempo fuera del hospital antes del Txc (231 vs 142 d, P < 0.03)
  - Tx más tarde (244.0 vs 150 d, P < 0.002).
- **No efecto en mortalidad a los 6 m post TxC**
  - 6/10 muertes x infección



Lerman DT. Transpl Infect Dis. 2018;20:e12995

Dispositivos de asistencia ventricular

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

Treatment of LVAD infections

>30% will relapse or progress to deeper infections: poorer survival

BSI in LVAD X 8-fold increase in the incidence of stroke and less HT (32% vs 81%)

Table 2. Summary of ISHLT 2017 Recommendations for the Medical and Surgical Management of LVAD Infections [50]

	Infection	Medical Management	Surgical Management
LVAD-specific	Superficial DLI	IV/PO antibiotics for 2 weeks or until infection resolves	None
	Deep DLI/PPI	IV antibiotics for 6–8 weeks or until infection resolves followed by long-term PO suppression	Surgical debridement with or without wound vacuum; new driveline exit site may be required
	Pump, cannula, or Bacteremia	IV antibiotics until after heart transplant or an extended course followed by PO suppression (destination therapy); ID consult is advised	Surgical drainage, debridement, or explant may be required; urgent device replacement should be considered in bridge to transplant to prevent end-organ damage that may preclude heart transplant
LVAD-related	Bacteremia	Duration of antibiotics depends on the source, organism, and clearance, at least 2 weeks from first negative blood cultures	
	Bacterial mediastinitis	Antibiotics for at least 6–8 weeks from last surgical debridement	Surgical debridement is often indicated
	Infective endocarditis	Same as for pump and cannula infection	Surgical intervention may be required

Abbreviations: BSI, bloodstream infection; DLI, driveline infection; ID, infectious disease; IE, infective endocarditis; IV, intravenous; LVAD, left ventricular assist device; PO, oral; PPI, pump pocket infection.

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Zinoviev R. Open Forum Infectious Diseases 2020; ;7(5):ofaa124

Supresión Ab

Efficacy and safety of chronic antimicrobial suppression therapy for left ventricular assist device driveline infections: A single-center descriptive experience

Chronic antimicrobial suppression

Yale, 2007-2019. 24/219 (**11%**) continuous-flow LVADs required chronic suppression for DLIs

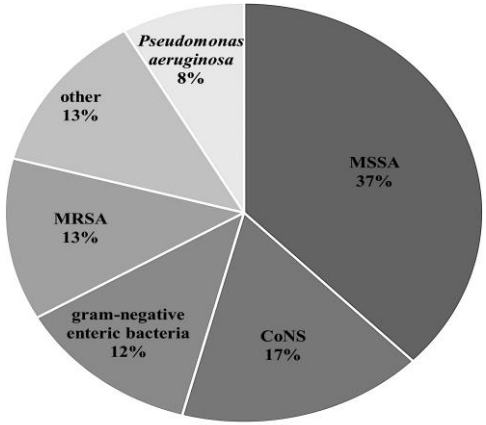
- *S. aureus 50%*
- Mean length of CAS 486 d (48-2287 d).
- Successful outcomes in 50%

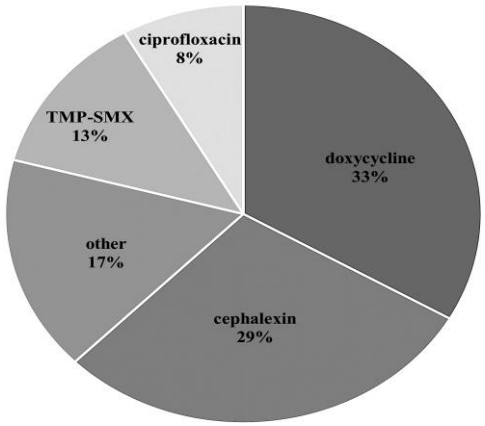
  29% treatment failures *(89% staph)*

  13% reinfections (GNB R to CAS)

Indication of CAS??

Bacteremia? Pocket or cannula infections?





Radcliffe C. Transpl Infect Dis 2020: 22: e13379

An ISHLT consensus document for prevention and management strategies for mechanical circulatory support infection

Recommendations:

1. Change in the DLES (pain, erythema, drainage) or fever should prompt evaluation for infection.
2. In patients with superficial DLIs and without BSI or systemic illness, empiric anti-microbial therapy can be initiated and adjusted in the ambulatory setting once DLES culture results are obtained.
3. Patients with suspected deep DLI, pocket infection, pump, cannula infection, systemic illness or sepsis should be hospitalized.

Kusne S. JHLT 2017;36(10):1137-1153.

An ISHLT consensus document for prevention and management strategies for mechanical circulatory support infection

6. In patients with systemic illness and/or sepsis, empiric intravenous anti-bacterial therapy targeting *S aureus*, and *P aeruginosa* should be initiated in the hospital setting.

Kusne S. JHLT 2017;36(10):1137-1153.

An ISHLT consensus document for prevention and management strategies for mechanical circulatory support infection

10. In hemodynamically stable transplant candidates with BSI, HT should be considered provided there is safe, effective, targeted anti-microbial therapy.
11. In patients with persistent sepsis and instability due to device infection, exchange should be performed if feasible to stabilize the patient (HT candidates or DT patients). Some patients may not be candidates for device exchange, as noted in Recommendation 9 (above).
12. In patients with superficial DLI, anti-microbial therapy should be discontinued when all signs of infection have resolved and the exit site has healed. DLES should be monitored by a QHP for early recurrence of superficial infection.
13. In patients with pocket, pump and cannula infection, anti-microbial therapy should be continued until clinically stable after device exchange or HT. A longer antibiotic course (4 to 6 weeks) may be offered to patients with evidence of positive intra-operative cultures or recent pre-operative bacteremia, and shorter courses (14 days) to those without such evidence.

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Kusne S. JHLT 2017;36(10):1137-1153.

Late sequelae of left ventricular assist device infection presenting after heart transplant

Retained infected velour driveline material as cause of relapse after Htx (first series)

- 4 cases (27 d to 32 m after Tx)
- Subacute presentation (drainage from former driveline exit site (2/4), abdominal pain (2/4), loose stools (2/4), and fever (1/4).
- 3 *Pseudomonas* sp and 1 *Enterococcus*

Required removal/s of the retained material and antibiotics

Careful at Tx surgery and remove it all. If not possible, communication to ID and to the patient!!

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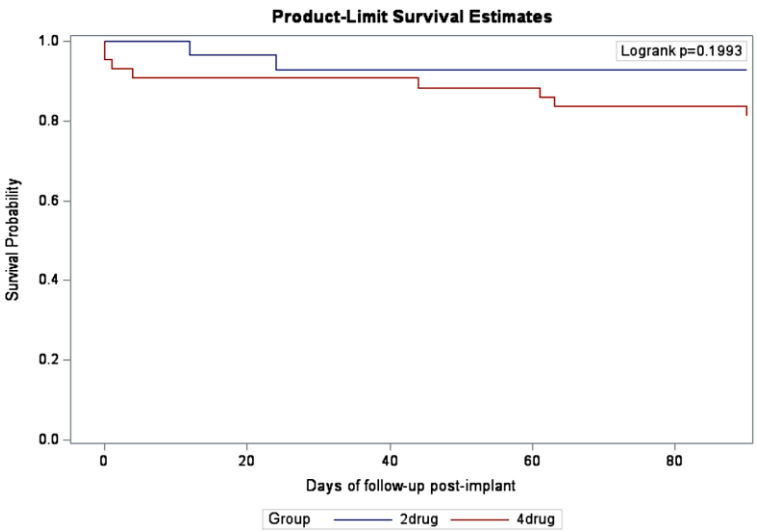
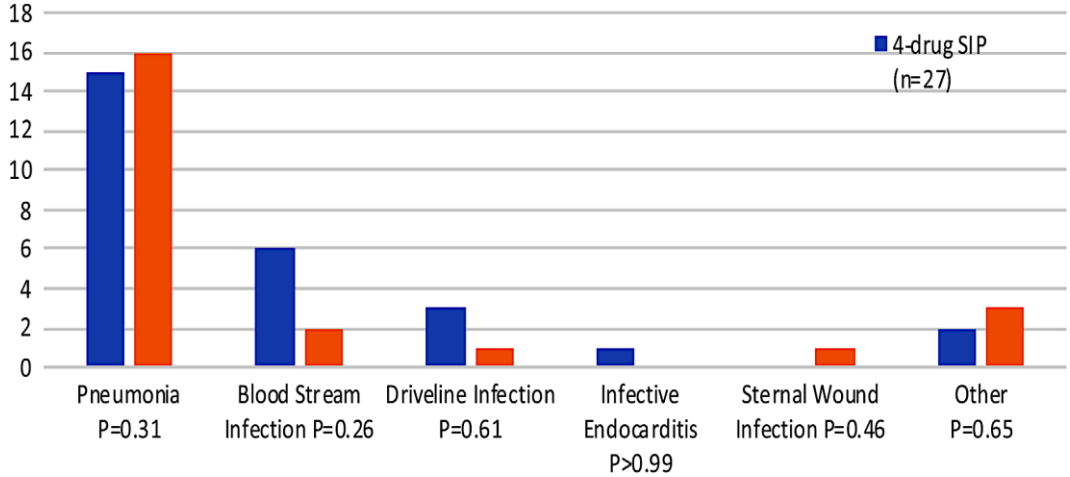
Transpl Infect Dis 2016: 18: 453–456

Impact of narrowing perioperative antibiotic prophylaxis for left ventricular assist device implantation

Profilaxis quirúrgica

- Survey: 43% of centers use a 4-drug regimen (3 antibiotics+ fluconazole), 24% use a 3-drug regimen (3 antibiotics or 2 antibiotics + fluconazole), 24% use a 2-antibiotic regimen, and 9% use vancomycin only [J Card Surg 2011; 26:440)
- From 4 drugs (fluconazole, ciprofloxacin, rifampin, and vancomycin) to 2 (cefazolin + vancomycin)





Zinoviev OFID 2020: single-drug prophylaxis with cefazolin, with vancomycin in colonized with MRSA, for 24-hour perioperative period

Allen L. Transpl Infect Dis. 2022;24:e13900

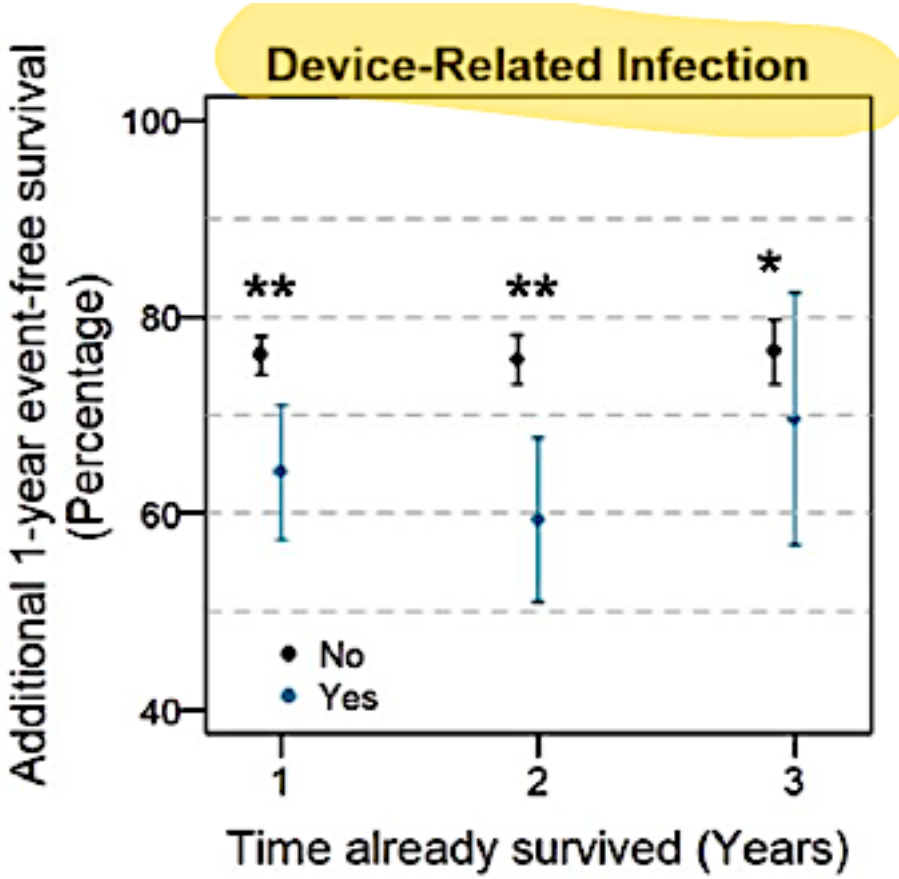
Dynamic Forecasts of Survival for Patients Living With Destination Left Ventricular Assist Devices: Insights From INTERMACS

1-yr Survival

LVAD destination therapy

Certain nonfatal adverse event within the 1st year, reduces **subsequent 1-year conditional survival**

- Stroke
- Pump thrombosis or malfunction and
- **Device-related infection (64% vs 76% ; P<0.001)**



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Michelis KC. J Am Heart Assoc. 2020;9:e016203

Consider earlier for Tx

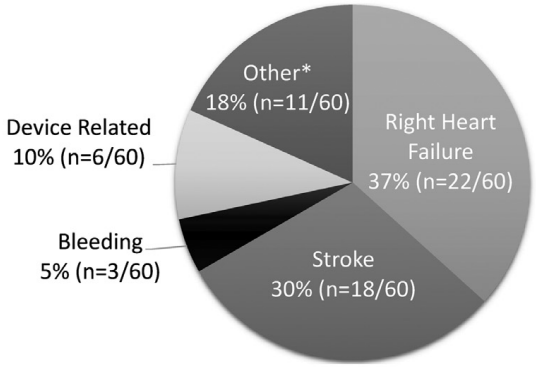
Mortalidad

1,213 pts (634 HM3 and 579 HMII)

Major infection at 2 yrs 58% and 56%. **Marker for decreased post-implant survival**

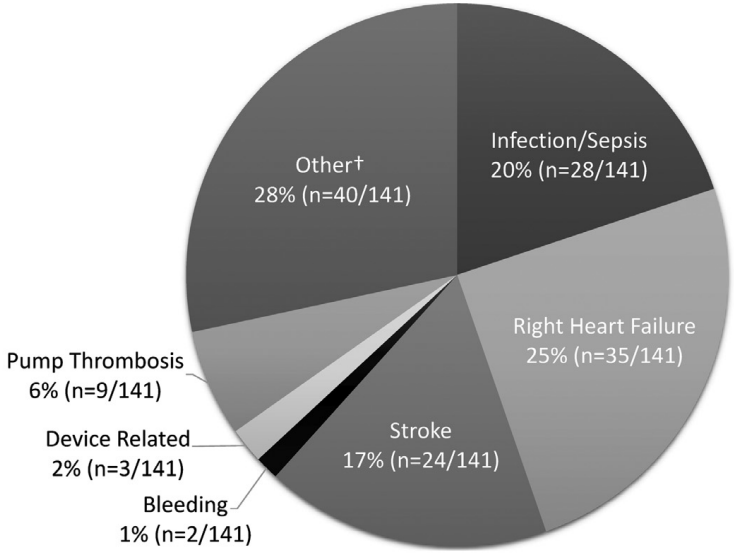
Should be considered earlier for HT or listed at higher urgency status??

No Infection (n=435)
Total Deaths – 60



*Cardiopulmonary related (3), brain-related (3), ischemic bowl (2), suicide (1), failure to thrive (1), unknown (1)
†Cardiopulmonary related (13), brain-related (6), pneumonia (6), unknown (4), cancer (2), hepatic failure (2), renal failure (2), trauma (1), failure to thrive (1), multi-organ failure (1), intravenous drug use (1), bowel perforation (1)

Infection (n=585)
Total Deaths – 141



Patel CB. J Heart Lung Transplant 2020;39:774–781

En resumen

- Incremento del uso de DAV y durante más tiempo. Nuevos tipos de asistencias con diseños avanzados y mayor experiencia reducen el riesgo de infección.
- La infección en pacientes con DAV tiene gran morbilidad y coste y reduce la supervivencia al año. Continua siendo la complicación más frecuente en el soporte a largo plazo, sobre todo la infección del driveline. Los estafilococos y *P. aeruginosa* son los patógenos más frecuentes, pero hay otros.
- Continúan siendo infecciones difíciles de manejar que precisan equipos multidisciplinares. Hay gran variabilidad asistencial a pesar de que existen recomendaciones de diagnóstico, profilaxis y tratamiento.

- Necesitamos registros multicéntricos propios con definiciones y tratamientos estandarizados. ¿**Empezamos uno en la SEICAV**????

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

Muchas gracias!!

SaludMadrid
Comunidad de Madrid

Algunas buenas citas además de las comentadas

Epidemiology of infection in mechanical circulatory support: A global analysis from the ISHLT Mechanically Assisted Circulatory Support Registry

Margaret M. Hannan, MD,[a] Rongbing Xie, DrPH, MPH,[b]

CONSENSUS STATEMENT

Updated definitions of adverse events for trials and registries of mechanical circulatory support: A consensus statement of the mechanical circulatory support academic research consortium

Robert L. Kormos, MD,[a] Christiaan F.J. Antonides, MD,[b]

Management and Outcome of Left Ventricular Assist Device Infections in Patients Undergoing Cardiac Transplantation

Zerelda Esquer Garrigos,[1,4] Natalia E. Castillo Almeida,[1] Pooja Gurram,[1] Prakhar Vijayvargiya,[1,4] Cristina G. Corsini Campioli,[1] John M. Stulak,[2] Stacey A. Rizza,[1] Larry M. Baddour,[1,3] and M. Rizwan Sohail[1,3]

Consensus Statement

HFSA/SAEM/ISHLT Clinical Expert Consensus Document on the Emergency Management of Patients with Ventricular Assist Devices

MICHAEL M. GIVERTZ, MD,[1] ERSILIA M. DEFILIPPIS, MD,[1] MONICA COLVIN, MD,[2] CHAD E. DARLING, MD,[3]

MECHANICAL CIRCULATORY SUPPORT INFECTIONS

An ISHLT consensus document for prevention and management strategies for mechanical circulatory support infection

Shimon Kusne, MD,[a] Martha Mooney, MD, FACP,[b] Lara Danziger-Isakov, MD,