TECNOLOGÍA PARA EL MANEJO DE INSUFICIENCIA CARDIACA EN EL ADULTO MAYOR

MA VICTORIA ARGUEDAS ASTUA

Introducción

- IC se asocia a alta morbilidad y mortalidad
- 12% AM > 75 a presentan IC
- La mortalidad aumenta luego de las hospitalizaciones

Objetivos

- Evaluar la eficacia del telemonitoreo para el manejo de pacientes con IC.
- Describir la eficacia de los dispositivos implantables y no implantables para el manejo de IC.
- Describir la eficacia de los dispositivos de asistencia del ventrículo izquierdo y estimulación de baroreflejo del ventrículo izquierdo para el manejo de la IC.

TELEMONITOREO

Meta análisis de apoyo telefónico y telemonitoreo vs cuidado usual en IC

Resultados	Riesgo absoluto con cuidado usual	Riesgo absoluto con teléfono o telemonitoreo	Riesgo relativo (IC 95%)	# participante (estudios)
Todas las causas de hospitalización: apoyo telefónico estructurado vs cuidado usual	422 por 1000	401 por 1000	RR 0,95 (0,9-1.0)	7210 (16 RCT)
Todas las causas de hospitalización : Telemonitoreo vs cuidado usual	517 por 1000	491 por 1000	RR 0,95 (0,89-1,01)	3332 (13 RCT)

Inglis SC, Clark RA, Dierckx R, Prieto-Merino D, Cleland JGF.
Structured telephone support or non-invasive telemonitoring for patients with heart failure. Cochrane Database of Systematic Reviews 2015, Issue 10.

Meta análisis de apoyo telefónico y telemonitoreo vs cuidado usual en IC

Resultados	Riesgo absoluto con cuidado usual	Riesgo absoluto con teléfono o telemonitoreo	Riesgo relativo (IC 95%)	# participante (estudios)
Hospitalización por IC: apoyo telefónico estructurado vs cuidado usual	214 por 1000	182 por 1000	RR 0,85 (0,77-0.93)	7030 (16 RCT)
Hospitalización por IC : Telemonitoreo vs cuidado usual	272 por 1000	193 por 1000	RR 0,71 (0,60-0,83)	2148 (8 RCT)

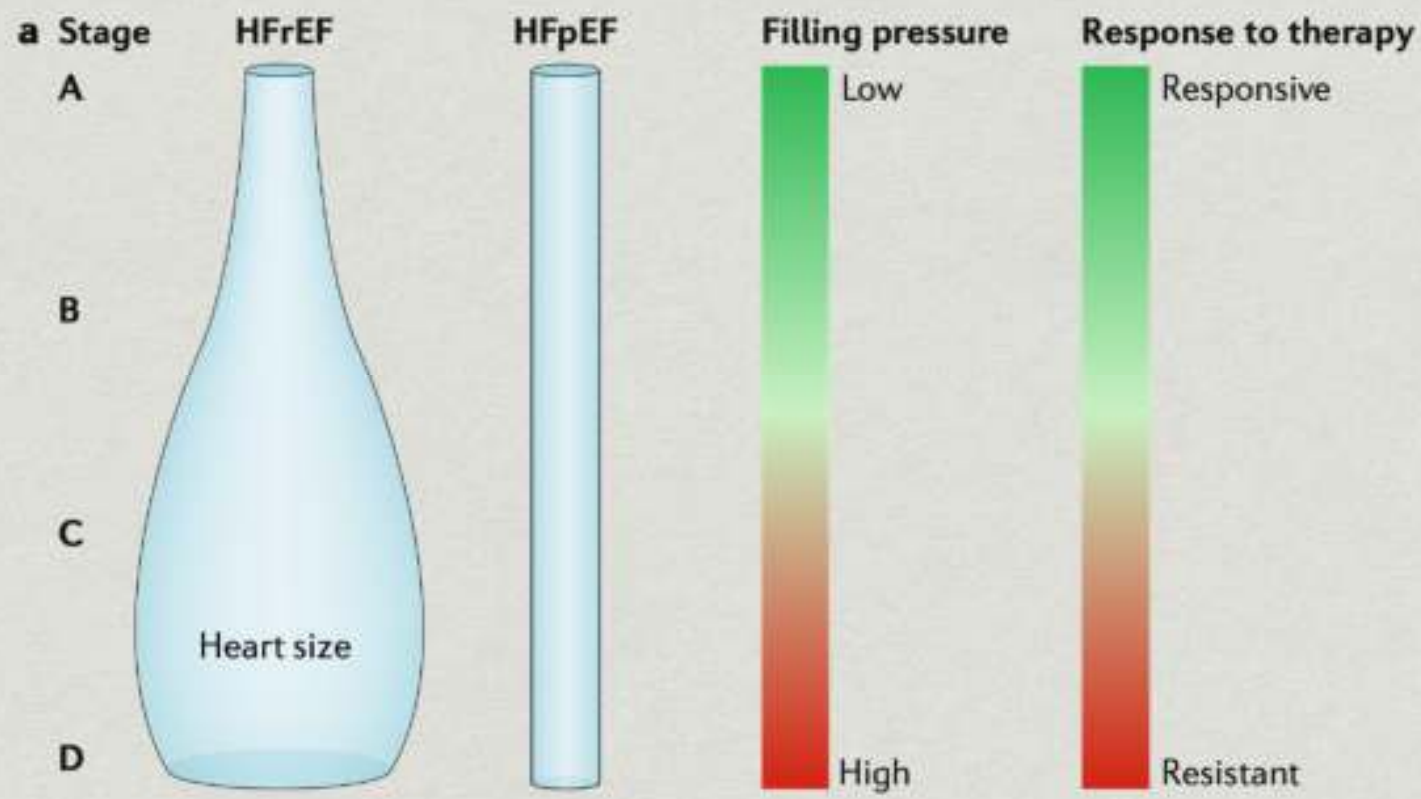
Inglis SC, Clark RA, Dierckx R, Prieto-Merino D, Cleland JGF.
Structured telephone support or non-invasive telemonitoring for patients with heart failure. Cochrane Database of Systematic Reviews 2015, Issue 10.

Meta análisis de apoyo telefónico y telemonitoreo vs cuidado usual en IC: EDAD

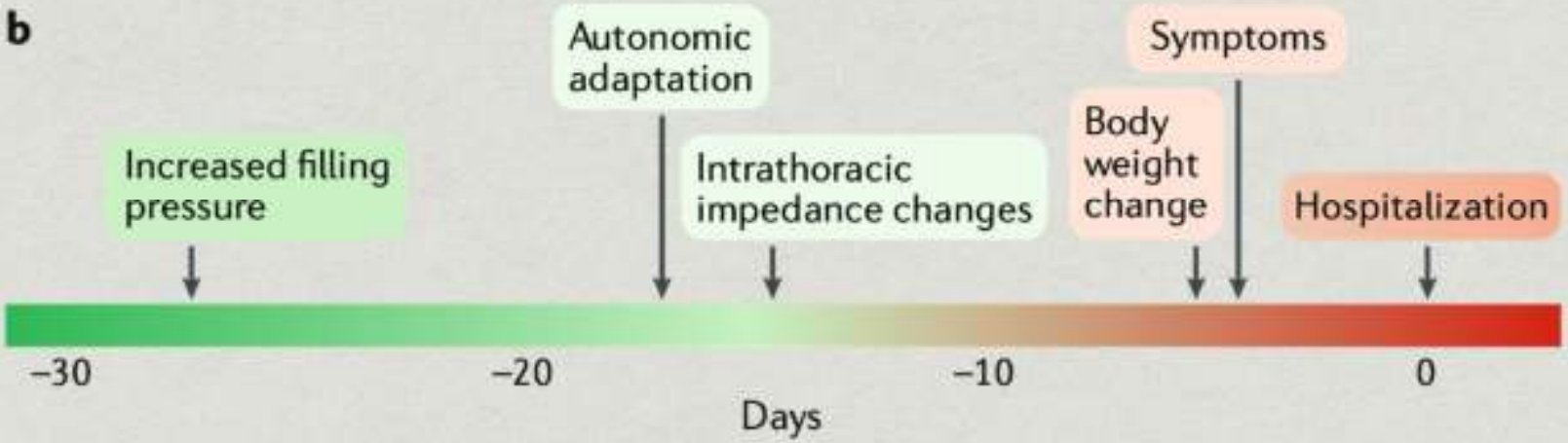
Resultados	Riesgo relativo (IC 95%) Menores de 70 años	Riesgo relativo (IC 95%) Mayores de 70 años
Hospitalización por cualquier causa: apoyo telefónico estructurado vs cuidado usual	RR 0,95 (0,89-1,01) 10 RCT (5203)	RR 0,94 (0,85-1,04) 6 RCT (1923)
Hospitalización por culquier causa: Telemonitoreo vs cuidado usual	RR 0,98 (0,9-1,07) 7 RCT (2185)	RR 0,90 (0,82-0,99) 6 RCT (1147)

Inglis SC, Clark RA, Dierckx R, Prieto-Merino D, Cleland JGF.
Structured telephone support or non-invasive telemonitoring for patients with heart failure. Cochrane Database of Systematic Reviews 2015, Issue 10.

Estadios de IC y presión de llenado



Secuencia de eventos y hospitalización



DISPOSITIVOS PARA MONITOREO

Impedancia transtorácica

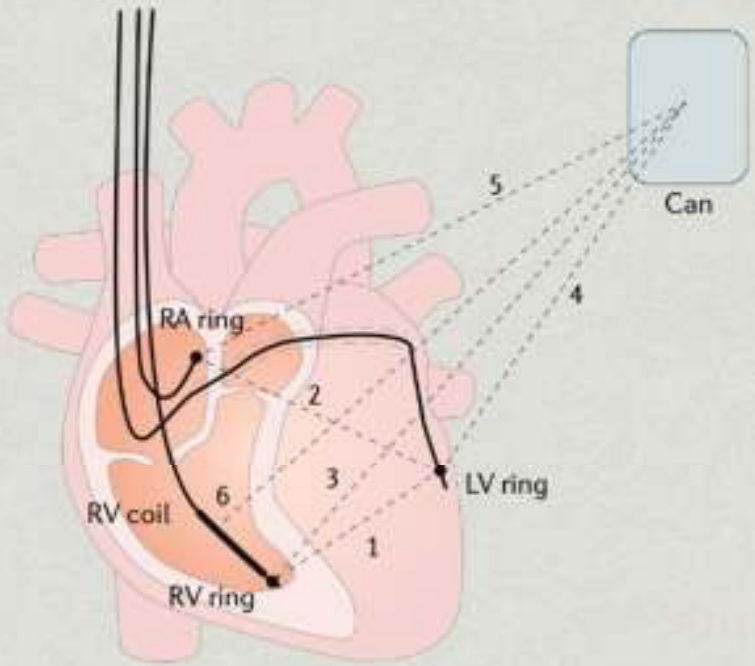


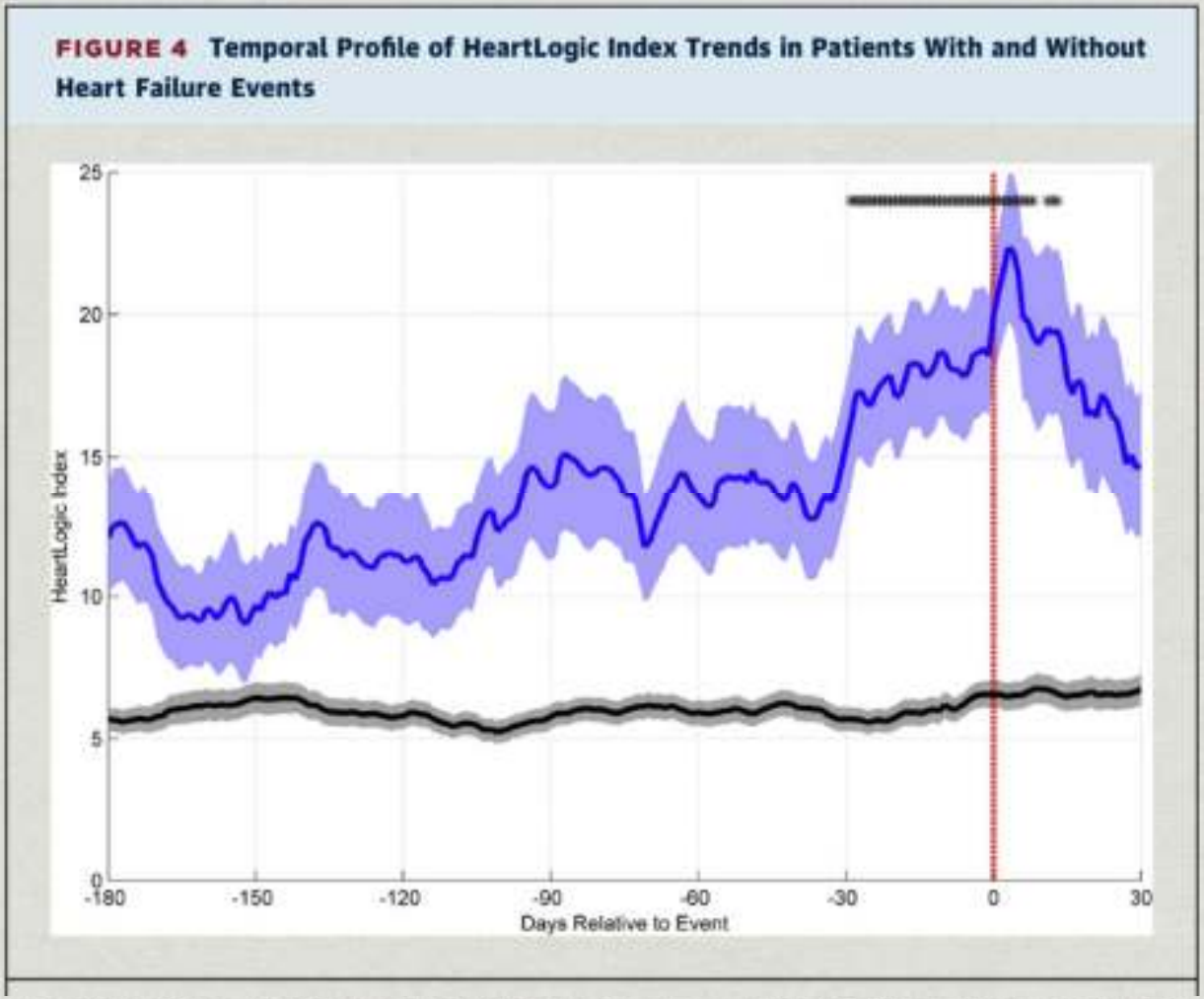
Fig. 3 | **Estimating lung congestion using transthoracic impedance.** The ring and coil electrode configurations used for measuring impedance are: (1) left ventricular (LV) ring–right ventricular (RV) ring, (2) LV ring–right atrial (RA) ring, (3) RV ring–Can, (4) LV ring–Can, (5) RA ring–Can and (6) RV coil–Can. Reproduced from REF.[81], Springer Nature Limited.

Multi-SENSE: Variables fisiológicas

- N 900 (Desarrollo 500/Evaluación 400)
  - Ruidos cardiacos
  - Impedancia torácica
  - Frecuencia respiratoria
  - Frecuencia cardiaca
  - Actividad

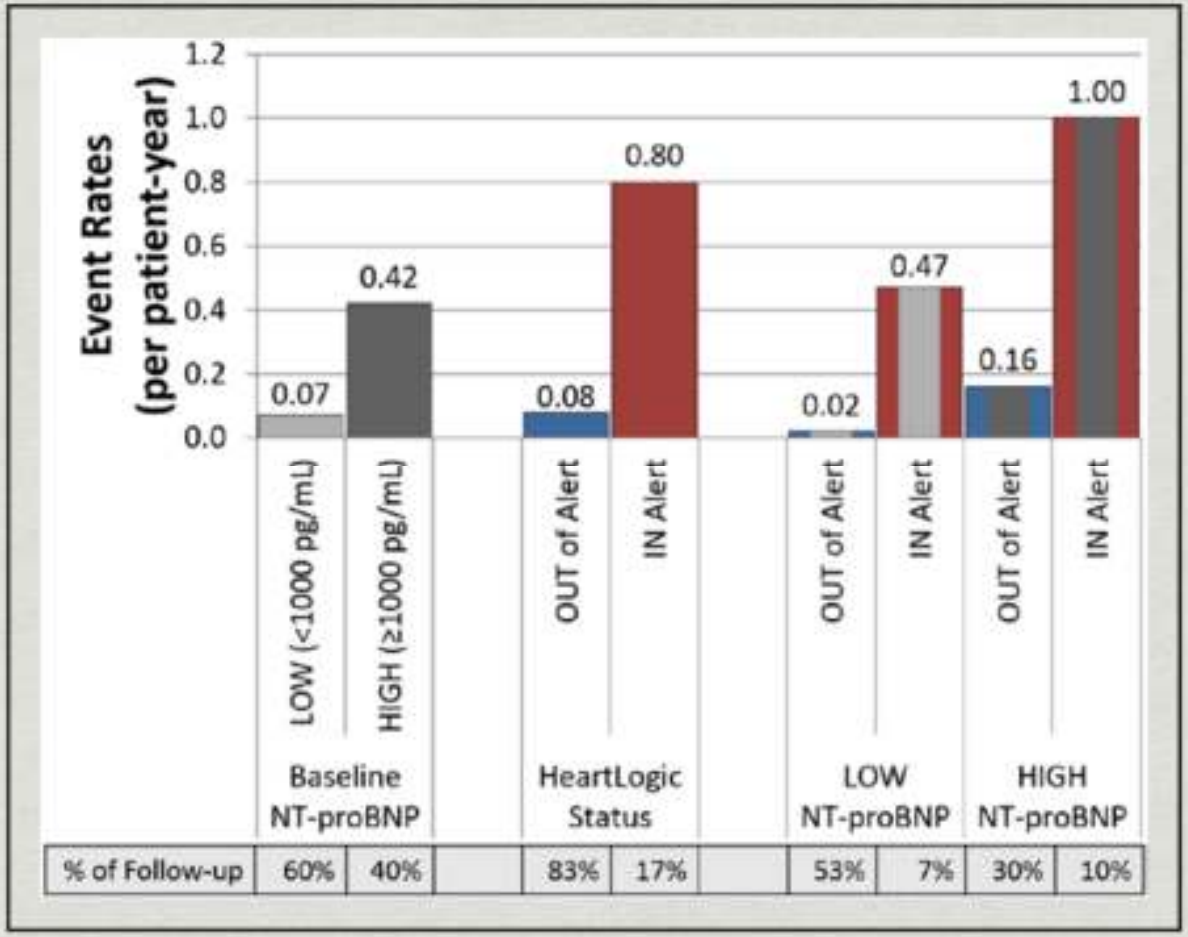
Bohemher J, A et al. Multisensor Algorithm Predicts Heart Failure Events in Patients With Implanted Devices.J Am Coll Cardiol HF 2017;5:216–25

Multi-SENSE



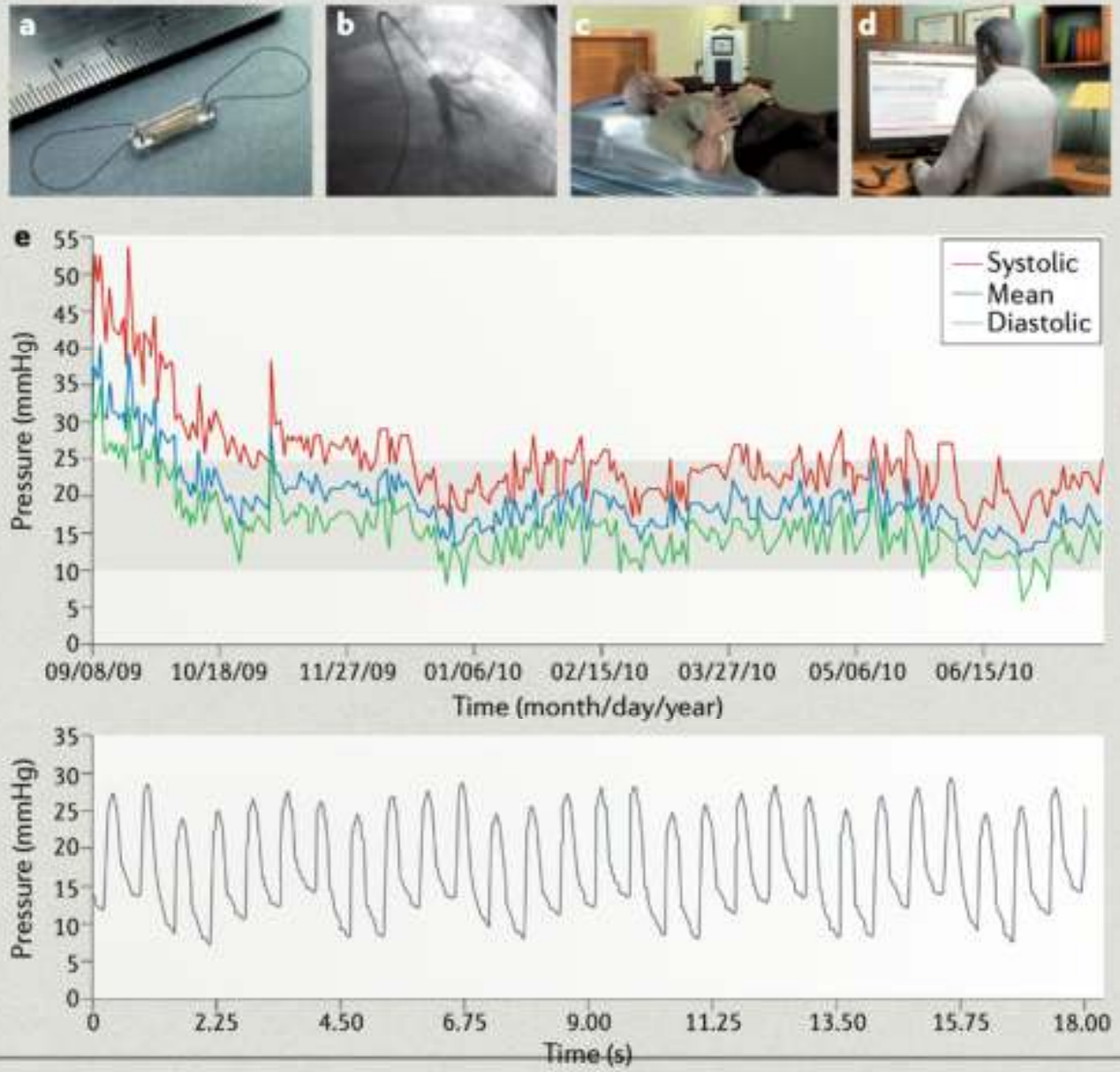
Bohemher J, A et al. Multisensor Algorithm Predicts Heart Failure Events in Patients With Implanted Devices.J Am Coll Cardiol HF 2017;5:216–25

HEART-Logic y NTProBNP



rtLogic Multisensor Algorithm Identifies Patients During Periods of Significantly Increased Risk of Heart Failure Events Results From the MultiSENSE Study.

Cardio MEMS


a
b
c
d
e
Systolic
Mean
Diastolic
Pressure (mmHg)
55
50
45
40
35
30
25
20
15
10
5
0
09/08/09
10/18/09
11/27/09
01/06/10
02/15/10
03/27/10
05/06/10
06/15/10
Time (month/day/year)
Pressure (mmHg)
35
30
25
20
15
10
5
0
0
2.25
4.50
6.75
9.00
11.25
13.50
15.75
18.00
Time (s)

Estudio CHAMPION

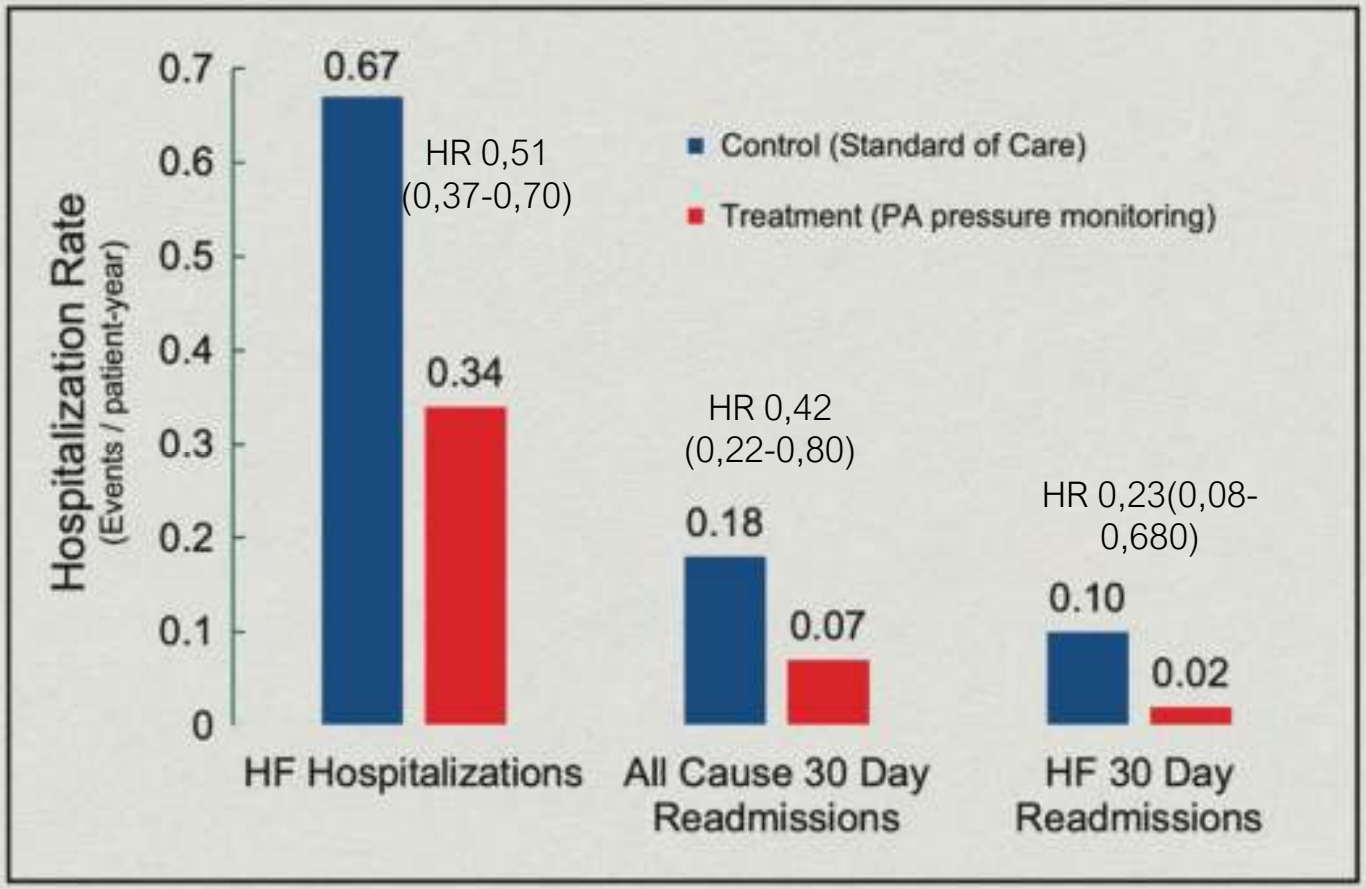
	Not enrolled (n=25)	Treatment group (n=270)	Control group (n=280)	All patients (n=575)	Risk (95% CI)	p value	NNT
Primary efficacy endpoints*							
Heart-failure-related hospitalisations up to 6 months (number; events per patient per 6 months)	NA	84 (0·32)	120 (0·44)	NA	0·72† (0·60–0·85)	0·0002	8
Primary safety endpoints‡							
Device-related or system-related complications	2 (8%)	3 (1%)	3 (1%)	8 (1%)	§	<0·0001	NA
Pressure-sensor failures	0	0	0	0	§	<0·0001	NA
Prespecified supplementary efficacy endpoints¶							
Heart-failure-related hospitalisations during entire randomised follow-up	NA	158	254	NA	0·63† (0·52–0·77)	<0·0001	4
Secondary efficacy endpoints							
Change from baseline in pulmonary artery mean pressure at 6 months (mm Hg×days; mean area under the curve)	NA	-156	33	NA	NA	0·008	NA
Patients admitted to hospital for heart failure at 6 months	NA	55 (20%)	80 (29%)	NA	0·71‖ (0·53–0·96)	0·03	NA
Days alive outside hospital at 6 months (mean, SD)	NA	174·4 (31·1)	172·1 (37·8)	NA	NA	0·02	NA
Minnesota Living with Heart Failure Questionnaire at 6 months (mean, SD)	NA	45 (26)	51 (25)	NA	NA	0·02	NA

Data are number (%) or number, unless otherwise indicated. NNT=number needed to treat. NA=not applicable. *p value from negative binomial regression for comparison of treatment group with control group. †Hazard ratio. ‡p value from exact test of binomial proportions of freedom from events compared with 80% (device-related or system-related complications) and 90% (pressure sensor failure) for all patients. §Risk difference not reported because analysis by randomisation group was not prespecified. ¶p value from the Anderson-Gill model for comparison of treatment group with control group. ‖Relative risk.

Table 2: **Effect of wireless implantable haemodynamic monitoring on safety and efficacy endpoints**

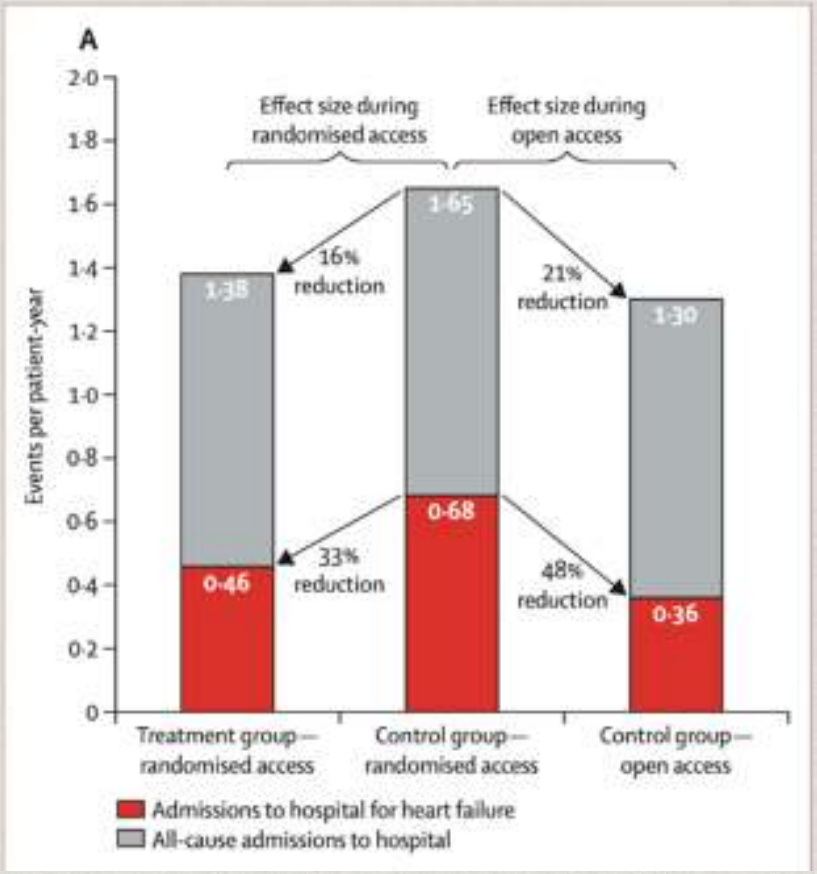
Abraham W et al. Wireless pulmonary artery haemodynamic monitoring in chronic heart failure: a randomised controlled trial. Lancet 2011; 377: 658–66

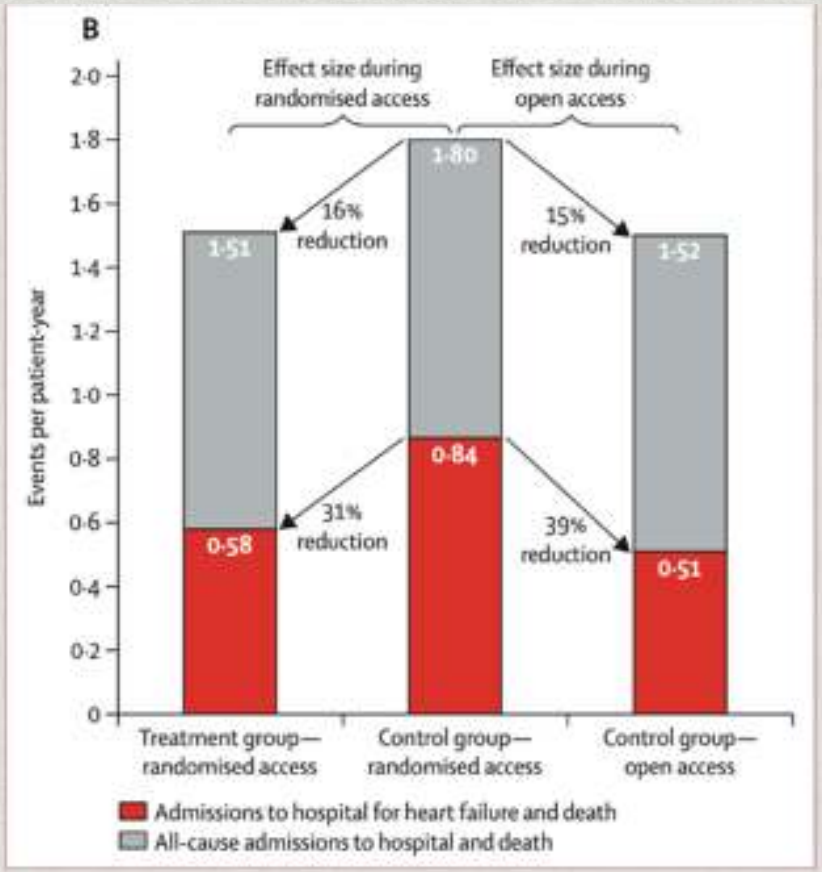
CARDIO MEMS en mayores de 65 años



Adamson P et al. Pulmonary Artery Pressure–Guided Heart Failure Management Reduces 30-Day Readmissions . Circ Heart Fail. 2016;9

Efecto de CardioMEMS a los 18 m





Abraham W et al. Sustained efficacy of pulmonary artery pressure to guide adjustment of chronic heart failure therapy: complete follow-up results from the CHAMPION randomised trial. Lancet 2016; 387: 453–61

Monitoreo no invasivo de fluido pulmonar: ReDS



Uriel N et al. Relationship Between Noninvasive Assessment of Lung Fluid Volume and Invasively Measured Cardiac Hemodynamics. J Am Heart Assoc. 2018

Correlación ReDS/TAC

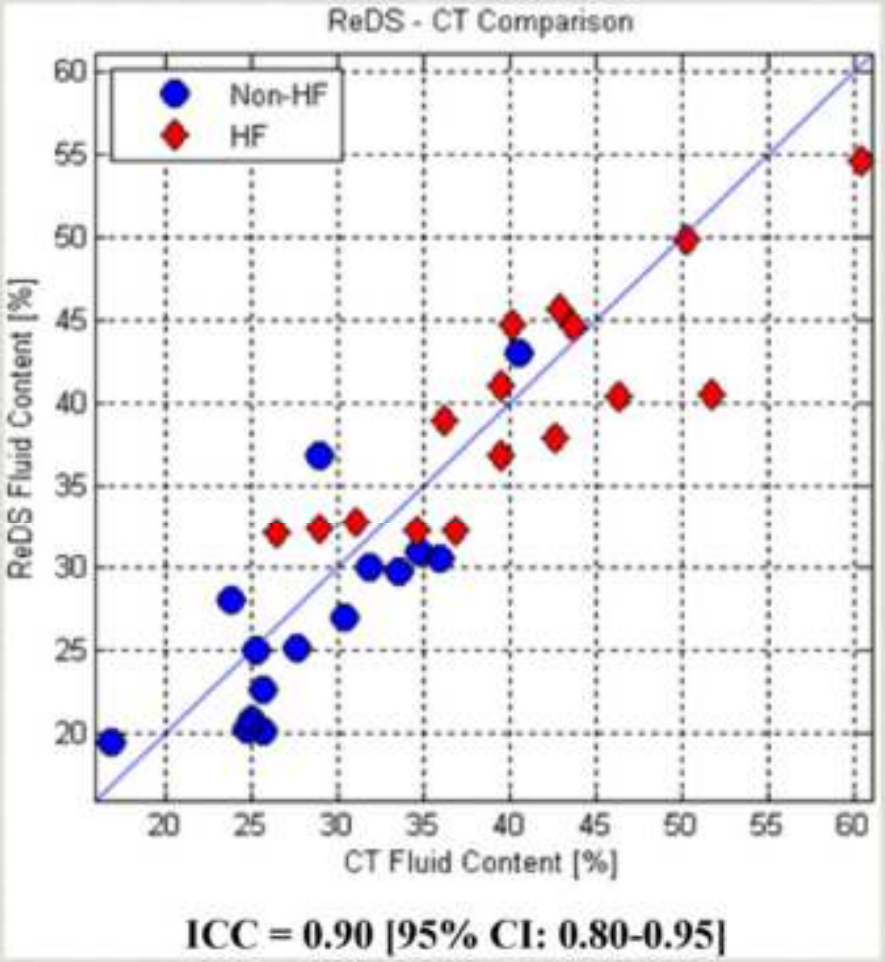
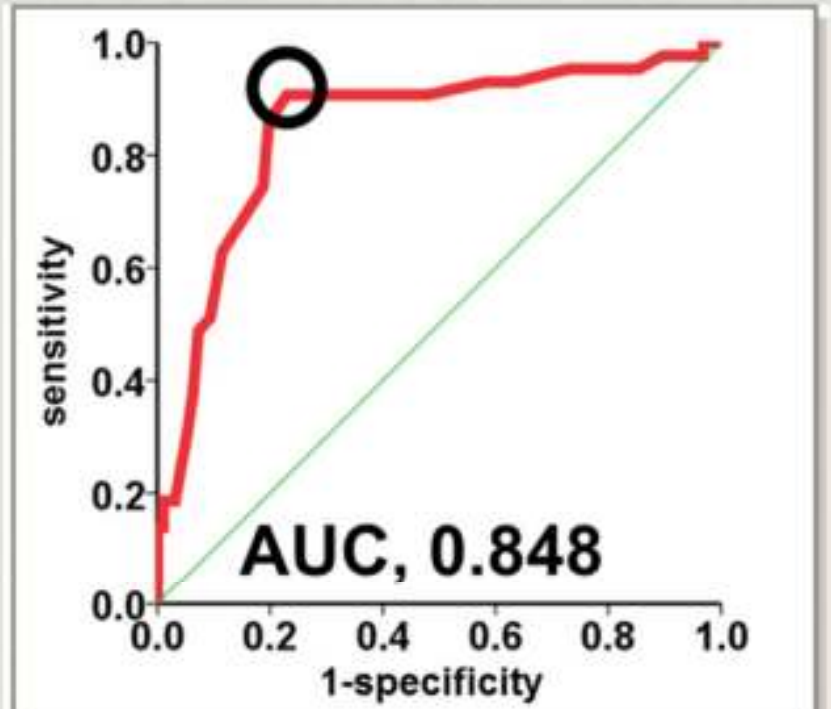


Fig. 3. ReDS™ vs. CT – comparison of lung fluid level quantification (N = 31).

Amir O et al. Validation of remote dielectric sensing (ReDSTM) technology for quantification of lung fluid status: Comparison to high resolution chest computed tomography in patients with and without acute heart failure .International Journal of Cardiology 221 (2016) 841–846

Correlación ReDS/Monitoreo invasivo



	N = 139
Endpoint	PAWP ≥18
Cutoff	ReDS >34
Sensitivity	90.7%
Specificity	77.1%
Positive predictive value	63.9%
Negative predictive value	94.9%

Uriel N et al Relationship Between Noninvasive Assessment of Lung Fluid Volume and Invasively Measured Cardiac Hemodynamics. J Am Heart Assoc. 2018

DISPOSITIVOS DE ASISTENCIA AL VENTRICULO IZQUIERDO

Dispositivos de asistencia del VI: Flujo continuo vs pulsatil

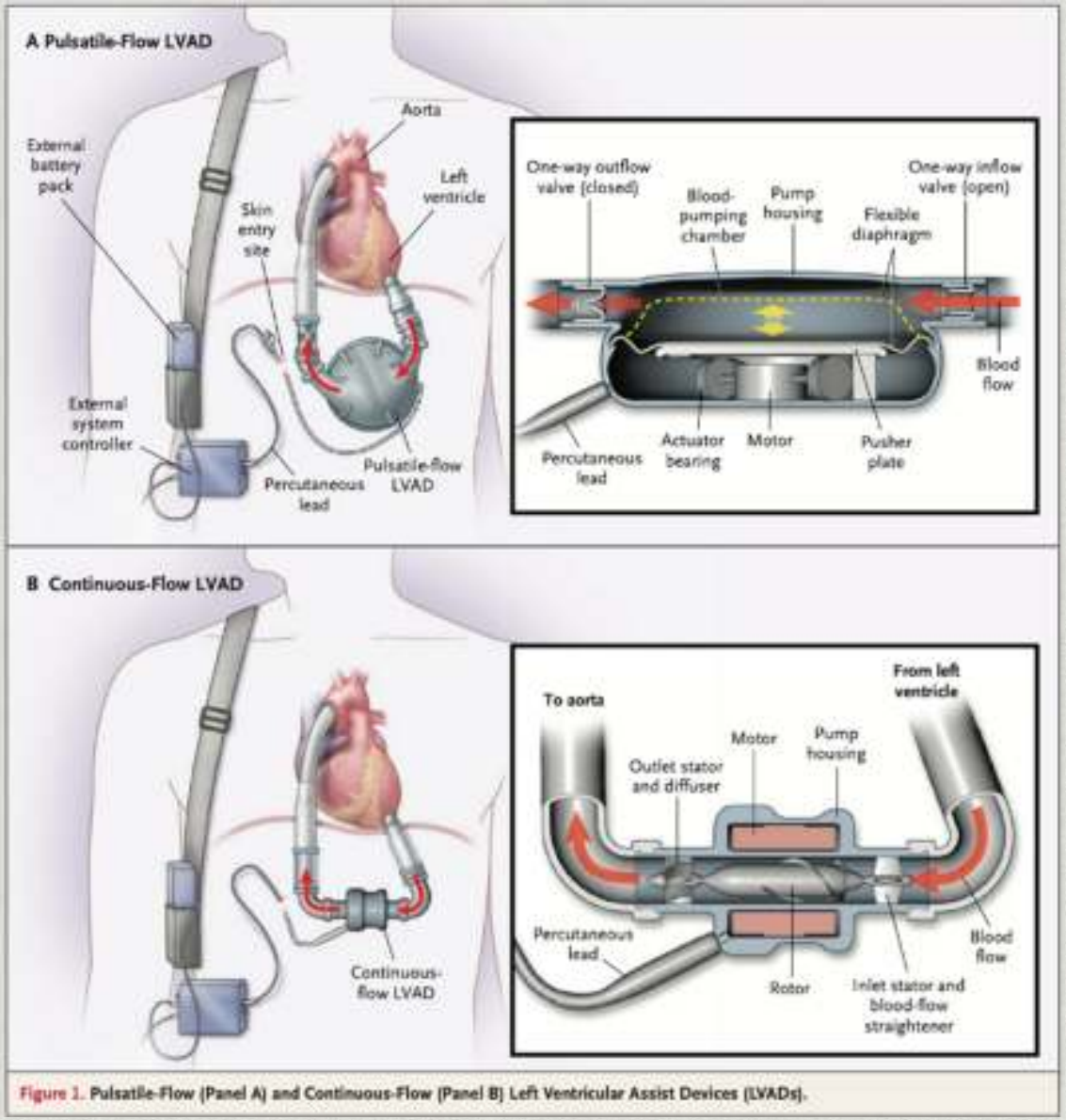


Figure 1. Pulsatile-Flow (Panel A) and Continuous-Flow (Panel B) Left Ventricular Assist Devices (LVADs).

Slaughter M et al. Advanced Heart Failure Treated with Continuous-Flow Left Ventricular Assist Device. N Engl J Med 2009;361:2241-51.

Dispositivos de asistencia del VI: Flujo continuo vs pulsatil

Variables primarias	Flujo continuo (N 134)	Flujo pulsatil (N 66)	Hazard Ratio (95% IC)	Valor P
Sobrevida libre de ECV discapacitante y re-intervención para reparar o reemplazar dispositivo a 2 años	62 (46%; 38-55)	7 (11%; 3-18)		<0,001
Eventos prevenidos de la variable primaria				
ECV discapacitante	15 (11%; 6-17)	8 (12%; 4-20)	0,78 (0,33-1,82)	0,56
Re-intervención para reparar o reemplazar bomba	13 (10%; 5-15)	24 (36%; 24-48)	0,18 (0,09-0,37)	<0,001
Muerte a los 2 años	44 (33%; 25-41)	27 (41%; 29-53)	0,59 (0,35-0,99)	0.048
Cualquiera	72 (54%; 45-62)	59 (89%; 82-97)	0,38 (0,27-0,54)	<0,001

Slaughter M et al. Advanced Heart Failure Treated with Continuous-Flow Left Ventricular Assist Device. N Engl J Med 2009;361:2241-51.

Dispositivos de asistencia del VI: Flujo continuo vs pulsatil

Table 3. Functional Status and Quality-of-Life Secondary End Points, Based on the As-Treated Analysis, According to Time Point.*

End Point	Continuous-Flow LVAD					Pulsatile-Flow LVAD					P Value between Treatments at 12 mo
	Baseline	3 Mo	12 Mo	24 Mo	P Value for Treatment over Time†	Baseline	3 Mo	12 Mo	24 Mo	P Value for Treatment over Time†	
NYHA class											
No. of patients tested	126	91	72	50		55	38	18	1		
Class I — no. (%)	0	30 (33)	30 (42)	21 (42)		0	10 (26)	6 (33)	1 (100)		
Class II — no. (%)	0	38 (42)	25 (35)	19 (38)		0	16 (42)	5 (28)	0		
Class IIIA — no. (%)	4 (3)	16 (18)	13 (18)	6 (12)		1 (2)	10 (26)	4 (22)	0		
Class IIIB — no. (%)	27 (21)	5 (5)	4 (6)	1 (2)		11 (20)	1 (3)	2 (11)	0		
Class IV — no. (%)	95 (75)	2 (2)	0	3 (6)		43 (78)	1 (3)	1 (6)	0		
Patients with class I or II — no. (%)	0	68 (75)	55 (76)	40 (80)	<0.001	0	26 (68)	11 (61)	1 (100)	<0.001	0.22
6-Minute walk test											
No. of patients tested	50	77	61	36		19	29	12	1		
Distance walked — m	182±140	319±191	318±164	372±191	<0.001	172±108	291±134	306±145	277	<0.001	0.62
Minnesota Living with Heart Failure questionnaire											
No. of patients tested	116	89	76	44		49	36	19	1		
Score	75.4±17.7	37.4±22.2	34.1±22.4	29.6±22.4	<0.001	76.1±18.0	42.1±23.3	44.4±23.2	61.0	<0.001	0.03
Kansas City Cardiomyopathy questionnaire											
No. of patients tested	115	89	76	47		47	36	18	1		
Overall summary score	27.4±16.3	63.4±18.5	65.9±20.0	69.9±18.7	<0.001	26.5±17.4	56.7±21.1	59.1±20.3	33.3	<0.001	0.06
Clinical summary score	35.1±18.5	67.2±17.4	68.6±21.8	72.9±19.3	<0.001	31.6±18.4	64.0±19.8	60.8±20.2	63.5	<0.001	0.12

Slaughter M et al Advanced Heart Failure Treated with Continuous-Flow Left Ventricular Assist Device. N Engl J Med 2009;361:2241-51.

ACTIVACION DEL BARO REFLEJO

Terapia de activación de Baroreflejo

TABLE 2 Effect of BAT on Primary Efficacy End Points (Change From Baseline to 6 Months)

	Treatment Group		Control Group		Difference	
	n	Mean ± SE	n	Mean ± SE	Mean ± SE	p Value
NYHA functional class (% improved, same, worse)	64	55%, 42%, 3%	54	24%, 67%, 9%	0.002	
MLWHFQ QoL	64	−17.4* ± 2.8	54	2.1 ± 3.1	−19.5 ± 4.2	<0.001
6MHW distance (m)	56	59.6* ± 14.1	43	1.5 ± 13.2	58.1 ± 19.8	0.004

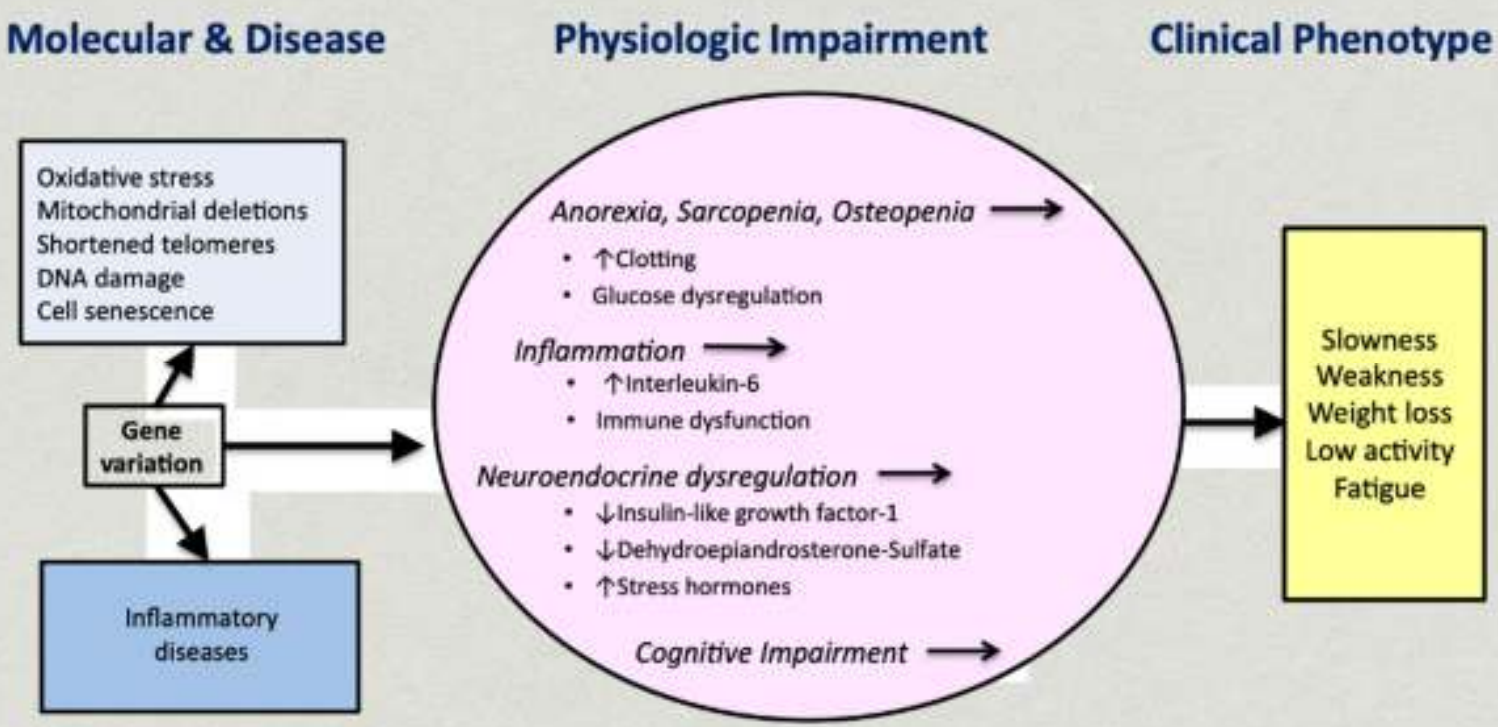
*$p < 0.001$ for within-group change.

6MHW = 6-minute hall walk; SE = standard error; other abbreviations as in Table 1.

nam T et al. Baroreflex Activation Therapy for the Treatment of Heart Failure With a Reduced Ejection Fraction. JAmCollCardiolHF2015;3:487–96

FRAGILIDAD COMO SIGNO VITAL EN ENFERMEDAD CARDIACA

Fragilidad como signo vital en Adultos Mayores

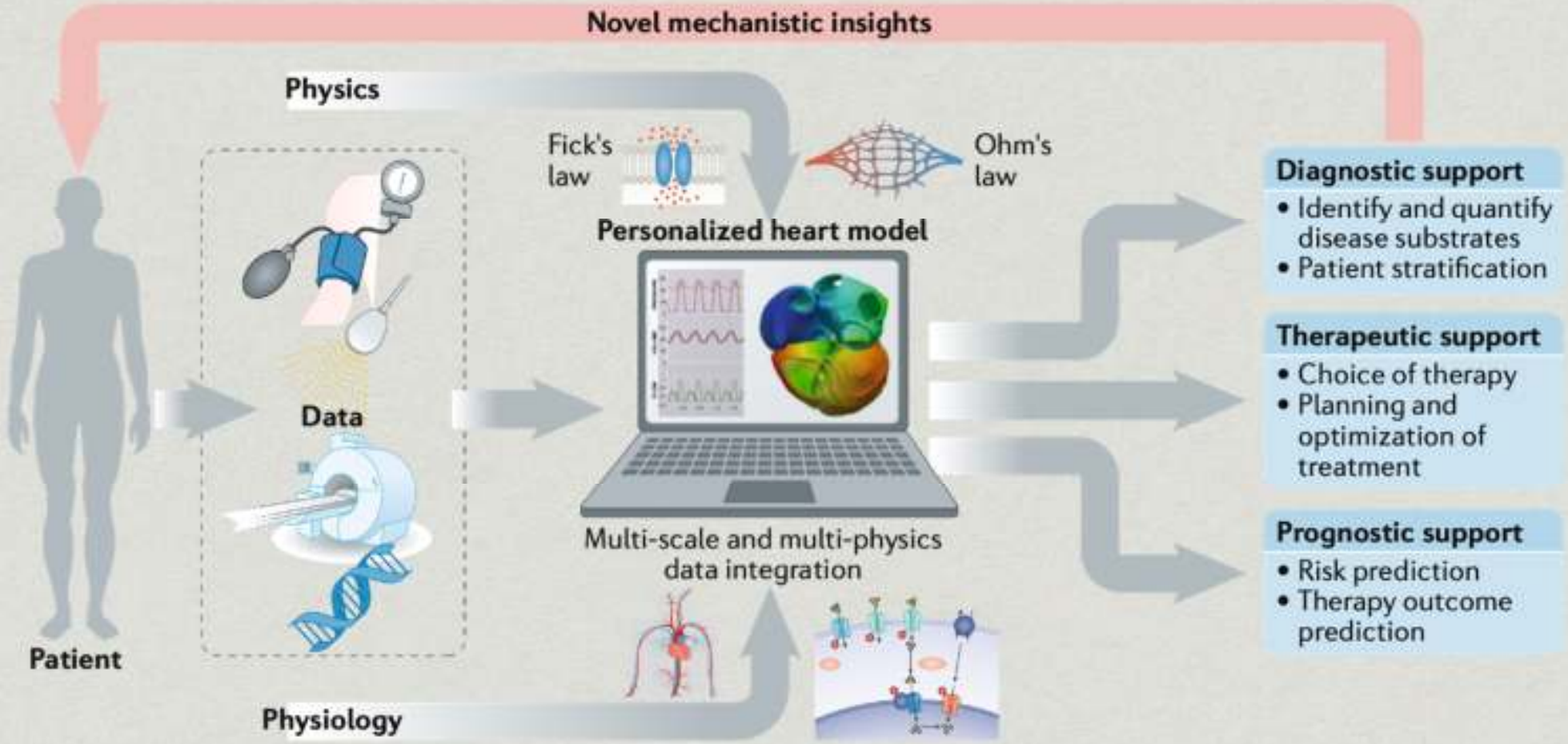


Forman D et al. Frailty: A Vital Sign for Older Adults With Cardiovascular Disease. Canadian Journal of Cardiology 32 (2016) 1082e1087

Conclusiones

- Variables fisiológicas permiten intervención temprana para evitar descompensaciones de insuficiencia cardiaca.
- Los dispositivos de asistencia del ventrículo y la activación del baroreflejo han mejorado calidad de vida en pacientes con insuficiencia cardiaca.

GRACIAS



Nierder S. Computational models in cardiology. Nature Reviews Cardiology 2019

Estudio CHAMPION

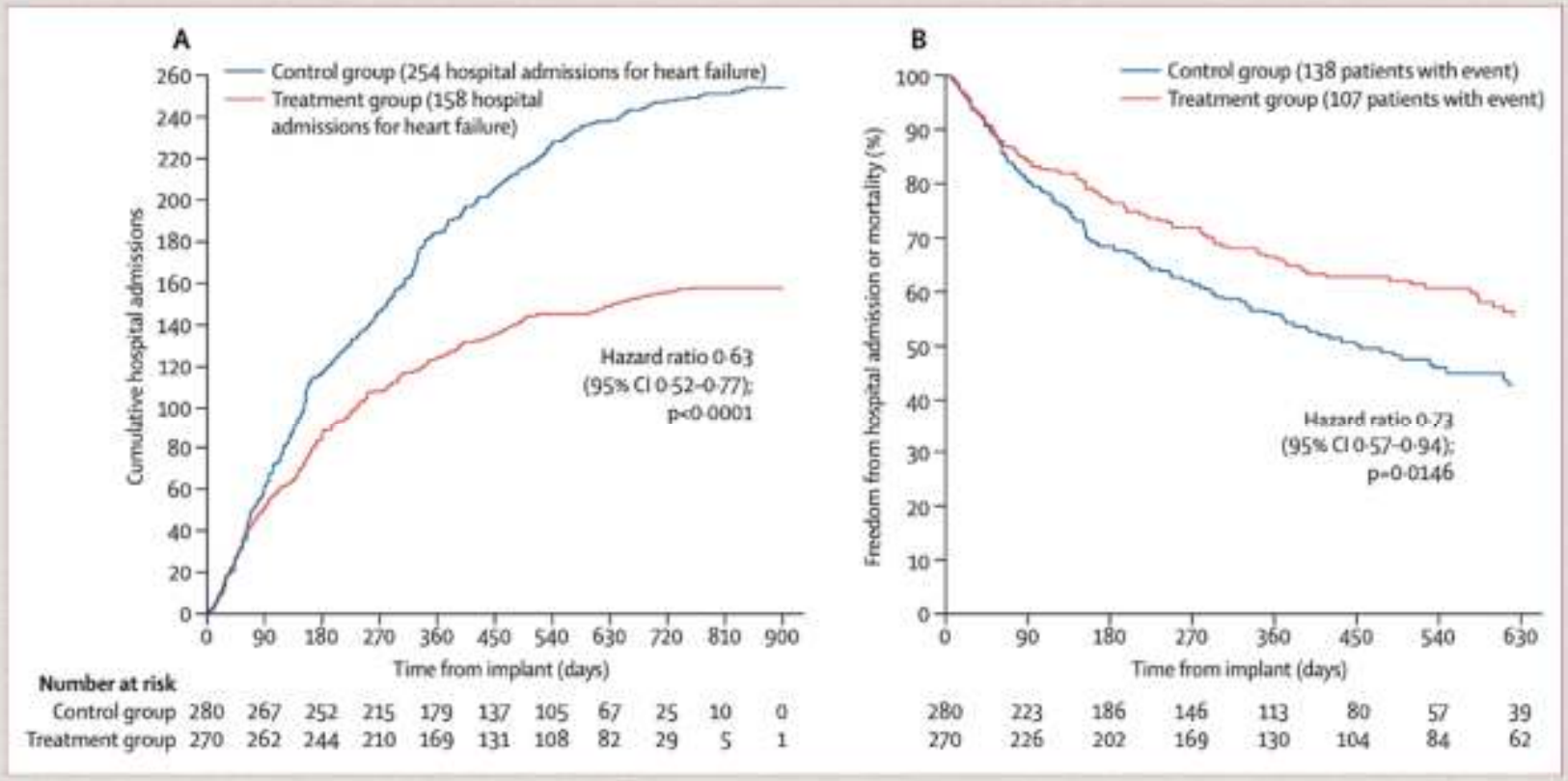


***Figure 3*: Cumulative heart-failure-related hospitalisations during entire period of randomised single-blind follow-up (A), and freedom from first heart-failure-related hospitalisation or mortality during the entire period of randomised follow-up (B)**

Abraham W. Wireless pulmonary artery haemodynamic monitoring in chronic heart failure: a randomised controlled trial. Lancet 2011; 377: 658–66

Efecto de CardioMEMS a los 18 m

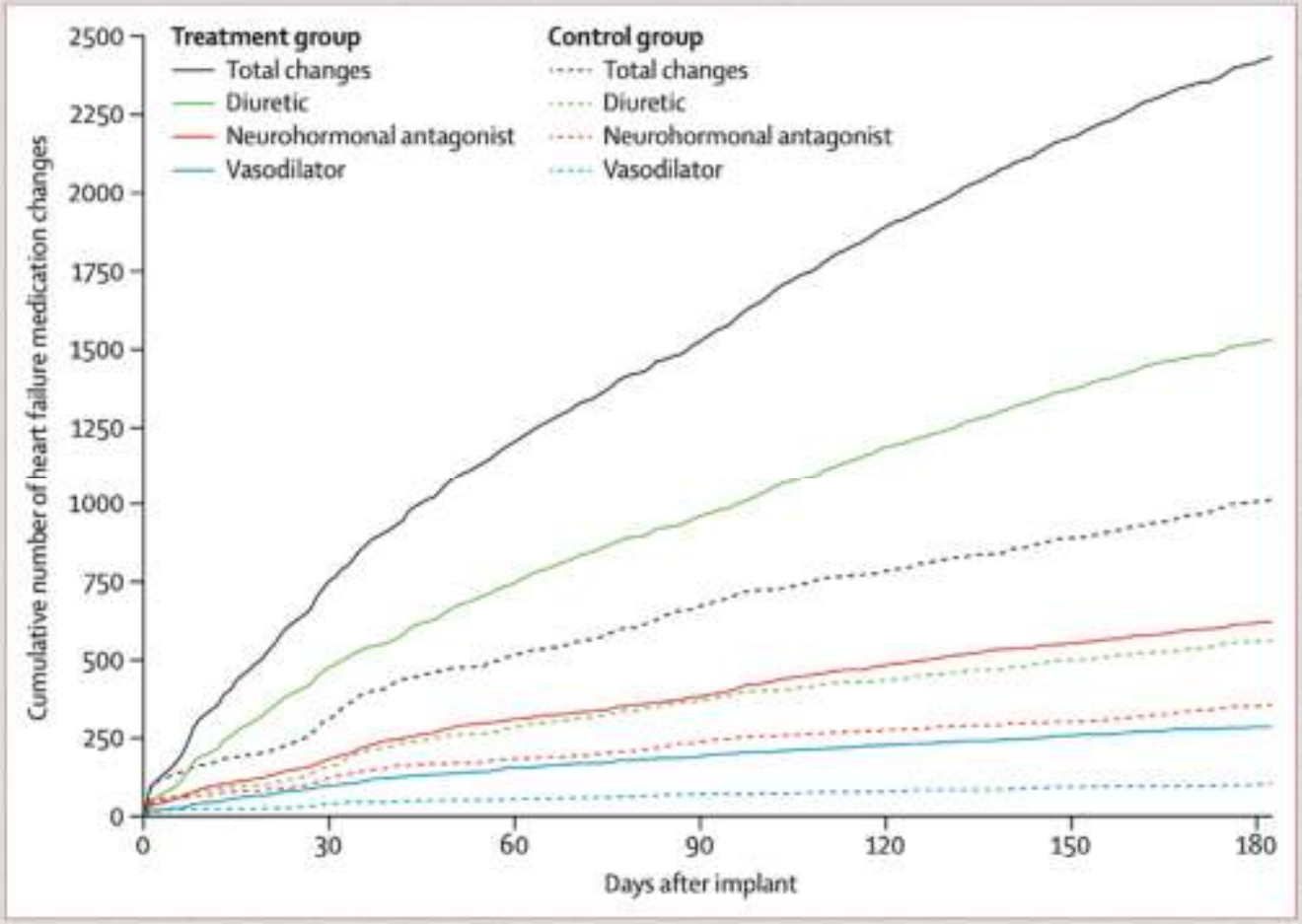


Figure 2: **Medication changes over time by class and treatment group**

ained efficacy of pulmonary artery pressure to guide adjustment of chronic heart failure therapy: complete follow-up results from the CHAMPION randomised trial. Lan

DOT/HF

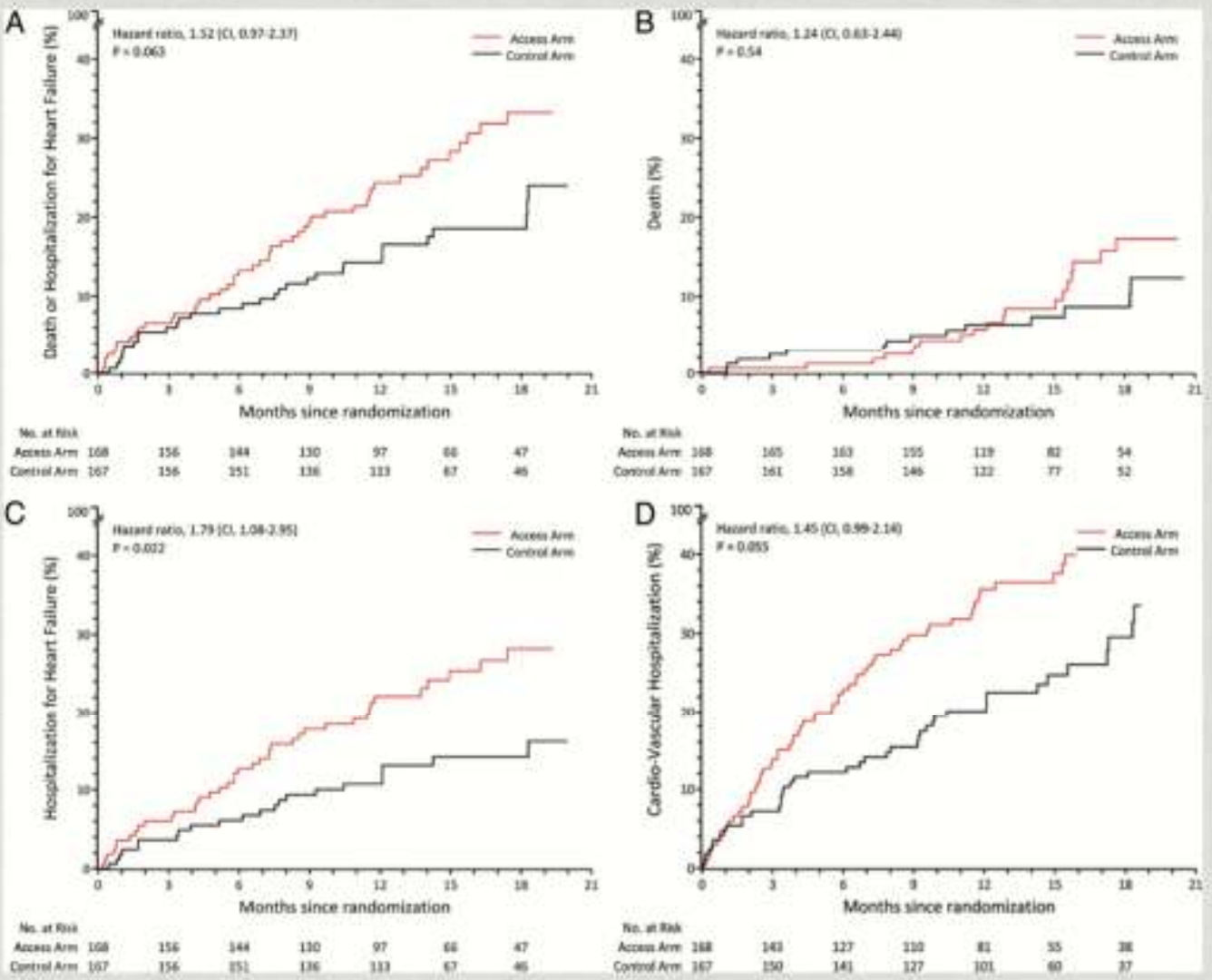


Figure 3. Kaplan-Meier estimates of the cumulative incidence of clinical events according to treatment group. **A**, Incidence of the primary end point (time to first end point, ie, all-cause death, heart transplantation, or [unplanned] heart failure hospitalization). **B**, All-cause death (secondary end point). **C**, First unplanned heart failure hospitalization (secondary end point). **D**, First cardiovascular hospitalization (secondary end point).

Dirk J. Intrathoracic Impedance Monitoring, Audible Patient Alerts, and Outcome in Patients With Heart Failure. Circulation. 2011;124:1719-1726

Dispositivos de asistencia del VI: Flujo centrifugo vs axial

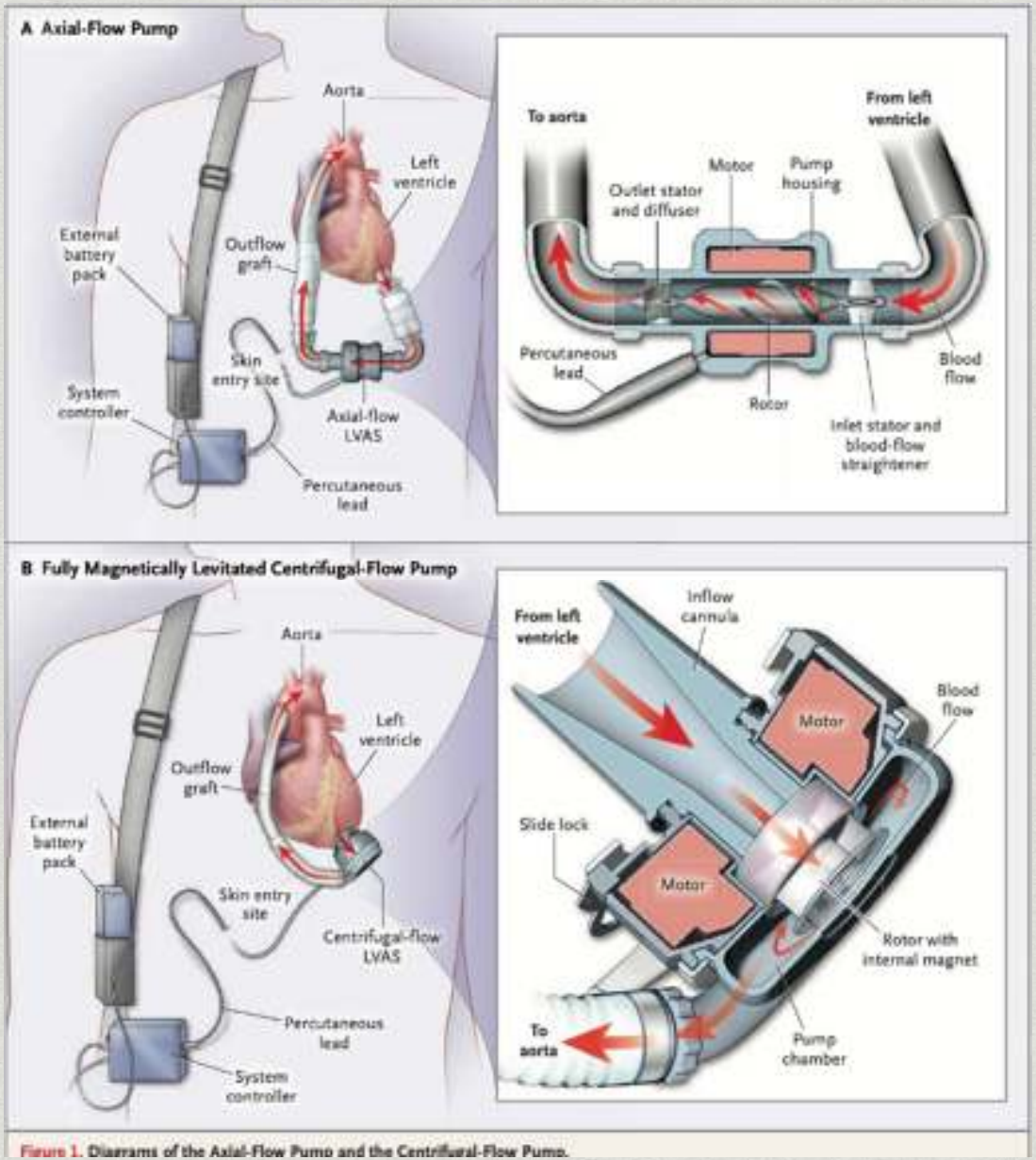


Figure 1. Diagrams of the Axial-Flow Pump and the Centrifugal-Flow Pump.

Mandeep RA Fully Magnetically Levitated Circulatory Pump for Advanced Heart Failure . N Engl J Med 2017;376:440-50.

	Randomised access treatment group (n=270)	Randomised access control group (n=280)	Statistical analysis	Randomised access control group (n=280)	Open access former control group (n=170)	Statistical analysis	Randomised access treatment group (n=270)	Open access former treatment group (n=177)	Statistical analysis
Admissions to hospital for heart failure	182 (0·46)	279 (0·68)	Diff 97 (0·23); NNT 4; HR 0·67 (33% RRR; 95% CI 0·55–0·80); p<0·0001*	279 (0·68)	64 (0·36)	Diff 215 (0·32); NNT 3; HR 0·52 (48% RRR; 95% CI 0·40–0·69); p<0·0001*	182 (0·48)	78 (0·45)	Non-significant; HR 0·93 (95% CI 0·70–1·22); p=0·58*
Death and admissions to hospital for heart failure	232 (0·58)	343 (0·84)	Diff 111 (0·26); NNT 4; HR 0·69 (31% RRR; 95% CI 0·59–0·82); p<0·0001*	343 (0·84)	85 (0·51)	Diff 258 (0·33); NNT 3; HR 0·61 (39% RRR; 95% CI 0·48–0·78); p<0·0001*	232 (0·61)	109 (0·67)	Non-significant; HR 1·09 (95% CI 0·86–1·39); p=0·46*
Death	50 (19%)	64 (23%)	Non-significant; HR 0·80 (95% CI 0·55–1·15); p=0·23†	64 (23%)	21 (12%)	Non-significant; HR 0·71 (95% CI 0·43–1·17); p=0·17†	50 (19%)	31 (18%)	HR 1·40 (95% CI 0·89–2·23); p=0·15†
Death or first admission to hospital for heart failure	121 (45%)	145 (52%)	Diff 2·4 (7·0%); HR 0·77 (23% RRR; 95% CI 0·60–0·98); p=0·0330†	145 (52%)	49 (29%)	Diff 96 (23%); HR 0·53 (47% RRR; 95% CI 0·38–0·73); p<0·0001†	121 (45%)	55 (31%)	Non-significant; HR 0·85 (95% CI 0·61–1·17); p=0·32†
All-cause admissions to hospital	554 (1·38)	672 (1·65)	Diff 118 (0·26); NNT 4; HR 0·84 (16% RRR; 95% CI 0·75–0·95); p=0·0032*	672 (1·65)	230 (1·30)	Diff 442 (0·35); NNT 3; HR 0·79 (21% RRR; 95% CI 0·67–0·92); p=0·0034*	554 (1·51)	218 (1·32)	Non-significant; HR 0·87 (95% CI 0·74–1·03); p=0·10*
Deaths and all-cause admissions to hospital	604 (1·51)	736 (1·80)	Diff 132 (0·29); NNT 3; HR 0·84 (16% RRR; 95% CI 0·76–0·94); p=0·0017*	736 (1·80)	251 (1·52)	Diff 485 (0·28); NNT 4; HR 0·85 (15% RRR; 95% CI 0·72–0·99); p=0·0351*	604 (1·65)	249 (1·61)	Non-significant; HR 0·97 (95% CI 0·83–1·14); p=0·75*

Data are N (events per patient-year), or N (%), unless otherwise indicated. Diff=difference. NNT=number needed to treat. HR=hazard ratio. RRR=relative risk reduction. *HR (95% CI) and p value from the Andersen-Gill model. †HR (95% CI) from the Cox proportional hazards model and p value from log-rank test.

***Table 2*: Long-term clinical outcomes from randomised access and open access periods**

Dispositivos de asistencia del VI: Flujo centrifugo vs axial, 6 meses

Variables	Flujo centrífugo (N 152)	Flujo axial (N 142)	Hazard Ratio (95% IC)	Valor P
No inferioridad				
Variable Primaria	131 (86,2%; 79,7-91,2)	109 (76,8%; 68,9-83,4)		<0,001
Superioridad				
Variable Primaria	131 (86,2%; 79,7-91,2)	109 (76,8%; 68,9-83,4)	0,55 (0,32-0,95)	0.04
Primer evento que ocasionó falla en alcanzar el objetivo primario				
No recibir el implante asignado	1 (0,7%; 0-3,6)	4 (2,8%; 0,8-7,1)	0,23 (0,03-2,09)	0,15
ECV discapacitante	6 (3,9%; 1,5-8,4)	4 (2,8%; 0,8-7,1)	1,31 (0,37-4,64	0,59
Re-intervención para reparar o reemplazar bomba	1 (0,7%; 0-3,6)	11 (7,7%; 3,9-13,4)	0,08 (0,01-0,60)	<0,001
Muerte a los 6 meses	13 (8,6%; 4,6-14,2)	14 (9,9%; 5,5-16,0	0,82 (0,38-1,73)	0,70

Mandeep RA Fully Magnetically Levitated Circulatory Pump for Advanced Heart Failure . N Engl J Med 2017;376:440-50.

Dispositivos de asistencia del VI: Flujo centrifugo vs axial, 24 meses

Variables	Flujo centrífugo (N 190)	Flujo axial (N 176)	Hazard Ratio (95% IC)	Valor P
No inferioridad				
Variable Primaria	151 (79,5%; 73,0-85,0)	106 (60,2%; 52,6-67,5)		<0,001
Superioridad				
Variable Primaria	151 (79,5%; 73,0-85,0)	106 (60,2%; 52,6-67,5)	0,46 (0,31-0,69)	<0,001
Primer evento que ocasionó falla en alcanzar el objetivo primario				
No recibir el implante asignado	1 (0,5%; 0-2,9)	4 (2,3%; 0,6-5,7)	0,23 (0,03-2,07)	0,16
ECV discapacitante	11 (5,8%; 2,9-10,1)	7 (4,0%; 1,6-8,0)	1,45 (0,56-3,75)	0,42
Re-intervención para reparar o reemplazar bomba	3 (1,6%; 0,3-4,5)	17 (11,8%; 1,18-23,4)	0,08 (0,03-0,27)	<0,001
Muerte a los 24 meses	22 (11,6%; 7,4-17)	26 (14,8%; 9,9-20,9)	0,75 (0,43-1,33)	0,37

Meta M. Two-Year Outcomes with a Magnetically Levitated Cardiac Pump in Heart Failure. N Engl J Med 2018;378:1386-95.