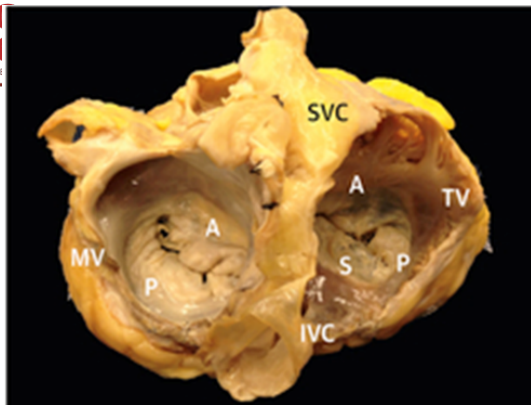


La Cardiologia Interventistica Strutturale nel 2030

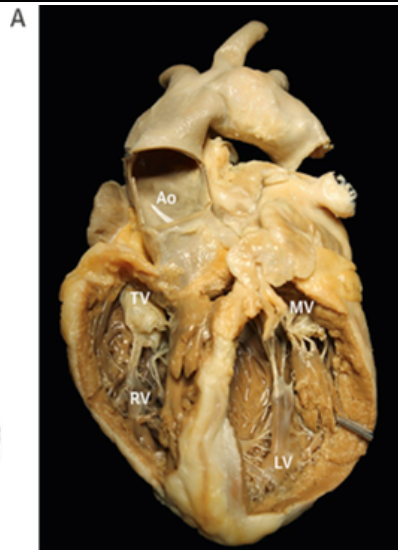
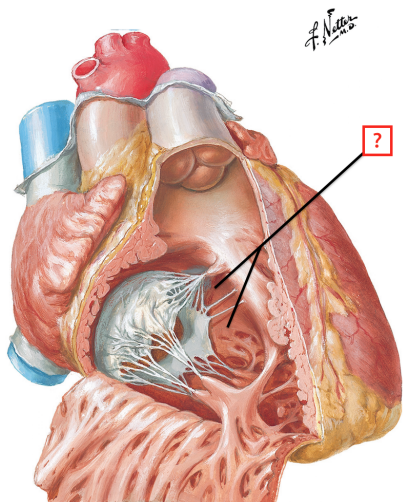
La Valvola Tricuspidale

Gian Paolo Ussia

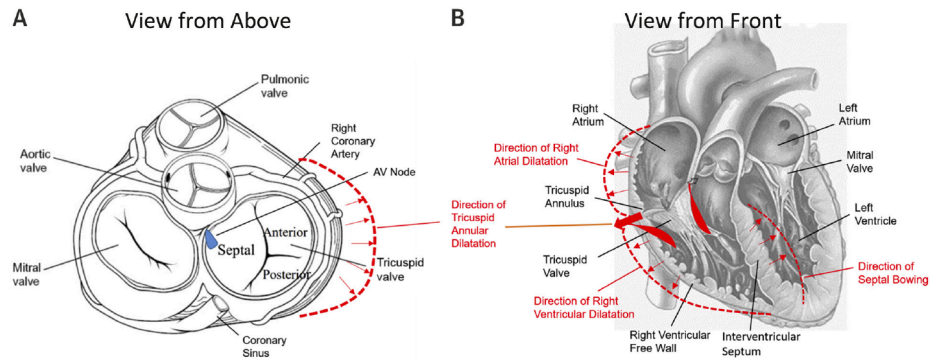




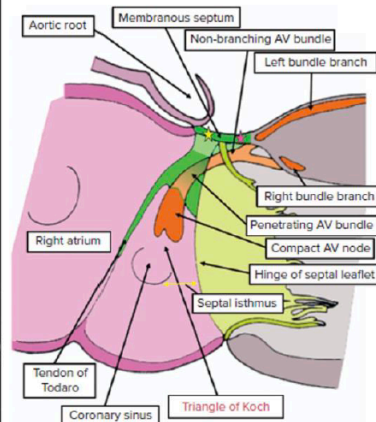
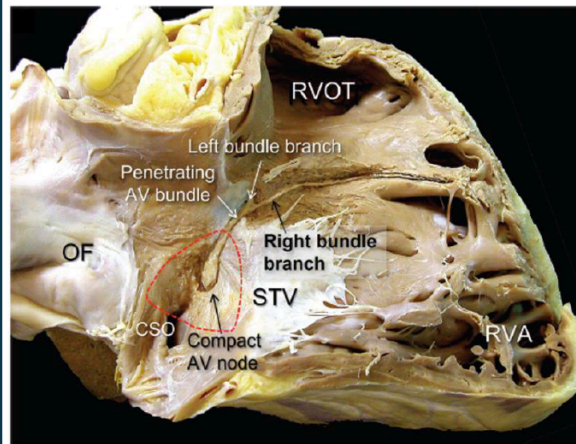
Opened right ventricle: anterior view



CENTRAL ILLUSTRATION Appreciating the Complex Anatomy of the TV Anatomy Is Essential to Understand the Pathophysiology of Tricuspid Regurgitation



Dahou, A. et al. J Am Coll Cardiol Img. 2019;12(3):458-68.





L'EVOLUZIONE DELLA CONOSCENZA DEL CUORE DESTRO E DELL'IMPORTANZA DELLA VALVOLA TRICUSPIDE

Dai pionieri della cardiologia pediatrica alle riparazioni transcattetere: conoscenza, imaging e innovazione

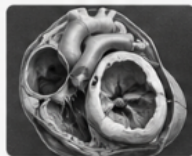
I PIONIERI 1950-1970



ABRAHAM M. RUDOLPH
(1920-2070)

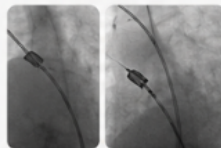
Visione pionieristica
del cuore destro
e delle cardiopatie congenite

COMPNDERE IL CUORE DESTRO E LA TRICUSPIDE 1970-1990



Dalla "valvola dimenticata"
alla consapevolezza della sua
rilevanza clinica nel determinare
sintomi, prognosi e outcome

LE PRIME RIPARAZIONI TRANSCATETERE 1990-2000



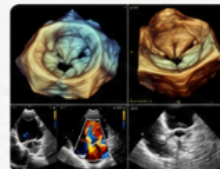
Riparazioni percutanee
in pazienti pediatrici e adulti:
dai primi device (PTMC, valvuloplastiche)
alle tecniche di edge-to-edge

CONOSCENZA E FISIOPATOLOGIA DEL CUORE DESTRO 2000-2015



Il concetto di malattia del cuore destro:
interazione ventricolo-valvola-atrio-circolazione
polmonare e sistemica

EVOLUZIONE DELL'IMAGING 2005-2020



ECO 3D, strain, speckle-tracking,
valutazione integrata della tricuspid,
dell'anello e del ventricolo destro
per una migliore selezione del paziente

NUOVA ERA: DISPOSITIVI PERCUTANEI AVANZATI 2015-OGGI



Dai sistemi edge-to-edge ai device
per anuloplastica: soluzioni su misura
per una malattia complessa e
multi-mecanismo

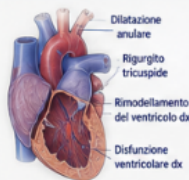


OBIETTIVO COSTANTE: migliorare i sintomi, la qualità di vita e la sopravvivenza
attraverso una comprensione sempre più profonda e terapie sempre meno invasive



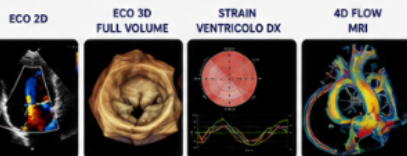
LA TRICUSPIDE NON È PIÙ
UNA VALVOLA DIMENTICATA:
È UNA FRONTIERA ATTIVA
DELLA CARDIOLOGIA

CONOSCENZA E FISIOPATOLOGIA



- Malattia spesso secondaria ma con impatto prognostico primario
- Progressione: dilatazione anulare, tethering dei lembi, disfunzione ventricolare dx
- La TR severa è associata a ↑ ospedalizzazioni, scompenso e mortalità
- "Treat the tricuspid, save the right ventricle"

EVOLUZIONE DELL'IMAGING



Imaging multimodale = valutazione completa della tricuspid e del ventricolo destro per una terapia personalizzata

INNOVAZIONE: DISPOSITIVI TRANSCATETERE



Terapie su misura per una malattia multi-mecanismo e multi-livello



DALLA VISIONE DEI PIONIERI ALLA TECNOLOGIA DEL FUTURO:
UN VIAGGIO DI CONOSCENZA E INNOVAZIONE PER IL CUORE DESTRO



PAZIENTE
AL CENTRO

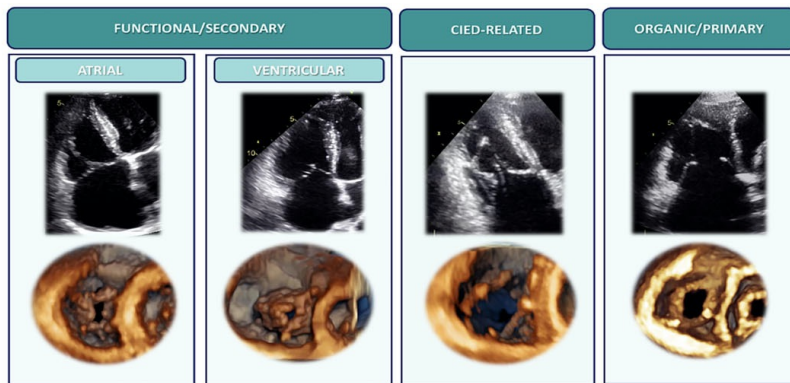


EVIDENZE
IN CRESCITA



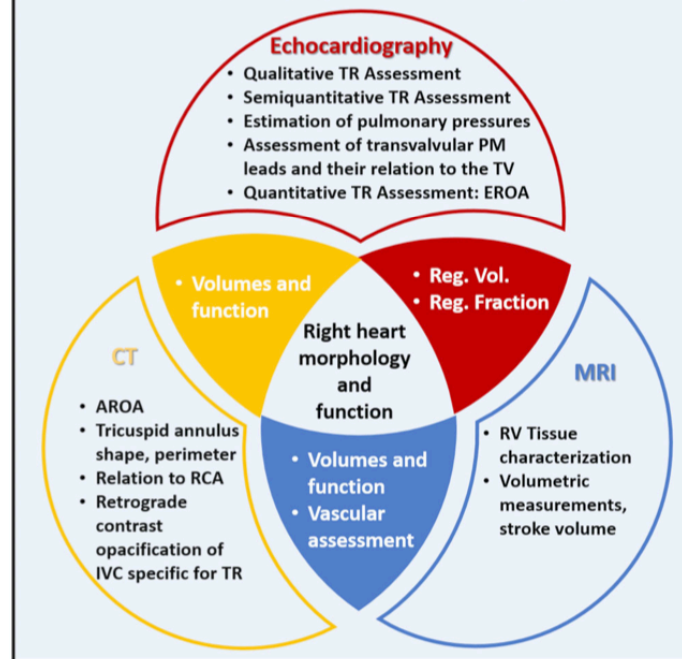
COLLABORAZIONE
GLOBALE



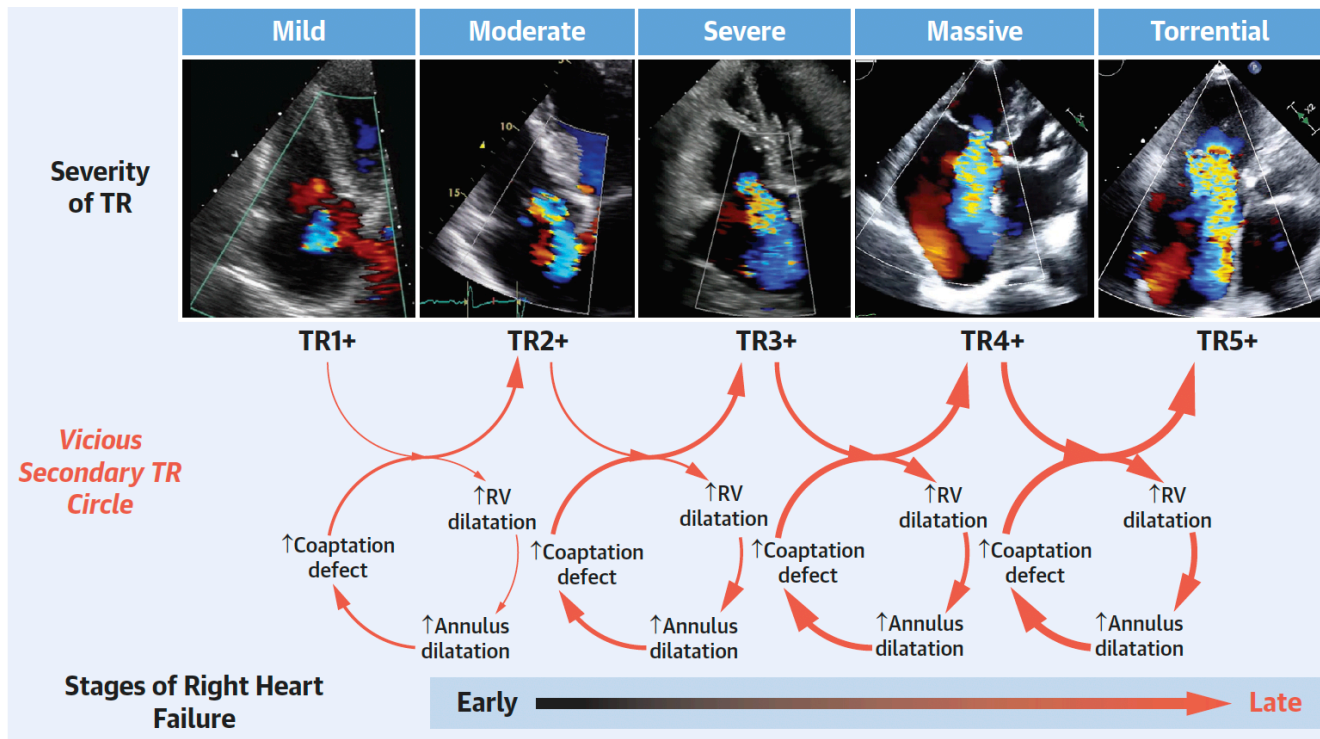


Parameter	Atrial FTR	Ventricular FTR	CIED-Related	Primary TR	
				Prolapse (I)	RHD (IIIA)
Leaflet Tethering	-	+++	++	-	-
Leaflet Restriction	-	Systole	Systole/Diastole	-	Diastole
RA/TA Dilatation	+++	++	+/-	++	++
RV Dilatation	+/-	+++	+/-	+/-	+/-
RV Dysfunction	+/-	+++	+/-	+/-	+/-

Multimodality Imaging of Tricuspid Regurgitation



Progression of TR and RHF

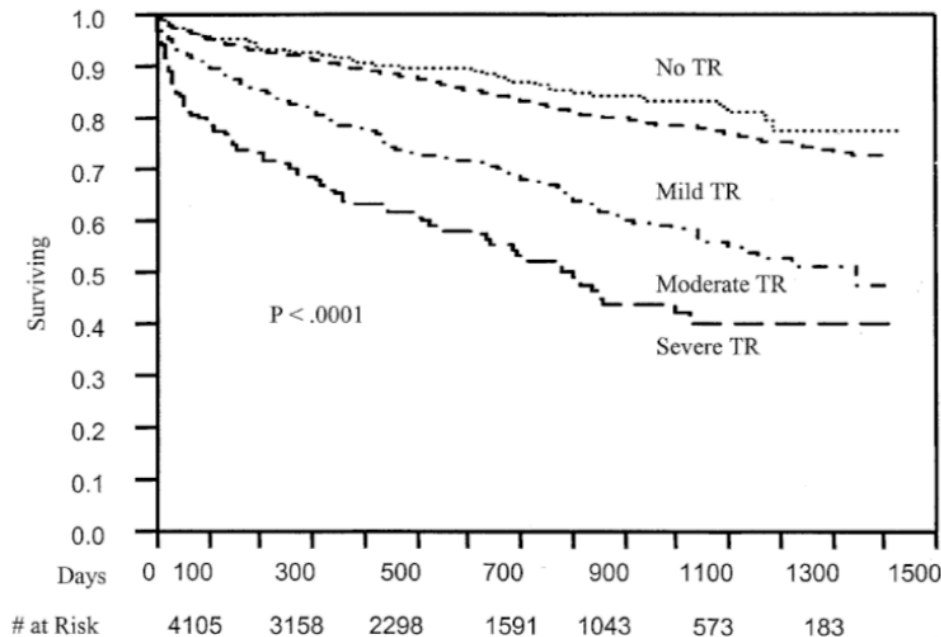


Tricuspid regurgitation (TR) of any etiology results in maladaptive dilatation of the right ventricle, which can subsequently result in further annular dilatation and tethering of the leaflets. A vicious cycle then ensues until, late in the disease, the reduced cardiac output results in signs and symptoms of right heart failure.



Tricuspid Regurgitation is Prevalent and Undertreated

40% Mortality Rate for Severe TR



Prevalence:
2.4 million

10,000 TR
surgeries/year

Increasing
severity: higher
excess-mortality

Enriquez-Sarano et al., 2019 - Tricuspid regurgitation is a public health crisis
Nath et al., 2004 – Impact of Tricuspid Regurgitation on Long Term Survival

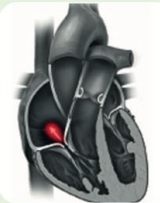


Treatment of TR: is there an unmet need for treatment?



Stage 1

- No symptoms
- TR < 2+
- Normal RV function, no remodelling
- No treatment



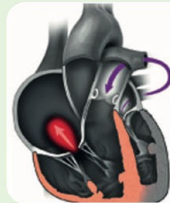
Stage 2

- No symptoms
- TR ≥ 3+
- Normal RV function, mild remodelling
- None/low-dose diuretics



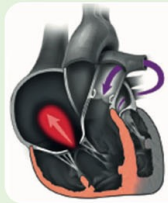
Stage 3

- Vague symptoms
- Severe TR
- Mild RV dysfunction/remodeling
- Diuretics



Stage 4

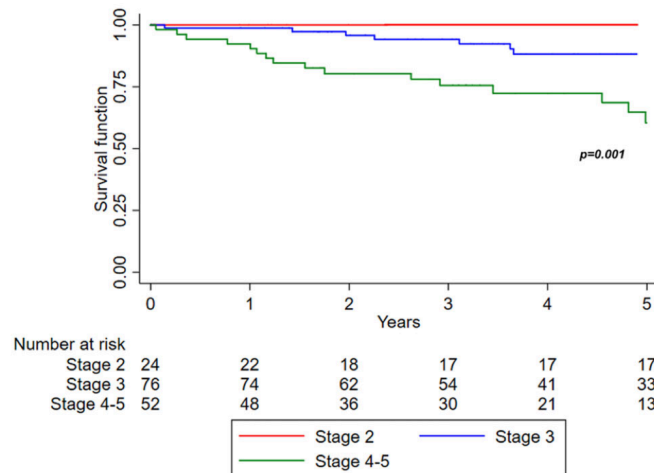
- Previous RHF episodes
- Severe TR
- > moderate RV dysfunction/remodeling
- moderate-high dose diuretics



Stage 5

- Overt RHF and/or organ damage
- Torrential TR
- Severe RV dysfunction
- high-dose diuretics/IV diuretics

Kaplan-Meier curve for survival

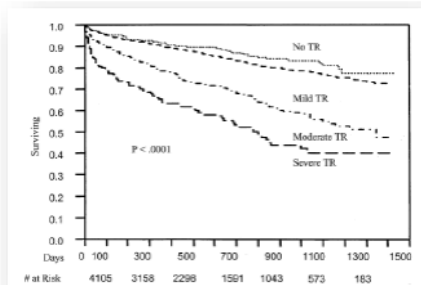


Tricuspid regurgitation (TR) of any etiology results in maladaptive dilatation of the right ventricle, which can subsequently result in further annular dilatation and tethering of the leaflets. A vicious cycle then ensues until, late in the disease, the reduced cardiac output results in signs and symptoms of right heart failure.

Sala A. et al. European Journal of Cardio-Thoracic Surgery 2022, 62(2), ezac172

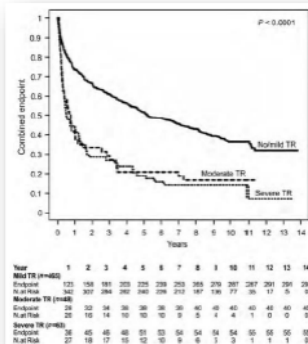


Outcome of TR: is TR a serious condition?



Nath et al., J Amer. Col of Cardiol., 2004

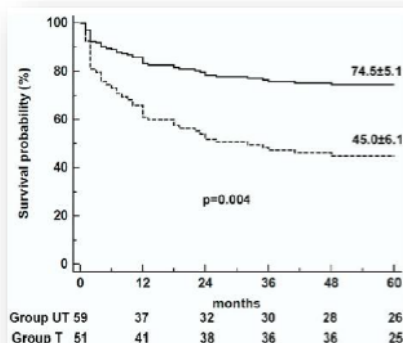
TR in CHF



Neuhold et al, EHJ, 2013

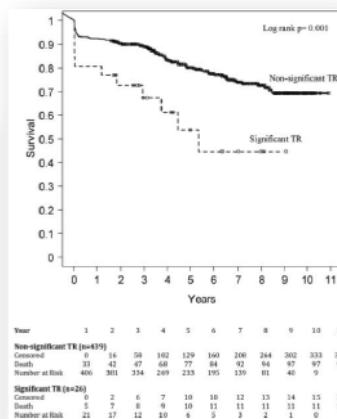
- Severe and moderate TR has impact on mortality
 - In MR patients
 - In CHF patients
 - In AS patients
 - In AI patients

TR in MR



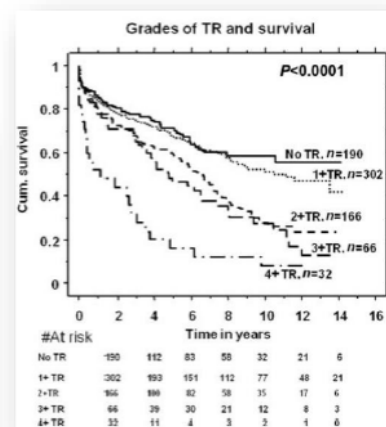
Calafiore et al, An Thor Surg, 2009

TR in Severe AS



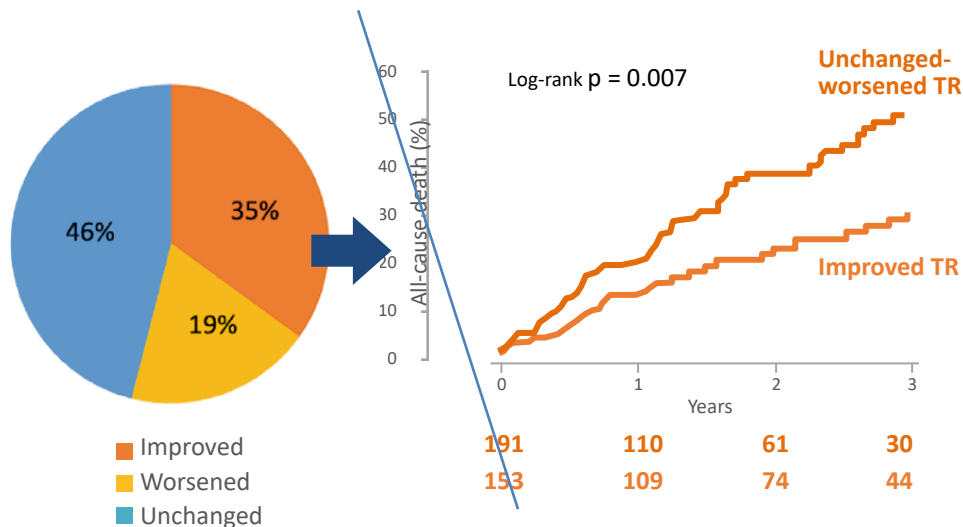
Mascherbauer et al., 2015

TR in Severe AI



Varadarajan, P. et al, Interactive CV and Thor Surg 2012

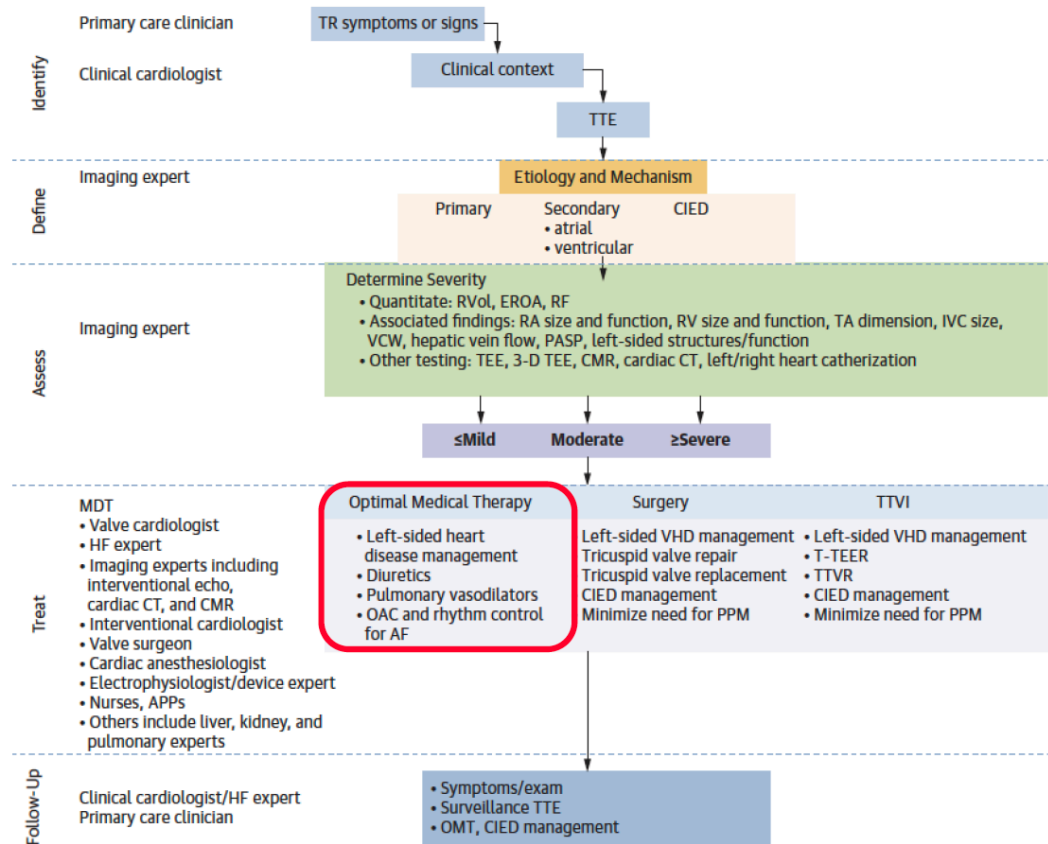
Prevalence of severe TR in M-TEER candidates = 27%

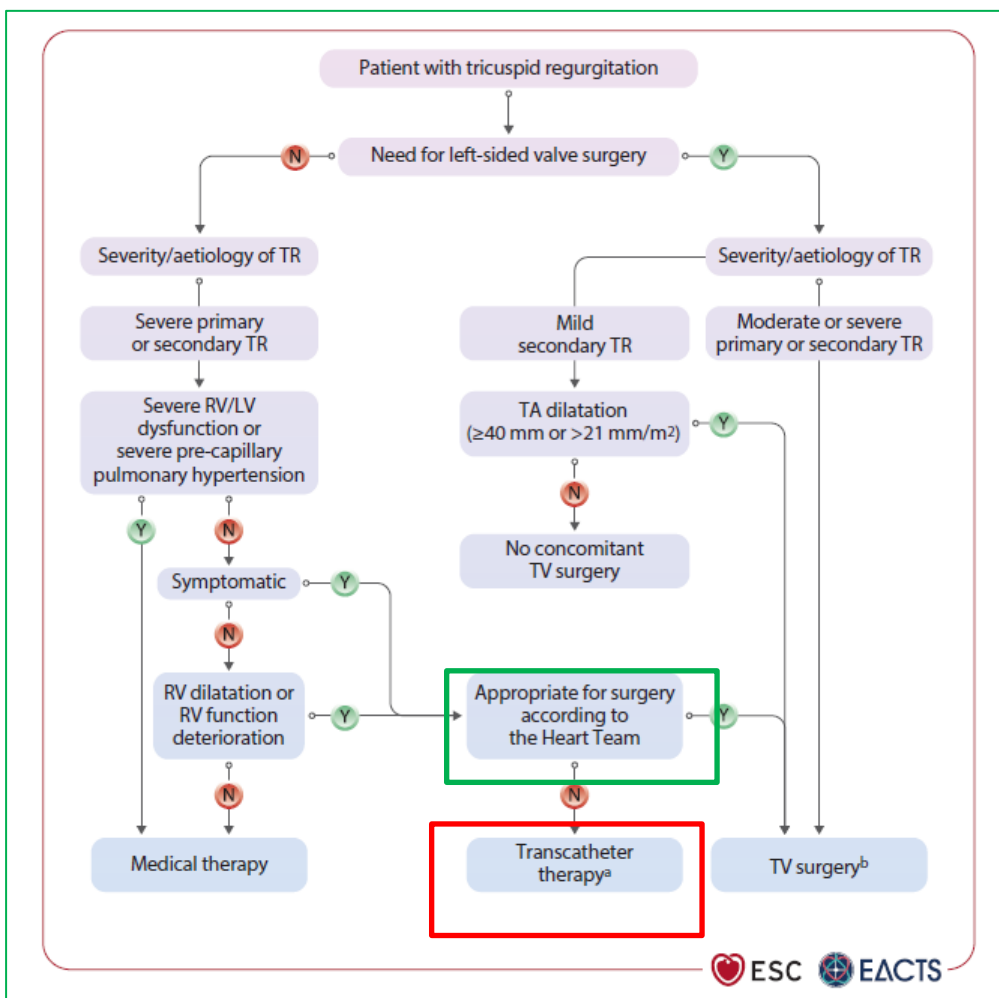


Prevalence of severe TR in TAVI candidates = 3%



TR: ACC Expert Consensus Decision Pathway





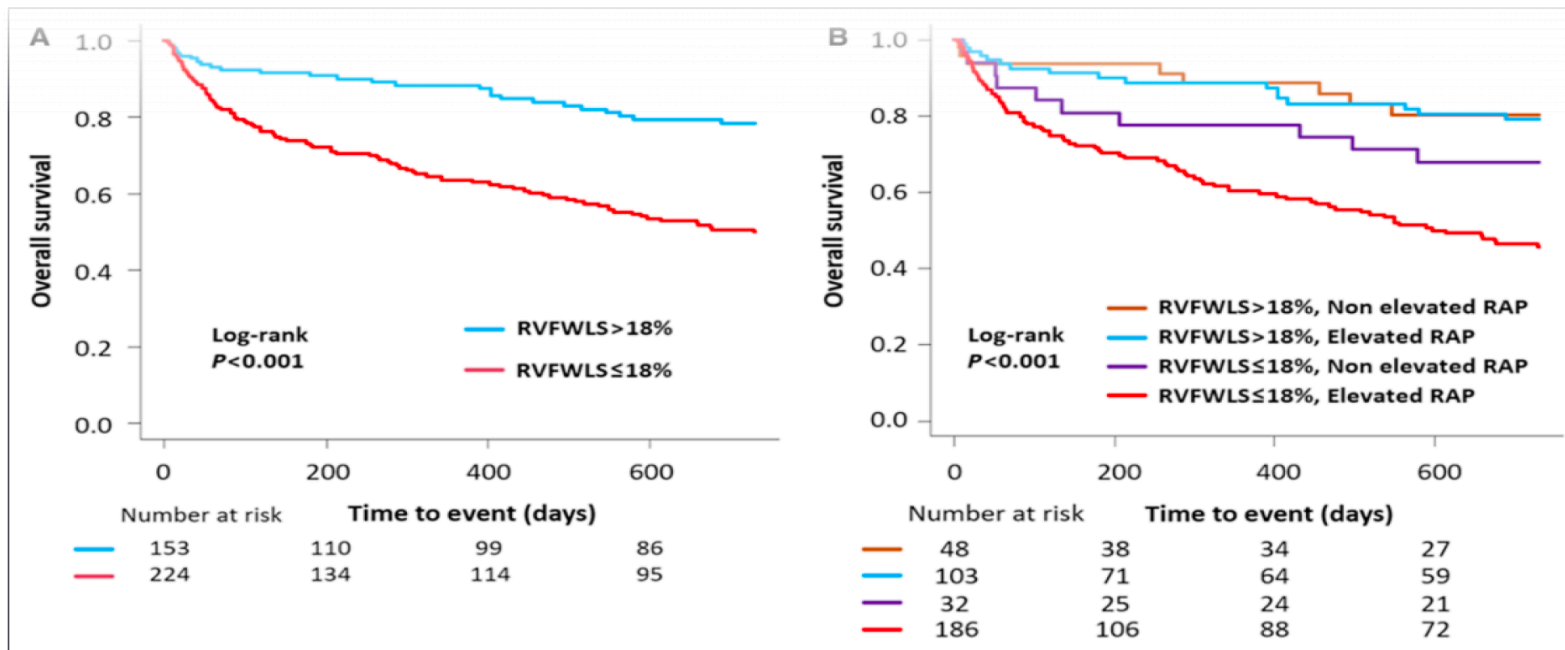
Patients with tricuspid regurgitation and left-sided valvular heart disease requiring surgery

Concomitant TV surgery ^c is recommended in patients with severe primary or secondary TR. ^{725,731,743,744}	I	B
Concomitant TV repair should be considered in patients with moderate primary or secondary TR, to avoid progression of TR and RV remodelling. ^{723,724,726,731}	IIa	B
Concomitant TV repair may be considered in selected patients with mild secondary TR and tricuspid annulus dilatation (≥ 40 mm or > 21 mm/m ²), to avoid progression of TR and RV remodelling. ^{723–726,731,743}	IIb	B

Patients with severe tricuspid regurgitation without left-sided valvular heart disease requiring surgery

TV surgery ^c is recommended in symptomatic patients with severe primary TR without severe RV dysfunction or severe PH.	I	C
TV surgery ^c should be considered in asymptomatic patients with severe primary TR who have RV dilatation/RV function deterioration, but without severe LV/RV dysfunction or severe PH.	IIa	C
TV surgery ^c should be considered in patients with severe secondary TR who are symptomatic or have RV dilatation/RV function deterioration, but without severe LV/RV dysfunction or PH. ^{685,720,745–747}	IIa	B
Transcatheter TV treatment should be considered to improve quality of life and RV remodelling in high-risk patients with symptomatic severe TR despite optimal medical therapy in the absence of severe RV dysfunction or pre-capillary PH. ^{713,733,735,738,748–751}	IIa	A

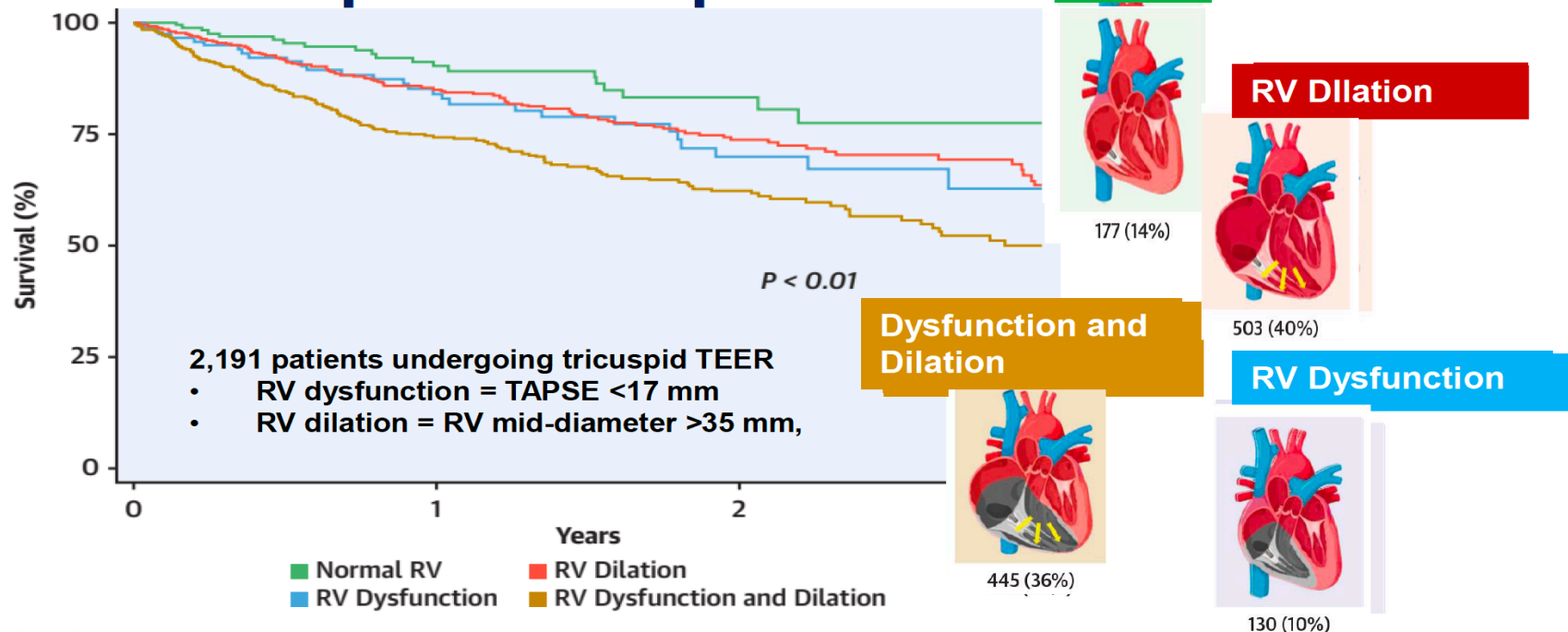
Right atrial pressure adds to the risk prediction of measures of RV dysfunction



RVFWLS = right ventricular free wall longitudinal strain Ogawa M et al. JAHA. 2024



Baseline RV Dysfunction and Dilation Predict Survival post tricuspid TEER



Brunner S et al. JACC Int. 2025

Transcatheter TV Intervention

Orthotopic Replacement

Evoque



Intrepid



V-Dyne



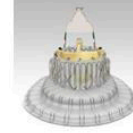
Navigate



Trisol



Lux



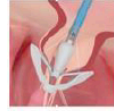
Topaz



Edge-to-Edge



TriClip
TricValve



Pascal
TriCento



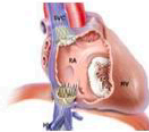
Dragonfly
Trillium

Mitralix



Coaptation Enhancement

Heterotopic Replacement



Trialign



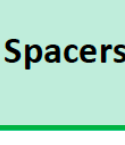
Cardioband



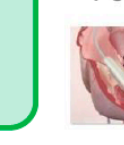
TriCinch



Millipede



MIA



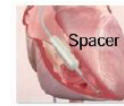
PASTA



DaVinci

Spacers

Forma



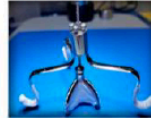
Croi



Coramaze



Tri-Flow



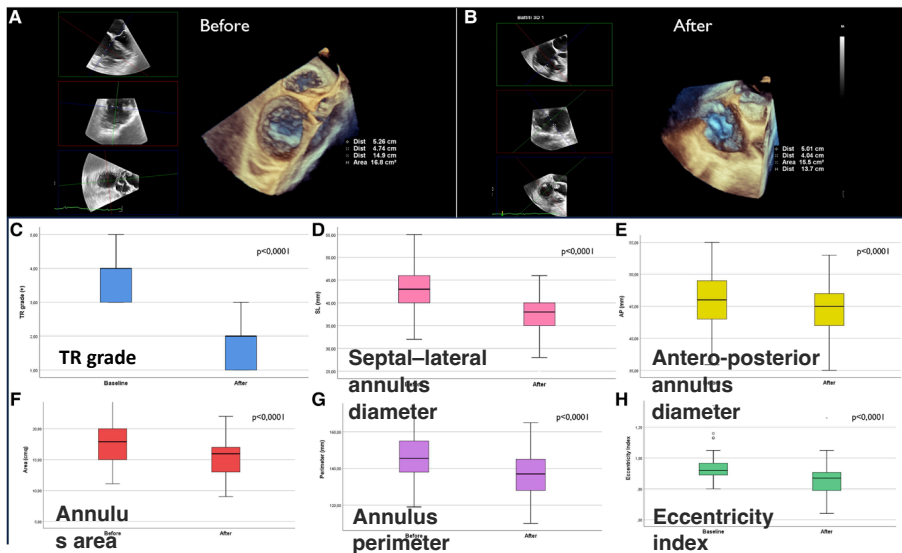
Annuloplasty



Strategy	Favourable anatomy	Feasible anatomy	Unfavourable anatomy
Leaflet approximation	Small septolateral gap ≤ 7 mm¹⁰ Anteroseptal jet location Confined prolapse or flail Trileaflet morphology	Septolateral coaptation gap >7 but ≤ 8.5 mm⁶⁵ Posteroseptal jet location Non-trileaflet morphology Incidental CIED RV lead (i.e., without leaflet impingement)	Large septolateral coaptation gap >8.5 mm⁶⁵ Leaflet thickening/shortening (rheumatic, carcinoid)/perforation Dense chordae with marked leaflet tethering Anteroposterior jet location Poor echocardiographic leaflet visualisation CIED RV lead leaflet impingement Unfavourable device angle of approach
Annuloplasty	Annular dilatation as primary mechanism of TR Mild tethering (tenting height <0.76 cm, tenting area <1.63 cm², tenting volume [3D] <2.3 mL)^{110,111} Central jet location Sufficient landing zone for anchoring	Moderate tethering (tenting height ≥ 0.76 cm but <1.0 cm, tenting area >1.63 but <2.5 cm², tenting volume [3D] ≥ 2.3 mL but ≤ 3.5 mL)^{110,111} Incidental CIED RV lead (i.e., without leaflet impingement)	Excessive annular dilatation (exceeding device size) Severe tethering (tenting height >1.0 cm, tenting volume >3.5 mL). Poor echocardiographic annular visualisation^{110,111} Annular proximity of RCA CIED RV lead leaflet impingement
Orthotopic valve implantation	Previous surgical repair or bioprosthetic valve replacement Leaflet thickening/shortening (rheumatic, carcinoid) Incidental CIED RV lead (i.e., without leaflet impingement) Any leaflet morphology	Large coaptation gap CIED RV lead leaflet impingement	Excessive annular dilatation (exceeding device size) Unfavourable device angle of approach Severe right ventricular dysfunction
Heterotopic valve implantation	Appropriate caval diameters (and intercaval distance) No option for direct valve treatment		Proximity of the RA to the orifice of the liver veins (<10-12 mm) Severely increased pulmonary artery and RA pressures due to the risk of fracture of bicaval valved stents

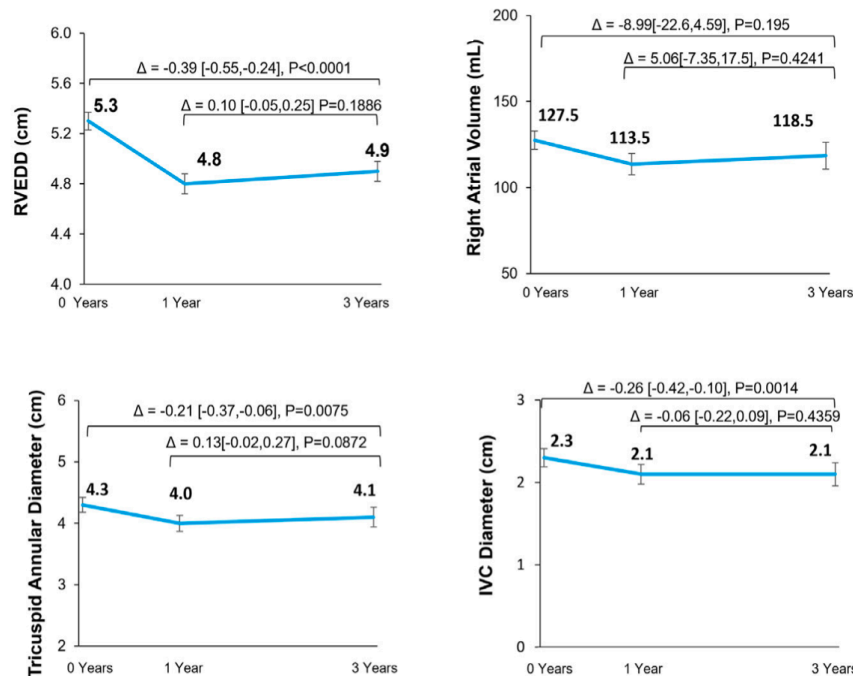


T-TEER induces favourable Annulus and RV remodelling



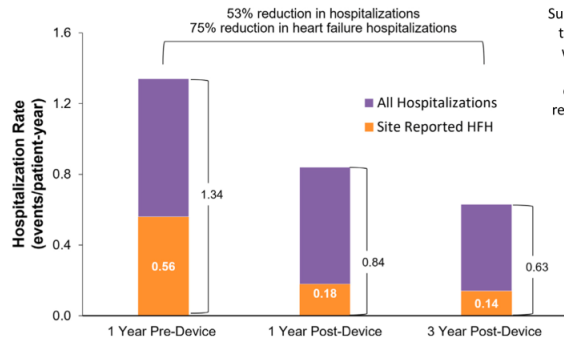
Cammalleri et al. EHJ: Cardiovasc Imaging 2024

Nickenig et al, JACC: cardiovasc Interv 2023



T-TEER prevents recurrent hospitalizations

Data from the TRILUMINATE trial



Subjects achieving a TR reduction to moderate or less at 30 days were less likely to experience HFH or death at 3 years compared with subjects who remained with severe or greater TR at 30 days (0.026)

Nickenig et al, JACC: cardiovasc Interv 2023

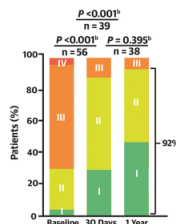
T-TEER with the PASCAL system

Data from the CLASP TR trial (prospective, single-arm, multicenter study)

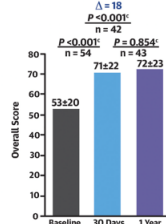
N= 65 pts with severe, symptomatic TR (no previous tricuspid valve procedure, hemodynamic instability, CKD, significant frailty)

1-year results

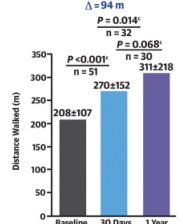
NYHA Functional Class



Overall KCCQ Score

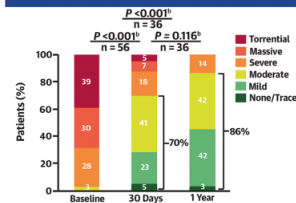


6-Minute Walk Distance

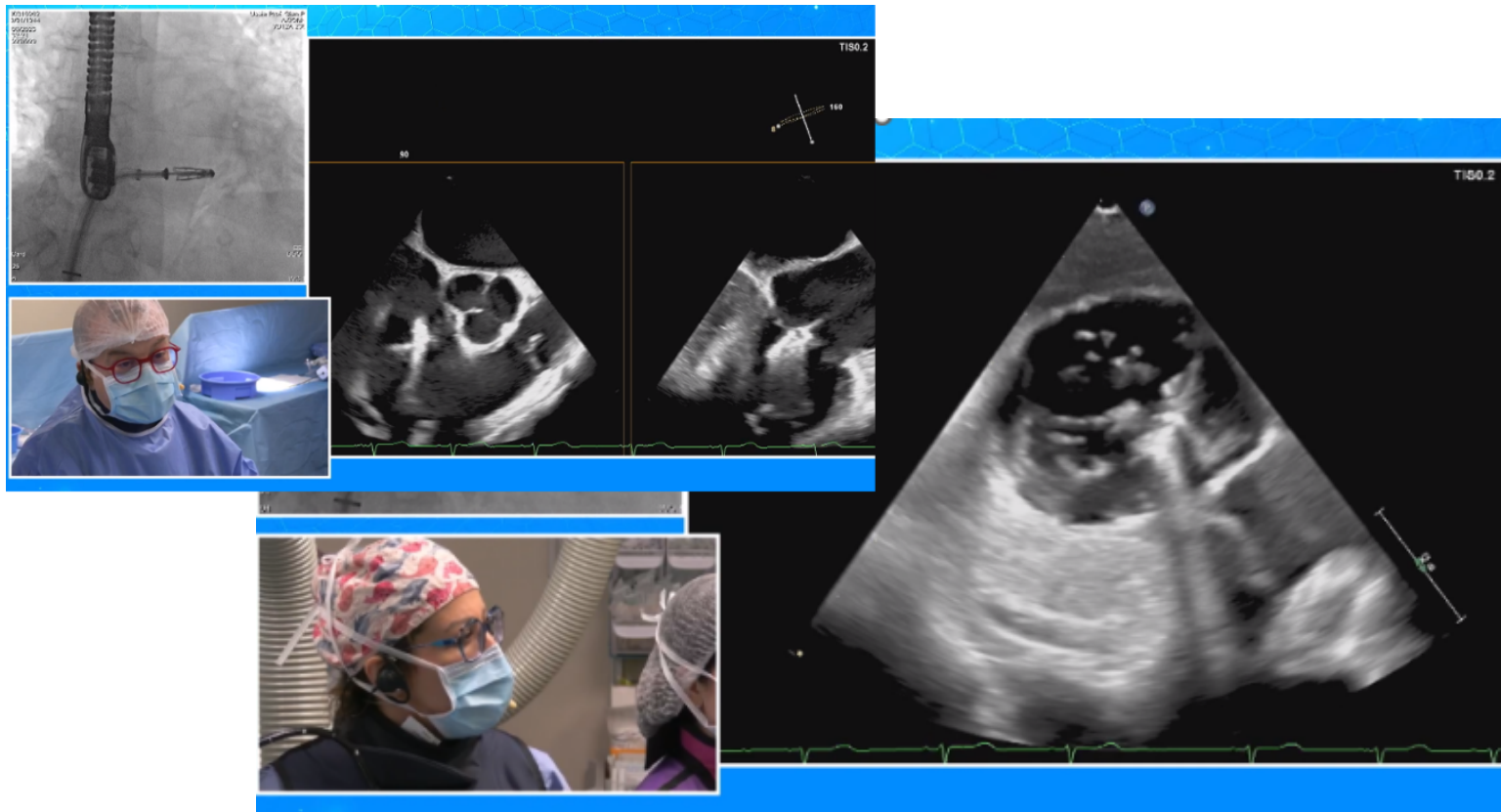


Kodali et al, JACC 2023

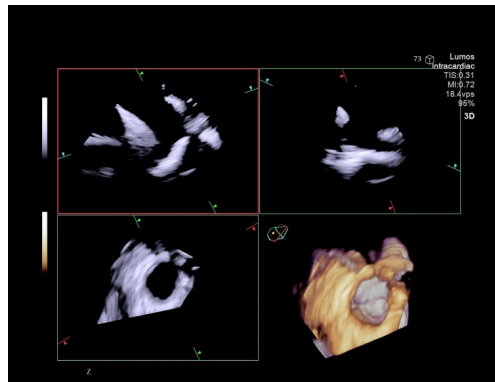
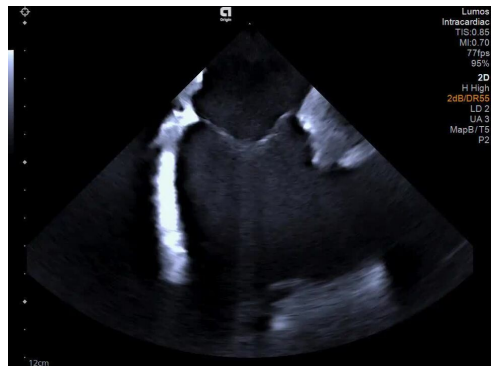
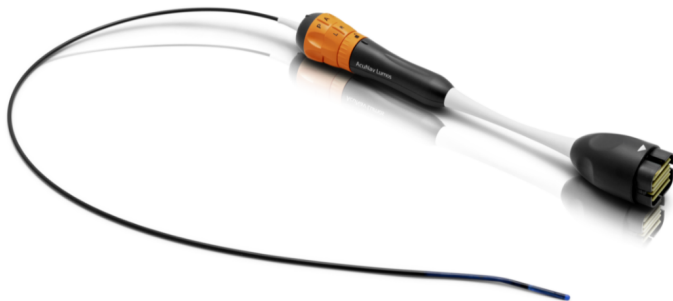
TR Severity by Core Lab*

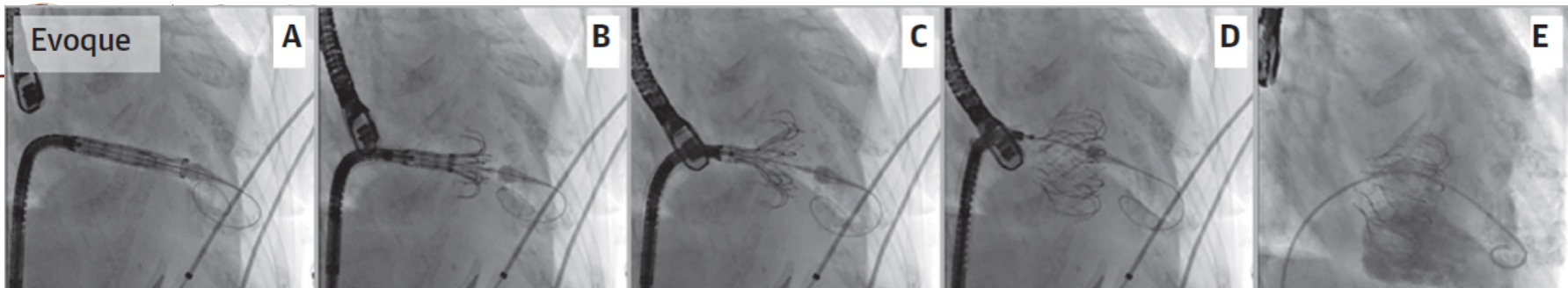


Procedura Triclip con ETE



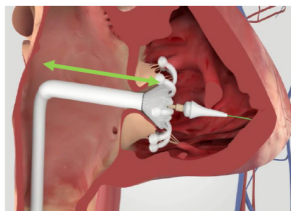
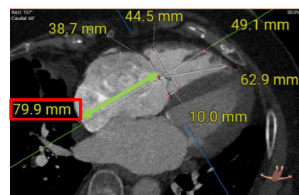
- Senza intubazione endotracheale
- Sedazione profonda in respiro spontaneo
- Senza ETE



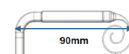


RIJV access

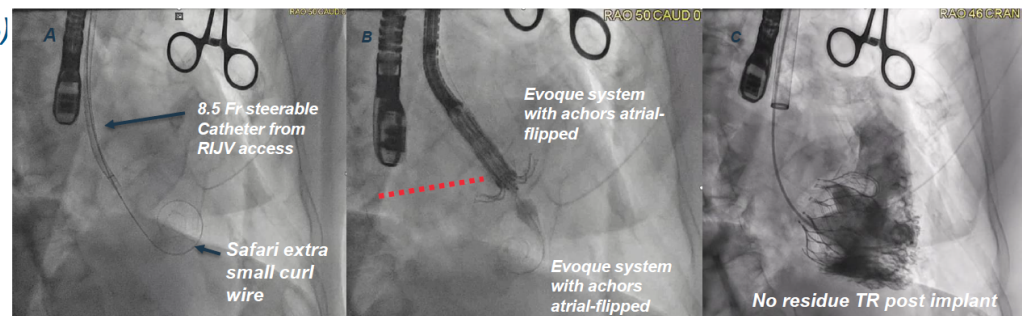
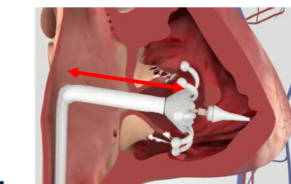
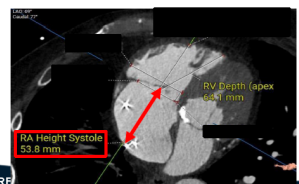
Concept of geometric constraint: Right atrial height (25%)



Sufficient
RA height



Insufficient
RA height
Device too
ventricular



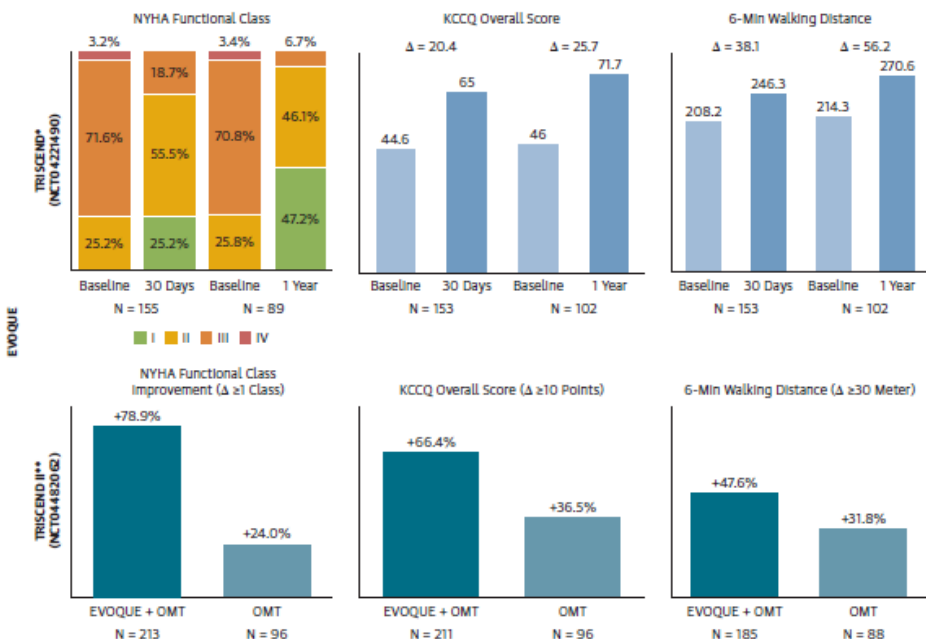
RA height is no longer a concern from RIJV in access
5 out of 6 aborted cases successfully treated via RIJV



Transcatheter Tricuspid Valve Replacement

Sig Harsfelder, MD,^{1,2,3,4} Lukas Stolz, MD,^{1,2,3,4} Philipp Lenz, MD,^{1,2,3,4} Volker Rudolph, MD,^{1,2} Ines Hahn, MD,¹ Rodrigo Estrecho-Lorenzo, MD,^{1,2} Charles Davidson, MD,^{1,2} Firas Zahr, MD,¹ Sushel Kodali, MD,¹ Raj Makkar, MD,¹ Arnon Chiong, MD,¹ Renato D. Lopes, MD, PhD,^{1,2} Francesco Mammi, MD,¹ Neil Fan, MD,¹ Arsen Luthi, MD,¹ Stephan Windecker, MD,¹ Fabien Praz, MD¹

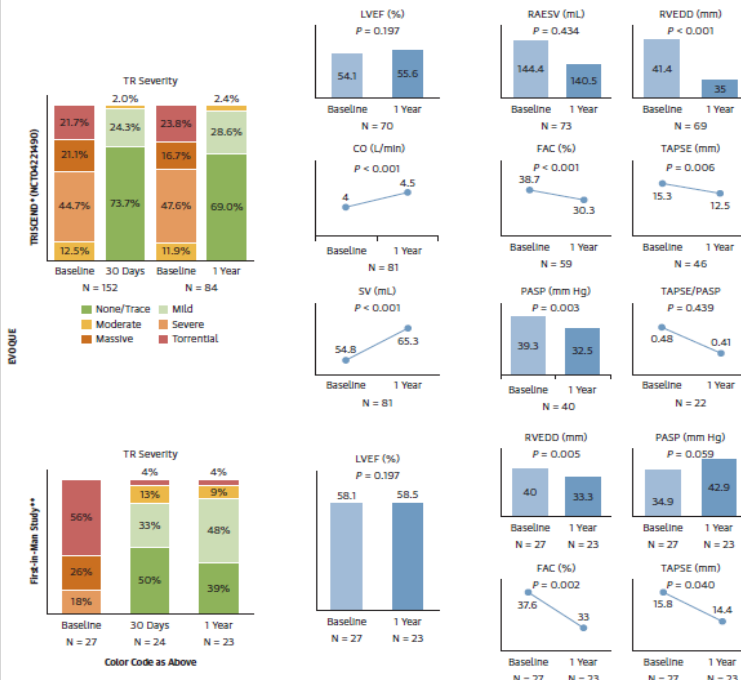
FIGURE 2 Functional Improvement After EVOQUE Transcatheter Tricuspid Valve Replacement



Functional changes after transcatheter tricuspid valve replacement. Improvement in NYHA functional class, Kansas City Cardiomyopathy Questionnaire (KCCQ) score, and 6-minute walking test distance after EVOQUE transcatheter tricuspid valve replacement as reported by TRISCEND and TRISCEND II. *Kodali et al.²⁶

†Hahn et al.²⁶

FIGURE 3 Summary of Published Echocardiographic Results



CO = cardiac output; FAC = fractional area change; LVEF = left ventricular ejection fraction; LV SV = left ventricular stroke volume; PASP = pulmonary arterial systolic pressure; RAESV = right atrial end-systolic volume; RVVEDD = right ventricular end-diastolic dimension; TAPSE = tricuspid annular plane systolic excursion; TR = tricuspid regurgitation. *Kodali et al.²⁶ **Webb et al.²⁷ †Hahn et al.²⁸ ‡Fan et al.²⁹ §Zhang et al.³⁰

Safety Outcomes

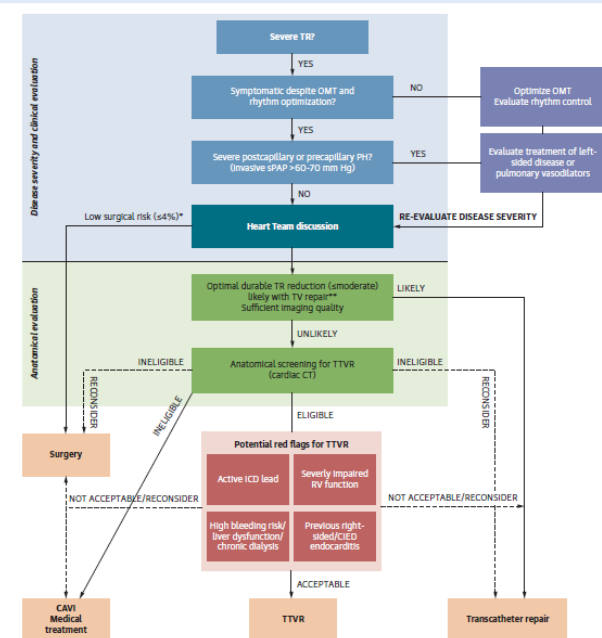
CEC-adjudicated Event	Early Events (≤ 30 Days)		Late Events (31 to 365 Days) ^a	
	TTVR N=259 % (n)	Control N=133 % (n)	TTVR N=247 % (n)	Control N=128 % (n)
Cardiovascular mortality	3.1% (8)	0.0% (0)	5.7% (14)	7.8% (10)
Myocardial infarction	0.8% (2)	0.0% (0)	1.2% (3)	0.8% (1)
Stroke	0.4% (1)	0.0% (0)	1.2% (3)	0.0% (0)
Severe bleeding ^b	10.4% (27)	1.5% (2)	5.3% (13)	4.7% (6)
Nonelective TV reintervention	0.8% (2)	0.8% (1)	0.0% (0)	2.3% (3)
New Pacemaker/CIED Implantation				
CIED implant in pacemaker-naïve patients ^c	24.7% (40/162)	0.0% (0/80)	4.2% (5/118) ^d	3.9% (3/76) ^d



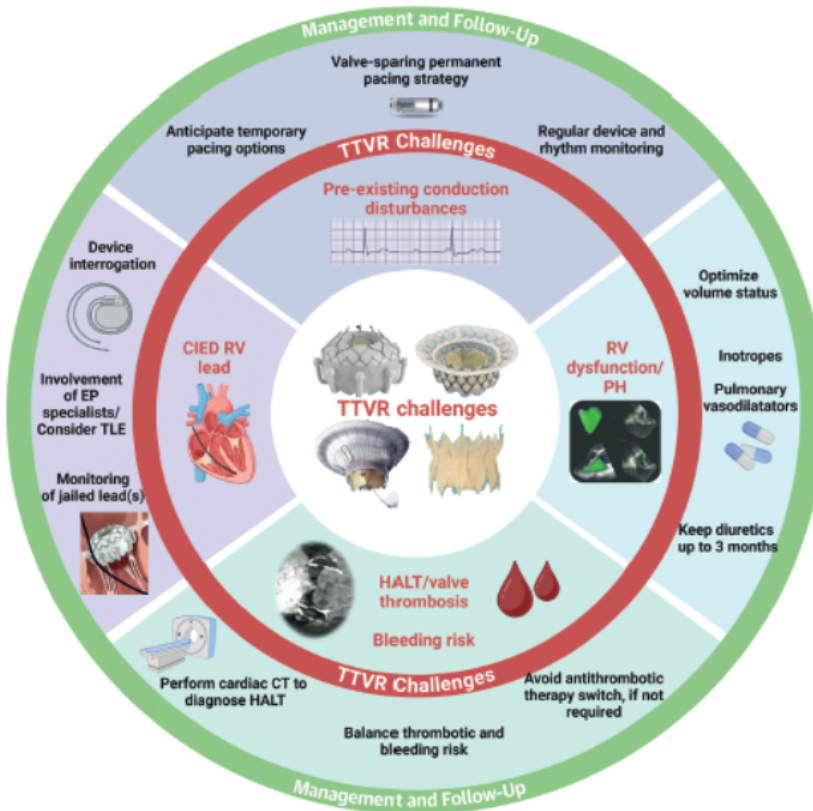
Transcatheter Tricuspid Valve Replacement

Jörg Hausleiter, MD,^{1,2,3,4} Lukas Stolz, MD,^{2,3,4} Philipp Lurz, MD,⁵ Volker Rudolph, MD,⁴ Rebecca Hahn, MD,⁶ Rodrigo Estévez-Loureiro, MD,⁶ Charles Davidson, MD,⁷ Firas Zaher, MD,⁸ Susheel Kodali, MD,⁹ Raj Makkar, MD,¹ Anson Cheung, MD,¹ Renato D. Lopes, MD, PhD,^{1,2} Francesco Maisano, MD,¹⁰ Neil Fam, MD,¹¹ Azeem Latib, MD,⁸ Stephan Windecker, MD,¹ Fabien Praz, MD¹

FIGURE 8 Treatment Algorithm for Patients With Severe TR Focusing on the Implementation of TTVR



CENTRAL ILLUSTRATION Specific Challenges of Transcatheter Tricuspid Valve Implantation and Their Management



Hausleiter J, et al. JACC. 2024;■(■):■-■.

CIED = cardiac implantable electronic device; CT = computed tomography; EP = electrophysiologist; HALT = hypoattenuated leaflet thickening; PH = pulmonary hypertension; RV = right ventricle; TLE = transvenous lead extraction; TTE = transthoracic echocardiography; TTVR = transcatheter tricuspid valve replacement.

A Walk Through the Desert-marche ou crève

If the desert doesn't get you the enemy will ; If the enemy doesn't get you the legion will; If the legion doesn't get you...I will. March or Die 1977..PC Wren's Beau Geste

① THE DESERT

Untreated TR

*The disease
itself*

~30%

1-year mortality

Majority left on
medical therapy alone

Surgery not an option.
No meaningful
alternative offered

② THE ENEMY

TTVR

*The Cure
Complete TR elimination*

~25%

PPM at 30 days

Bleeding(10.4%), 3% CV mortality
prolonged anticoagulation,
Afterload Mismatch, Jailed PPM
leads-IE

Device embolization
in real-world data

③ THE LEGION

T-TEER

*The first-line approach
patients enter*

32%

unfavorable anatomy

Tanaka JACC Interv. 2024

~20% residual severe TR
at 1 yr .Anatomy-limited

No mortality benefit
vs. medical therapy

④ "I WILL"

The Status Quo

The shelf is empty.

23%

ineligible for both

No transcatheter
option remains

Back in
the desert

L'EVOLUZIONE DELL'IMAGING NON INVASIVO PER LE PROCEDURE INTERVENTISTICHE SULLA VALVOLA TRICUSPIDE

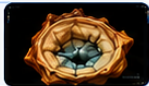
Dalla diagnosi alla procedura: intelligenza artificiale, simulazione personalizzata e guida integrata per risultati su misura



1 ACQUISIZIONE MULTIMODALE

- Ecocardiografia 2D/3D/4D
- Cardio TC
- Cardio RMN
- Dati clinici

ECO 3D/4D



CARDIO TC



CARDIO RMN



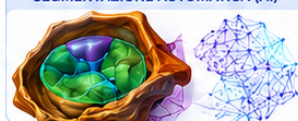
DATI CLINICI



2 DIAGNOSI AVANZATA CON INTELLIGENZA ARTIFICIALE

- Rilevazione automatica e segmentazione
- Quantificazione severità
- Analisi predittiva del remodeling VD

SEGMENTAZIONE AUTOMATICA (AI)



QUANTIFICAZIONE AI

- ✓ Rigurgitazione tricuspidale
- ✓ Geometria dell'anello
- ✓ Funzione ventricolo destro
- ✓ Volume atrio destro
- ✓ Stroke volume

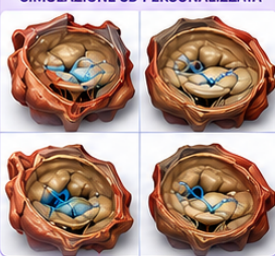
RISK PREDICTION AI

- Modelli predittivi di outcome e risposta alla terapia

3 SIMULAZIONE PROCEDURALE PER IL SINGOLO PAZIENTE

- Piattaforma di simulazione 3D
- Test virtuale dei dispositivi
- Previsione del risultato

SIMULAZIONE 3D PERSONALIZZATA



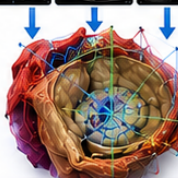
PIANIFICAZIONE OTTIMALE

- ✓ Scelta dispositivo più appropriato
- ✓ Dimensionamento e posizionamento
- ✓ Valutazione impatto su RV e anello
- ✓ Previsione riduzione della rigurgitazione

4 INTEGRAZIONE IMAGING E FUSIONE DEI DATI

- Fusione Eco-TC-RM
- Allineamento anatomico
- Roadmap procedurale personalizzata

FUSIONE MULTIMODALE



ROADMAP PROCEDURALE

Visualizzazione integrata per la navigazione in sala ibrida

5 GUIDA PROCEDURALE E VALUTAZIONE FINALE

- Imaging in tempo reale 3D/4D
- Guida alla procedura
- Valutazione immediata del risultato

GUIDA IN TEMPO REALE



VALUTAZIONE RISULTATO



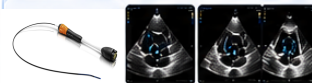
AGGIUNTE CHIAVE PER UNA GUIDA ANCORA PIÙ PRECISA

ECOCARDIOGRAMMA TRANSESOFAGEO (TEE)



- ✓ Migliore definizione anatomica
- ✓ Valutazione del meccanismo di rigurgito
- ✓ Guida avanzata al posizionamento
- ✓ Valutazione risultato immediata

ECOCARDIOGRAMMA INTRACARDIACO (ICE)



- ✓ Visualizzazione in tempo reale intraventricolare
- ✓ Navigazione sicura dei cateteri
- ✓ Valutazione del contatto device-tessuto
- ✓ Riduzione esposizione ai raggi

IL FLUSSO DI LAVORO INTEGRATO



I BENEFICI PER IL PAZIENTE



MECCATRONICA E ROBOTICA: PRECISIONE E CONTROLLO



IMAGING AVANZATO + INTELLIGENZA ARTIFICIALE + SIMULAZIONE PERSONALIZZATA + ECOCARDIOGRAFIA INTRACARDIACA E TRANSESOFAGEEA =
CARDIOLOGIA INTERVENTISTICA DI PRECISIONE

EVOLUZIONE FUTURA: I PROSSIMI 5 ANNI

- 2025 Integrazione sistematica di ICE e TEE in sala ibrida
- 2026 Piattaforme AI in tempo reale per decisioni intra-procedurali
- 2027 Modelli predittivi evoluti per outcome a lungo termine
- 2028 Robotica e automazione assistita dall'AI
- 2029-2030 Imaging molecolare e biomarcatori per selezione paziente

ECO: Ecocardiografia
TC: Tomografia Computerizzata
RMN: Risonanza Magnetica
RV: Riscordigrale
TC: Tomografia a Risonanza Magnetica
ICE: Intracardiac Echocardiography
TEE: Transesophageal Echocardiography

SISTEMI ROBOTICI PER LA CARDIOLOGIA INTERVENTISTICA

Tecnologie robotiche e meccatroniche per procedure cardiovascolari più precise, sicure ed efficaci

PRINCIPALI SISTEMI ROBOTICI



R-One™
Robotic System



Robot per angioplastica coronarica e procedure percutanee

- Precisione sub-millimetrica
- Controllo remoto in tempo reale
- Riduzione dell'esposizione ai raggi X
- Maggiore stabilità e sicurezza del catetere



Niobe® ES System



Sistema robotico con navigazione magnetica per elettrofisiologia e strutturale

- Navigazione magnetica 3D senza attrito
- Accesso avanzato alle cavità cardiache
- Maggiore precisione e riproducibilità
- Riduzione complicitanze procedurali



Sensei®
Robotic System



Piattaforma robotica per elettrofisiologia e mappaggio avanzato

- Mappaggio ad alta densità
- Ablazione precisa e automatizzata
- Riduzione variabilità operatore
- Workflow integrato e intuitivo



LIBERTY®
Robotic System



Sistema robotico endovascolare miniaturizzato

- Cateteri ultra-sottili e flessibili
- Accesso a anatomie complesse
- Maggiore sicurezza e controllo
- Riduzione trauma tissutale



Hansen
Robotic System



Piattaforma robotica modulare per interventi strutturali e valvolari

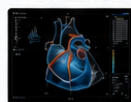
- Modularità e flessibilità d'uso
- Integrazione imaging avanzata
- Controllo remoto intuitivo
- Supporto multi-dispositivo



Le piattaforme robotiche rappresentano la nuova frontiera della cardiologia interventistica, abilitando procedure più precise, sicure, efficienti e personalizzate.

IL VALORE DELLA MECCATRONICA: UN WORKFLOW INTEGRATO

PIANIFICAZIONE PRE-PROCEDURALE



Imaging 3D e AI per pianificare la strategia personalizzata

ACCESSO E NAVIGAZIONE ROBOTICA



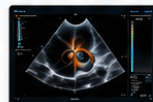
Cateteri robotici steerable per raggiungere il target in sicurezza

POSIZIONAMENTO DI PRECISIONE



Controllo fine e stabilità per il corretto rilascio del dispositivo

FEEDBACK E CONTROLLO IN TEMPO REALE



Imaging e sensori per validare il risultato e garantire la coaptazione ottimale

FOLLOW-UP DIGITALE



Monitoraggio remoto e analytics per follow-up personalizzato e predittivo

OBIETTIVO FINALE



Riparazioni più efficaci, più sicure e durature per i pazienti con insufficienza tricuspidale

VANTAGGI DELLA MECCATRONICA NELLA CARDIOLOGIA INTERVENTISTICA



PRECISIONE ASSOLUTA

Il controllo robotico e la stabilità del catetere consentono un posizionamento sub-millimetrico anche in anatomie complesse.



SICUREZZA MAGGIORE

Navigazione avanzata, controllo della forza e feedback in tempo reale riducono complicitanze e migliorano gli outcome.



RIDUZIONE DELL'ESPOSIZIONE AI RAGGI X

Il controllo remoto e l'automazione riducono l'esposizione per paziente e operatore.



IMAGING E INTEGRAZIONE AVANZATA

Integrazione di ecocardiografia 3D, fluoroscopia e mappaggio in tempo reale per decisioni più informate e immediate.



ERGONOMIA E CONTROLLO REMOTO

Migliore ergonomia per l'operatore, con possibilità di interventi a distanza e collaborazione in rete tra centri.



EFFICIENZA E RIPRODUCIBILITÀ

Workflow standardizzati e tracciabili con supporto di intelligenza artificiale per ottimizzare risultati clinici e predicibilità.



MIGLIORI RISULTATI CLINICI

Procedure più precise, riparazioni più durature e miglioramento della qualità di vita dei pazienti.



TECNOLOGIA ROBOTICA DI NUOVA GENERAZIONE



SICUREZZA E CONTROLLO SENZA COMPROMESSI



INNOVAZIONE PER MIGLIORARE LA VITA DEI PAZIENTI



COLLABORAZIONE E CONDIVISIONE PER UN FUTURO CONNESSO



Criticità e sfide future

- Identificazione del timing ottimale dell'intervento.
- Durabilità dei dispositivi.
- Costi e sostenibilità economica.
- Formazione degli operatori.
- Accesso alle tecnologie nei diversi sistemi sanitari.



- Nuove generazioni di dispositivi.
- Procedure completamente guidate da imaging multimodale.
- Robotica e navigazione avanzata.
- Intelligenza artificiale intra-procedurale.
- Personalizzazione dei dispositivi mediante modellazione 3D.
- Riduzione delle complicanze e dei tempi procedurali.



- La tricuspide come "nuova frontiera" delle valvulopatie.
- Integrazione tra imaging, AI e terapie transcateretere.
- Passaggio da procedure sperimentali a standard terapeutico.
- Ruolo dei centri ad alta specializzazione.
- L'evoluzione tecnologica consentirà trattamenti sempre più sicuri, efficaci e personalizzati.
- L'approccio multidisciplinare e l'innovazione digitale saranno determinanti per migliorare gli outcome clinici dei pazienti con insufficienza tricuspidale

