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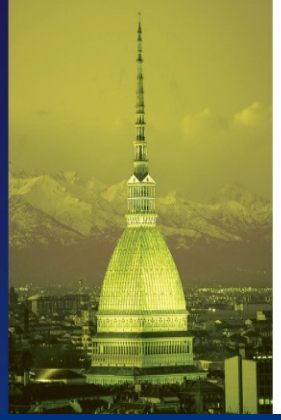


UNIVERSITÁ DEGLI STUDI DI TORINO

AZIENDA OSPEDALIERO - UNIVERSITARIA
Città della Salute e della Scienza di Torino

Mini-invasive approach to Tricuspid regurgitation: literature review and a single center experience

Davide Ricci MD PhD

SC Cardiochirurgia U
Universita' degli Studi di Torino
Direttore: Prof. M. Rinaldi

Tricuspid Valve Disease

Etiology of Tricuspid Valve Disease

Primary causes (25%)

- Rheumatic
- Myxomatous
- Ebstein anomaly
- Endomyocardial fibrosis
- Endocarditis
- Carcinoid disease
- Traumatic (blunt chest injury, laceration)
- Iatrogenic (pacemaker/defibrillator lead, RV biopsy)

Secondary causes (75%)

- Left heart disease (LV dysfunction or valve disease) resulting in pulmonary hypertension
- Any cause of pulmonary hypertension (chronic lung disease, pulmonary thromboembolism, left to right shunt)
- Any cause of RV dysfunction (myocardial disease, RV ischemia/infarction)

RV indicates right ventricular; LV, left ventricular.

(*Circulation*. 2009;119:2718-2725.)

Organic
Abnormal leaflets

Functional
Normal leaflets

Introduction

- **Right-sided cardiac valvular disease** has traditionally been considered **less clinically important** than mitral or aortic valve pathology, and its optimal management remains controversial

- Patients are **rarely referred for isolated** surgical **tricuspid** valve (TV) repair or replacement, and most procedures are done in the context of other planned cardiac surgery

- Although **TR leads to a dismal prognosis after symptom development** and in-hospital mortality and actuarial survival are improved in patients undergoing TV annuloplasty at the time of mitral valve (MV) surgery, **TR remains frequently undertreated**

Ricci et al. J. Thorac Cardiovasc Surg 2013

Impact of Tricuspid Regurgitation on Long-Term Survival

Jayant Nath, MD,* Elyse Foster, MD, FACC,† Paul A. Heidenreich, MD*
Palo Alto and San Francisco, California

OBJECTIVES The goal of this study was to examine mortality associated with tricuspid regurgitation (TR) after controlling for left ventricular ejection fraction (LVEF), right ventricular (RV) dilation and dysfunction, and pulmonary artery systolic pressure (PASP).

BACKGROUND Tricuspid regurgitation is a frequent echocardiographic finding; however, the association with prognosis is unclear.

METHODS We retrospectively identified 5,223 patients (age 66.5 ± 12.8 years; predominantly male) undergoing echocardiography at one of three Veterans Affairs Medical Center laboratories over a period of four years. Follow-up data were available for four years (mean 498 ± 402 days). Kaplan-Meier and proportional hazards methods were used to compare differences in survival among TR grades.

RESULTS Mortality increased with increasing severity of TR. The one-year survival was 91.7% with no TR, 90.3% with mild TR, 78.9% with moderate TR, and 63.9% with severe TR. Moderate

We conclude that increasing TR severity is associated with worse survival in men regardless of LVEF or pulmonary artery pressure. Severe TR is associated with a poor prognosis, independent of age, biventricular systolic function, RV size, and dilation of the inferior vena cava. (J Am Coll Cardiol 2004;43:405–9) © 2004 by the American College of Cardiology Foundation

CONCLUSIONS We conclude that increasing TR severity is associated with worse survival in men regardless of LVEF or pulmonary artery pressure. Severe TR is associated with a poor prognosis, independent of age, biventricular systolic function, RV size, and dilation of the inferior vena cava. (J Am Coll Cardiol 2004;43:405–9) © 2004 by the American College of Cardiology Foundation

JACC Vol. 43, No. 3, 2004
February 4, 2004:405–9

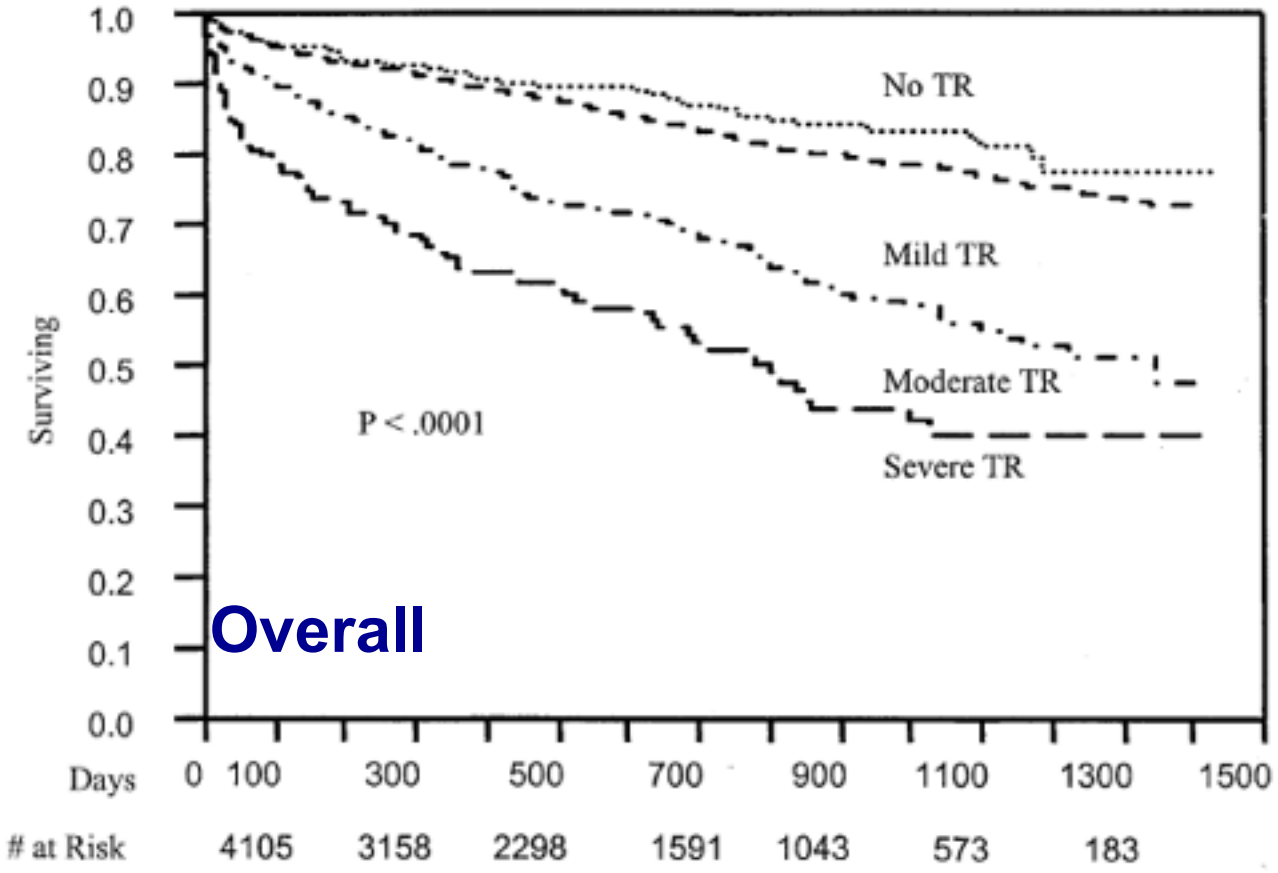
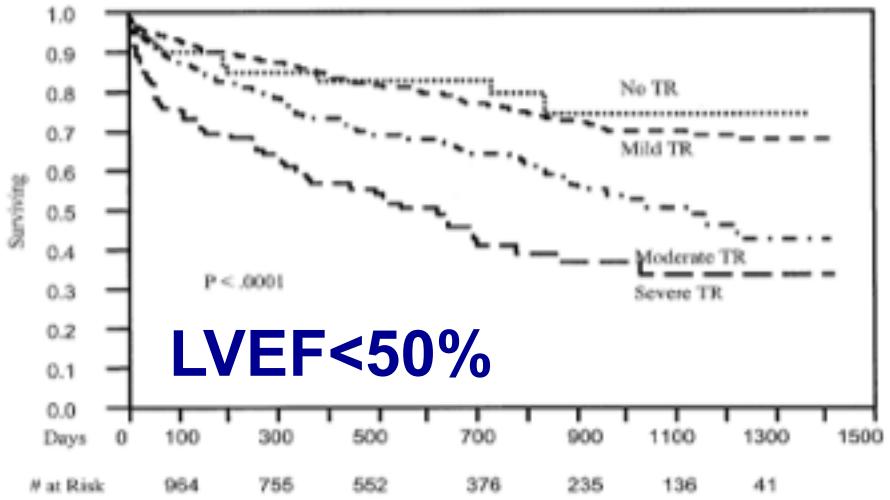


Figure 1. Kaplan-Meier survival curves for all patients with tricuspid regurgitation (TR). Survival is significantly worse in patients with moderate and severe TR.

JACC Vol. 43, No. 3, 2004
February 4, 2004:405–9



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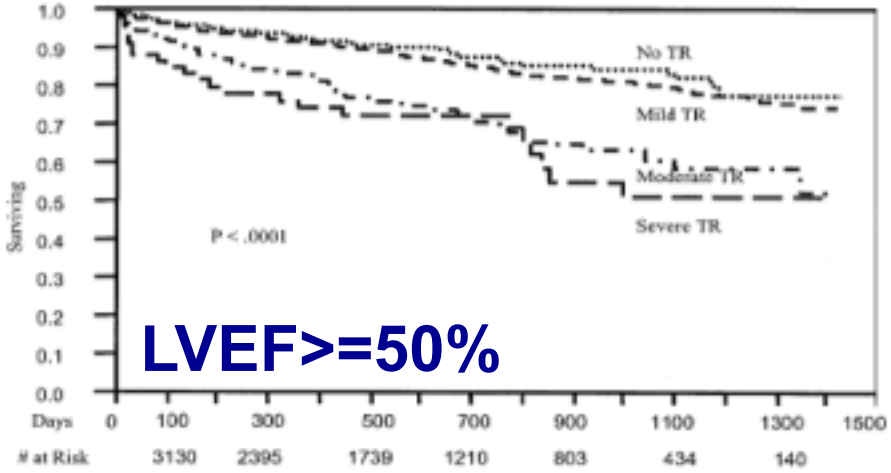
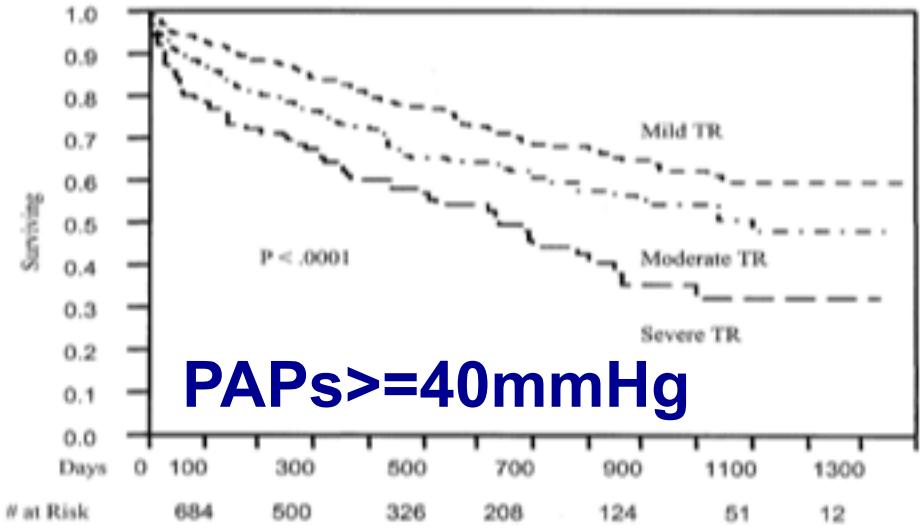


B

Figure 3. Kaplan-Meier survival curve for **(A)** patients with tricuspid regurgitation (TR) and a low left ventricular ejection fraction (<50%) and **(B)** patients with TR and a normal left ventricular ejection fraction (≥50%).



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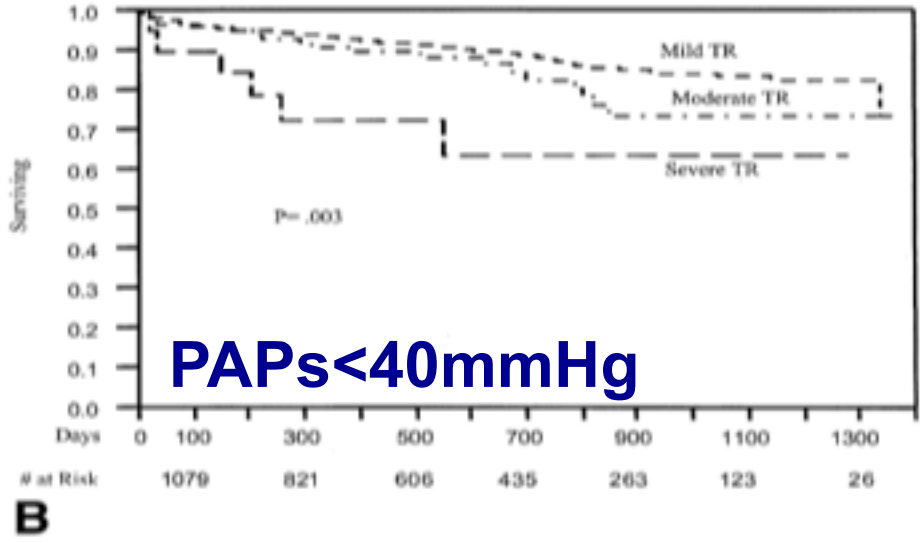

B

Figure 2. Kaplan-Meier survival curves for **(A)** patients with tricuspid regurgitation (TR) and high pulmonary artery systolic pressure (≥40 mm Hg) and **(B)** patients with TR and normal pulmonary artery systolic pressure (<40 mm Hg).

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CLINICAL PRACTICE GUIDELINE: FOCUSED UPDATE

2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Class I

1. **Tricuspid valve surgery is recommended for patients with severe TR (stages C and D) undergoing left-sided valve surgery.** ***(Level of Evidence: C)***

Class IIa

1. **Tricuspid valve repair can be beneficial for patients with mild, moderate, or greater functional TR (stage B) at the time of left-sided valve surgery with either 1) tricuspid annular dilation or 2) prior evidence of right HF (237-246).** ***(Level of Evidence: B)***
2. **Tricuspid valve surgery can be beneficial for patients with symptoms due to severe primary TR that are unresponsive to medical therapy (stage D).** ***(Level of Evidence: C)***

Class IIb

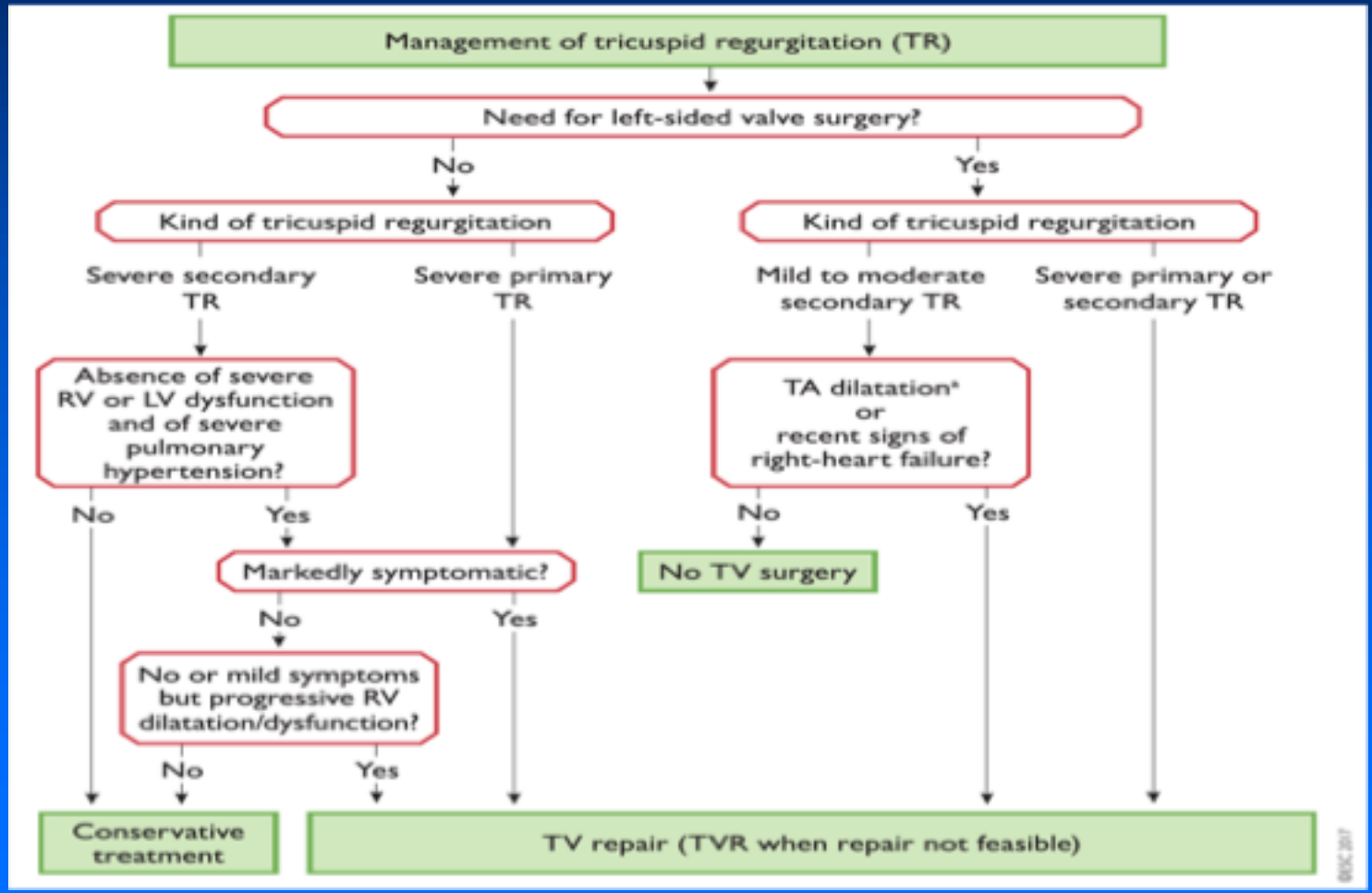
1. **Tricuspid valve repair may be considered for patients with moderate functional TR (stage B) and pulmonary artery hypertension at the time of left-sided valve surgery.** ***(Level of Evidence: C)***

2. **Tricuspid valve surgery may be considered for asymptomatic or minimally symptomatic patients with severe primary TR (stage C) and progressive degrees of moderate or greater RV dilation and/or systolic dysfunction.** ***(Level of Evidence: C)***
3. **Reoperation for isolated tricuspid valve repair or replacement may be considered for persistent symptoms due to severe TR (stage D) in patients who have undergone previous left-sided valve surgery and who do not have severe pulmonary hypertension or significant RV systolic dysfunction.** ***(Level of Evidence: C)***

ESC European Society of Cardiology
European Heart Journal (2017) 38, 2739–2791
doi:10.1093/eurheartj/ehx391
ESC/EACTS GUIDELINES

2017 ESC/EACTS Guidelines for the management of valvular heart disease

The Task Force for the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)



Recommendations on secondary tricuspid regurgitation		
Surgery is indicated in patients with severe secondary tricuspid regurgitation undergoing left-sided valve surgery.	I	C
Surgery should be considered in patients with mild or moderate secondary tricuspid regurgitation with a dilated annulus (≥40 mm or > 21 mm/m^2 by 2D echocardiography) undergoing left-sided valve surgery.	IIa	C
Surgery may be considered in patients undergoing left-sided valve surgery with mild or moderate secondary tricuspid regurgitation even in the absence of annular dilatation when previous recent right-heart failure has been documented.	IIb	C
After previous left-sided surgery and in absence of recurrent left-sided valve dysfunction, surgery should be considered in patients with severe tricuspid regurgitation who are symptomatic or have progressive RV dilatation/dysfunction, in the absence of severe RV or LV dysfunction and severe pulmonary vascular disease/hypertension.	IIa	C

Recommendations on tricuspid stenosis		
Surgery is indicated in symptomatic patients with severe tricuspid stenosis.[c]	I	C
Surgery is indicated in patients with severe tricuspid stenosis undergoing left-sided valve intervention.[d]	I	C
Recommendations on primary tricuspid regurgitation		
Surgery is indicated in patients with severe primary tricuspid regurgitation undergoing left-sided valve surgery.	I	C
Surgery is indicated in symptomatic patients with severe isolated primary tricuspid regurgitation without severe RV dysfunction.	I	C
Surgery should be considered in patients with moderate primary tricuspid regurgitation undergoing left-sided valve surgery.	IIa	C
Surgery should be considered in asymptomatic or mildly symptomatic patients with severe isolated primary tricuspid regurgitation and progressive RV dilatation or deterioration of RV function.	IIa	C

SIZE OF TREATMENT EFFECT

ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT

	CLASS I *Benefit >>> Risk* Procedure/Treatment **SHOULD** be performed/ administered	CLASS IIa *Benefit >> Risk* *Additional studies with focused objectives needed* **IT IS REASONABLE** to perform procedure/administer treatment	CLASS IIb *Benefit ≥ Risk* *Additional studies with broad objectives needed; additional registry data would be helpful* Procedure/Treatment **MAY BE CONSIDERED**	CLASS III *No Benefit* or CLASS III *Harm* Procedure/Test / Treatment COR III: No benefit — Not Helpful / No Proven Benefit COR III: Harm — Excess Cost w/o Benefit or Harmful / Harmful to Patients
LEVEL A Multiple populations evaluated* Data derived from multiple randomized clinical trials or meta-analyses	■ Recommendation that procedure or treatment is useful/effective ■ Sufficient evidence from multiple randomized trials or meta-analyses	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Sufficient evidence from multiple randomized trials or meta-analyses
LEVEL B Limited populations evaluated* Data derived from a single randomized trial or nonrandomized studies	■ Recommendation that procedure or treatment is useful/effective ■ Evidence from single randomized trial or nonrandomized studies	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Evidence from single randomized trial or nonrandomized studies
LEVEL C Very limited populations evaluated* Only consensus opinion of experts, case studies, or standard of care	■ Recommendation that procedure or treatment is useful/effective ■ Only expert opinion, case studies, or standard of care	■ Recommendation in favor of treatment or procedure being useful/effective ■ Only diverging expert opinion, case studies, or standard of care	■ Recommendation's usefulness/efficacy less well established ■ Only diverging expert opinion, case studies, or standard of care	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Only expert opinion, case studies, or standard of care
Suggested phrases for writing recommendations	should is recommended is indicated is useful/effective/beneficial	is reasonable can be useful/effective/beneficial is probably recommended or indicated	may/might be considered may/might be reasonable usefulness/effectiveness is unknown/unclear/uncertain or not well established	COR III: No Benefit is not recommended is not indicated should not be performed/ administered/ other is not useful/ beneficial/ effective COR III: Harm potentially harmful causes harm associated with excess morbidity/mortality should not be performed/ administered/ other
Comparative effectiveness phrases†	treatment/strategy A is recommended/indicated in preference to treatment B treatment A should be chosen over treatment B	treatment/strategy A is probably recommended/indicated in preference to treatment B it is reasonable to choose treatment A over treatment B		

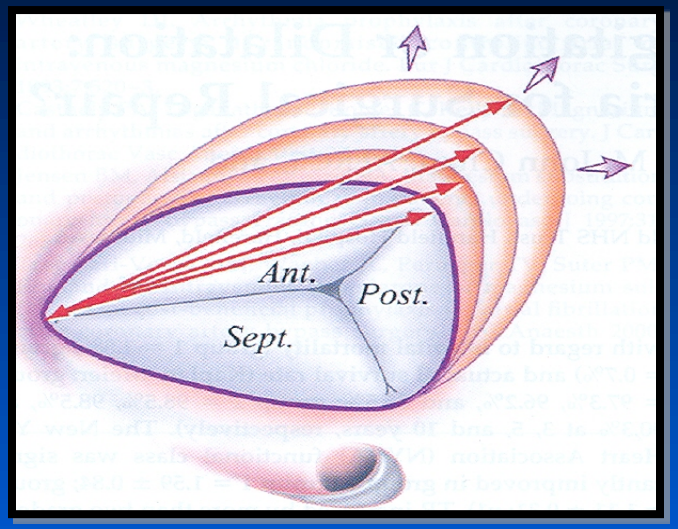
Guidelines

Because TR can vary according to the **preload, afterload, and right ventricular function**, the assessments of leaflet morphology, annular dimension and pulmonary artery pressure are particularly important for determining subsequent management

- **TR grade**
- **Pulmonary hypertension**
- **Annular dilatation**

Circulation. 2006;114:e84–e231.
(*Circulation*. 2009;119:2718-2725.)

Tricuspid Regurgitation

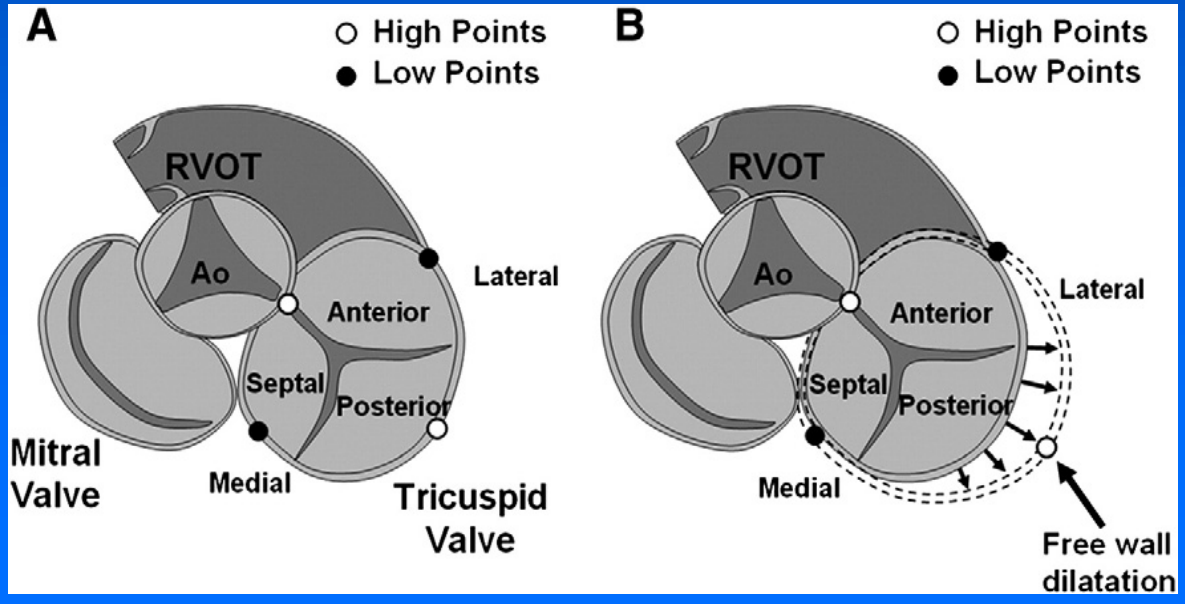


- **Anteroseptal commissure to anteroposterior commissure ≥ 70 mm** ***(Intra-operative measurement)***

  Dreyfus et al: Ann Thorac Surg, 2005

- **Annulus diameter ≥ 40 mm** ***(Echo)***

  Bolling et al: Circulation, 2009



European Journal of Cardio-Thoracic Surgery 43 (2013) 2–8
doi:10.1093/ejcts/ezs441 Advance Access publication 3 August 2012

REVIEW

Role of concomitant tricuspid surgery in moderate functional tricuspid regurgitation in patients undergoing left heart valve surgery

Balakrishnan Mahesh, Francis Wells, Samer Nashef and Sukumaran Nair*

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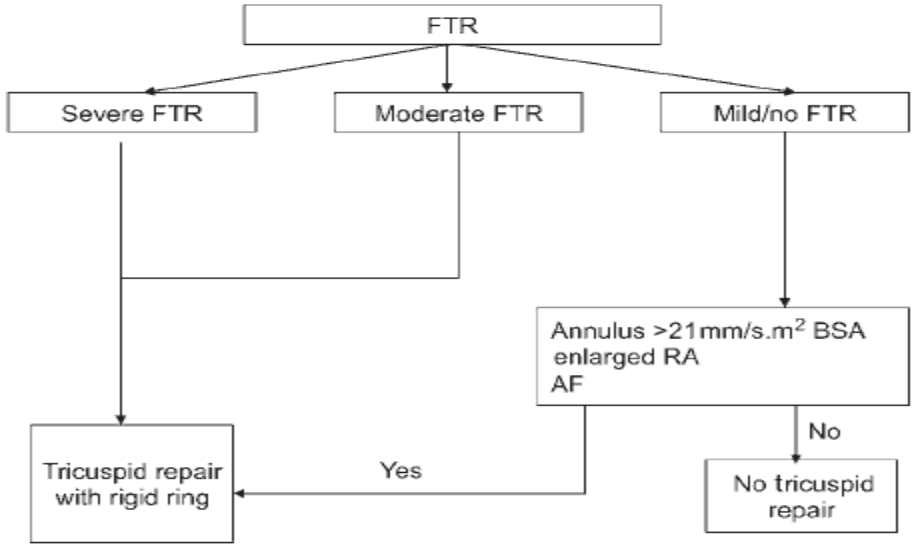
Received 4 April 2012; received in revised form 17 June 2012; accept

Summary

Functional tricuspid regurgitation (FTR) is frequently pr
Untreated FTR may lead to right heart failure. Reoperativ
Therefore, severe FTR has emerged as a Class I indicati
surgery. Concomitant tricuspid valve surgery during left
review addresses this issue and proposes an algorithm for

suggest. We propose that to prevent recurrence of FTR in future, no/mild FTR should be corrected by annuloplasty ring if the systolic tricuspid annular dimension exceeds 21 mm/m^2 body surface area, especially in the presence of dilated right atrium and atrial fibrillation, at the time of left heart valve surgery



Systolic Tricuspid Annular dimension > 21 mm/mq

NB: AF and enlarged RA

Tricuspid Regurgitation

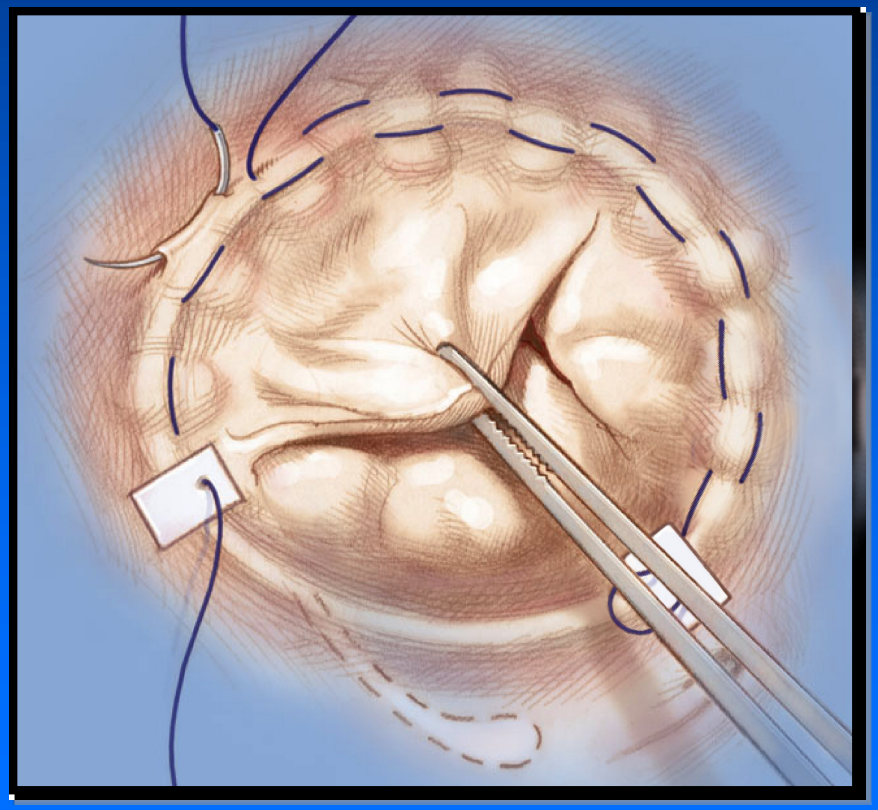
1. Do nothing

Should be the first choice

2. Valvuloplasty
   - De Vega
   - Kay
   - ring (Duran, Carpentier, Cosgrove)
   - leaflet augmentation
3. Valve replacement
   - tissue
   - mechanical

Tricuspid Valve Surgical Options

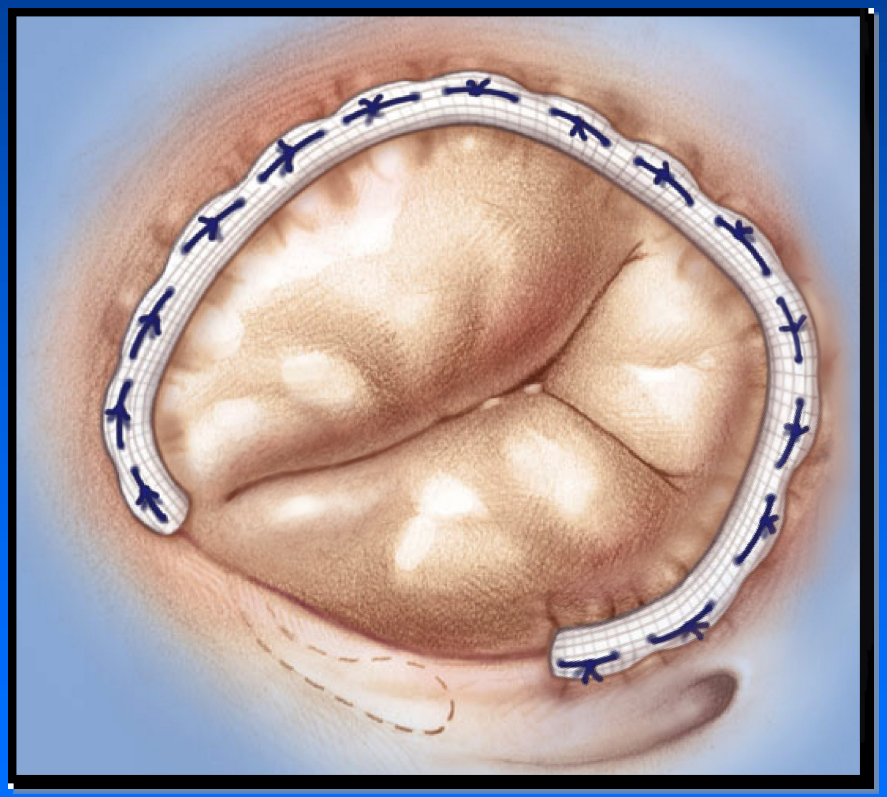
Pursestring Annuloplasty



- Addition to MVR, AVR for functional TR
- No pulmonary hypertension

Tricuspid Valve Surgical Options

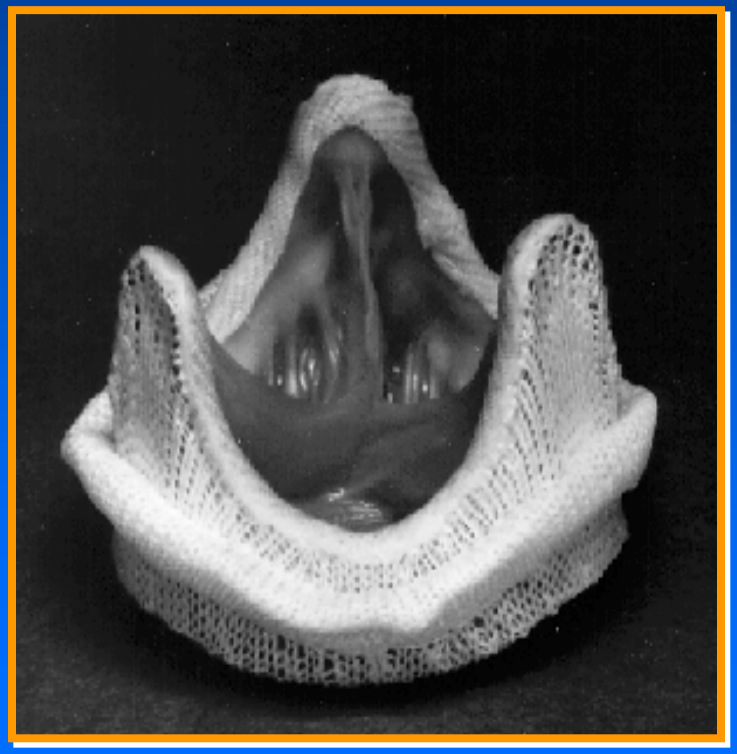
Ringed Annuloplasty



- Mild-mod pulmonary hypertension
- Marked dilatation of the annulus

Tricuspid Valve Surgical Options

Biological TVR



- No permanent anticoagulation
- Severe annular or RV dilatation
- Abnormal leaflets

Tricuspid Valve Surgical Options

Mechanical TVR

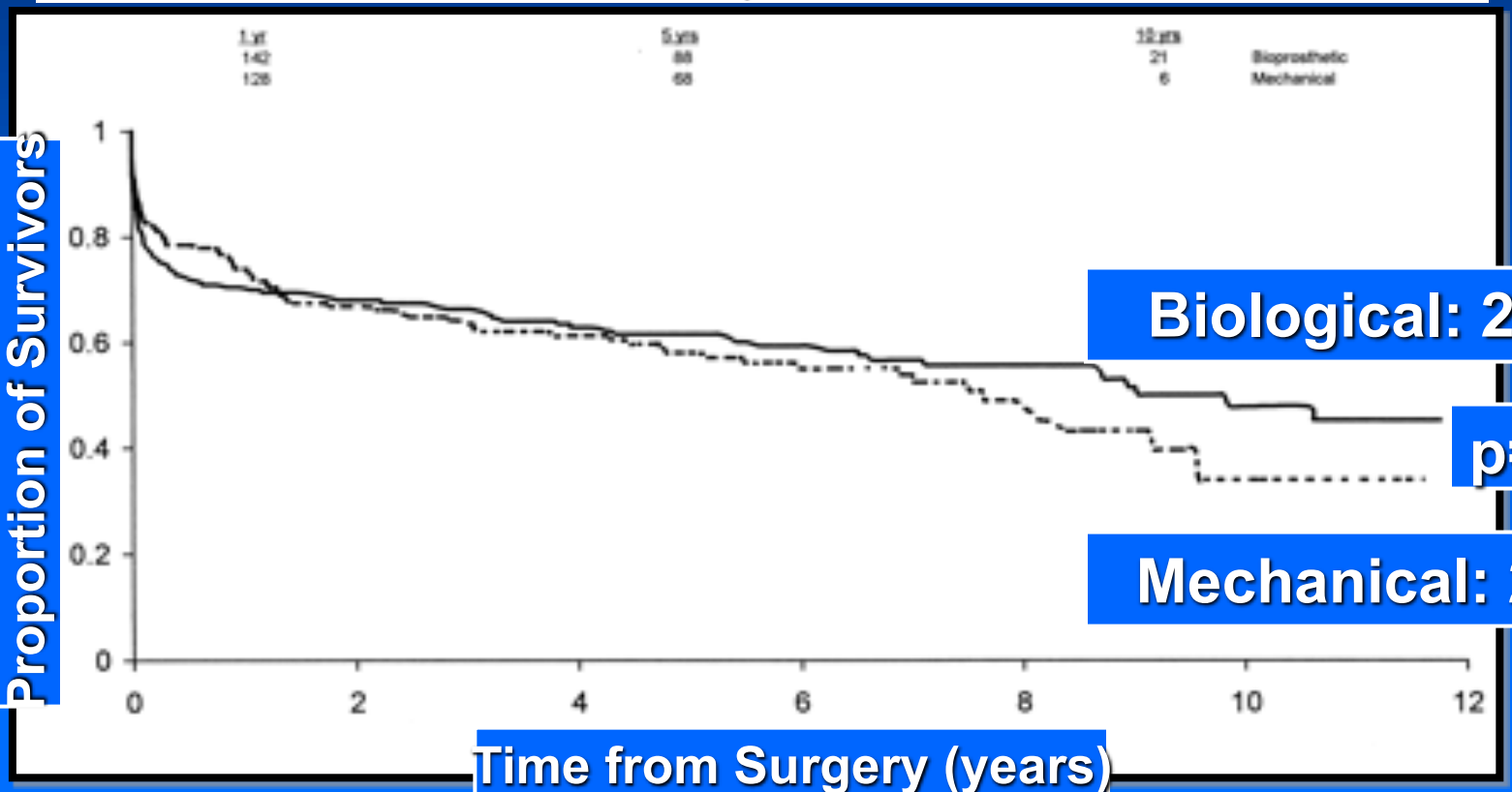
- Presence of mechanical left-sided prosthesis
- Abnormal leaflets/annular dilatation

But

- Higher rate of thrombosis in the tricuspid position need for appropriate anticoagulation

Tricuspid Valve Replacement: UK Heart Valve Registry Mid-Term Results Comparing Mechanical and Biological Prostheses (Ann Thorac Surg 1998;66:1940–7)

Chandana P. Ratnatunga, FRCS, Maria-Benedicta Edwards, MPhil, Caroline J. Dore, BSc, and Kenneth M. Taylor, FRCS



Biological: 225 pt

p=NS

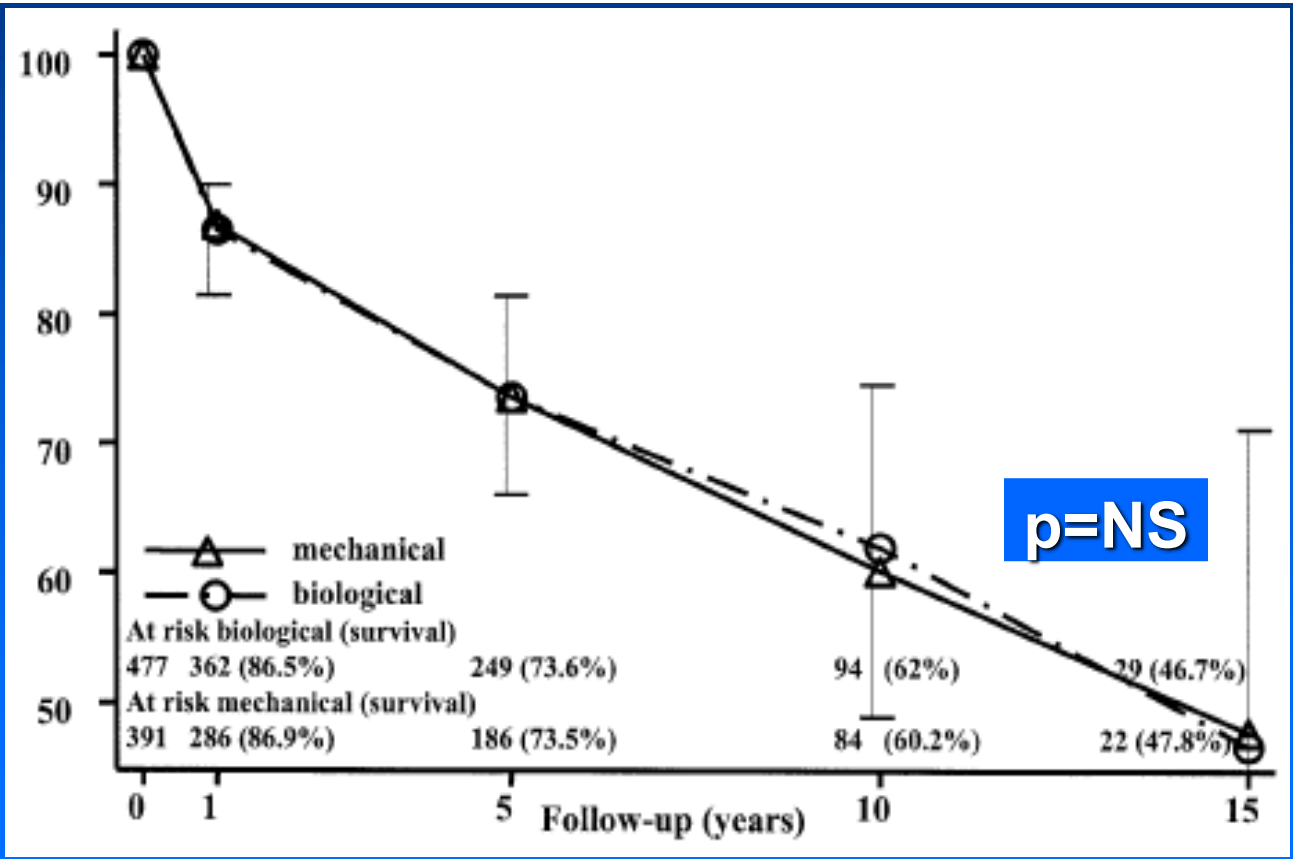
Mechanical: 200 pt

Biological or Mechanical Prostheses in Tricuspid Position? A Meta-Analysis of Intra-institutional Results

(Ann Thorac Surg 2004;77:1607–14)

Giulio Rizzoli, MD, FETCS, Igor Vendramin, MD, Georgios Nesseris, MD, Tomaso Bottio, MD, Cosimo Guglielmi, MD, and Laura Schiavon, DStat

Istituto di Chirurgia Cardiovascolare and Centro Informativo di Ateneo, Università di Padova, Padova, Italy



Tricuspid Regurgitation

1. **Functional tricuspid regurgitation**

Mild → **No surgery**

Moderate or Severe → **Fix the aortic and/or mitral valve**

→ **Tricuspid annuloplasty - Ring**

Tricuspid Regurgitation

2. Organic tricuspid regurgitation

Mild → no surgery

Moderate

- → Asymptomatic → medical treatment
- → Symptomatic despite medicine → Surgery
  - → Repair (?)
  - → TVR

Severe TVR

Tricuspid Regurgitation

3. **Recurrent tricuspid regurgitation after surgery**

   - Investigate aortic and mitral valves and LV function

   - Fix aortic and/or mitral valve

   - Tricuspid annuloplasty / TVR

Tricuspid Regurgitation

Because **reoperation** for recurrent isolated TR carries high **mortality rates** (up to **37%**), **TV surgery is not routinely offered** to many patients.

As **minimally invasive approaches** for treatment of aortic and MV disease are developing, parallel alternative approaches for TR may be necessary, **especially** for those patients with **high surgical risk**

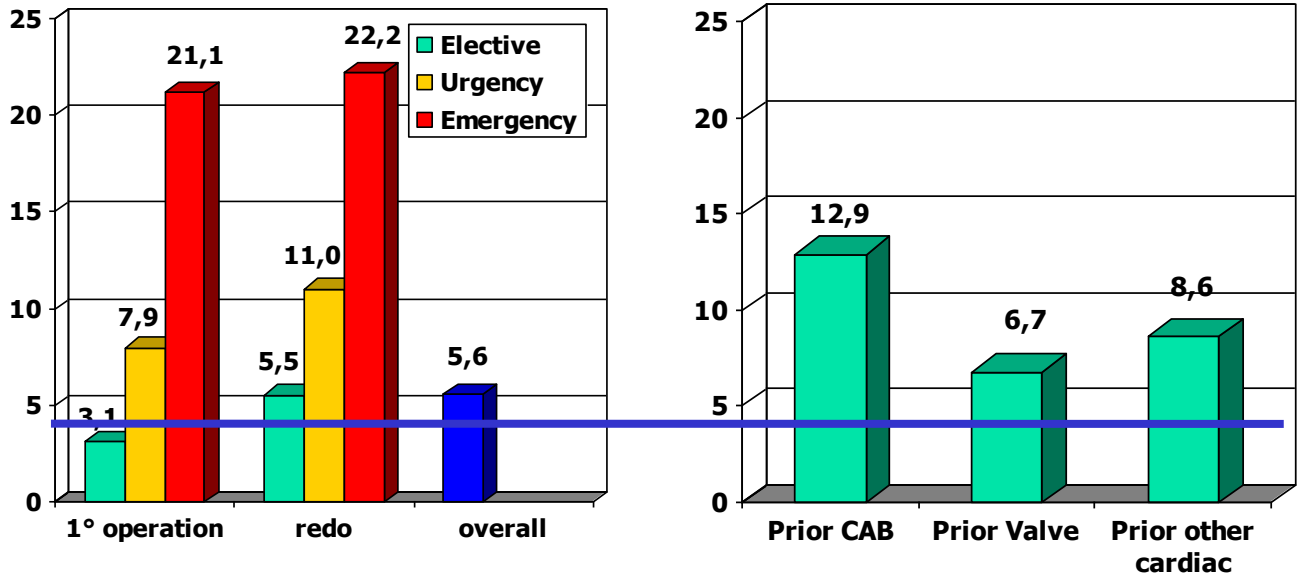
Ricci et al. J. Thorac Cardiovasc Surg 2013

Port-access surgery as elective approach for mitral valve operation in re-do procedures

Davide Ricci [b,*], Carlo Pellegrini [a], Marco Aiello [a], Alessia Alloni [a], Barbara Cattadori [a], Andrea M. D'Armini [a], Mauro Rinaldi [b], Mario Viganò [a]

[a] Division of Cardiac Surgery, Foundation I.R.C.C.S. Policlinico San Matteo, University of Pavia, 27100 Pavia, Italy
[b] Division of Cardiac Surgery, San Giovanni Battista Hospital "Molinette", University of Torino, 10126 Turin, Italy

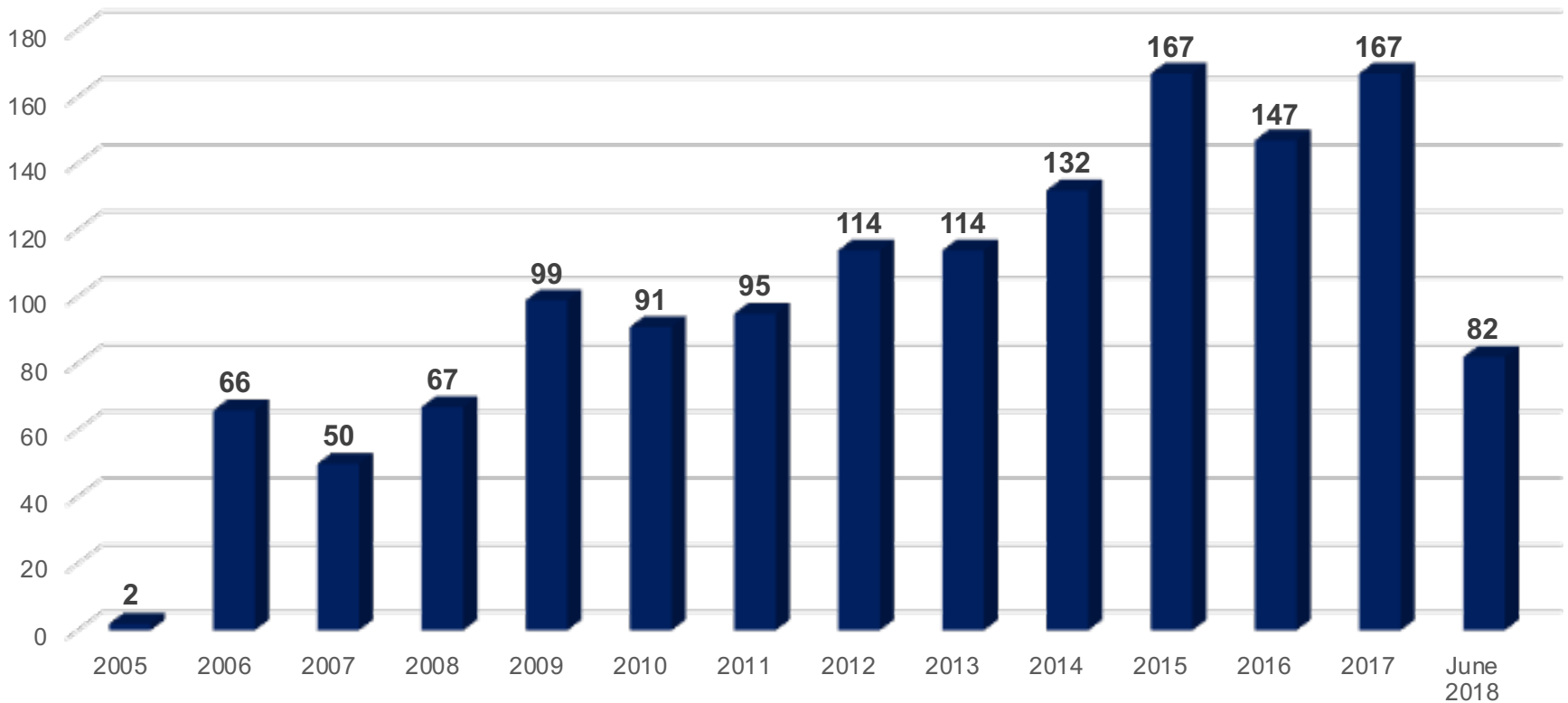
European Journal of Cardio-thoracic Surgery 37 (2010) 920–927



Variable	*N* (%) or median
Major neurologic event	14/241 (5.8%)
Re-operation for bleeding	12/241 (4.9%)
Respiratory failure	9/241 (3.7%)
Low cardiac output	2/241 (0.8%)
Multi-organ failure	3/241 (1.2%)
Cardiac arrest	1/241 (0.4%)
Acute myocardial infarction	1/241 (0.4%)
Hospital mortality	12/241 (4.9%)
Hospital stay	8 days

Turin MIS experience

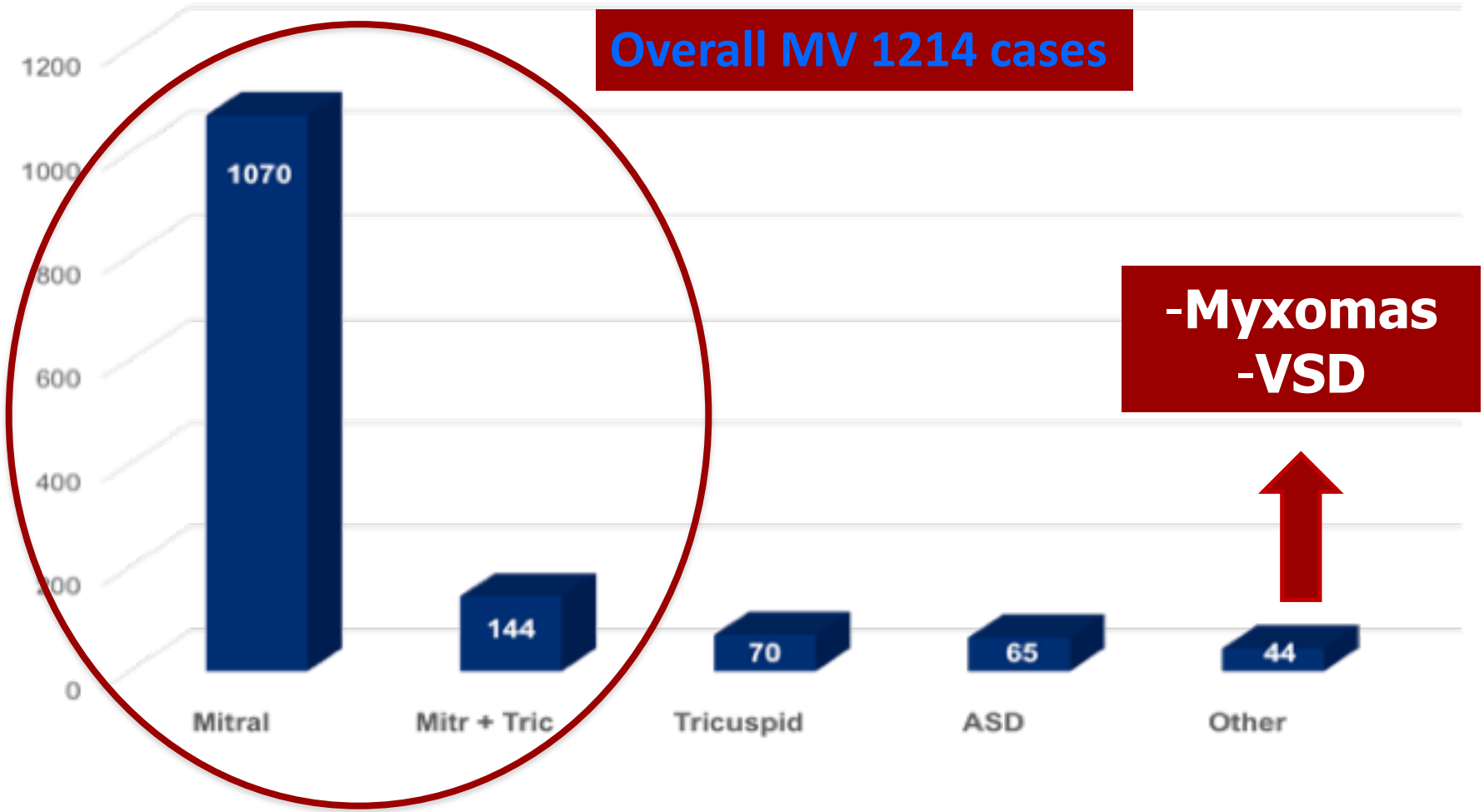
July 2005 – June 1st 2018: 1393 procedures



MIS Consecutive unselected patients

Turin MIS experience

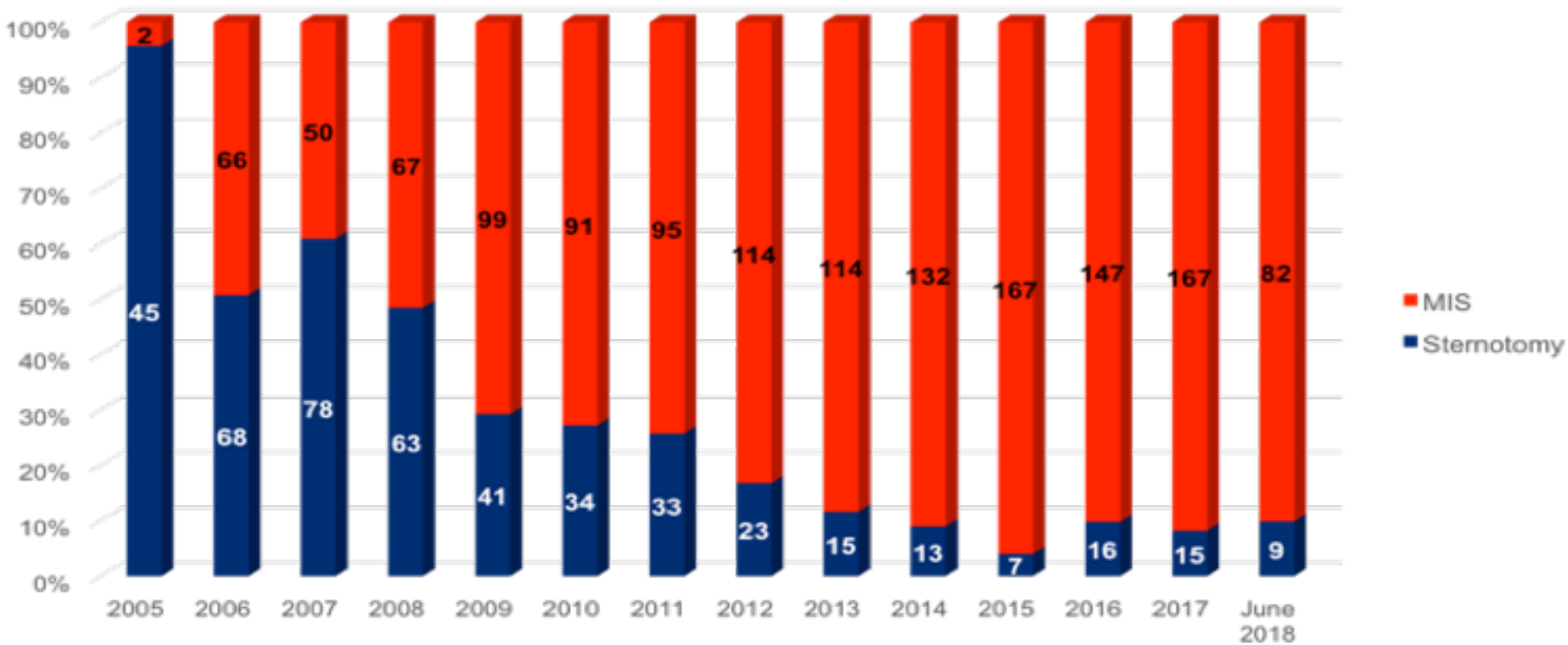
July 2005 – June 1st 2018: 1393 procedures



Turin MIS experience

Mini-invasive surgeries

MIS Mitral/Tricuspid/ASD procedures vs Median Sternotomy
2005 - June 2018

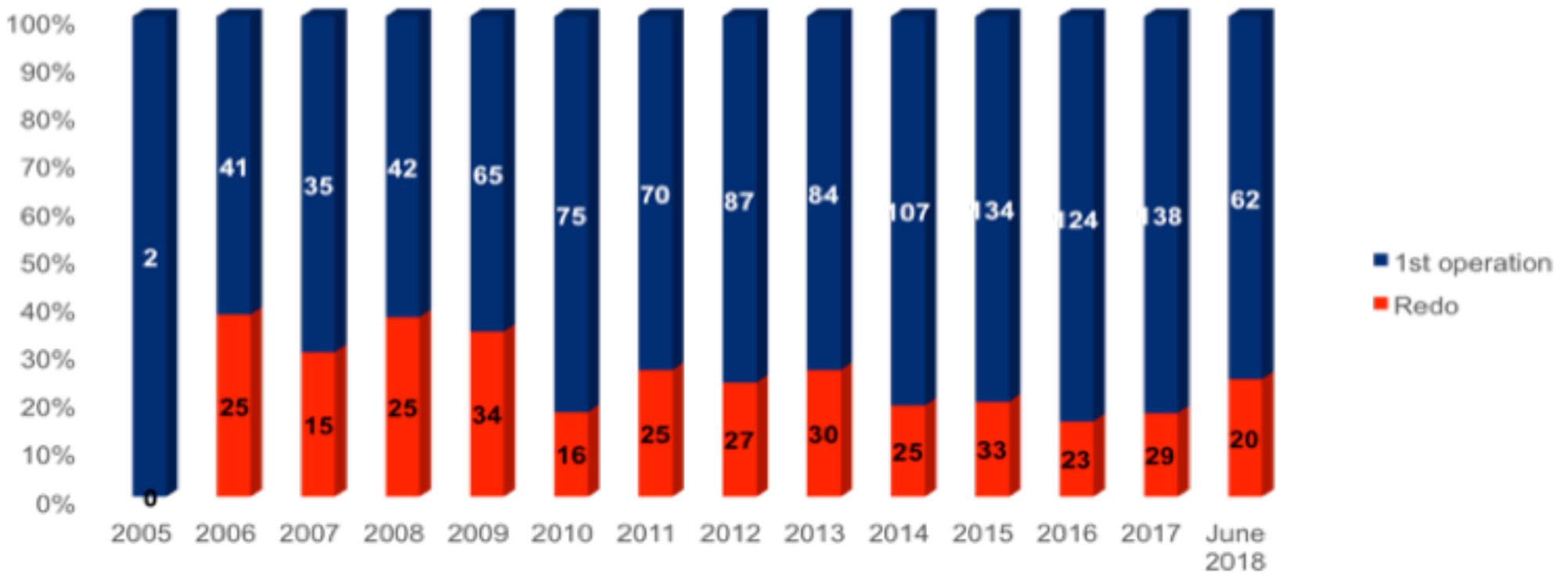


Turin MIS experience

Redo surgery: 327/1393 (23.5%)

- 1st redo 229 (70.0%)
- 2nd redo 60 (18.5%)
- 3rd redo 30 (9.2%)
- 4th redo 8 (2.5%)

98 (30.0%)

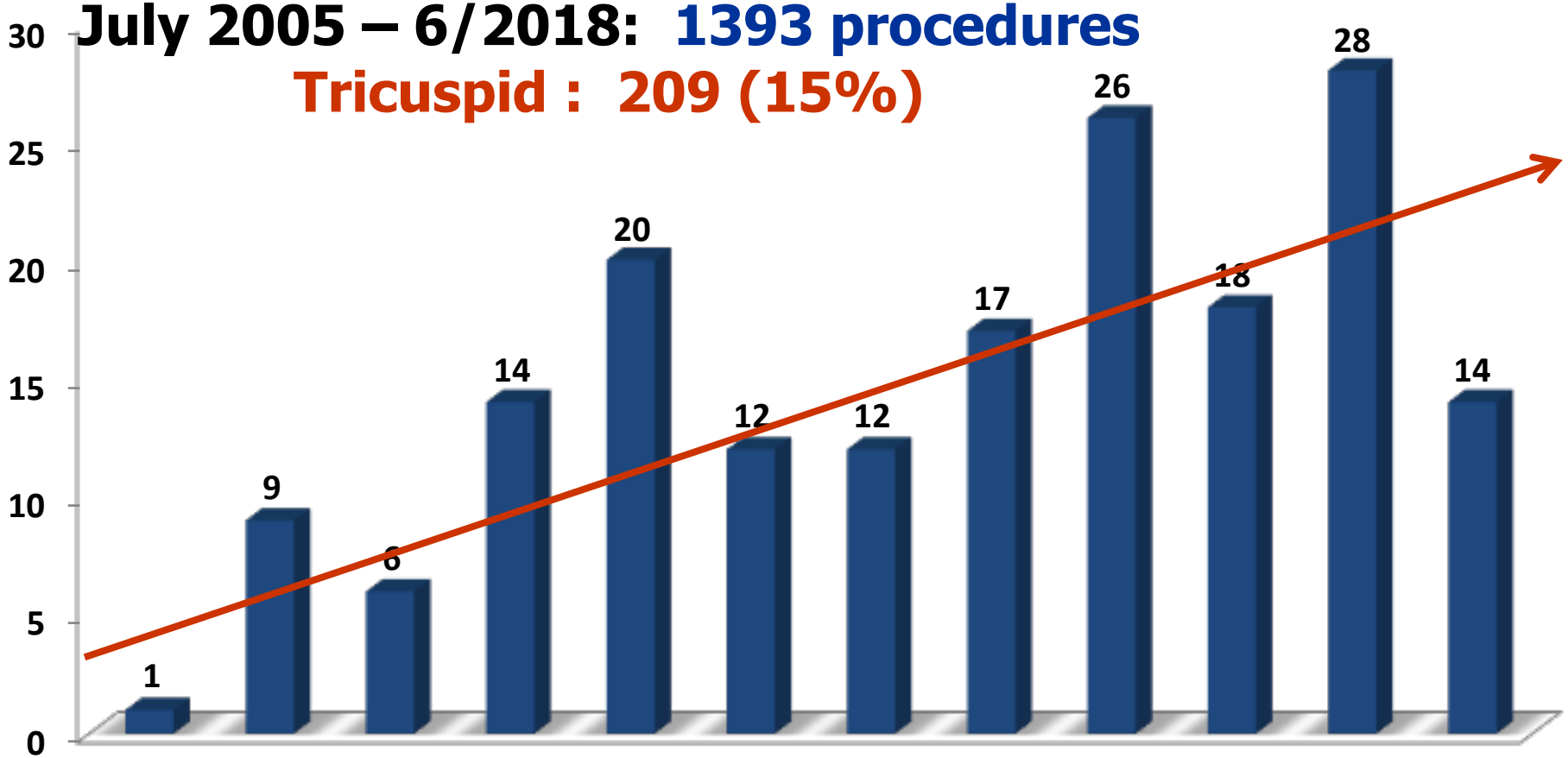


Turin MIS experience

Mini-invasive surgeries

July 2005 – 6/2018: 1393 procedures

Tricuspid : 209 (15%)



Turin MIS experience

Minimally invasive tricuspid valve surgery in patients at high risk

Davide Ricci, MD,[a,b] Massimo Boffini, MD,[a] Cristina Barbero, MD,[a] Suad El Qarra, MD,[a] Giovanni Marchetto, MD,[a] and Mauro Rinaldi, MD[a]

Objective: Reports of minimally invasive tricuspid valve operations are rare, and results are often contradictory. This study analyzes our 5-year experience with minimally invasive tricuspid valve operations in high-risk patients.

Methods: Between November 2005 and December 2011, tricuspid valve surgery using a nonsternotomy minimally invasive technique was performed in 64 patients (19 male, 45 female; mean age, 63.2 ± 12.8 years). Mean preoperative European System for Cardiac Operative Risk Evaluation was 7.3 ± 2.9, and predicted mortality was 11.6% ± 11.7%. Tricuspid valve regurgitation cause was functional in 36 patients (56.2%), endocarditis in 2 patients (3.1%), and rheumatic in 24 patients (37.5%). Two patients (3.1%) showed prosthesis dysfunction. Forty patients (62.5%) had undergone previous cardiac surgery.

Results: Tricuspid valve repair was performed in 35 patients (54.7%). Tricuspid valve replacement with bioprosthesis was performed in 27 patients (42.2%), and the remaining 2 patients (3.1%) underwent bioprosthetic replacement. Concomitant procedures (48) included mitral valve surgery (42 patients), atrial septal defect closure (5 patients), and myxoma exeresis (1 patient). Conversion to sternotomy occurred in 1 patient (1.6%). Overall hospital mortality was 7.9%. Stroke occurred in 1 patient (1.6%), and 5 patients underwent reoperation for bleeding (7.8%). Mean follow-up time was 21 ± 16 months (range, 1-59 months) and 100% completed. Cumulative Kaplan–Meier estimated 5-year survival was 81.3%, and 5-year freedom from reoperation was 100%.

Conclusions: The heart-port–based minimally invasive approach seems to be safe, feasible, and reproducible in case of tricuspid valve operations. It ensures low perioperative morbidity, moderate to low rates of tricuspid regurgitation recurrence, and low late mortality. It also seems to have an added value in case of reoperative procedures. (J Thorac Cardiovasc Surg 2013;■:1-6)

64

consecutive unselected pts

2005-2011

TABLE 1. Preoperative clinical and echocardiographic characteristics (N = 64 patients)

Age, y (mean, SD)	63.2 ± 12.8
Female sex (n, %)	45 (70.3%)
Diabetes (n, %)	12 (18.7%)
Renal failure (n, %)	9 (14.1%)
Hypertension (n, %)	42 (65.6%)
COPD (n, %)	3 (4.7%)
Pulmonary hypertension (≥60 mm Hg) (n, %)	27 (42.2%)
AF (n, %)	43 (67.2%)
Cumulative additive euroSCORE (mean, SD)	7.3 ± 2.9
Cumulative log euroSCORE (mean, SD)	11.6 ± 11.7
NYHA class (mean, SD)	2.8 ± 0.9
class I/II (n, %)	27 (42.2%)
class III/IV (n, %)	37 (57.8%)
TV grade (mean, SD)	3.3 ± 1.1
TV annulus (mm) (mean, SD)	45.5 ± 7.2
Ejection fraction (mean, SD)	58.7 ± 3.5
Ejection fraction <50%	7 (10.9%)
Native MV disease	28/64 (43.7%)
MV stenosis	10/28 (35.7%)
MV regurgitation	18/28 (64.3%)
Redo (n, %)	40 (62.5%)
1st redo (n, %)	20/40 (50%)
2nd redo (n, %)	8/40 (20%)
3rd or more redo (n, %)	12/40 (30%)

SD, Standard deviation; *COPD*, chronic obstructive pulmonary disease; *AF*, atrial fibrillation; *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *NYHA*, New York Heart Association; *TV*, tricuspid valve; *MV*, mitral valve.

Mean TV annulus diameter 45.7±7.2 mm

Turin MIS experience

Operative data

TV repair	35 (54.7%)
Annular ring	33/35 (94.3%)
De Vega annuloplasty	2/35 (5.7%)
TV replacement	27 (42.2%)
Tricuspid prosthesis replacement	2 (3.1%)

CEC 135.4±41.9 min

Conversion to sternotomy 1/64 (1.6%)

Isolated TV procedures	16 (25%)
Combined procedures	48 (75%)
MV repair	14 (29.2%)
MV replacement	14 (29.2%)
Mitral prosthesis replacement	14 (29.2%)
ASD closure	5 (10.4%)
Myxoma resection	1 (2%)

MV 87.5%

TV procedures on beating heart	33 (51.5%)
Isolated TV procedures on beating heart	16/16 (100%)
Combined procedures on beating heart	17/48 (35.4%)
AF cryoablation	5/43 preoperative

11.6%

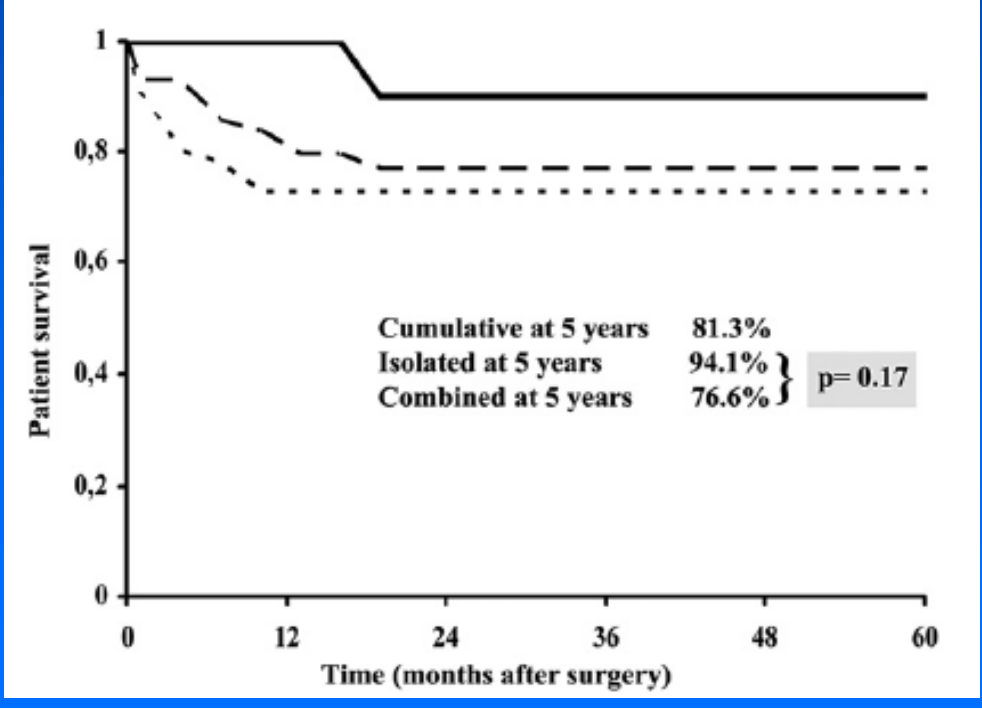
Aortic clamp 87.4.±27.4 min

Turin MIS experience

Post-operative and FUP data

Hospital mortality (n, %)	5 (7.8%)
Length of postoperative stay (d) (mean, SD, median)	14.1 ± 19.0 (8)
Reoperation for bleeding (n, %)	5 (7.8%)
Stroke (n, %)	1 (1.6%)
Acute renal failure (n, %)	5 (7.8%)
Blood loss (mL)	471 ± 382
Pacemaker requirement (n, %)	1 (1.6%)

TV repair 2.8%
TV replac. 13.8%



0% Groin wound infections
0% Femoral artery complications

5-year freedom from reoperation 100%

J Heart Valve Dis. 2014 Nov;23(6):783-7.

Minimally invasive approach for isolated tricuspid valve surgery.

Urbandt P, Santana O, Mihos CG, Pineda AM, Joseph Lamelas.

Abstract

BACKGROUND AND AIM OF THE STUDY: Isolated tricuspid valve surgery has been associated with a high morbidity and mortality. The study aim was to analyze the feasibility of a minimally invasive approach for isolated tricuspid valve surgery.

METHODS: A total of 2,945 heart operations performed at the authors' institution between January 2009 and April 2013 was retrospectively reviewed to identify patients who had undergone isolated, minimally invasive tricuspid valve surgery via a right mini-thoracotomy approach. Details of operative times, intensive care unit (ICU) and hospital lengths of stay, postoperative complications, and mortality were analyzed.

RESULTS: A total of 12 patients (eight females, four males; mean age 68 +/- 18 years) was identified. The median left ventricular ejection fraction was 58% (IQR 47-64%), and prior valve or coronary artery bypass graft surgery was noted in four patients (33%) and two patients (17%), respectively. Most of the patients underwent tricuspid valve repair (92%), with a median cardiopulmonary bypass time of 106 min (IQR 82-122 min). The median ICU and total hospital lengths of stay were 84 h (IQR 47-157 h) and 7 days (IQR 6-12 days), respectively. Postoperative complications included prolonged ventilation (50%), reintubation (17%), atrial fibrillation (17%), and acute kidney injury (8%). There were no postoperative cerebrovascular accidents, myocardial infarctions, reoperations for bleeding, or deep wound infections. The 30-day mortality rate was 17%, and two-year survival 67%.

CONCLUSION: A minimally invasive approach for isolated tricuspid valve surgery is feasible, with a high rate of valve repair.

Thorac Cardiovasc Surg. 2017 Dec;65(8):606-611. doi: 10.1055/s-0035-1546428. Epub 2015 Mar 5.

Isolated Tricuspid Valve Surgery: A Single Institutional Experience with the Technique of Minimally Invasive Surgery via Right Minithoracotomy.

Minol JP[1], Boeken U[1], Weinreich T[1], Heimann M[1], Gramsch-Zabel H[1], Akhyari P[1], Kamiya H[1], Lichtenberg A[1].

⊕ Author information

Abstract

Background Minimally invasive cardiac surgery via right lateral minithoracotomy is a well-described approach. However, reports on isolated tricuspid valve surgery (TVS) in this technique are rare. Therefore, we like to give a contribution by reporting our experience. **Methods** We retrospectively reviewed 25 tricuspid valve operations via right lateral minithoracotomy with femoral cannulation between August 2009 and September 2013 (18 repairs, 7 replacements, and 72% repair rate). Three patients (12%) presented for a re-do operation, and nine patients (36%) suffered from active endocarditis at admission. All patients underwent TVS as single valve procedure. Ten patients received additional procedures such as removal of infected leads, resection of atrial tumors, or closure of atrial septal defects. An annuloplasty ring was inserted in 12 cases. We investigated the short-term morbidity and mortality with regard to the surgical procedure. **Results** Repair rate was 72%. Thirty-day and 1-year mortality were 4 and 20%, respectively. The only patient with early mortality received the surgical procedure on the tricuspid valve as fourth cardiac-related surgery and postoperative mortality was due to intracranial air embolism. Perioperative morbidity included reoperation for bleeding (8%) and stroke (4%). No disturbance of wound healing occurred. Durations of intensive care unit stay and hospital stay were 2.3 ± 2.4 and 17.4 ± 13.1 days, respectively. Endocarditis-caused surgery did not reveal any significant difference in the intra- or perioperative course compared with other indications. **Conclusion** Minimally invasive TVS via right lateral minithoracotomy is feasible with good results. Even in a cohort of patients suffering from elevated rate of active endocarditis, a high repair rate can be achieved.

Thorac Cardiovasc Surg. 2018 Apr 19. doi: 10.1055/s-0038-1627452. [Epub ahead of print]

Minimally Invasive, Isolated Tricuspid Valve Redo Surgery: A Safety and Outcome Analysis.

Färber G[1], Tkebuchava S[1], Dawson RS[1], Kirov H[1], Diab M[1], Schlattmann P[2], Doenst T[1].

⊕ Author information

Abstract

BACKGROUND: Isolated tricuspid valve (TV) surgery is considered a high risk-procedure. The optimal surgical approach is controversial. We analyzed our experience with isolated TV redo surgery performed either minimally invasively (redo-MITS) or through sternotomy.

METHODS: We retrospectively analyzed all patients with previous cardiac surgery who underwent redo-MITS ($n = 26$) and compared them to redo-Sternotomy ($n = 17$). A group of primary-MITS ($n = 61$) served as control.

RESULTS: The redo-MITS approach consisted of a right anterolateral mini-thoracotomy, transpericardial right atrial access, and beating heart TV surgery without caval occlusion. Redo-MITS patients were oldest and had the most comorbidities (EuroScore II: 9.83 ± 6.05% versus redo-Sternotomy: 8.42 ± 7.33% versus primary-MITS: 4.15 ± 4.84%). There were no intraoperative complications or conversions to sternotomy in both MITS groups. Redo-Sternotomy had the highest 30-day mortality (24%), the poorest long-term survival, and the highest perioperative complication rate. Redo-MITS did not differ in perioperative outcome from primary-MITS. Multivariable logistic regression analysis identified redo-Sternotomy (odds ratio [OR] = 9.76; 95% confidence interval [CI] 1.88-63.26), liver cirrhosis (OR = 9.88; 95% CI 2.20-54.20), and body mass index (BMI) (OR = 1.16; 95% CI 1.02-1.35) as independent predictors of 30-day mortality. The Cox model revealed redo-Sternotomy (hazard ratio [HR] = 2.67; 95% CI 1.18-6.03), liver cirrhosis (HR = 3.31; 95% CI 1.45-7.58), and pulmonary hypertension (HR = 2.26; 95% CI 1.04-4.92) as risk factors for poor long-term survival. TV surgery significantly reduces NYHA class.

CONCLUSION: Minimally invasive, isolated TV surgery as reoperation without caval occlusion and on the beating heart can be safe and may improve clinical outcome.

Turin MIS experience

Mini-invasive surgeries

July 2005 – 6/2018: 1393 procedures

Tricuspid al 2017: 177 (13%)

Table 1. Preoperative clinical and echocardiographic characteristics (N=177 patients)

Age (mean, SD)	64.3 ± 13.7
Female sex (n,%)	**128 (72.3 %)**
Diabetes (n,%)	35 (19.8%)
Renal failure (n,%)	32 (18.4%)
Hypertension (n,%)	116 (65.5 %)
COPD (n,%)	15 (8.5 %)
Pulmonary hypertension (≥ 60 mmHg) (n,%)	72 (40.1 %)
AF (n,%)	129 (72.9 %)
Cumulative additive EURO Score (mean, SD)	7.25 ± 2.8
Cumulative log EURO Score (mean, SD)	10.5 ± 9.3
NYHA class (mean, SD)	2.4 ±1.2
class I/II (n,%)	73 (41.2 %)
class III/IV (n,%)	104 (58.7 %)
TV grade (mean, SD)	3.5 ± 0.8
TV annulus (mm) (mean, SD)	45.5 ± 7.4
Ejection fraction (mean, SD)	58.4 ± 9.6
Ejection fraction <50%	20 (11.3 %)
Native MV disease	120/177 (67.7%)
MV stenosis	36/120 (30.0%)
MV regurgitation	84/120 (70.0%)
REDO (n,%)	84 (47.5%)
1 st REDO (n,%)	47/84 (55.9%)
2 nd REDO (n,%)	19/84 (22.6%)
≥ 3 rd REDO (n,%)	18/84 (21.4%)

SD: standard deviation; COPD: Chronic Obstructive Pulmonary Disease; AF: Atrial fibrillation; NYHA: New York Heart Association; TV: Tricuspid Valve; MV: Mitral Valve.

Similar pre-operative data

Turin MIS experience
Mini-invasive surgeries

July 2005 – 6/2018: 1393 procedures

Tricuspid al 2017: 177 (13%)

Table 2. Type of surgical procedures and operative data (n,%) (N=177 patients)

TV repair	**120 (67.7%)**
Anular ring	115/120 (95.8%)
De Vega annuloplasty	5/120 (4.2%)
TV replacement	**53 (30.0%)**
Tricuspid protesis replacement	**4 (2.3%)**
Isolated TV procedures	**49 (28%)**
Combined procedures	**128 (72%)**
MV repair	41 (32.0%)
MV replacement	54 (42.2%)
Mitral prosthesis replacement	25 (19.5%)
ASD closure	17 (13.3%)
Mixoma resection	1 (0.8%)
TV procedures on beating heart	**83 (46.9%)**
Isolated TV procedures on beating-heart	28/49 (57.1%)
Combined procedures on beating-heart	49/128 (38.3%)
AF crioablation	**17/128 pre-op AF (13.2%)**
Conversion to sternotomy	**3 (1.6%)**

TV: Tricuspid Valve; ASD. Atrial Septal Defect; AF: Atrial fibrillation MV: Mitral Valve;.

Similar peri-operative data

Turin MIS experience

Mini-invasive surgeries

July 2005 – 6/2018: 1393 procedures

Tricuspid al 2017: 177 (13%)

Table 3. Postoperative outcomes (N=177 patients)	
Hospital mortality (n,%)	7 (3.9%)
Length of post-operative stay (days) (mean, SD, median)	13.8 ± 16.0 (8)
Reoperation for bleeding (n,%)	16 (9.0%)
Stroke (n,%)	1 (0.6%)
Acute renal failure (n,%)	10 (5.6%)
Blood loss (ml)	528 ± 436
Pacemaker requirement (n,%)	5 (2.8%)

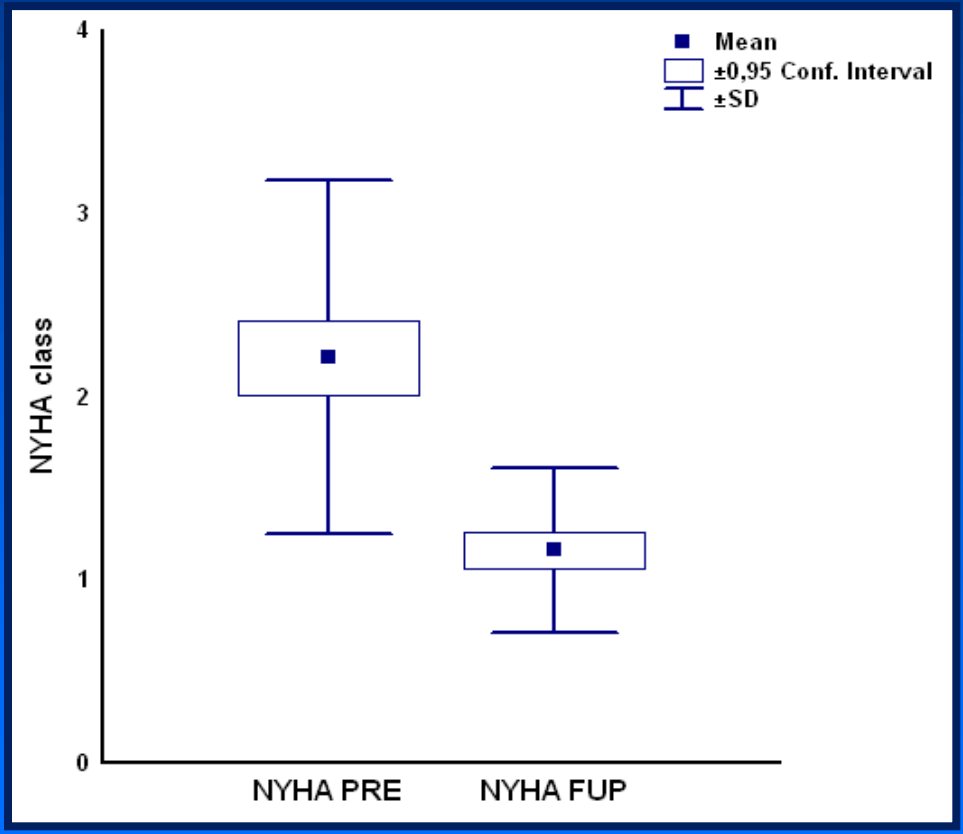
SD: standard deviation

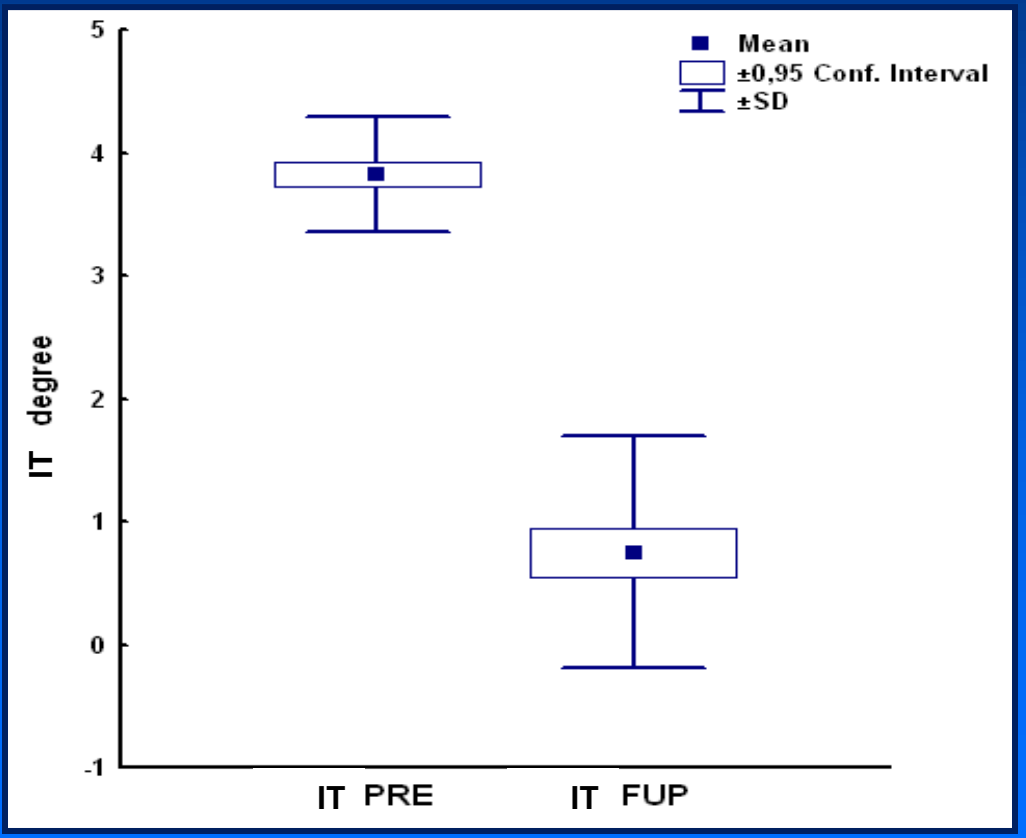
Lower mortality and major neurologic events

Turin MIS experience

Post-operative and FUP data

Mean follow-up time: 21.5 ± 36.9 months





Superior and inferior vena cava Endovascular snaring kit

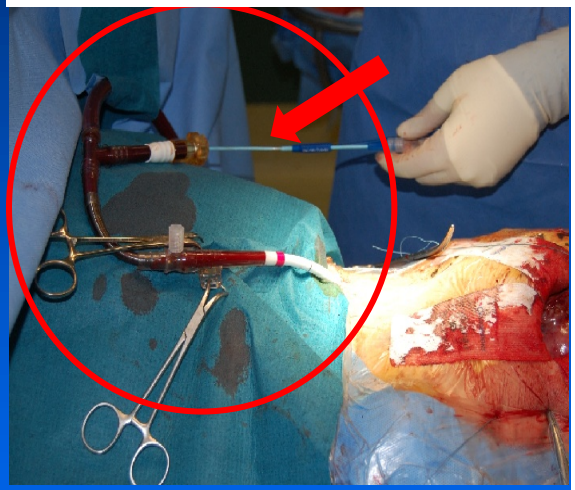
EQUALIZER BALLOON

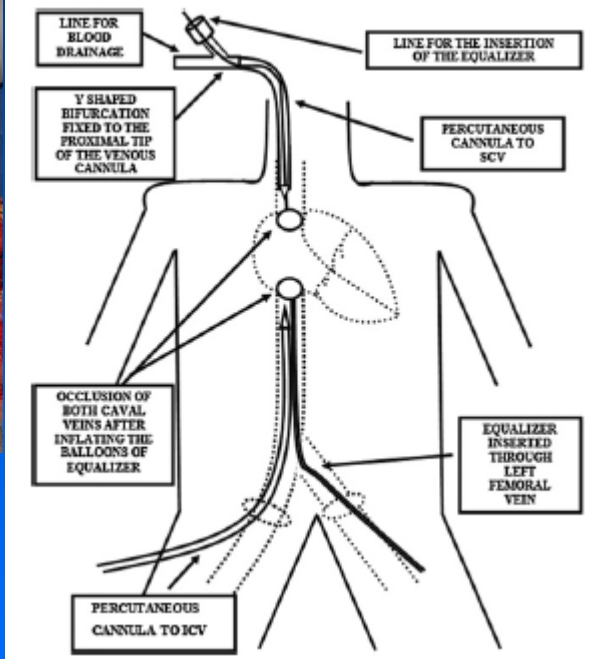
Meditech Boston Scientific

Occlusion of Both Caval Veins by an Endovascular Occluder

Fabrizio Sansone, MD*, Cristina Barbero, MD and Mauro Rinaldi, MD

Division of Cardiac Surgery, San Giovanni Battista Hospital, University of Turin, Corso Bramante 88, 10135 Turin, Italy





Max diameter 7Fr
Lenght 65 cm

Max diameter with inflated balloon
Inferior vena cava: 40 mm
Superior vena cava: 33 mm

(Heart, Lung and Circulation 2012;21:275–277)


PHILIPS
17/09/2010 11:50:15 TIS1.3 MI 0.7
44321120100917 Cardioch. Prof.Rinaldi T6H/Adulti
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2D
66%
C 50
P Off
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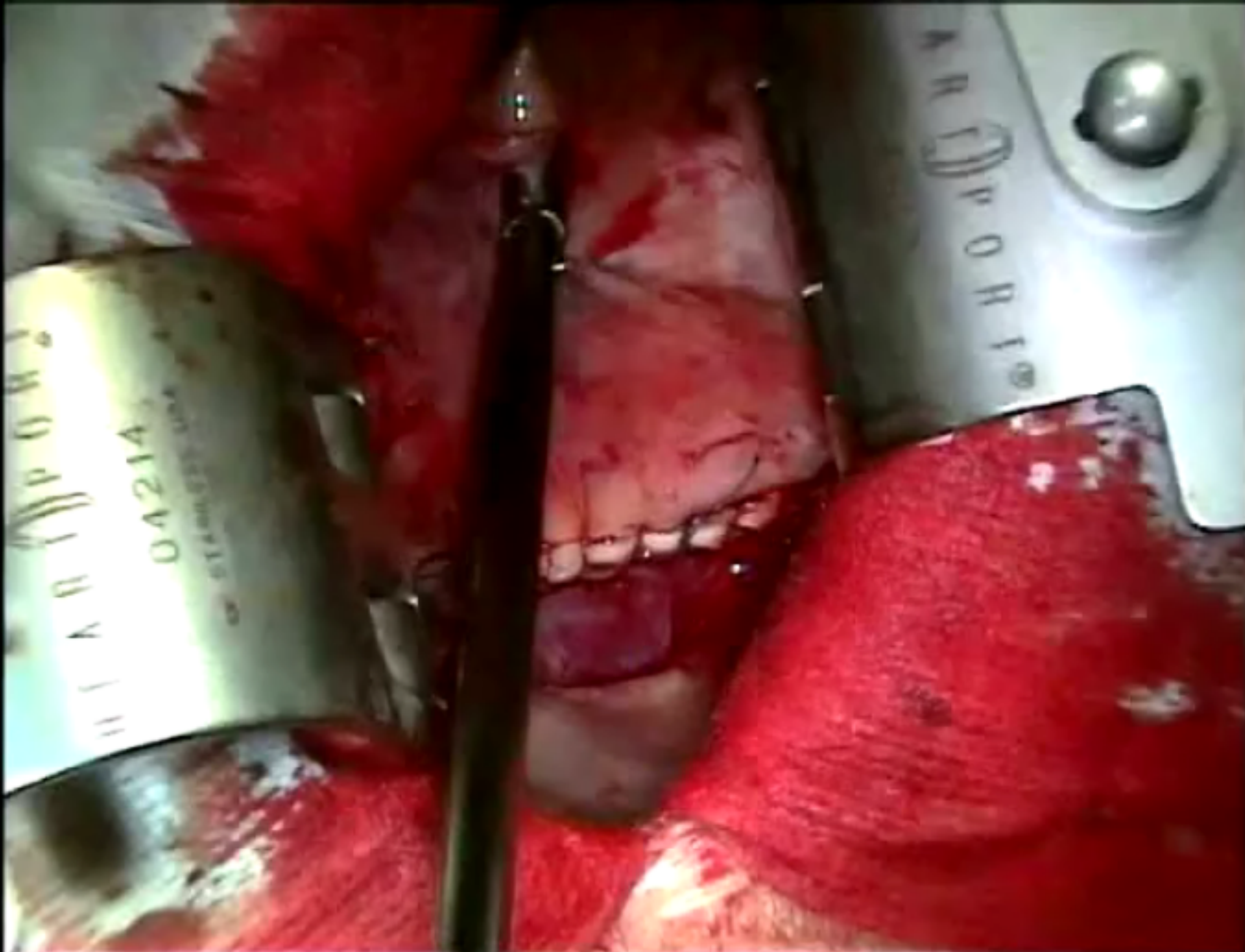
108 bpm
32bpm



Lessons Learned for the Tricuspid Valve

- Tricuspid valve disease often unrecognized and under estimated
- Functional regurgitation common with significant mitral and other left sided problems
- Think Mitral !----------Think Tricuspid!

Lessons Learned for the Tricuspid Valve

- Repair for most cases of functional regurgitation and a dilated annulus
- Replacement
    - Marked annular dilatation
    - Recurrent TR after prior surgery
    - Organic disease
    - Endocarditis

Lessons Learned for the Tricuspid Valve

- Isolated TR should be more aggressively considered especially with MIS approaches
- In high risk pts MIS is safe, feasible, and effective; ensures low perioperative morbidity and mortality; low rates of recurrent TR and late mortality
- MIS is the gold standard in REDO at our Institution


SIGILL·VNIVERS·AVGVSTAE·TAVRINORVM: