Treatment of severe tricuspid regurgitation: the surgeon's point of view

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Direttore: Prof. M. Rinaldi

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

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.)

Functional
Normal leaflets

Organic
Abnormal leaflets

Impact of Tricuspid Regurgitation on Long-Term Survival

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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

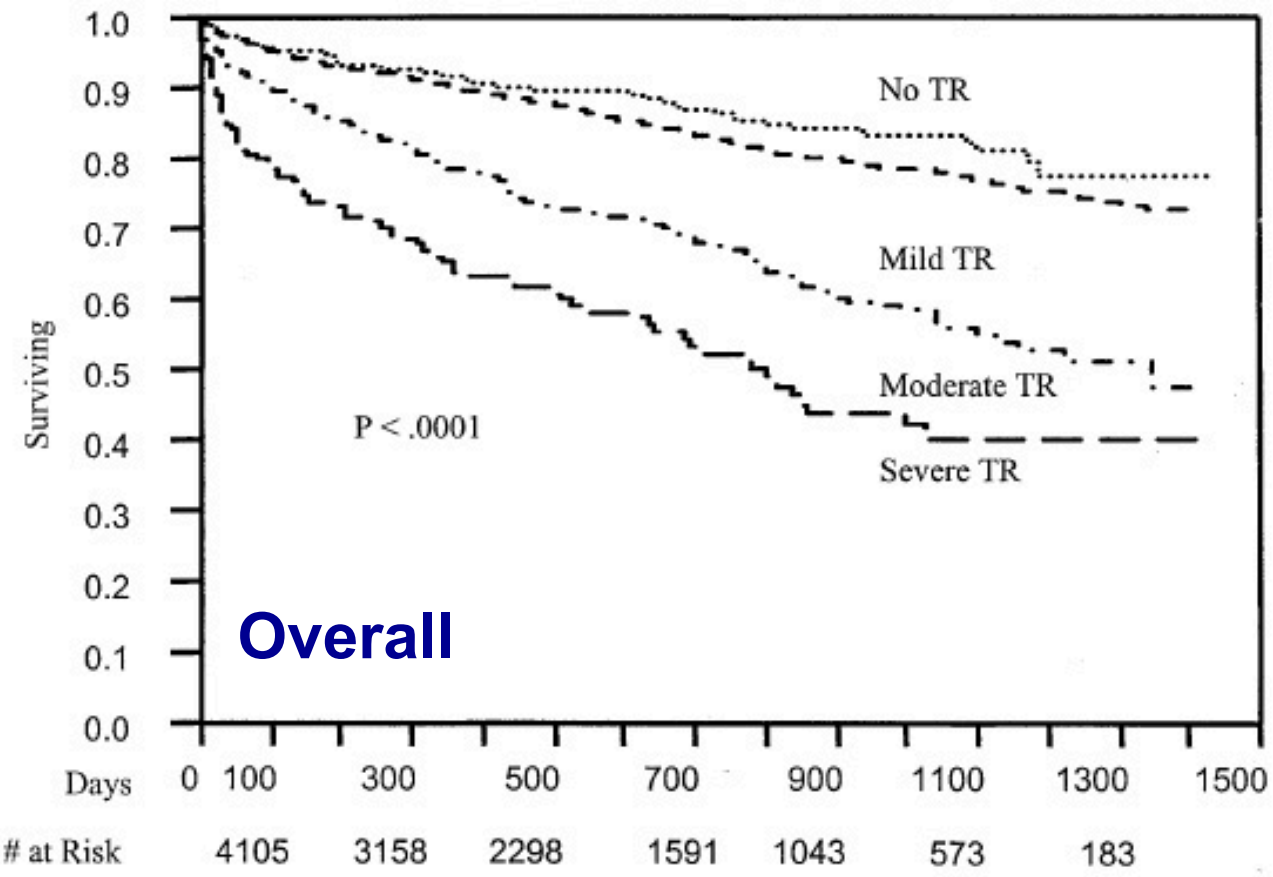
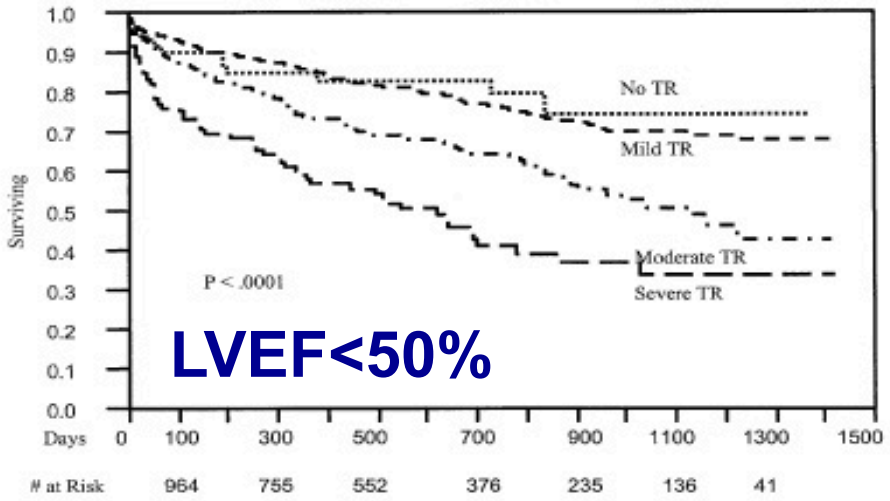


Figure 1. Kaplan-Meier survival curves for all patients with tricuspid regurgitation (TR). Survival is significantly worse in patients with moderate and severe TR.

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



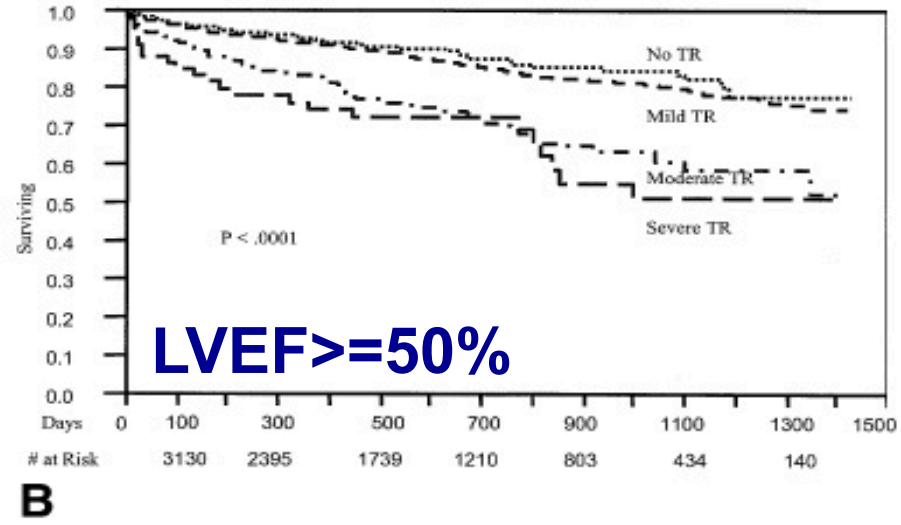
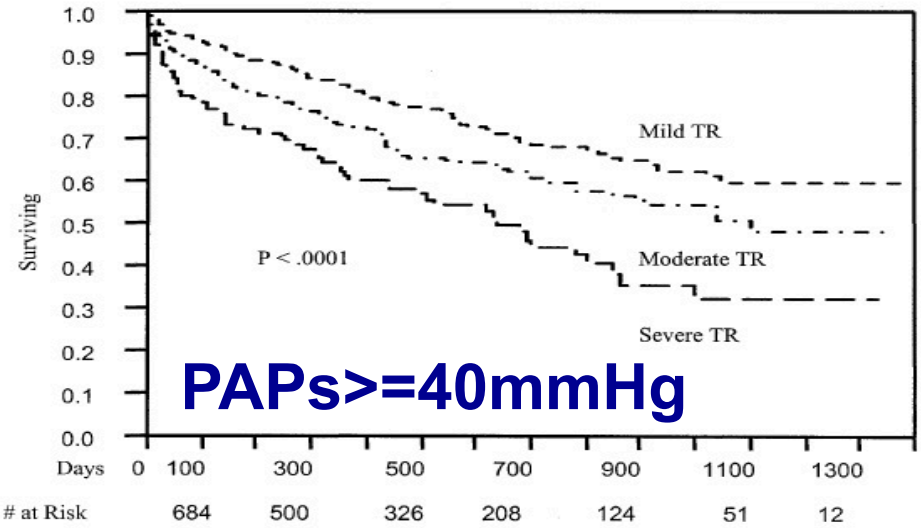


Figure 3. Kaplan-Meier survival curve for **(A)** patients with tricuspid regurgitation (TR) and a low left ventricular ejection fraction (<50%) and **(B)** patients with TR and a normal left ventricular ejection fraction (≥50%).



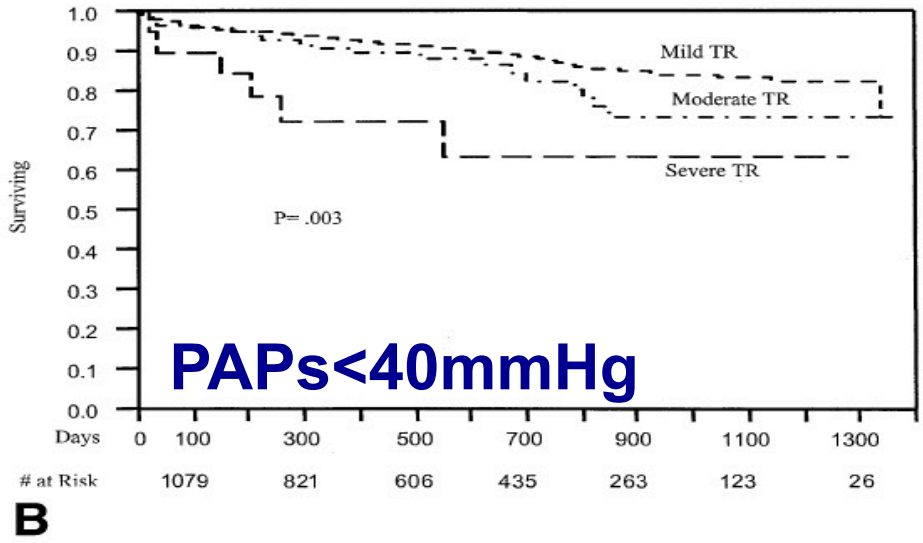


Figure 2. Kaplan-Meier survival curves for **(A)** patients with tricuspid regurgitation (TR) and high pulmonary artery systolic pressure (≥40 mm Hg) and **(B)** patients with TR and normal pulmonary artery systolic pressure (<40 mm Hg).

Guidelines

Nishimura, RA et al.
2014 AHA/ACC Valvular Heart Disease Guideline

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary

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

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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)***

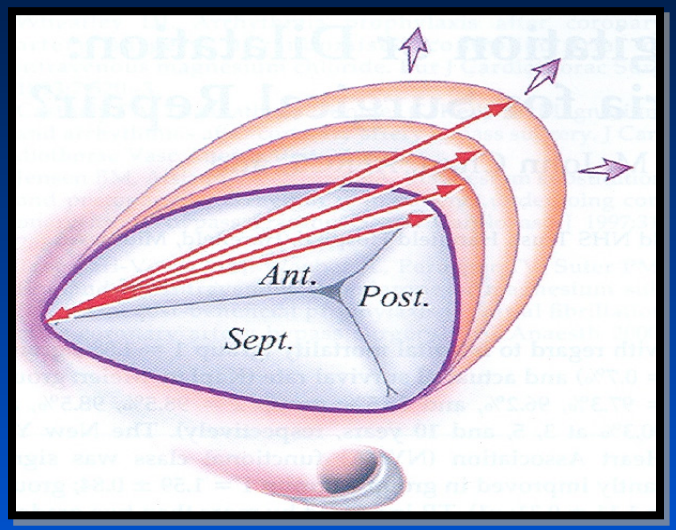
Guidelines

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**
- **Annular dilatation**
- **Pulmonary hypertension**

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

Tricuspid Regurgitation

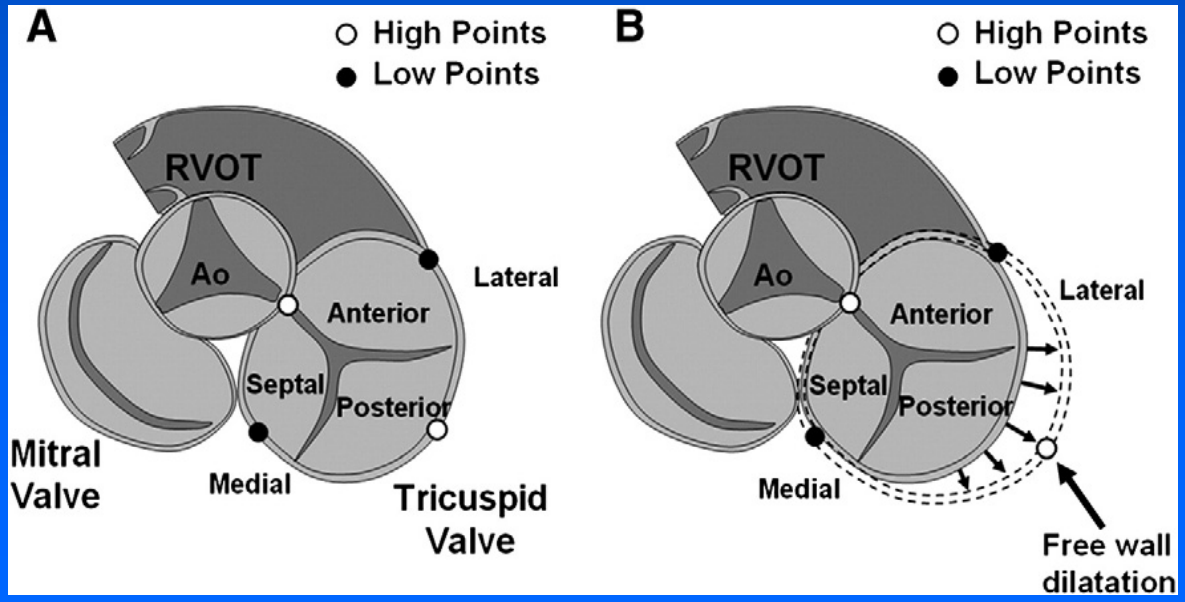


- **Anteroseptal commissure to anteroposterior commissure ≥ 70 mm** ***(Intra-operative measurement)***

  Dreyfus et al: Ann Thorac Surg, 2005

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

  Bolling et al: Circulation, 2009



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REVIEW

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

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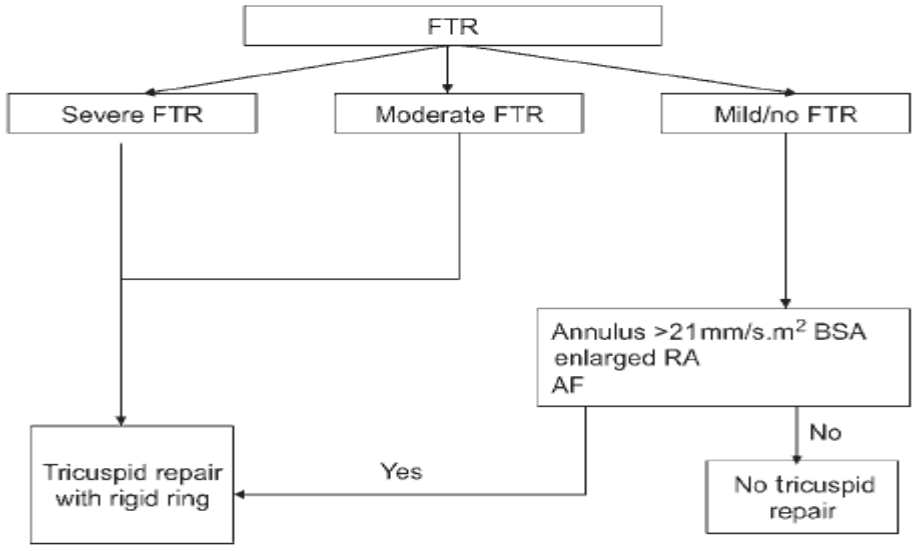
Received 4 April 2012; received in revised form 17 June 2012; accept

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

Moderate Tricuspid Regurgitation With Left-Sided Degenerative Heart Valve Disease: To Repair or Not to Repair?

Jose L. Navia, MD, Nicolas A. Brozzi, MD, Allan L. Klein, MD, Lee Fong Ling, MBBS, Chanapong Kittayarak, MD, Edward R. Nowicki, MD, MS, Lillian H. Batizy, MS, Jiansheng Zhong, MS, and Eugene H. Blackstone, MD

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Background. Uncertain
surgically unaddressed m
pid valve (TV) regurgita
sided degenerative heart
reasons for and factors a
pare safety and clinical ef
identify factors associated
tive TR.

Methods. From 1997 to 2008, 1,724 patients with 2+ TR underwent 830 mitral, 703 aortic, and 191 double-valve procedures; 91 (5%) had concomitant TV repair. Logistic regression analysis was used to identify factors associated with TV repair and for propensity-matched comparison of safety (in-hospital morbidity, mortality) and effectiveness of TV repair (longitudinal echocardiographic assessment of postoperative TR and New York Heart Association class, TV intervention, survival).

Results. Factors associated with TV repair of 2+ TR included larger right ventricles and left ventricles ($p <$ 3/4+ TR.

Conclusions. A TV repair for moderate TR concomitant with surgery for degenerative left-sided heart valve disease is reasonable to provide an opportunity to prevent its progression and development of right ventricle dysfunction, particularly for patients with important right ventricle remodeling and evidence of right ventricular failure, and for patients with advanced left-sided disease requiring mitral valve replacement.

patients. The TV repair patients had less 3/4+ TR at discharge (7% versus 15%), sustained out to 3 years. No TV repair ($p = 0.05$), female sex ($p < 0.0001$), and mitral valve replacement ($p = 0.008$) were associated with 3/4+ TR.

(Ann Thorac Surg 2012;93:59–69)

Tricuspid Regurgitation

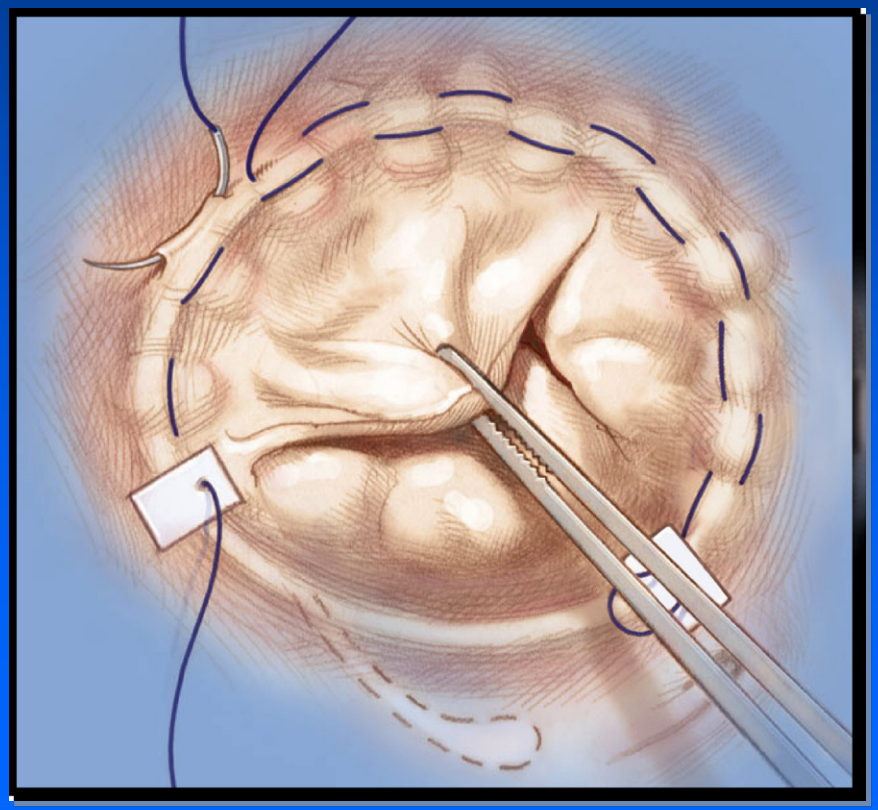
1. Do nothing

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

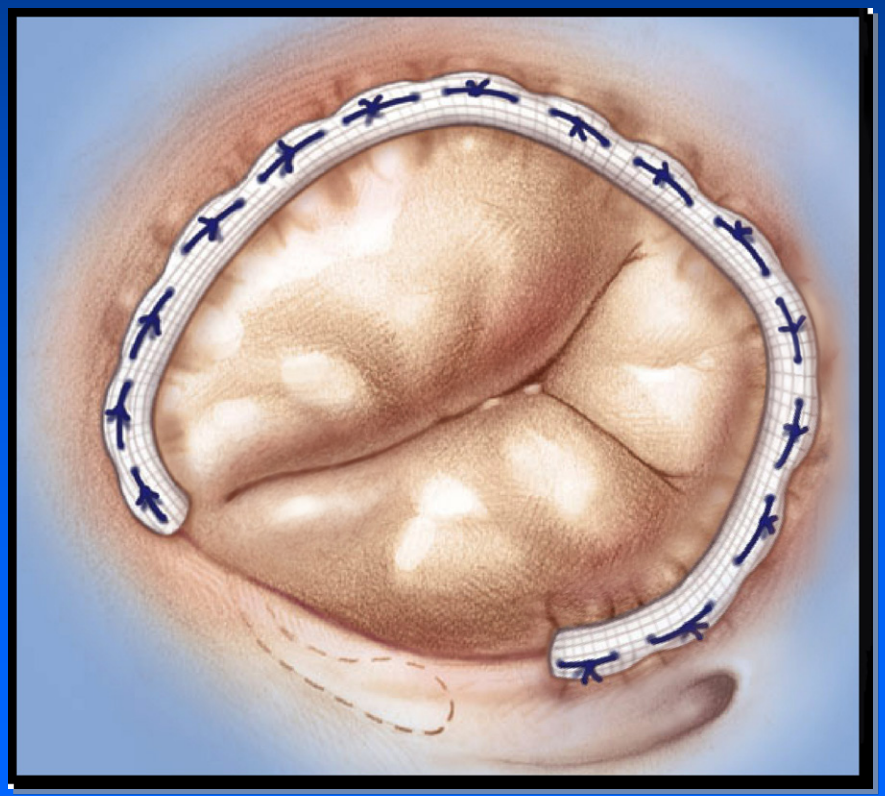
Pursestring Annuloplasty



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

Tricuspid Valve Surgical Options

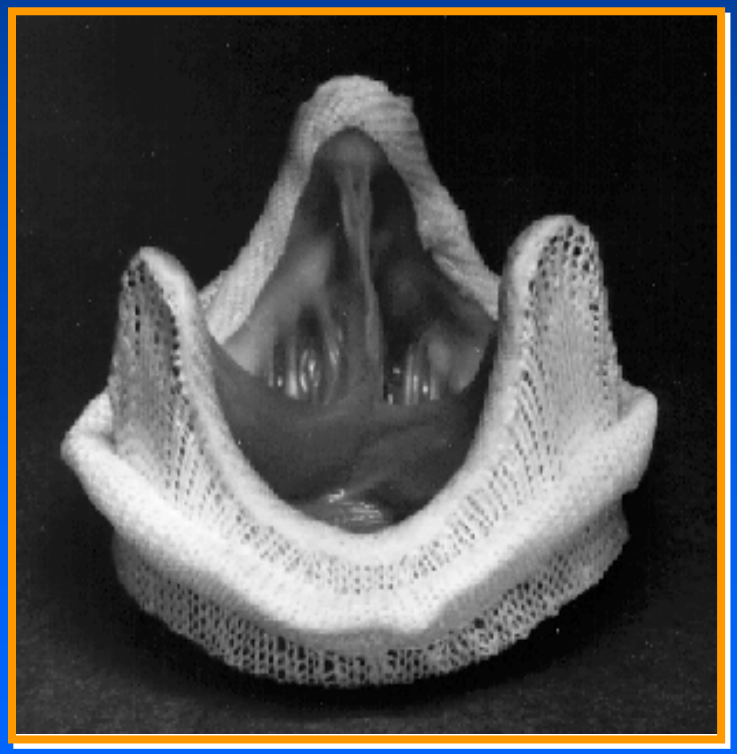
Ringed Annuloplasty



- 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

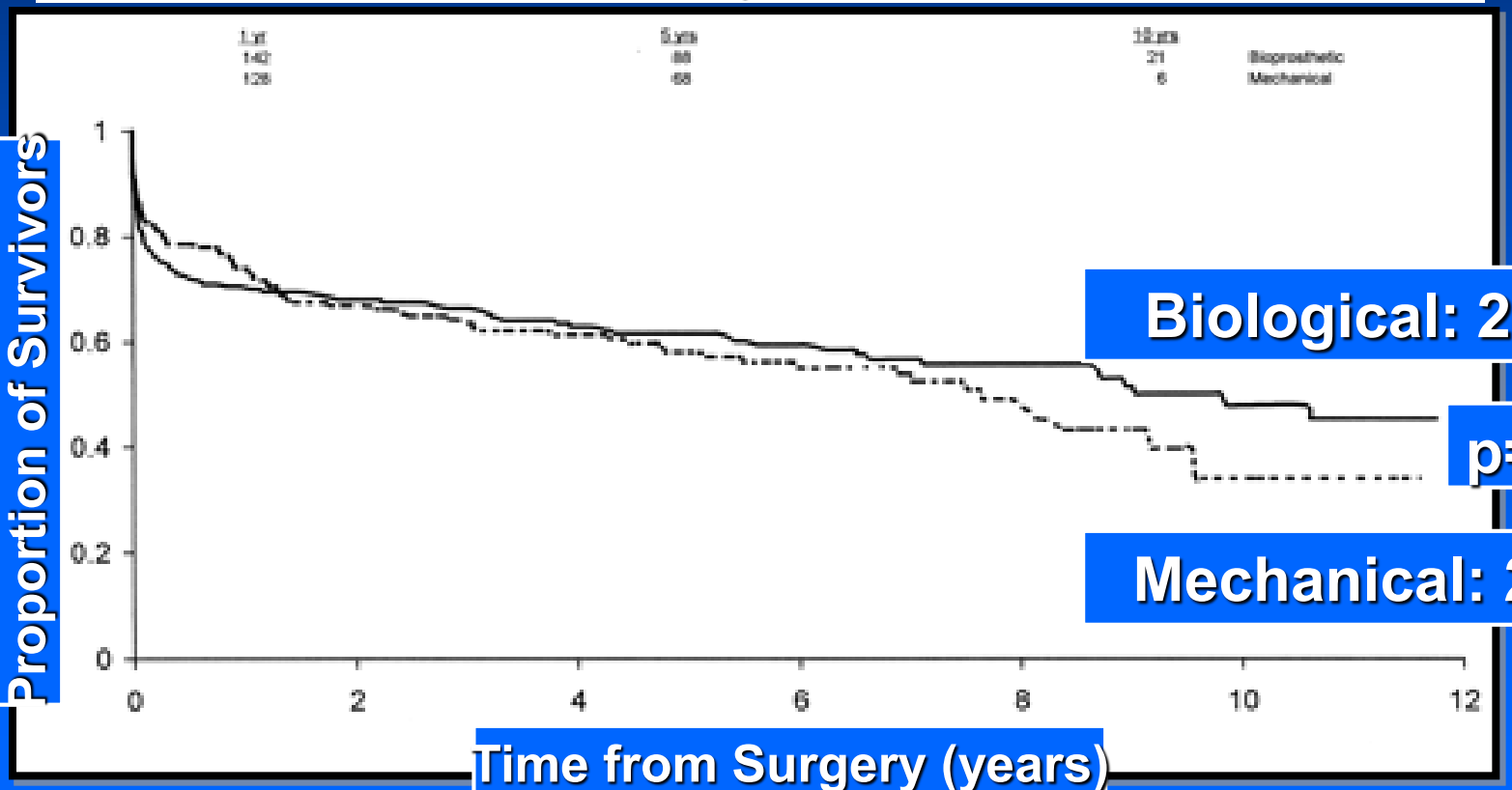
But

- 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)

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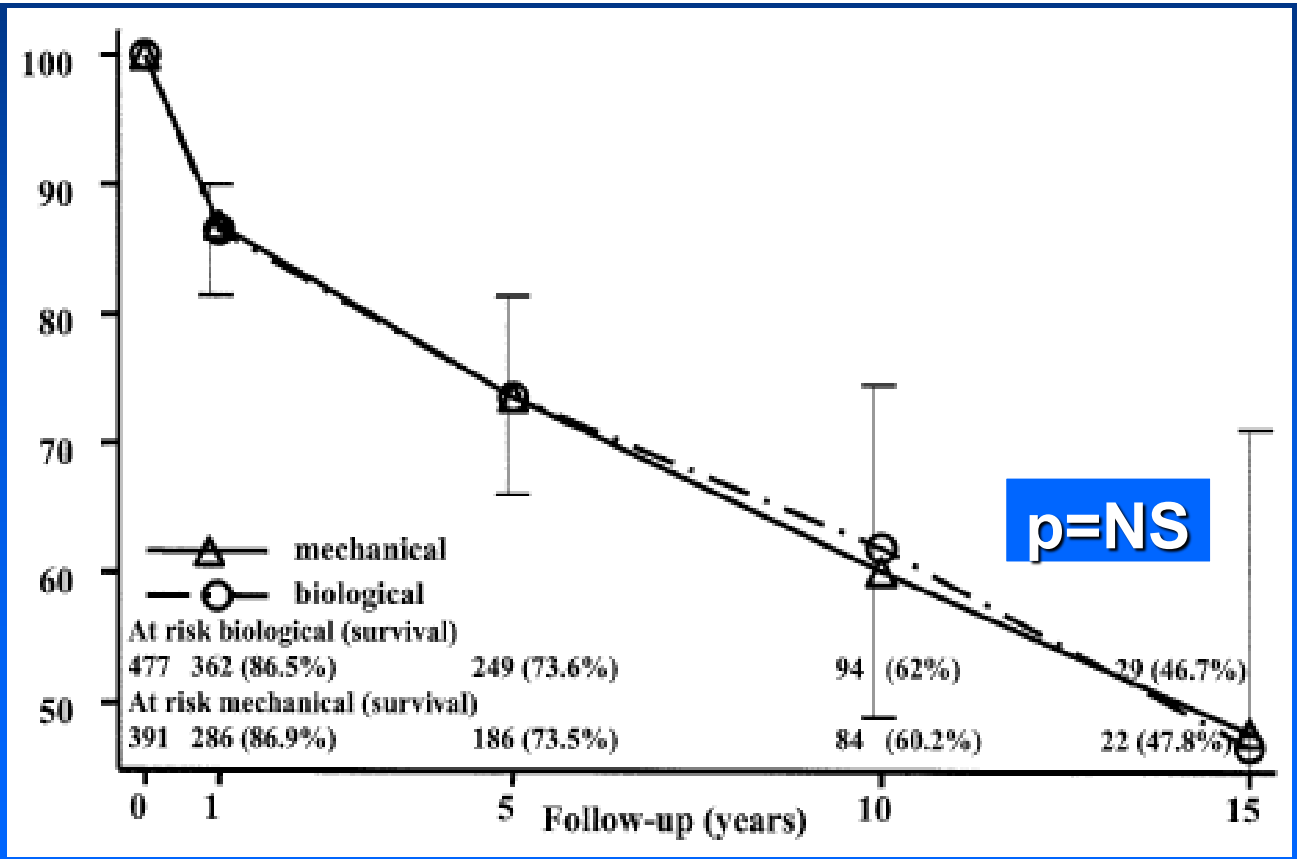


Tricuspid Regurgitation

1. **Functional tricuspid regurgitation**

   Mild → **No surgery**

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

   → **Tricuspid annuloplasty**

   - De Vega or 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

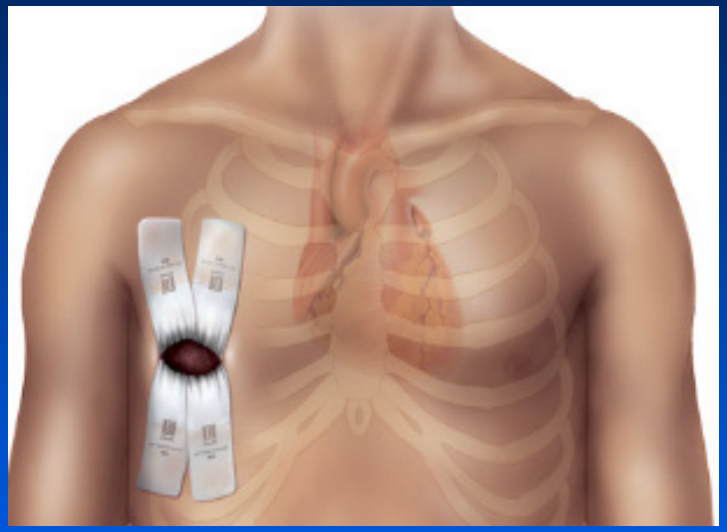
Tricuspid Regurgitation

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

Tricuspid Regurgitation



- Reduce surgical trauma
- Minimize disruption of the chest wall
- Provide a safe and reproducible approach to CPB and myocardial protection

- Be applicable to the majority of patients and procedures
- Provide same safety and efficacy as conventional cardiac surgery

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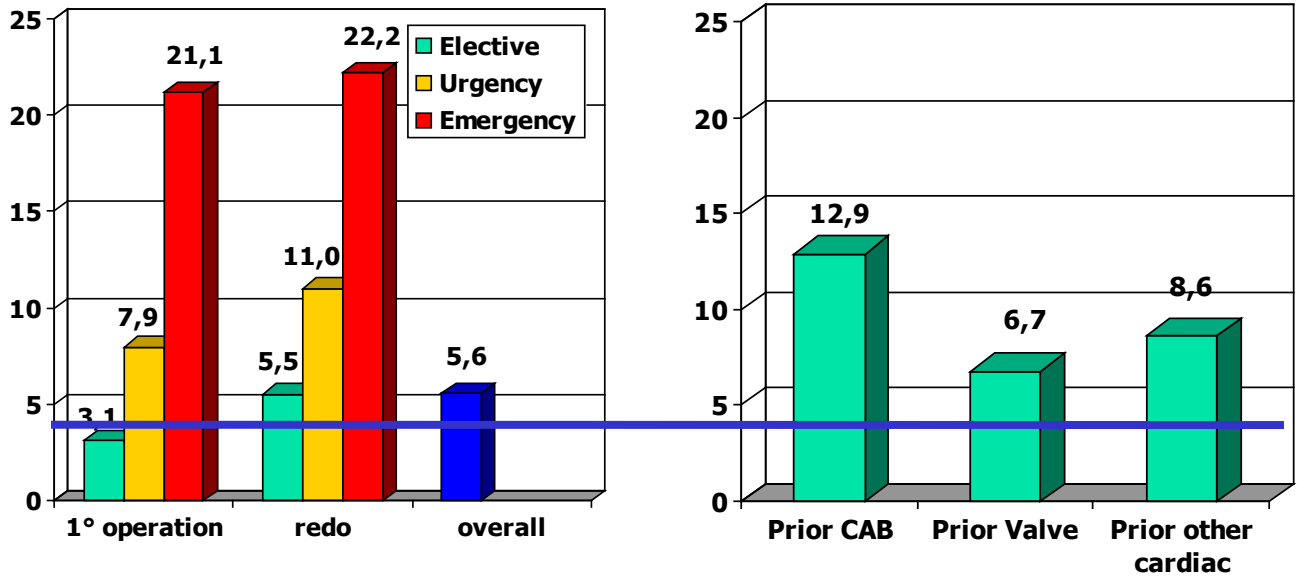
European Journal of Cardio-thoracic Surgery 37 (2010) 920–927



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

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%)

ECC 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 87.5%
MV replacement	14 (29.2%)	
Mitral prosthesis replacement	14 (29.2%)	
ASD closure	5 (10.4%)	
Myxoma resection	1 (2%)	

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

Superior and inferior vena cava Endovascular snaring kit

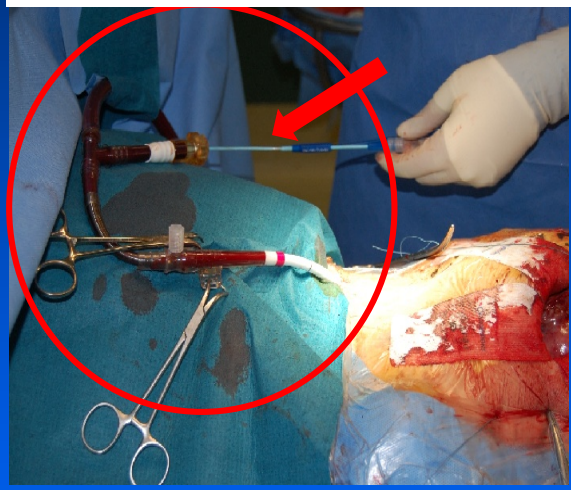
EQUALIZER BALLOON

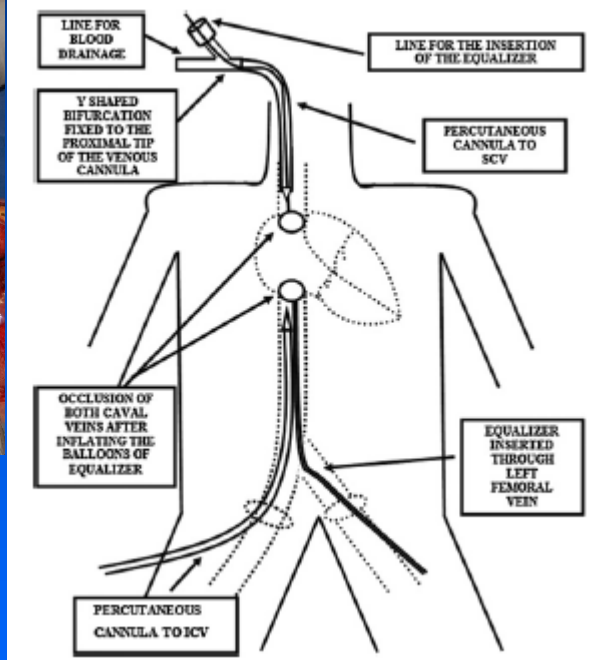
Meditech Boston Scientific

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
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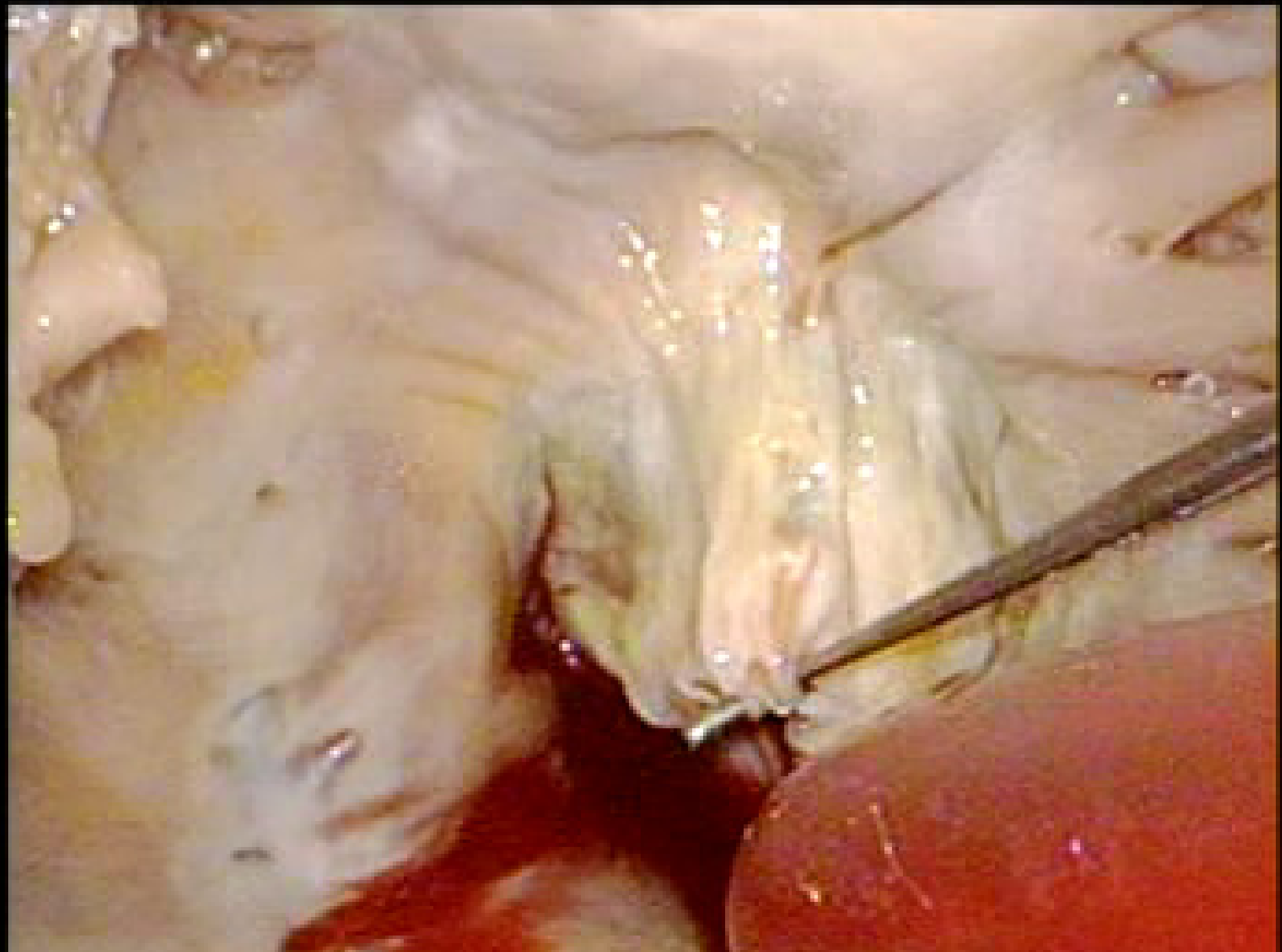
14cm
2D
66%
C 50
P Off
Gain
32bpm

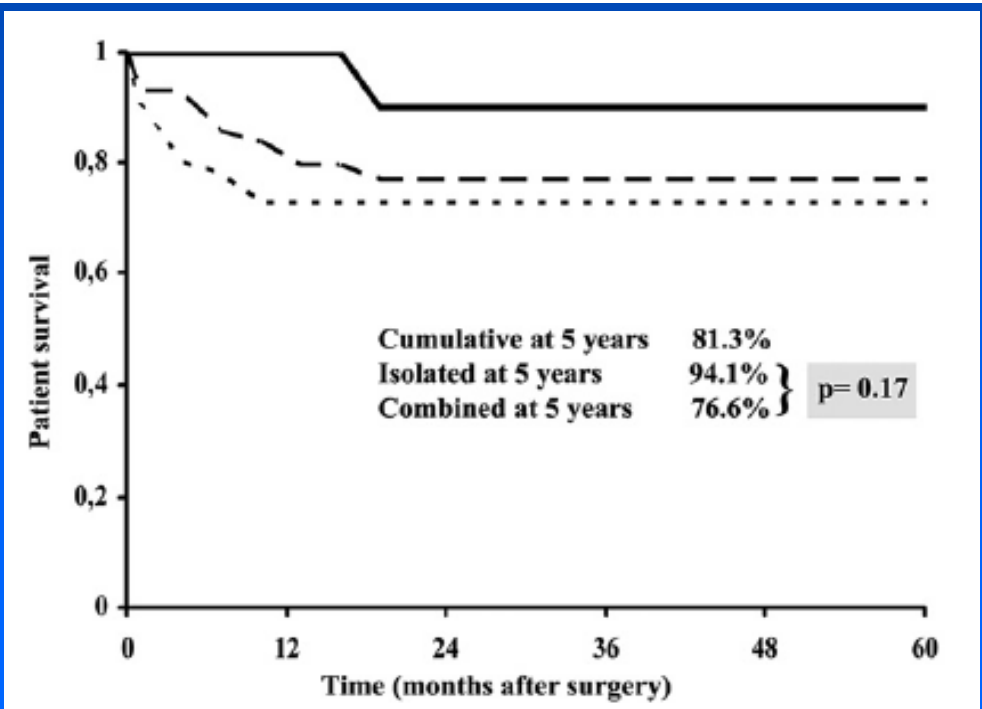


Turin MIS experience

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%



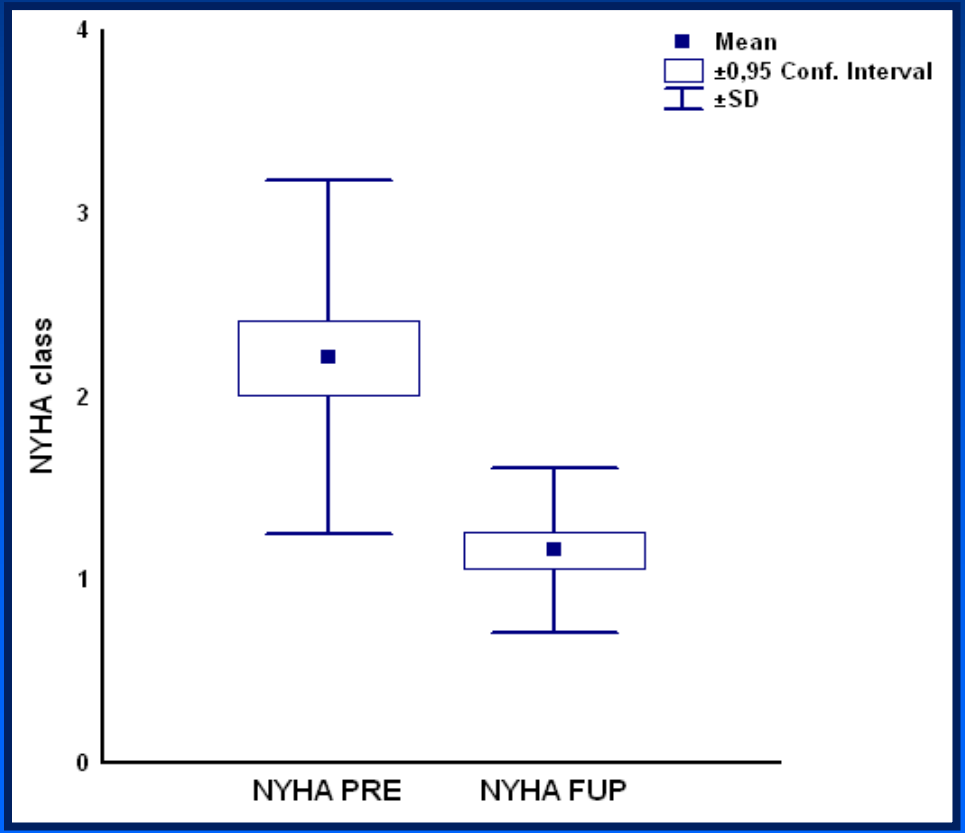
0% Groin wound infections
0% Femoral artery complications

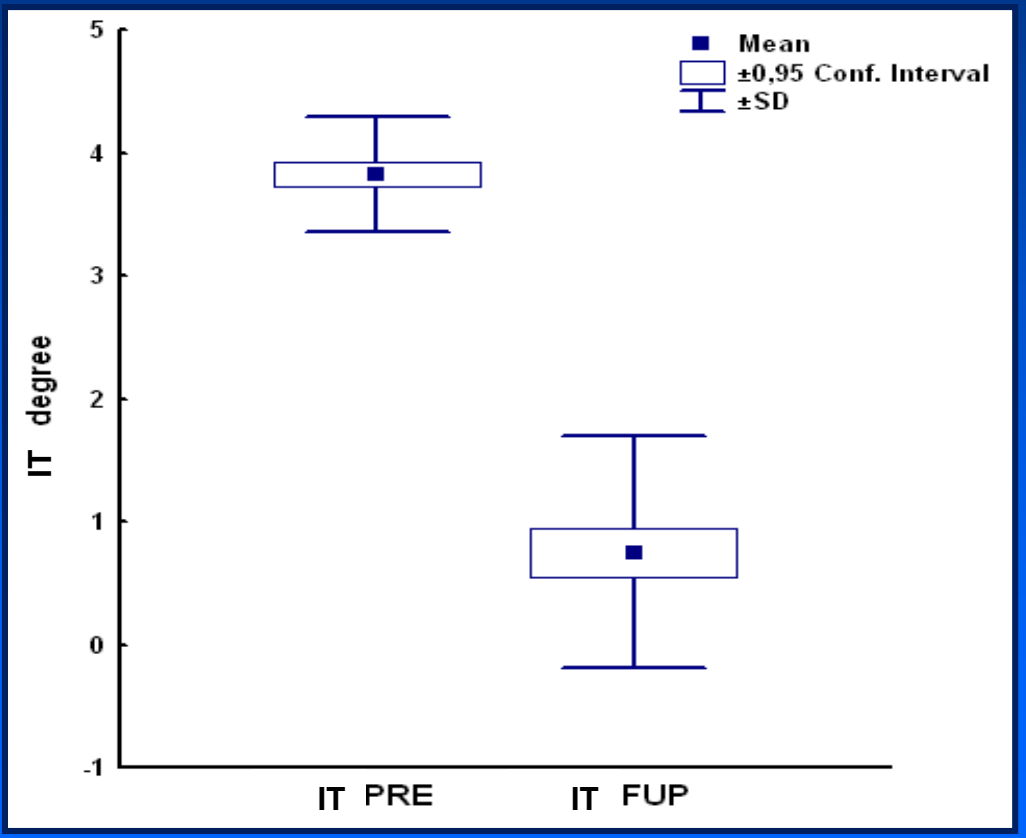
5-year freedom from reoperation 100%

Turin MIS experience

Post-operative and FUP data

Mean follow-up time: 21.5 ± 36.9 months

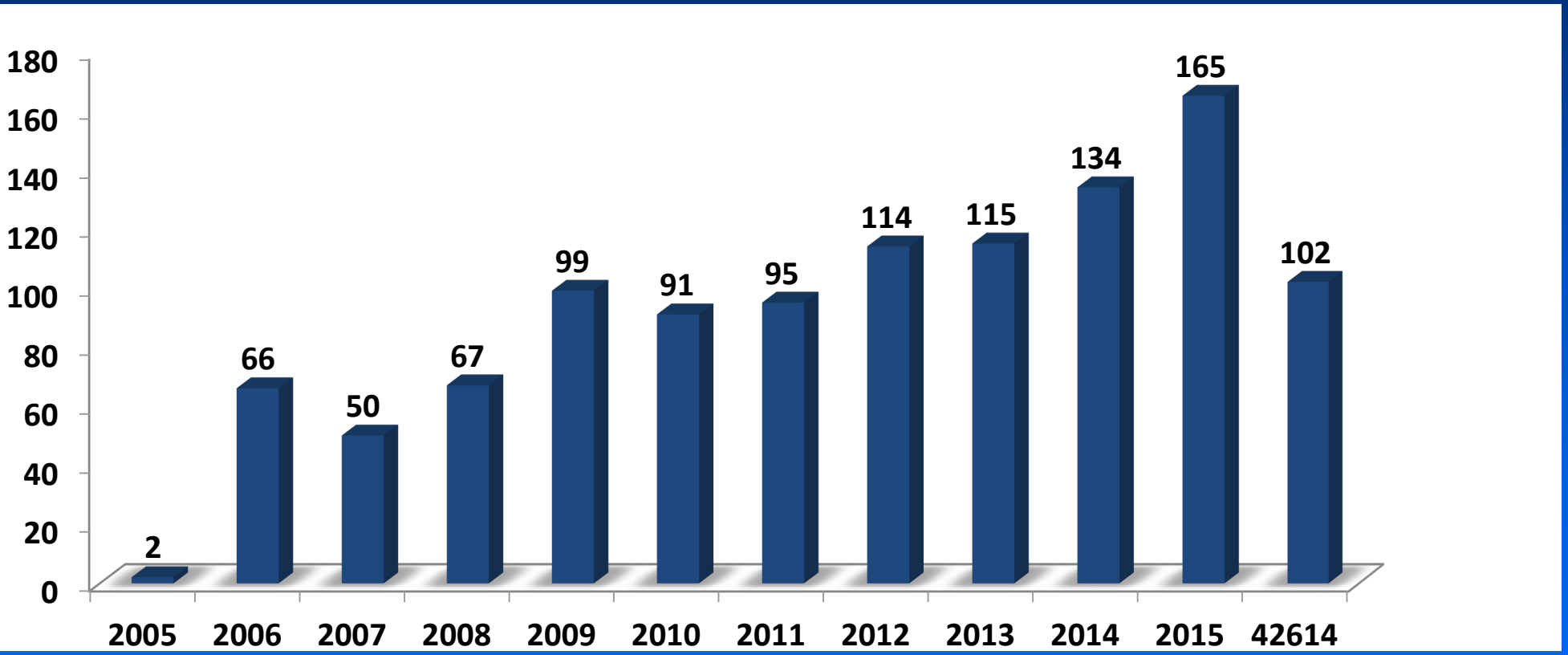




Turin MIS experience

Mini-invasive surgeries

July 2005 – 9/2016: 1099 procedures



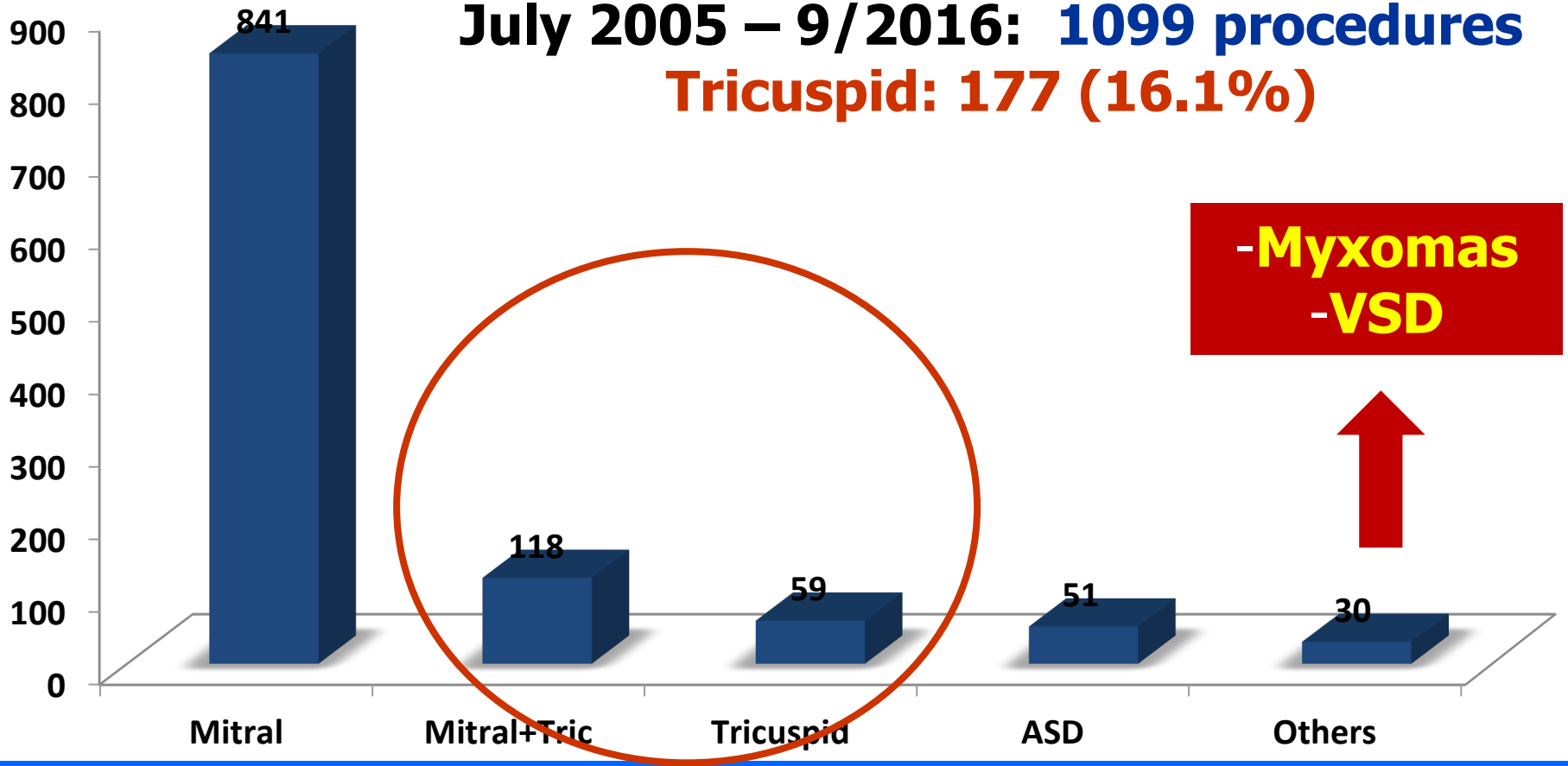
Consecutive unselected patients

Turin MIS experience

Mini-invasive surgeries

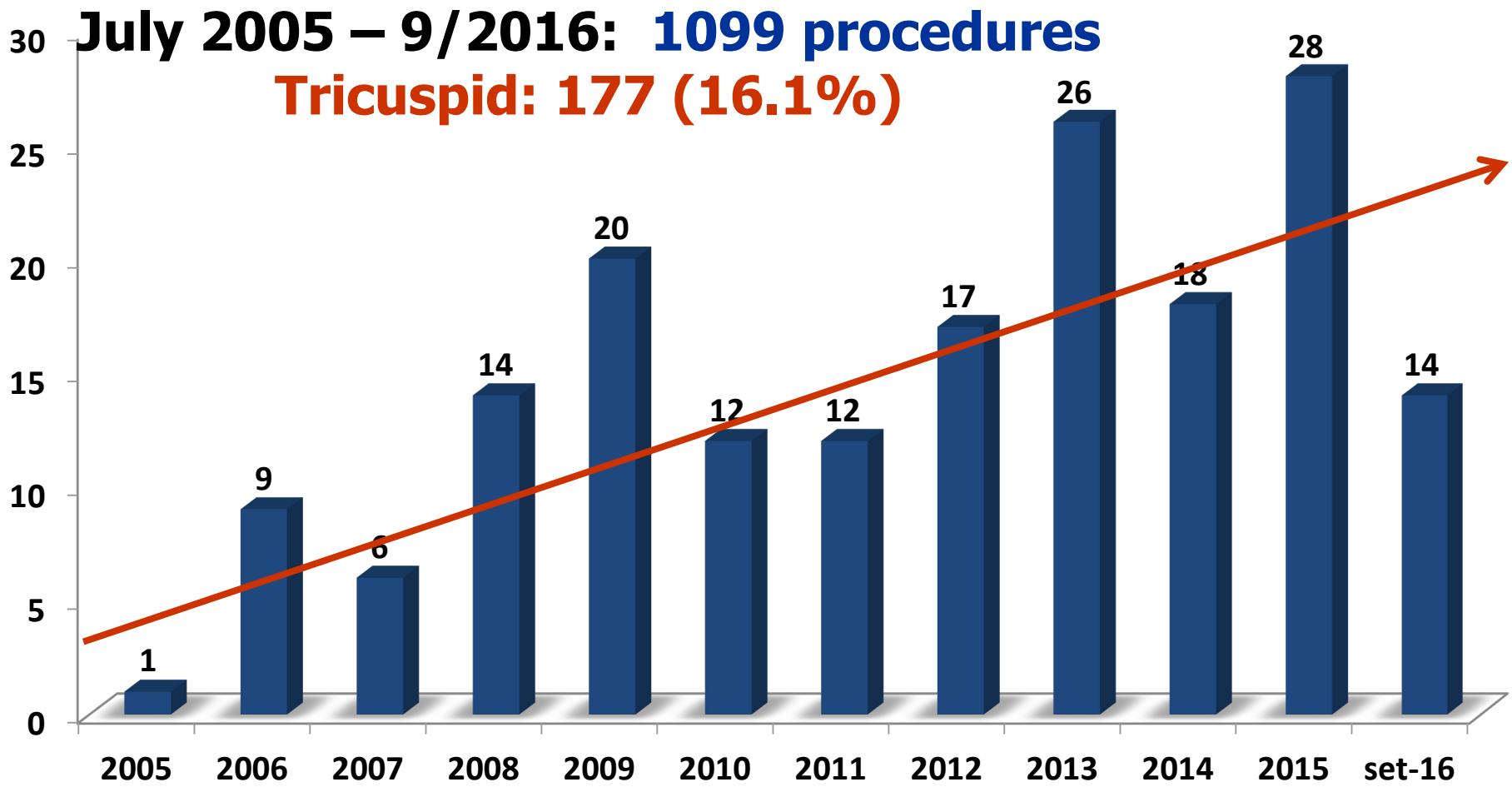
July 2005 – 9/2016: 1099 procedures

Tricuspid: 177 (16.1%)



Turin MIS experience

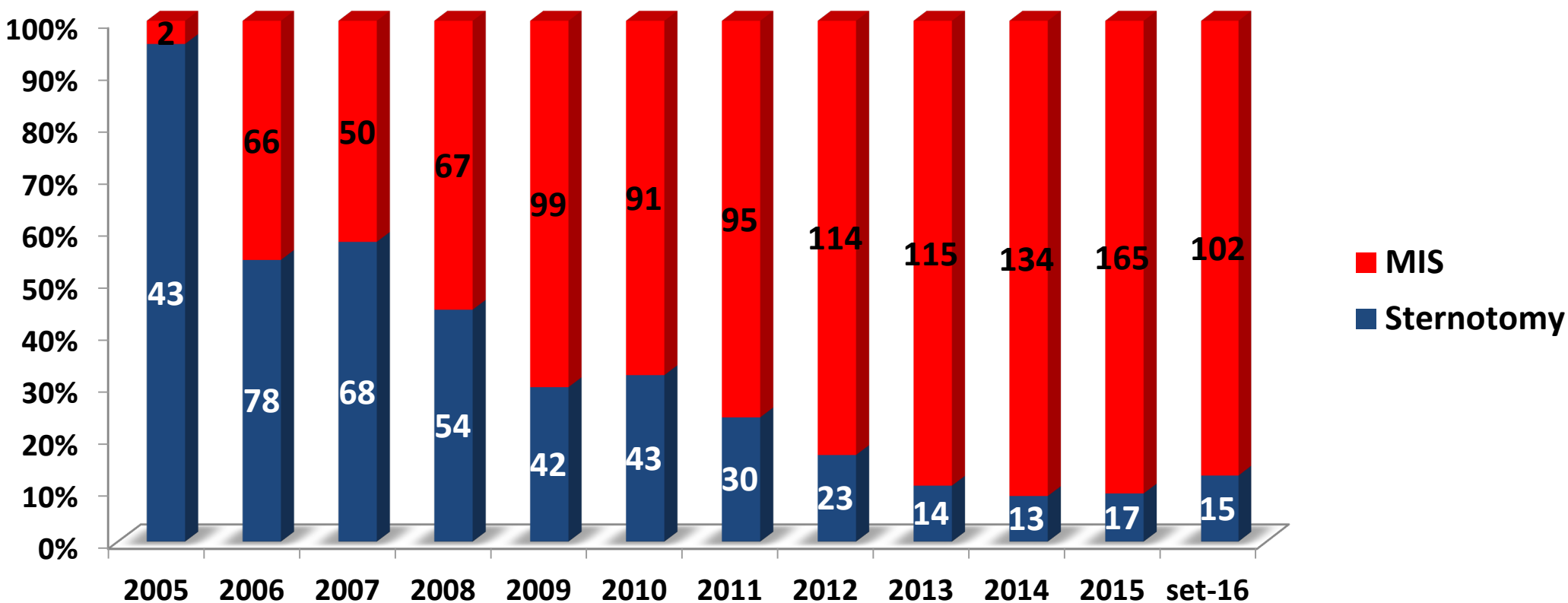
Mini-invasive surgeries



Turin MIS experience

Mini-invasive surgeries

MIS valve procedures vs Median Sternotomy
2005-9/2016



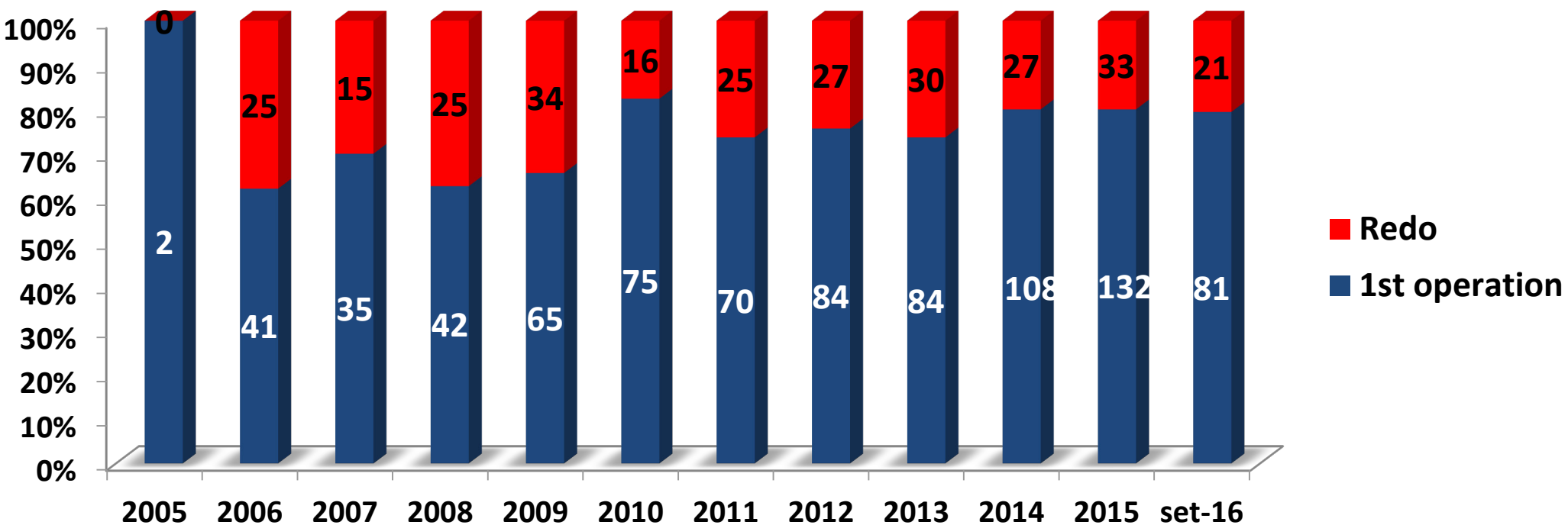
Turin MIS experience

Mini-invasive surgeries

Redo surgery: 278/1099 (25.3%)

- 1st redo 192 (69.1%)
- 2nd redo 52 (18.7%)
- 3rd redo 27 (9.7%)
- 4th redo 7 (2.5%)

86 (30.9%)



Turin MIS experience

Mini-invasive surgeries

July 2005 – 9/2016: 1099 procedures

Tricuspid: 177 (16.1%)

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 vs our previous report

Turin MIS experience
Mini-invasive surgeries

July 2005 – 9/2016: 1099 procedures
Tricuspid: 177 (16.1%)

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 vs our previous report

Turin MIS experience

Mini-invasive surgeries

July 2005 – 9/2016: 1099 procedures

Tricuspid: 177 (16.1%)

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 vs our previous report

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: