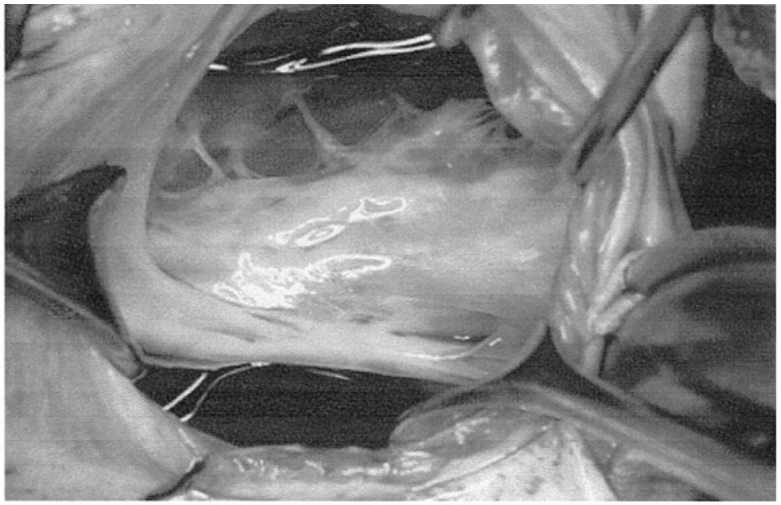
The tricuspid valve

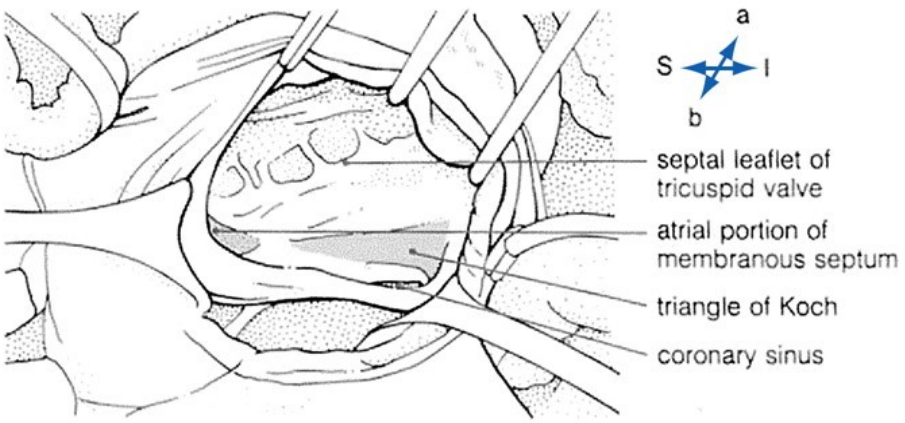
Sotiris Papaspyros

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Anatomy

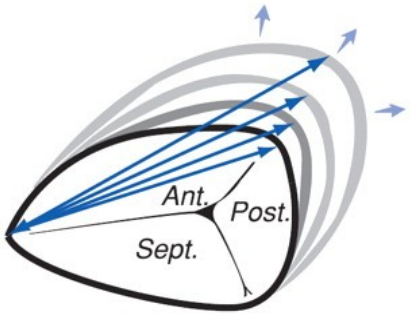
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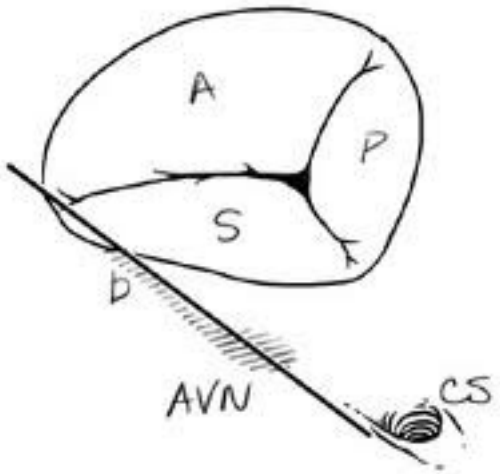
Pathological process of tricuspid annular dilatation

B

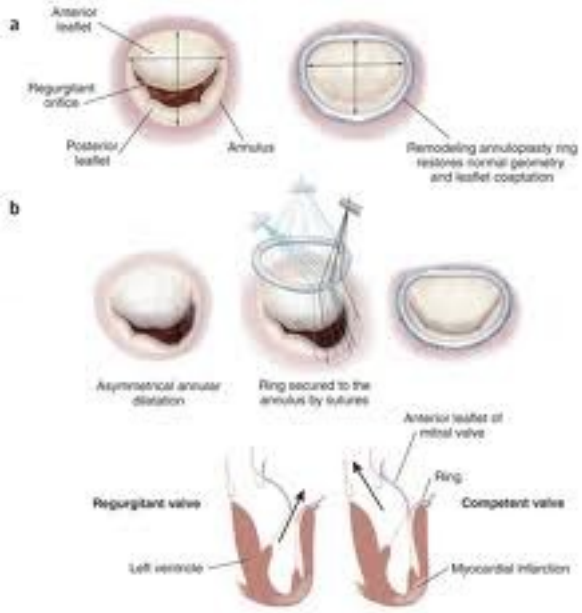


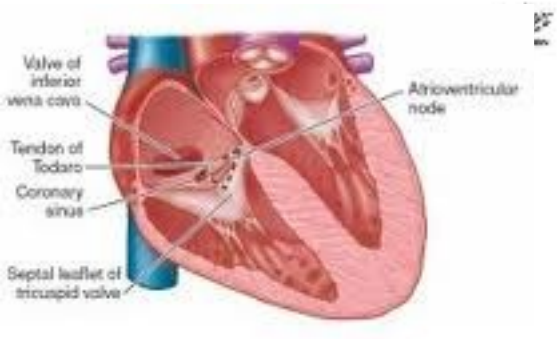
Dreyfus, G. D. et al; *Ann Thorac Surg* 2005;79:127-132

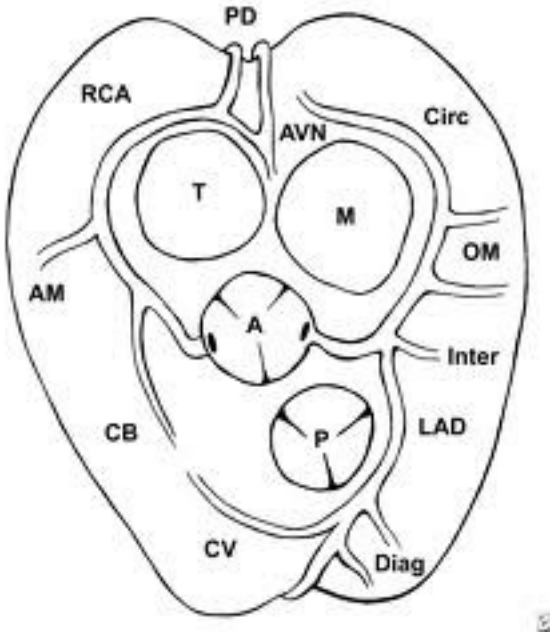
Tricuspid (Right Atrioventricular) Valve













Tricspd regurg

- **Primary (organic)**: leaflets, chordae tendinea, annulus, and papillary muscles.
- endocarditis
- rheumatic disease, generally occurs in combination with tricuspid stenosis.
- Ebstein anomaly is the most common congenital form of tricuspid regurgitation.
- Carcinoid
- Marfan syndrome and other variations of myxomatous disease affecting the mitral and tricuspid valves can lead to prolapsing leaflets, elongation of chordae, or chordal rupture, producing valvular incompetence.

Tricspd regurg

- **Secondary (functional)**: caused by RV dilatation.
- most common presentation of TR is secondary to cardiac valvular pathology (mostly mitral valve disease) on the left side of the heart.
- Eisenmenger syndrome and
- primary pulmonary hypertension lead to the same pathophysiology of progressive right ventricular dilatation, tricuspid annular enlargement, and valvular incompetence.
- **right ventricular infarction** produces either disruption of the papillary muscle or a severe regional wall motion abnormality that prevents normal leaflet apposition by a tethering effect on the leaflets, leading to regurgitation.

Prognosis, Incidense, Demographics

- **Incidence** of tricuspid regurgitation appears to be less than 1%.
- **Mortality/Morbidity** secondary to the underlying cause
  - rheumatic disease, with treatment less than 3%.
  - Ebstein anomaly, mortality depends upon the severity of the valvular deformity and the feasibility of correction. Mortality rates with correction are approximately 10%.
  - myocardial dysfunction or dilatation has a mortality of up to 50% at 5 years.
- **Race:** No race predilection is apparent.
- **Sex:** No sex predilection is apparent.
- **Age**
  - Ebstein anomaly can be detected at birth and during early childhood.
  - 15 years, the most common form of tricuspid regurgitation is rheumatic valvular disease.
  - Adult population, other predisposing factors, including carcinoid, bacterial endocarditis, and CHF, takes precedence.

Signs and symptoms

- The patient with tricuspid regurgitation presents with the signs and symptoms of **right-sided heart failure**.
- S3 gallop is present, and the following physical findings may be found:
- Jugular venous distention with a prominent V wave: When present, a pansystolic murmur is heard along the lower left sternal border with inspiratory accentuation.
- Pulmonary rales if the tricuspid regurgitation is associated with LV dysfunction or mitral stenosis
- RV heave and S 4 gallop that increases with inspiration
- Ascites
- Peripheral edema
- Cachexia and jaundice
- Atrial fibrillation
- A high-pitched pansystolic murmur (loudest in the fourth intercostal space in the parasternal region). The murmur is usually augmented during inspiration and is reduced in intensity and duration in the standing position and during a Valsalva maneuver.

Investigations

- **Chest radiography**
  - Marked cardiomegaly is evident.
  - Evidence of elevated right atrial pressure may include distention of the azygous vein and pleural effusions.
  - Ascites with diaphragmatic elevation may be present.
  - Pulmonary arterial and venous hypertension is common.
- **Echocardiography**
  - The right ventricle is dilated.
  - Paradoxical motion of the ventricular septum is observed and is similar to that found in an atrial septal defect.
- **Cardiac catheterization**: Right atrial pressure and RV end-diastolic pressure are elevated. A rise or no change in right atrial pressure on deep inspiration is characteristic of tricuspid regurgitation. The use of angiography in this setting is controversial.

Surgical decisions

- **Surgical intervention is indicated:**
- **structural deformity** of the valve (eg, Ebstein anomaly) If this produces symptomatic tricuspid regurgitation.
- **bacterial endocarditis**,
  - Total excision of the tricuspid valve without immediate replacement is recommended. The diseased valvular tissue is excised to eradicate the endocarditis, and antibiotic treatment is continued. Most patients tolerate loss of the tricuspid valve well for years.
  - If right heart failure symptoms persist despite medical management and the infections have been controlled, an artificial valve can be inserted.
- **ventricular dilatation** severe and refractory to medical therapy.
- **Tricuspid regurgitation associated with mitral valve disease** and pulmonary hypertension
  - mild tricuspid regurgitation does not require intervention. Severe regurgitation has been successfully treated with tricuspid annuloplasty.
  - As pulmonary vascular pressures fall with successful mitral valve therapy, the tricuspid regurgitation tends to disappear.
- **Organic disease of the tricuspid valve**: Corrective measures for organic disease of the tricuspid valve usually involve valve replacement. Because of the increased incidence of mechanical prosthetic valve thrombosis in this low-flow position, a bioprosthetic valve is preferable.

Tricspd stenosis

- Tricuspid stenosis is almost always rheumatic in origin and is generally accompanied by mitral and aortic valve involvement
- Rare causes: carcinoid syndrome, endocarditis, endomyocardial fibrosis, systemic lupus erythematosus, and congenital tricuspid atresia
- Most stenotic tricuspid valves are associated with clinical evidence of regurgitation.

Pathophysiology

- With rheumatic tricuspid stenosis, the valve leaflets become thickened and sclerotic as the chordae tendineae become shortened.
- The restricted valve opening hampers blood flow into the right ventricle and, subsequently, to the pulmonary vasculature.
- **Right atrial enlargement** is observed as a consequence. The obstructed venous return results in **hepatic enlargement**, decreased pulmonary blood flow, and peripheral edema.

Incidence, demographics

- Tricuspid stenosis is found in approximately 3% of the international population. It is more prevalent in areas with a high incidence of rheumatic fever.
- **Mortality/Morbidity**: The mortality associated with tricuspid stenosis depends on the precipitating cause. The general mortality rate is approximately 5%.
- **Race**
  - No racial predisposition is apparent.
- **Sex**
  - Tricuspid stenosis is observed more commonly in women than in men, similar to mitral stenosis of rheumatic origin. The congenital form of the disease has a slightly higher male predominance.
- **Age**
  - Tricuspid stenosis can present as a congenital lesion or later in life when it is due to some other condition. The congenital form accounts for approximately 0.3% of all congenital heart disease cases. The frequency of tricuspid stenosis in the older population, due to secondary causes, ranges from 0.3-3.2%.

Signs and symptoms

- Fatigue, due to limited cardiac output, may be present.
- Systemic venous congestion leads to abdominal discomfort and swelling. The onset is usually gradual, but it may be rapid if atrial fibrillation or flutter develops.
- Dyspnea may be present but is not severe unless concomitant mitral valve disease is present.
- Patients may complain about prominent pulsations in the neck.
- When tricuspid stenosis occurs concomitantly with mitral stenosis, the decrement of cardiac output to the pulmonary bed may paradoxically diminish the dyspnea, hemoptysis, and orthopnea typically seen with mitral stenosis.

Imaging

- **Chest radiography**: Cardiac size may range from normal to enlarged (ie, cardiomegaly). Right atrial enlargement may be prominent.
- **Echocardiography**: This test has become the procedure of choice for the diagnosis of valvular disorders. The test results help delineate the structure of the tricuspid valve and any other intracardiac pathology.
- **Cardiac catheterization**:
  - concomitant coronary artery disease.
  - Right heart catheterization can be used to determine the gradient across the valve and valve area (ie, severity of stenosis) and assess the presence of associated congenital defects (eg, septal defects, intracardiac shunts, anomalous veins) if present.
  - Assessment of aortic and mitral valves via left heart catheterization is useful in patients with rheumatic disease.

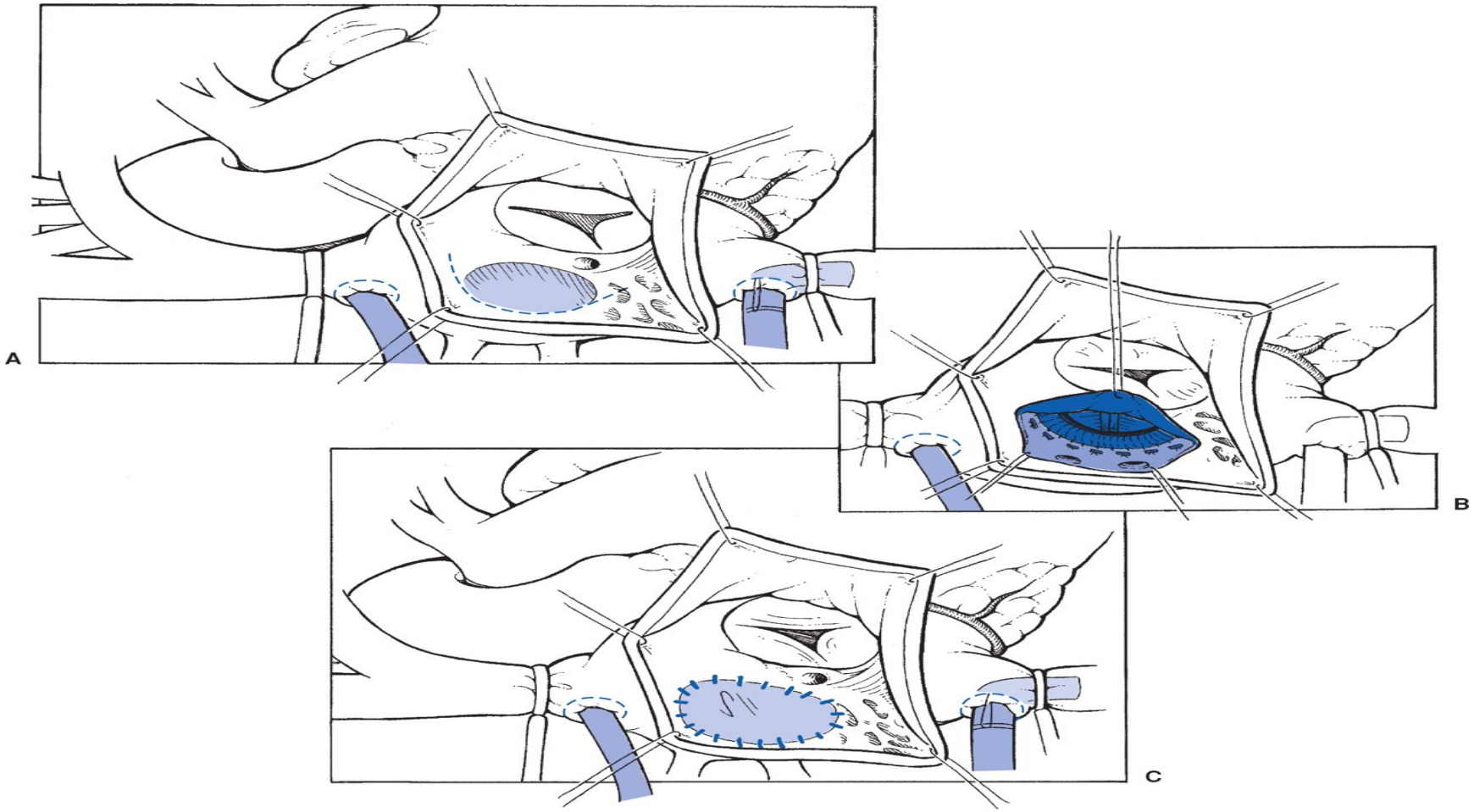
Surgical decisions

- Surgery is rarely performed solely on the tricuspid valve; it is usually performed in combination with mitral and/or aortic valve disease repair.
- With tricuspid valve replacement, the risk of thrombosis is significant and many surgeons advise warfarin therapy for either mechanical or bioprosthetic valve placement.
- Percutaneous balloon valvuloplasty has been used successfully, as long as concomitant regurgitation is not significant.
- The therapy chosen depends on the structure of the valve and the degree of deformity encountered.
- Redundant portions of the dilated right atrium can be excised during the same procedure for restoring the atrium back to normal size.

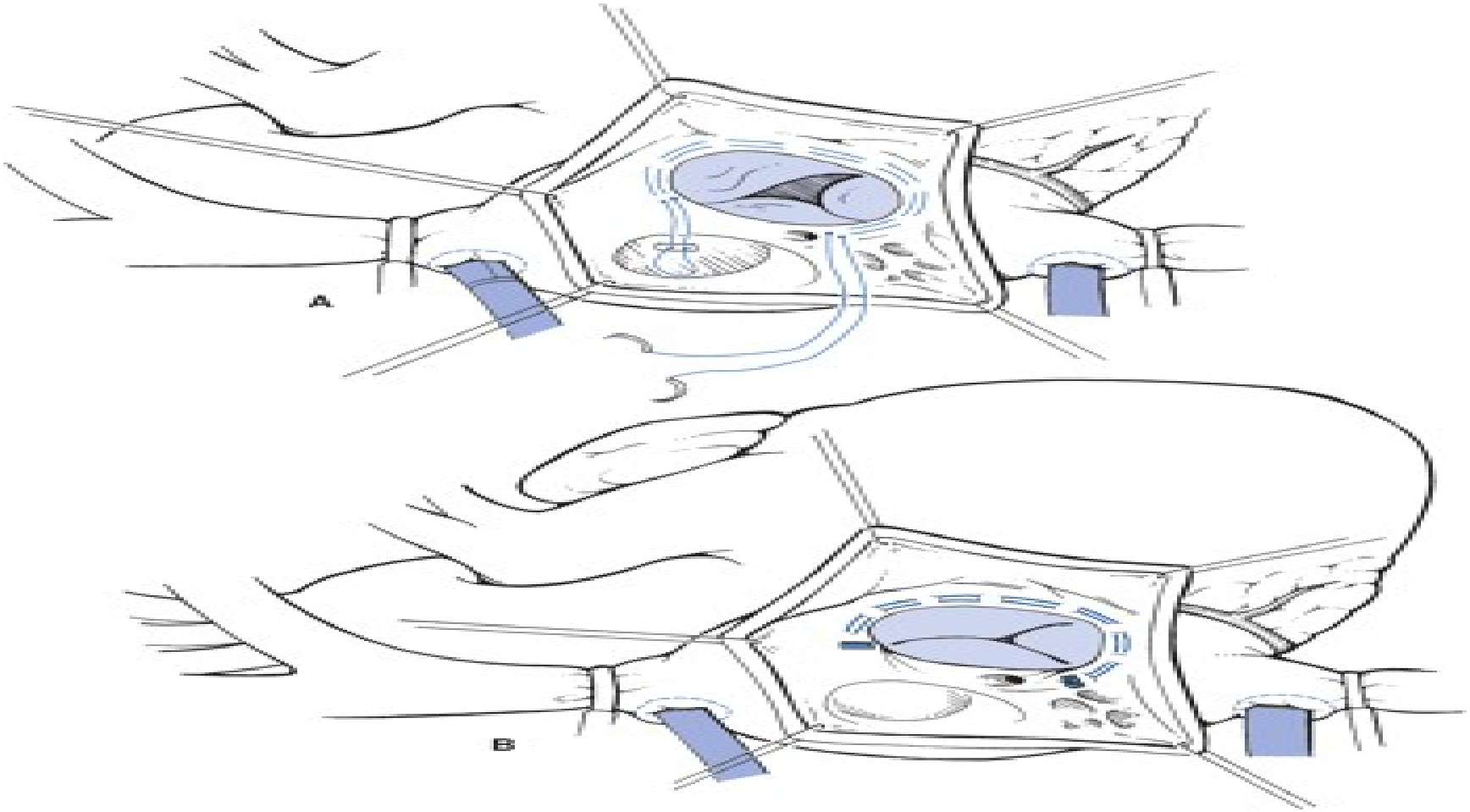
Lawrence Cohn, Richard Shemin

- The choice of reparative technique to use for a durable result must be evaluated,
- which type of valve, mechanical or bioprosthesis, to employ to maximize durability and minimize complications (i.e., thrombosis and thromboembolism).
- The surgical literature can be misleading due to case-selection bias and the various time frames of retrospective reviews. This is particularly true during the era that cage-ball and single-disk mechanical valves were in use.

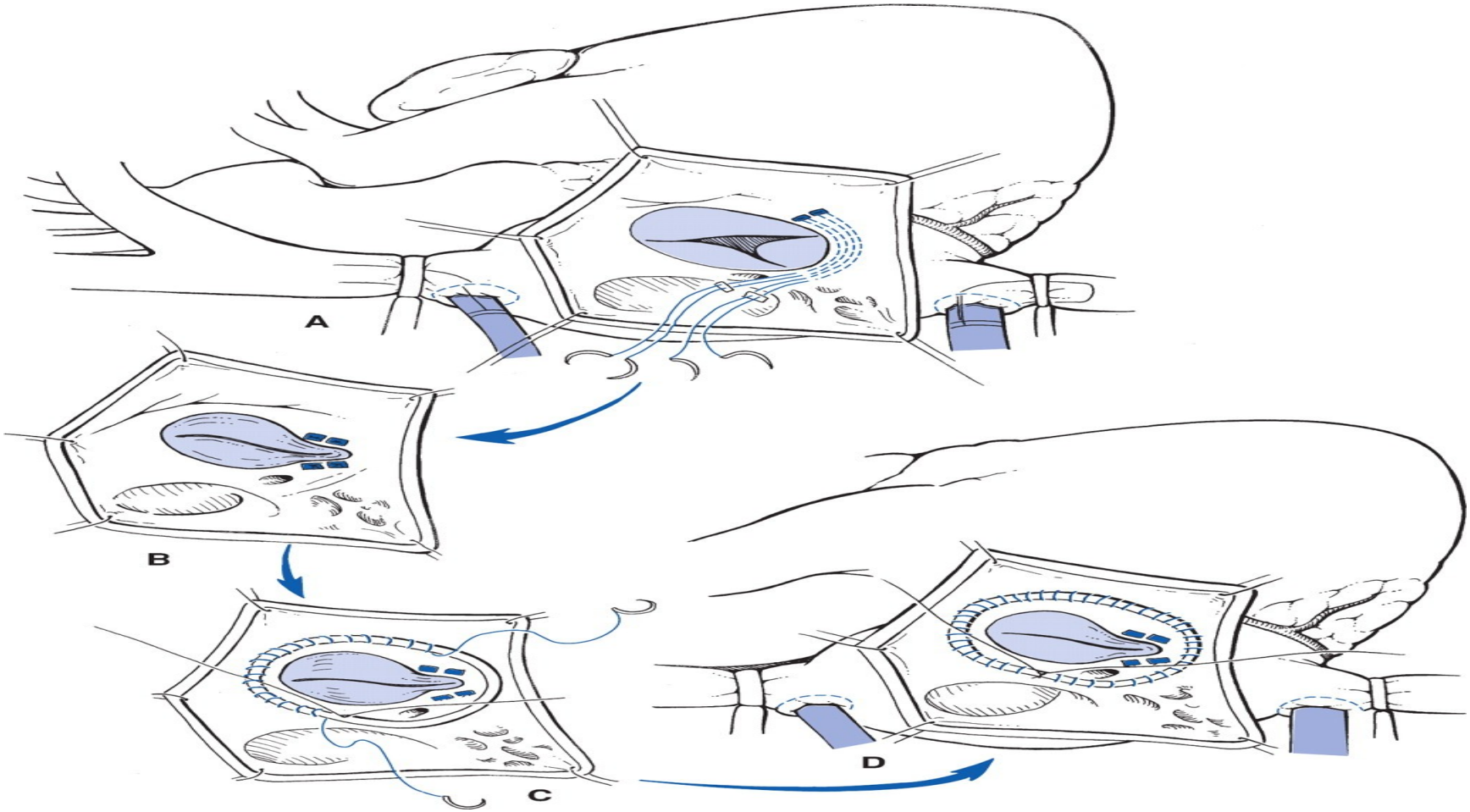
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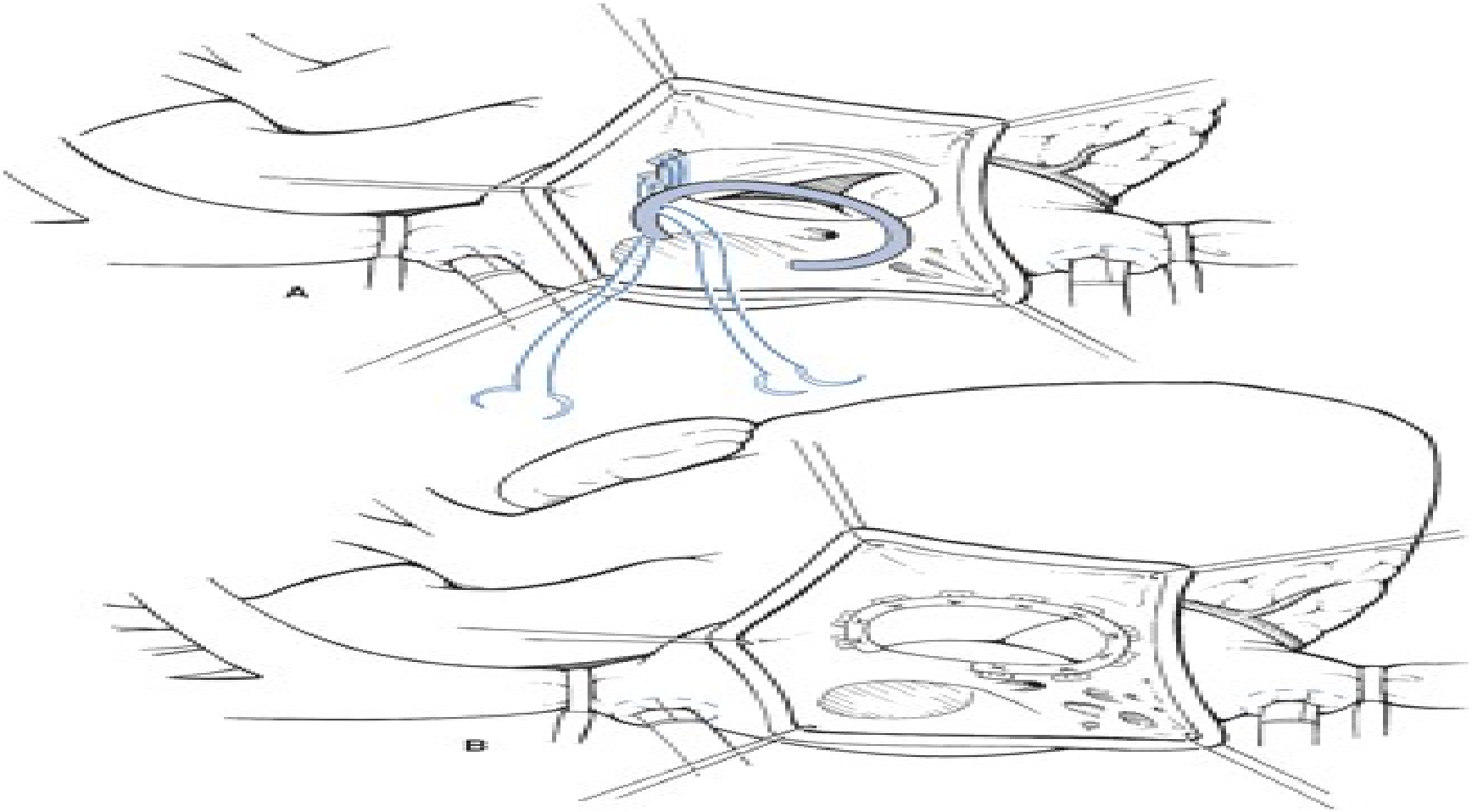
DeVega technique



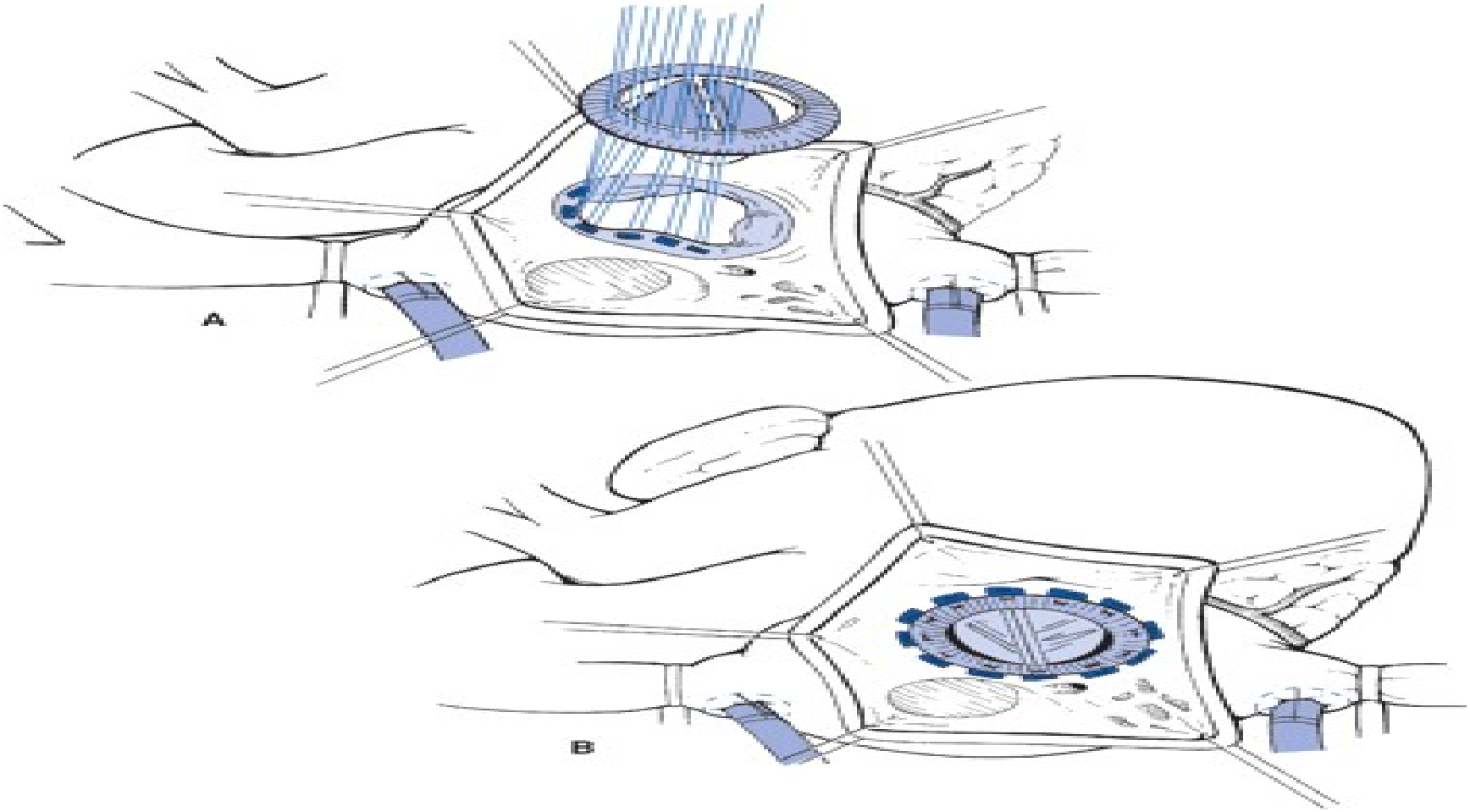
Bicuspidization



Rings and bands



Replacement



Literature review

Repair of Rheumatic Tricuspid Valve Disease: Predictors of Very Long-Term Mortality and Reoperation

J. Aurelio Sarralde, MD, PhD,* José M. Bernal, MD, PhD,* Javier Llorca, MD, PhD, Alejandro Pontón, MD, PhD, Lorena Diez-Solorzano, MD, Juan R. Giménez-Rico, MD, and José M. Revuelta, MD, PhD

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Background. We examined predictors of reoperation and late mortality in patients undergoing tricuspid valve repair for rheumatic disease.

Methods. Between 1997 and 2007, 299 consecutive patients (mean age 50.8 ± 13.7 years) underwent surgical repair of the tricuspid valve for multivalvular organic rheumatic disease. A total of 184 patients was found to have mitral and tricuspid valve disease, 108 triple valve disease, 5 isolated tricuspid lesion, and 2 aortic and tricuspid valve disease. Prosthetic ring annuloplasty was performed in 78 patients, commissurotomy and ring annuloplasty in 82, isolated commissurotomy in 10, suture annuloplasty in 105, and commissurotomy and suture annuloplasty in 24.

Results. Thirty-day mortality was 7.4%. Previous valve surgery and reoperation for bleeding were risk factors for early death. Late mortality was 51.2%, in the majority of patients due to cardiac causes. There was a median follow-up of 16.4 years (range, 6 months to 34 years) and cumulative follow-up of 5,432 patients per year (96.7% complete). Age, New York Heart Association functional class IV and postclamping time were predictive factors for late mortality. At 25 years, the Kaplan-Meier survival was 26.6% ± 4.2%. A total of 106 patients required valve reoperation. Age older than 40 years was a protective factor for reoperation. At 25 years, Kaplan-Meier freedom from reoperation was 35.0% ± 5.3%.

Conclusions. Repair of the tricuspid valve in patients with rheumatic valve disease can be performed with acceptable early results, but progression of rheumatic disease is associated with a high incidence of valve dysfunction and mortality in the long term.

(Ann Thorac Surg 2010;90:503–9)

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Table 1. Surgical Techniques for Tricuspid Valve Repair and Concomitant Intracardiac Procedures in 299 Patients

Technique	No. of Patients
Tricuspid valve	299
Isolated commissurotomy	10
Isolated suture annuloplasty	105
Isolated Duran flexible ring annuloplasty	78
Commissurotomy and De Vega or segmental annuloplasty	24
Commissurotomy and Duran flexible ring annuloplasty	82
Mitral valve	292
Mitral valve replacement	141
Bioprosthesis	47
Mechanical prosthesis	94
Isolated mitral commissurotomy	25
Commissurotomy and Duran flexible ring annuloplasty	102
Isolated Duran flexible ring annuloplasty	24
Associated repair of the subvalvular apparatus	50
Aortic valve	110
Aortic valve replacement	75
Bioprosthesis	37
Mechanical prosthesis	38
Repair procedures	35

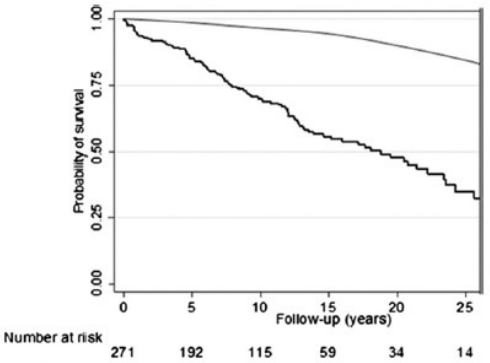


Fig 1. Kaplan-Meier freedom from cardiac causes of death and expected survival curve for a cohort of Spanish population with the same age and sex distribution (thicker line).

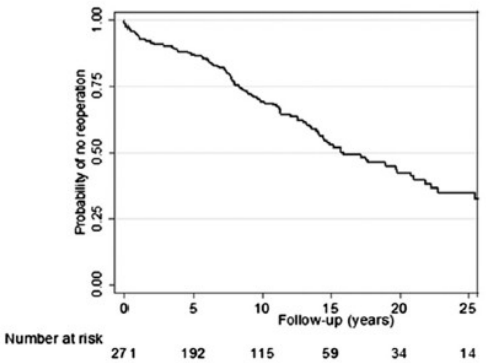


Fig 2. Kaplan-Meier curve for freedom from reoperation for valve-related dysfunction.

Table 3. Valve-Related Lesions at Reoperation and Surgical Techniques for Tricuspid Valve Dysfunction

	No. of Patients	Percentage
Patients undergoing reoperation	106	100
Reason for reoperation		
Isolated mitral valve dysfunction	23	21.7
Isolated aortic valve dysfunction	3	2.8
Mitral and aortic valve dysfunction	11	10.4
Tricuspid valve dysfunction	69	65.1
Isolated tricuspid dysfunction	3	2.8
Mitral and tricuspid dysfunction	33	31.1
Aortic and tricuspid dysfunction	2	1.9
Mitral, aortic, and tricuspid dysfunction	31	29.3
Reoperations on the tricuspid valve		
Prosthetic valve replacement	33	47.8
Bioprosthesis	17	24.6
Mechanical prosthesis	16	23.2
Tricuspid valve repair	36	52.2
Duran flexible ring annuloplasty	16	23.2
Suture annuloplasty	15	41.7
Resuture of the ring	5	7.2

Midterm Outcomes of Tricuspid Valve Repair Versus Replacement for Organic Tricuspid Disease

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Background. Organic tricuspid valve (TV) disease is uncommon. Few studies have compared TV repair with replacement in these patients. The current study compared midterm outcomes of TV repair versus replacement in a large group of patients with organic tricuspid disease.

Methods. Two-hundred and fifty patients underwent surgery for organic TV disease at our institution from 1979 to 2003. Clinical and echocardiographic follow-up were obtained, were 99% complete, and were 5.2 ± 4.1 years long (mean ± standard deviation).

Results. One hundred and seventy-eight patients (71%) underwent TV repair and 72 (29%) received TV replacement (54 bioprosthetic, 18 mechanical). Repair patients were more likely to have hypertension, rheumatic pathology, or elective surgery. Concomitant procedures included mitral (50% of patients), aortic (26%), and coronary bypass (6%) operations. Perioperative and midterm mortality were higher in the replacement group (both $p < 0.001$). Cox regression analysis revealed TV replacement as an independent predictor of midterm mortality (hazard ratio: 5.1, 95% confidence interval: 2.9 to 9.1, $p < 0.001$) and decreased event-free survival (hazard ratio: 2.0, 95% confidence interval: 1.1 to 3.6, $p = 0.02$). Follow-up echocardiography revealed more moderate to severe tricuspid regurgitation in repair patients (38% vs 5%, $p < 0.001$), but no difference in New York Heart Association functional class or reoperation rates.

Conclusions. Tricuspid valve repair is associated with better perioperative, midterm, and event-free survival than TV replacement in patients with organic tricuspid disease. Despite more tricuspid regurgitation in the repair group during follow-up, reoperation rates and functional class were similar. Repair should be performed whenever possible in patients with organic tricuspid disease.

(Ann Thorac Surg 2006;82:1735–41)

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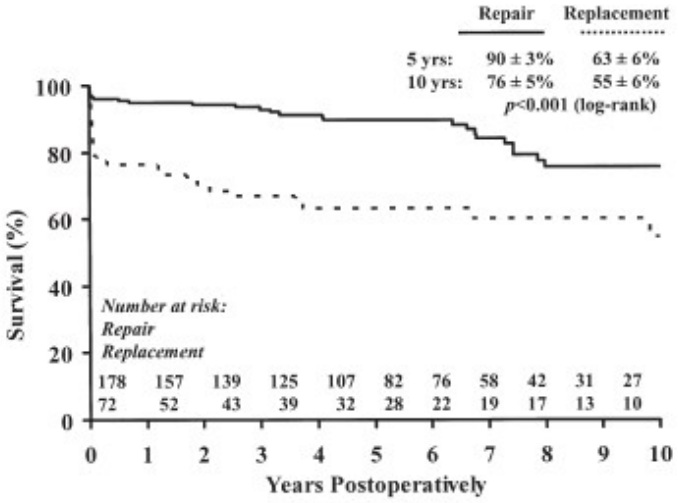


Fig 1. Kaplan-Meier curve comparing survival in patients with organic tricuspid disease who receive tricuspid valve (TV) repair versus replacement surgery.

Tricuspid valve surgery: a thirty-year assessment of early and late outcome☆

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Abstract

Objective: Tricuspid valve (TV) surgery is usually performed as a concomitant reconstruction procedure in addition to the correction of oth cardiac pathologies. Isolated tricuspid procedures are exceptionally rare. Prosthetic valve replacement is also seldom required. Generally, thes patients face a high risk of operative mortality and long-term outcome is poor. In this study we reviewed our experience with TV surgery focusir on risk factors for operative mortality, long-term outcome and incidence of valve related complications **Methods:** Retrospective analysis of 41 consecutive patients >18 years with acquired TV disease operated on between 1974 and 2003. The follow-up is 97% complete (mean 5.9 ± 6 years). Three hundred and sixty-six patients (88%) underwent TV surgery with concomitant mitral (n = 340) or aortic (n = 100) valve surgery. Th tricuspid valve was repaired in 310 patients (74.5%) and replaced in 106 (25.5%). A biological prosthesis was used in 68 patients (64%). Mean age repair and replacement was 61 ± 12.5 and 50 ± 11.3 years, respectively ($p < 0.001$). **Results:** Overall 30-day mortality was 18.8% (78/416) ar decreased from 33.3% (1974–1979) to 11.1% (2000–2003) ($p \leq 0.0001$). Thirty-day mortality after TV repair and replacement was 13.9% (43/31 and 33% (35/106), respectively ($p \leq 0.001$). Cox regression analysis revealed TV replacement as an independent predictor of 30-day mortalit Ten-year actuarial survival after TV repair and replacement was 47 ± 3.5% and 37 ± 4.8%, respectively ($p = 0.002$). Forty-five patients (10.8 required a TV re-operation after 7.7 ± 5.1 years. Freedom from TV re-operation 10 years after TV repair and replacement was 83 ± 3.6% ar 79 ± 6.1%, respectively ($p = 0.092$). **Conclusions:** Patients who require tricuspid valve surgery constitute a high-risk group. Tricuspid valve repa is associated with better perioperative and long-term outcome than valve replacement. However, patients undergoing replacement showed significant higher incidence of risk factors for operative mortality. The incidence of re-operation is low with no significant difference when th tricuspid valve has been repaired or replaced. When valve replacement is necessary we recommend the use of a biological prosthesis considering the poor long-term survival.

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Table 1
Preoperative and perioperative characteristics of the 416 patients who underwent tricuspid valve surgery

	TV repair (n = 310)		TV replacement (n = 106)		p value
	n	%	n	%	
Age (mean ± SD) (years)	60.6 ± 12.5		49.9 ± 11.3		<0.001
Female gender	201	65	84	79	0.006
Tricuspid valve lesion					
Regurgitation	277	89	34	32	<0.001
Stenosis		10	3	15	14
Combined		15	5	51	48
Unavailable		8	3	6	6
Peripheral edema	139	45	38	36	<0.001
Ascites	34	11	19	18	<0.001
Permanent pacemaker	41	13	6	6	0.034
LV-EF (mean ± SD) (%)	54.7 ± 12.2		54.9 ± 13.9		0.922
PAm (mean ± SD) (mmHg)	33.1 ± 13.1		33.3 ± 12.7		0.929
Previous cardiac surgery	137	44	46	43	0.777
Concomitant procedures	279	90	87	82	0.065
Emergency operation	10	3	12	11	0.004
CPB time (min; mean ± SD)	112 ± 45		112 ± 38		0.85
Cross-clamp time (min; mean ± SD)	72 ± 30		62 ± 29		0.012

LV-EF, left ventricular ejection fraction; PAm, mean pulmonary artery pressure; CPB, cardiopulmonary bypass.

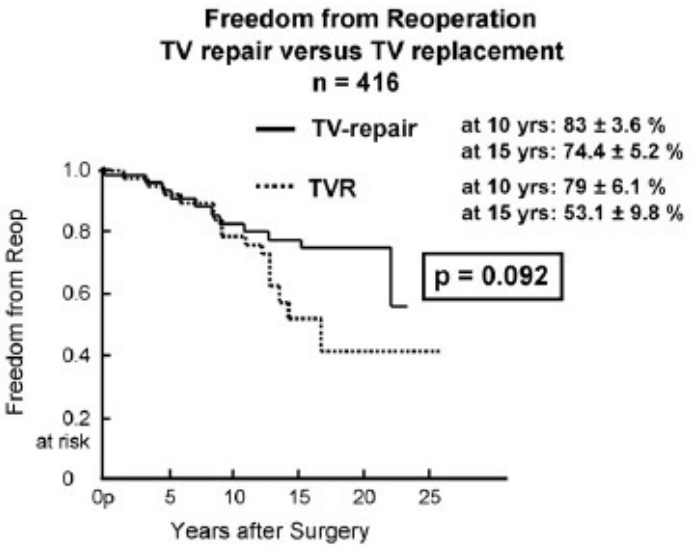


Fig. 4. Freedom from tricuspid valve related re-operation. Kaplan–Meier estimate of freedom from re-operation for patients who underwent tricuspid valve repair (solid line) or replacement (dotted line). Freedom from tricuspid valve re-operation 10 years after TV repair and replacement was 83 ± 3.6% and 79 ± 6.1%, respectively.

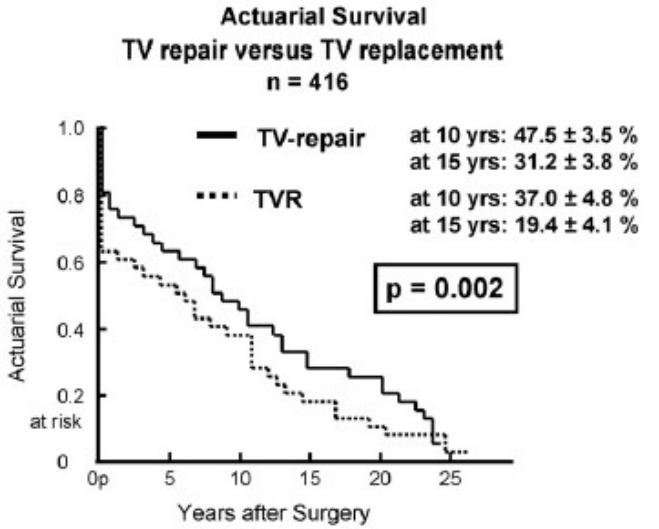


Fig. 3. Actuarial survival after TV repair and replacement. Kaplan–Meier estimate of survival for patients, who underwent tricuspid valve repair (solid line) or replacement (dotted line). The actuarial survival probability at 10 years was 47.5 ± 3.5% for patients who underwent tricuspid valve repair and 37 ± 4.8% for patients who underwent valve replacement.

Outcomes of Tricuspid Valve Repair and Replacement: A Propensity Analysis

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Background. The purpose of this study was to compare operative mortality and long-term outcome of patients undergoing tricuspid valve replacement versus tricuspid valve repair.

Methods. From February 1986 to July 2006, 315 patients underwent tricuspid valve surgery including 93 replacements (72 biologic, 21 mechanical) and 222 repairs. To control for selection bias and varying comorbidities, a matched cohort of patients undergoing repair versus replacement was selected using propensity score analysis (68 patients in each group).

Results. In the propensity-matched cohorts, operative mortality was similar for tricuspid valve replacement (13% ± 4%) and repair (18% ± 5%; $p = 0.64$). Intensive care unit length of stay was similar between cohorts (replacement, 4 days; repair, 3 days; $p = 0.45$), but the replacements had a significantly longer hospital lengths of stay (9 days versus 6 days; $p = 0.01$). In the replacement cohort, survival was 85% at 1 year, 79% at 5 years, and 49% at 10 years. In the repair cohort, survival rates were similar with 80% at 1 year, 72% at 5 years, and 66% at 10 years ($p = 0.66$ versus replacement).

Conclusions. Surgical treatment of tricuspid valve disease, regardless of the operative approach, is associated with significant early and late mortality. However, there is no difference favoring tricuspid valve repair over replacement. Thus, we should not hesitate to consider tricuspid valve replacement for patients in whom we believe there is a reasonable chance for recurrence of regurgitation after repair.

(Ann Thorac Surg 2009;87:83–9)

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Table 2. Operative Details for All Patients Undergoing Tricuspid Valve Replacement or Tricuspid Valve Repair

Variable	Replacement (n = 93)	Repair (n = 222)	*p* Value
Operative procedure			<0.001
TV procedure only	56 (60%)	73 (33%)	
TV procedure plus valve(s)	28 (30%)	140 (63%)	
TV procedure plus other cardiac procedure	9 (10%)	9 (4%)	
Cross-clamp time (min)[a]	91 ± 57 (n = 51)	98 ± 52 (n = 222)	0.39
Cardiopulmonary bypass time (min)	159 ± 85	172 ± 75	0.18
Biologic valve	72 (77%)	NA	
Size of valve	30.8 ± 2.3	NA	
Annuloplasty ring	NA	101 (46%)	
Size of ring	NA	29.3 ± 2.6	

[a] Forty-two replacements were performed without clamping.

NA = not applicable; TV = tricuspid valve.

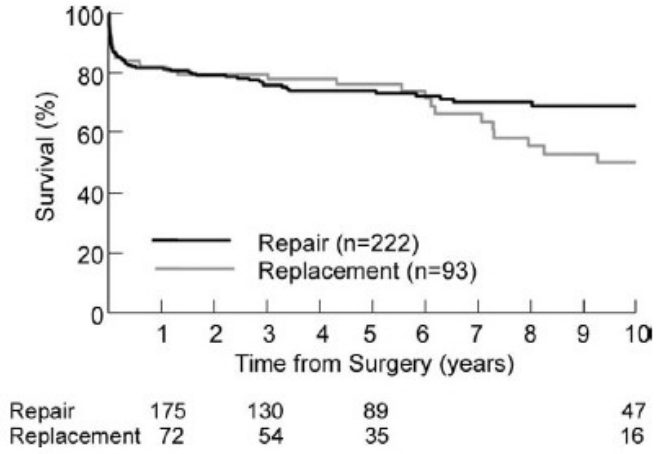


Fig 1. Long-term survival estimates for all patients undergoing tricuspid valve replacement (gray line [n = 93]) or repair (black line [n = 222]). The numbers of patients at risk for each group are reported at 1, 3, 5, and 10 years.

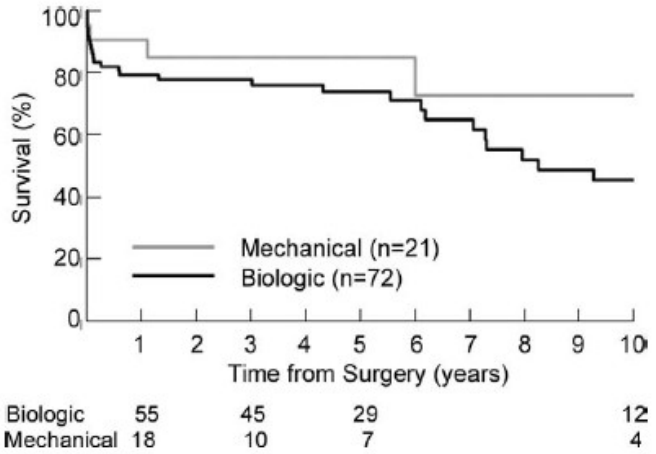


Fig 2. Long-term survival estimates for all patients undergoing tricuspid valve replacement with a biologic prosthesis (black line [n = 72]) or a mechanical prosthesis (gray line [n = 21]). The numbers of patients at risk for each group are reported.

Table 1. Preoperative Characteristics for All Patients Undergoing Tricuspid Valve Replacement or Tricuspid Valve Repair

Variable	Replacement (n = 93)	Repair (n = 222)	*p* Value
Age (years)	52.2 ± 16.2	58.4 ± 16.4	0.002
Sex (female)	58 (62%)	138 (62%)	1.00
Urgent/emergent procedure	8 (9%)	15 (7%)	0.64
Pulmonary hypertension	34 (37%)	125 (56%)	0.002
Diabetes mellitus	19 (20%)	47 (21%)	1.00
Hemodialysis	2 (2%)	16 (7%)	0.11
Cerebrovascular accident	14 (15%)	20 (9%)	0.16
History of infectious endocarditis	30 (32%)	27 (12%)	<0.001
Active infection at surgery	16 (17%)	27 (12%)	0.28
Valve etiology			<0.001
Endocarditis	28 (30%)	23 (10%)	
Myxomatous/annular dilation	28 (30%)	133 (60%)	
Rheumatic	11 (12%)	34 (15%)	
Prosthetic valve failure	8 (9%)	10 (5%)	
Congenital	18 (19%)	22 (10%)	
Previous cardiac surgery	61 (66%)	80 (36%)	<0.001
Previous TV operation	21 (23%)	10 (5%)	<0.001
Prior TV replacement	14 (15%)	NA	
Prior TV repair	7 (8%)	10 (5%)	
Time since previous TV procedure (years)	16 ± 10	8 ± 6	0.28
NYHA			<0.001
Class I	11 (12%)	16 (7%)	
Class II	14 (15%)	32 (14%)	
Class III	28 (30%)	99 (45%)	
Class IV	40 (43%)	75 (34%)	

NYHA = New York Heart Association; NA = not applicable; TV = tricuspid valve.

Table 3. Preoperative Characteristics for Patients Undergoing Tricuspid Valve Replacement or Repair Matched Using Propensity Score Analysis

Variable	Replacement (n = 68)	Repair (n = 68)	*p* Value
Age (years)	51 ± 16	51 ± 19	0.85
Sex (female)	42 (62%)	34 (50%)	0.22
Urgent/emergent procedure	6 (9%)	8 (12%)	0.78
Pulmonary hypertension	22 (32%)	26 (38%)	0.59
History of infectious endocarditis	22 (32%)	22 (32%)	1.00
Valve etiology			0.08
Endocarditis	28 (29%)	23 (34%)	
Myxomatous/annular dilation	13 (19%)	26 (38%)	
Rheumatic	10 (15%)	5 (7%)	
Prosthetic valve failure	8 (12%)	4 (6%)	
Congenital	17 (25%)	10 (15%)	
Previous cardiac surgery	42 (62%)	35 (52%)	0.30
NYHA			0.29
Class I	9 (13%)	11 (16%)	
Class II	13 (19%)	14 (21%)	
Class III	21 (31%)	28 (41%)	
Class IV	25 (37%)	15 (22%)	
Operative procedure			0.12
TV procedure only	38 (56%)	27 (40%)	
TV procedure plus valve(s)	27 (40%)	39 (57%)	
TV procedure plus other cardiac procedure	3 (4%)	2 (3%)	

NYHA = New York Heart Association; TV = tricuspid valve.

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

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Background. Tricuspid valve replacement (TVR) is an uncommon procedure. The use of biological vs mechanical prostheses in TVR has pros and cons. Therefore, we debate the choice between the different types of valves by means of a meta-analysis of studies of the last decade.

Methods. The heading "tricuspid valve replacement and (bio* or mec*)" was used to retrieve studies from Medline, Current Contents, and Embase. Eight out of 11 studies met the preset strict criteria: intra-institutional comparison of results of biological or mechanical TVR. Survival of hospital-discharged patients was recalculated to reduce the effect of unbalanced perioperative risk factors on overall survival. Hazard ratio was obtained from actuarial survival graphics comparison and at-risk groups, according to the method described by Parmar . If missing, the number of patients at risk was approximated assuming constant and noninformative censoring. Hazard pooling was done according to study heterogeneity. Bioprostheses were assumed as the gold standard and mechanical prostheses assumed as the challenging device. Therefore, a hazard more than 1 pointed to a higher risk of mechanical prostheses. Our 1998 study was updated for this analysis.

Results. In this study, 1,160 prostheses and 6,046 follow-up years were analyzed. The pooled survival hazard ratio of mechanical prostheses versus bioprostheses was 1.07 (0.84 to 1.35, $p = 0.60$). The pooled freedom from reoperation hazard ratio was 1.24 (0.67 to 2.31, $p = 0.67$). Pooled survival differences were trivial, favoring mechanical prostheses at 1 (−0.04%) and 15 years (−1.1%) and favoring bioprostheses (+1.8%) at 10 years.

Conclusions. There is not a gold standard in tricuspid prostheses replacement. Prosthetic choice is left to the surgeon's clinical judgment, taking into consideration each patient's characteristics and needs.

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Table 1. Selected Studies of the Literature

Study (Publication Date)	Location	Operative era	No. Bio-All-Mec	M/F ratio	Age (Years) Bio-All-Mec	Operative Death(%)
Van Nooten (1995) [11]	Belgium	1967–87	69 146 77	0.28	51	16.4
Scully (1995) [20]	Canada	1978–93	28 60 32	0.46	50	26.6
Munro (1995) [18]	Canada	1975–92	83 97 14	0.20	55	14.4
Farinas (1996) [19]	France	1969–93	47 55 8	0.37	49	23.6
Hayashi (1996) [16]	Japan	1978–95	14 29 15	0.70	36–40–43	17.2
Ratnatunga (1998) [14]	UK	1986–97	225 425 200	0.27	57	17.2
Dalrymple (1999) [17]	UK	1973–96	52 87 35	0.17	59	10.3
Do (2000) [12]	France	1978–98	26 32 6	0.61	48	18.7
Kaplan (2002) [15]	Turkey	1980–00	32 129 97	0.27	33–36–37	23.2
Carrier (2003) [3]	Canada	1977–02	82 97 15	0.37	53–52–48	17.5
Local data (2003)	Italy	1970–02	78 101 23	0.44	46–46–48	25.7
Total (mean)	11	1967–02	646 1258 514	(0.37)	(49.3)	(19.2)

Bio = biological; Mec = mechanical; M/F = male/female.

Table 2. Follow-Up and Survival Data

Study	Mean Follow-up (Years)	Total Follow-up (Years)	Mec total follow-up (Years)	Bio total Follow-up (Years)	Biological Valve 5 yr-surv.	Mechanical Valve 5 yr-surv.
Van Nooten [11]	7.8	1015	535	480	84.5[a]	70[a]
Scully [20]	6.3	375	200	175	60	65
Munro [18]	3.7	360	52	308	56	60
Farinas [19]	9.5	521	76	445	70	70
Hayashi [16]	6.7	194	100	94	84[a]	71[a]
Ratnatunga [14]	–	1585	746	839	61.5	57.9
Dalrymple [17]	8.1	707	284	423	66	73
Do [12]	5.6	162	30	132	60	60
Kaplan [15]	6.3	349	234	115	65	77.5
Carrier [3]	4.0	132	22	110	68	75
Local data	7.4	646	135	511	55	54.5
Total (mean)	(6.8)	6046	2414	3632	(66.7)	(66.4)

[a] survival of hospital discharged patients.

Bio = biological; Mec = mechanical; 5 yr-surv. = overall 5 year postoperative survival.

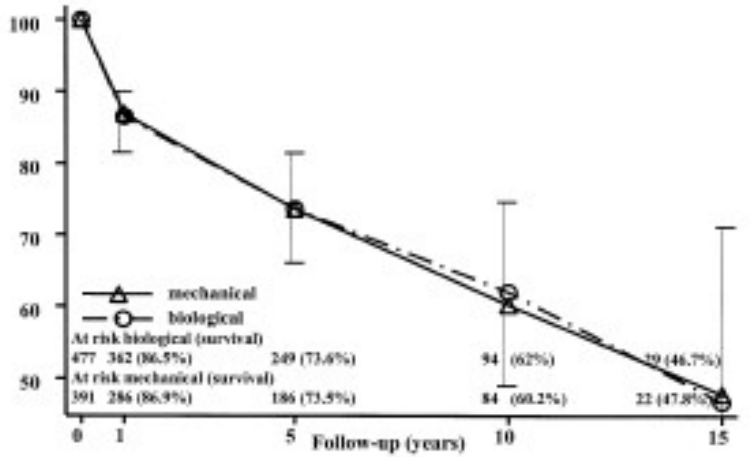


Fig 3. Average survival of the hospital-discharged patients, at stated follow-up years, from the studies of Table 1. The difference in survival between biological and mechanical prostheses is reported with the 95% confidence limits.

Long-Term Clinical Results of Tricuspid Valve Replacement

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Background. Tricuspid valve replacement (TVR) has been performed with mechanical or bioprosthetic valves. However, the relative advantages of the two types are incompletely known.

Methods. Between 1978 and 2003, we performed 138 TVR (35 bioprosthetic, 103 mechanical) in 125 patients (50 men, 75 women), with a mean age of 43.7 ± 16.6 years. The diseases that required TVR were rheumatic (94), prosthetic valve failure (14), congenital (14), infective endocarditis(5), isolated tricuspid regurgitation (4), and miscellaneous conditions (7). The operations included the following: isolated TVR (41), double valve replacement (58), and triple valve replacement (39). The follow-up rate was 98.3%, and cumulative follow-up was 828.5 patient-years.

Results. There were 22 in-hospital deaths (17.6%) and 13 (10.4%) late deaths. Fourteen patients required additional operations. There were 33 postoperative valve-related events including 11 throm
episodes. Kaplan-Meier sur
years was 73.8 ± 8.5% (bioprosthetic: 70.2 ± 10.4%, mechanical: 66.0 ± 19.4%). At 15 years, freedom from reoperation was 66.3 ± 9.4% (bioprosthetic: 55.1 ± 13.8%, mechanical: 86.0 ± 6.2%) and freedom from valve-related events was 49.9 ± 8.0%. The linearized incidence of valve thrombosis was 1.28%/patient-year (bioprosthetic: 0, mechanical: 1.92), anticoagulation-related bleeding was 0.37%/patient-year (mechanical: 0.54), reoperation was 1.71%/patient-year (bioprosthetic: 2.68, mechanical: 1.25), and valve-related events were 4.33%/patient-year (bioprosthetic: 3.83, mechanical: 4.6).

Conclusions. Both bioprosthetic and mechanical valves revealed similar long-term outcomes. However, findings suggest that greater care is needed to prevent valve thrombosis in mechanical valves in the early postoperative period, and there is a greater chance for reoperation in bioprosthetic valves.

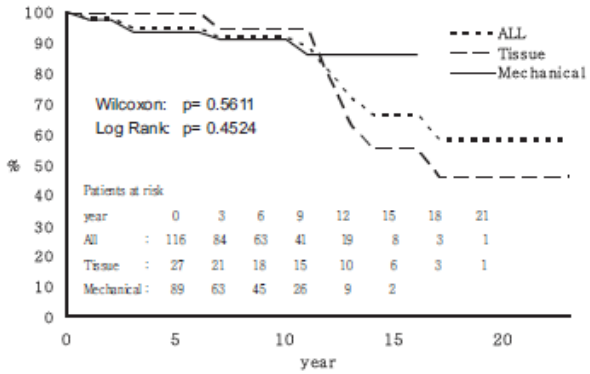


Fig 4. Kaplan-Meier estimated freedom from reoperation.

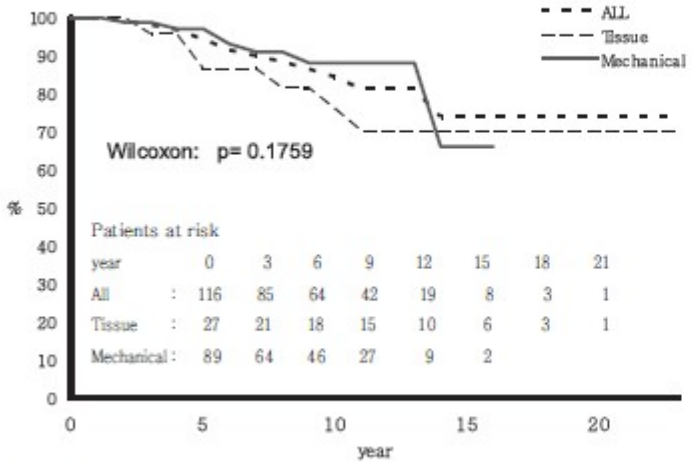


Fig 2. Kaplan-Meier estimated survival curves.

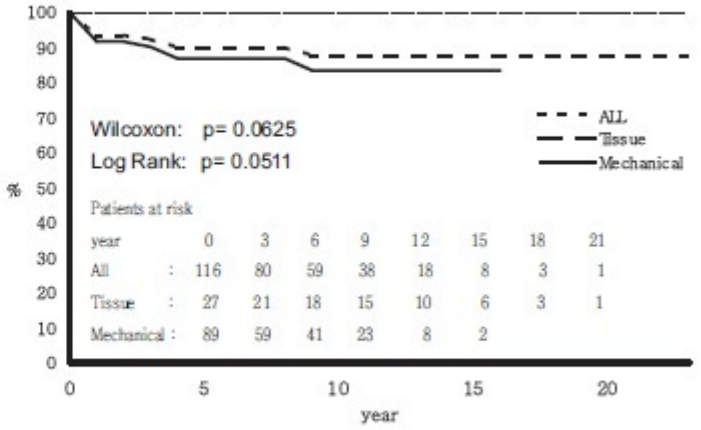


Fig 3. Kaplan-Meier estimated freedom from thromboembolic events.

Results of 141 Consecutive Minimally Invasive Tricuspid Valve Operations: An 11-Year Experience

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Background. Reports of minimally invasive tricuspid valve operations are rare. We reviewed our experience and results of tricuspid valve operation using mini-thoracotomy during an 11-year period.

Methods. Consecutive patients (n = 141) undergoing tricuspid valve operation using mini-thoracotomy were retrospectively analyzed. Access was through a 6-cm right thoracotomy and cardiopulmonary bypass was instituted by means of the femoral artery (n = 16) or ascending aorta (n = 125) with augmented venous return. In most cases, vacuum assist without caval occlusion and snaring the cavae was used to minimize mediastinal dissection. In all cases, the tricuspid valve operation was done with the heart unclamped, and the heart either beating or fibrillating.

Results. Seventy-three percent (103 of 141 patients) of the patients underwent combined mitral and tricuspid valve operations. The tricuspid valve was repaired instead of being replaced in 61% (86 of 141 patients). Previous sternotomy was present in 49% (69 of 141 patients). The average patient age was 64 years. Conversion rate to median sternotomy was only 3% (4 of 141 patients). The mean cardiopulmonary bypass time was 216 minutes. Thirty-day mortality was 2.1% (3 of 141 patients). Stroke occurred in 2.8% (4 of 141 patients), and reexploration for bleeding occurred in 5.6% (8 of 141 patients). The stroke rate was 3 of 16 patients (18.8%) using mini-thoracotomy through femoral cannulation versus 1 of 125 patients (0.8%) through aortic cannulation ($p = 0.005$).

Conclusions. In this largest reported series of patients undergoing tricuspid valve operation, mini-thoracotomy provides excellent short-term morbidity and mortality in these high-risk patients while avoiding redo sternotomy with a low conversion rate. Mini-thoracotomy with aortic cannulation is an attractive alternative approach to the tricuspid valve, particularly in patients with previous sternotomy.

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Table 3. Associated Surgical Procedures

Associated Procedure	N (%)
Mitral replacement	57 (40%)
Mitral repair	35 (25%)
None	35 (25%)
Mitral repair/maze	8 (6%)
Mitral repair/ASD	3 (2%)
ASD	1 (1%)
Maze	1 (1%)
Mitral replacement/maze	1 (1%)

ASD = atrial septal defect.

Table 4. Outcomes

30-Day mortality	3 (2%)
Length of stay (days)	10 ± 8 (4–80)
Conversion to sternotomy	4 (3%)
Reoperation for bleeding	9 (6%)
Pacemaker requirement	11 (8%)
New onset atrial fibrillation	31 (22%)
Pericarditis	16 (11%)
Dissection (type B)	1 (0.7%)
Mediastinitis	0 (0%)
Stroke	
Femoral cannulation	3/16 (18.8%)
Aortic cannulation	1/125 (0.8%)
Renal failure	9 (6%)
Respiratory failure	7 (5%)

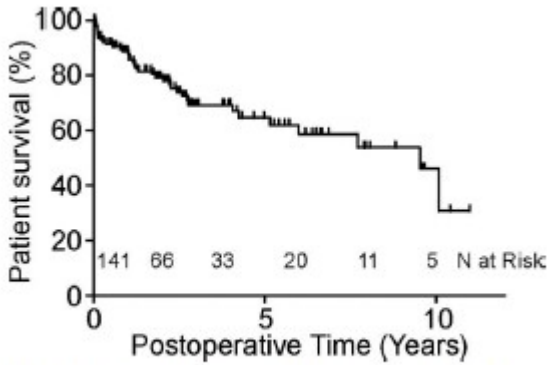


Fig 1. Patient survival after tricuspid valve operation through a right mini-thoracotomy.

Early and Midterm Outcomes for Tricuspid Valve Surgery After Left-Sided Valve Surgery

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Background. The purpose of this study was to compare the early and midterm results of tricuspid valve replacement (TVR) versus tricuspid valve repair (TVr) for late tricuspid regurgitation after left-sided valve surgery.

Methods. Fifty-one consecutive patients who underwent tricuspid valve surgery after left-sided valve surgery between January 1995 and April 2008 were included. Thirty-seven patients underwent TVR, and 14 patients underwent TVr. Tricuspid valve replacement was performed along with concomitant procedures in 27 patients (73.0%). Patients undergoing TVR were more likely to have severe tricuspid regurgitation (64.3% versus 89.2%; $p = 0.037$), or a previous history of tricuspid regurgitation repair (7.1% versus 51.4%; $p = 0.004$).

Results. There was no hospital death in both TVr and TVR groups. However, in comparison to TVr patients, TVR patients needed a greater amount of hemofiltration (59 ± 23 versus 80 ± 36; $p = 0.026$) and had longer periods of hospital stays (13.5 ± 4.4 versus 26.9 ± 25.7 days; $p = 0.049$). Survival rates at 1, 5, and 10 years were 97%, 93%, and 63% for patients undergoing TVR, and 93%, 93%, and 81% for patients undergoing TVr, respectively. There was no statistical difference in midterm survival rates between the two groups. Cox regression analysis revealed that left ventricular ejection fraction of 0.40 or less ($p = 0.034$) and age ($p = 0.035$) were independent predictors of late mortality after TVR or TVr.

Conclusions. Patients undergoing TVR had a more advanced preoperative tricuspid regurgitation grade and significantly prolonged hospital stays. However, there were no statistical differences in early and midterm outcomes between the two groups.

(Ann Thorac Surg 2009;88:1216–23)

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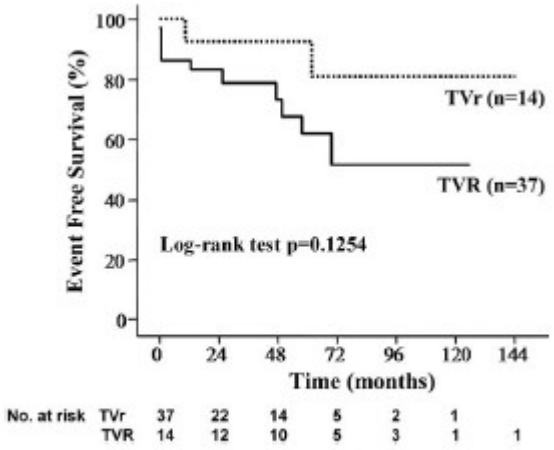


Fig 2. Kaplan-Meier estimated freedom from valve-related events. (TVr = tricuspid valve repair; TVR = tricuspid valve replacement.)

Table 2. Operative Procedures Concomitant With Tricuspid Valve Surgery

Variable	TV Repair (n = 14)	TV Replacement (n = 37)
TVR only	0 (0%)	10 (27.0%)
+ AVR	0 (0%)	2 (5.4%)
+ Redo AVR	1 (7.1%)	8 (21.6%)
+ 2nd redo AVR	0 (0%)	2 (5.4%)
+ Redo MVR	6 (42.9%)	5 (13.5%)
+ 2nd redo MVR	1 (7.1%)	1 (2.7%)
+ 2nd redo MVR, redo AVR	1 (7.1%)	0 (0%)
+ Redo MVR, AV repair	1 (7.1%)	0 (0%)
+ Redo MVR, AVR, or Bentall	0 (0%)	1 (2.7%)
+ Redo AVR, redo MVR	4 (28.6%)	6 (16.2%)
+ 2nd redo AVR, MVR	0 (0%)	1 (2.7%)
+ LVVRS	0 (0%)	1 (2.7%)
+ Maze procedure	1 (7.1%)	1 (2.7%)
+ Permanent pacemaker insertion	0 (0%)	4 (10.8%)

AV = aortic valve; AVR = aortic valve replacement; LVVRS = left ventricular volume reduction surgery; MVR = mitral valve replacement; TV = tricuspid valve; TVR = tricuspid valve replacement.

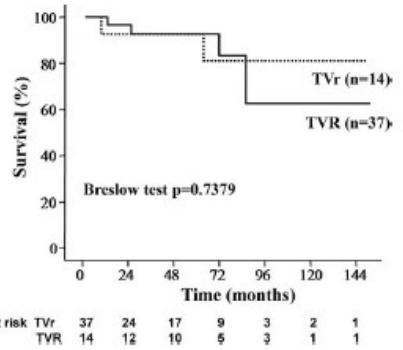


Fig 1. Kaplan-Meier curve comparing survival in patients who underwent tricuspid valve surgery (n = 51) after left-sided valve surgery. (TVr = tricuspid valve repair; TVR = tricuspid valve replacement.)

Clinical and Echocardiographic Impact of Functional Tricuspid Regurgitation Repair at the Time of Mitral Valve Replacement

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Background. The indications for tricuspid valve repair in the setting of mitral valve disease and concomitant tricuspid regurgitation (TR) remain unclear. We examined patients undergoing mitral valve replacement (MVR) to determine the effect of TR and tricuspid valve repair on survival, functional status, and postoperative TR.

Methods. Between 1990 and 2005, 624 patients underwent MVR. Data included detailed serial echocardiographic tricuspid valve measurements, functional status, and survival data. Preoperative TR exceeded 2+ in 231: 125 received tricuspid repair and MVR, whereas 106 received MVR alone. Clinical and echocardiographic follow-up were complete (average, 6.8 ± 4.8 years). Parametric and semi-parametric tests were used to analyze outcomes.

Results. TR exceeding 2+ at operation was associated with a 53% increase in late death ($p = 0.003$). Tricuspid repair prevented echocardiographic progression of TR and improved congestive heart failure symptoms (both $p < 0.01$). Overall survival did not improve ($p = 0.3$). A trend to worsening TR in patients was noted with a larger tricuspid annulus diameter and without significant (≤ 1+) TR preoperatively (odds ratio, 1.4 per cm increase in annulus diameter; $p = 0.5$), but this was not associated with worse functional or vital outcomes.

Conclusions. In patients undergoing MVR, tricuspid repair is indicated when TR exceeds 2+ to alleviate heart failure symptoms, but without significantly improving survival in this population. TR of 2+ or less may not require repair. Echocardiographic tricuspid annular dimensions alone, in the absence of significant (≤ 1+) TR preoperatively, should not dictate the performance of tricuspid repair.

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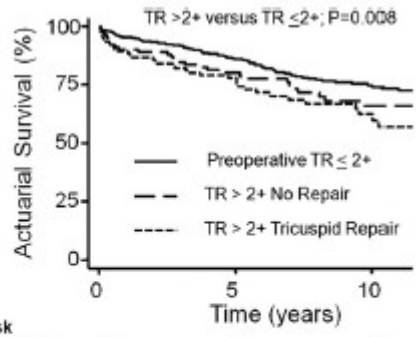


Fig 2. Actuarial survival for patients with preoperative tricuspid regurgitation (TR) at 2+ or less (black line), TR exceeding 2+ with no repair (large dashes), and TR exceeding 2+ with repair (small dashes).

Recommendations

In patients undergoing MVR, tricuspid repair is indicated when TR exceeds 2+ to alleviate CHF symptoms, but without significantly improving survival. TR at 2+ or less may not require repair. Furthermore, echocardiographic tricuspid annular dimensions alone, in the absence of significant (≤ 1+) TR preoperatively, should not dictate the performance of tricuspid repair.

Best evidence topic - Valves

Which patient undergoing mitral valve surgery should also have the tricuspid repair?

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Received 29 July 2009; received in revised form 20 August 2009; accepted 9 September 2009

Summary

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was 'Which patient undergoing mitral valve surgery should also have the tricuspid repair?' Altogether 390 papers were found using the reported search, of which 17 represented the best evidence to answer the clinical question. The authors, journal, date and country of publication, patient group studied, study type, relevant outcomes and results of these papers are tabulated. While a general agreement exists for tricuspid valve (TV) repair in cases of severe regurgitation and concomitant multivalvular disease requiring surgical intervention, current guidelines provide more vague indications for patients with less severe tricuspid regurgitation (TR). Since this condition has a lower event-free survival rate and the prognosis after symptoms development is dismal, a lower threshold and a more aggressive strategy for intervention is needed. In rheumatic valve disease, mitral valve involvement and disease spreading to TV may be responsible for further regurgitation. Although patients with pulmonary hypertension (PH) may benefit from mitral valve replacement (MVR) or balloon valvotomy, many studies found that preoperative PH does not predict late TR. However, patients with high pulmonary pressure have a lower occurrence of late TR. Tricuspid annular dilation is probably the most important factor for late TR. Once established, it might be irreversible even after resolution of PH as well as absence of 'reverse remodelling'. It has been proposed to treat TR independently from the grade of regurgitation when the annular dimension is over 21 mm/m² or ≥3.5 cm at echo measurement or when the intra-operative tricuspid annulus (TA) diameter is >70 mm. TV repair should be accomplished in patients with preoperative atrial fibrillation (AF), since it may cause late significant TR development and affect the patient's long-term survival. The presence of a trans-tricuspid pacemaker lead is another known factor for late TR development secondary to adhesions and fibrous retraction. TV repair is probably better than replacement in non-severe organic TV disease. Annuloplasty ring repair has better outcome compared with non-ring based repair techniques; the beneficial effect is also independent of the type of mitral valve surgery performed.
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7. Clinical bottom line

TV insufficiency should be treated during left-sided valve surgery when TR annulus is dilated (≥21 mm/m²; >70 mm intra-operatively; ≥3.5 cm at trans-thoracic echocardiography (TTE) [18]) regardless of the absolute grade of regurgitation, in cases of preoperative AF, trans-tricuspid PMK lead and underlying rheumatic disease. Also, 'ring' annuloplasty techniques should be preferred over the 'non-ring' techniques.

Predictors of Residual Tricuspid Regurgitation After Mitral Valve Surgery

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Background. Whether preoperative tricuspid regurgitation (TR) will regress or progress late after surgery is unknown. The aim of this study was to evaluate predictors of significant TR late after mitral valve surgery.

Methods. A retrospective analysis was performed on a total of 174 patients who underwent mitral valve surgery without tricuspid valve surgery. Preoperatively, 46 patients (26%) had 2+ TR, and 128 patients (74%) had 1+ or less TR. Postoperative 3+ TR was considered significant TR. Variables were used to evaluate predictors of TR development by univariate or multivariate analysis.

Results. The mean follow-up was 8.2 years (range 1.0 to 14.5 years) after surgery. There was progressive TR (3+ or more) in 28 patients (16%) during the follow-up period. In univariate analysis, atrial fibrillation, rheumatic etiology, huge left atrium, left ventricular dysfunction, and preoperative 2+ TR were significant risk factors for TR development. Multivariate analysis identified preoperative 2+ TR, atrial fibrillation, and huge left atrium as statistically significant predictors for late TR after surgery.

Conclusions. Aggressive repair of accompanying TR should be undertaken at the time of initial surgery in patients with huge left atrium or atrial fibrillation, even if preoperative TR is 2+.

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Tricuspid Valve Repair: An Old Disease, a Modern Experience

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Background. We review our experience in patients who required surgical correction of tricuspid valve disease with concomitant disease of the mitral or aortic valve, or both, operated on between 1987 and 1999.

Methods. We studied 232 consecutive patients (mean age, 59.8 years) followed for a mean of 6.8 years (range, 2 to 12 years). All patients were investigated by means of Doppler echocardiography, with hemodynamic studies in 135. Median tricuspid insufficiency was 3+. The cause was rheumatic heart disease in 186 patients and degenerative in 46. All patients underwent suture annuloplasty (De Vega or segmental) at the time of mitral or aortic valve surgery. Tricuspid lesions were functional in 128 patients and organic in 104.

Results. The hospital and late mortality rates were 8.1% and 23.3%, respectively. These figures were independent of the type of annuloplasty performed. Predictors of hospital mortality were biologic prosthesis, renal insufficiency, time of cardiopulmonary bypass, and use of inotropic drugs. Predictors of late mortality were age older than 60 years, left ventricular ejection fraction less than 0.50, and New York Heart Association functional class IV. At 12 years, the actuarial survival rate was 50.5% ± 6.1%, and the actuarial curve free from reoperation 75.7% ± 7.3%. The actuarial curve for freedom from valve-related complication was 39.0% ± 6.3% at 11 years.

Conclusions. Despite the use of modern technologic advances in the diagnosis and treatment of valvular heart disease, tricuspid insufficiency continues to be a poor prognostic factor in patients with concomitant disease of the mitral or aortic valve, or both.

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Table 2. Predictors of Mortality by Multivariate Analysis

Predictor	Hospital Mortality		Late Mortality	
	Hazard Ratio (95% CI)	*p* Value	Hazard Ratio (95% CI)	*p* Value
Biologic prosthesis	5.83 (1.38 to 24.55)	0.016		
Renal insufficiency	13.37 (0.70 to 253.8)	0.08		
Time of cardiopulmonary bypass	1.01 (1.00 to 1.02)	0.11		
Inotropic drugs	7.00 (0.83 to 58.83)	0.07		
Age older than 60 years			3.35 (1.43 to 7.86)	0.005
Left ejection fraction, <0.50			2.37 (0.98 to 5.75)	0.06
NYHA functional class IV			2.14 (0.94 to 4.86)	0.07

CI = confidence interval; NYHA = New York Heart Association.

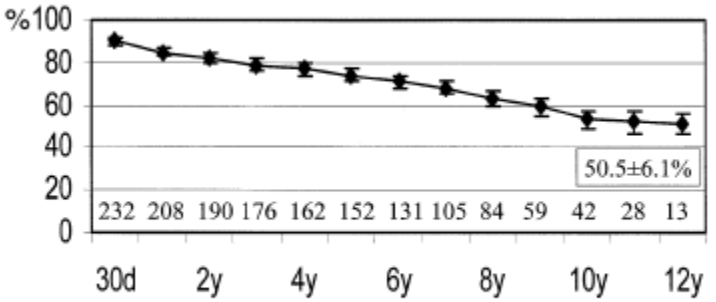


Fig 1. Actuarial survival curve.

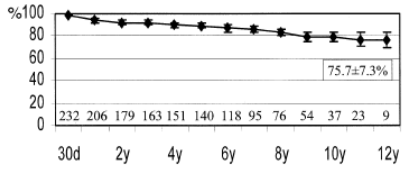


Fig 2. Actuarial curve for freedom from reoperation.

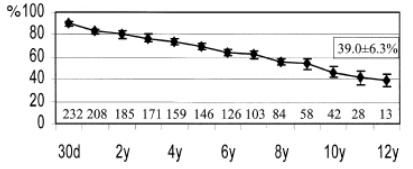


Fig 3. Actuarial curve for freedom from valve-related complications.

Tricuspid Valve Replacement: UK Heart Valve Registry Mid-Term Results Comparing Mechanical and Biological Prostheses

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Background. Little is known of time-related outcome and comparative performance of biological and mechanical prostheses following tricuspid valve replacement (TVR).

Methods. A retrospective UK Heart Valve Registry study (Jan 1, 1986 to June 30, 1997) identified 425 patients who underwent TVR. Two-hundred twenty-five (52.9%) received biological and 200 (47.1%) received mechanical valves. One-hundred sixty (38%), 158, and 76 had isolated, double, and triple valve replacements, respectively. The follow-up was 96% complete with a total of 1,585 patient-years.

Results. Thirty-day mortality for TVR was 17.3% (73 deaths). One-, 5-, and 10-year survival rates were 72.2%, 59.9%, and 42.9%, respectively. Year of operation ($p = 0.04$), age ($p = 0.04$), and number of valves implanted ($p = 0.03$) predicted overall mortality. Age ($p < 0.001$) and year of operation ($p = 0.002$) predicted overall survival. Thirty-day mortality for biological and mechanical prostheses was 18.8% and 15.6%, respectively. One-, 5-, and 10-year survival rates were 70.5%, 61.5%, and 47.7% for biological and 74.0%, 57.9%, and 33.9% for mechanical prostheses, respectively. Freedom from reoperation at 1 and 10 years was 98.7% and 97.4%. Freedom from death or reoperation was 71.2% at 1 year and 41.9% at 10 years. None of the above outcomes was significantly different between the type of valve prostheses.

Conclusions. TVR carries a high 30-day mortality and a poor longer term survival. No superiority could be identified for biological or mechanical prostheses in the tricuspid position for either survival or reoperation.

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Table 2. Time-Related Survival for Tricuspid Valve Replacement

Variable	30-day Mortality (73 deaths)	1-Year Survival	5-Year Survival	10-Year Survival
Overall	73 (17.3%; 14.0–21.3%)	72.2% (67.6–76.3%)	59.9% (54.7–64.8%)	42.9% (35.3–50.2%)
Biological	18.8% (14.3–24.0%)	70.5% (64.0–76.1%)	61.5% (54.3–67.8%)	47.7% (38.3–56.5%)
Mechanical	15.6% (11.2–21.5%)	74.0% (67.1–80.0%)	57.9% (50.0–65.1%)	33.9% (20.4–48.0%)

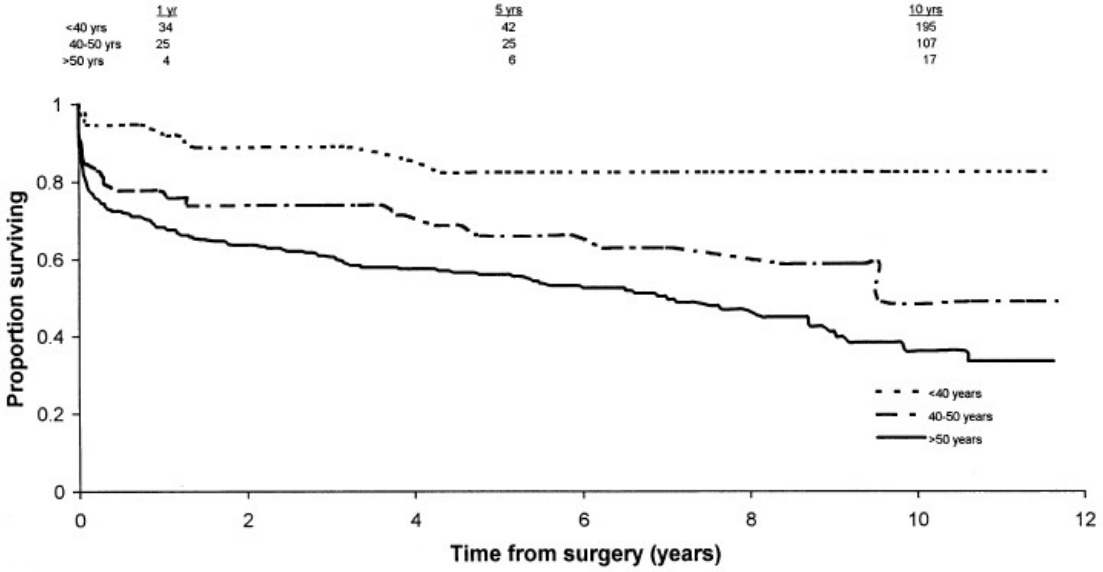


Fig 3. Survival after tricuspid valve replacement according to age.

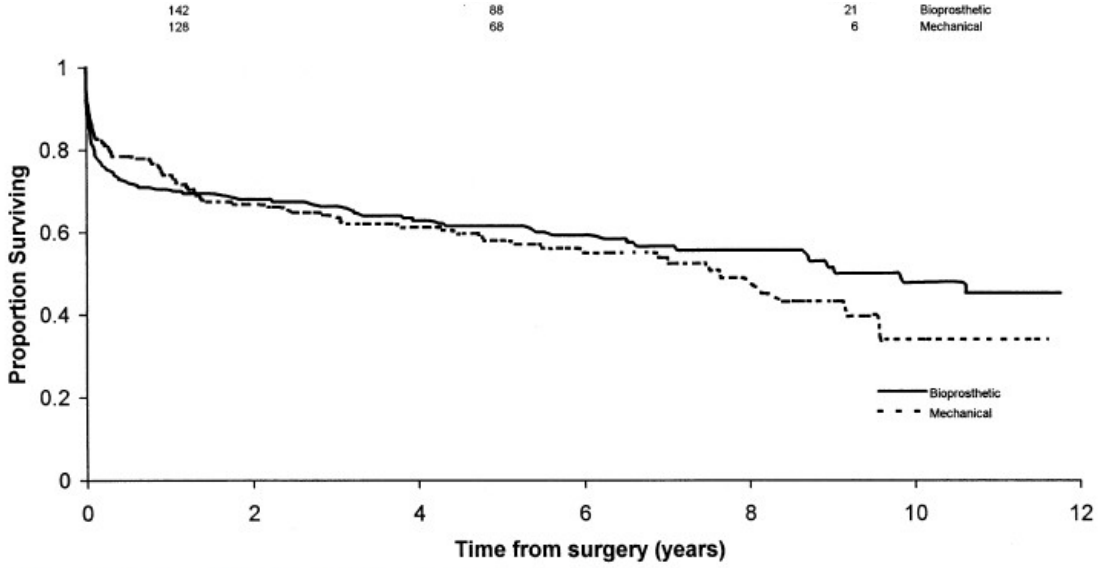


Fig 4. Survival after tricuspid valve replacement according to type of prosthesis.

Table 1. Preoperative Variables in Patients Undergoing Tricuspid Replacement (n = 425)

Variable	Data
Age	
Mean ± SD	57.1 ± 12.3 years
Range	18.5–81 years
Sex	
Female	334 (78.6%)
Male	91 (21.4%)
Biological	225 (52.9%)
Mechanical	200 (47.1%)
Size	31 ± 3 mm
Previous sternotomy	19 (4.5%)
TVR	160 (37.6%)
TVR + MVR	158 (37.2%)
TVR + AVR	31 (7.3%)
TVR + MVR + AVR	76 (17.9%)

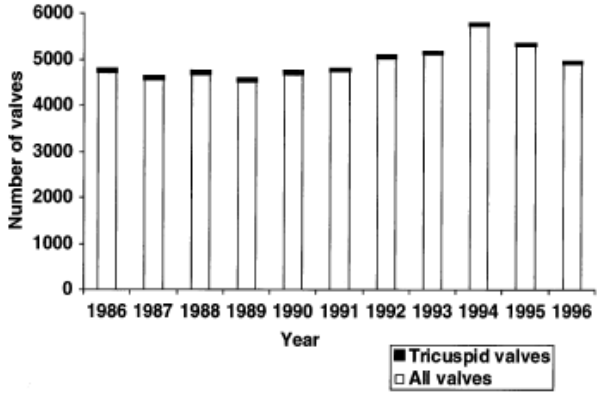


Fig 1. Annual incidence of all valve and tricuspid valve implants registered in the UK Heart Valve Registry 1986 to 1996.

Tricuspid valve replacement with the St. Jude Medical valve: 19 years of experience

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Abstract

Objective: The choice of the valve substitute in the tricuspid position remains controversial. A St. Jude Medical valve is a choice of valve substitute and its lower thrombogenicity and excellent hemodynamic performance have been reported even in the tricuspid position. However, little is known of the long-term durability of the St. Jude Medical valve in the tricuspid position. Our long-term experience of tricuspid valve replacement showed the higher thrombogenicity than we had expected, therefore, this study was done to reconsider our strategy for valve choice. **Methods**: This study reviewed 23 patient who underwent 25 tricuspid valve replacements with the St. Jude Medical valves from 1980 to 1997. The mean age was 40 years. Eleven patients (48%) were men. There were four in-hospital deaths (17%). The remaining 19 patients were all alive and followed from 2.2 to 19.0 years (mean 11.8 years). **Results**: The overall survival, including hospital mortality, was 83%, 10 and 15 years after surgery. Valve thrombosis occurred in six patients. Freedom from valve thrombosis was 78 and 70%, 10 and 15 years after surgery, respectively. The linearized rate of the valve thrombosis was 2.9%/patient-years. Six patients required reoperation. The mean interval to reoperation was 9.5 years. Freedom from reoperation was 83% and 75%, 10 and 15 years after surgery, respectively. The linearized rate of the reoperation was 2.8%/patient-years. No structural valve deterioration was found. Echocardiographic study showed that the function of the St. Jude Medical valve without valve-related complications was well maintained. **Conclusions**: The higher thrombogenicity of the St. Jude Medical valve in the tricuspid position altered our choice of valve substitutes from the St. Jude Medical valve to a bioprosthesis which is lack of need for anticoagulant therapy except for juvenile patients who are able to maintain potent anticoagulant therapy. © 2000 Elsevier Science B.V. All rights reserved.

Prosthetic Replacement of Tricuspid Valve: Bioprosthetic or Mechanical

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Background. Tricuspid valve replacement is one of the most challenging operations in cardiac surgery. Selection of the suitable prosthesis is still debatable.

Methods. In our institution, between January 1980 and December 2000, 129 tricuspid valve replacements were performed in 122 patients (14.7%). Bioprosthetic valves were used in 32 patients, whereas 97 patients had mechanical valve implantation. Twenty-two percent of replacements were done on men. Mean age was 35.27 ± 11.56 years. In all patients, initially an annuloplasty technique was tried. Tricuspid valve replacement was performed when annuloplasty was not sufficient. In most of the cases, tricuspid valve interventions were done under cardiopulmonary bypass and on a beating heart.

Results. Early mortality was 24.5%. Patients were followed for 2 to 228 months. Seven patients underwent reoperation because of tricuspid valve dysfunction (7.6%). Nine patients died during the follow-up period. Late mortality was 9.7%. Actuarial estimates of survival in 20 years of follow-up for all tricuspid prosthetic valves, mechanical valves, and bioprosthetic valves were 65.1% ± 9.3%, 68.3% ± 10.6%, and 54.8% ± 12.1%, respectively. For the bioprosthetic valve group, freedom from structural valve degeneration was 90% ± 5.5%; for the mechanical valve group, freedom from deterioration, endocarditis, and leakage was 97.8% ± 4.2%, and freedom from thromboembolism was 92.6% ± 6.9%.

Conclusions. We found that there was no statistically significant difference between the two groups in terms of early mortality, re-replacement, and midterm mortality ($p > 0.05$). Nevertheless, we recommend low profile modern bileaflet mechanical valves for prosthetic replacement of the tricuspid valve, due to their favorable hemodynamic characteristics and durability.

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Best evidence topic - Valves

Should the tricuspid valve be replaced with a mechanical or biological valve?

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Summary

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was whether patients requiring tricuspid replacement should have a mechanical or a biological valve. Using the reported search, 561 papers were identified. Thirteen papers represented the best evidence on the subject. The author, journal, date and country of publication, patient group studied, study type, relevant outcomes, weaknesses, results and study comments were tabulated. We conclude that there are no major differences between the insertion of a mechanical or biological tricuspid valve. Aggregating the available data it is found that the reoperation rate is similar with bioprosthetic degeneration rate being equivalent to the mechanical thrombosis rate. Conversely up to 95% of patients with a bioprosthesis still receive anticoagulation. Survival in over 1000 prostheses pooled by meta-analysis was equivalent between biological and mechanical valves.
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7. Clinical bottom line

There are no major differences between the insertion of a mechanical or biological tricuspid valve. Aggregating the available data it is found that the reoperation rate is similar with bioprosthetic degeneration rate being equivalent to the mechanical thrombosis rate. Conversely up to 95% of patients with a bioprosthesis still receive anticoagulation. Survival in over 1000 prostheses pooled by meta-analysis was equivalent between biological and mechanical valves.

Surgical management of secondary tricuspid valve regurgitation: Annulus, commissure, or leaflet procedure?

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Objectives: Techniques employed today concomitantly with left-sided heart valve surgery address secondary tricuspid valve regurgitation at 3 anatomic levels—annulus, commissure, and leaflet—although success of these alone or in combination in eliminating tricuspid regurgitation is uncertain. Our objective was to assess the comparative effectiveness of these techniques in reducing or eliminating secondary tricuspid regurgitation.

Methods: From 1990 to 2008, 2277 patients underwent tricuspid valve procedures for secondary tricuspid regurgitation concomitantly with mitral (n = 1527, 67%), aortic (n = 180, 7.9%), or combined (n = 570, 25%) valve surgery. These included annulus (flexible prosthesis [n = 1052, 46%], rigid prosthesis [standard = 387, 3-dimensional = 197; 26%], Peri-Guard annuloplasty [Synovis Surgical Innovations, St Paul, Minn; n = 185, 8.1%], and De Vega suture [n = 129, 5.7%]), commissure (Kay [n = 248, 11%]), and leaflet (edge-to-edge suture [n = 79, 3.5%] ± annulus or commissural) procedures. A total of 4745 postoperative transthoracic echocardiograms in 1965 patients were analyzed.

Results: By 3 months after surgery, only 32% of patients overall had no tricuspid regurgitation. However, by 5 years, this had decreased to 22%, and 3+/4+ tricuspid regurgitation had increased from 11% at 3 months to 17%. Patients with rigid ring annuloplasty alone, either standard or 3-dimensional, had the least increase of 3+/4+ tricuspid regurgitation (to 12% at 5 years) compared with either a commissural or leaflet procedure.

Conclusion: Rigid prosthetic ring annuloplasty, standard or 3-dimensional, provides early and sustained reduction of tricuspid regurgitation secondary to left-sided valve disease without need for an additional leaflet procedure. However, results are imperfect, possibly because other anatomic levels (subvalvular, papillary muscle, and right ventricular) contributing to its pathophysiology are unaddressed. (J Thorac Cardiovasc Surg 2010;139:1473-82)

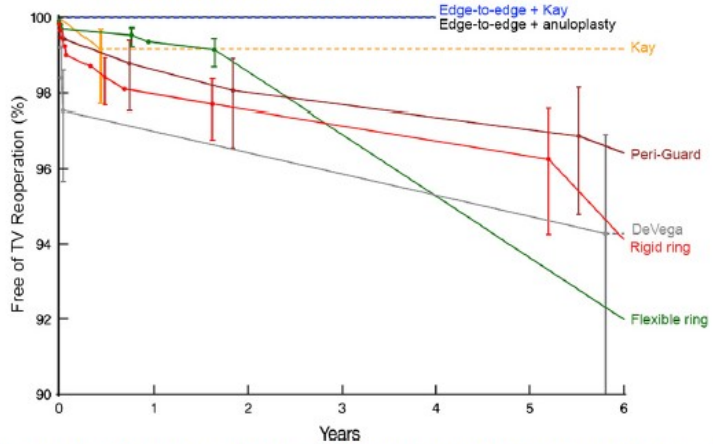


FIGURE 4. Freedom from reoperation (Kaplan–Meier estimates) according to tricuspid valve *(TV)* procedure. *Vertical bars* represent 68% confidence limits (equivalent to ±1 standard error).

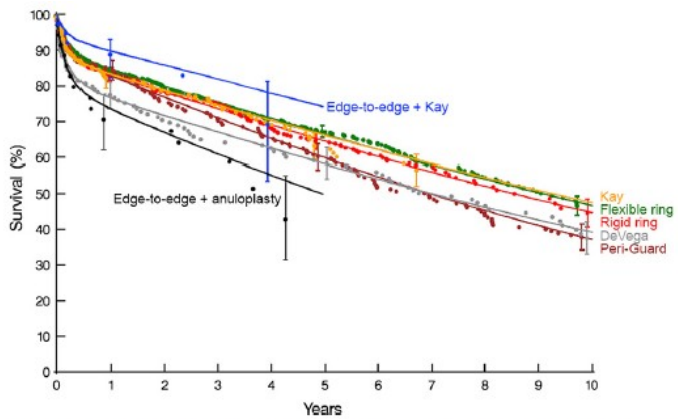


FIGURE 5. Survival after tricuspid valve repair according to procedure performed. Format is as in Figure 4.

Tricuspid valve repair: Durability and risk factors for failure

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Jeevanantham Rajeswaran, MSc
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Objectives: To compare durability of tricuspid valve annuloplasty techniques, identify risk factors for repair failure, and characterize survival, reoperation, and functional class of surviving patients.

Methods: From 1990 to 1999, 790 patients (mean age 65 ± 12 years, 51% New York Heart Association functional class III or IV, and mean right ventricular systolic pressure 56 ± 18 mm Hg) underwent tricuspid valve annuloplasty for functional regurgitation using 4 techniques: Carpentier-Edwards semi-rigid ring, Cosgrove-Edwards flexible band, De Vega procedure, and customized semicircular Peri-Guard annuloplasty. Of these patients, 89% had concomitant mitral valve surgery. A total of 2245 follow-up transthoracic echocardiograms were retrieved. Tricuspid regurgitation was analyzed, and risk factors for worsening regurgitation were identified, by multivariable ordinal longitudinal methods.

Results: Tricuspid regurgitation 1 week after annuloplasty was 3+ or 4+ in 14% of patients. Regurgitation severity was stable across time with the Carpentier-Edwards ring ($P = .7$), increased slowly with the Cosgrove-Edwards band ($P = .05$), and rose more rapidly with the De Vega ($P = .002$) and Peri-Guard ($P = .0009$) procedures. Risk factors for worsening regurgitation included higher preoperative regurgitation grade, poor left ventricular function, permanent pacemaker, and repair type other than ring annuloplasty. Right ventricular systolic pressure, ring size, preoperative New York Heart Association functional class, and concomitant surgery were not risk factors. Tricuspid reoperation was rare (3% at 8 years), and hospital mortality after reoperation was 37%.

Conclusions: Tricuspid valve annuloplasty did not consistently eliminate functional regurgitation, and across time regurgitation increased importantly after Peri-Guard and De Vega annuloplasties. Therefore, these repair techniques should be abandoned, and transtricuspid pacing leads should be replaced with epicardial leads.

From the Department of Thoracic and Cardiovascular Surgery, The Cleveland Clinic Foundation, Cleveland, Ohio.

Read at the Eighty-third Annual Meeting of The American Association for Thoracic Surgery, Boston, Mass, May 4-7, 2003.

Supported in part by an education grant from Edwards Lifesciences. Drs McCarthy and Cosgrove have developed annuloplasty rings for tricuspid valve repair (Cosgrove-Edwards, Edwards-MC³).

Received for publication May 5, 2003; re-

Data Analysis

The following questions were addressed:

1. What is the durability of tricuspid valve repair?
2. Did durability differ among the 4 annuloplasty techniques?
3. What are the risk factors for repair failure?
4. How many patients had reoperation for tricuspid valve disease?
5. What was the New York Heart Association (NYHA) functional class at follow-up?
6. Did right ventricular systolic pressure change over time?
7. What is survival following tricuspid valve repair?
8. Do patients with high residual tricuspid regurgitation have a longer postoperative hospital stay?

TABLE 3. Predicted prevalence across time of grades 3+ and 4+ tricuspid valve regurgitation for various annuloplasty techniques*

		1 month		1 year		5 years		8 years	
Technique	**TR grade**	**%**	**CL (%)**	**%**	**CL (%)**	**%**	**CL (%)**	**%**	**CL (%)**
Carpentier	3+	10	9-11	10	9-12	11	9-13	11	8-14
	4+	5.2	4.6-5.9	5.5	4.7-6.3	6	4.3-7.4	6	4-8
Cosgrove	3+	10	9-11	12	11-13	12	9-14		N/A
	4+	5.3	4.6-6.0	6	6-7	6	5-8		N/A
De Vega	3+	9	8-10	12	10-13	17	15-20	20	17-22
	4+	4.6	4-5	6	5-7	11	9-13	13	10-16
Peri-Guard	3+	10	9-11	13	12-14	19	17-21	22	19-24
	4+	5.4	4.8-6.0	7	6-8	13	10-15	15	12-18
Overall	3+	10	9-11	13	11-14	15	14-17	19	17-21
	4+	5	5-6	7	6-8	9	8-10	12	10-15

TR, Tricuspid regurgitation; *CL*, 68% confidence limits; *N/A*, not applicable (not enough patients in follow-up at this time).
*Model-based time-related estimates (%).

Long-Term Outcomes of Tricuspid Valve Replacement in the Current Era

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Background. Regardless of the indication, tricuspid valve replacement (TVR) has historically been associated with high mortality and morbidity. We report the results of our experience in a high-risk patient population with an emphasis on operative mortality, long-term survival, and valve related events according to the type of prosthesis.

Methods. Between 1985 and 1999 TVR was performed in 81 patients (isolated n = 25, combined with valve surgery n = 44, combined with CABG or other n = 12). The mean age was 61 years old (range 19–83 years old). Risk factors included New York Heart Association functional class III/IV (n = 73, 90%), reoperation (n = 58, 72%), urgent/emergent indication (n = 62, 76%), and hepatic dysfunction (n = 13, 16%). Mean pulmonary artery pressure was 34 mmHg. Etiology of tricuspid regurgitation was classified as functional (n = 18, 22%) or organic (n = 52, 64%), or failed previous tricuspid valve surgery (n = 11, 14%).

Results. Tricuspid valve replacement was performed with either a bioprosthetic (n = 34, 42%) or mechanical valve (n = 47, 58%). The overall operative mortality was 22% (n = 18). Risk factors for mortality included urgent/emergent status, age greater than 50 years old, functional etiology, and elevated pulmonary artery pressure. Of the 60 survivors, 26 (43%) died during follow up. After univariate analysis, organic etiology was the only predictor of late death ($p = 0.01$). Kaplan-Meier survival at 2.5, 5, and 10 years was 80%, 60%, and 45% for bioprosthetic, and 84%, 69%, and 59% for mechanical valves, respectively.

Conclusions. Patients requiring TVR are typically high-risk with a high-percentage of reoperations, concomitant cardiac procedures, and end-stage functional class. Operative and overall mortality remains high. Heart failure was the predominant cause of early and late deaths, emphasizing importance of timely referral before the development of end-stage cardiac impairment.

(Ann Thorac Surg 2005;80:845–50)

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Table 2. Etiology of Tricuspid Valve Regurgitation

	Number	Percent
Rheumatic heart disease	35	43
Degenerative	4	5
Endocarditis	6	8
Carcinoid heart disease	6	8
Epstein's anomaly	1	1
Functional	17	21
Failed valve repair	4	5
Failed porcine prosthesis	8	10

Table 3. Operative Procedures

	Number	Percent
TVR	25	31
TVR+MVR	28	35
TVR+AVR	4	5
TVR+MVR+AVR	9	11
TVR+CABG	6	7
TVR+MVR+CABG	3	4
TVR+Other	6	7

AVR = aortic valve replacement; CABG = coronary artery bypass graft; MVR = mitral valve replacement; TVR = tricuspid valve replacement.

Table 4. In-Hospital Complications

	All (n = 81)		Mechanical (n = 47)		Bioprosthetic (n = 34)	
	N	%	N	%	N	%
Death	18	22	11	32	7	15
Low output syndrome	24	29	11	32	13	27
Reoperation for bleeding	15	18	5	15	10	21
Elevated creatinine	13	16	6	17	7	15
Gastrointestinal bleed	6	7	0	0	6	13
Pneumonia	5	6	2	6	3	6
Cerebrovascular accident	4	4	1	3	3	7
Sternal infection	2	3	2	6	0	0

N = number; % = percent.

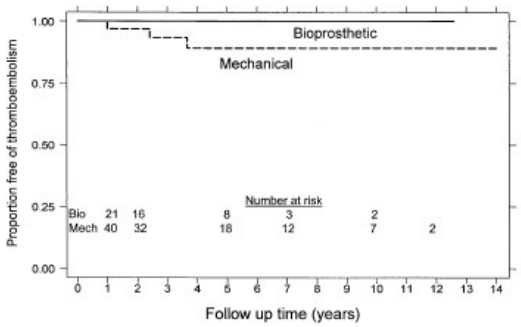


Fig 1. Kaplan-Meier curves for freedom from thromboembolism in patients with bioprosthetic versus mechanical valves who survived the first postoperative year. (Bio = *bioprosthetic;* Mech = *mechanical.*)

Is tricuspid valve replacement a catastrophic operation?

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Abstract

Objective: Tricuspid valve replacement (TVR) has a high postoperative mortality, despite recent advances in perioperative care. We report the results of our experience in TVR with an emphasis on early mortality and morbidity and long-term follow-up. **Methods:** Between October 1994 and August 2007, 80 consecutive TVRs were performed in 78 patients. The mean age was 48 ± 14 (range: 20–70) years. The underlying disease of the patients was classified as rheumatic (n = 54), congenital (n = 12), endocarditis (n = 10) or degenerative (n = 4). Previous cardiac surgery had been performed in 40 patients (50%). Isolated TVR was performed in 24 patients (30%). **Results:** Hospital mortality occurred in one patient (1.4%). Postoperative morbidities included intra-aortic balloon pump (n = 5), bleeding re-operation (n = 4), delayed sternal closure (n = 3), acute renal failure (n = 3), subdural haematoma (n = 3), extracorporeal membrane oxygenation (n = 1), mediastinitis (n = 1) and pacemaker insertion (n = 4). In 42 patients, ventilator support was needed for more than 72 h. Based on multivariate analysis, age ($p < 0.001$) and the cardiopulmonary time ($p = 0.004$) were the identified risk factors. Follow-up was completed in all patients with a mean duration of 56 ± 37 (range: 0–158) months. During the follow-up period, there were seven deaths (8.8%), including five cardiac deaths. The 5- and 8-year survival rates were 95 ± 3% and 79 ± 9% and event-free survival rates were 76 ± 6% and 61 ± 9%, respectively. Based on multivariate analysis, the only identified predictors of late deaths was a postoperative low cardiac output ($p = 0.024$). **Conclusions:** TVR can be performed and low operative mortality can be achieved thorough optimal perioperative management in the current era.

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Table 3
Early outcomes.

	Number	Percent (%)
Hospital mortality	1	1.3
Morbidity		
IABP	5	6.3
ECMO	1	1.3
Permanent pacemaker insertion	4	5.0
Re-operation due to bleeding	4	5.0
Delayed sternal closure	3	3.8
Subdural haematoma	3	3.8
Acute renal failure	3	3.8
CVA	0	0
Deep sternal wound infection	1	1.3
Redo valve surgery	1	1.3
Tracheostomy	4	5.0
Pancreatitis	1	1.3

ECMO, extracorporeal membrane oxygenation; CVA, cerebrovascular accident; IABP, intra-aortic balloon pump.

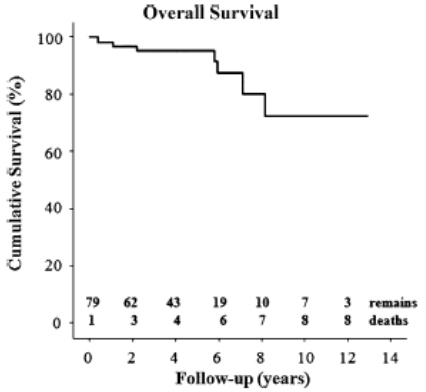


Fig. 1. Kaplan–Meier survival curve in all patients, including operative mortality.

relatively favourable operative results. We did not know the precise reason(s) our patients had favourable operative results; however, we have attempted to offer some reasonable explanations.

First, our patient population was younger than the patients which comprised other studies [2–4]. The mean age of our patients was 48.7 ± 13.2 years, while the mean age of the other patients was >50 years. Second, improved myocardial protection strategies and perioperative care may have had a partial impact [2,5,6]. Multiple valve procedures need long aortic cross-clamping times, which may cause ischaemic damage of the heart. Long ischaemic time itself may not be a risk factor for early mortality in the current era. Third, we used as large prosthesis as possible so as not to create an unnecessarily high transvalvular pressure gradient [8]. High transvalvular pressure gradients can cause unnecessarily high central venous pressures and can lead to persistent right heart failure symptoms. Some might argue that large prosthesis could cause atrioventricular block. However, most patients already had dilated tricuspid annulus, so it is not difficult to implant larger size valves.

However, these possible causes do not satisfactorily explain the early favourable results. In spite of poor scientific proof, we speculated that modified ultrafiltration may play an important role [9]. The positive effect of modified ultrafiltration was proposed by Naik et al. in 1991 [10] and was verified by the findings in a prospective, randomised study in paediatric patients [11], but not in adult cardiac surgery, especially on right ventricular function. By decreasing myocardial oedema, improving left ventricular function [12,13] and improving pulmonary function compliance [11,14,15], modified ultrafiltration could improve right ventricular function as well. With the exception of a few early cases, we routinely use modified ultrafiltration. We

Institutional report - Valves

Clinical mid-term results after tricuspid valve replacement☆

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Abstract

Tricuspid valve replacement (TVR) is associated with high mortality and morbidity. Frequently, TVR is performed in critically ill patients with high frequency of re-intervention. We analyzed our experience in TVR focusing on predicting risk factors, mid-term survival and quality of life assessed with a Short-Form 36 Health Survey (SF-36) questionnaire. Between January 1992 and May 2007, 81 consecutive patients underwent TVR (54 re-interventions, 66.7%; 46 procedures, associated with a left-sided operation, 56.8%). There were 59 females (73%) with a mean age of 59.3±11.6 years. The most prevalent etiology was rheumatic fever (61.7%). Pulmonary hypertension was present in 64%. Mean left ventricle ejection fraction (LVEF) was 56.6% and mean right ventricle ejection fraction (RVEF) was 48.1%. All but four patients (4.9%) received a bio-prosthesis. Hospital mortality was 9.88%. The mean follow-up was 61±42 months. Survival was 68% at five years. Univariate predictors of hospital mortality were atrial fibrillation (AFib) ($P<0.01$), associated procedures on the left heart ($P=0.025$) and preoperative chronic right heart failure symptoms ($P<0.01$). At follow-up: 10.8% of patients had a pace-maker (PM) induced rhythm; the mean SF-36 score was 51.1±4.8 (range 59–38). Age ($P=0.015$), associated procedures ($P=0.024$) and previous cardiovascular surgery ($P=0.015$) were univariate predictors of the SF-36 score. At a multivariate analysis LVEF, venous congestion and pulmonary artery pressures (PAPs) were related with a SF-36 score.

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Follow-up was performed by telephone interview and using recent echocardiographic data. Quality of life (QoL) was quantified using a SF-36 questionnaire. The SF-36 form consists of 36 questions grouped into eight item domains, combined into two meta-scores, the physical component summary (PCS) and the mental component summary (MCS), reflecting global physical and mental functioning. There

At the latest follow-up the majority of the patients had a significant improvement in symptoms. Unexpectedly, more than half of the patients had no limitations in most of the physical domains. Mental status was also unaffected by surgery, showing similar results. Compared with general population norms, there were no statistically significant differences between the two groups, reflecting a fairly good QoL after TVR. In the patients who survived the intervention, QoL improved significantly in most of the domains. HRQoL was negatively univariate predicted by age, previous cardiac surgery and left-sided operations.

Reoperations after tricuspid valve repair

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Objective: The objective was to analyze the short- and long-term results of patients with previous tricuspid valve repair who had valve dysfunction and required cardiac reoperations.

Methods: Between 1976 and 2002, 74 patients with a mean age of 53.8 ± 12.2 years underwent valve reoperations for dysfunction of previous tricuspid valve repair. Mitral and tricuspid lesions were diagnosed in 40 patients (54%), triple valve disease (mitral, aortic, tricuspid) was diagnosed in 26 patients (35.1%), isolated tricuspid disease was diagnosed in 6 patients (8.1%), and aortic and tricuspid lesions were diagnosed in 2 patients (2.7%). Reoperations included tricuspid valve replacement in 43 patients (58.1%) and a new tricuspid valve repair procedure in the remaining 31 patients (41.9%).

Results: Hospital mortality (30-day or within first admission) was 35.1% (n = 26). In the multivariate analysis, risk factors for hospital mortality included body mass index less than 20 kg/m^2 and greater than 24 kg/m^2, triple valve disease, use of intra-aortic balloon counterpulsation, and presence of postoperative complications. The follow-up was complete in 100% of patients, with a mean follow-up of 14.2 years (range 4 months to 26 years). The late mortality was 40.5% (n = 30). Predictors of late mortality were body mass index less than 20 kg/m^2, cardiac surgery before 1991, and development of dysfunction early after tricuspid valve repair. At the follow-up closing date, 19 patients are alive (25.7%). The actuarial survival was 11.8% ± 4.9% at 26 years.

Conclusions: Patients with failure of a tricuspid valve repair procedure requiring reoperation have a poor prognosis with a high mortality rate both in-hospital and in the long-term.

Surgery for rheumatic tricuspid valve disease: A 30-year experience

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Objective: This study was undertaken to assess factors influencing short- and long-term outcomes of surgery for rheumatic disease of the tricuspid valve.

Methods: Between 1974 and 2005, a total of 328 consecutive patients (mean age 51.3 ± 13.6 years) underwent tricuspid valve surgery for rheumatic disease. There were 12 cases of isolated tricuspid lesion, 199 of triple-valve disease, 114 of tricuspid and mitral valve disease, and 3 of aortic and tricuspid valve disease. Most patients (72%) had predominantly tricuspid regurgitation. Tricuspid valve prosthetic replacement was performed in 31 cases and valve repair in 297.

Results: In-hospital mortality was 7.6%. Late mortality was 52.1%, whereas the expected mortality of the Spanish population of the same age was 24.2%. Predictors of in-hospital mortality were male sex, isolated tricuspid lesion, moderate aortic insufficiency, postclamping time, and tricuspid valve replacement. Mean follow-up was 8.7 years (range 1–31 years). Follow-up was 98.9% complete. Predictors of late mortality were age, New York Heart Association functional class IV, postclamping time, and mitral valve replacement. In total, 114 patients required valve reoperation, but only 4 (3.5%) for isolated tricuspid valve dysfunction. At 30 years, actuarial survival was 12.1% ± 4.4%, actuarial freedom from reoperation was 27.5% ± 5.8%, and actuarial freedom from valve-related complications was 2.0% ± 1.3%.

Conclusion: Organic tricuspid valve disease associated with rheumatic mitral or aortic lesions increases hospital and late mortality, but valve repair compared favorably with valve replacement. Long-term results may be considered acceptable for otherwise incurable valve disease.

Tricuspid Valve Replacement: An Analysis of 25 Years of Experience at a Single Center

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Background. Tricuspid valve replacement is seldom used in clinical practice, but the choice between mechanical and biologic prostheses remains controversial.

Methods. Between 1977 and 2002, 97 patients underwent tricuspid valve replacement and were followed at the Montreal Heart Institute Valve Clinic. Patients underwent replacement with bioprostheses (n = 82) and mechanical valves (n = 15).

Results. Patients with bioprosthetic tricuspid replacements averaged 53 ± 13 years of age compared with 48 ± 11 years in those with tricuspid mechanical valve replacements ($p = 0.2$). Isolated tricuspid valve replacement was performed in 11 patients (73%) in the mechanical valve group compared with 31 patients (38%. $p = 0.01$) in the bioprosthetic replacement group. In patients undergoing bioprosthetic tricuspid replacement, 51 (62%) underwent multiple associated valve replacements. The 5-year survival after tricuspid replacement averaged 60% ± 13% in the mechanical valve group and 56% ± 6% in the biologic replacement group ($p = 0.8$). The 5-year freedom rate from tricuspid valve reoperation averaged 91% ± 9% in patients with mechanical valves and 97% ± 3% in those with biologic valves ($p = 0.2$).

Conclusions. Patient survival after tricuspid valve replacement is suboptimal but related to the clinical condition at operation. The use of biologic prostheses for tricuspid valve replacement remains a good option in young patients because of limited life expectancy unrelated to the type of tricuspid prostheses at long-term follow-up.

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Tricuspid Valve Replacement With Bioprostheses: Long-Term Results and Causes of Valve Dysfunction

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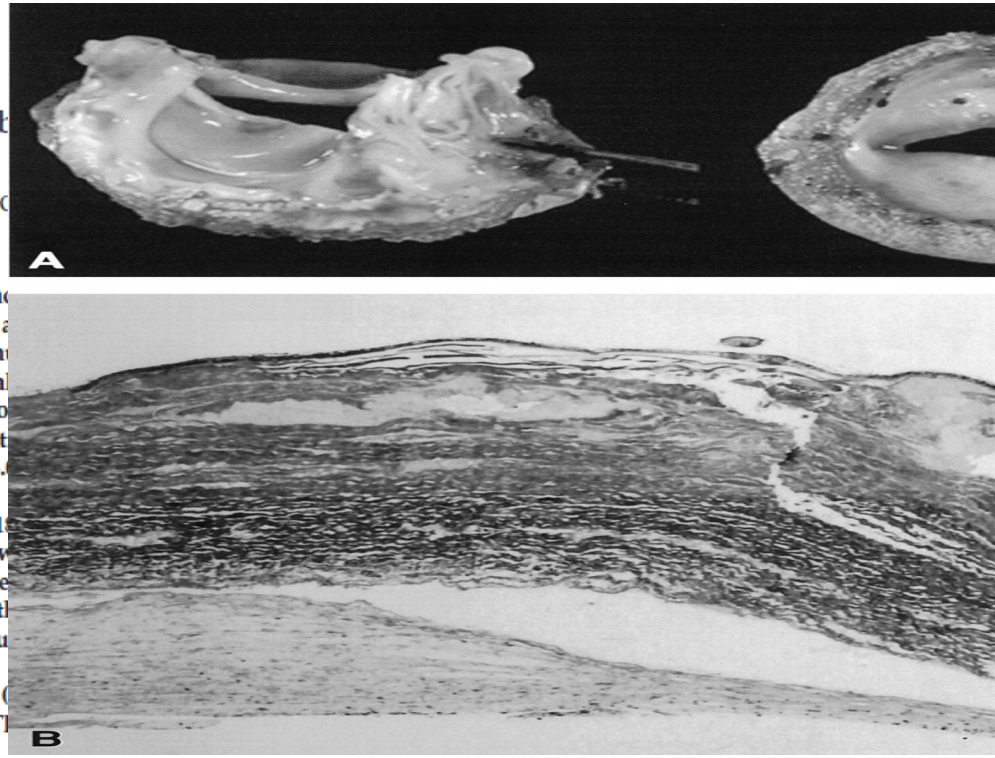
Background. Although the clinical performance of bioprostheses after valve replacement in the aortic and mitral position has been reported, little is known of the performance of tricuspid bioprostheses. The mechanism of bioprosthetic valve dysfunction after tricuspid valve replacement (TVR) is not clear.

Methods. We reviewed 98 cases of TVR with bioprostheses. To clarify the causes of valve dysfunction, pathologic examination of the explanted valve at the reoperation was performed.

Results. Actuarial survival at 18 years was 68.7% ± 5.8%. There were 12 redo TVRs. In six of the 12 cases, isolated redo TVR was performed. In the other cases, concomitant cardiac procedures were performed. The causes of prosthetic valve dysfunction were pannus formation on the cusps of the right ventricle side (four cases), native valve atta
mation + native valve a
change (one case), pannu
(one case), and native val
(one case). Freedom fro
deterioration, and nonst
was 62.7% ± 10.7%, 96.
respectively.

Conclusions. In our 1
the survival after TVR w
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serious problem that cau
the tricuspid position.

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Thank you