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# Minimally invasive Tricuspid valve surgery in high risk patients

# Background / Study Objective

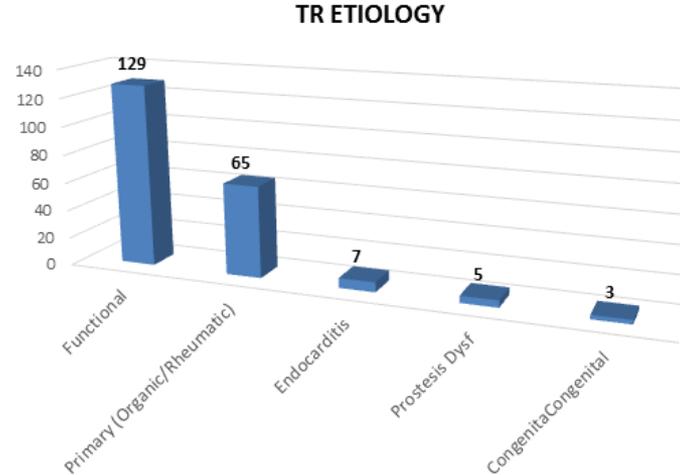


- Minimally invasive surgery has been an increasingly success in recent years and excellent results have been published in correlation with mitral valve surgery
- In literature there is not a large series of study about minimally invasive tricuspid valve surgery and the outcomes after this approach have not been well described. Even the latest ESC/AHA guidelines have not been expressed about the use of minimally invasive techniques
- In the era of increasing adoption of catheter-based treatments, this study analyzed our 12-year experience with minimally invasive TV operations.

# Patients

From November **2005** to June **2018**, Minimally Invasive TV surgery was performed in **209** patients

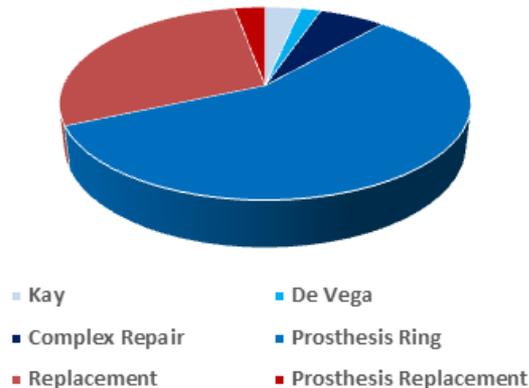
PREOPERATIVE CHARACTERISTICS	(n=209)
Age, mean±SD (median)	64.9 ± 13.2 (67)
Male sex, n (%)	64 (30.6%)
BMI, mean±SD (median)	24.5 ± 4.4 (23.8)
EuroAdd, mean±SD (median)	7.3 ± 2.8 (7.0)
EuroLog, mean±SD (median)	10.2 ± 9.0 (7.2)
Urgency, n (%)	3 (1.4%)
Hypertension, n (%)	136 (65.1%)
Renal failure, n (%)	38 (18.2%)
Crea PRE, mean±SD (median)	1.21 ± 0.78 (1.0)
COPD, n (%)	17 (8.1%)
Diabets, n (%)	34 (16.3%)
Peripheral Vasculopathy, n (%)	10 (4.8%)
Atrial fibrillation, n (%)	152 (72.7%)
Pre-op Neuro deficit, n (%)	12 (5.7%)
NYHA III-IV, n (%)	142 (67.9%)
Redo, n (%)	101 (48.3%)
Previous TV procedures, n (%)	24 (11.5%)
TR grade, mean±SD (median)	3.5 ± 0.8 (4.0)
TV annulus mm, mean±SD (median)	45.8 ± 7.2 (43.0) [89]
TR functional, n (%)	129 (61.7%)
TR primary, n (%)	65 (31.1%)
TV Endocarditis, n (%)	7 (3.5%)
TV Prosthesis Dysfunction, (%)	5 (2.4%)
TR Congenital, n (%)	3 (1.4%)
MV disease, n (%)	139 (66.5%)
MV stenosis, n (%)	37 (17.7%)
MV regurgitation, n (%)	111 (53.1%)
EF, mean±SD (median)	58.2 ± 9.8 (60.0)
Pulmonary Hypertension (>60 mmHg), n(%)	53 (25.4%)
PAPs, mean±SD (median)	52.5 ± 14.4 (51) [159]



REDO CHARACTERISTICS	(n=101/209) 48.3%
1 <sup>st</sup> Redo, n (%)	59/101 (58.4%)
2 <sup>nd</sup> Redo, n (%)	22/101 (21.8%)
3 <sup>rd</sup> or more Redo, n (%)	20/101 (19.8%)
Previous TV Procedures, n (%)	24/101 (23.8%)
TV Replacement, n (%)	5/24 (20.8%)
TV Repair, n (%)	19/24 (79.2%)
Kay procedures, n (%)	4/24 (16.6%)
De Vega procedures, n (%)	14/24 (58.3%)
Prosthesis Ring, n (%)	1/24 (4.2%)

# Methods

OPERATIVE DATA	(n=209)
<b>TV repair</b>	143 (68.4%)
<b>De Vega annuloplasty</b> , n (%)	4 (1.9%)
<b>Kay annuloplasty</b> , n (%)	7 (3.3%)
<b>Annular ring</b> , n (%)	119 (56.9%)
<b>Complex TV repair</b> , n (%)	13 (6.2%)
Leaflet Augmentation, n (%)	4 (1.9%)
<b>TV replacement</b> , n (%)	60 (28.7%)
<b>Tricuspid prosthesis replacement</b> , n (%)	6 (2.9%)
<b>Isolated TV procedure</b> , n (%)	61 (29.2%)
<b>Combined procedures</b>	
<b>MV repair</b> , n (%)	47 (22.5%)
<b>MV replacement</b> , n (%)	64 (30.6%)
<b>Mitral prosthesis replacement</b> , n (%)	28 (13.4%)
<b>ASD closure</b> , n (%)	21 (10.0%)
<b>Myxoma resection</b> , n (%)	2 (0.9%)
<b>AF cryoablation</b> , n (%)	17 (8.1%)
<b>TV procedures on beating heart</b> , n (%)	97 (46.4%)
<b>Clamping</b>	
<b>Endoreturn</b> , n (%)	112 (53.6%)
<b>Transthoracic</b> , n (%)	56 (26.8%)
<b>Endodirect</b> , n (%)	2 (0.9%)
<b>Fibrillatory arrest</b> , n (%)	12 (5.7%)
<b>Femoral cannulation</b> , n (%)	202 (96.7%)
<b>Axillary cannulation</b> , n (%)	4 (1.9%)
<b>External Caval snaring (touriquestes)</b> , n (%)	178 (85.2%)
<b>Endovascular balloons Caval occlusion</b> , n (%)	31 (14.8%)
<b>CPB</b> , mean±SD (median)	146.5 ± 49.5 (140.0)
<b>X-Clamp</b> , mean±SD (median)	90.1 ± 36.6 (90.0)
<b>Conversion to sternotomy</b> , n (%)	6 (2.8%)
<b>Death OR</b> , n (%)	0 (0%)



ISOLATED TRICUSPID DATA	(n=61/209)29.2%
<b>EuroAdd</b> , mean±SD (median)	7.0 ± 2.3 (7.0)
<b>EuroLog</b> , mean±SD (median)	7.7 ± 5.9 (6.0)
<b>Redo</b> , n (%)	42 (68.95)
<b>Previous TV procedures</b> , n (%)	10 (16.4%)
<b>TV repair</b>	22 (36.1%)
<b>De Vega annuloplasty</b> , n (%)	0 (0%)
<b>Kay annuloplasty</b> , n (%)	0 (0%)
<b>Annular ring</b> , n (%)	12 (19.7%)
<b>Complex TV repair</b> , n (%)	10 (16.4%)
<b>TV replacement</b> , n (%)	33 (54.1%)
<b>Tricuspid prosthesis replacement</b> , n (%)	6 (9.8%)
<b>TV procedures on beating heart</b> , n (%)	42 (68.9%)
<b>CPB</b> , mean±SD (median)	102.0 ± 26.9 (100.0)
<b>X-Clamp</b> , mean±SD (median)	48.3 ± 31.6 (51.5)
<b>Conversion to sternotomy</b> , n (%)	3 (4.9%)

# Results 1



- Mean Cardiopulmonary bypass (CPB) time was  $146.5 \pm 49.5$ , the mean cross clamp was  $90.1 \pm 36.6$ . In patients with isolated tricuspid CPB time was  $102.0 \pm 26.9$ , while the mean cross clamp was  $48.3 \pm 31.6$ .
- Conversion to sternotomy was necessary in 6 patients (2.8%), in half of the cases it occurred, at the beginning, as a result of tenacious adhesions.
- Reoperation for bleeding was necessary in 19 (9.1%) cases, of which 15 were redo, and blood transfusion in 100 (47.8%) patients.
- Stroke complication occurred only in 2 (0.9%) patients, PMr implantation in 15 (7.2%), hemodialysis for acute renal failure in 10 (4.8%), new onset of atrial fibrillation in 16 (28.1%) and groin wound infection or lymphocele in 5 (2.4%).
- Mean Intensive care unit stay was  $3.6 \pm 11.3$  days (median 1.0 day). Mean Ventilation time was  $40.5 \pm 245.2$  hours (median 12.0 h). Mean hospital stay was  $11,9 \pm 12,8$  days (median 8.0 days).
- Overall hospital mortality was 3.8%. Intraoperative death occurred in 1 patient due to hemorrhagic shock. Other causes of death were multi-organ failure in 5 patients and sepsis in 2. 30- day mortality after TV repair was 2.1% (3/143) compared to 7.6 % (5/66) after TV replacement while after TV isolated procedure was 1.6% (1/61) compared to TV associated procedures 4.7% (7/148).
- At the early postoperative TEE evaluation trivial or no regurgitation was identified.
- Freedom from early re-operation for TV disease was 100%.

# Results 2

POST-OPERATIVE CHARACTERISTICS	(n=209)
Ventilation, mean±SD (median)	40.5 ± 245.2 (12.0)
Prolonged VAM, n (%)	14 (6.7%)
Re-intubation, n (%)	22 (10.5%)
ICU stay, mean±SD (median)	3.6 ± 11.3 (1.0)
Tracheostomy, n (%)	5 (2.4%)
Unit GRC transfused, mean±SD	2.5 ± 4.4 (2.0)
Unit PFC transfused, mean±SD	0.8 ± 2.0 (0.0)
Unit PLT transfused, mean±SD	0.2 ± 0.6 (0.0)
Patients transfused, n (%)	100 (47.8%)
Re exploration for bleeding, n (%)	19 (9.1%)
Re exploration <i>pooled</i> , n (%)	4 (1.9%)
TV Re-operation, n (%)	0 (0%)
Thoracentesis, n (%)	7 (3.3%)
Neurologic events, n (%)	10 (4.8%)
Minor, n (%)	8 (3.8%)
Major, n (%)	2 (0.9%)
Groin wound infection/linfocele, n (%)	5 (2.4%)
Hemodialysis, n (%)	10 (4.8%)
Crea POST, mean±SD (median)	1.1 ± 1.0 (0.78)
New onset AF, n (%)	16/57 (28.1%)
PM implantation, n (%)	15 (7.2%)
Hosp stay, mean±SD (median)	11.9 ± 12.8 (8.0)
30-day mortality, n (%)	8 (3.8%)

DEATH CHARACTERISTICS	(n=8/209) 3.8%
<b>Cause of death</b>	
Heart Failure, n (%)	4/8 (50%)
Sepsis, n (%)	2/8 (25%)
Massive Bleeding, n (%)	1/8 (12.5%)
Major Neurologic event, n (%)	1/8 (12.5%)
<b>30- day Mortality after</b>	
TV repair, n (%)	3/143 (2.1%)
TV replacement, n (%)	5/66 (7.6%)
TV associated procedures, n (%)	7/ 148(4.7%)
TV isolated procedures, n (%)	1/61 (1.6%)

# Conclusion

- Minimally invasive Tricuspid surgery is safe, feasible and reproducible, even for high-risk population.
- It ensures low perioperative morbidity and mortality. It has an added value in case of reoperative procedures
- In our centre it represents the gold standard and the standard technique of TV surgery.
- Minimally invasive TV Surgery should be considered the benchmark for new hybrid catheter-based technologies