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Comparative Outcomes of Medical, Percutaneous, And Surgical Treatments For Tricuspid Valve Endocarditis

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Abstract: Background: Tricuspid valve endocarditis (TVE) remains a significant cause of morbidity and mortality worldwide. Given the considerable variation in presentation and severity, as well as ongoing advances in percutaneous and operative interventions, the optimal treatment strategy remains undetermined. This study aims to report the outcomes of medical management (MM), percutaneous mechanical aspiration (PMA), and surgical intervention in isolated TVE patients. **Methods:** We conducted a single-centre retrospective review of consecutive patients with isolated TVE from June 2020 to January 2023. Diagnosis was based on the modified Duke criteria and confirmed with echocardiographic findings. Patients were categorized based on the intervention received: MM, PMA, or surgical intervention. The type of intervention received was determined by the consensus agreement of a multidisciplinary high-risk heart team. Primary outcomes included 30-day and 1-year survival rates. Secondary outcomes included length of hospital stay, degree of residual tricuspid regurgitation, and complications including septic emboli, pleural effusion, and stroke. **Results:** Overall, 20 patients were treated for TVE: 7 received MM, 4 underwent PMA, and 9 underwent surgical intervention. The 30-day survival rates were 57.1% for MM, 100% for PMA, and 100% for surgery (p=0.038). One-year survival rates were 57.1% for MM, 100% for PMA, and 88.9% for surgery (p=0.155). PMA patients had the longest median hospital stay (14.5 days), followed by surgical (13.5 days) and MM (5 days) groups. Post-intervention echocardiography showed a significant reduction in tricuspid regurgitation severity in the surgical group but an increase in the PMA group. Complications including septic emboli, reoperation, heart block and pleural effusion were insignificant between groups. **Conclusion:** This study suggests that intervention, either PMA or surgery, may offer superior short-term survival benefits compared to MM in surgically fit patients presenting with isolated TVE. The findings highlight the need for a multidisciplinary approach in managing TVE and suggest further prospective studies are warranted to establish definitive treatment guidelines.

Keywords: Tricuspid valve endocarditis, Percutaneous mechanical aspiration, Medical management, Surgical intervention, Tricuspid regurgitation, Multidisciplinary approach

1. Introduction

Isolated tricuspid valve endocarditis (TVE), historically associated primarily with intravenous (IV) drug use, has seen an increased prevalence due to the rising use of cardiac implantable devices (CIEDs) (Nappi et al., 2020). Despite its varied clinical presentations, TVE continues to be associated with significant morbidity and mortality (Baddour et al., 2015). This is particularly evident in subgroups of patients with IV drug use-related TVE and those with cardiac device infective endocarditis (CDIE), where 30-day mortality rates have been reported as high as 30% (Athan et al., n.d.; Cahill & Prendergast, 2016; Galeone et al., 2024; Hamandi et al., 2019; Zhang et al., 2023).

Decision-making for optimal management of patients with TVE is a dynamic process requiring individualized risk assessment, given the vast differences in presentation and illness severity. TVE has traditionally been managed with medical therapy and surgical intervention, including tricuspid valve replacement, repair, debridement, or excision (Baddour et al., 2015; Nappi et al., 2020). Surgical outcomes, however, have been mixed, often dictated by the patient's overall condition (Witten et al., 2019; Yanagawa et al., 2018). As percutaneous therapies, including mechanical aspiration, have advanced, the role of surgical intervention has become less clearly defined (Baddour et al., 2015; Delgado et al., 2023; El Sabbagh et al., 2024a; Otto et al., 2021).

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Current ACC/AHA guidelines do not provide specific recommendations for the implementation of minimally invasive approaches (Otto et al., 2021). Consequently, data comparing the outcomes of medical management (MM), percutaneous mechanical aspiration (PMA), and surgical intervention remain limited. To gain further insight into the outcomes of each approach, we conducted a retrospective analysis of consecutive patients with isolated TVE treated at our institution.

2. Methods

This study presents the findings of a comprehensive single-centre retrospective review, spanning the period from June 2020 to January 2023. The focus of this study was to describe and report the outcomes of patients admitted and treated for tricuspid valve endocarditis, with the introduction of PMA in mind. All adult patients over the age of 18 who presented with a diagnosis of isolated TVE were included in the study. Those with multivalvular involvement or peri-prosthetic valve endocarditis were excluded. The diagnosis of endocarditis was established using the modified Duke criteria in conjunction with echocardiographic findings consistent with the diagnosis. Definite endocarditis was diagnosed if patients met either 2 major criteria, 1 major criterion and 3 minor criteria, or 5 minor criteria. Possible endocarditis was diagnosed with 1 major criterion and 1 minor criterion, or 3 minor criteria (Baddour et al., 2015; Durack et al., 1994; Li et al., 2000).

A key aspect of this study was the multidisciplinary heart team approach taken in the evaluation and treatment of patients with tricuspid valve endocarditis. Each case was individually reviewed and discussed at a high-risk heart team conference, which consisted of, but was not limited to, cardiac surgeons, interventional cardiologists, heart failure cardiologists, advanced practice providers, and cardiac imaging specialists. The collaborative efforts of this multidisciplinary team were instrumental in formulating individualized treatment plans tailored to each patient's unique needs and circumstances.

Patients included in the study were further categorized based on the type of intervention they received: MM, PMA, or surgery. For those who underwent PMA, the large-bore AngioVac (AngioDynamics) system was utilized. The AngioVac system is a large-bore aspiration device that uses either a 22 or 18Fr cannula. The telescoping cannula is advanced into position, and using a venovenous recirculation system, the aspirated valvular vegetations are filtered and removed. The major limitation of this device is its increased cost and logistical complexity, as a trained perfusionist is typically required (El Sabbagh et al., 2024a).

Baseline patient and procedural data were collected retrospectively via electronic medical record review. Information collected included gender, age, and various comorbid conditions such as hypertension, coronary artery disease, atrial fibrillation, heart failure, COPD, end-stage renal disease on dialysis, smoking status, IV drug use, prior cardiac interventions, and The Society of Thoracic Surgeons predicted risk of mortality (STS PROM) for isolated tricuspid valve replacement (TVR) (O'Brien et al., 2018; Shahian et al., 2018). As some patients in this study were treated prior to the release of the STS PROM for TVR, the STS Primary MR Risk Calculator was used as a surrogate. The STS PROM for TVR was calculated retrospectively for all patients to ensure statistical consistency.

The primary outcome of interest was 30-day survival. Secondary outcomes included 1-year survival, length of hospital stay, the severity of residual tricuspid regurgitation at admission and following intervention, and complications such as reoperation, septic emboli, pleural effusion, and stroke. Categorical variables are presented as counts and percentages, while continuous data are expressed as median values within an interquartile range. Statistical analysis was performed using a chi-square test for categorical data and the Kruskal-Wallis test for numerical data. A p-value of <0.05 was considered statistically significant.

3. Results

During the study period from June 2020 through January 2023, 20 patients were admitted with a diagnosis of isolated tricuspid valve endocarditis (TVE). Of these, 7 patients (35%) received medical management (MM) alone, 4 (20%) underwent percutaneous mechanical aspiration (PMA), and 9 (45%) underwent surgery. There were no statistically significant differences between the groups regarding median age, gender, comorbidities, or STS PROM for TVR (Table 1). Notably, 75% of the patients were transferred to our center from another facility. Four patients presented with acute cardiac decompensation within 48 hours of arrival, and one within 72 hours.

Table 1: Baseline characteristics of patients admitted with the diagnosis of tricuspid valve endocarditis within each treatment group.

Characteristics	Medical Management	Percutaneous Mechanical Aspiration	Surgery	p-value
N	**7**	**4**	**9**	
Demographics				
Age	52 [33.5-75]	31 [27.8-37.8]	34 [31-61]	0.224
Female	5 (71.4%)	3 (75%)	3 (33.3%)	0.210
Comorbidities				
HTN	4 (57.1%)	2 (50%)	4 (44.4%)	0.881
CAD	2 (28.6%)	0 (0%)	2 (22.2%)	0.509
AFib	1 (14.2%)	0 (0%)	0 (0%)	0.376

Heart Failure	2 (28.6%)	0 (0%)	1 (11.1%)	0.402
DM	3 (42.8%)	2 (50%)	0 (0%)	0.063
COPD	1 (14.2%)	0 (0%)	2 (22.2%)	0.584
CVA	2 (28.6%)	1 (25%)	1 (11.1%)	0.661
ESRD on HD	2 (28.6%)	2 (50%)	0 (0%)	0.090
Tobacco abuse	1 (14.2%)	1 (25%)	5 (55.5%)	0.205
IV Drug abuse	2 (28.6%)	2 (50%)	3 (33.3%)	0.766
ICD	2 (28.6%)	0 (0%)	2 (22.2%)	1.0
Prior cardiac intervention	3 (42.8%)	0 (0%)	3 (33.3%)	0.741
STS PROM for TVR	6.7% [2.8-29.2]	3.3% [1.7-5.8]	1.9 % [1.0-2.9]	0.131

Values are reported as number (%) or median [interquartile range]. HTN: Hypertension; CAD: Coronary Artery Disease; AFib: Atrial Fibrillation; DM: Diabetes Mellitus; COPD: Chronic Obstructive Pulmonary Disease; CVA: Cerebrovascular Accident; ESRD: End-Stage Renal Disease; HD: Hemodialysis; ICD: Implantable Cardiac Device; STS PROM: Society of Thoracic Surgeons Predicted Risk of Mortality; TVR: Tricuspid Valve Replacement

3.1. Medical Management

Of the seven patients who received MM, the median age was 52 (33.5–75). Five of the seven were female. Most patients had a preserved ejection fraction (EF) on admission, with an average of 57.5% (46.3–61.3). Moderate to severe tricuspid regurgitation (TR) was identified in 4 patients (57.1%). Two of the seven (28.5%) reported IV drug use and two patients had an ICD in place. The underlying cause for the remaining 3 patients was unknown. A definitive diagnosis of endocarditis was established in six patients, while one was classified as likely. The median STS PROM was 6.7% (2.8–29.2). Blood cultures were positive for MSSA in 3 patients, while others were positive for pseudomonas, corynebacterium, or coagulase-negative staphylococci. One patient had culture-negative TVE. The 30-day survival rate for this cohort was 57.1% (4/7). Two patients expired during hospitalization, and a third was transitioned to hospice care after transfer to a skilled nursing facility. The median STS score of those who died within 30 days compared to those who survived was 42 vs. 2.8 (p=0.057). One-year survival remained at 57.1%, as the remaining four patients were alive at the one-year follow-up. The median length of stay was 5 days (3.5–7.5), and the median ICU length of stay was 0 days (0–4.5). Septic emboli were identified in 2 patients (28.5%). Of the 4 patients who survived to discharge, 2 were discharged home, and 2 were admitted to a skilled nursing facility.

3.2. Percutaneous Mechanical Aspiration

Four of the 20 patients underwent PMA. The median age was 31 years (27–47). Three of the four were female, and two reported IV drug use. The other two patients had end-stage renal disease on dialysis with recurrent tunnelled dialysis catheter infections. None of the patients had an ICD. A pre-intervention echocardiogram confirmed the presence of tricuspid vegetations and quantified baseline EF and TR. All four patients had definitive endocarditis, with a median STS PROM score of 3.3% (1.7–5.8). No deaths were reported at 30 days or 1 year in the PMA group (0/4). The median preoperative EF was 57.5% (48.75–61.25). Severe TR was identified in two patients (50%). Two patients had MSSA as the infective organism, while the other two had no growth on blood cultures. Following PMA, overall EF remained unchanged at 57.5% (51.25–61.25). However, TR increased in 3 of the 4 patients, with one patient remaining with severe TR and a concomitant flail leaflet necessitating tricuspid valve replacement. Two patients (50%) experienced septic pulmonary emboli, which did not require additional intervention. The median length of stay was 14.5 days (11.8–22.3), with a median ICU stay of 2 days (0–6.5).

3.3. Operative Intervention

As recommended by the multidisciplinary heart team, 9 patients (42.8%) underwent urgent operative intervention. None of the procedures were performed emergently. The choice of operation—tricuspid valve replacement (TVR), tricuspid valve repair (TVr), or tricuspid valve debridement (TVd)—was left to the operating surgeon. The median age of patients who received operative intervention was 34 years (31–61). Six of the nine patients were male. All patients were classified as having definitive endocarditis. Three patients (22.2%) reported IV drug use, and two patients (22.2%) had an ICD in place. The underlying cause for the remaining four patients was undetermined. The median STS PROM was 1.9% (1.0–2.9). Of the 9 patients who underwent operative intervention, 5 received TVR, 3 received TVr, and 1 underwent TVd. Three patients also required VSD repair. Eight patients had a traditional median sternotomy, while one underwent robotic-assisted TVr with concurrent biologic patch closure of a VSD and primary closure of an ASD. Thirty-day survival was 100%, and at 1-year follow-up, survival was 88.9% (8/9). Pre-operative EF was 60% (55–60) and was preserved postoperatively at 55% (55–56.25). Six patients (66.6%) had moderate to severe TR preoperatively, which improved postoperatively, with 5 patients (55.5%) having no residual TR and 3 patients (33.3%) having only mild residual TR. One patient with moderate preoperative TR did not have a postoperative echocardiogram. Of the 3 patients who underwent TVr, all showed improvement in TR, with 66% having no TR and 33% having trivial TR postoperatively. The one patient who underwent TVd had unchanged mild TR postoperatively. One patient (11.1%) required permanent pacemaker (PPM) placement

due to heart block. No patients had septic emboli. The median length of stay was 13.5 days (11.5–15.25), with a median ICU stay of 3 days (3–5). Six patients (66.6%) were discharged home, while the remaining three were admitted to either a skilled nursing facility or an inpatient rehabilitation center.

4. Discussion

The present study provides insight into the different management strategies and outcomes of patients treated for isolated tricuspid valve endocarditis (TVE) at a single institution. We conducted a retrospective analysis of 20 patients over a two-and-a-half-year period, aiming to compare the outcomes of medical management (MM), percutaneous mechanical aspiration (PMA), and surgical intervention. Our goal was to elucidate the characteristics and results of patients within each treatment group.

The baseline characteristics of patients in our study cohort revealed relative consistency across the three treatment groups. Although patients receiving MM were generally older (median age 52 years) compared to those undergoing PMA (median age 31 years) and surgery (median age 34 years), this difference did not reach statistical significance (p=0.224). There appeared to be a higher proportion of females in both the MM (71.4%) and PMA (75%) groups compared to the surgical cohort (33.3%), though this also failed to reach significance (p=0.210). The prevalence of comorbidities, such as hypertension, coronary artery disease, diabetes, and end-stage renal disease on dialysis, varied across groups but was not statistically significant. STS PROM scores for TVR were also reported in each group and were not significantly different (6.7% vs 3.3% vs 1.9%, p=0.131).

As a result of in-depth discussions involving all members of the high-risk multidisciplinary heart team, the most appropriate treatment plan was developed and implemented. Patients who ultimately received MM were typically poor surgical candidates due to the severity of disease burden, comorbidities, or ongoing intravenous drug use (IVDU) (Table 2). Patients who underwent PMA, though having a similar risk profile to those who received surgery, were at high risk of reinfection due to ongoing IVDU, renal failure requiring long-term dialysis catheters, or being unable to tolerate anticoagulation required for operative intervention. All patients who received PMA were continued on long-term IV antibiotics and followed for ongoing assessment and consideration of operative intervention if deemed appropriate.

Table 2: Characteristics and management decision strategy for patients managed with either MM or PMA.

Case	Age	Sex	EF	Vegetation Size (mm)	TR	STS PROM	Treatment Modality	Heart Team Decision	30-day Survival	1-year Survival
1	75	F	55	18	Mild	6.7	MM	Pancytopenia, severe thrombocytopenia. High risk for bleeding -> MM with home hospice	Yes	Yes
2	52	M	60	16	Mod	16.4	MM	Severe AS, severe MS w/ diffuse MAC and acute cerebral infarcts. High risk for surgery -> MM	No	No
3	31	F	65	18	Sev	1.6	MM	Current IVDU. High risk for recurrent infection -> MM vs PMA with failure of antibiotic therapy	Yes	Yes
4	36	M	55	Minimal	Trivial	4	MM	Current IVDU. High risk or recurrent infection -> MM w/ outpatient follow-up	Yes	Yes
5	78	F	60	Minimal	Sev	51.2	MM	Acute cerebral infarcts and advanced cirrhosis (Meld-Na of 27). High risk for surgery -> MM with palliative care	No	No
6	28	F	55	16	Mild	0.7	MM	COVID pneumonia and subsequent cavitary lung lesions. High risk due to underlying pulmonary disease -> MM with outpatient follow-up	Yes	Yes
7	75	F	20	Minimal	Mod	42	MM	ICD related endocarditis in MODs. Prohibitive risk for surgery -> MM w/ palliative care	No	No
8	28	M	55	16	Mod	4.7	PMA	Recurrent tunneled dialysis catheter infections and acute ICH. High risk for anticoagulation -> PMA w/ outpatient follow-up	Yes	Yes
9	27	F	60	15	Sev	1.3	PMA	Current IVDU. High risk for recurrent infection -> PMA -> Significant residual TR necessitating staged TVR.	Yes	Yes
10	34	F	65	58	Sev	9.1	PMA	Recurrent tunneled dialysis catheter infection. High operative risk and high risk of recurrence -> PMA w/ outpatient follow-up	Yes	Yes
11	47	F	30	18	Mild	1.85	PMA	Current IVDU w/ failure of conservative management. High risk for recurrence -> PMA w/ outpatient follow-up	Yes	Yes

EF: Ejection Fraction; TR: Tricuspid Regurgitation; STS PROM: Society of Thoracic Surgeon Tricuspid Valve Replacement Risk of Mortality Score; MM: Medical Management; PMA: Percutaneous Mechanical Aspiration; ICH: Intracranial Hemorrhage

Thirty-day survival varied significantly between each group, with the highest survival observed in patients who underwent PMA and surgery (100% in both groups) compared to those managed medically (57.1%) (Table 3). These findings underscore the potential benefits of interventional approaches in enhancing short-term survival in TVE patients, especially in those who are not at prohibitive risk for intervention. The median STS score of those who died within 30 days was notably higher than those who survived (42 vs. 2.8), with near statistical significance (p=0.057). Interestingly, the one-year survival rates showed a slight decline in the surgical group (88.9%). One patient who underwent TVR expired approximately 6 months following his procedure for an unknown cause.

Table 3: Primary and secondary outcomes between each group.

Outcomes	MM	PMA	Surgery	p-value
N	**7**	**4**	**9**	
Survival				
30-day survival	57.1%	100%	100%	**0.038**
1 year survival	57.1%	100%	88.9%	0.155
Echocardiogram				
Admission EF	57.5% [46.3-61.3]	57.5% [48.75-61.25]	60% [55-60]	-
Admission TR (moderate-severe)	57.1%	50%	66.6%	0.0836
Vegetation Size (mm)	17 [16-18]	17 [15.75-28]	17 [15.45-22.5]	0.978
Post-operative EF		57.5% [51.25-61.25]	55% [55-56.25]	-
Post-operative TR (moderate-severe)		100%	0%	**0.003**
Infective Organism				
MSSA	3	2	1	-
MRSA	0	0	1	-
Pseudomonas	1	0	0	-
Corynebacterium	1	0	0	-
Coagulase-negative staphylococci	1	0	0	-
Strep viridians	0	0	2	-
Strep anginosus	0	0	1	-
Candida	0	0	1	-
No growth	0	2	3	-
Complications				
Septic Emboli	28.5%	50%	0%	0.090
Reoperation	0%	25%	0%	0.122
Heart block/Pacemaker	0%	0%	11.1%	0.526
Pleural Effusion	0%	0%	11.1%	0.526
Death/Hospice	42.9%	0%	0%	**0.038**
Length of Stay	5 [3.5-7.5]	14.5 [11.8-22.5]	13.5 [11.5-15.25]	**0.011**
Length of ICU Stay	0 [0-4.5]	2 [0-6.5]	3 [3-5]	0.685

Values are reported as median [interquartile range]. MM: Medical Management; PMA: Percutaneous Mechanical Aspiration; EF: Ejection Fraction; TR: Tricuspid Regurgitation; MSSA: Methicillin-Sensitive Staphylococcus Aureus; MRSA: Methicillin-Resistant Staphylococcus Aureus

Admission transesophageal echocardiogram demonstrated significant valve dysfunction in patients who received surgical intervention, with 66.6% having moderate to severe tricuspid regurgitation (TR) preoperatively. There was a significant reduction in TR severity postoperatively, with no patients exhibiting >mild TR. This remained true for both the TVR and TVr subgroups. The one patient who received TR debridement had unchanged mild TR following the procedure. Conversely, patients in the PMA group experienced an increase in TR severity post-intervention (p=0.003). One patient remained with severe, symptomatic TR secondary to a flail leaflet, necessitating TVR. Although operative intervention was only required for one patient in this group, it highlights a potential limitation of percutaneous aspiration and its inherent inability to correct or possibly worsen TR. Additionally, there was a 50% incidence of septic emboli in the PMA group, while no cases were reported in the surgical cohort. Operative intervention with either replacement or repair of the diseased valve is not without risk; one patient who underwent surgery developed heart block postoperatively, necessitating permanent pacemaker (PPM) placement.

The median length of hospital stay was longest for the PMA group (14.5 days), followed closely by the surgical group (13.5 days), and shortest for the MM group (5 days), p=0.011. It must be noted, however, that the cohort treated with MM demonstrated a wide range of presentations and disease severity. Two patients presented with mild disease and were discharged home after two and five days, respectively, with long-term antibiotic therapy. Three patients in this cohort presented with severe disease, and following discussions with family and palliative care teams, were transitioned to comfort measures (Table 2). Two patients expired during the index hospitalization, and the third while at a skilled nursing facility. The length of ICU stay was also evaluated, with the PMA group having a median ICU stay of 2 days, the surgical group 3 days, and the MM group 0 days. Despite these differences, the ICU length of stay was not significantly different between the groups (p=0.685). Overall, the length of hospital stay for patients receiving PMA or surgery was similar.

The spectrum of infective organisms identified in our study cohort was diverse, with MSSA being the most common pathogen across all groups (Table 3). Notably, a significant proportion of patients in the surgical group had no growth on blood cultures, which may reflect prior antibiotic use or limitations in microbiological detection methods.

Our institutional approach to determining the optimal treatment strategy for TVE patients centers around a comprehensive multidisciplinary discussion, as outlined in our methodology. Each patient's case is reviewed by a high-risk heart team, ensuring individualized treatment plans tailored to each patient's unique clinical presentation and comorbidities. This collaborative approach should be considered a best practice in managing TVE patients, similar to its application in other complex cardiovascular diseases such as coronary and structural disease (Baddour et al., 2015; Delgado et al., 2023). The outcomes of this multidisciplinary approach are evident in the 100% 30-day survival rate for patients who received an intervention, while historical mortality rates have been reported

between 15% and 30% (Athan et al., n.d.; Cahill & Prendergast, 2016; Galeone et al., 2024; Hamandi et al., 2019; Zhang et al., 2023).

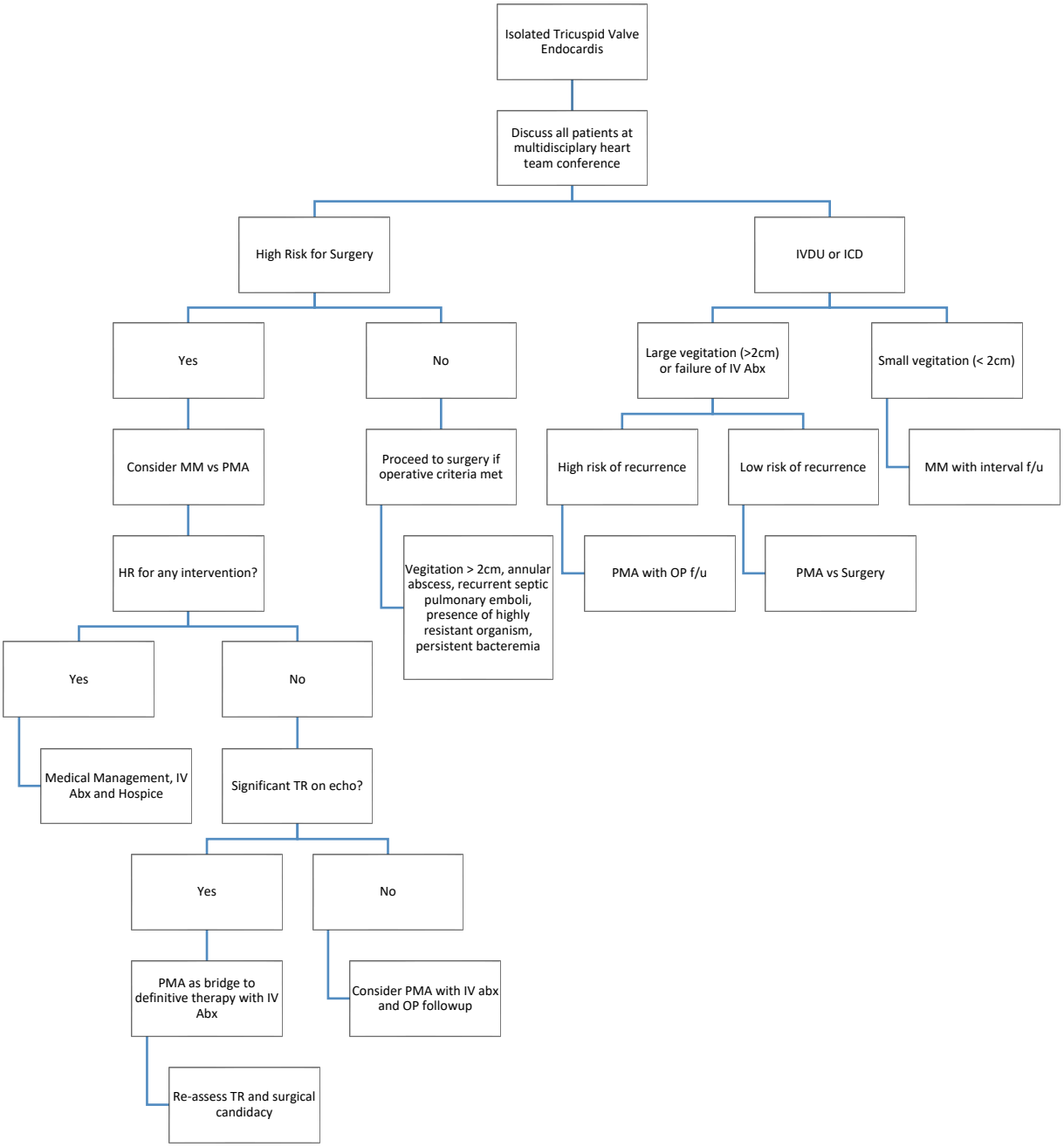

Chart 1. Proposed treatment algorithm for isolated tricuspid valve endocarditis

As demonstrated in this study, PMA appears to be a valid treatment option and should be considered in managing these complex patients (El Sabbagh et al., 2024a, 2024b; Mourad et al., 2023; Veve et al., 2021). The most recent European Society of Cardiology Guidelines for managing endocarditis suggest that aspiration of right intra-atrial septic masses may be considered in selected high-risk surgical patients, a class IIb indication (Delgado et al., 2023; Starck et al., 2019). Similar recommendations have yet to be included in the ACC/AHA Guidelines (Otto et al., 2021). Given the potential for persistent severe TR to result in decreased quality of life and increased long-term adverse events (Henning, 2022; Nishiura et al., 2023; Sorajja et al., 2023), special consideration should be given to patients with severe regurgitation from infection, as PMA may not address this issue and may worsen it. Repeat echocardiograms and interval re-evaluation following PMA are crucial to determining the severity of residual TR and assessing surgical candidacy. PMA may be most beneficial for patients with isolated TVE secondary to IV drug use or as a bridge to more definitive therapy (Galeone et al., 2024; Martín-Dávila et al., 2005; Veve et al., 2021).

Several limitations must be acknowledged in interpreting our study results. As a retrospective analysis, it is subject to the limitations of all such studies, most importantly patient selection bias. Additionally, the single-center setting limits the generalizability of our findings. Given the small sample size and inherent heterogeneity in patient characteristics, results should be interpreted cautiously. Moreover, statistical significance may be affected by the

cohort sizes. Future randomized trials will be essential to understanding the true impacts of interventions versus medical management.

5. Conclusion

The optimal treatment strategy for TVE and the specific role of PMA remains to be definitively established. Our early experience suggests that both PMA and surgical interventions offer promising results, particularly in terms of short-term survival when compared to MM. However, each treatment modality presents its own set of limitations and risks. PMA is associated with an increased incidence of worsened tricuspid regurgitation and septic emboli, while surgical intervention carries risks such as heart block and stroke. The integration of a multidisciplinary heart team discussion proves to be a valuable adjunct in determining the most appropriate management strategy for these complex patients. Although our findings are promising, future prospective studies are essential to gain a more comprehensive understanding of the impacts and implications of these treatment strategies, ultimately guiding the establishment of more definitive treatment guidelines.

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