

Chapter 11

Tricuspid Valve: A Heart Team Approach



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The Heart Team Evolves for Tricuspid Valve Disease Management

The multidisciplinary heart team (MDHT) has become recognized as essential in the management of patients with complex valvular heart disease (VHD) and has been incorporated into valvular disease management guidelines worldwide [1–3]. The concept of a multidisciplinary team of healthcare professionals is well established in the care of patients with malignancies and organ failure that requires transplantation. Recognition of the “heart team” in the cardiac world emerged with the Syntax trial in 2006, where the combined opinion of the cardiac surgeon and the interventional cardiologist determined the patient’s eligibility for the trial, followed by appropriateness for percutaneous coronary intervention (PCI) and/or coronary artery bypass graft (CABG) [4]. Over the next decade, the “heart team” moved from the coronary disease setting into valvular disease. The MDHT was incorporated into major valve research protocols, requiring collaboration in decision-making [5–11]. Although the “heart team” was initially defined as the interventional cardiologist and the cardiac surgeon [12], the advanced decision-making process for the treatment of complex valve disease found that the treatment discussion

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reached beyond the procedure itself. The team expanded to include an advanced echocardiographer, imaging specialists, anesthesiologists, the valve nurse clinician, and others who have unique contributions to make to the patient's care. This larger MDHT has been shown to improve clinical and economic outcomes in aortic valve procedures [13–17].

As transcatheter therapies moved to treatment of the other heart valves, the composition of the MDHT evolved. The most recently published recommendations for operator and institutional requirements for mitral valve intervention included the heart failure specialist and specified that the echocardiographer should have advanced training per American Society of Echocardiography standards [18]. Core to the clinical management of secondary or mixed mitral regurgitation is guideline-directed medical therapy (GDMT), which is generally led by the heart failure specialist [19]. Standardized echocardiographic assessment for mitral valve regurgitation analysis alone includes 14 qualitative parameters, 12 quantitative parameters, and hemodynamic and rhythm parameters [19]. Full evaluation of the regurgitant mitral valve with consideration of the various repair versus replacement options requires knowledge of both advanced echocardiographic interpretation and interventional imaging. An interventional imager with level III training is an essential component of the MDHT, providing indispensable direction throughout the diagnostic period and guidance for and during transcatheter procedures [18]. Decisions regarding surgical versus transcatheter treatment strategies require assessment of concomitant valvular and structural disease [19]. Surgical mitral valve treatment generally requires definition of all indications for intervention to allow a single “all at once” procedure. A transcatheter approach, however, generally adopts staged interventions, allowing for medical treatment of concomitant diseases and time for ventricular remodeling or patient conditioning between procedures. The history of disease progression of mitral valve disease extends over years; the patient and family report diminished activity over time to avoid symptoms, unaware that the decline is disease related. The advanced valve clinician and nurse coordinators provide ongoing navigation and treatment adjustments for the patient with mitral valve disease [19].

The MDHT for the tricuspid valve (TV-MDHT) has taken direction from its “sister” atrio-ventricular mitral valve. The etiology of tricuspid regurgitation (TR) is divided into primary and secondary causes, with an emerging population of adult patients showing isolated TR not associated with congenital disease, the presence of left heart failure, or pulmonary hypertension. The TV-MDHT comprises the same members as the mitral valve team, with the addition of specialists from the other associated disease processes. Tricuspid valve trials have incorporated these key members into their research protocols.

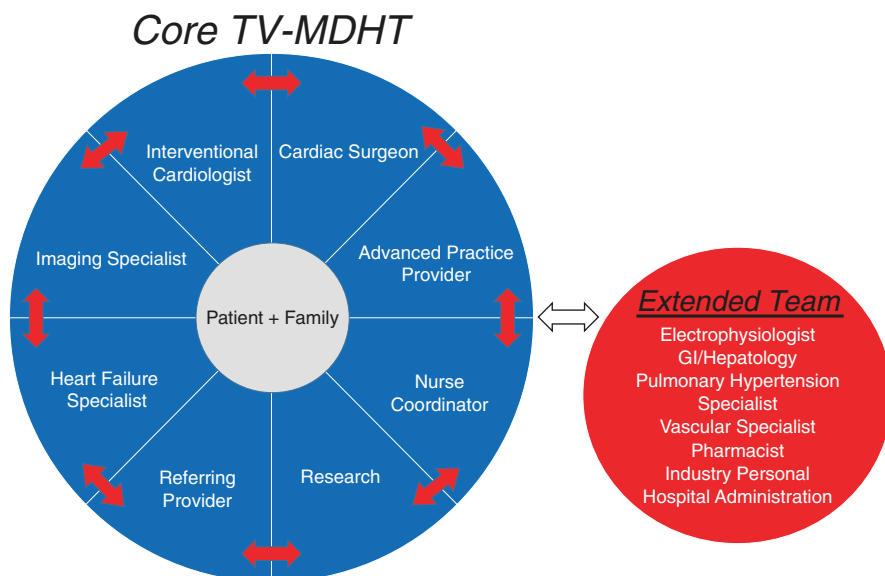


Fig. 11.1 Tricuspid valve multidisciplinary heart team

An Overview of the Multidisciplinary Team for the Tricuspid Valve

The Core Members of the TV-MDHT

A core group of healthcare professionals are intimately involved in the evaluation and management of patients with TV disease. From initial presentation and throughout the continuum of treatment, each of these key specialists is integral to the care in every patient with TV disease. Figure 11.1 provides an illustration of the TV-MDHT.

Interventional Cardiologist

Interventional cardiology has grown to bridge many cardiac specialties that were once separate. Broadly, interventional cardiologists who have gathered experience as well as special interest within the subspecialty of VHD often are referred to as “heart valve specialists.” This first generation of structural interventional cardiologists (SIC) has more recently helped establish dedicated, formalized training programs for interventional cardiology fellows who aspire to incorporate SHD treatments into their individual practice. In many ways, SICs are the champions of the contemporary TV-MDHT. Screening, selection, and optimization remain critical in high-risk subsets of patients in whom protocol-based TV treatments may be

indicated. These professionals must collaborate with all members of the MDHT to provide coordinated, comprehensive, high-quality care.

Given the relative infancy of percutaneous treatments for TR, the specific diagnosis and treatment of TR patients require particular expertise and learned experiences on the behalf of IC. Deep knowledge and understanding of the complex TV anatomy as well as novel transcatheter-based TV technologies to include annuloplasty systems, coaptation devices, leaflet devices, caval valve implantation, and TV replacement are fundamental. Patient selection remains dependent on many factors to include anatomy of the TV and its relationships with surrounding structures, severity and etiology of TR, right ventricular (RV) size and function, among others. SICs must incorporate consistent and deliberate dialogue with all members of the MDHT during pre-procedural planning as well as interventions in order to successfully implement, prevent, and anticipate procedural complications.

Cardiothoracic Surgeon

Surgery has long been and remains the only guideline-indicated therapy for TR patients who remain symptomatic on medical therapy. Current American and European guidelines for the management of patients with VHD recommend TV surgery in (1) patients with symptomatic severe organic TR despite optimal pharmacological treatment without severe RV dysfunction; (2) asymptomatic patients with severe organic TR and signs of RV remodeling or dysfunction; and (3) patients with moderate or severe organic TR, or functional TR who undergo surgical treatment of left-sided VHD [20, 21]. However, due to an increasing appreciation of the inherently complex TV pathology and high morbidity and mortality associated with TV surgery, a variety of innovative, less-invasive techniques have been developed and are an attractive alternative to surgical-based correction.

The primary role of cardiothoracic surgeons (CTS) on the TV-MDHT is to provide expert opinion regarding surgical risks, as well as to determine overall candidacy and/or operability for surgical treatment. In addition to open surgery, surgeons could be trained to offer transcatheter-based or minimally invasive treatment options alike. Not unlike SICs, many CTS have skilled understanding of anatomy, pathophysiology, and hemodynamics of SHD. Given CTS are uniquely positioned to offer the full spectrum of therapy in structural heart disease they too remain a central pillar of the TV-MDHT.

Interventional Imaging

The complexity of percutaneous transcatheter-based technologies and devices for structural interventions continues to evolve in parallel to the development of a new subspecialty of structural heart interventional imagers [22, 23]. Advanced structural imaging is crucial to accurate diagnosis of the pathology, patient selection, and procedural planning for specific interventions.

The inherent complexity of the TV and RV anatomy and function provides unique challenges for structural heart interventional imagers. Two-dimensional (2D) echocardiography has now been supplemented with three-dimensional (3D) imaging, and advanced imagers have been able to incorporate computed tomography and cardiovascular magnetic resonance imaging in procedural planning and execution. The use of these additional modalities has helped in the understanding of TR severity grading, and assessment of RV remodeling and function, which was limited, and in part has led to the under-recognition of the magnitude of the problem [24]. The expansion of new devices and technologies to percutaneously address TR has led to an improvement of understanding of the pathophysiology, but more work is necessary and will be a central component of the imaging specialist's responsibilities and of the multidisciplinary heart team discussion.

Beyond this, imagers meticulously guide pre-procedural planning and ultimately procedural implementation of TV interventions. Strong communication skills are an absolute essential throughout all phases of the care continuum however, paramount during an interventional procedure to ensure optimal and safe patient outcomes.

Advanced Practice Providers: The Valve Clinicians

Advanced practice providers (APPs) are uniquely positioned to participate in the care of patients across the entire spectrum of care delivery. This group, which comprises nurse practitioners and physician assistants, has continued to demonstrate the ability to deliver safe, cost-effective, efficient, and high-quality care [20, 21, 25] with complex patients. Their education and training provide knowledge and skills that are exceptionally suited to meet the needs of complex valve patients, permitting them autonomy that can greatly extend a MDHT's capabilities.

Many patients burdened with TV disease endure a long and sometimes rigorous journey. If effectively integrated, APPs offer a continuous link or bridge to care that crucially improves patient access and continuity of care. Advanced practice providers can function either independently or alongside a collaborating physician in care coordination or in the provision of direct patient care.

Valve Program/Nurse Coordinator

Alongside the continuous, exponential growth of structural heart disease therapies, the role of valve program/nurse coordinators (VPCs), too, has evolved at an ineffable speed. Historically transcatheter aortic valve replacement patients were the initial focus population of the VPCs' efforts; however, VPCs now assist the MDHT in the management of mitral, tricuspid, and even pulmonic valve patients. Their contributions to the MDHT are endless. Mainly these individuals manage intake and keep the plan of care in constant motion. Consistent and clear communication is an essential skill to ensure all members of the MDHT are up to speed with the patient's individual care pathway. The VPCs spend a large amount of time interacting with

the patient and family and their insights are critical toward implementing treatment strategies. Particularly with TV patients, percutaneous treatment methods are focused on research protocol-based care. The VPC must closely collaborate with research coordinators and industry personal alike in order to ensure timely and adequate treatment.

Research Coordinators

Research coordinators involvement in the core TV-MDHT primarily starts with screening the TR patient populations for eligibility in protocol-based percutaneous TV treatments. Consideration of concomitant VHD treatments or percutaneous coronary intervention can affect eligibility and may require treatment prior to consideration for TV protocols. The research coordinators are responsible for having in-depth knowledge of research protocols, compliance with inclusion and exclusion criteria, guidance of diagnostic testing, and coordination of care to ensure adherence to research protocols. They oversee all communication with study sponsors, maintaining ongoing and final data collection, and reporting protocol deviations. They are the key resource for patients, ensuring they are fully informed of the purpose and requirements of protocol participation from initial consent, throughout the treatment process, until final data collection is completed.

Heart Failure Specialists

Severe TR disease is often associated with symptoms of right heart failure such as hepatosplenomegaly, ascites, and peripheral edema. Inclusion of the advanced heart failure specialist on the TV-MDHT is particularly valuable in managing the difficult right-sided fluid overload the TR patient experiences. Additionally, TR protocols typically mandate that advanced heart failure specialists be key members of the protocol, to independently verify that the TR patient is on stable goal-directed medical therapy prior to initiating any transcatheter or surgical-based definitive treatment.

Referring Provider

The referring provider could be identified as the initial or “frontline” TV-MDHT member. It is the referring provider who frequently recognizes the initial signs of TR and provides referral for advanced valve evaluation and treatment. It is imperative they are involved in or receive communication regarding treatment plans and implementation. The referring provider may be a valuable resource for the patient regarding titration of diuretics, as well as managing concomitant health issues that may impact TR management. Ultimately, they will provide the essential follow-up for the patient regardless of which treatment strategy is pursued.

Patient and Family

Finally, the most important member of core MDHT remains the patient. The patient and the patient's family should continuously be included in shared discussions surrounding diagnosis, treatment, and attune care plans specifically their individual goals of care. These goals should be clearly articulated and understood by all members of the MDHT.

The Extended Team Members of the TV-MDHT

Although the core TV-MDHT members serve as the principal team for the care and management of TR patients, the close collaboration and assistance of an extended care team may be needed in order to provide optimal care.

Electrophysiologist

Lead management and extraction are increasingly essential components of the comprehensive care of patients with device-related TR. During MDHT collaboration, cautious review of multimodality imaging for clear delineation of pacemaker lead impact on the tricuspid leaflet motion and contribution is essential prior to device modification. The procedure for lead extraction requires a careful risk and benefit discussion by the MDHT and with the patient.

Vascular Specialists

In patients with severe TR, the symptoms of fluid overload are treated with diuretic therapy. However, patients with refractory peripheral edema and lymphedema may benefit from management by vascular medicine specialists.

Hepatologist

Systolic flow reversal in the hepatic vessels is considered the strongest non-valvular metric for identifying severe TR [26]. Long-standing severe TR often leads to liver enlargement, ascites, and cirrhosis, from the passive congestion due to right heart failure. The hepatologist is a valuable TV-MDHT member because he or she can manage the recurring ascites and abnormal liver function that may develop with severe TR, perform a thorough workup for other etiologies of liver dysfunction, and help prognosticate outcomes for patients with severe liver disease.

Pulmonary Hypertension Specialist

Pulmonary hypertension (whether primary or secondary) may lead to symptoms of low cardiac output, including fatigue, weakness, shortness of breath, and exercise intolerance. Reduction of pulmonary pressures may reduce the severity of TR, associated symptoms, and need for valve treatment [12]. The pulmonary hypertension specialist plays a key role in managing pulmonary hypertension therapies for chronic disease management and providing key guidance during transcatheter procedures when rapid shifts in pressures during valve modifications can have significant impact on hemodynamics and cardiopulmonary function.

Pharmacist

As medication therapy for heart failure symptoms that occur with TV disease involves a combination of multiple medications [12], inclusion of a pharmacist on the MDHT is helpful in coordinating up-titration of medications, preventing drug–drug interactions, or strategically identifying complementary regimens [27]. When the valve issue occurs in association with other diseases that require an additional layer of therapy, or severe regurgitation has impacted liver or other organ function, pharmacist involvement becomes essential to creating a safe and effective medication regimen. Polypharmacy creates an increased risk for drug–drug interactions as well as creates a scenario conducive to poor adherence, compliance, and adverse events. A large body of evidence supports involvement of the pharmacist in management of heart failure. A systematic review has shown the pharmacist’s significant impact with regard to a reduction in all-cause and heart failure admissions and improvement of medication adherence in the elderly with heart failure [28].

The Heart Team Collaboration

The complexity of TV disease prompts robust discussions during the MDHT conference. Tricuspid regurgitation is the most common form of tricuspid valve disease encountered in the clinical setting. Primary TR results from infective endocarditis, rheumatic disease, RV biopsy-related damage, PM wire–induced, prolapse, carcinoid, and Ebstein anomaly among other causes. Secondary TR is the most prevalent form; it occurs in association with other diseases, including left ventricular dysfunction, left-sided valve disease, pulmonary hypertension, atrial fibrillation, annular dilation, and/or RV dysfunction [29–31]. The diversity of the primary or secondary disease processes support the need for a more diverse team discussion. Recent guidelines support a systematic multimodality approach to diagnosis and treatment of tricuspid valve disease [32]. Comprehensive imaging is required to ascertain valve pathology, which provides understanding of the valve morphology and development of the symptom burden. Valve morphology provides a basis for assessing

transcatheter versus surgical treatment strategies. It also provides direction to the various members of the team who guide medical and lifestyle management. Surgical repair or replacement for TV disease is a Class I indication for severe TR for isolated primary disease that is symptomatic or with secondary disease when it occurs in conjunction with left-sided valve surgery. Isolated TV surgery is a Class IIa indication for asymptomatic or mildly symptomatic with RV enlargement or deteriorating RV function [32–34].

The association of secondary TR with left-sided valve dysfunction, RV dysfunction, pulmonary disease, and the complications of right heart overload including hepatic, abdominal, and peripheral edema calls for the involvement of a broader team than involved in the earlier aortic valve MDHT design. In transcatheter procedures for the patient with severe pulmonary hypertension, it may be necessary for a pulmonologist to be present in order to manage nitric oxide inhalation therapy. Chronic and recurring ascites may benefit from communication with the hepatologist regarding liver involvement.

The impact of tricuspid disease on functional status and quality of life of the patient is a long, insidious process. Patients and family members frequently do not recognize a decline has occurred until prompted by questions about previous activity levels. Continual reassessment and titration of diuretic therapy requires close collaboration between the patient and the team. Advanced practice provider valve clinicians, as integral members of the MDHT, play a key role in managing symptom burden on an ongoing basis. Pharmacy input to manage polypharmacy and drug–drug interactions is integral to discussions of ongoing pharmacologic care.

Community Awareness

Increasing both professional and public awareness of valve disease in general and TV specifically will result in improved care of these patients. Great progress has been made in the last 10 years regarding nonsurgical, catheter-based treatments, and the development of transcatheter aortic therapies has led to progress in the advancement of other transcatheter heart valve treatments. Access to nonsurgical repair or replacement procedures has brought hope for curative treatment and facilitates discussion with patients. Catheter-based treatments for the TV are currently in research stage, with patient access limited based on physical proximity to institutions with protocols, ability for patient-protocol “fit” based on inclusion/exclusion criteria, and finally the challenge of designing devices that address the various valve morphologies.

In order to move TV therapies forward, the first step lies in increasing professional awareness of TV disease. Historically, the impact of TR has been underappreciated with late diagnosis, treatments postponed until significant right-sided symptoms are present and right ventricular dysfunction has developed. Current guidelines recommend a direct path to surgical treatment only for symptomatic severe primary TR [12], yet secondary TR is a common form of the disease and both

have a long, subtle progression with a definitive diagnosis not occurring until well established. The timing of surgical treatment is often postponed until severe symptoms have developed, and at a point in time when additional comorbidities and right ventricular remodeling increase surgical mortality risk. Ultimately limiting the treatment options and long-term prognosis.

A second step to move treatment forward is to improve public awareness. There has been public education regarding cardiac risk factors for coronary heart disease and stroke. Similar programs for valve disease and its contribution to development of heart failure are needed. Many elderly attribute their functional decline to the aging process when its true source is declining cardiac function from valve disease. Recommendations are for physicians and providers to see patients on a recurring basis, while paying attention to physical exam findings that identify valve disease and diagnostic testing that establishes severity. Educating patients regarding valve function and disease progression so that early referral before ventricular dysfunction occurs can help reduce the debilitating impact of severe TR.

The definitive road forward lies in research. More than 1.6 million Americans have at least moderate-to-severe TR, yet less than 8000 TV operations are performed annually in the USA [35]. The vast majority of these are done in combination with other valve surgeries; in the 10-year period, between 2004 and 2013, only 5005 were performed for isolated TR [36]. In 2020, the development of percutaneous treatments is still in the early stages, with no approved transcatheter devices for either tricuspid replacement or repair. Many protocols explore various transcatheter techniques for TV replacement or repair. The engagement of the MDHT will play an integral role in creating less invasive solutions for TV disease. The knowledge of advanced imagers, cardiac surgeons, and structural interventional cardiologists will be needed to understand device and procedural development to address the complex TV anatomy and pathoanatomy. The skills of our physicians, advanced practice providers, nurse coordinators, and pharmacists will be necessary to help guide the patient through the multistep evaluation process and to continue medical management while searching for curative solutions. The entire MDHT will need to be fully engaged in their team conference to create and implement a procedure plan that meets the unique needs of the patient.

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