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Comprehensive Advances in Valvular Heart Disease: Current Treatment Alternatives and New Therapeutic Paradigms

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Abstract

Background: Valvular heart disease (VHD) is a wide range of structural and functional Valvular cardiac abnormalities leading to severe cardiovascular morbidity and mortality worldwide.

Objective: The paper summarizes current treatment techniques, i.e., medical, surgical, and trans catheter therapy, highlighting new trends, clinical results, and evolving paradigms of care.

Methods: A 2015-2025 narrative study of peer-studyed literature, clinical trials, and guideline recommendations was performed in PubMed, Scopus, and Google Scholar.

Results: Advances in surgical technology, such as minimally invasive and robotic surgery, have enhanced long-term outcomes. Trans catheter interventions, such as TAVR (Trans catheter Aortic Valve Replacement) and TEER (Trans catheter Edge-to-Edge Repair), have made the treatment of inoperable and high-risk patients possible.

Conclusion: The current treatment for VHD is moving toward individualized, minimally invasive, and image-guided therapy. The best outcome depends on early diagnosis, multidisciplinary assessment, and individualized therapeutic intervention selection.

Keywords: Valvular heart disease, aortic stenosis, mitral regurgitation, valve replacement, TAVR, TEER, surgical valve repair, minimally invasive cardiac surgery

Introduction

Valvular heart disease (VHD) is any condition or illness of the mitral, pulmonary, tricuspid, or aortic valve, or two or all of them, which results in either stenosis (valve opening is narrowed) or regurgitation (backward flow) [1]. VHD is extremely common throughout the world with millions of patients, mostly in older patients and rheumatic heart disease-endemic areas [2]. The disease contributes a great deal of morbidity, heart failure, arrhythmias, and mortality [3].

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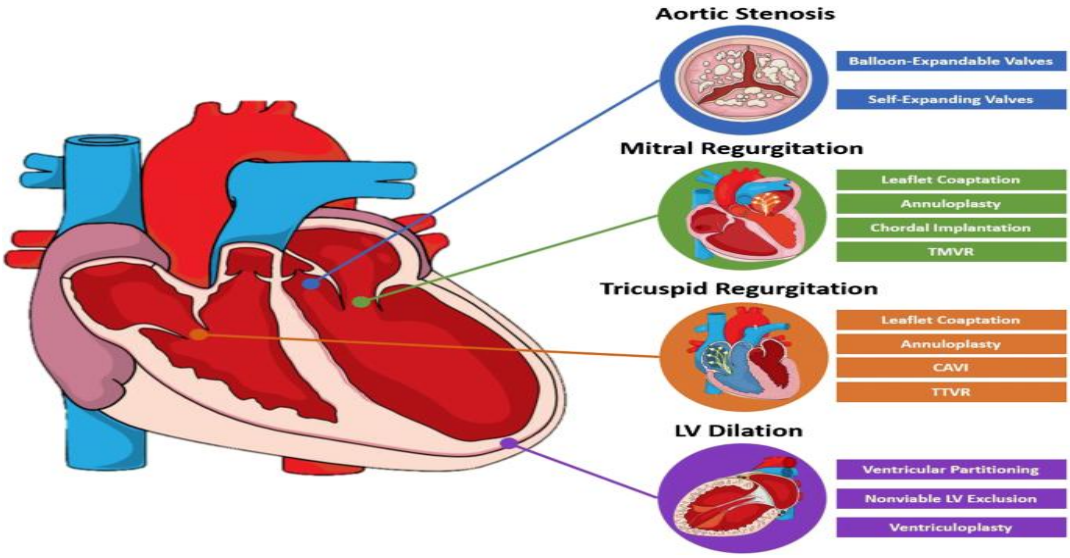

Traditionally, the most frequent etiology of VHD was rheumatic fever, especially in the developing world [4]. Nowadays, in the developed world, the most frequent etiologies are degenerative, calcific, and ischemic. The two most frequent conditions seen in daily practice are aortic stenosis (AS) and mitral regurgitation (MR) [5]. The natural evolution of left untreated severe VHD results in symptomatic heart failure and diminished survival and is therefore an indication for early treatment. Management of VHD has dramatically altered over the past two decades [6]. Early diagnosis by echocardiography, cardiac MRI, and CT imaging allows proper anatomical and functional assessment. Medical therapy remains short of reversing disease but plays a critical role in symptom management and optimization before intervention [7]. Valvular replacement or repair with surgery is still the norm for the majority of patients, but advances in technology have promoted less invasive procedures, especially in high-risk patients who otherwise would not have been considered operable [8].

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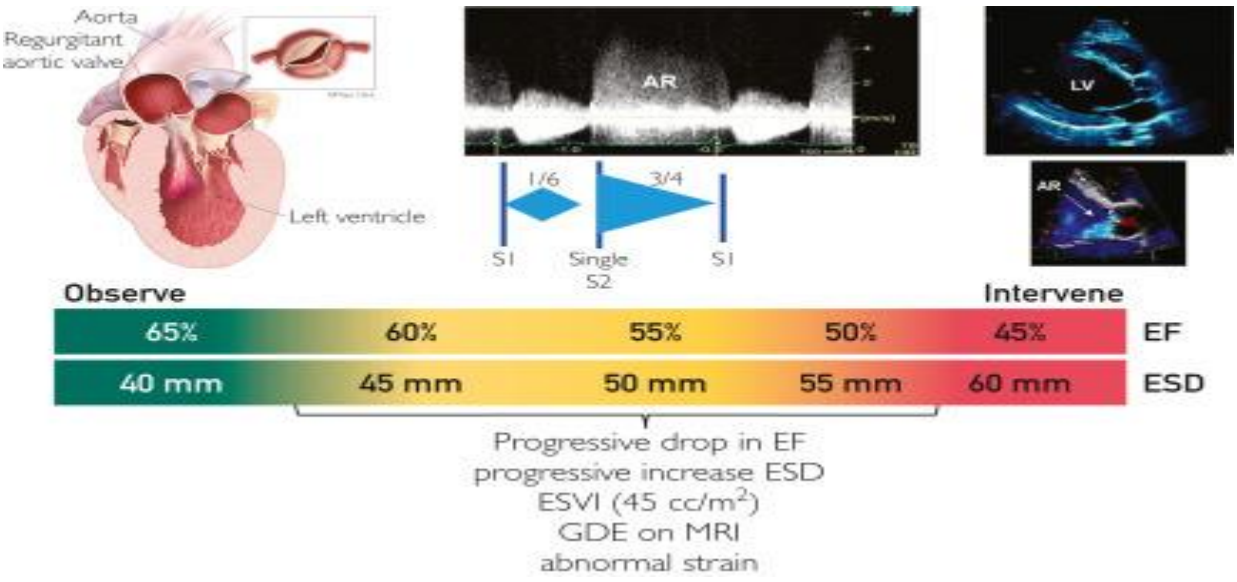

Trans catheter procedures like Trans catheter Aortic Valve Replacement (TAVR) and Trans catheter Edge-to-Edge Repair (TEER) have transformed treatment planning through successful, minimally invasive treatment [9]. The technology is evolving to further optimize it, enhance durability, and extend indications to less risky patients. Complementary to these are the multidisciplinary Heart Team approaches involving cardiologists, cardiac surgeons, and imaging experts that have become key to maximizing patient outcomes and choosing the most suitable therapy [10]. Here, we concisely study contemporary treatments for VHD with emphasis on medical treatment, surgery, and catheter interventions and fresh paradigms altering clinical practice.

Methodology

There was a systematic study of the literature that was carried out to assess the present therapeutic environment of Valvular heart disease. The search strategy made use of databases such as PubMed, Scopus, and Google Scholar from January 2015 to September 2025 for published papers. The keywords used for searching included "Valvular heart disease," "aortic stenosis," "mitral regurgitation," "valve replacement," "TAVR," and "trans catheter repair." Inclusion were treatment modality and patient outcome clinical trials, systematic studys, meta-analyses, and high-impact society guidelines (ESC, AHA/ACC, and STS). There were comparative studies between medical, surgical, and trans catheter interventions. Excluded were case reports, small series without outcomes, and non-English language articles. Information was collected on therapeutic management, indication, procedural success rate, rate of complications, and long term survival. Outcomes between trans catheter and surgery were qualitatively compared because of diversity in patient groups and unequal length of follow-up. Results were integrated narratively with an emphasis on evidence-based practice and emerging trends. Formal ethical permission was not required as the study did not entail direct collection of patient information.

Results

The study had breathtaking innovations in Valvular heart disease trans catheter and surgical interventions. Traditional open-chest method remains the gold standard for low-risk and younger patients with excellent

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long-term durability. Trans catheter alternatives now have comparable results, although in a carefully selected population of patients, especially in mitral and aortic valve disease. Minimally invasive and robot-assisted procedures continue to decrease hospitalization, morbidity, and postoperative stay.

Table 1: Comparative Outcomes of Surgical vs. Trans catheter Valve Therapies

Parameter	Surgical Valve Replacement	Trans catheter Valve Intervention
30-day mortality (%)	3–5	2–4
Hospital stay (days)	7–10	2–4
Long-term durability (10 years)	Excellent	Moderate (ongoing evaluation)
Ideal patient profile	Low–intermediate risk	High or inoperable risk

Table 2: Common Complications After Valve Interventions

Complication	Surgical Procedures	Trans catheter Procedures
Stroke	2–3%	2–5%
Paravalvular leak	<1%	5–10%
Pacemaker requirement	3–5%	8–12%
Prosthetic valve endocarditis	1–2%	1–3%

Discussion

Evolution of the treatment of Valvular heart disease is a mirror reflection of the paradigm shift toward precision, minimally invasive, and patient-centered care [11]. Open replacement and repair established the gold standard of the past decades for rheumatic or degenerative valve disease patients. The longevity of mechanical and bio prosthetic valves has been well established, with mechanical prostheses providing long-term durability at the expense of lifelong anticoagulation [12]. Trans catheter valve therapy has revolutionized treatment [13]. TAVR, the only option for inoperable or high-risk patients just ten years ago, has demonstrated itself to be non-inferior and superior in some trials to surgical aortic valve replacement in intermediate and even low-risk patient groups [14]. In the same way, TEER interventions (e.g., MitraClip) have offered successful alternatives for mitral regurgitation, enhancing symptom and quality-of-life outcomes in open surgery non-candidates. In spite of all these advancements, some things still pose a challenge [15]. Long-term durability of the valve and management of paravalvular regurgitation, conduction disturbances, and prosthesis-patient mismatch are still concerns. Surgical methods keep improving with minimally invasive and robotic-assisted surgery improving accuracy and minimizing trauma [16]. Hybrid suites and sophisticated imaging have also allowed for superior

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preprocedural planning in addition to intraoperative evaluation. One of the key elements in the management of VHD now is the Heart Team model [17]. This is a multi-team approach that optimizes patient preference, risk stratification, and individualized planning. Another key element is long-term follow-up because cure remains observation for prosthetic failure and endocarditis. Guidelines for future research include second-generation bioresorbable and tissue-engineered valves, trans catheter repair technology of the next generation, and artificial intelligence-augmented imaging and procedural guidance [18]. These technologies are going to further improve the safety, durability, and accessibility of valve interventions across populations of patients.

Conclusion

Valvular heart disease continues to be a major contributor to the burden of cardiovascular disease worldwide. Pathophysiology-directed development of surgical and trans catheter therapy strategies hastened therapeutic options, making therapy safer and more tailored. Patient customized risk profile, valve anatomy, comorbid illness, and long-term outcome should be addressed when an intervention is planned. Innovation, evidence-based medicine, and multimodal heart team decision-making will propel subsequent therapy of Valvular heart disease to enhanced survival and quality of life.

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