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REVIEW ARTICLE

TAVI vs SAVR in severe aortic stenosis: A systematic review

Şiddetli aort darlığında TAVI ve SAVR karşılaştırması: Sistematik bir inceleme

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Abstract

Severe aortic stenosis (AS) represents a major burden among elderly patients, with high mortality once symptoms develop. Transcatheter aortic valve implantation (TAVI) has emerged as an alternative to surgical aortic valve replacement (SAVR), expanding from inoperable to low-risk populations. This systematic review compares short- and long-term outcomes between TAVI and SAVR in patients with severe AS. Following PRISMA 2020 guidelines, PubMed, Scopus, and Web of Science were searched (2010–2025). Eligible randomized controlled trials (RCTs) and comparative cohorts reporting mortality, stroke, pacemaker, or valve durability were included. Twenty-one studies (16 RCTs, 5 registries; n≈23,000) were analyzed. Thirty-day mortality was similar (RR 0.94, 95% CI 0.82–1.07). TAVI reduced bleeding (RR 0.63) and acute kidney injury (RR 0.71) but increased pacemaker implantation (RR 2.46) and paravalvular leak (RR 3.32). Five-year results (PARTNER 3, NOTION) showed comparable survival and valve durability. TAVI provides equivalent survival and superior early recovery compared to SAVR, although conduction disturbances and leak remain limitations. SAVR remains preferred for younger or bicuspid patients pending longer durability data.

Keywords: Aortic stenosis, transcatheter aortic valve implantation, surgical aortic valve replacement, comparative outcomes, systematic review, valve durability.

Özet

Şiddetli aort darlığı (AS), semptomlar ortaya çıktığında yüksek mortalite ile yaşlı hastalar arasında önemli bir yük oluşturmaktadır. Transkateter aort kapak implantasyonu (TAVI), cerrahi aort kapak replasmanına (SAVR) bir alternatif olarak ortaya çıkmış ve ameliyat edilemeyen popülasyonlardan düşük riskli popülasyonlara doğru yayılmıştır. Bu sistematik derleme, şiddetli AS hastalarında TAVI ve SAVR arasındaki kısa ve uzun vadeli sonuçları karşılaştırmaktadır. PRISMA 2020 kılavuzları, PubMed, Scopus ve Web of Science'ta (2010-2025) arama yapılmıştır. Mortalite, inme, kalp pili veya kapak dayanıklılığını bildiren uygun randomize kontrollü çalışmalar (RCT'ler) ve karşılaştırmalı kohortlar çalışmaya dahil edilmiştir. Yirmi bir çalışma (16 RCT, 5 kayıt; n≈23.000) analiz edilmiştir (Şekil 1). Otuz günlük mortalite benzerdi (RR 0,94, %95 CI 0,82-1,07). TAVI kanamayı (RR 0,63) ve akut böbrek hasarını (RR 0,71) azaltırken, kalp pili implantasyonunu (RR 2,46) ve paravalvüler kaçağı (RR 3,32) artırdı. Beş yıllık sonuçlar (PARTNER 3, NOTION) benzer sağkalım ve kapak dayanıklılığı gösterdi. TAVI, SAVR ile karşılaştırıldığında eşdeğer sağkalım ve daha üstün erken iyileşme sağlar, ancak iletim bozuklukları ve kaçak hala sınırlamalar arasındadır. SAVR, daha uzun süreli dayanıklılık verileri beklenene kadar genç veya biküspit hastalarda tercih edilmeye devam etmektedir.

Anahtar Kelimeler: Aort darlığı, transkateter aort kapak implantasyonu, cerrahi aort kapak replasmanı, karşılaştırmalı sonuçlar, sistematik inceleme, kapak dayanıklılığı.

INTRODUCTION

Aortic stenosis (AS) is the most prevalent valvular heart disease in developed countries and represents a major cause of cardiovascular morbidity and mortality in the elderly. Its pathophysiology is characterized by progressive leaflet calcification, chronic inflammation, and increasing left ventricular pressure overload, leading to hypertrophy and fibrosis. Once symptoms such as angina, syncope, or dyspnea develop, prognosis worsens significantly, with a two-year mortality approaching 50% if left untreated (1,2).

Surgical aortic valve replacement (SAVR) has long been considered the standard and most durable treatment for severe AS, offering excellent long-term outcomes. However, the surgical approach requires median sternotomy and cardiopulmonary bypass, which increase perioperative risk in older or frail patients and in those with comorbidities such as chronic kidney disease, chronic obstructive pulmonary disease, or diabetes mellitus (3).

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Transcatheter aortic valve implantation (TAVI), introduced in 2002, transformed the therapeutic landscape for AS. Initially reserved for inoperable or extremely high-risk patients, TAVI has progressively expanded to intermediate- and low-risk populations following pivotal randomized trials including PARTNER 1, PARTNER 2, PARTNER 3, SURTAVI, Evolut Low Risk, and NOTION. These studies have demonstrated that TAVI is non-inferior to SAVR regarding mortality and disabling stroke, while providing faster recovery and shorter hospitalization. Improvements in valve design, imaging, and procedural experience have further reduced early complications such as paravalvular leak and vascular injury (4–8).

Despite these advances, some concerns remain. TAVI is associated with higher rates of new-onset conduction abnormalities and permanent pacemaker implantation particularly with self-expanding valves due to deeper implantation depth and interaction with the conduction system (9). Additionally, long-term durability beyond ten years is still being evaluated, as current data primarily extend to 5–8 years (10). These uncertainties are particularly relevant for younger patients, who may require multiple interventions during their lifetime.

Current European (ESC) and American (ACC/AHA) guidelines emphasize a Heart Team–based, individualized approach that integrates clinical risk, anatomy, frailty, comorbidities, and patient preference (11,12). TAVI is recommended in patients aged ≥75 years or those with high/intermediate surgical risk, whereas SAVR remains the preferred strategy for younger patients, individuals with bicuspid aortic valves, or those requiring concomitant procedures such as coronary artery bypass grafting.

As device technology and operator experience continue to improve, real-world practice increasingly blurs the traditional boundaries between TAVI and SAVR. Therefore, contemporary comparative evidence is essential to guide decision-making. This systematic review aims to provide an updated analysis of short- and long-term outcomes of TAVI versus SAVR in severe AS, focusing on mortality, neurological and renal complications, conduction disturbances, valve durability, and quality-of-life outcomes.

METHODS

Search Strategy

Databases searched: MEDLINE (PubMed), Scopus, and Web of Science (January 2010 – June 2025). Keywords included: “Aortic Stenosis,” “TAVI,” “TAVR,” “SAVR,” and “Comparative.”

Selection Criteria

- Population: Adults (≥18 years) with severe AS.
- Intervention: TAVI (any prosthesis).
- Comparator: SAVR (biological/mechanical).
- Outcomes: mortality (30 d, 1 y, 5 y), stroke, pacemaker, bleeding, AKI, valve durability, QoL.
- Design: RCTs or comparative cohorts ≥ 50 patients.

Data Extraction

Two independent reviewers screened and extracted data; discrepancies were resolved by consensus. Risk of bias was assessed with RoB 2 (RCTs) and ROBINS-I (observational).

Data Synthesis

Pooled effects were calculated via random-effects meta-analysis (DerSimonian–Laird). Heterogeneity was quantified using I^2. Evidence strength was graded by GRADE.

RESULTS

Study Characteristics

From 3126 citations, 21 studies were included (Figure 1). Sixteen RCTs and five registries enrolled≈ 23000 patients (mean age 79±8 years; 46 % female). Table 1 summarizes core characteristics (PARTNER 3, SURTAVI, NOTION, Evolut Low Risk, UK TAVI, GARY).

Mortality and Stroke

Thirty-day mortality was similar between TAVI and SAVR (RR 0.94; 95 % CI 0.82–1.07; p=0.27). One-year mortality also showed no difference (RR 0.97; p=0.41) (4–9). Stroke was slightly lower after transfemoral TAVI (RR 0.84; p =

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0.04) but comparable via non-femoral access.

Complications

TAVI reduced major bleeding (RR 0.63) and acute kidney injury (RR 0.71) relative to SAVR (6–9). However, permanent pacemaker implantation was higher (14.3% vs. 5.8%, RR 2.46, p<0.001) and paravalvular leak ≥ mild was more frequent (24% vs. 9%, p<0.001). Average hospital stay was 3–4 days shorter after TAVI.

Long-Term Outcomes

At 5 years, NOTION and PARTNER 3 extensions showed similar survival and hemodynamics between TAVI and SAVR (p>0.05) (7,13). Valve gradients remained stable (≤13 mmHg) with no increase in SVD. Registry analyses (UK TAVI, GARY) confirmed durability comparable to surgical bioprostheses.

Quality of Life

QoL (KCCQ score) improved faster in TAVI at 30 days and 1 year, equalizing by 2 years (13,14). Patients reported less pain and earlier return to daily activity compared to SAVR.

DISCUSSION

TAVI has evolved from a niche procedure to a mainstream therapy for AS. Our review demonstrates that TAVI offers equivalent mortality and superior early recovery in high and intermediate-risk patients (4–10). The reduction in bleeding and AKI likely reflects avoidance of sternotomy and cardiopulmonary bypass.

However, device-related issues persist. Permanent pacemaker rates remain≈2–3× higher after TAVI, particularly with self-expanding valves due to deeper implantation (9). Conduction disturbances may impact ventricular synchrony and heart-failure progression. Similarly, paravalvular leak—even mild—has been linked to late mortality (11). Modern sealing cuffs and CT-guided sizing may mitigate this risk.

Durability data are encouraging but still limited. Five-year NOTION and PARTNER 3 findings show no difference in SVD (7,10), but follow-up beyond 10 years is needed. Surgical bioprostheses have decades-long durability records, while transcatheter valves have only ≈ 8 years of evidence. "Valve-in-valve TAVI" offers a future solution for degeneration, but requires further validation.

Economically, TAVI reduces hospital stay and rehabilitation costs but has higher device cost. Health-system analyses indicate cost-neutrality within 3–5 years when reduced hospitalization and rehabilitation are included (15).

Finally, patient selection remains paramount. Guidelines recommend TAVI for patients ≥ 75 years or with STS score ≥4 %, and SAVR for younger patients or those requiring concomitant CABG (2,11). The Heart Team approach integrating frailty, comorbidities, and life expectancy remains the cornerstone of decision-making.

CONCLUSION

TAVI is a safe and effective alternative to SAVR in most patients with severe AS. It achieves similar survival and lower early morbidity, while SAVR retains superiority for younger and bicuspid cases. Future research should focus on long-term durability, re-intervention strategies, and device optimization.

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Ethical Approval: This article is a systematic review based on previously published studies; therefore, no new human or animal subjects were involved, and ethical approval was not required.

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