Transcatheter versus surgical aortic valve replacement in patients at low surgical risk: A meta-analysis of randomized trials and propensity score matched observational studies

Guy Witberg, MD1,2* | Adi Lador, MD1,2* | Dafna Yahav, MD2,3 | Ran Kornowski, MD1,2

1Department of Cardiology, Rabin medical center, Petach, Tikva, Israel
2Sackler Faculty of Medicine, Tel-Aviv university, Tel, Aviv, Israel
3Infectious diseases unit., Rabin medical center, Petach, Tikva, Israel

Correspondence
Guy Witberg, MD, Rabin Medical center, Department of Cardiology, 100 Jabutinski St, Petach Tikva, 98100, Israel.
Email: vitberguy@gmail.com

Abstract

Background: Although transcatheter aortic valve replacement (TAVR) is officially indicated for high risk aortic stenosis (AS) patients, the procedure is increasingly being performed in patients who are not at high surgical risk, including a substantial number of low risk patients. However, data on the benefit of TAVR in this patient population is limited.

Methods: We conducted a systematic review and meta-analysis of randomized controlled trials (RCTs) and observational studies with propensity score matching (PSM) of TAVR versus surgical aortic valve replacement (SAVR) in patients who are at low surgical risk. The primary outcome was all-cause mortality. The secondary outcomes included stroke, myocardial infarction, bleeding, and various procedural complications.

Results: Six studies (2 RCTs and 4 PSM studies) totaling 3,484 patients were included. Follow-up ranged from 3 months to 3 years (median 2 years). The short-term mortality was similar with either TAVR or SAVR (2.2% for TAVR and 2.6% for SAVR, RR 0.89, 95% CI 0.56–1.41, P = 0.62), however, TAVR was associated with increased risk for intermediate-term mortality (17.2% for TAVR and 12.7% for SAVR, RR 1.45, 95% CI 1.11–1.89, P = 0.006). In terms of periprocedural complications, TAVR was associated with reduced risk for bleeding and renal failure and an increase in vascular complications and Pacemaker implantation.

Conclusions: In patients who are at low surgical risk, TAVR seems to be associated with increased mortality risk. Until more data in this population is available, SAVR should remain the treatment of choice for these patients.

KEYWORDS
surgical aortic valve replacement, surgical risk category, transcatheter aortic valve replacement

1 INTRODUCTION

Aortic stenosis (AS) is the most common valvular heart disease (VHD) in the Western world [1,2]. The prevalence of AS increases with age [3] and its burden is expected to increase due to the aging of the general population in the developed world. Patients with symptomatic severe AS who do not undergo aortic valve replacement (AVR) have a dismal prognosis, with an expected survival of 2 to 3 years [4]. For decades, the only available treatment for AS was surgical aortic valve replacement (SAVR), but over the last decade transcatheter aortic valve replacement (TAVR) has emerged as an alternative to SAVR. In a series of pivotal randomized trials, TAVR was shown to be superior to conservative management in patients who are inoperable [5], and at least equivalent to SAVR among patients who are at high surgical risk [6,7]. Following these trials, the use of TAVR has increased exponentially, with >24,000 procedures performed annually in the United States...
alone [8]. Temporal analysis has shown that many patients undergoing TAVR are actually at intermediate surgical risk; subsequently, few randomized trials in this population have shown that TAVR is at least equivalent to SAVR [9–12].

With improved experiences and advances in transcatheter valve techniques, the outcomes of TAVR are expected to continue to improve, raising the possibility of extending the use of TAVR further to low risk populations. Clinical trial data in this population is limited, a recent meta-analysis that focused on intermediate risk patients but included low risk patients as well [13] found no difference in short-term (in hospital/30 days) mortality between TAVR/SAVR, but did not assess other short-term outcomes or longer-term mortality. A meta-analysis by Arora et al. [14] reported similar data on short-term mortality and in addition found TAVR to be superior in terms of acute kidney injury (AKI) and bleeding and inferior to SAVR in terms of vascular complications and the need for pacemaker implantation (PMI), but again, did not examine mortality beyond the short-term—we therefore conducted an updated systematic review and meta-analysis on the relative risks and benefits of TAVR versus SAVR in patients who are at low surgical risk for AVR.

2 MATERIALS AND METHODS

The registered study protocol is available on PROSPERO (CRD42017060014). We searched Medline, Embase, and Cochrane CENTRAL from January 1, 2005, up to March 31, 2017, using a combination of keywords and MeSH terms for “aortic stenosis” AND “surgical valve replacement” OR “transcatheter valve replacement” with no restrictions on language. We also searched all references of included studies.

Studies comparing TAVR and SAVR that met the following criteria were considered for inclusion:

- Randomized controlled trial (RCT) or observational trial that used propensity score matching (PSM) to create patient groups with similar baseline characteristics;

All titles and abstracts were screened, and those thought to possibly meet the inclusion criteria were screened for eligibility using the full text.

Studies were excluded if:

- Patients were at intermediate/high surgical risk for SAVR, as defined by a mean society for thoracic surgery (STS) score >4% and/or logistic EuroScore >10% for both TAVR and SAVR arms. In case the authors reported both STS and logistic EuroScore data and the results were discordant, we used the STS data for eligibility.
- The manuscript did not include data on overall mortality for at least short-term follow-up (either in hospital or 30 days).
- The SAVR arm included only patients who received sutureless valves.

Two reviewers (GW, AL) independently extracted the data and resolved conflicts by discussion. For all outcomes, data were extracted for the largest patient population evaluated. The primary outcome was mortality, including short-term mortality (defined as either in-hospital or 30-day mortality) and late mortality (i.e., mortality at longest available follow-up). Secondary outcomes were peri-procedural (in-hospital or 30-day) complications: cerebrovascular disease (CVA), myocardial infarction (MI), AKI, major bleeding (as defined in individual studies), vascular complications, and the need for PMI.

Two authors assessed the risk of bias (GW, AL). Cochrane’s handbook tool [15] was used to assess the RCTs. The Newcastle-Ottawa tool was used to assess the quality of the PSM studies [16]. The reviewers resolved conflicts through consensus. A funnel plot was used to assess publication bias.

A systematic review and meta-analysis was performed in compliance with the Cochrane Collaboration and Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement [15]. Meta-analysis was performed using the Review Manager (RevMan) software (version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014).

Heterogeneity between the included trials was assessed using the chi-squared test for heterogeneity and the I² measure of inconsistency [17], but the choice between a random/fixed effect model was not determined by the results of statistical tests for heterogeneity, but rather, as recently recommended by a scientific statement of the American heart association [18] by evaluating the functional similarity between the included studies and the goal of estimating a common effect size that will be applicable to similar populations to those included in this meta-analysis. For fixed effects, pooled estimates of odds ratio (OR) with 95% confidence intervals (CI) were calculated using the Mantel Haenszel method. For random effects, the DerSimonian and Laird random method was used. Reported values are two-tailed, and hypothesis-testing results were considered significant at $P < 0.05$.

Comparisons were subcategorized by the study’s design (RCT/PSM).

3 RESULTS

The results of the study selection process are shown in Figure 1. Our initial search yielded 1,783 citations, 53 of which were judged to be potentially eligible and underwent full text review. Seven studies were found to be eligible for inclusion after full text review: two RCTs [10,11] and five PSM observational studies [19–23]. There were two studies from the OBSERVANT registry [19,22], of whom only the study by Rosato et al. [22] intentionally included only low surgical risk patients, while the study by Fraccaro et al. [19] was limited to patients older than 80 and intended to include also intermediate risk patients. We therefore included the study by Rosato et al. and excluded the study by Fraccaro et al. as a duplicate publication. From the study by Piazza et al. [21], we used the mortality data on the subgroup of patients with STS <4 rather than the overall results that included intermediate risk patients as well. Overall, our meta-analysis included data on a total of 3,484 patients (350 from RCTs and 3,134 from PSM studies). The characteristics of the trials included in this meta-analysis are shown in
Table 1. Three of the included studies [20,21,22] specifically included only patients at low surgical risk, while the other three studies [10,11,23] intended to include patients at low–intermediate surgical risk, but their mean value was in the low risk category. The average EuroScore [20,22,23] was $6.5 \pm 2.4$, average STS [10,11,21] was $3.0 \pm 1.5$. Given these data, only between 5 and 7% of patients included in this meta-analysis are expected to have STS/EuroScore values above the low surgical risk cutoff.

All of the PSM studies were ranked as good quality according to the Newcastle-Ottawa tool (score range 7–9). In addition, all of the RCTs were at low risk of bias in terms of the generation of randomization and concealment of allocation. Due to the invasive nature of the examined interventions, none were blinded.

A summary of major comorbidities, clinical, and echocardiographic characteristics of the patients included in the meta-analysis is presented in Table 2.

Table 1. Characteristics of studies included in the meta-analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Publication year</th>
<th>Design</th>
<th>Sample size</th>
<th>Follow up</th>
<th>STS (mean)</th>
<th>EuroScore (mean)</th>
<th>Age (mean)</th>
<th>male</th>
<th>Femoral access</th>
<th>NCOQA Score</th>
<th>Risk of bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nielsen et al.</td>
<td>2012</td>
<td>RCT</td>
<td>TAVR-34</td>
<td>3 months</td>
<td>3.1 ± 1.5</td>
<td>9.4 ± 3.9</td>
<td>80 ± 3.6</td>
<td>26.5%</td>
<td>0%</td>
<td>NA</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAVR-36</td>
<td></td>
<td>3.4 ± 1.2</td>
<td>10.3 ± 5.8</td>
<td>82 ± 4.4</td>
<td>33.3%</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thyregod et al.</td>
<td>2015</td>
<td>RCT</td>
<td>TAVR-145</td>
<td>1 year</td>
<td>2.9 ± 1.6</td>
<td>8.4 ± 4.0</td>
<td>79.2 ± 4.9</td>
<td>53.8%</td>
<td>96.5%</td>
<td>NA</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAVR-135</td>
<td></td>
<td>3.1 ± 1.7</td>
<td>8.9 ± 5.5</td>
<td>79.0 ± 4.7</td>
<td>52.6%</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piazza et al.</td>
<td>2013</td>
<td>PSM</td>
<td>TAVR-191</td>
<td>1 year</td>
<td>&lt;4&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAVR-191</td>
<td></td>
<td>&lt;4&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schymik et al.</td>
<td>2015</td>
<td>PSM</td>
<td>TAVR-216</td>
<td>3 years</td>
<td>–</td>
<td>8.7 ± 2.7</td>
<td>78.3 ± 5.2</td>
<td>46.3%</td>
<td>NA</td>
<td>8</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAVR-216</td>
<td></td>
<td>–</td>
<td>8.8 ± 2.8</td>
<td>78.2 ± 4.6</td>
<td>51.4%</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freker et al.</td>
<td>2017</td>
<td>PSM</td>
<td>TAVR-805</td>
<td>In hospital</td>
<td>–</td>
<td>6.8 ± 1.7</td>
<td>77.5 ± 4.4</td>
<td>39.6%</td>
<td>100%</td>
<td>8</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAVR-805</td>
<td></td>
<td>–</td>
<td>4.2 ± 1.4</td>
<td>77.5 ± 4.4</td>
<td>39.6%</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rosato et al.</td>
<td>2016</td>
<td>PSM</td>
<td>TAVR-355</td>
<td>3 years</td>
<td>–</td>
<td>6.3 ± 2.7</td>
<td>80.1 ± 6.4</td>
<td>58.0%</td>
<td>NA</td>
<td>9</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAVR-355</td>
<td></td>
<td>–</td>
<td>6.3 ± 3.0</td>
<td>80.0 ± 5.1</td>
<td>58.9%</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Assessment included, selection, performance, attrition and reporting bias. Since none of the RCTs was blinded, detection bias was not relevant for assessment. assessment of bias was performed according to the Cochrane collaboration’s tool for assessing risk of bias.

<sup>b</sup>Results are from a subgroup analysis of patients with STS < 4 from a larger (405 patients pairs) PSM study, the mean STS for this subgroup was not reported.

NA = not available, NCOQA = Newcastle Ottawa quality assessment, PSM = propensity score matching, RCT = randomized controlled trial, SAVR = surgical aortic valve replacement, STS = society of thoracic surgeons, TAVR = transcather aortic valve replacement.
### TABLE 2  Baseline characteristics of patients included in the meta-analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Pulmonary disease</th>
<th>DM</th>
<th>CVA</th>
<th>PVD</th>
<th>CKD</th>
<th>NYHA III-IV</th>
<th>EF (%)</th>
<th>AVA (cm²)</th>
<th>Peak AVG (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nielsen et al. [11]</td>
<td>TAVR</td>
<td>2.9%</td>
<td>8.3%</td>
<td>2.9%</td>
<td>5.9%</td>
<td>2.9%</td>
<td>NA</td>
<td>56.5 ± 9.7</td>
<td>0.66 ± 0.17</td>
</tr>
<tr>
<td></td>
<td>SAVR</td>
<td>2.8%</td>
<td>2.9%</td>
<td>2.8%</td>
<td>8.3%</td>
<td>0.0%</td>
<td>NA</td>
<td>56.3 ± 10</td>
<td>0.71 ± 0.17</td>
</tr>
<tr>
<td>Thyregod et al. [10]</td>
<td>TAVR</td>
<td>11.7%</td>
<td>17.9%</td>
<td>16.6%</td>
<td>4.1%</td>
<td>1.4%</td>
<td>48.7%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>SAVR</td>
<td>11.9%</td>
<td>20.7%</td>
<td>16.3%</td>
<td>6.7%</td>
<td>0.7%</td>
<td>45.5%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Schymik et al. [23]</td>
<td>TAVR</td>
<td>9.3%</td>
<td>NA</td>
<td>2.8%</td>
<td>5.1%</td>
<td>3.2%</td>
<td>NA</td>
<td>62.2 ± 11.3</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>SAVR</td>
<td>8.8%</td>
<td>NA</td>
<td>3.7%</td>
<td>6.9%</td>
<td>3.2%</td>
<td>NA</td>
<td>62.0 ± 10.5</td>
<td>NA</td>
</tr>
<tr>
<td>Freker et al. [20]</td>
<td>TAVR</td>
<td>1.7%</td>
<td>23.6%</td>
<td>4.1%</td>
<td>0.6%</td>
<td>10.6%</td>
<td>76.4%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>SAVR</td>
<td>1.7%</td>
<td>23.6%</td>
<td>4.1%</td>
<td>0.6%</td>
<td>10.6%</td>
<td>76.4%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Rosato et al. [22]</td>
<td>TAVR</td>
<td>18.3%</td>
<td>14.9%</td>
<td>4.2%</td>
<td>10.1%</td>
<td>NA</td>
<td>50.7%</td>
<td>0.67 ± 0.26</td>
<td>84 ± 21</td>
</tr>
<tr>
<td></td>
<td>SAVR</td>
<td>19.7%</td>
<td>16.1%</td>
<td>4.2%</td>
<td>8.7%</td>
<td>51.3%</td>
<td>NA</td>
<td>0.71 ± 0.25</td>
<td>86 ± 22</td>
</tr>
</tbody>
</table>

AVA = aortic valve area, AVG = aortic valve gradient, CKD = chronic kidney disease, CVA = cerebrovascular disease, DM = diabetes mellitus, EF = ejection fraction, NA = not available, NYHA = New York heart association, PVD = peripheral vascular disease.

**FIGURE 2**  Forest plots of mortality after TAVR and SAVR. Forrest plots of the risk ratio for mortality at short-term (A), and late (B) mortality for TAVR versus SAVR. SAVR = surgical aortic valve replacement, TAVR = transcatheter aortic valve replacement [Color figure can be viewed at wileyonlinelibrary.com]
Since the STACCATO trial was prematurely terminated, resulting in a low sample size and reporting only on short-term outcomes, we decided to perform a sensitivity analysis for all short-term outcomes (mortality and periprocedural complications) excluding this trial from the analysis.

3.1 | Clinical outcomes
3.1.1 | Mortality
The short-term mortality rate was 2.2% for TAVR and 2.6% for SAVR, with no difference between TAVR and SAVR (5 studies, 3,102 patients, RR 0.89, 95% CI 0.56–1.41, P = 0.62, I² = 0%), see Figure 2A.

The intermediate-term (median follow-up 2 years range 1–3 years) mortality rate was 17.2% for TAVR and 12.7% for SAVR. TAVR was associated with increased mortality (4 studies, 1,804 patients, RR 1.45, 95% CI 1.11–1.89, P = 0.006, I² = 51%), see Figure 2B.

Funnel plots did not show any evidence of publication bias (Supporting Information Figure S1).

3.1.2 | Periprocedural complications
Periprocedural complications are summarized in Table 3 and the corresponding forest plots are shown in Figure 3. There was no difference in the risk for CVA or MI between TAVR/SAVR (Figure 3A, B). TAVR was associated with reduced risk for AKI and bleeding (Figure 3C,D) and an increased risk for PMI and vascular complications (Figure 3E,F).

Since the STACCATO trial [10] was prematurely terminated, resulting in a very small sample size (n = 70), we performed a sensitivity analysis for all short-term outcomes analyses that excluded this trial (mortality, CVA, MI, major bleeding, AKI, and PMI)—the results were consistent to the main analysis, though with a tendency for lower heterogeneity (Figure 4A–F).

4 | Discussion
We conducted a systematic review and meta-analysis of all RCTs and PSM studies evaluating TAVR versus SAVR for patients with severe AS who are at low surgical risk.

Our main findings are:

- Although there is no difference in short-term mortality between TAVR/SAVR, TAVR was associated with an increased risk for intermediate (median 2 years) term mortality (RR = 1.45, P = 0.004).
- The risk/benefit profile for periprocedural complications in low risk patients is similar to the overall TAVR population (reduction in AKI and bleeding on the one hand and an increase in PMI and vascular complications).

Our results represent the first comprehensive meta-analysis of TAVR versus SAVR in this patient population, a previous analysis by Tam et al. [13], was a subgroup analysis performed as part of a larger meta-analysis of intermediate and low risk patients, differs from our study in several aspects:

- It did not assess any outcomes other than short-term mortality (with results similar to ours).
- Smaller sample size—although both analyses included six studies overall, Tam et al. did not include the study with the largest sample size (n = 1,710) included in our analysis by Freker et al. [20], which was classified by them as intermediate risk, although the average EuroScore for the TAVR and SAVR arms were 4.2 and 6.4, respectively (as it also appears in the data by Tam et al.), as well as the subgroup analysis of the study by Piazza et al. [21]. Tam et al did include the study by Repossini et al. [24] which we excluded for using only sutureless valves in the SAVR arm, and the study by Castredoza et al. [25], whose average Euroscore is in the low risk stratum (9.4 and 9.3 in the TAVR and SAVR arms, respectively) but

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>Summary of periprocedural complications.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TAVR rate</td>
</tr>
<tr>
<td>CVA</td>
<td>Summary</td>
</tr>
<tr>
<td>MI</td>
<td>Summary</td>
</tr>
<tr>
<td>AKI</td>
<td>Summary</td>
</tr>
<tr>
<td>Bleeding</td>
<td>Summary</td>
</tr>
<tr>
<td>PMI</td>
<td>Summary</td>
</tr>
<tr>
<td>Vascular complications</td>
<td>Summary</td>
</tr>
</tbody>
</table>

AKI = acute kidney injury, CVA = cerebrovascular accident, MI = myocardial infarction, OR = odds ratio, PMI = pacemaker implantation, SAVR = surgical aortic valve replacement, TAVR = transcatheter aortic valve replacement.
it's STS scores are in the intermediate risk stratum (4.6 and 4.3), and was therefore excluded from our analysis. Overall, the sample size for our meta-analysis was considerably larger—3,484 compared to 2,036 patients.

A meta-analysis dedicated to low risk patients by Arora et al. [14] did not examine outcomes beyond the short-term, and again, had a considerably smaller sample size compared to ours—2,252 compared to 3,484 patients.

The median STS score of TAVR patients is decreasing and is already within the intermediate surgical risk category. In addition, the fraction of younger patients (<75 years of age) is growing (>20% in the latest TVT registry data) [8], which raises the question of expanding TAVR even further, to patients at low surgical risk. To the best of our knowledge, our results are the first to compare mortality beyond short-term follow-up in this population. For intermediate-term mortality, there was a signal of increased mortality with TAVR (RR 1.45, 95% CI 1.11–1.89, P = 0.006). This finding is difficult to explain. Since there was no sign for a difference in short-term mortality, two explanations come to mind:

- Much of the benefit from TAVR is derived from its less invasive nature, which hastens recovery and helps avoid periprocedural morbidity. With patients who are a priori at low risk for surgery, this advantage may be negated, resulting in the overall risk/benefit ratio leaning toward the SAVR option.
- Different periprocedural complications profile. It may be that lower risk patients, who are generally younger and suffer from less comorbidities, can recover better from bleeding and AKI (which are more prevalent following SAVR), compared to vascular complications or conduction system disorders and long-term implications of PMI (which are more prevalent following TAVR)—eventually manifesting as an increase in later mortality.
- Superior durability of surgical compared to transcatheter valves. This issue is probably more relevant to first generation devices (which were used in the majority of patients included in our analysis), and may not be as significant for the current generation of transcatheter valves.

Although our analysis of intermediate-term mortality is based on a modest sample size (n = 1804), it should raise concerns regarding the appropriateness of offering TAVR to patients who are at low surgical risk. The risk/benefit profile of TAVR in the low surgical risk population is currently being evaluated by three RCT’s: the PARTNER 3
trials, all expected to complete data collection for their primary end-points over the next 2 years, their combined sample size is expected to be 3,520 patients.

Our study has several limitations. First, we did not have access to individual patient data and could not present a subgroup analysis according to access site or device type, which may have different risk/benefit profiles. Second, most of the data in this analysis is based on studies performed in an earlier stage of the evolution of TAVR, and primarily used first generation devices [8]. Given the evidence of improved TAVR results with more experience and the use of more advanced generation devices [8], this may not be true in the current era, but this has yet to be shown. Third, the currently accepted risk scores for TAVR are actually based on historical SAVR patients and may not be able to accurately describe the risks involved with TAVR, causing misclassification of patient risk. Fourth, some studies did not include low risk patients exclusively, but rather a mixture of low-intermediate risk patients. However, as described earlier, the mean risk of the patients included in this meta-analysis was well within the low risk category (a EuroScore of 6.5 ± 2.4), so that only 5–7% of the patients included in our trial are expected to be at intermediate, rather than low surgical risk. Fifth, we did not have data on the prevalence and severity of paravalvular leak in the TAVR patients from all studies, and therefore could not assess whether this may possibly explain the difference in late mortality. Sixth, we did not include trials comparing surgically implanted sutureless aortic valves to TAVR, both due to the design of this meta-analysis and the paucity of data [26], especially in patients not at high surgical risk. Finally, our study included mainly patients from PSM studies, with RCT patients constituting less than 10% of the overall sample size.

The major strength of our study lies in its being the first ever comprehensive in-depth assessment of the risks and benefits of TAVR versus SAVR in low risk patients when excluding the results of the STACCATO trial. AKI = acute kidney injury, CVA = cerebrovascular accident, MI = myocardial infarction, SAVR = surgical aortic valve replacement, TAVR = transcatheter aortic valve replacement [Color figure can be viewed at wileyonlinelibrary.com]
CONCLUSIONS

The results of this first comprehensive meta-analysis of TAVR versus SAVR in patients who are at low surgical risk show, that for these patients, TAVR is equivalent to SAVR in terms of short-term mortality, and that the tradeoff in periprocedural complications profile is similar to that of intermediate/high risk patients. Importantly, our data suggests that in this patients’ population, TAVR may not be equivalent to SAVR in terms of mortality beyond the short-term; therefore, its use should not be expanded to this patient population until data from prospective RCTs dedicated to this population become available, and for now—SAVR should firmly remain the treatment of choice for these patients.

CONFLICT OF INTEREST

Nothing to report.

ORCID

Guy Witberg MD http://orcid.org/0000-0003-2110-0484
Ran Kamowski MD http://orcid.org/0000-0002-7708-8253

REFERENCES


SUPPORTING INFORMATION
Additional Supporting Information may be found online in the supporting information tab for this article.