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Review

Transcarotid transcatheter aortic valve implantation: A systematic review☆

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ABSTRACT

Background: The carotid artery is a novel access route for transcatheter aortic valve implantation (TAVI), especially useful in patients unsuitable for traditional access routes including transfemoral (TF), subclavian, transapical (TAp), and aortic (TAo). This systematic review summarizes the evidence on TAVI via the carotid artery for its efficacy and safety.

Methods: A systematic review was conducted as per the Preferred Reporting Instructions for Systematic Reviews and Meta-analysis (PRISMA) guidelines on three online databases: Medline (via Pubmed), SCOPUS, and Cochrane Database.

Results: There were 8 non-randomized controlled trials identified comprising 650 patients in four TAVI vascular access sites: transcarotid (TC) ($N = 364$), TF ($N = 100$), TAp ($N = 151$), TAo ($N = 35$). The 30-day rates of mortality and neurological complications for TC TAVI were 6.5% and 3.8%, respectively, with 1 incidence of myocardial infarction. Other complications included vascular complications (7.7%), insertion of new pacemaker (17.4%), atrial fibrillation (5.2%), and acute kidney injury (6.9%), bleeding episodes (14.3%), of which 13 (3.6%) cases were life-threatening; 5 (1.4%) were major; and 35 (9.3%) were minor cases. Follow-up to 1 year showed 19 further deaths. There were no significant differences in terms of mortality rates [risk ratio (RR) = 0.31, 95%CI 0.05–1.79; $p = 0.19$] and onset of dialysis treatment (RR = 2.53, 95%CI 0.31–19.78; $p = 0.38$) between the TC and TAp groups.

Conclusion: The available data on TC TAVI show comparable technical feasibility with other traditional access routes, representing a viable alternative. However, the paucity of data warrants the need for larger randomized controlled trials to establish a firm conclusion.

☆ This study was presented as a poster during the *Australian and New Zealand Society for Vascular Surgery 2017* conference, and the Asia Society of Vascular Surgeons 2017 conference.

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Contents

Introduction

Aortic valve disorders are the most common type of valve disorders. The prevalence rate of moderate or severe aortic stenosis amongst elderly aged 75 years and above is 2.8% [1]. Patients with severe symptomatic aortic stenosis or regurgitation were traditionally managed with a valve replacement in an open surgery. Despite a low operative mortality rate, the surgical risks remain high among old and frail patients with multiple comorbidities [2]. However, since its first description by Cribier and colleagues in 2002 [3], transcatheter aortic valve implantation (TAVI) has been a comparable alternative for patients at high risk of open surgery. Several large trials, most notably The Placement of Aortic Transcatheter Valves (PARTNER) trial [4,5]; PARTNER I trial [6], have shown favorable outcomes for TAVI compared to surgery.

Among the various possible assess sites, transfemoral (TF) access remains the safest, least invasive, and most preferred option for TAVI [7]. However, an estimated 20% of patients are not suitable for TF access [8]. This approach is contraindicated in patients with iliofemoral atherosclerosis, calcifications, tortuosity, abdominal aneurysms, or previous vascular surgery [9]. As such, alternative access routes should be considered based on the American College of Cardiology (ACC) expert consensus decision pathway [10]. These include transapical (TAp), transaortic (TAo), axillary/subclavian, and carotid access.

The TAp approach was first described by Ye and colleagues [11], and is currently the alternative choice of access site for patients with non-viable femoral access in most institutions. However, this more invasive procedure requires a left anterolateral mini-thoracotomy along the fifth or sixth intercostal space and direct puncture of the left ventricular apex [9], making it less suitable for patients with multiple comorbidities.

The subclavian/transaxillary approach has been shown to be safe, but risks damaging the subclavian artery in stenotic or severely calcified settings. Moreover, patients with previous coronary bypass artery grafts from the left subclavian artery would ordinarily be excluded from this approach [9].

The TAo access is done through a mini-sternotomy or a right thoracotomy, allowing exposure of the proximal ascending aorta. Despite its invasiveness, it has shown favorable outcomes and lower complication rates. However, it is unsuitable for patients with severe respiratory pathology, as well as those with 'porcelain aorta' [12].

Modine and colleagues first described the transcarotid (TC) access in 2010, offering a viable alternative to the femoral access [13]. Although it is regarded as a secondary option by the ACC [10], and is often the last resort in most centers [14], it presents a direct and shorter route to the aortic valve from the entry site, with the additional potential benefit of improving movement precision and stability of catheter delivery [9]. The aim of this systematic review is to assess its feasibility and safety in comparison to the highly preferred TF and TAp procedures in TAVI.

Method

This study was conducted as per the guidelines of the *Cochrane handbook for systematic reviews of interventions* [15] and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines [16].

Literature search and selection criteria

The following databases were searched to identify all randomized controlled trials (RCTs), prospective and retrospective cohort studies without language restriction from 2002 onwards: Pubmed, SCOPUS, and Cochrane databases. Since the first TAVI procedure was documented by Cribier and colleagues in 2002, studies published prior to 2002 were excluded [3]. Gray and bibliography searching was done by reviewing the references of included studies and related review articles. The databases were searched with a combination of the key words: (transcatheter aortic valve replacement OR transcatheter aortic valve implantation OR TAVI OR TAVR) AND (transcarotid OR carotid artery OR transfemoral or transapical), as well as the following 'Medical Subject Headings' (MeSH) search terms derived from our previous review [12]: "TAVI", "TAVR", "PAVR", "aortic valve replacement", "aortic valve implantation", "aortic valve insertion", "aortic heart valve replacement", "aortic heart valve implantation", "aortic heart valve insertion". Last date of the search was 1st August 2017. Studies evaluating the use of common carotid arteries as vessel access sites

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