Carotid Artery Stenosis in the Setting of Transcatheter Aortic Valve Replacement: Clinical and Technical Considerations of Carotid Stenting

Vijay M. Ravindra[1], Marcus D. Mazur[1], Ganesh S. Kumpati[2], Min S. Park[1], Amit N. Patel[2], Anwar Tandar[3], Frederick G. Welt[3], David Bull[2], William T. Couldwell[1], Philipp Taussky[1]

OBJECTIVE: **No consensus exists regarding the safety and efficacy of treatment of carotid stenosis before transcatheter aortic valve replacement (TAVR). Our objective was to review our series of patients treated for carotid stenosis with stenting in the setting of severe aortic valve disease and TAVR to evaluate its safety and efficacy.**

METHODS: **We reviewed patients who underwent carotid stenting in the setting of preoperative work-up or after TAVR from August 2012 through January 2015. Perioperative patient outcomes were collected to assess the safety and efficacy of carotid stenting.**

RESULTS: **Five patients (4 men, 1 woman; median age, 83 years; range, 72–88 years) underwent successful carotid stenting before (median, 30 days before; range, 2 days–3 months) TAVR. The median extent of carotid stenosis was 80% (range, 75%–90%), but the diagnoses were incidental and all patients were asymptomatic. One patient suffered acute systolic heart failure during stenting requiring emergent balloon aortic valvuloplasty and vasopressor therapy. Median intensive care unit stay was 1 day (range, 1–16 days) for all patients, and 1 day for patients treated electively. The median hospital stay was 1 day (range, 1–16 days) for all patients, and 1 day for patients treated electively. All patients were discharged home. None suffered immediate or delayed neurological complications.**

CONCLUSIONS: **We successfully performed carotid stenting in 5 patients before TAVR for severe aortic pathology. These patients require intensive care and careful monitoring. Larger prospective studies are needed to determine whether carotid stenting in the setting of TAVR can provide long-term neurological benefits.**

INTRODUCTION

Aortic stenosis is the most commonly acquired valvular disease in adults,[1] and the standard treatment is surgical aortic valve replacement (SAVR).[2] For patients with multiple comorbidities, including congestive heart failure, coronary artery disease, and chronic obstructive pulmonary disease, SAVR is not indicated because of elevated perioperative risk.[3] In the one third of patients with severe aortic stenosis who are not candidates for SAVR, transcatheter aortic valve replacement (TAVR) can be a suitable alternative.[4] TAVR involves replacement of the native, stenosed valve with a valvular bioprosthesis without the use of cardiopulmonary bypass and may avoid traditional perioperative complications. Although TAVR is a relatively new procedure, having received U.S. Food and Drug Administration approval in 2011, reports have shown comparable survival and left ventricular functional recovery between TAVR and SAVR in high-risk patients with symptomatic severe aortic stenosis.[4]

Key words
- Aortic valve
- Carotid artery stenosis
- Carotid stenting
- Monitored anesthesia care
- Transcatheter
- Valve replacement

Abbreviations and Acronyms
ASA: American Society of Anesthetists
AVR: Aortic valve replacement
CEA: Carotid endarterectomy
ICU: Intensive care unit
NASCET: North American Symptomatic Carotid Endarterectomy Trial
PARTNER: Placement of AoRtic TraNscathetER valves
SAVR: Surgical aortic valve replacement
TAVR: Transcatheter aortic valve replacement

From the [1]Department of Neurosurgery, Clinical Neurosciences Center; [2]Division of Cardiothoracic Surgery; and [3]Division of Cardiovascular Medicine, University of Utah, Salt Lake City, Utah, USA

To whom correspondence should be addressed: Philipp Taussky, M.D. [E-mail: neuropub@hsc.utah.edu]

Citation: World Neurosurg. (2016) 86:194-198.
http://dx.doi.org/10.1016/j.wneu.2015.09.063

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

The most feared perioperative complication of either SAVR or TAVR is stroke, which occurs in 1%–4% of patients.[5-7] In the Placement of AoRtic TraNscathetER valves (PARTNER) trial, neurological events occurred more frequently after TAVR than after SAVR at 30 days; this trend continued up to 24 months.[8] The occurrence of a stroke had a significant impact on overall mortality: 43% of patients who suffered a neurological event died, whereas 29% of those without a neurological event died.[8]

Because of these statistics, evaluation of the carotid arteries is part of the preoperative work-up for aortic valve replacement (AVR) at our institution. If severe carotid stenosis is identified, endovascular carotid stenting performed under moderate sedation represents an attractive alternative to carotid endarterectomy under general anesthesia. The safety and efficacy of endovascular stenting in the setting of TAVR has not been previously reported. In this pilot study, we describe our early results treating asymptomatic high-grade carotid stenosis with endovascular stenting in patients with severe aortic stenosis (aortic valve area, <1.0 cm^2) who are undergoing TAVR.

METHODS

After obtaining Institutional Review Board approval, we retrospectively identified all patients who underwent carotid stenting in preoperative work-up for TAVR at our institution from August 2012 through January 2015. Preoperative evaluation for TAVR as part of a research protocol at the University of Utah includes coronary angiography; computed tomography angiography of the chest, abdomen, and pelvis; echocardiogram; pulmonary function testing; and evaluation of the carotid arteries with ultrasound or other noninvasive techniques.

Medical records were reviewed for clinical and radiographic information. Clinical information collected included the degree of carotid stenosis as defined by North American Symptomatic Carotid Endarterectomy Trial (NASCET) criteria,[9] indication for stenting procedure, side of stenting, and date of TAVR. The type of stent, use of embolic protection device, and anesthetic technique were also recorded. Outcomes included complications after stenting, immediate neurological deficits after stenting or TAVR, length of stay in the intensive care unit (ICU), length of hospital stay, discharge disposition, and death. Data were summarized using medians and ranges for continuous variables and counts and frequencies for categorical variables.

RESULTS

Patient Population

Since 2012, TAVR has been performed in 102 patients at our institution. Eighty-nine patients (87%) were screened for carotid artery disease, most commonly with carotid ultrasound (95%) (Table 1). Of the 89 patients screened, 5 patients (5.6%) underwent carotid artery stenting (4 men, 1 woman; median age, 83 years; range, 72–88 years) (Table 2). All 5 patients underwent carotid artery stenting a median 30 days before TAVR (range, 2 days–3 months). Carotid stenting was performed on the left in 3 patients (60%). All patients were asymptomatic, and the diagnosis was made incidentally as part of TAVR-related evaluation for vascular disease. The median degree of carotid stenosis, as defined by NASCET criteria, was 80% (range, 75%–90%) (Table 2).

Table 1. Number of Patients Undergoing Evaluation of Carotid Artery Disease in the Setting of Aortic Stenosis

Screening Test	Number (%) of Patients (n = 102)
Initial screening for carotid artery disease	89 (87)
Carotid duplex (ultrasound)	85 (83)
Magnetic resonance angiography	2 (1.9)
Computed tomography angiography	1 (0.9)
Angiography for initial screening*	1 (0.9)

*Note that all 5 patients treated with stenting underwent carotid angiography for confirmation immediately before treatment.

All patients were placed under monitored anesthesia care, local anesthesia together with sedation and analgesia (Table 2). The median American Society of Anesthetists (ASA) physical status classification score was 3 (range, 3–4), indicating that patients suffered from severe systemic disease.[10,11] Two patients were classified as ASA 4, indicating severe systemic disease that is a constant threat to life.[10] All of the patients had coronary artery disease; 3 also had diabetes mellitus, and 1 had congestive heart failure (Table 2).

Procedural Information

Before carotid stenting all patients were administered 650 mg of aspirin and 300 mg of clopidegrel to a P2Y12 Reaction Units (VerifyNow, Accriva Diagnostics, San Diego, California, USA) of <194. Patients were kept on 325 mg of aspirin and 75 mg of clopidogrel after stenting for at least 6 months and transitioned to 325 mg of aspirin. Patients undergoing TAVR received periprocedural heparin infusion with a goal activating clotting time >200 seconds, followed by dual antiplatelet therapy. In the case of a transapical TAVR approach, patients were loaded with 650 mg of aspirin and were kept on an Integrilin drip until they could resume their dual antiplatelet regimen after valve replacement.

All patients were treated using a 6F shuttle (Cook Medical, Bloomington, Indiana, USA) and nitinol Precise stents (Cordis Corporate, Warren, New Jersey, USA) with a distal embolic protection device. Care was taken not to induce hypotension or bradycardia in the presence of severe aortic stenosis, and all patients were treated using moderate sedation. A residual stenosis of up to 25% after stenting was considered acceptable and no further angioplasty would be performed.

One patient suffered worsening of acute systolic heart failure during stenting that required emergent aortic balloon valvuloplasty and vasopressor therapy. None of the patients suffered immediate or delayed neurological complications (Table 3). The median length of the stay in the ICU was 1 day (range, 1–16 days) for all patients and 1 day for patients treated on an elective basis (patients 1–3). The median length of hospital stay was 1 day (range, 1–16 days) for all patients and 1 day for patients treated on an elective basis (patients 1–3) (Table 3). All