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Mid-term Results of Chimney and Periscope Grafts in Supra-aortic Branches in High Risk Patients

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WHAT THIS PAPER ADDS

The use of chimney and periscope grafts for the treatment of aneurysms involving the supra-aortic branches is reported with mid-term follow-up. This tool uses off the shelf devices and it can be employed in the emergency setting. This single centre experience reports the use of self expandable covered stents for parallel graft construction with particular attention to a standardised technique. The limited experience and follow-up available allow the use of this technique in high risk patients unfit for conventional surgery.

Purpose: Report mid-term outcomes of thoracic endovascular aneurysm repair (TEVAR) with chimney and periscope grafts (CPG) in supra-aortic branches (SAB).

Methods: Retrospective analysis, from October 2009 to May 2014, of patients with aneurysms requiring TEVAR with zone 0/1/2 proximal landing in association with at least one CPG in the SAB. All patients were considered at high risk for conventional surgery. Peri-operative mortality and morbidity, retrograde type A dissection, maximum aortic transverse diameter (TD) and its post-operative evolution, endoleak, survival, freedom from cardiovascular re-interventions, and CPG freedom from occlusion during the follow-up were analysed.

Results: Forty-one patients (28.05% EuroScore II) with thoraco-abdominal aortic aneurysm (17%), arch aneurysm (39%), descending aneurysm (34%), and aneurysm extending from the arch to the visceral aorta (10%) were included. Fifteen (37%) patients were treated non-electively. Fifty-nine SABs were treated with the CPG technique: one, two, three, and four CPG were employed in 71%, 19%, 5%, and 5% of patients, respectively. The proximal landing was in zone 0 in 49% of patients, zone 1 in 17%, and zone 2 in 34%. Technical success was 95%. Peri-operative complications and neurological events were registered in six (14.6%) patients and there were 5 deaths (12%). At a median follow-up of 21.2 (mean 22, SD 18; range 0–65) months, type I/III endoleaks were registered in three (7%) cases and re-intervention in six (15%) patients. A significant aneurysm sac shrinkage ($p<.001$) was reported at mean follow-up and no significant aneurysm sac increase (>5 mm). The estimated 2 year survival, freedom from re-intervention, freedom from endoleak, and freedom from branch occlusion were 75%, 77%, 86%, and 96%, respectively.

Conclusion: The chimney and periscope grafts technique was shown to be safe in aortic aneurysm disease involving the supra aortic branches, even in an emergency setting using off the shelf devices. Mid-term follow-up results in this high risk population are good, but longer follow-up is mandatory before this technique is used in intermediate-risk patients.

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INTRODUCTION

Thoracic endovascular aortic repair (TEVAR) is the first line approach for the treatment of aortic disease involving the descending thoracic aorta with reduced mortality and morbidity rates compared with conventional surgery.[1]

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Aneurysm extension over supra-aortic branches (SAB) still represents a limitation to standard TEVAR. Fenestrated and branched devices have been introduced with promising results in the elective setting to overcome such limitations.[2] Also chimney and periscope grafts (CPG) in the SAB have been reported, but experience and follow-up is generally very limited. Herein, mid-term experience with this technique is reported.

METHOD

From October 2009 to May 2014, data from patients treated with CPG in the SAB were collected in the clinical information system of the University Hospital of Zurich (KISIM 4.901; Dendrite, Dendrite Clinical System, Henley-on-Thames, UK).

Indications for treatment were aneurysmal aortic disease (ascending, arch or descending) requiring TEVAR proximal landing in zone 0, 1, or 2 in association with at least one CPG in the SAB. All patients were considered high risk for conventional surgery. The high risk profile for conventional surgery (graft replacement) with a Euroscore II >5% and/or presenting multifocal aneurysm locations was defined according to Andersen et al., including comorbidities (age >65 years, coronary artery disease, heart failure, chronic obstructive disease, and impaired renal function) and anatomical characteristics (thoraco-sternotomy incision and two stage open repair).[3] At the study institution there is a policy for high risk patients unfit for conventional surgery with a life expectancy more than 2 years. In younger/fitter patients, SAB rerouting in association with standard TEVAR is the preferred choice. In more frail patients a total endovascular solution is preferred with adequate anatomy. Surgical and endovascular solutions for SABs were combined in cases of anatomical challenge. Interventions were planned on CT angiography in all patients.

Demographic and clinical data were collected including the NSQIP[4] and the EuroSCORE II risk model.[5] The New York Heart Association (NYHA) heart function[6] and the Global Initiative for Chronic Obstructive Lung Disease (GOLD)[7] were employed to assess cardiac and respiratory function. The study was approved by the local ethics committee and all patients gave informed consent for the procedure itself and the anonymous data collection and analysis. Earlier data with shorter follow-up for 29 of these patients have been published previously inside a multicentre study.[8]

Technical success was defined according to TEVAR reporting standards.[9] Outcomes measured included peri-operative mortality and morbidity, retrograde type A dissection, maximum aortic TD and aneurysm volume with post-operative evolution, endoleak, survival, freedom from re-interventions, and freedom from CPG occlusion during the follow-up.

Follow-up consisted of clinical examination and CTA performed at 3, 6, and 12 months, and annually thereafter. CTA was performed with low dose contrast (40cc) and, to protect renal function, patients were generously hydrated intravenously pre and post CTA. Patients with renal function impairment were followed with non-contrast computed tomography and duplex ultrasound (DUS) imaging of the aorta and target vessels. For endoleak with a stable or reduced aneurysm sac, follow-up with clinical examination, CTA, and echocardiography was repeated every 6 months. For increasing sac size, imaging follow-up was performed within 3 months and if growth was detected a redo procedure was performed. Median follow-up was 21.2 (mean 22, SD 18; range 0—65) months.

Statistical analysis

Means and standard deviation (SD) or median and range were reported for parametric data; absolute values and percentages for non-parametric data. Differences in pre-operative and post-operative maximum aortic TD were assessed using the *t* test. Kaplan—Meier curves were used to estimate survival and freedom from cardiovascular re-intervention. Statistical significance was considered at $p < .05$. For Kaplan—Meier curves, confidence intervals (CI) and standard error exceeding 10% were reported. Statistical analysis was performed using SPSS 16.0 (SPSS Inc., Chicago, IL, USA).

Technique

Procedures were performed in a dedicated angio-suite (Artiszeego; Siemens AG, Forchheim, Germany) or in a hybrid room (Philips Medical Systems, Inc., Shelton, CT, USA) in 31% and 69%, respectively, of cases.

As reported, accesses were selected according to the anatomy and the intention to address SABs according to the proximal landing zone.[10] For chimney configuration access was performed with consideration of the target vessel. For the brachiocephalic trunk (BCT), access was generally performed percutaneously from the right axillary/brachial artery. Alternatively, surgical access via the right carotid artery (RCA) was employed. The left carotid artery (LCA) was accessed via surgical access and the left subclavian artery (LSA) via percutaneous axillary/brachial access.

For periscope configuration access was via the femoral artery (surgical or percutaneous).[11,12] All percutaneous accesses were performed with the preclosure technique (Proglide, Abbott Vascular, Redwood City, CA, USA),[13] under DUS imaging. Axillary percutaneous access was performed using the micropuncture technique to reduce the risk of nerve or plexus damage.[14]

For the chimney configuration, after gaining access to the target vessel, a standard wire (Boston Scientific, Natick, MA, USA) was inserted and placed in the ascending aorta. For the periscope configuration, the SABs were engaged from the femoral access with a long introducer sheath. Before sheath introduction, 5000 units of heparin were first administered. Heparin administration was then modulated to maintain an activated clotting time > 300 s to reduce the risk of thrombus generation and cerebral events while wire, catheters, and stent grafts were parked in the ascending aorta and/or aortic arch. In addition, patients were kept in the Trendelenburg position during aortic stent graft

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