Initial Experience with the Transapical Access for TEVAR
Erste Erfahrungen mit dem transapikalen Zugang für das Stenting der thorakalen Aorta

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ZUSAMMENFASSUNG

Material and Methoden Bei drei Patienten mit thorakalem Aortenaneurysma bei denen ein transfemoraler Zugang nicht möglich war (2 × chronisches Leriche-Syndrom; 1 × massives Kinking aller Gefäßabschnitte) wurde ein transpikaler Zugangsweg für die TEVAR gewählt. Über eine Mini-Thorakotomie wurde der Herzanulus freigelegt und nach Direkt punktion ein Führungsdraht über die Aortenklappe in die Aorta descendens gelegt. Hierüber erfolgte die TEVAR Prozedur unter angiographischer Führung.


Schlussfolgerung Der transapikale Zugang bietet in ausgewählten Fällen eine mögliche und sichere Alternative zum transfemoralen Zugang für die TEVAR.

Kernaussagen

▪ Der transapikale Zugang sollte bei TEVAR bedacht werden, sofern die transfemorale Route nicht möglich ist.

▪ Die umgekehrte Positionierung des Stents muss bei der Planung der Prozedur und der Stentplatzierung bedacht werden.

▪ Im Fall von Vegetationen der Aortenklappe ist besondere Vorsicht geboten, um das Risiko eines Schlaganfalls und peripherer Embolien zu reduzieren.

ABSTRACT

Background The endovascular approach has become a mainstay in the treatment of aortic aneurysms. While the transfemoral approach is most commonly used, it is often inaccessible due to a vascular pathology, such as occlusion, tortuosity or heavy calcifications. The transapical access provides an alternative approach. The goal of this study is to report the feasibility of the transapical approach for total endovascular repair of thoracic aortic aneurysms (TEVAR).

Methods Three patients with thoracic aortic aneurysms with inaccessible femoral arteries underwent TEVAR via the transapical approach. For access, the apex of the left ventricle was exposed by a mini-thoracotomy. After left ventricular puncture, a stiff guidewire was placed through the aortic valve into the descending thoracic aorta. All stent grafts were delivered under fluoroscopic guidance.

Results All three procedures were technically successful with complete exclusion of the aneurysm without endoleak. One patient suffered spinal ischemia with subsequent paraplegia on day 4 after the procedure. The same patient died on day 43 after the procedure due to esophageal rupture. The two remaining patients did not present procedure-related problems.

Conclusion The transapical access is a feasible and safe alternative to the transfemoral route in selected cases scheduled for TEVAR.
Key Points
- Transapical TEVAR is a feasible option if the transfemoral route is not accessible.
- Reversed orientation of the stent graft has to be taken into account for procedure planning and graft deployment.
- Care has to be taken in the case of aortic valve vegetation in order to avoid stroke due to downstream embolism.

Citation Format

Introduction
First reported in 1994, total endovascular repair for thoracic aneurysms (TEVAR) has become a mainstay of therapy, particularly for treating high-risk patients [1]. TEVAR provides several advantages over open surgical repair, including fewer complications, less blood loss and shorter hospital stay. Early problems such as durability of the devices have been greatly improved over the years. Problems caused by the size and limited flexibility of the delivery systems were mostly overcome by the introduction of low-profile delivery systems and routine use of hydrophilic coatings. Moreover, advanced access techniques, such as crack-and-pave or application of one or more buddy wires, have been described [2]. Thereby access vessel-related limitations of TEVAR were reduced. Nevertheless, access-related limitations and complications are still to be considered, particularly in patients with small vessel size or complex anatomy of the access vessels. This may eventually lead to devastating sequelae.

In these patients alternative access routes need to be considered. The transapical access has proven feasible in transcatheter aortic valve implantation (TAVI) [3]. First published in 2009 for treating an aortic arch aneurysm, TEVAR as an antegrade approach towards the descending thoracic aorta also proved feasible [4]. In this technical report we describe the transapical access technique, our early results using this approach for treating aneurysms in the descending aorta and provide a review on the available literature for this approach.

Technique
Informed consent was obtained from all patients prior to the procedure. All procedures were performed in a hybrid operating room with a fixed C-arm fluoroscopy unit (Artis Zee, Siemens, Erlangen, G) under general anesthesia. First an i. v. antibiotic (Cefuroxim 1.5 g, Actavis, Hafnarfjörður, IS) was administered and systemic heparinization (100 U/kg) with a target-activated coagulation time of 250 seconds was achieved. Thereafter, the left ventricular apex was surgically exposed by means of a left thoracic mini-thoracotomy at the level of the sixth intercostal space. Prior to puncture of the left-ventricular apex, two-paired felt-pledgeted purse-string sutures were applied at the left ventricular apex and secured by tourniquets. Thereafter, the left ventricle was punctured with an 18G needle (Surflo, Terumo, Leuven, BE) and a hydrophilic guidewire was advanced through the aortic valve into the ascending aorta. In Seldinger’s technique a short 6F introducer sheath (Pinnacle, Terumo, Leuven, BE) was then placed distal to the aortic valve. Via a pigtail catheter an arteriogram of the aorta and the supra-aortic arteries was obtained in the left anterior oblique position (LAO 40°) in order to depict the aneurysm anatomy and to have an orthogonal view on the origin of the left subclavian artery. The pathology was crossed by means of a hydrophilic guidewire and exchanged for a stiff Lunderquist guidewire (Cook, Bloomington, IN) which was placed deep in the abdominal aorta far beyond the intended distal landing zone. A 24F introducer sheath (Extra Large Check-Flo Introducer, Cook, Bloomington, IN) was advanced into the left ventricle without crossing the aortic valve and manually stabilized throughout the procedure. A standard thoracic stent graft, sized to meet the individual patient’s pathology, was introduced and advanced under fluoroscopic control. After the target position was reached, the blood pressure was lowered medically aiming for a target mean pressure of about 55 mmHg and the stent graft was released under fluoroscopic control. Care was taken not to cover the left subclavian or left carotid artery, as in the reversed position there were no bare springs through which the supra-aortic perfusion could be maintained. After the deployment system was removed, a 40-mm Coda balloon (Cook, Bloomington, IN) was introduced and the proximal and distal landing zones were carefully molded to the aortic wall. A final angiogram was obtained and the wire and sheaths were removed while the purse-string sutures were tightened, thus closing the left ventricular apex. A chest tube was placed in the left thoracic cavity. The thoracic incision was closed using a standard surgical technique. Finally the patients were transferred to the intensive care unit (ICU).

Case 1
A 79-year-old male presented with chest pain and a known thoracoabdominal aortic aneurysm (TAAA). He had undergone endovascular treatment of an infrarenal abdominal aneurysm 13 years before. Contrast-enhanced computed tomography (CT) revealed progression of his known TAAA with a progression in diameter of 1 cm within 9 months and a maximum diameter of 6.7 cm. There were also two new penetrating aortic ulcers present. He was diagnosed with symptomatic TAAA and stent graft placement was considered the treatment of choice. As CT showed a tortuous anatomy of the iliac arteries with stenosis and severe double curve kinking of the thoracic aorta, a flexible low-profile stent graft (Zenith alpha, Cook, Bloomington, IN) was chosen. The procedure commenced in standard fashion via a left common femoral artery approach. The femoral artery was surgically exposed. After a Lunderquist wire was placed in the ascending aorta, the stent graft was advanced into the aorta, but it proved...
impossible to properly place the stent across the proximal part of the double kinking of the thoracic aorta. An attempt to straighten the access with 3 additional Lunderquist wires inserted in parallel failed. Therefore, it was decided to change access to a transapical approach as described above. A 46–46–233 mm Zenith alpha aortic stent graft (Cook, Bloomington, IN) and a 46–46–150 mm Valiant Captivia stent graft (Medtronic, Santa Rosa, CA) were implanted with a 4 cm overlap. Contrast-enhanced CT obtained the following day confirmed complete exclusion of the rupture and the hematoma dorsal of the left atrium. Four weeks later the patient came back with chest pain. While the stent is in the correct position, the hematoma is completely gone and there is some air close to the stent graft (arrow), separate from the esophagus (asterisk). This finding is indicative of esophageal rupture.

Case 2

A 66-year-old patient presented with acute chest pain. He had a history of myocardial infarction treated by coronary artery bypass graft surgery and coronary stenting with subsequent double antiplatelet medication. Contrast-enhanced CT revealed a contained rupture of the thoracic aorta with compression of the left atrium (Fig. 1). Furthermore, severe iliac artery stenoses were diagnosed. Urgent aortic stent graft placement was indicated. The procedure commenced via the left common femoral artery as the left iliac arteries appeared to be more suited for endovascular treatment. First “cracking-and-paving” of the left iliac axis with placement of a 10 mm bare metal stent (SMART Flex, Cordis, Fremont, CA) was performed. However, preparation of the iliac arteries proved insufficient for advancing the 24F deployment.
system of the 38–200 mm Valiant Captivia endoprosthesis (Medtronic, Santa Rosa, CA). Therefore, the transfemoral procedure was abandoned and a transapical approach was chosen. The same 38–200 mm endoprosthesis was successfully deployed and the procedure was completed uneventfully. The day after the procedure, he presented with incomplete paraplegia, which was considered to be due to overstenting of the artery of Adamkiewicz without protective liquor drainage. The latter was considered too risky due to the double antiplatelet medication. Contrast-enhanced CT two days after the procedure showed complete exclusion of the rupture with regular perfusion of the aorta and excellent run-off. The patient was transferred to a neurologic rehabilitation center on day 16 after the procedure. On day 38 after the procedure, he was re-admitted with improved neurologic function, but a new episode of chest pain. Contrast-enhanced CT showed no device migration, but the perigraft hematoma at the level of the left atrium was completely gone. Subsequent endoscopy revealed a 6 cm long tear of the esophagus at the same level. It was assumed to be secondary to the pressure from the extensive hematoma with rupture of the hematoma into the esophagus. The patient refused any kind of treatment and died 43 days after the initial procedure from mediastinitis due to the esophageal rupture.

Case 3

A 60-year-old man under treatment for mantle-cell lymphoma was newly diagnosed with a penetrating aortic ulcer directly distal to the left subclavian artery. The ulcer was diagnosed on the basis of contrast-enhanced CT performed as a regularly scheduled staging examination. Based on this diagnosis, endovascular treatment was deemed the therapy of choice. As the patient showed only small iliac arteries with a diameter of 5.5 mm for both common iliac arteries, a transfemoral access was deemed inappropriate and elective transapical stent graft placement was considered. The procedure was performed as described above and a 32–200 mm Valiant Captivia endoprosthesis (Medtronic, Santa Rosa, CA) was successfully placed. The procedure was completed without complications and the patient was transferred to the ICU. His further course was uneventful and follow-up CT prior to discharge showed a correct stent position with preserved perfusion of all supra-aortic vessels. He was discharged 10 days after the procedure and oncologic therapy was continued. During a 24-month follow-up period, no further events occurred and the patient is doing well.

Discussion

TEVAR in patients without sufficient peripheral vascular access or a very tortuous aortic anatomy poses a challenge, despite major improvements in the design of both stent grafts and deployment systems. While adjunctive techniques such as “crack-and-pave”, iliac conduits and direct aortic access have been described [2], these options may not provide the anticipated success or are quite invasive. Access to the target lesion is a relevant issue in patients with iliofemoral diseases such as stenosis, severe calcification, and tortuosity precluding delivery of an aortic stent graft in about 10–25% of patients [5]. Therefore, an alternative approach, avoiding the iliac segment and providing more direct access with only a short distance towards the target is appealing.

With the introduction of TAVI in the clinical routine, the transapical approach became a routinely used option [3]. Thus, the use of the transapical access for stenting of the thoracic aorta seems an obvious approach. Consequently initial animal data on this technique proving the feasibility and safety of this novel approach
such as in our setting where cardiac surgeons and interventional radiologists are working closely together. The effect of using apical closure devices, which are currently under investigation, on these treatments remains to be seen [9].

The transapical approach for TEVAR is feasible and safe. It should be considered as an alternative in patients with severe aorto-iliac atherosclerotic disease and severe kinking of the access vessels.

Conflict of Interest

The authors declare that they have no conflict of interest.

References