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ORIGINAL PAPER

# Extensive Operation as One of the Solution for Patients with the Insufficient Proximal Landing Zone for TEVAR in Aortic Dissection – short term results

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**ABSTRACT**

***Objective:*** In our study we wanted to showed the safety, feasibility, efficacy and way how to solve the problems of endovascular repair for aortic dissection with insufficient proximal Landing Zone. ***Methods:*** The clinical data of all the patients with insufficient proximal Landing Zone (PLZ) for endovascular repair for aortic aneurism and dissection Stanford type B for the period from October 2013 to June 2014 was prospectively reviewed. According to the classification proposed by Mitchell et al, aortic Zone 0 was involved in 3 cases, Zone 1 in 1 case, Zone 2 in 9 cases and Zone 3 in 6 cases (19 patients in total). A hybrid surgical procedure of supraortic debranching and revascularization, with direct anastomosed truncus brachiocephalicus and left common carotid artery, were performed to obtain an adequate aortic PLZ. Revascularization of the left subclavian artery was carried out on the patient with dissection Stanford type B and short PLZ 2. ***Results:*** There was no significant difference of risk factors between Zone 0, Zone 1, and Zone 2 (Table1.), but the length of the PLZ significantly differed between groups ($p<0.01$) and there is no significant difference in technical and clinical success rate among the groups. ***Conclusion:*** The procedure of extending insufficient PLZ for endovascular repair for aortic arch pathology is feasible and relatively safe. The TEVAR applicability in such aortic disorders could be extended.

**Key words: endovascular repair, aortic dissection, proximal Landing Zone**

## 1. INTRODUCTION

Thoracic endovascular aortic repair (TEVAR) is a less invasive method for treatment of almost all the thoracic aortic lesions. First of all, TEVAR is one of the best solutions for the treatment of aortic dissections, penetrating ulcer, pseudoaneurism and aneurism. (1)The minimal PLZs are at least 16 mm for most devices. However, sometimes a surgical debranching procedure is needed to obtain safe and sufficient PLZ (2).In patients with thoracic aorta diseases, specially when the aortic arch is involved, the first strategy is endovascular therapy such as fenestrated endografts and Chimney graft (3, 4, 5).The second strategy, for treatment of aortic arch disease, is hybrid procedures including intentional occlusion of the arch vessel origin, vessel transposition, and bypass grafting. The clinical data of 4 cases with aortic arch aneurism and dissection with insufficient PLZs were prospectively analyzed.

## 2. PATIENTS AND METHODS

In the period from October 2013 to June 2014, a total of 19 thoracic endografts procedures were performed at our institution, but in this study we will pay attention to 13 of them with PLZ 0, 1 and 2. Out of these 13 patients, four patients (30.7%) were involved with insufficient PLZ. Patients were classified into 3 groups according to PLZ (Figure 1.) (6). Zone 0 included 3 patients(3 male); Zone 1 included 1 patient (1male) and Zone 2 included9 patients (6 males/3 females). The patients characteristics are shown in Table 1.

All patients were operated in our Hybrid Operating Room usinga Siemens Artis Zeego system. For this procedure we used Medtronic Valiant Thoracic prosthesis – Captivia delivery system. For measurement of Stent graft, we used the Trimensio software. We analyzed the duration of surgery, amount of used contras, duration of ICU stay, appearance of the early postoperative complications, neurologic status, and the presence of endoleak. Control analysis was made by com-

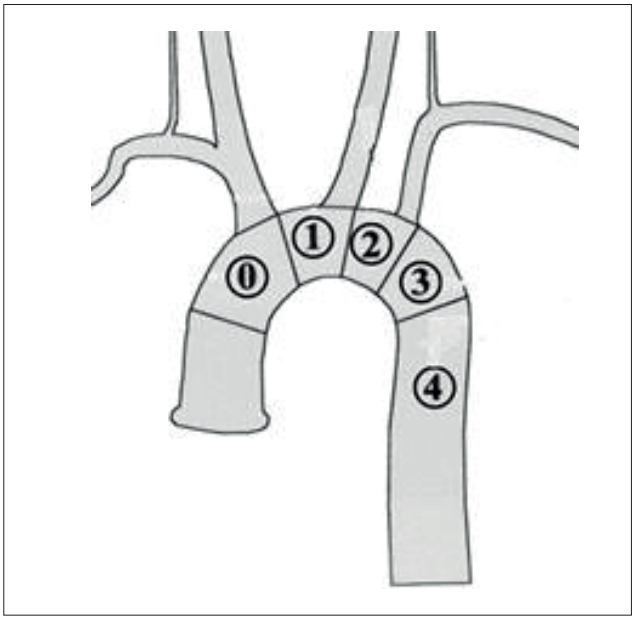


Figure 1. *Proximal Landing Zones*

puter tomography angiography 3 month safter the procedure.

## 3. PRE PROCEDURAL IMAGING

All patients were evaluated preoperatively with computer tomography angiography (CTA) scans using 3 mm slice intervals. Imaging becomes important as it can allow accurate assessment of the most ideal location for endograft proximal and distal Landing Zones. In addition, preoperative planning is important to make an assessment of the endograft length which is required. When the proximal aortic neck length was ≤12 mm, we considered it as insufficient PLZ. All measurements, dimension and types of prostheses are taught on software Trimensio. Before the procedure, when TEVAR with covering of LSA was planned, imaging of the cerebral, vertebrobasilar, and spinal circulations was made. We then inferred from the findings of whether there isany or minimal risk for brain or spinal cord perfusion to be compromised.

Figure 2. *Dissection Stanford type B (proximal type)*

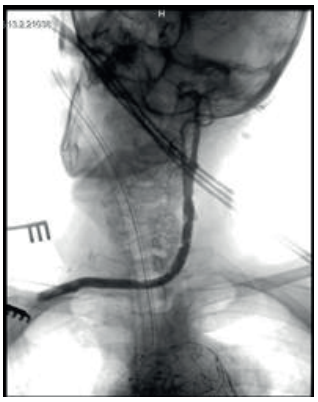

Figure 3. *Subclavio-carotis crossover bypass*

Special attention was given to the length and quality of the aorta and the development of collateral circulation, which supplies the vertebrobasilar system. After that, an assessment of possible complications and the need for preoperative bypass

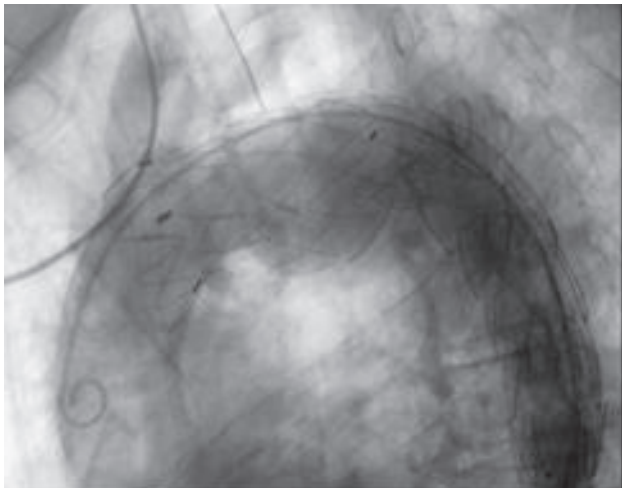

Figure 4. *Stent-graft PLZ 1*

## 4. PROCEDURE OF TEVAR

Procedures were carried out in the Hybrid operating room with a Siemens Artis Zeego system under general anesthesia. Before stent-graft placement, 3 cases were performed with debranching vessel to extend the PLZ 1, one case with the right subclavian artery (RSA) to the left common carotid artery (LCCA) bypass (Figure 3.), while the length between the left subclavian artery and distal edge of LCCA, where PLZ was <9 mm. The nine cases were performed with PLZ 2, if the length between the distal edge of LCCA to the first entry of subclavian artery was >12 mm and Willis circulation was sufficient. The femoral artery in all cases was surgically exposed with "cut down" technique, the length of incision was 4-5 cm. We chose a stent-graft with an oversized 15%–20% larger than the diameter of the aortic arch. We used one stent-grafts device, Talent Thoracic Captivia(Medtronic, USA). The endoleak was checked by intraoperative angiography and postoperative CTA (7).

## 5. FOLLOW-UP

The stent-graft repair surveillance was performed using CTA at intervals of 1 and 3 months time from the date of the procedure. The mean length follow-up was 6 months.The follow-up included rate of survival, position and morphology of stent-graft, diameter of true-false lumen, thrombosis of false lumen, local complications and related morbidity.

**Statistical analysis**

We used the Fisher's exact test. Analysis was performed with SPSS 10.0 software.

## 6. RESULTS

There was no significant difference of risk factors and diameter of PLZ between Zone0, Zone 1 and Zone 2 (Table1.), but the length of the PLZ significantly differed between

| | Zone 0 (n=3) | Zone 1 (n=1) | Zone 2 (n=9) |
|---|---|---|---|
| Age | 0±0 | 0±0 | 0±0 |
| Smoke | 3 | 0 | 7 |
| Diabetes | 0 | 0 | 4 |
| Hypertension | 3 | 1 | 9 |
| Pulmonary disease | 0 | 1 | 2 |
| Renal disease | 0 | 0 | 3 |
| Cardiac disease | 2 | 0 | 5 |
| Cerebrovascular disease | 0 | 0 | 1 |
| Hypercholesterolemia | 3 | 1 | 6 |
| ASA class 3 | 1 | 0 | 2 |
| ASA class 4 | 0 | 0 | 0 |

Table 1. *Patient Characteristics*

| | Zone 0 | Zone 1 | Zone 2 |
|---|---|---|---|
| Procedure forshort length of PLZ | AA-TB-LCCA bypass (n=3) | RSA-LCCA bypass (n=1) | Directly coverage LSA (n=9) |
| Diameter of PLZ (mm) | 36-42 | 34 | 32-38 |
| Length of PLZ (mm) | 12-34 | 18 | 16-28 |
| Type of endoleak | - | - | Type 1 |
| 30 days mortality | - | - | - |
| Short term clinical success | Good | Good | Good |
| 6 Months clinical success | Good | Good | Good |
| Disappearance of endoleak | - | - | Balloon dilatation |
| Migration of prosthesis | - | - | - |

Table 2. *Results according to the Proximal Landing Zone. PLZ – Proximal Landing Zone; AA – Aorta Acendens; TB – Truncus Brachiocephalicus; RSA – Right Subclavian Artery; LCCA – Left Common Carotid Artery; LSA – Left Subclavian Artery*

groups (p<0.01). The length of PLZ was obtained after supra-aortic vessels debranching or subclavio-carotid crossover bypass. The shortest length of PLZ was achieved with Zone 1 (12 mm) and the longest with Zone 0 (34 mm) (Table 2). In all procedures, endografts were placed successfully. Two patients from Zone 2 group appeared as type 1endoleak intraoperatively. To solve the complications, one patient was treated with balloon dilatation, and in another patient subclavian steel syndrome spontaneously disappeared, which was confirmed by CTA finding on the first of the controls.

We did not record any paraplegia, stroke, arm or spinal cord ischemia and other related complications.

## 7. DISCUSSION

The TEVAR has replaced conventional surgery as the elective treatment for acute diseases of the thoracic aorta. Many studies reported high procedural success rates and low mortality and morbidity rates, low rate of paraplegia, stroke and arm ischemia (8–11). The sufficient length of PLZ is the key point for the successful TEVAR of the aortic lesion, especially when it comes to PLZ 0or PLZ 1. The anatomical position is often trouble some since many thoracic aortic diseases and injuries happen close to incipience of the LSA (12). Some authors have the opinion that when the PLZ is less than 15 mm of normal aorta, between the lesion of aorta and the LSA, the covered part of the stent-graft has to cover the beginning of the left subclavian arteries LSA or LCCA, and so provides enough length of the PLZ (13, 14). We believe that 12 millimeters is enough length, while in our cases we did TEVAR with length of PLZ of 12 mm or more. In some cases, especially with PLZ 0, as a prophylactic measure, the surgeon has to make a supra-aortic vessel bypass or transposition to protection supra-aortic vessel perfusion (15). We used a widely accepted map of Landing Zones in the indications description, in intraoperative control and of postoperative follow-up period. This is important for a better understanding among other institutions.

In this study, 9 patients were treated with intentional coverage the LSCA without any cerebral or spinal ischemia. Our results are similar with the results of Christoph A. Nienaber et al.(16) and Riesenman et al. (17). The subclavian revascularization should be considered in the presence for a dominant left vertebral artery, bilateral carotid artery disease, an occluded/stenotic right vertebral artery, presence of a left internal mammary artery graft, or when a long length of thoracic aorta should be covered.Both procedures,intentional bypass absent coverage of the LSCA and the adjunctive surgical bypass, appear to be feasible and effective in managing the insufficiency of the PLZ during the endovascular thoracic aortic repair.

For the patients requiring a Zone 1 repair, a procedure with revascularization of LCCA was carried out due to the coverage of the LCCA and LSCA. It obtained the shortest length of PLZ of just 0.7 mm. This result was similar to the results of Greenberg et al. (18) and Ishimary et al. (19).

Out of all the studied patients, one was with endoleak type 1, which spontaneously disappeared on the first control examination. In all other cases, we did not record any type of endoleak. So, if the endografts were positioned with adequate proximal neck length, complete spontaneous resolution of type 1 endoleaks appears, with an acceptable short and mid-term clinical success rate (20).

Another concern of endovascular treatment of PLZ 1 is the durability of the extrathoracic revascularization of LCCA. Some authors (21) reported five years patency with over 90% after extra-anatomic arch reconstruction. In this study, after 6 months follow-up period, we have good patency of graft, without signs of stenosis, kinking or occlusion. So, extra-anatomic bypasses are durable and rarely require re-intervention.

The patients with ascendenting aorta disease and reconstruction of Zone 0 needed total arch debranching with or without extracorporal circulation, often referred to repositioning of the origin of the afferent blood supply to the truncus brachiocephalicus and carotid artery, with or without a revascularization procedure to the LSA (22).

In our 3 patients, we decided to extend the PLZ to the ascending aorta (Zone 0) (23).

We reimplanted the brachiocephalic trunk and LCCA with a Dacron tube, which was anastomozed to the proximal part of the ascending aorta with a sternotomic approach.

After surgical debranching, stent-graft implantation was performed simultaneously in the same operating setting. There was no mortality and morbidity recorded.

The follow-up examination, after 6 months showed that all 3 debranching grafts are potent and patients did not have any signs of neurological deficits. Our results are similar as in study Burks et al. (24).

There was no significant difference between the short-term mortality and mortality comparing with just a TEVAR after extending the PLZ by hybrid procedure, intentional coverage of LSCA or chimney graft of LCCA.

## 8. CONCLUSION

Hybrid procedure for aortic arch pathology is feasible and relatively safe. The TEVAR applicability in such aortic disorders may be expanded. The effectiveness and potential advantages of the hybrid aortic arch repair technique need to be validated in a larger patient sample with long-term follow-up.

**CONFLICT OF INTEREST: NONE DECLARED.**

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