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 (Table 1.), 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 (1 male) and Zone 2 included 9 patients (6 males/3 females). The patients characteristics are shown in Table 1.

All patients were operated in our Hybrid Operating Room using a 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-
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 is any or minimal risk for brain or spinal cord perfusion to be compromised.

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

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

| Procedure for short length of PLZ | Zone 0 (n=3) | Zone 1 (n=1) | Zone 2 (n=9) |
|----------------------------------|-------------|-------------|-------------|
| Procedure for short length of PLZ | AA-TB-LCCA bypass | RSA-LCCA bypass | 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 Ascendens; 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, endogrfts were placed successfully. Two pa-
tients from Zone 2 group appeared as type I endoleak intraoperati-
vely. To solve the complications, one patient was treated with
balloon dilatation, and in another patient subclavian steel syndrome spontaneously disappeared, which was con-
formed 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 elec-
tive treatment for acute diseases of the thoracic aorta. Many studies reported high procedural success rates and low mort-
tality 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 0 or 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 au-
thors 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 mil-
limeters is enough length, while in our cases we did TEVAR
with length of PLZ of 12 mm or more. In some cases, espe-
cially with PLZ 0, as a prophylactic measure, the surgeon has
to make a supra-aortic vessel bypass or transposition to pro-
tection 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 in-
stitutions.

In this study, 9 patients were treated with intentional cov-
erage the LSCA without any cerebral or spinal ischemia. Our
results are similar with the results of Christoph A. Nielsen
et al.(16) and Riesenman et al. (17). The subclavian revascu-
larization should be considered in the presence for a domi-
nant left vertebral artery, bilateral carotid artery disease, an
occluded/stenotic right vertebral artery, presence of a left in-
ternal mammary artery graft, or when a long length of tho-
racic aorta should be covered. Both procedures, intentional
bypass absent coverage of the LSCA and the adjunctive sur-
gical 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 cover-
age 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 ex-
anmination. In all other cases, we did not record any type of
endoleak. So, if the endogrfts 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%
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-an-
tomic bypasses are durable and rarely require re-intervention.

The patients with ascending aorta disease and recon-
struction of Zone 0 needed total arch debranching with or
without extracorporal circulation, often referred to reposi-
tioning 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 as-
cending aorta (Zone 0) (23).

We reimplantated 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 disor-
ders may be expanded. The effectiveness and potential advan-
tages of the hybrid aortic arch repair technique need to be val-
licated in a larger patient sample with long-term follow-up.

CONFLICT OF INTEREST: NONE DECLARED.

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