

## ORIGINAL ARTICLE

# Percutaneous and surgical femoral access for thoracic endovascular aortic repair using local anesthesia

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## ABSTRACT

**BACKGROUND:** Nowadays, thoracic endovascular aortic repair (TEVAR) is frequently the choice for treatment of thoracic aortic disease because of its less invasiveness. Generally, this technique is performed with surgical femoral access with general and epidural anesthesia or with a local anesthesia without spinal catheterization, but there is evidence in literature that suggests the validity of percutaneous approach. The aim of this study is to compare the different techniques according to our personal experience.

**METHODS:** We retrospectively studied patients affected from thoracic aortic disease, in particular those with thoracic aortic aneurysm (TAA) and acute type B aortic dissection (TBAD), in the period September 2002 to December 2016. The first endpoint was the possibility to achieve the femoral access only by local anesthetic injection, and the second endpoint was the comparison between TEVAR with femoral exposure and the percutaneous approach.

**RESULTS:** From September 2002 to December 2016 we have selected a cohort of 45 patients affected by thoracic aortic disease, divided in 22 patients with thoracic aortic aneurysm (TAA) and 23 patients with acute type B aortic dissection (TBAD). All patients were treated with TEVAR undergoing a local anesthesia. Most of the patients were treated with surgical exposition of the common femoral artery while in 10 eligible patients was used the percutaneous approach. In all cases we had correct placement of the endograft, exclusion of false lumen in case of TBAD and absence of primary endoleak in case of TAA after the procedure.

**CONCLUSIONS:** The use of the local anesthesia, and of the percutaneous approach when possible, have proven to be particularly effective in our casuistry.

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**KEY WORDS:** Endovascular procedures - Thoracic aorta - Thoracic aortic aneurysm.

Over the last few years, the role of thoracic endovascular aortic repair (TEVAR) has been largely demonstrated as an alternative technique for the treatment of thoracic aortic disease, not only because of its smaller invasiveness and easier intraoperative management, but also because of its lower peri- and postoperative complication rates.<sup>1,2</sup>

Moreover, it was shown the similar long-term results of TEVAR in comparison with the open surgery.<sup>3,4</sup>

TEVAR can be performed with general anesthesia, as

the open approach, or with regional and local anesthesia, especially in select cases.<sup>5,6</sup>

The classic approach for positioning endoprosthesis in thoracic aortic disease is made with surgical femoral access because of the control of the insertion and the management of the puncture site after procedure.<sup>7</sup>

There are evidences in literature that show the possibility to treat thoracic aortic disease only with percutaneous strategy. This mini-invasive technique is performed

only with injection of local anesthetic as the common percutaneous endovascular procedures, but it is required to use specific devices for the closure of the femoral site, in order to prevent predictable complications like hemorrhage.<sup>8-10</sup>

In this study we analyze some approaches for TEVAR according to our personal experience.

### Materials and methods

We retrospectively studied patients affected from thoracic aortic disease, in particular those with thoracic aortic aneurysm (TAA) and acute type B aortic dissection (TBAD), in the period September 2002 to December 2016.

Data were collected in the Unit of Heart Surgery, at the University "Magna Graecia", Catanzaro, Italy. All data have been evaluated with participation and supervision of the senior author. Institutional Review Board (IRB) approval of Interuniversity Center of Phlebolympology (CIFL), part of the International Research and Educational Program in Clinical and Experimental Biotechnology, was obtained for this study (reference number ER.ALL.2013.34.A).

The main endpoints were the possibility to achieve the femoral access only by local anesthetic injection and the comparison between TEVAR with femoral exposure and the percutaneous approach.

#### Preoperative evaluation

The criteria for study inclusion were as follows: 1) presence of collateral spinal cord perfusion network; 2) possible anchorage of the endoprosthesis in distal and proximal site; 3) valid diameter of the common femoral artery (CFA); 4) informed consent from the patient or an authorized representative (*e.g.* relative).

Criteria number 1, 2, and 3 have been studied preoperatively with CT scans in order to estimate collateral network capable to provide for spinal cord and proximal/distal site for endograft deployment, as shown by Ishimaru aortic map,<sup>10</sup> and also to control the conditions and diameter of the common femoral artery used as vessel access in all the cases.

As previously shown in current literature, TEVAR is performed with delivery sheath sizes of 18-24 Fr in case of surgical access and 12-24 Fr in case of percutaneous approach,<sup>9, 11</sup> because normally the mean diameter of CFA is 9.3 mm in male subjects and 8,4 mm in female subjects;<sup>12</sup> in particular in this study we used the Talent™ and, after having been modified, the Valiant™ endoluminal stent-

graft systems (Medtronic Inc., Santa Rosa, CA, USA) with delivery sheath sizes of 24 Fr, so the diameter of the vessel used for the access had been >8 mm.

In case of percutaneous approach, we considered exclusion criteria the presence of calcification because it is a predictor for failure as shown in literature.<sup>7, 13-15</sup>

Also, we considered the presence of obesity, significant arterial tortuosity, hematoma in site puncture, and scar tissue as contraindications for the percutaneous approach, because of the possible complications shown in literature like hematomas (both inguinal and retroperitoneal), arteriovenous fistulae, dissection, pseudoaneurysm, infections and venous thrombosis.<sup>14</sup>

The choice of the technique for the access was evaluated for every single patient by a team of vascular surgeons, heart surgeons, and cardiologists.

#### Anesthesia

Our purpose was to reach a complete cooperation with the patient avoiding the complications related with the general and loco-regional anesthesia, so we used local anesthesia with 1% or 2% lidocaine hydrochloride in both cases of TEVAR performed with femoral exposure or with the percutaneous approach.

In case of lidocaine allergy, we used procaine-based anesthetic.

Often, in the open approach we have needed more than one injection of local anesthetic because of the pain sensation referred by the patient.

#### TEVAR procedure

Before the beginning of the TEVAR procedure a cerebrospinal fluid catheter was inserted at the level of L3 or L4 in order to control the neurological integrity of the spinal cord avoiding damage sustained by spinal cord ischemia made by hypotension during stent-graft placement or the coverage of medullary arteries.

In order to guarantee an adequate spinal cord perfusion a pressure of 10 mmHg or below was maintained and monitored in the 48 hours after the procedure, instead the mean arterial pressure was maintained between a range of 90 – 120 mmHg for the first 72 hours.<sup>16</sup>

Radial artery was cannulated in order to control blood pressure and ceftriaxone 2 g was administered intravenously before the procedure.

Consequently, a dose of 5000 UI of heparin was administered always considering the risk of bleeding of the single patient.

In all patients we used the Talent™ and, after having been modified, the Valiant™ endoluminal stent-graft systems (Medtronic Inc.) with its deployment maintaining a systolic pressure at 80 mmHg.

The femoral access was surgically reached with multiple injections of local anesthetic or with a percutaneous approach where possible. In this case, previous injection of local anesthetic, the CFA was punctured above its bifurcation under ultrasound guidance. At least the site of puncture was closed performing a preclose technique inserting two 6-Fr Perclose Proglide devices, that were deployed in a standard manner after 30° rotation.

The knots were gradually tightened previous lubrication with saline and in case of inadequate hemostasis we placed an AngioSeal.

The preclose technique has been previously described in the literature.<sup>17</sup>

After the procedure we performed a digital subtraction angiography and echocardiography with color-flow mapping in order to evaluate the correct positioning of the endoprosthesis avoiding any primary endoleak.

The goal of the procedure consisted in placing patent endograft, excluding false lumen in case of TBAD and the absence of primary endoleak according to the definition of the Committee for Standardized Reporting Practices in Vascular Surgery of The Society for Vascular Surgery/American Association for Vascular Surgery.<sup>18</sup>

Lastly, we controlled patients with contrast-enhanced computed tomographic (CT) scanning or angiographic analysis and also with a routine examination of heart, lung, liver and kidney function.

Follow-up was made before discharge, at 1, 3 and 6 months, and yearly thereafter with CT scan.

## Results

From September 2002 to December 2016 we have selected a cohort of 45 patients affected by thoracic aortic disease, divided in 22 patients with thoracic aortic aneurism (TAA) and 23 patients with acute type B aortic dissection (TBAD).

Their characteristics fulfilled the criteria described above and they were grouped also for their personal data and other comorbidities like hypertension, diabetes, coronary artery disease, previous cerebrovascular accident or chronic obstructive pulmonary disease, as shown in Table I.

All patients were treated with TEVAR undergoing a local anesthesia and a group of these, consisting in 10 patients, was treated with percutaneous approach.

In all cases we had correct placement of the endograft,

TABLE I.—Patients' preoperative demographics.

Characteristics	TAA group (N.=22)	TBAD group (N.=23)
Age, years	73.4±7.1	75.3±7.4
Sex		
Male	18	13
Female	4	10
Hypertension	20	21
Diabetes	10	7
Coronary artery disease	5	7
Chronic obstructive pulmonary disease	8	10
Previous cerebrovascular accident	2	1
Smokers	18	15

exclusion of false lumen in case of TBAD and absence of primary endoleak in case of TAA after the procedure.

During the follow-up we had 5 cases of endoleak treated again with endovascular approach.

## Outcomes

According to our primary objective we treated all patients with local anesthetic. 35 cases, divided in 21 TBAD and 14 aneurysms, were treated with surgical exposition of the common femoral artery using more than one injection of anesthetic. 4 patients (11.5%) presented complications at site of surgical exposition: 3 cases with lymphorrhea successfully treated with drainage and local bandage and 1 patient with local infection at 3 months of TEVAR treated with Vacuum Assisted Closure (VAC)-therapy.

The percutaneous approach was possible in a group of 10 patients, divided in 2 TBAD and 8 aneurysms, thanks to their characteristics of CFA shown previously. They were treated with percutaneous approach with a single injection of local anesthetic.

Only 1 of 10 presented hematoma in the site of puncture, that was treated with surgical revision.

## Discussion

The development of endovascular surgery has largely downsized the role of open surgery in the treatment of thoracic aortic disease, that has been performed for years with the use of prosthesis that were surgically placed on the thoracic aorta with a lot of intra-, peri-, and postoperative complications, especially in case of sudden rupture of aneurism or traumatic damage of the thoracic aorta.<sup>19-21</sup>

Gradually, the experiences of authors have passed from a total surgical approach to a hybrid technique, and finally the literature shows us that now the election way is the endovascular one.<sup>3, 22-24</sup>

TEVAR has been widely performed with surgical femoral access under a spinal cord anesthesia, but in the last years authors reported studies with surgical approach made with only injection of local anesthetic and in the last years only with a percutaneous technique.<sup>5-8</sup>

In our center experience we have used these different approaches and this study shows our results of comparison of TEVAR with an open surgery femoral access and with a percutaneous approach, using in both cases only the injecting of local anesthetic avoiding regional or general anesthesia.

Therefore, we could treat all patients without the standard anesthetic management, commonly associated with complications like the intubation or the assisted ventilation.

According to our experience the preclose technique is safe and useful for the closure of femoral access during the percutaneous TEVAR, especially with the Proglide device, as shown in the literature.<sup>25</sup>

In those cases of percutaneous approach there were some advantages such as more intraoperative stability of the patient, but also a better postoperative management with a significant reduction in hospital stay and consequently a reduction in hospitalization costs.

Moreover, the use of local anesthetic has proven to be beneficial and the percutaneous approach, where possible, has been better than the surgical one, even if it was limited by the inclusion criteria.

## Conclusions

The future perspectives look at a less invasiveness in the treatment of aortic thoracic disease, especially to the technology advancement that will reduce the dimension of the devices, with a significant reduction in the complications associated with the percutaneous approach, which are actually the real limit for this technique.

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*Conflicts of interest.*—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

*Authors' contributions.*—Raffaele Serra conceived and designed the study, collected data, performed the literature research, wrote the paper, made revisions, gave final style to the paper, read and gave final approval of the version to be published. Antonio Di Virgilio collected data, made literature research, made revisions, gave final style to the paper, read and gave final approval of the version to be published. Davide Turchino collected data, made literature research, made revisions, gave final style to the paper, read and gave final approval of the version to be published. Stefano de Franciscis designed the study, collected data, made literature research, made revisions, gave final style to the paper, read and gave final approval of the version to be published. Ciro Indolfi designed the study, collected data, made literature research, made revisions, gave final style to the paper, read and gave final approval of the version to be published. Pasquale Mastroroberto conceived and designed the study, collected data, made literature research, made revisions, gave final style to the paper, read and gave final approval of the version to be published.

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