Trans-caval Endoleak Embolization (TCEE) of Type I and II Endoleaks Occurring after Endovascular Abdominal Aortic Aneurysm Repair (EVAR).

Poster No.: C-0820
Congress: ECR 2014
Type: Scientific Exhibit
Authors: R. Gandini¹, M. Chiocchi², D. Morosetti¹, G. Loreni¹, A. Chiaravalloti³, C. Del Giudice¹, G. Simonetti¹, ¹Rome/IT, ²Roma/IT, ³Rome, IT/IT
Keywords: Arteries / Aorta, Cardiovascular system, Fluoroscopy, CT-Angiography, Embolisation, Outcomes
DOI: 10.1594/ecr2014/C-0820

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR’s endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys’ fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Aims and objectives

Endoleak is defined as the persistence of arterial flow within the aneurysm sac after endovascular aneurysm repair (EVAR) (1).

Endoleaks are detected in approximately 25% of patients undergoing EVAR of the abdominal aorta (2).

Endoleaks are divided in five types: flow at the proximal (type Ia) or distal (type Ib) sealing zone, as retrograde flow from collateral branches into aneurysm sac (type II), graft malfunction or disruption (type III), graft porosity (type IV), and endotension (type V), in which the aneurysm sac increases in size without a definite visualization of a leak on imaging studies (3). Type I and type II endoleaks are the most frequent endoleaks with a reported incidence after EVAR of respectively 7-16% and 10-20% (4).

Operator skills and improvement in the materials for EVAR can reduce the incidence of type I and type III endoleaks, however type II endoleak remain unpredictable as it is not related to the type and configuration of the endograft. While a common consensus exists on the need for treating all type I, III and IV endoleaks, the management type II and V endoleaks remains controversial and continues to be a source of discussion and debate. Treatment is mandatory in case of type II and V endoleaks with a growing aneurysm sac, while a "watch and wait" strategy is preferred when a sac shrinkage is observed. No clear consensus exists on treatment in case of stability of the size of the aneurysm sac. (8-11)

Type I endoleaks are normally treated by balloon modelling of the sealing zones or placing an extension cuff.

Type II endoleaks are usually treated by a trans-arterial or percutaneous trans-lumbar embolisation.

Combined laparoscopic and percutaneous treatment has also been reported (12). The transarterial approach involves the embolization of the dominant feeding artery, typically through the inferior or superior mesenteric artery or iliolumbar arteries. This technique has been associated with encouraging initial results (13). However, selective catheterization of these vessels can be technically difficult and, during follow-up, this technique has been shown to be less effective in providing a durable result with a failure and recurrence rates estimated in up to 80% (11-20). In the percutaneous approach, an access needle is directly advanced into the aneurysm sac under fluoroscopic guidance after a preprocedural contrast-enhanced CT scan has been performed (18). Recently Mansueto et al. (21) proposed a new technique
for the treatment of type II endoleaks by direct transcaval puncture of the aneurysm sac and embolization using thrombin and coils. This technique could overcome the limitations associated with conventionally techniques, in fact endoleaks often recur after transarterial approach, because of multiple communicating vessels or persistent flow through the coils. Also in translumbar technique have been reported cases of ischemic colitis following thrombin injection (17) and still requires a wider experience confirms.

We describe the treatment of type Ia, II and Ia-II endoleaks by transcaval endoleak embolisation (TCEE) using coils, thrombin and acrylic glue.

**Methods and materials**

The institutional review board at our institution gave full approval and waiver of informed consent for our retrospective study and had previously approved our treatment protocol. Written patient informed consent was obtained from each patient prior to treatment.

Clinical indication for treatment was type Ia, type II or type Ia-II with evidence an increase of the aneurysm sac's diameter of at least 25% during post-EVAR follow-up.

The treatment was considered technically feasible, when the inferior vena cava was found to be adjacent and adherent to the aneurysm sac. (Fig 1)

In addition, there must be sufficient space between the aneurysm wall and the endograft wall. In fact, in the absence of such space would run the risk of perforating the prosthesis wall causes the lesion with fistula formation and bleeding. (Fig 1).

Fourteen patients (6 males, 8 females; mean age: 71.6 ± 7.9 years; range: 57-83) with type Ia, type II or type Ia-II endoleak were treated by transcaval embolization between January 2006 and January 2007 at our Department. After EVAR treatment with different endografts types, these Patients were followed by Computed Tomography angiography (CTA) at minimum intervals of one week, 1, 6 and 12 months, and yearly thereafter.

Nine patients were treated and followed at our institution while the other five were treated at other hospitals but the follow-up were performed at our institution. When an endoleak was detected CTA was performed at 6-month intervals to detect eventual changes in the dimensions of the aneurysm sac. The mean increase of aneurysm sac diameter was 26.8 ± 1.3 % (14.7 ± 1.5 mm) over a mean period of 8.6 ± 3.1 months after EVAR.

Two patients presented a type Ia endoleak, 10 with type II endoleak and 2 with type I-II associated endoleak and a significant increase in aneurysm sac diameter.

**Technique**
In the first 4 patients treated, all with a type II endoleak, TCEE was selected as an alternative method after an unsuccessful attempt of intra arterial retrograde catheterization of the feeding artery.

In the first patient treated for a type Ia endoleak, TCEE was selected as the deployment of an extension cuff was unfeasible due to the short infrarenal neck. In all patients treated in our institution, was not possible to treat endoleak at the time of implantation.

After our initial experience with TCEE, this was chosen as the primary approach in the successive patients treated for a type Ia, II or type Ia-II endoleak.

All procedures were performed in a dedicated angiography suite under moderate sedation.

The common femoral vein was punctured under local anesthesia using lidocaine and a standard 0.035” J tipped 180 cm long hydrophilic guidewire (Radiofocus, Terumo, Tokyo, Japan) was advanced into the inferior vena cava (IVC).

A 12F introducer sheath 40 cm long was placed and advanced into the IVC to give stability and allow a safe puncture.

Transcaval puncture of the aneurysm sac was performed with the same technique for all patients, using an Angiodinamics TIPS puncture set (Angiodynamics, Queensbury NY, US).

The 8 French transjugular curved catheter and the 5F curved guiding cannula was advanced through the introducer sheath over the guidewire.

The system was oriented to the stent graft so that the curved guiding cannula resting against the vena cava wall. The orientation of the system was verified on multiple fluoroscopic projections to clarify landmarks which are the vertebrae and if present the aorta wall calcification.

The Colapinto needle assembly with the 5F curved guiding cannula was advanced through the system and finally the aneurysm sac was punctured according to the landmarks gathered from the pre-procedural CT scan. (fig 2-3)

The 5 Fr cannula with its catheter was introduced under fluoroscopic guidance through the Colapinto needle. The flexible puncture needle was removed, and a 0.035” standard J tipped 180cm long hydrophilic guidewire was slowly advanced into the aneurysm sac until a low resistance path was engaged. (Fig 4)

This was considered as an indirect sign of the passage of the guidewire into an unthrombosed area, suggestive of the site of the endoleak. The catheter was then advanced over the guidewire into the area of the presumed endoleak.
The backflow of blood through the catheter, after removal of the guidewire, confirmed its position within the endoleak.

The contrast media was manually injected low pressure to visualize the presence of intrasac flow and, in case of type II endoleaks, an eventual back-flow into lumbar arteries. (Fig.5-6)

Intrasac pressure was also evaluated during the procedure to confirm the drop of intrasac pressure after embolisation.

When a type Ia endoleak was suspected, the passage of the guidewire through the proximal sealing zone into the aorta was assessed. (Fig7)

When such a communication was found, the guiding catheter was advance into the sealing zone and contrast media was gently injected to visualize the endoleak. (Fig. 8) Type Ia endoleaks were embolised using 7-15 platinum fibered coils (Target, Boston Scientific, Natick MA, US), with diameters ranging between 6-9 mm, and 1.8 ± 1.0 ml (range 1-3) of human thrombin (Tissucol, Baxter SpA, Italia) (Fig 9). Type II endoleaks were embolised using a combination of 7-15 platinum fibered coils, with a diameter ranging between 6-9 mm, and 1ml of Glubran 2 acrylic glue (GEM, Viareggio, Italy) mixed to Lipiodol using a 1:3 volume ratio, in order to allow its fluoroscopic visualization (fig 10,11).

Type Ia-II endoleaks were embolised using 17-23 platinum fibered coils (Target, Boston Scientific, Natick MA, US), with diameters ranging between 6-9 mm, and 1,5 ml of Glubran 2 acrylic glue (GEM, Viareggio, Italy) mixed to Lipiodol.

The complete exclusion of the endoleak was confirmed by the persistence of contrast medium within the aneurysm sac (Fig. 11), the absence of intrasac flow and the drop of intrasac pressure measured with a continuous in-line hemodynamic monitoring performed by the ACIST System. (Bracco, Italy).

The Mean fluoroscopy time was 15.4 ± 4.1 (range: 10-22).

Patients were discharged 24 hours post-procedurally, after a CTA examination had been performed. (fig 12-13)

FOLLOW-UP

Follow-up was performed by Computed Tomography angiography (CTA) at 1, 3, 6 and 12 months post-procedurally.
Results

TCEE

TCEE with combination of coils, Glubran 2 acrylic glue and thrombin was feasible and effective in all patients with exclusion of all type Ia, type II and type Ia-II endoleaks.

Mean intrasac pressure before and after TCEE was respectively 63.6 ± 15.2 mmHg (range: 43-89) and 7.8 ± 2.3 mmHg (range: 5-12). Mean fluoroscopy time was 15.4 ± 4.1 minutes (range: 10-22).

No major or minor complications were observed intra-and peri-procedurally. All patients reported a dull lumbar pain a

during transcaval puncture terminated immediately without drugs.

Follow-up

During a mean follow-up period of 9.9 ± 4.5 months, no aneurysm-related deaths, increases of aneurysm sac diameter

or recurrent endoleaks were observed. Was found also a size reduction of 15% ± 6 of the aneurysm sac in 8 patients

compared with the pre procedural values.

Conclusion

Endoleaks are the most important complications in patients treated with EVAR. Clinical trials using endovascular stent

grafts for treatmentof AAA consistently demonstrate a significant incidence of endoleak. These endoleaks compromise

overall effectiveness of aneurysm repair.(22)

A significant proportion of endoleaks, especially Type Ia, are detectable intraoperatively with completion angiography

following graft deployment. Demonstration of a endoleak requires immediate remedial intervention. Type II endoleaks,
which are more common, are generally of little concern at this stage, but should be noted and observed during followup.

However, there is evidence that the infrarenal neck of AAA following endovascular repair undergoes progressive enlargement (23,24).

This may lead development of a secondary proximal endoleak and the potential for aneurysm rupture (8,25). Careful poststent surveillance is required.

The main concern with proximal Type I endoleaks is the associated risk of aneurysm rupture. It has been postulated that large primary type I endoleaks with significant flow into the aneurysm sac confer a higher risk of rupture to the patient than the untreated aneurysm, due to the fact that arterial blood is flowing into a closed system. Similarly secondary Type I endoleaks should be treated as they have been associated with a significant aneurysm rupture rate (2).

Type Ia endoleaks due to an irregular or angulated neck may be sealed using a modelling balloon.

Alternative strategies include the use of Palmaz (Cordis, Miami Lakes, Florida, USA) stents to aid conformity within an irregular neck, or proximal extension cuffs.

Placement of a secondary endovascular extension graft for treatment of an attachment site leak can be performed whenever technically feasible.

Indeed, the use of an endovascular extension graft required that an adequate length of undilated artery be present in the region adjoining the attachment site endoleak. Proximal neck anatomy is of particular significance in endoleaks originating at the proximal aortic attachment site, where the level of the renal artery ostia may be a significantly limiting factor (22).
Recent alternative options are the use of a proximal fenestrated cuff which enables the extension of the sealing zone to the suprarenal aorta or the transrenal fixation with a custom-made extension graft, to provide increased fixation of the endovascular extension graft.

Coil embolization of the perigraft space has been reported. This method is limited to patients in whom no alternative treatment is available; no adequate site for implantation is present that would allow use of an extension graft or cuff and patients have extensive comorbid medical conditions that precluded surgery conversion to conventional repair.

In fact the efficacy of this technique for endoleak repair has been questioned and in addition studies conducted in animal models of AAA suggest that coil embolization of type I endoleak does not effectively reduce intra-aneurysmal pressure.

In this study we used a new technique for the treatment of type Ia endoleak. First TCEE was selected as the deployment of an extension cuff was unfeasible due to the short infrarenal neck.

After our initial experience, this technique was chosen as the primary approach. This technique adds to others already described above and based on our preliminary encouraging results, should be considered a valid alternative approach.

If all endovascular techniques described prove ineffective, open conversion should be considered. Conversion to conventional open repair is associated with significant complications and this is a major undertaking, especially if the presence of a suprarenal stent.

Immediate conversion is associated with a high mortality and morbidity.
The management of patients with II endoleak is still under discussion, and there is no common consensus on the best therapeutic approach.

According to some authors, treatment should be performed only when the aneurysm increases in size (9-11,30,31)

According to others, a type II endoleak should be treated regardless of its dimensional changes, because the collateral vessels always transmit arterial pressure to the aneurysm sac placing the patient at risk of aneurysm rupture. (32,33)

In our experience we perform the treatment of a type II endoleak when it persists for more than six months and is associated with a growth of the aneurysm sac's diameter of at least 25% on CTA scans.

In order to avoid the risk of rupture and to decrease the pressure within the aneurysm sac, persistent type II endoleaks with a growing aneurysm sac are usually treated by transarterial or percutaneous approaches. The target of the transarterial approach is the feeding vessel of the type II endoleak. This is usually represented by the ileo-lumbar arteries or the Riolano arcade connecting the superior and the inferior mesenteric arteries.

The transarterial approach can be technically challenging, time-consuming, and unfeasible in some patients because of anatomic limitations such as endoleaks caused by back-bleeding from hypogastric and lumbar arteries (32,34). As a result, embolization of a single feeding vessel may not provide a durable repair.

Direct percutaneous endoleak embolization has been shown to provide the best outcome (35). The challenges of a direct percutaneous approach are determination of a safe needle route to the aneurysm, correct placement of the needle within the aneurysm without damaging the endograft, and controlled embolization of the endoleak. Different approaches have
been reported: direct transabdominal and translumbar puncture.

The disadvantage of a transabdominal approach is that the needle must cross the abdominal cavity with high risk of bowel puncture (perforation). This approach is furthermore complicated by respiratory movements.

The most common approach is the direct translumbar approach with the patient in a prone position. This approach avoids the crossing of the abdominal cavity or organs.

Multiple projections are necessary for the correct orientation of the needle under fluoroscopic guidance (34,35) and, thereby, the procedure is usually associated to relatively long fluoroscopy times.

The most challenging step with fluoroscopic guidance is the correct placement of the needle into the endoleak. As a matter of fact, the accidental puncture of the endograft can theoretically result in a new type III endoleak.

The safe and accurate placement of the needle into the endoleak has been reported with CT guidance (34,35).

However, CT guidance alone has limitations during embolization. The visualized area is confined to an acquired 10-mm axial slab (34,35). Therefore, misplacement of any embolic material in a cranio-caudal direction could go undetected.

For this reason, most interventionalists prefer to perform embolisation under real-time fluoroscopy.

A combination of CT and fluoroscopic guidance has been previously reported. The needles are placed under CT guidance and the patients are then transferred to the angiographic suite for embolisation.

The transferring of a patient with a needle in the back, however, entails risks of needle dislocation and loss of sterility and has logistical drawbacks.

A CT-guidance may not be easily available to all endovascular specialists and thereby more versatile techniques need
to be developed in order to allow a feasible and safe treatment of type I and II endoleaks on larger scales.

TCEE has several advantages. A direct CT guidance is not required for aneurysm sac puncture and the procedure can be

entirely performed under fluoroscopy.

It is therefore enough to have access to C-arm fluoroscopy unit to perform a TCEE.

An accurate pre-procedural CTA evaluation and the eventual presence of aortic wall calcifications are usually enough to
determine the correct orientation of the needle during aneurysm sac puncture.

The placement of the catheter directly inside the aneurysm sac permits intrasac pressure monitoring. The embolization
results are followed with usual angiographic controls.

TCEE was first described by Mansueto et all. using metal coils and/or thrombin injection under intrasac pressure
monitoring. We believe that the real-time visualisation of the distribution of the embolic agent [Discussion R 70] during
its injection is essential for determining its optimal required quantity. Thereby, in our series, we preferred the use of
Glubran 2 acrylic glue mixed with Lipiodol instead of thrombin alone. Lipiodol enabled the fluoroscopic visualisation
of the glue. Small quantities of thrombin were also injected in case of type Ia endoleaks during catheter withdrawal at
the end of the procedure in order to further ensure the exclusion of the endoleak.

The persistence of glue mixed with Lipiodol and the absence of a dynamic flow within the aneurysm sac indicated the
complete resolution of the endoleak. This was further confirmed by the drop of intrasac pressure.

The major limitation to TCEE is that it can be performed only in cases in which the aneurysm sac is adherent to the
inferior vena cava and there is sufficient space between the aneurysm's wall and the endograft. This information is
obtained with CTA which is thereby mandatory for an accurate pre-procedural planning.

Although, theoretically, the procedure can be complicated by retroperitoneal haemorrhage and deep venous thrombosis,

no procedure-related complications were observed in our series.

To our knowledge this is the first study reporting the treatment of type Ia, II and Ia-II endoleaks by TCEE using metal

coils, Glubran 2 acrylic glue and thrombin. This technique, when indicated, is feasible, does not require high operator

skills and can be performed by almost all endovascular specialists in most clinical contexts using a simple C-arch.

The safety and feasibility features of this technique suggest its use as the treatment of choice in type Ia and II endoleaks

in selected patients.

Images for this section:
**Fig. 1:** CTA demonstrates the presence of type II endoleak after EVAR. The vena cava is adherent to the aneurysm sac (arrow) and there is a sufficient space between the aneurysm wall and the endograft (double arrow).
Fig. 2: TCEE type II endoleak. Puncture of vena cava wall with trans-jugular kit after correct orientation, performed under fluoroscopic control, with injected contrast media into aneurismal sac.
**Fig. 3:** TCEE type I endoleak. Puncture of vena cava wall with transjugular kit after correct orientation, performed under fluoroscopic control.
Fig. 4: TCEE type II endoleak. A guidewire is introduced inside the aneurysm sac trough the transcaval approach. Afterwards a 5 F cathether was advanced.
Fig. 5: TCEE type II endoleak. Diagnostic angiography highlights the contrast medium inside the aneurysm sac, which flows through lumbar arteries (arrow).
Fig. 6: TCEE type I endoleak. Diagnostic angiography highlights the contrast medium inside the aneurysm sac.
**Fig. 7:** TCEE type I endoleak. Under fluoroscopic control the guidewire are advanced in the sealing zone.
**Fig. 8:** TCEE type I endoleak. The catheter are advanced into the sealing zone and contrast media are gently injected to confirm the presence of type I endoleak.
Fig. 9: After the transcaval embolization of type I endoleak, diagnostic angiography shows embolizing coils (arrows) in the sealing zone and stable contrast medium (asterisk) inside the sac.

Fig. 10: The angiographic control after transcaval embolization of type II endoleak, shows multiple (black arrows) and the persistence of endoleak demonstrated by rapid out-flow of contrast media through lumbar arteries (white arrows).
Fig. 11: Final check after embolization of type II endoleak. After administering Glubran 2 acrylic glue mixed with Lipiodol and other embolizing coils (arrows), is documented resolution of contrast media out-flow trough lumbar arteries with persistence contrast medium (asterisk) inside the sac.
Fig. 12: CTA after TCEE of type II endoleak. (A) Axial scan without contrast medium shows coils (black arrows) and stable contrast medium with gas bubbles inside the aneurysm sac (white arrows). B) Axial scan at the same level of (A), in the arterial phase, demonstrates the absence of type II endoleak.
Fig. 13: CTA after TCEE of type Ib endoleak. (A,B) Axial scan without contrast medium shows embolizing coil in the sealing zone and stable contrast medium with gas bubbles (arrow) inside the aneurysm sac, as a result of embolization treatment. (C,D) Scan in arterial phase shows coils and complete exclusion of the aneurysm sac.
Personal information

References


1999

Sep;178(3):225-3.

12. Wisselink, W., Cuesta, M.A., Berends, F.J., Van Den Berg, F.G., Rauwerda, J.A. Retroperitoneal endoscopic

ligation of lumbar and inferior mesenteric arteries as a treatment of persistent endoleak after endoluminal aortic


13 Jonker, F.H., Aruny, J., Muhs, B.E. Management of Type II Endoleaks: Preoperative versus Postoperative versus


Stavropoulous, S William [corrected to Stavropoulos, S William].