

Importance of Fusion Software in Type II endoleaks treatment after EVAR

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Abstract:

Objectives: Introduction and objective: The presence in the CT-angiography (CTA) system of a "vessel navigation" engine equipped with a co-registration and navigation software (Fusion) allow for greater diagnostic accuracy and to precisely identify the "Target Vessel" in Type II endoleaks treatment after EVAR.

The aim of this preliminary study is to demonstrate the feasibility of "Fusion" software to reduce the amount of contrast medium and radiation dose to patients and the time of procedure.

Methods: Between 2020 and 2022, we treated 12 patients for type II endoleak after EVAR.

We divided the patients in two groups: a Group A (n=7) of patients treated using a new high-end angiograph (International Tools Workstation, Philips), equipped with the "Fusion" software; a Group B (n=5) of patients treated without it. The amount of contrast medium and the Dose Area Product (DAP) were recorded and compared between the two groups.

Results: We found no death or need for surgical conversion in both groups. The amount of contrast medium injected was similar between the two groups. A dramatic reduction of the DAP was observed for group A compared with group B. The DAP median values were 4.9 Gy x cm² (range: 3.2-21.1 Gy x cm²) for group A and 9.76 Gy x cm² (range: 6.3-11.75 Gy x cm²) for group B. Shorter times of procedures for Group A patients were recorded, with a median value of 72 minutes compared to 53 minutes for Group B.

Conclusion: The use of the "Fusion" software as "vessel navigator" during the embolization procedure of the type II endoleaks guarantees a greater efficacy in the endovascular treatment but also a dramatic reduction of the amount of radiation needed for the treatment, with great benefits from a radiation protection point of view for both the patient and the healthcare operator.

INTRODUCTION

Endovascular abdominal aortic aneurysm repair (EVAR) is a less invasive but equally effective technique to treat aneurysm compared to open surgery repair (OSR). EVAR has been shown to have lower 30-day mortality and morbidity rates than OSR. However long and medium-term follow up results have shown

that the early benefit is lost over time.

Type I endoleak, type II endoleak with sac expansion, type III endoleak, stent migration and kinking were associated with an increased risk of rupture¹.

Endoleak is defined as continued perfusion of the aneurysm sac despite endograft deployment; therefore, the aneurysm sac is not completely excluded from the systemic circulation.

Different types of endoleak have been described in the literature depending on the origin of the leak². Type II are the most common endoleaks after EVAR and are caused by back-flow of collateral arteries into the aneurysm sac [Fig. 1].

The most common arterial branches that give rise to type II endoleak are the inferior mesenteric artery and lumbar arteries.

Several treatments are available for Type II endoleaks after EVAR such as conversion to open surgery, embolization and

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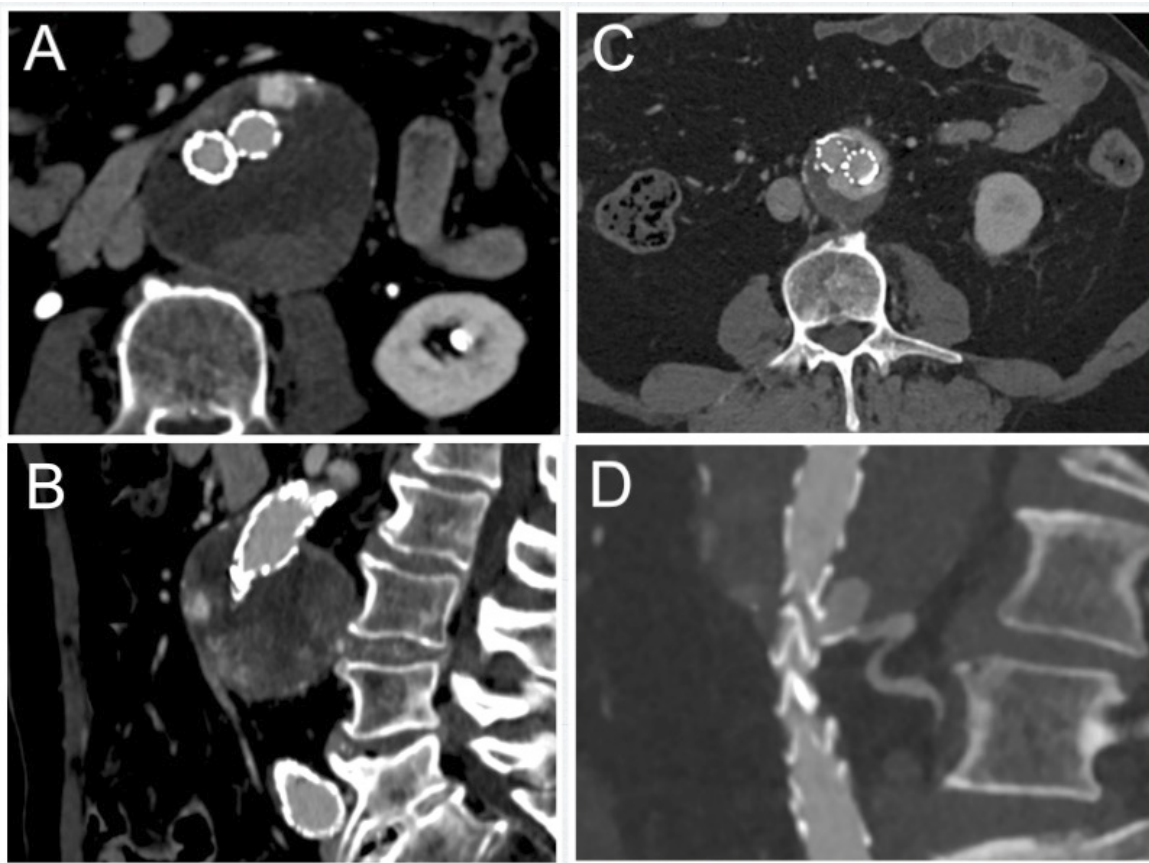


Fig.1: CT scan images showing a Type II endoleak in the aneurysm sac (A, C); example of inferior mesenteric artery (B) and lumbar artery (D) giving rise to the endoleak.

laparoscopic clipping.

The most common and effective techniques are the transarterial embolizations or direct percutaneous sac injection by translumbar or transabdominal approaches³.

A review from Ameli-Renani et al.⁴ described Type 2 endoleak management, with embolization as the mainstay treatment reserved for persistent cases with a significant sac size increase.

These procedures are all performed in an angiography suite using fluoroscopy and a wide variety of embolic agents such as coils, ethylene-vinyl-alcohol copolymer, glue⁵.

The presence in the CT-angiography (CTA) system of a “vessel navigation” engine equipped with a co-registration and navigation software (Fusion) allow the coupling of actual CTA images acquired during the procedure with the pre-operative ones.

First, a 3D model is generated from preoperative imaging, typically a CTA. The model is then used in the procedure’s planning, with specific markers placement (e.g. at the ostium of the target vessels) and storing of C-arm angles that will be used for intra-operative guidance. At the time of the procedure, an intraoperative cone-beam CT is performed and the 3D model is aligned to the patient’s anatomy. Finally, the 3D model coupled to the fluoroscopic image is used for live guidance [Fig. 2].

This allows for greater diagnostic accuracy and to precisely identify the “Target Vessel” to be embolized to effectively treat

the endoleak nidus, with a potential reduction of amount of contrast medium and patient’s irradiation⁶.

There are many applications for image fusion in endovascular surgery, such as for endovascular aneurysm repair (EVAR), complex EVAR, thoracic endovascular aneurysm repair (TEVAR), carotid stenting and for Type 2 endoleaks.

The aim of this preliminary study was to demonstrate the feasibility of “Fusion” software to reduce the amount of contrast medium and radiation dose to patients and the time of the procedure.

MATERIALS AND METHODS:

We collected data from patients treated in our Institution and then we performed a single-center retrospective analysis: one hundred-eighteen patients (median age: 73 years, 109 men and 9 women, 115 asymptomatic and 3 symptomatic/ruptured) underwent endovascular treatment for abdominal aortic aneurysm between 2020 and 2022.

All the patients performed standard EVAR to treat infrarenal abdominal aortic aneurysms (mean sac diameter 59 mm, all inside IFU). After the procedures a 6-months follow-up CTA was performed.

12 of these patients presented a type II endoleak with significant increase (> 5 mm) in the aneurysm sac that we treated with endoleak embolization.

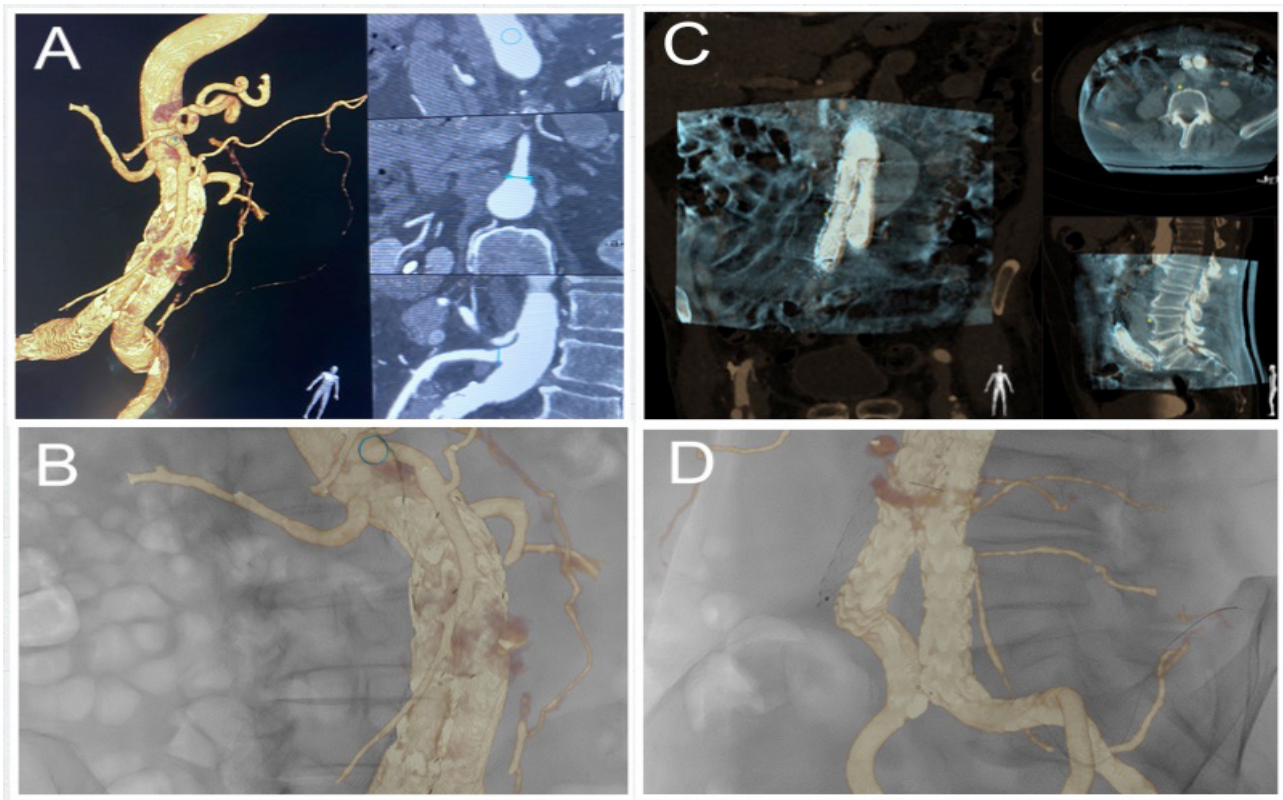


Fig. 2: CT- angiography (CTA) with “vessel navigation” engine equipped with a co-registration and navigation software “Fusion” (A); coupling of live images acquired during the procedure with the pre-operative CTA scan images (C); examples of Fusion-guided cannulation of target vessels (B, D).

All these patients had at least one patent aortic side branch (inferior mesenteric artery and/or lumbar arteries) at the pre-operative CTA. 10 patients were on antiplatelet therapy, 2 patients were on oral anticoagulation.

Embolizations were performed by the same physician in all cases. Through a 6-months follow-up CTA we found a decrease of the mean sac diameter (0.4 mm, range: 0.2-0.7 mm).

For all the patients we used controlled release coils by a transarterial approach, using two different angiographic equipment's.

We divided the patients in two groups with no significant differences in baseline characteristics: 7 patients treated using a new high-end angiograph (International Tools Workstation, Philips), equipped with the “Fusion” software (Group A); 5 patients treated without it (Group B). The amount of contrast medium and the Dose Area Product (DAP) were recorded and compared between the two groups.

RESULTS

We found no death in either Group A or Group B patients. No surgical approach to endoleaks treatment, nor for surgical conversion, was needed.

Only one patient of Group A could not complete embolization of the target vessel afferent to endoleak nidus, while the size of the aneurysm sac remained stable. In all the other patients the procedure was performed completely.

The amount of contrast medium injected was similar be-

tween the two groups with a median of 160 ml (range: 100-200 ml) for group A versus a median value of 180 ml (range: 100-350) for group B.

A dramatic reduction of the DAP was observed for group A compared with group B. The DAP median values were 4.9 Gy x cm² (range: 3.2-21.1 Gy x cm²) for group A and 9.76 Gy x cm² (range: 6.3-11.75 Gy x cm²) for group B. Shorter times of procedures for Group A patients were recorded, with a median value of 72 minutes compared to 53 minutes for Group B.

DISCUSSION

Nowadays, Type II endoleaks (EL) management is still a topic of debate among the vascular surgeons and interventionalists.

Current guidelines recommend conservative treatment for Type II EL; however, if there is a significant increasing of the aneurysm sac (more than 10 mm), a secondary intervention is recommended.

Several authors have described their experience about this topic.

Some studies suggest the safety of a conservative approach, even in case of increasing aneurysm diameter. In this comparative study of 2018 pts, Mulay et al. highlighted no differences in overall survival between patients with and without Type II EL, and no difference in survival between patients who underwent a secondary intervention and those who not⁷.

Other studies propose an intervention when the aneurysmal sac enlarges or if the endoleaks does not resolve within 6

months of operation⁸.

Moulakakis et al. reported that endovascular approach should be the preferred treatment option, while open repair should be reserved for good risk patients with multiple feeding arteries, considering his better results in sac exclusion but more serious complications⁹.

In this review¹⁰, Hajibandeh et al. evaluated that conservative management of persistent Type II EL in the absence of sac expansion might be the appropriate approach. On the other hand, where intervention is indicated, occult type I and III endoleaks should be excluded by imaging.

Long-term surveillance is necessary after successful treatment of Type II EL as recurrence is common.

As mentioned above, several treatments are available for Type II endoleaks after EVAR.

The most common and effective techniques are the transarterial or translumbar embolizations.

Recently, many new radiological techniques have been developed to facilitate the interventional approach to Type II EL.

One of the major advances in imaging guidance for vascular procedures during the last decade has been the commercialization of cone-beam computed tomography (CBCT), a technology that provides three-dimensional rendering of opacified vascular structures.

There is emerging application of CBCT fusion with magnetic resonance angiography (MRA) or computed tomographic angiography (CTA) that has been shown to improve the technical success of many arterial and venous procedures, such as Type II EL embolization¹¹.

Many authors have described the feasibility and utility of the Fusion - a "vessel navigation" engine equipped with a co-registration and navigation software that allow the coupling of actual CTA images acquired during the procedure with the pre-operative ones - in vascular procedures¹².

With our study we want to confirm literature data about the Fusion software potential to improve technical success rates of transarterial embolization of Type II EL. Additionally, we want to demonstrate his feasibility in decreasing of radiation dose for both the patient and the healthcare operator.

CONCLUSIONS

The use of the "Fusion" software as "vessel navigator" during the embolization procedure of the Type II endoleaks allows to highlight the path of the target vessel that feeds the endoleaks nidus.

This software guarantees not only a greater efficacy in the endovascular treatment but also a dramatic reduction of the amount of radiation needed for the treatment, with great benefits from a radiation protection point of view for both the patient and the healthcare operator.

INFORMED CONSENT

Informed consent was obtained from the patient for publication of this Case report and any accompanying images.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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