Complex retrograde transarterial access and embolization of a giant internal iliac artery aneurysm after occlusion failure of Micro vascular plug (MVP) embolization and preceding EVAR in the distal ectatic Aorta and bilateral iliac artery aneurysms in a 90 years old patient

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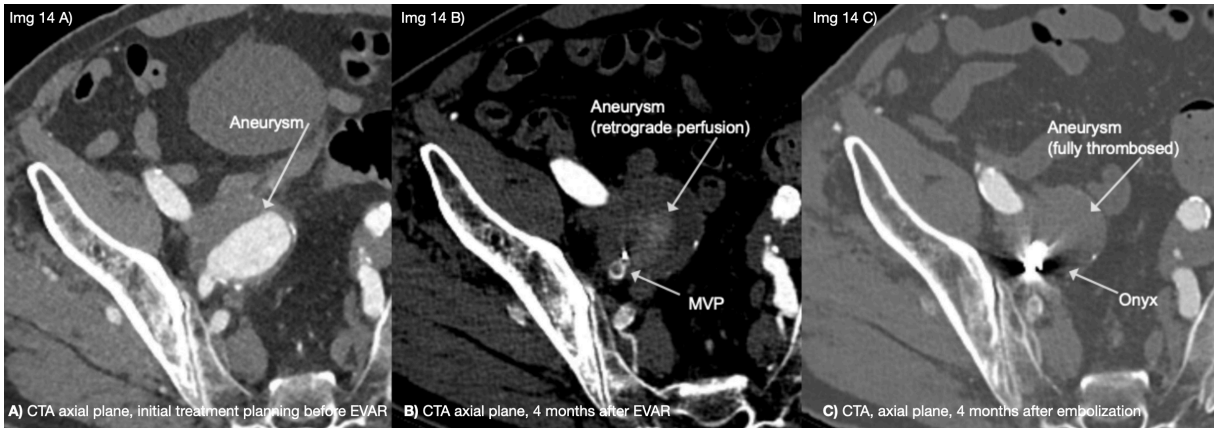
Abstract

The therapy of pelvic aneurysms is minimally invasive through interventional radiology using various devices and embolic agents:

1. By using a covered stent/prosthesis to maintain antegrade flow when a landing zone, i.e., a vascular segment angiographically present into which the stent can be placed to bridge the neck of the aneurysm, thereby interrupting aneurysm perfusion.

2. Through complete embolization of the aneurysm using embolic agents/coils.

3. As performed in our case, by covering the aneurysm (Img 14 A-C) with a covered stent / prosthesis, following prior embolization of the branching vessels using macroembolic agents.



In cases where there is insufficient occlusion of the aneurysm with residual perfusion, secondary embolization becomes considerably more complex due to the occlusion of the anatomically antegrade access and the altered hemodynamics around the aneurysm causing retrograde collateralization.

Through detailed analysis of CT angiography, even in static CT, retrograde circulation could be identified, allowing for a minimally invasive secondary approach to the aneurysm without the need for general anesthesia and/or surgery. By completely eliminating the aneurysm, the risk of rupture in the elderly patient was minimally invasively eliminated. The treatment of this patient exemplifies the possibilities that embolization with a wide array of embolic agents and catheters offers in a hemodynamically very complex situation.

Keywords: *Aneurysm, right internal iliac artery, complex embolization of 4 feeding vessels with Microcoils, Onyx after preceding unsuccessful Micro-vascular plug (MVP) implantations, EVAR in distal abdominal aorta and both iliac arteries*

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Introduction

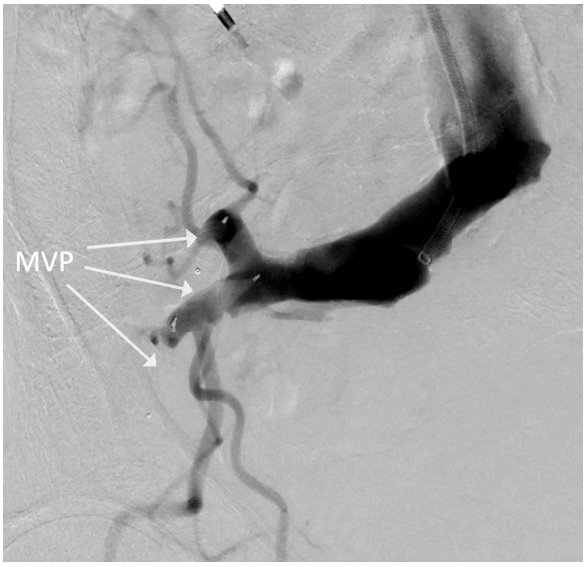
Internal iliac artery aneurysms occur in the aorto-iliac vascular system with an incidence of up to 0.04% of all aneurysms in patients with a mean age of 71.9 years (range 47-89 years), as reported in the review article by Dix et al. encompassing 372 publications (12). The mean size is 7.7 cm (range 2-13 cm). The risk of rupture in an untreated isolated internal iliac artery aneurysm (Img 1) is described with an incidence of up to 40% and up to a 31% mortality rate if not promptly treated (2,12). This includes internal iliac artery (8) aneurysms ranging from 2-13 cm in size. It can be

Img. 1: CT angiography (CTA) MIP, showing 52 mm right int. iliac artery aneurysm

assumed that with increasing size, the risk of rupture increases up to the maximum incidence reported by the authors (12). An exact determination of the size at which the specified high rupture risk of up to 40% occurs was not provided, especially given that it involved compiling published data from various authors.

The primary causes of aneurysm formation are primarily arteriosclerotic vascular changes and hypertension (1). Other causes include iatrogenic factors such as postoperative (4,9,10), post-traumatic, or mycotic / inflammatory (14) etiologies. The latter is primarily treatable by vascular surgery, as the implantation of stents and coils into inflamed tissue is contraindicated (1,11,14). Vascular surgical resection with reconstruction of the vascular pathway can be quite complex on a case-by-case basis.

A highly efficient alternative is the primary minimally invasive trans-catheter therapy, which is reported to have a high technical and clinical



Img 2: angiography during crossover distal AII branch embolization using 3x MVP

success rate, averaging up to 98% (5). Technically, this includes minimally invasive interventional radiological vascular reconstruction (Img 2) using covered stents (5), embolization of the aneurysm using detachable embolic agents such as coils or plugs, rarely liquid embolic agents, or a combination of these techniques (5). Ideally, vascular reconstruction (Img 3) should be preferred over embolization whenever possible to maintain antegrade flow, but only if angiographically a "landing zone" is demonstrable, enabling secure placement within the internal iliac artery vessel with complete sealing of the aneurysm (Img 14).

Alternatively, the aneurysm and its vessel branches can be closed off using (detachable) embolic agents such as coils or plugs (Img 2). If there is a risk of coil protrusion into the original vessel lumen, such as with a broad-based aneurysm and a lack of neck, the combination with (covered) stents is preferable (3,7).

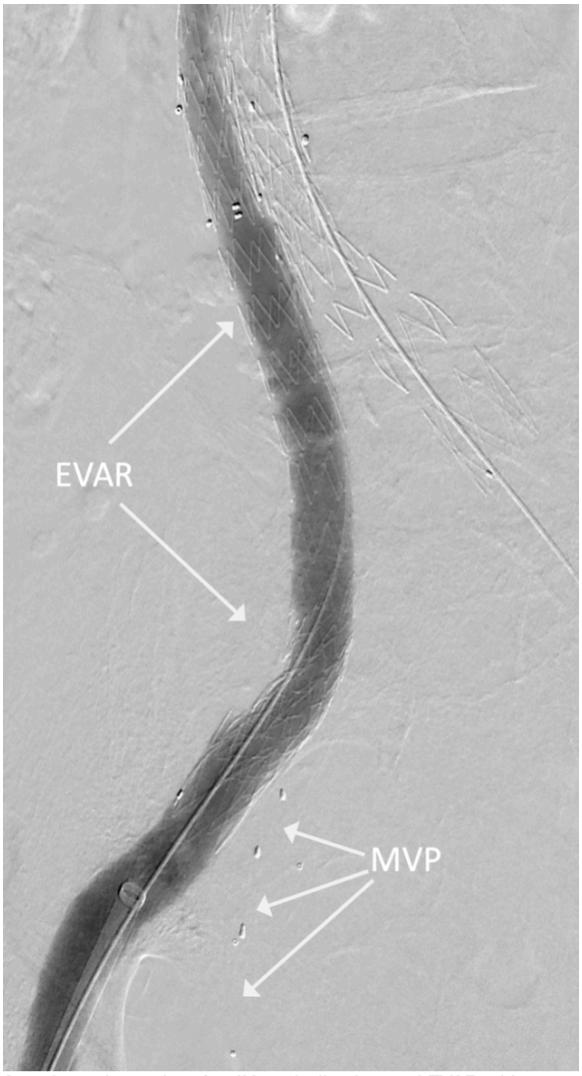
Another treatment option is the so-called back door and front door (Img 10-15) embolization to interrupt the perfusion of the aneurysm from the original vessel or so-called "feeding vessels" (Img 1) without embolization of the aneurysm itself, for example, due to the size of the aneurysm (7). However, if further perfusion occurs afterward, via "secondary opening" fee-

ding vessels due to altered hemodynamics, the situation becomes hemodynamically more complicated. This situation arose in our case of a 90-year-old patient with a prior EVAR placement in the distal abdominal aorta extending into the left common iliac artery and into the right external iliac artery, (Img 4-9) due to a coincidental aneurysm (Vid 3) of the right internal iliac artery involving the branch of the internal iliac artery, which was embolized in the same session (Fig 1).

Case report:
A 90-year-old patient presenting with age-appropriate reduced general condition and nutritional status, along with numerous comorbidities including:

- Arterial hypertension
- Dyslipidemia
-History of three-level lower limb venous thrombosis
- Opioid dependence
- Herpes zoster neuralgia at the level of TH4 on the right side
- History of left hemicolectomy
- Appendectomy
- Cholecystectomy
- Mild mitral valve prolapse
- Prostatic hyperplasia
- History of right peripheral facial nerve palsy since 1959
- Evidence of dilative arteriopathy with multiple previous endovascular interventions.
- Status post-EVAR implantation with coverage of the right internal iliac artery branch following peripheral embolization of the right internal branches.

Diagnostic workup:
The CT angiography revealed a dilative arteriopathy of the vessels, enlargement of the distal abdominal aorta, enlargement of the bilateral common iliac arteries, as well as a partially thrombosed/retrogradely perfused right internal iliac artery aneurysm measuring 5.2 cm in diameter. The 5.2 cm large right internal iliac artery aneurysm with moderate partial thrombosis posed a significantly increased rupture risk for the elderly patient: the risk of rupture already exists at 4.5 cm with 6.3% per year (1). A vascular surgical therapy for the treatment of the internal iliac artery aneurysm was no longer possible due to the patient's existing inability to undergo anesthesia. Therefore, selective embolization of the branches arising from the right internal iliac artery aneurysm was initially performed, with crossover from the left using 3 "microvascular Plugs" (MVP) (Img 4).
Following this, there was a significantly reduced but still minimally preserved residual perfusion. As this was deemed irrelevant, the EVAR implantation was then performed, covering the origin of the right internal iliac artery with the



Img 3: angiography after IIA embolization and EVAR without perfusion of aneurysm

prosthesis. This was intended to completely exclude the aneurysm itself without the need to fill the large, approximately 5.2 cm measuring vessel lumen of the aneurysm completely with coils or other embolic agents (Img 3).

Unfortunately, the initial follow-up CT scan revealed retrograde partial perfusion of the internal iliac artery aneurysm, prompting further evaluation of additional measures.

Surgical repair remained unfeasible. Direct puncture of the aneurysm via a relatively long, oblique, transmuscular approach (Img 8) and subsequent embolization appeared challenging and, from our assessment, too risky without general anesthesia / complete immobilization of

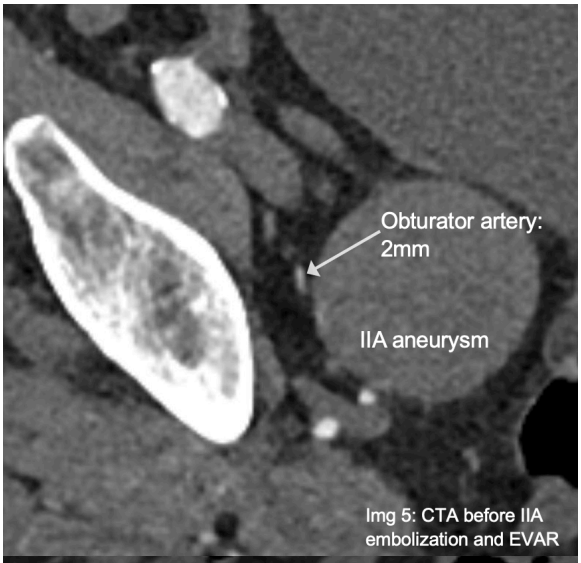
Img 4: CTA MIP, showing persistent perfusion of the aneurysm despite distal MVPs

the patient. In the follow-up CT scan after the EVAR implantation, a significant hypertrophy of the right obturator artery compared to before the implantation was clearly evident (Img 5, 6).

Upon closer analysis, a connection to the common femoral artery via the deep external pudendal artery was detected. Due to the distal origin of the vessel, an antegrade approach proximal to the deep external pudendal artery seemed feasible. Subsequently, in interdisciplinary discourse, the patient was proposed for transarterial embolization under local anesthesia, to which he consented.

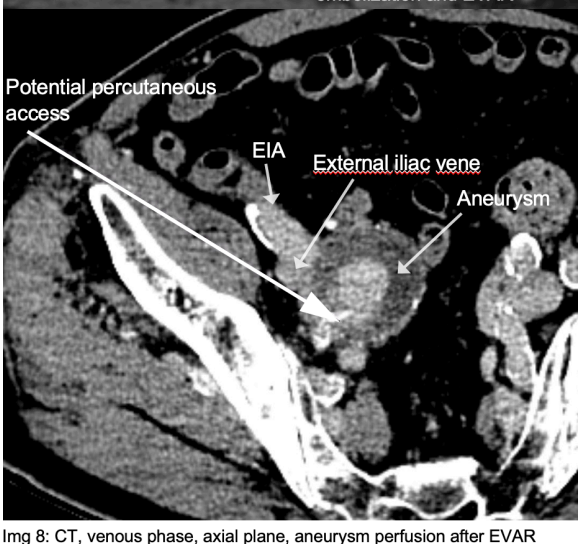
Angiography Report

Following successful antegrade puncture of the right common femoral artery under local anesthesia and angiography using the 21G puncture needle, the deep external pudendal artery was visualized. Subsequently, it was probed using a micro-wire (0.0018in) through the needle. A 3 French micro-puncture set was then inserted antegradely through the common femoral artery



Img 5: CTA before IIA embolization and EVAR

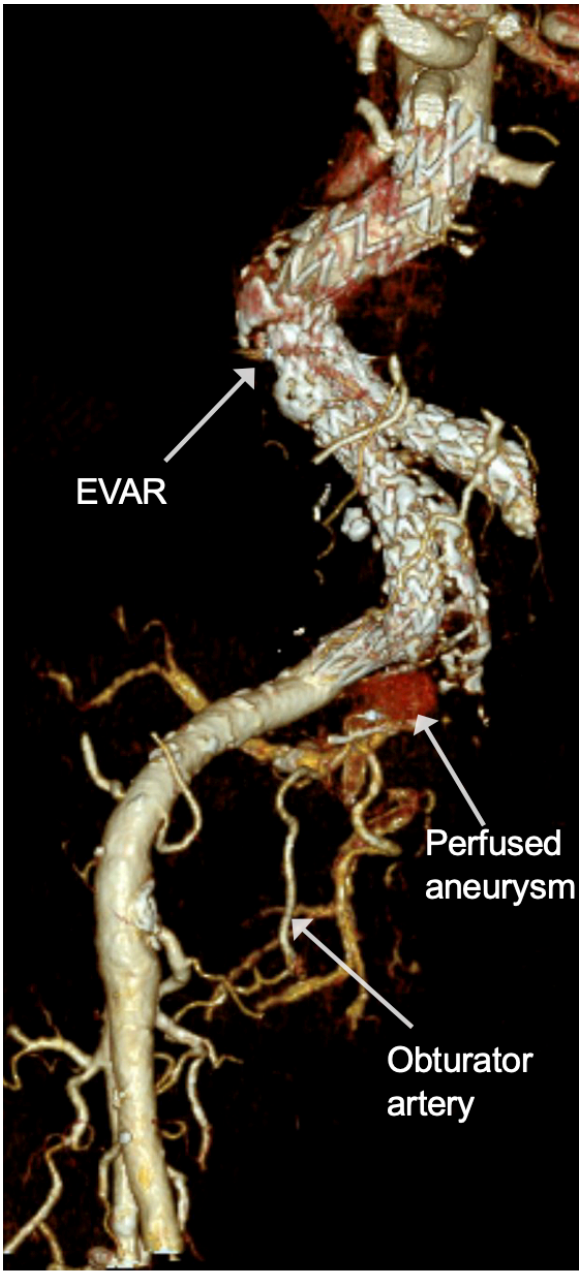
Img 6: CTA 4 months after IIA embolization and EVAR



Img 8: CT, venous phase, axial plane, aneurysm perfusion after EVAR

directly into the vessel's origin. Angiographically, the clearly hypertrophied connection to the aneurysm with detectable residual perfusion was evident.

Now, through an attached Y-connector, the smooth superselective (Img 12) probing of the

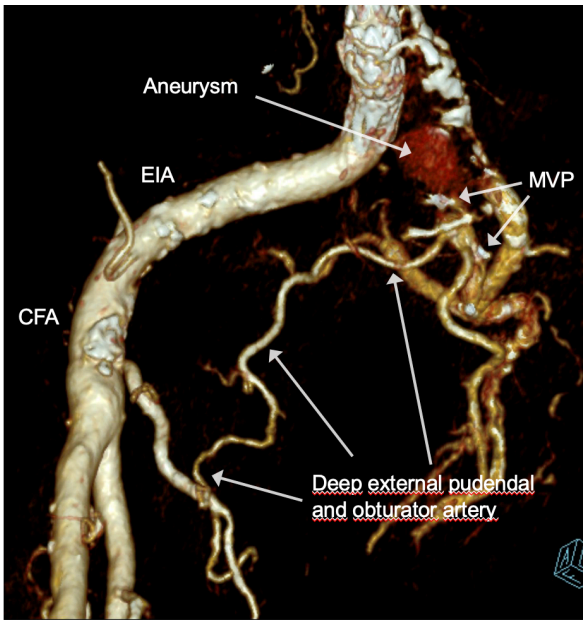


Img 7: CTA; cinematic rendering; after EVAR

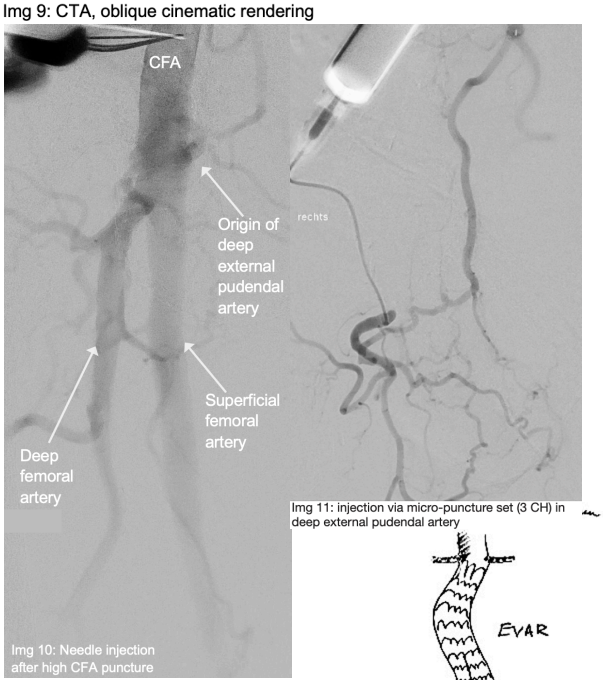
internal obturator artery via the deep external pudendal artery was performed using a 2.4 French microcatheter (ProGreat, Terumo), advancing it up to the inserted MVPs and into the aneurysm.

It appeared that the 3 MVPs were positioned in the delineation of the internal iliac artery (Img 9), causing the obturator artery and the pudendal artery (Img 12, 12A) to directly join between the plugs and therefore not occluded.

Following the initial coiling of two additional branches of the aneurysm to reduce flow, the seamless embolization of the aneurysmal lumen was performed using Onyx 34L (Medtronic) extending into the supplying vessels. Apart from mild pelvic discomfort attributed to the embolic agent/DMSO, (Img 19) no complications arose. Upon completion, (Img 17) total embolization of the aneurysm was achieved while maintaining perfusion to the peripheral internal iliac territory on the right. After removal of the micro-puncture set, hemostasis of the right common femoral artery was achieved smoothly through manual compression and application of a pressure bandage for 4 hours. The patient was discharged home on the same day following 6 hours of monitoring.



Img 9: CTA, oblique cinematic rendering



Img 10: Needle injection after high CFA puncture

Img 11: injection via micro-puncture set (3 CH) in deep external pudendal artery

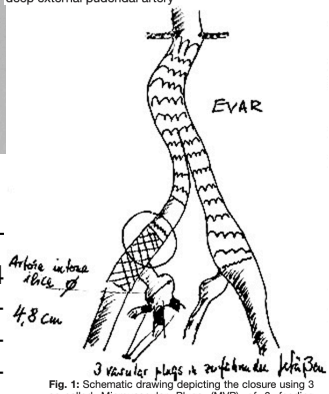
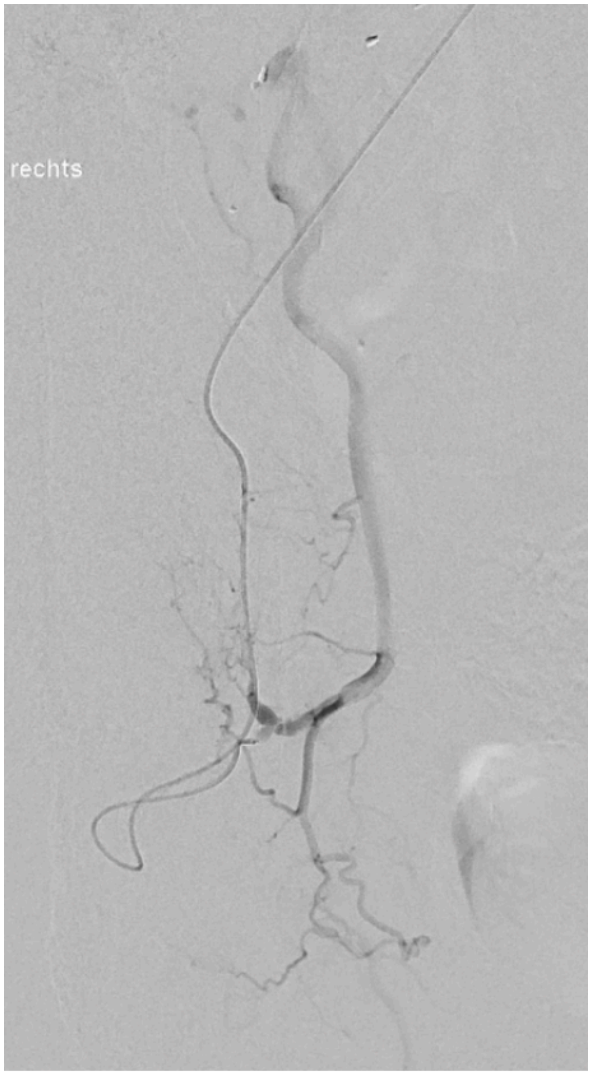
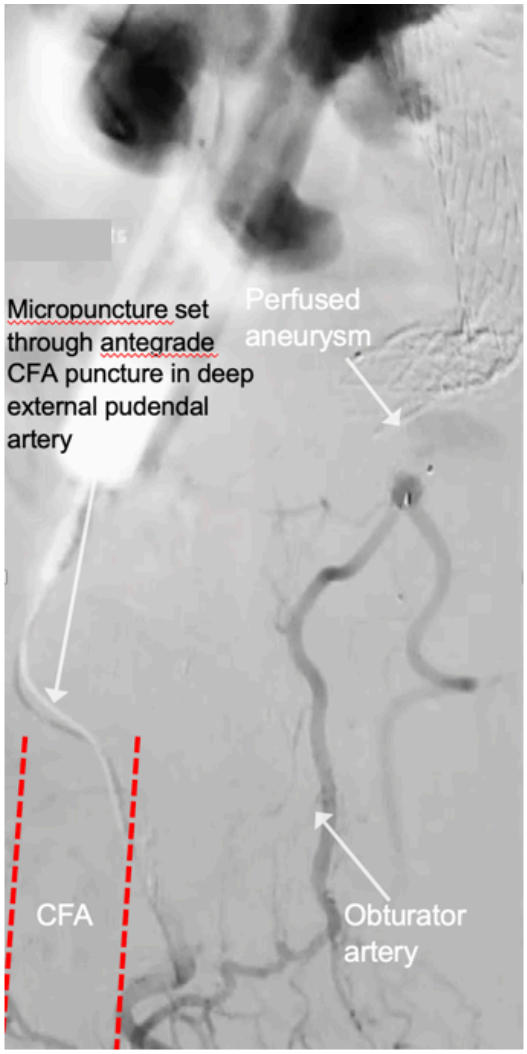


Fig. 1: Schematic drawing depicting the closure using 3 so-called Microvascular Plugs (MVP) of 3 feeding vessels supplying the aneurysm of the right internal iliac artery

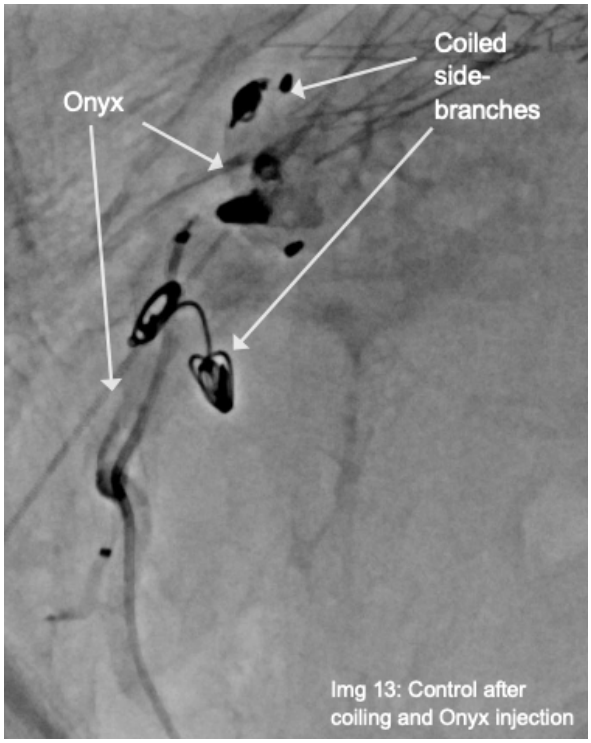
In the subsequent CT follow-up after 4 months, complete occlusion of the aneurysm (14 C) was confirmed, with no com-

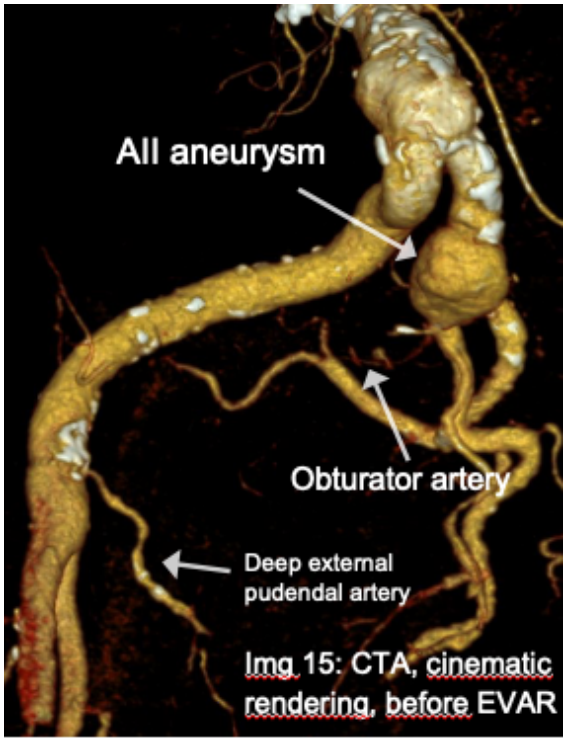


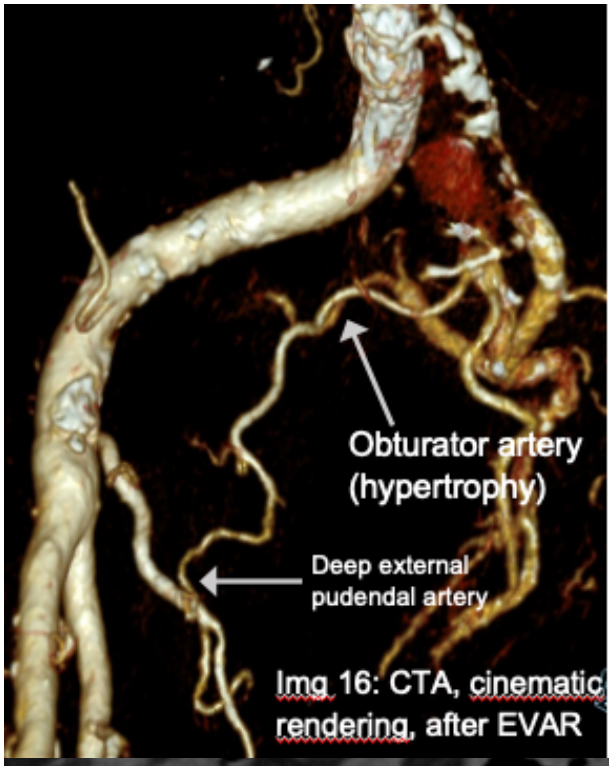
Img 12: Control angiography after selective probing, using 2.4 CH Microcatheter



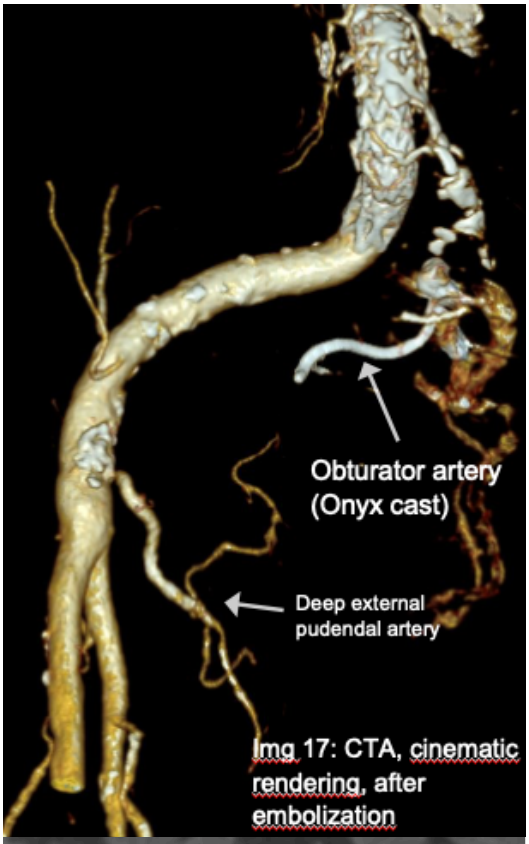
Img 12 A: Injection after probing of deep external pudendal artery



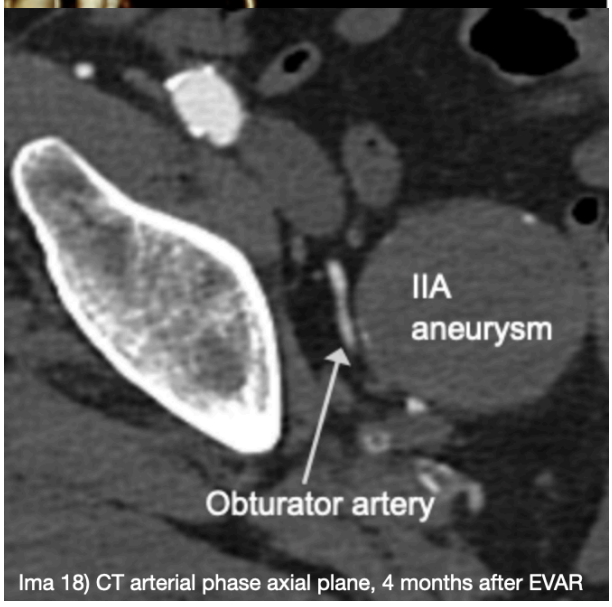




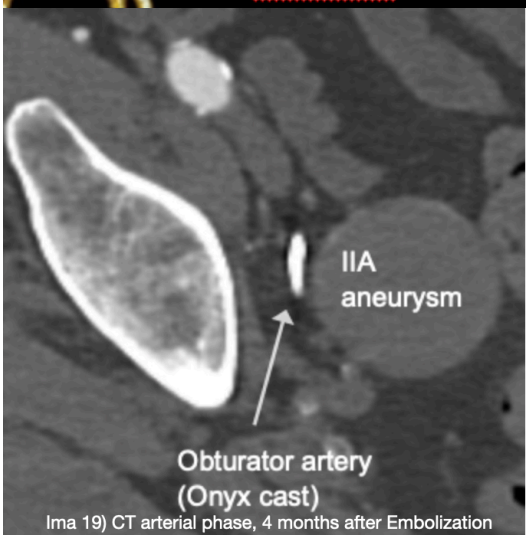
Img 16: CTA, cinematic rendering, after EVAR



Img 17: CTA, cinematic rendering, after embolization



Ima 18) CT arterial phase axial plane, 4 months after EVAR



Ima 19) CT arterial phase, 4 months after Embolization

plications observed during the clinical course.

Discussion:

The frequency of internal iliac artery aneurysms (IIAA) is reported to be 0.04% of all detected aneurysms (13). The postoperative mortality for singular internal iliac artery aneurysms is currently reported as 8.3% in a meta-analysis by Perini in 2021 (5), and 2.8% for minimally invasive embolization therapy (5). With the advent of minimally invasive (embolization) materials and the introduction of aneurysm therapy through EVAR, interventional radiology is capable of performing successful complete aneurysm exclusion using covered stents/ prostheses, macro- and micro-coils, Amplatzer vascular plugs, microvascular plugs (MVPs), and, if necessary, less frequently in combination with liquid embolic agents, such as in our patient with Onyx, while always aiming to maintain antegrade blood flow whenever possible.

In our case, the placement of a covered stent/ EVAR and MVPs was chosen as a common approach in the absence of a landing zone prior to EVAR implantation for the exclusion of the internal iliac artery aneurysm (7).

As a possible complication of embolization treatment, embolization-induced ischemia of adjacent vascular territories, especially the

vessels supplying the gluteal muscles, known as buttock claudication, has been described by Jihee Kang et al. in a total of 139 treated patients in 2 groups with unilateral and bilateral embolization. In this study, buttock claudication did not occur in 83 patients (60%) and occurred in a mild form in 51 patients (36.7%) (6). The potential occurrence of embolization-related gluteal necrosis, spinal cord ischemia, or ischemic colitis was not reported (6).

In our case, embolization was primarily found to be only partially effective. MDCT follow-up imaging revealed significant retrograde residual perfusion of the aneurysm. Due to altered local hemodynamics, there continued to be perfusion via a hypertrophied internal (Img 16) obturator artery and deep external pudendal artery. However, thanks to detailed analysis of the CTA, the retrogradely perfused collateral circulation was identified, and eventually, the aneurysm was completely embolized even in this complex situation using a micro-puncture set and microcatheter with coils and Onyx (Img 18).

Despite the elderly patient's comorbidities, a favorable outcome ensued as the embolization could be performed in an outpatient setting under local anesthesia. This was particularly advantageous as no major puncture was required, only the introduction of a 3 French micro-puncture set antegradely into the common femoral artery (Vid 1). The use of Onyx as an embolic agent has been reported by R. Wille et al. in 2009 (11). The prolonged polymerization time compared to other liquid embolic agents is a desirable advantage, allowing for controlled, complete embolization to be achieved and avoiding misembolization.

Conclusion

The therapy of pelvic aneurysms is feasible through interventional radiology using various devices and embolic agents in a minimally invasive manner:

1. By utilizing a covered stent / prosthesis to maintain antegrade flow if a so-called landing zone, i.e., an angiographically identifiable vascular segment where the stent can be placed to bridge the neck of the aneurysm and thus abolish aneurysmal perfusion, is present.

2. Through complete embolization of the aneurysm using embolic agents / coils.

3. As performed in our case, by covering the aneurysm with a covered stent / prosthesis following prior embolization of the outgoing vessels using macroembolic agents (Vid 2).

In cases where the occlusion of the aneurysm with residual perfusion, as observed in our case, is insufficient, secondary embolization becomes considerably more complex. This is due to the occlusion of the anatomically antegrade access and the altered hemodynamics around the aneurysm causing retrograde collateralization.

Through detailed analysis of the CT angiography, even the retrograde circulation could be identified in static CT scans, facilitating the establishment of a minimally invasive secondary access to the aneurysm without the need for general anesthesia and/or surgery.

By achieving complete exclusion of the aneurysm, the risk of rupture in the elderly patient could be minimally invasively eliminated.

The treatment of this patient exemplifies the possibilities offered by embolization using the vast arsenal of embolic agents and catheters in a hemodynamically complex situation.

Conflict of interest:

The authors declare that there were no conflicts of interest within the meaning of the recommendations of the International Committee of Medical Journal Editors when the article was written.

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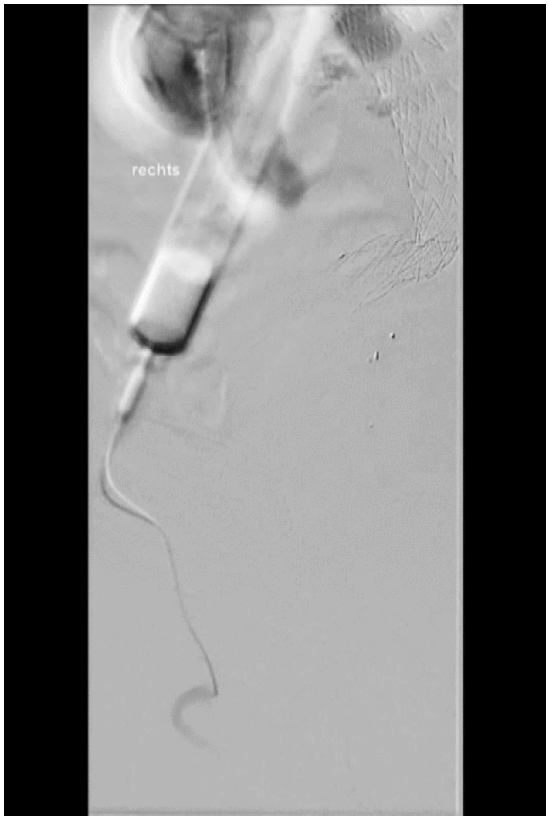
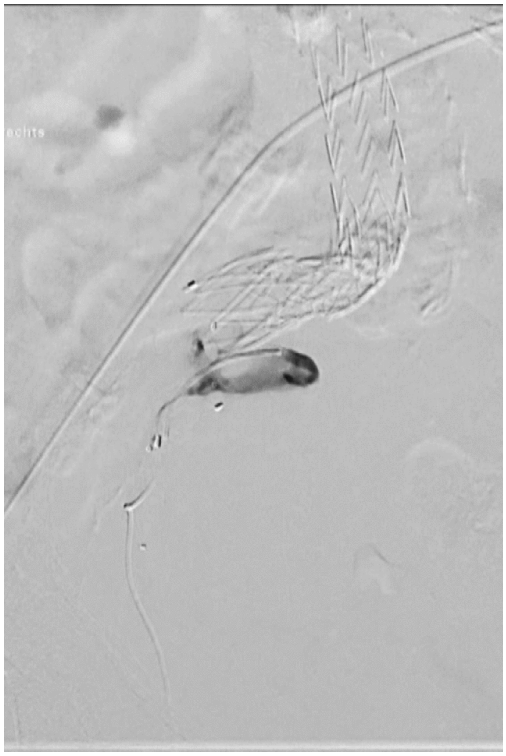
Video area:



Vid 1: Injection after probing of deep external pudendal artery

Vid 2: Final angiography after coiling / Onyx 34 L; occlusion of aneurysm and obturator artery, reversed flow in peripheral internal iliac artery branches



Vid 3: Selective Aneurysm angiography

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