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Successful Endovascular Treatment of a Giant Infrarenal Abdominal Aneurysm

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Abbreviations:

AAA: Abdominal aortic aneurysm; CFA: Common Femoral Artery; CT: Computed tomography; ESVS: European Society for Vascular Surgery; EVAR: Endovascular Aneurysm Repair; Fr: French catheter scale (size); GAAA: Giant abdominal aortic aneurysm; OAR: Open Aneurysm Repair; RCT: Randomised controlled trial; US: Ultrasound

1. Abstract

1.1. Introduction: There is no exact consensus on the definition of giant abdominal aortic aneurysm according to its diameter, but the prevalence of giant aneurysms is extremely rare, which can be attributed to the well-functioning screening system, the elective repair threshold and the high risk of rupture.

1.2. Case Report: A 65-year-old male patient was sent from radiology because a routine abdominal ultrasound scan detected an abdominal aortic aneurysm of 13 cm. Computed tomography angiography was performed and it revealed a giant abdominal aneurysm of 18 cm transverse diameter without any signs of rupture. The patient was immediately admitted to the department of vascular surgery, and we started to prepare for surgery. The patient was successfully treated with endovascular aneurysm repair and discharged on postoperative day 5. Computed tomography angiography performed one month later showed a well-positioned stent graft without any endoleak.

1.3. Conclusions: To our knowledge, this has been the biggest diameter reported in the literature where a giant abdominal aortic aneurysm was treated successfully with endovascular aneurysm repair, the patient was discharged and one month later a computed tomography angiography showed a well-positioned stent graft without endoleak. Although open surgery is the most preferable treatment for giant abdominal aortic aneurysm, in selective cases endovascular aneurysm repair can also be considered.

2. Introduction

Abdominal Aortic Aneurysms (AAA) are defined according to the diameter of the aorta. If the diameter is 3.0 cm or higher, it is considered to be an aneurysm, but the threshold for elective abdominal aneurysm repair is higher [1-3]. Randomised Trials (RCT) have been performed to determine the threshold diameter above which patients benefit from surgical treatment, as surgical intervention increases both morbidity and mortality. On the basis of these RCTs, the consensus is that aneurysms of less than 5.5 cm in diameter should be treated conservatively [4]. These studies were performed mostly among male patients, so the stronger recommendation of the European Society of Vascular Surgery (ESVS) applies to males with AAA, where elective abdominal aortic aneurysm repair is recommended if the diameter of the aortic aneurysm is 5.5 cm or higher [5]. Smaller, non-ruptured but symptomatic aneurysms (abdominal tenderness, abdominal or back pain, peripheral embolism from the AAA) and rapidly growing AAA (>1 cm/year) may also require surgical intervention with semi-elective indications [6, 7].

The risk of rupture is higher in women. Trials have proven that the risk of rupture in women with an AAA of 4.5 cm is similar to that of men with an AAA of 5.5 cm, but the operative mortality is higher in women [8, 9]. In view of these facts, the threshold diameter for considering elective AAA repair in women is 5.0 cm of diameter or higher, but this recommendation was not based on such strong evidence as for men.

The size of the aneurysm is one of the most important predictors of the risk of rupture. The risk increases significantly if the diameter of the aneurysm is higher than 5.5 cm. The Joint Council of the American Association for Vascular Surgery and the Society for Vascular Surgery presented the estimated annual rupture risk of AAA according to the diameter [10] (Table 1).

The prevalence of AAA ranges from 3.9 to 7.2 percent in screening studies including older people, but the prevalence of AAA above 5.5 cm of diameter is only around 0.5 percent among screened people [11-13]. The detection of an AAA with a diameter of more than 8 cm is extremely rare. This can be attributed to the well-functioning screening system and the elective repair threshold. Otherwise, if an AAA of such diameter remains undiscovered, there is an extremely high risk of rupture. This can lead to the conclusion that these calibers are extremely rarely detected; the reporting prevalence of AAAs with a diameter of 8 cm or higher is around 0.03% [14].

There is no exact definition of Giant Abdominal Aortic Aneurysms (GAAAs). Some authors define GAAAs as aortic diameter of more than 10 cm while others set a higher threshold, but irrespective of the size of the GAAA, surgical repair has to be performed as soon as possible in order to prevent rupture [15-17].

In our case report, we will present a patient who was sent to our department for the surgical repair of an AAA of 18 cm in diameter. We recorded the patient's demographic data, medical history, aneurysm features and sizing based on the preoperative imaging. Intraoperative imaging of the steps of the repair was also performed. CT angiography imaging was also recorded at the one-month follow-up.

We performed a search for similar cases reported in the literature with the following criteria: giant infrarenal aneurysm and <= 15 cm of diameter. The search was conducted in PubMed.

Table 1: The estimated annual rupture risk of abdominal aortic aneurysms in relation to diameter10

AAA diameter	Annual rupture risk
< 4.0 cm	0%
4.0 - 4.9 cm	0.5% to 5%
5.0 - 5.9 cm	3% to 15%
6.0 - 6.9 cm	10% to 20%
7.0 - 7.9 cm	20% to 40%
≥8.0 cm	30% to 50%

AAA: Abdominal Aortic Aneurysm

3. Case Report

3.1. Preoperative Management

A 65-year-old man was sent to a routine abdominal ultrasound by his general practitioner. The patient did not have any abdominal complaints; he needed the abdominal Ultrasound (US) for the renewal of his driving licence. The US detected an infrarenal abdominal aneurysm of 15 cm in diameter without any signs of rupture, thus it was an incidentally discovered aneurysm (Figure 1) [18-20].

The radiologist referred the patient to our department and immediately had him transported to the surgical outpatient clinic. The patient arrived in stable condition with the following vital signs: blood pressure 142/81 mm Hg; heart rate 78 bpm; respiratory rate 17 breaths per minute; and oxygen saturation on room air 98%. A brief physical examination was performed and it revealed a huge pulsating abdominal mass without any tenderness or abdominal pain. Blood gas analysis showed normal values suggesting an unruptured AAA. The patient's medical history only contained hypertension. The patient was referred to the intensive care unit for emergency admission but the intensive care unit did not consider the patient high dependency. The patient was transported to radiology for a Computed Tomography (CT) angiography, which showed a huge fusiform aneurysm of the infrarenal abdominal aorta measuring 18 cm in the transverse diameter extending to the aortic bifurcation without signs of rupture (Figure 2).

The patient was admitted to the department of vascular surgery and we started to prepare for a possible emergency operation (Open Aneurysm Repair - OAR) in case of impending rupture. The aneurysm was also suitable to perform an Endovascular Aneurysm Repair (EVAR) so we used the CT images to perform stent graft sizing and prepare for the intervention. A Medtronic Endurant II stent graft was made and transported to our department in the afternoon of the next day. The patient was in stable condition without any abdominal complaints so a scheduled operation was performed the next day.

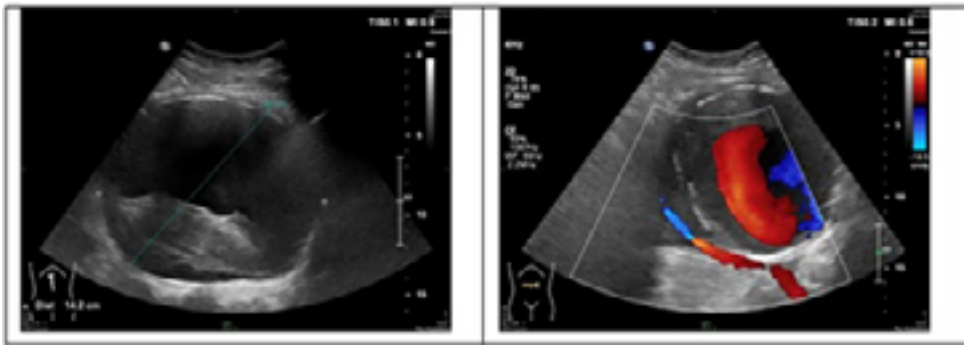

Figure 1: Preoperative ultrasound of the giant infrarenal aortic aneurysm.

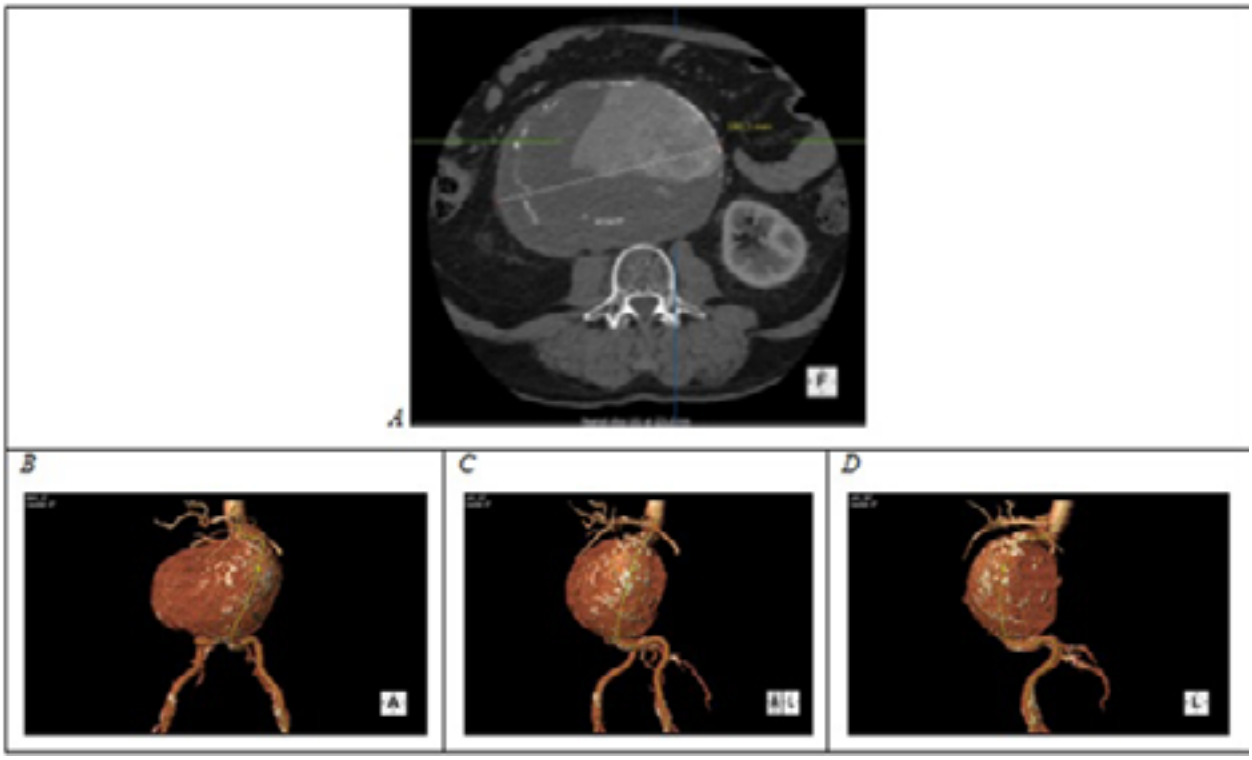

Figure 2: Preoperative computed tomography angiograms of the giant infrarenal aortic aneurysm
A) on the axial section B-D) three-dimensional reconstruction from different views.

3.2. Intervention

The intervention was performed in general anaesthesia. Through two small oblique femoral incisions we prepared the Common Femoral Arteries (CFAs). Two ml of intravenous heparin was administered. First, we punctured the right CFA and introduced a 0.035" TDOC wire with a 6 French size (Fr) sheath. Then, the TDOC wire was exchanged to an Amplatz "siff-wire" with a pigtail catheter and the 6 Fr sheath was also exchanged to an 18 Fr introducer to ensure the introduction of the main body. We performed similar steps on the contralateral side but a 16 Fr introducer was introduced to advance the contralateral branch. We advanced the main body from the right side and performed angiography from left side to localize the origin of the renal arteries. The main body was positioned directly below the left renal artery [21-30]. We used the crossed limb (Ballerina) technique to make the cannulation of the contralateral branch easier. After the successful canulation of the contralateral branch, another stent graft branches were advanced on both sides. After the implantation of the stent graft system, we performed post-dilation with a 16 mm diameter Reliant balloon on the proximal and distal sealing zones and the overlapping area. Control angiography was performed and no endoleak was shown on the screen (Figure 3). After removing the devices, we closed the punctures with direct sutures using Prolene 5/0 filament.

3.3. Postoperative Management

The postoperative period passed without any severe complications. The follow-up blood tests did not show any significant changes and there was no need for blood transfusion. The patient was discharged 5 days after the surgery. Suture removal was performed on the 10th postoperative day. One month after the operation, abdominal CT angiography was performed. The CT showed the stent graft in good position without any endoleak (Figure 4).

The patient provided written informed consent for the publication of his case. The editors and reviewers of this article have no relevant financial relationship to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest [30-34].

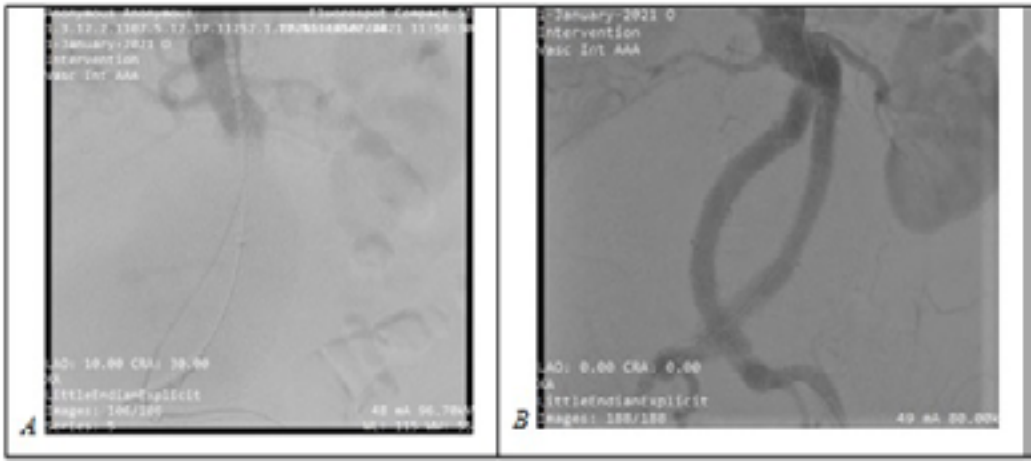

Figure 3: Intraoperative angiograms A) diagnostic angiogram after the advance of the main body B) final angiogram after implantation and post dilation.

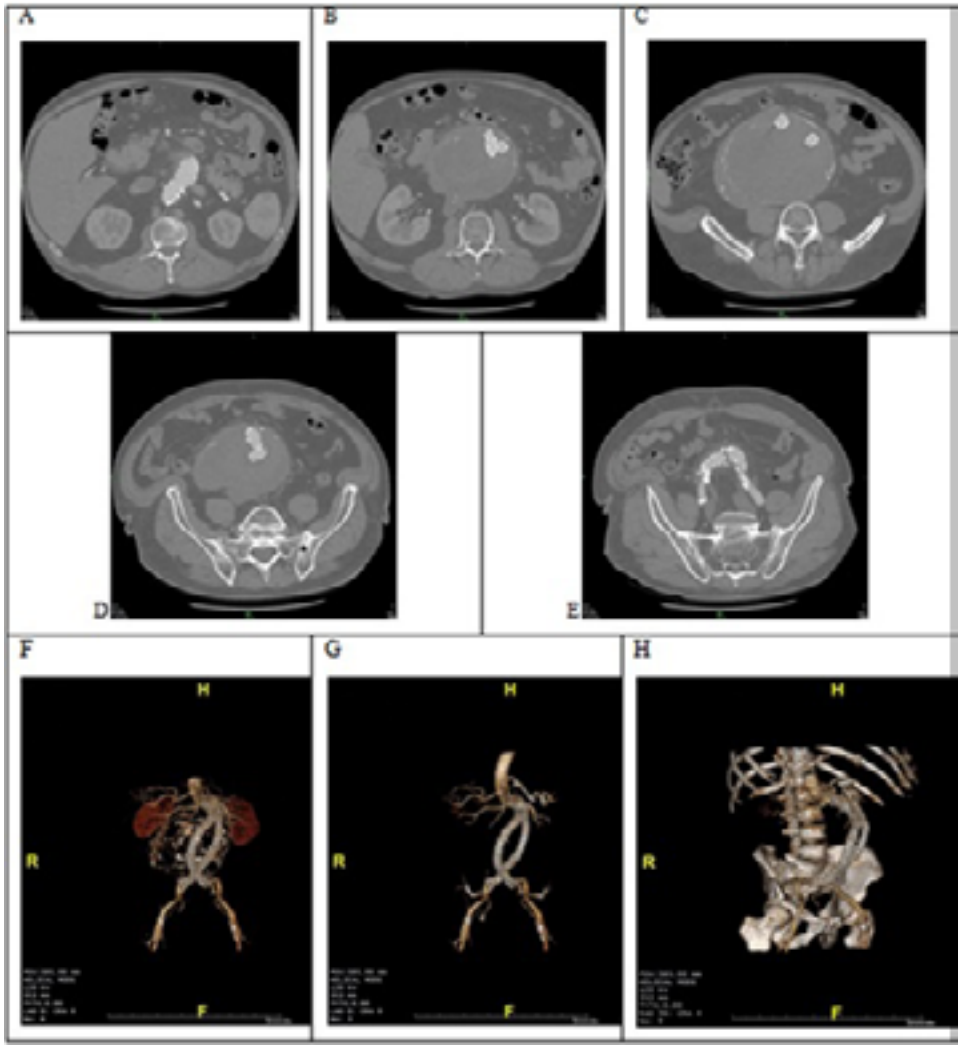

Figure 4: Computed tomography angiograms performed one month after the intervention. A-G) axial sections F-H) three-dimensional reconstructions.

4. Discussion

Giant AAA is a rare condition and only few international papers have been published in this topic. Our literature search found 20 cases in the topic of "giant, infrarenal aneurysm, with 15 cm of diameter or higher". The size of the AAA, acuteness, types of intervention and postoperative outcomes were also recorded (Table 2).

International results show that OAR was performed in most cases. One reason for the choice of OAR may have been the acuteness of the case since 9 patients had a ruptured AAA. EVAR is not available in some departments especially in emergency cases. Sometimes GAAAs are not suitable for EVAR (proximal neck angulation, short neck etc.), or if the aneurysm causes compression symptoms, OAR is needed to eliminate this complication. EVAR was successfully performed in just one reported case of GAAA; however, the patient died in the postoperative period due to respiratory insufficiency.

Table 2: Reported giant abdominal aortic aneurysm cases

Author (year) [ref]	AAA size (cm)	Acuity	Types of intervention	Postoperative outcome	Last follow up
Joshua NG (2021)[18]	18	unruptured	OAR	discharged	10 months later
Aurelian SV (2017)[19]	19.8	ruptured	OAR	death	-
Ferrero E [20]	15	ruptured	OAR	discharged	not reported
Yoshida RA[17]	25	unruptured	EVAR	death	-
Droz NM (2016)[16]	18	unruptured	OAR	discharged	3 months later
Duijzer C (2019)[21]	20.6	ruptured	OAR	discharged	4 years later
Meekel JP (2019)[22]	18	ruptured	OAR	discharged	6 months later
Kocaaslan C (2018)[23]	22.9	unruptured	OAR	death	-
Zhang TH (2018)[24]	20	ruptured	OAR	discharged	not reported
Rodrigues H (2014)[25]	25.6	ruptured	OAR	discharged	not reported
Ebaugh JL[26]	15	unruptured	OAR	discharged	not reported
Penugonda LC[27]	15.4	unruptured	OAR	discharged	not reported
Figueroa CB (2020)[28]	22	ruptured	OAR	discharged	not reported
Bayam L (2007)[29]	15	unruptured	OAR	discharged	6 months later
Ullery BW (2015)[15]	15.4	ruptured	OAR	discharged	not reported
Shen A (2017)[30]	17.3	ruptured	OAR	death	-
Desai SC (2019)[31]	20	unruptured	OAR	discharged	2 years later
Sakakura K (2013)[32]	15	unrutured	not operated	death	-
Woolgar JD (2001)[33]	15	unruptured	OAR	discharged	not reported
Villegas-Cabello (1997)[34]	20	ruptured	OAR	discharged	1 year later

OAR: Open Aneurysm Repair
EVAR: Endovascular Aneurysm Repair

According to the current ESVS guidelines, if the patient has suitable anatomy and reasonable life expectancy, EVAR should be considered; however, with long life expectancy, OAR should be considered as the preferred method of treatment [5]. RCTs demonstrated the advantage of EVAR in early survival but midterm outcomes did not show any difference between EVAR and OAR except for the reintervention rate, which was higher following EVAR [35-40]. These recommendations are supposed to be followed in case of GAAAs. Other symptoms (local compression, gastrointestinal or urinary passage disorder) associated with the GAAA can influence the method of choice.

In our case the patient was 65 years old without any severe diseases. Preoperative CT angiography showed good anatomical suitability for EVAR. The patient had no abdominal symptoms, compression or other bowel passage disorders due to this giant aneurysm so there was no need to perform an emergency operation. In view of these facts, it was reasonable to choose EVAR. The control CT angiography performed one month later showed the stent graft in good position without any endoleak. Considering the good anatomical situation for EVAR and the result of the control CT angiography, it does not seem reasonable to perform routine CT angiography more frequently than it is normally recommended.

5. Conclusion

According to our knowledge, this case has been the biggest GAAA treated successfully with EVAR. The patient recovered and was discharged after the intervention. One month later a CT angiography showed a well-positioned stent graft without endoleak. Although there are no recommendations on the method of treatment in case of giant AAAs, EVAR can be also a preferable method in selective cases.

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