

Stent thrombosis in aortic aneurysm: evaluation by multidetector CT

ROBERTO DE MORAES BASTOS¹, ALVARO RAZUK FILHO², ROBERTO BLASBALG³, ROBERTO AUGUSTO CAFFARO⁴, WALTER KHEGAN KARAKHANIAN⁵, FERNANDO PINHO ESTEVES⁶, ANDRE PACIELLO ROMUALDO⁶, ANTONIO JOSÉ DA ROCHA⁷

¹ Professor/Instructor; Radiologist

² M.D.; Assistant Professor of Faculdade de Ciências Médicas da Santa Casa de Misericórdia de São Paulo, São Paulo, SP, Brazil

³ Physician of Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo – USP, São Paulo, SP, Brazil

⁴ M.D.; Professor of Faculdade de Ciências Médicas da Santa Casa Misericórdia de São Paulo, São Paulo, SP, Brazil

⁵ M.D.; Professor of Faculdade de Ciências Médicas da Santa Casa de São Paulo, São Paulo, SP, Brazil

⁶ M.D.; Irmandade da Santa Casa de Misericórdia de São Paulo, SP, Brazil

⁷ M.D.; Professor of Faculdade de Ciências Médicas da Santa Casa de Misericórdia de São Paulo, São Paulo, SP, Brazil

ABSTRACT

Objective: To evaluate the demographic characteristics and imaging findings of thrombosis in a series of patients submitted to endovascular stent-graft repair of abdominal aortic aneurysm (ESGAAA). **Methods:** We evaluated the imaging features, which allowed the diagnosis of endoluminal thrombosis in a series of 30 patients undergoing ESGAAA and followed from 5 to 29 months, using 64-channel multidetector computed tomography (MDCT). **Results:** Thrombosis was diagnosed in 10 patients (33.3%), and in 3 of those patients, total thrombosis was observed in an iliac branch. **Conclusion:** MDCT allowed the diagnosis of different types of endoluminal thrombosis in patients submitted to ESGAAA. The use of this minimally invasive diagnostic technique should be encouraged in clinical practice.

Keywords: Aortic aneurysm; tomography; thrombosis.

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Corresponding author:

Roberto de Moraes Bastos
Rua Bergamota, 470 - Apt. 81
Bloco C
CEP: 05468 000
São Paulo, SP, Brazil
Phone: (11) 3021-1658 /
99047102
Fax: (11) 2176-7333
robertomb@uol.com.br

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INTRODUCTION

Until the early 90's, open surgery was the only treatment for abdominal aortic aneurysm (AAA), with perioperative mortality rate for patients undergoing elective surgery ranging from 4% to 8.4% in specialized centers^{1,2,3}. The continuous search for surgical techniques with lower mortality and morbidity rates led to the development of endovascular prosthesis and techniques to treat abdominal aortic aneurysm. They have been used in different regions of the world, being approved by the United States Food and Drug Administration (FDA) since 1999^{4,5}.

Endovascular surgery for AAA repair is not devoid of complications, which can develop during or after the procedure. However, the choice of this treatment modality has been justified when compared to conventional surgery¹. Parietal thrombosis may develop as a small circumferential thrombus on graft's wall, or as a luminal occlusion of the stent, demonstrated in digital angiography (DA) or computed tomography (CT), with an estimated incidence of 3-19% of the cases of endovascular stent-graft repair of abdominal aortic aneurysm (ESGAAA)^{6,7,8,9,10,11}.

Using a 64-channel multidetector CT (MDCT), we investigated a series of consecutive patients who underwent ESGAAA in order to assess the demographic characteristics and images of endoluminal thrombosis.

METHODS

PATIENTS

This transversal study was approved by the Research Ethics Committee of the Institution, and all patients signed an informed consent. From February to September 2007, 30 consecutive patients followed-up after ESGAAA (26 males and 4 females), ages 55 to 83 years (mean 70.9 years, median 72 years), were included in this study. All patients agreed to participate in the study. The follow-up period ranged from 5 to 29 months after surgery (mean 14.4 months, median 13.5 months). The proposed followed-up protocol included MDCT at 1, 3, 6, and 12 months in the first year after the surgery, followed by annual MDCT in cases with aneurism regression or stability. In those cases in which expansion on the aneurysm was observed, patients were followed-up with MDCT every three months. All patients were treated with aortoiliac abdominal stent grafts of the following brands: *Talent*[®], *Meditronic Vascular, Sunrise, Fla* (n = 18); *Excluder endoprosthesis*[®], *W.L. Gore & Associates, Sunnyvale, Calif* (n = 1); *Zenith*[®], *Cook Inc, Bloomington, Ind* (n = 8); and *Apolo*[®], *Nano Endoluminal, Florianópolis, Brasil* (n = 3). To analyze the development of endoluminal thrombosis, grafts were grouped according to their material, and they were separated in Polytetrafluorethylene (PTFE) (*Apolo*[®] and *Excluder endoprosthesis*[®]) and Dacron/Polyester (*Talent*[®] and *Zenith*[®]).

Patients who refused to participate, and those who presented contraindications to the injection of iodinated contrast media or exams with ionizing radiation, as well as those with renal failure were excluded from the study.

EXAMS

MDCT 64-channel Brilliance equipment (Phillips, Eindhoven, Holland) was used for the exams. The exam covered the area between the diaphragm and common femoral arteries in three phases: pre-contrast, with collimation of 2.5 mm, 120 Kv, and 322 mAs; and post-contrast, arterial and venous phases, both with acquired collimation of 0.625 mm and reconstructed with 1.0 mm thickness, increment of 1.0 mm, Pitch of 0.703, rotation velocity of 0.75 per second, 120 Kv, and 350 mAs.

A dose of 1.5 mL/kg of contrast medium (mean of 100 ml per patient), with concentration of 300 mg of iodine per ml, was injected through a venous puncture with a 20-Gauge catheter in the antecubital vein, with an infusion pump at a rate of 5 ml per second, followed by 30 ml of normal saline. Post-contrast administration phases were performed using an attenuation detector mechanism placed in the area of the aorta, at the level of the celiac branch (bolus tracker) that, when reached 180 Hounsfield units (HU) determined by the arrival of the contrast medium, began scanning the arterial phase, followed by the venous phase attained 60 seconds after the first one. In all phases, apnea time ranged from 12 to 18 seconds.

IMAGE ANALYSIS

All images were independently analyzed at a workstation (GE Medical Systems, Milwaukee, WI) by two radiologists (RMB and RB), with 11 and 15 years experience, respectively, and final results were obtained by consensus.

Data related to the integrity of the stents, presence or absence of luminal thrombus, characteristics and location of thrombus, as well as information related to the type of stent and its constituents were analyzed. All arterial phase images were used for tridimensional angiographic reconstitutions using appropriate volume rendering (VR) and maximum intensity projection (MIP) reconstruction algorithms.

STATISTICAL ANALYSIS

To determine the site where thrombi are formed, the incidence and percentage were calculated. Fisher's exact test was used to compare the occurrence of thrombosis with stent's brand, as well as the group of stents according to the constituent material, formed by PTFE (*Apolo*[®] and *Excluder endoprosthesis*[®]) and Dacron/Polyester (*Talent*[®] and *Zenith*[®]).

RESULTS

All prosthesis used were intact and without signs of fracture on MDCT. Ten cases (33.3%) of endoluminal thrombosis were identified. Five of those (16.7%) showed partial aortic thrombosis; one (3.3%) had partial thrombosis of the aorta and right iliac branch; one (3.3%) had partial thrombosis of the right iliac branch; and three (10%) had partial thrombosis of the aorta and total thrombosis of the right iliac branch (Figure 1). Data are presented in Table 1.

All patients with complete right iliac branch thrombosis were smokers and had been treated for aneurysms of external iliac arteries by placing stent extensions and occluders of the internal iliac arteries. In two of them, thrombosis was diagnosed between 30 and 60 days after surgery, requiring surgical limb revascularization with crossed

Figure 1 – Axial MDCT images showing a semi-circumferential thrombus on the anterior internal wall of aortic endoprosthesis (A); right common iliac artery aneurysm associated with occlusion of the endoprosthesis and presence of an occluder in the right internal iliac artery (B and C); and angiographic reconstruction with volume rendering algorithm (D). Note the absence of contrast column in the right common iliac artery and the presence of a patent crossed femorofemoral graft (D).

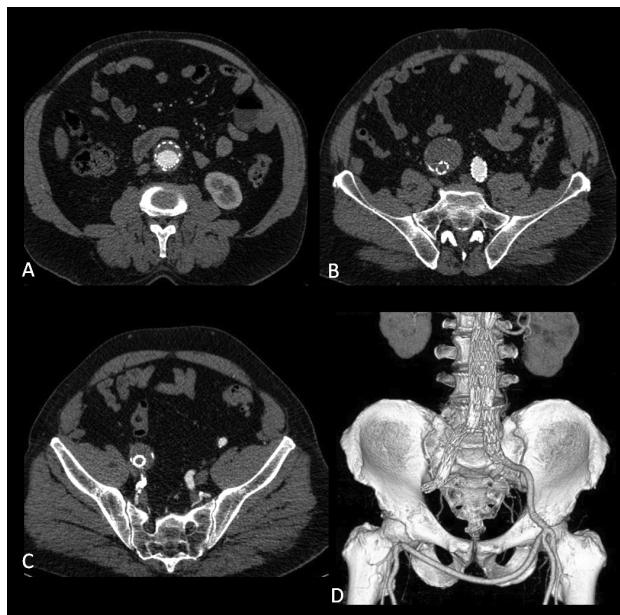


Table 1 – Types of thrombosis

Prosthesis	
Intraluminal thrombosis	
No	20 (66.7%)
Yes	10 (33.3%)
Partial aortic circumference + total R iliac branch	3 (10%)
Partial aortic circumference	5 (16,7%)
Partial R iliac branch circumference	1 (3.3%)
Parietal aortic and partial R iliac branch D	1 (3.3%)
Total	30

femorofemoral graft. The other patient presented thrombosis, diagnosed on control exam at six months, evolving with retroperitoneal and abdominal collateral circulation, without the need of new surgery.

Out of the 10 patients with endoluminal thrombosis, 8 were smokers, 2 had DM, and 1 had hypertension. No statistically significant relationship between the presence of thrombosis and these clinical conditions was identified using Fisher's exact test.

Among the brands of prosthesis associated with thrombosis, it was identified 1 case with Apollo[®], 7 with Talent[®], and 2 with Zenith[®]. A statistically significant difference in the presence of thrombosis among the brands was not observed.

Among the group of materials, one case of thrombosis in PTFE prosthesis (Apollo[®] and Excluder endoprosthesis[®]) and 9 cases in Dacron/Polyester prosthesis (Talent[®] and Zenith[®]) were identified. A significant difference in the presence of thrombosis among the material of the prosthesis was not observed.

DISCUSSION

Endoluminal vascular prosthesis thrombosis represents one of the main complications of ESGAAA diagnosed by CT scan. Specialized literature highlights the following key factors determining the characteristic of stents thrombogenic material¹², smoking, the need of adjuvant procedures, and the experience of the surgical team¹³. According to Thurnher *et al.*¹⁴, formation of semicircular thrombi can occur in up to 19% of the cases, usually not determinant of flow changes or clinical repercussion. Our results is in agreement with this observation, since all seven patients with partial thrombosis (23.3%) remained asymptomatic in clinical evaluations and subsequent MDCTs.

Occlusion of the blood vessel by thrombosis, which has an incidence of 1.5% to 10%, in general extending to the iliac branch, has as main triggering factor the marked tortuosity of the prosthesis or even prosthesis bending by aneurysmal remodeling¹⁴. It has been reported that the evolution of luminal thrombosis may be spontaneous resolution of the thrombus, embolization of distal limb branches, or even total occlusion of blood vessel¹⁰. According to Schunn *et al.*¹², bifurcated prostheses have a greater

chance of thrombosis- and embolization-related complications than tubular prostheses. The author reported an incidence of 10.5% of luminal thrombosis, 60% in bifurcated prosthesis and 13.3% in tubular prosthesis¹².

In the present study, we identified an elevated rate of thrombosis (33%), regardless of the type of material or prosthesis used, which is above those reported in international literature.¹⁴ Despite the absence of statistical significance in this case series, the literature has emphasized that superposition of some clinical conditions, especially smoking, may contribute to endoluminal thrombi formation¹³.

We believe that the high incidence of endoluminal thrombosis in this series might be due to the greater diagnostic accuracy of the high-resolution of the 64-channel MDCT images used in this study. High-resolution fine cuts (1.0 mm) allowed the detection of small intraluminal thrombi, in addition to tridimensional angiographic reformatting and reconstruction using volume rendering (VR) and maximum intensity projection (MIP) reconstruction algorithms. In a recent study using the same specification equipment and similar protocol, Thomaz *et al.*¹⁰ observed an elevated rate of luminal thrombosis in ESGAAA follow-up.

Specific studies on inherent particularities of the diagnosis and late treatment of AAA in the Brazilian population are required. Tortuosity with greater longitudinal and transversal dilation of aortic aneurysm has been considered a risk factor for the development of endoluminal thrombosis¹⁴. Nevertheless, our results do not allow close evaluation of this aspect.

Despite the limitations inherent in this type of study, we believe that our results indicate relevant factors regarding the diagnosis of endoluminal thrombosis by MDCT. In the opinion of the authors, studies with larger series of patients, with longer follow-up, using the high resolution MDCT protocol, may contribute for better understanding of endoluminal thrombosis, besides providing precise diagnostic parameters and more adequate therapy.

CONCLUSION

Multidetector CT allowed the diagnosis of different types of endoluminal thrombosis in this series of patients who underwent ESGAAA. The use of MDCT in clinical practice should be encouraged in order to obtain the best use of this minimally invasive diagnostic tool in the follow-up and diagnosis of individuals undergoing ESGAAA.

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