Original Article

Computed tomography angiography-confirmed aortic in-stents floating thrombus after endovascular stenting: a retrospective study

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Background: Aortic in-stents floating thrombus (ASFT) is a rare complication. The evolution of ASFT on computed tomography angiography (CTA) imaging and the treatment options remain under investigations. The aim of this study was to analyze the imaging manifestations of ASFT on CTA, and to explore safe and effective treatment options.

Methods: A retrospective, longitudinal study design was used. Clinical and imaging data were collected from patients with ASFT between January 2015 to December 2022 at the Union Hospital, Tongji Medical College, Huazhong University of Science and Technology. The imaging features of ASFT, including location, morphology, size, concomitant and dynamic changes during follow-up, were analyzed and classified into two types based on imaging manifestation. Type 1 showed a striated, irregular, or sheet-like appearance. Type 2 was a free-floating middle section in the cavity with attachment point to the thickened inner wall. The treatment protocol was also investigated. The Mann-Whitney U test was utilized for variable comparison.

Results: A total of 1,626 cases were screened, out of which 10 cases were enrolled, resulting in an incidence rate of ASFT of 0.62% (10/1,626). The pre-surgery levels of fibrinogen (FIB), prothrombin time (PT), and D-dimer showed a higher trend, while only the D-dimer level increased significantly during the postoperative period ($P<0.001$). During the follow-up, CTA examination detected 21 ASFTs, including 18 ASFTs of type 1 and three ASFTs as type 2. One patient experienced spleen infarction when ASFT developed. During the follow-up period, thrombus disappeared in six patients, while the lesions remained stable in four patients. Renal infarction occurred in one case. No new-onset ASFTs or patient deaths were reported.

Conclusions: ASFT is an extremely rare disease. The concomitant disorders and postoperative hemodynamic changes could be the cause. CTA examination presented as a safe and preferred imaging modality for evaluating the evolution and prognosis of ASFT. Conservative treatment may be a useful and effective option.

Keywords: Aortic in-stents floating thrombus (ASFT); aortic stent; computed tomography angiography (CTA); embolization

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Introduction

Aortic stenting is a crucial procedure for treating aortic diseases such as aneurysms, dissections, coarctation, and ulceration. This procedure has shown promising results (1-4). However, some of the common complications after the endovascular intervention include restenosis, endoleak, thrombosis, dislocation, and fracture of stent graft (3,4). To detect and correct serious complications and prevent death, several guidelines recommend lifelong postoperative imaging follow-up, such as duplex ultrasonography and computed tomography angiography (CTA) examination (1,3,4).

Postoperative aortic in-stent floating thrombus (ASFT) is a rare complication that can increase the risk of severe distal embolism (5). ASFT can present with nonspecific symptoms and can be identified through routine imaging examinations. Patients may experience abdominal or chest pain due to underlying visceral infarction (6). The diagnosis of ASFT is primarily based on imaging findings, such as CTA examinations. On CTA imaging, it is common to find a mural thrombus with free-floating components within the aorta. Yang and colleagues introduced the break-off risk ratio (boRR) as a parameter to predict the risk of the ASFT breaking away from the vessel wall (5). The boRR is defined as the length ratio of the floating portion. Despite ongoing research, the causes and treatment of ASFT remain unclear (5,6).

This study aimed to investigate the evolution of CTA imaging features in patients with ASFT after receiving aortic endovascular implantation of stent graft. The treatment protocol was also investigated. We present this article in accordance with the STROBE reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-23-1446/rc).

Methods

Study population

This study was a longitudinal, retrospective study. The consecutive patients with aortic diseases who received endovascular implantation of stent graft at the Union Hospital, Tongji Medical College, Huazhong University of Science and Technology from January 2015 to December 2022 were screened. The aortic diseases were confirmed through imaging findings and clinical symptoms. Patients with ASFT, confirmed by CTA examination during the follow-up period, were included in the study. Clinical features, as well as initial and follow-up CTA findings, were reviewed.

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the ethics committee of Union Hospital, Tongji Medical College, Huazhong University of Science and Technology (2023-0815), and individual consent for this retrospective analysis was waived.

Surgery procedure

A thorough history and physical examination were conducted on all patients, with special focus on aortic disease and the patient's performance status. A recent CTA scan was performed on all patients to evaluate vessel anatomy and determine the optimal stenting site. Prior to the operation, written consent from the patient or their family was obtained. During the operation, 3,000–5,000 units of heparin were administered as a standard practice, with smaller doses given to patients with injuries or elevated bleeding risks. The surgical procedure was consistent with the previously described protocol (1,2,7-9).

In this study, the endografts used were Aegis (MicroPort, Shanghai, China), Talent (Medtronic, Minneapolis, MN USA), and Valiant (Medtronic, Minneapolis, MN, USA). The size of grafts used was 5–20% larger than the maximum diameter (inside-inside) of the aorta at the proximal landing zone. Tapered stents or overlapping tapered stents were used when the diameter of the distal landing zone was too small. The choice of grafts was based on anatomical conditions, operator experience, and equipment availability. The proximal sealing length was determined to be at least 1.5 cm. Following aortic stenting, bridging stent grafts were inserted between the fenestration or branch and each target vessel as required. To prevent thrombus formation in patients at risk (such as those with clotting disorders, active cancer, or infection), an oral dual antiplatelet pharmacotherapy consisting of aspirin 75 mg and/or clopidogrel 75 mg per day was prescribed postoperatively for at least 3 months.

CTA protocol and image analysis

The CTA studies were conducted using a multislice helical computed tomography (CT) scanner (Somatom Definition AS Siemens, Erlangen, Germany) in accordance with our standard of care. We used prospective electrocardiogram (ECG) triggering for image acquisition, with 70% triggering when the heart rate was below 70 beats/min and 40% triggering when the heart rate was above 70 beats/min. Scanning parameters followed standard CTA techniques from the supra-aortic vessel level to the bilateral femoral arteries. The images were processed using Syngo.via (Siemens), which involved volume-rendering technique, maximum intensity projection, and multiplanar reconstruction.

The definition of ASFT stated that the thrombus was attached to one or more points on the blood vessel wall at its proximal end, while the distal end was free and moved with the blood flow. In contrast, a mural thrombus was defined as a thrombus that was attached to the inner wall of the stent and was not free at the distal end. The observed parameters included ASFT location, morphology, size, the involved aorta, concomitant visceral or vascular embolism, graft placement, and the dynamic changes of these signs during the follow-up period. The imaging of ASFT could be categorized into two types. Type 1 appeared striated, irregular, or sheet-like, and was usually short. Type 2 (classical type) was a free-floating middle section in the cavity with one or multiple points of attachment to the thickened inner wall of stent grafts. Two senior radiologists with 10 years of experience in radiology independently assessed the CT features using both axial CT images and multiplanar reconstructions. The images were evaluated independently in a blind fashion with a time gap of 2 weeks to minimize recall bias. In case of disagreements, readers discussed and reached consensus.

Follow-up

The preferred imaging modality for follow-up examinations was the CTA examination, except for patients with contraindications such as a known allergy to iodinated contrast material or renal dysfunction. The follow-up CTA scans were analyzed in a blinded fashion by the same experienced readers, as described for the baseline evaluation, to evaluate disease progression between the follow-up and baseline scans. All patients were scheduled for follow-up aortic CTA examinations and clinical symptom assessments at our institution. Additionally, detailed out-of-hospital histories and laboratory tests were requested if necessary.

Statistical analysis

Categorical data were presented as the number of patients and percentage, while continuous data were expressed as mean ± standard deviation and median (range) for non-normally distributed variables. The Mann-Whitney *U* test was utilized for variable comparison when necessary, and all statistical analyses were conducted using SPSS software (version 26.0; SPSS Inc., Chicago, Illinois, USA). A two-tailed P value less than 0.05 was considered statistically significant.

Results

Patient characteristics

In our study, 1,626 patients were screened and 72 cases were diagnosed with thrombus in the grafts. Finally, 10 cases were diagnosed with ASFT with CTA examination, resulting in an incidence rate of 0.62% (10/1,626) (*Figure 1*). The study included nine men and one woman with a median age of 54 years (range, 23–67 years). Among these patients, three had abdominal aortic aneurysm (AAA), three had type B aortic dissection (TBAD), and one each had type A aortic dissection (TAAD), abdominal aortic dissection (AAD), coarctation of the thoracic aorta (CoTA), and thoracic aortic ulcer. Seven patients had a history of hypertension and four patients developed atherosclerosis before admission. *Tables 1,2* summarize the patients' characteristics and the results of main laboratory tests before surgery. The fibrinogen (FIB), prothrombin time (PT), and D-dimer levels showed a higher trend compared to the standard value.

Imaging findings

In the 10 patients, 21 floating thrombi were observed in

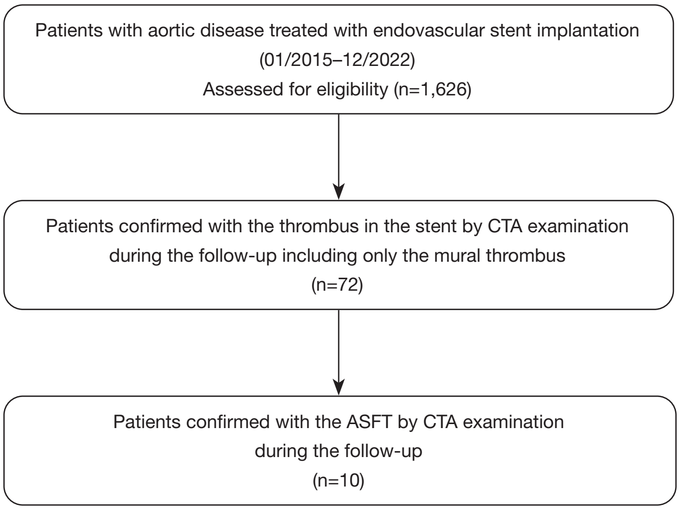

Figure 1 Flow chart of the study. CTA, computed tomography angiography; ASFT, aortic in-stents floating thrombus.

Table 1 Demographic and clinical characteristics of patients

Case	Age (years)	Sex	Main complaint	Other symptoms	Clinical histories	Physical examination (positive signs)	Diagnosis
1	39	M	Right lower extremity numbness	–	Hypertension, hyperuricemia, gouty arthritis and high blood sugar	–	TBAD
2	45	M	Chest pain	Chest tightness and dizziness	Hypertension	–	TAAD
3	67	M	Lower back pain	–	Hypertension and atherosclerosis	–	AAA
4	60	M	Abdominal discomfort	–	Hypertension, diabetes, coronary heart disease and atherosclerosis	–	AAD
5	67	F	Frequent persistent chest back pain	Dizziness and nausea	Hypertension, coronary heart disease and autoimmune hepatitis	–	TBAD
6	23	M	High blood pressure	Dizziness	–	Enhancement pulsation of bilateral carotid arteries and radial arteries and the weaken pulsation of the dorsalis pedis arteries of both lower limbs	CoTA
7	66	M	Chest tightness	Headache and dizziness	Hypertension and atherosclerosis	–	Thoracic aortic ulcer
8	51	M	Chest pain	Lower back pain	Atrophic gastritis	–	TBAD
9	57	M	Abdominal discomfort	–	Atherosclerosis	–	AAA
10	43	M	Abdominal pain	–	Hypertension	–	AAA

M, male; F, female; TBAD, type B aortic dissection; TAAD, type A aortic dissection; AAA, abdominal aortic aneurysm; AAD, abdominal aortic dissection; CoTA, coarctation of the thoracic aorta.

Table 2 Results of main laboratory examinations before and after the endovascular intervention

Variables	Before	Days 5–7	P value
TT (Ref, 14.0–21.0) (s)	16.67±1.72	18.08±1.80	0.112
FIB (Ref, 2.0–4.0) (g/L)	4.61±1.33	4.59±1.19	0.597
APTT (Ref, 28.0-43.5) (s)	40.33±3.64	41.76±5.07	0.762
INR (Ref, 0.80-1.31)	1.03±0.09	1.13±0.18	0.289
PT (Ref, 11.0-16.0) (s)	13.10±0.68	13.97±1.77	0.426
D-dimer (Ref, <0.5) (mg/L FEU)	0.97±0.659	5.02±1.91	<0.001
Plt (Ref, 125-350) (10^9/L)	323.4±148.92	296.2±112.20	0.880

Data are presented as mean ± standard deviation. Ref, reference; TT, thrombin time; FIB, fibrinogen; APTT, activated partial thromboplastin time; INR, international normalized ratio; PT, prothrombin time; FEU, fibrinogen equivalent units; Plt, platelet.

the cavity with CTA. The ASFT length ranged from 0.15 to 2.75 cm with an average of 1.18 cm, and boRR ranged from 1.2 to 4.3. The median time interval from surgery to thrombosis was 3.5 months (range, 1–25 months). A total of 36 CTA scans were performed in the 10 cases during hospitalization and follow-up.

Atherosclerotic plaque was confirmed in four patients before surgery through CTA imaging, which showed that the location of thrombus was closely related to the location of atherosclerotic plaque. Based on the CTA examination, 18 ASFTs were basically irregular and with flaky filling defects with short and striped appearance, which were classified as type 1 (*Figure 2*). Three ASFTs had a pedunculated mass with multiple attachments to the inner wall of stent grafts, with the distal segment free-floating, classified as type 2 (*Figure 3*). As shown in *Figure 4* (type 2), for the same patient, cine images of the thrombus with multiphase reconstruction from 0% to 90% of the cardiac cycle were obtained with intervals of 10% (Video S1). *Table 3* displays the imaging findings of all patients.

Outcomes

Ten patients underwent technically successful endovascular intervention without any cases being converted to open surgery. During a median follow-up period of 45 months (range, 22–88 months), there were no deaths during the perioperative period and none of the patients showed any late endoleak, graft migration, paraplegia, or reintervention. The details of the endovascular intervention are summarized in *Table 4*. There was no statistically significant difference in laboratory examinations after the endovascular intervention compared to that before the treatment, except for a statistically significant increase in D-dimer levels during the postoperative period (P<0.001) (*Table 2*). One patient developed partial splenic infarction after confirmation of ASFT and received conservative treatment with Warfarin and aspirin. The extent of splenic embolization did not increase further.

Regarding the aortic stent thrombosis, six patients were given conservative medical treatment. Two patients were administered clopidogrel, while two patients received aspirin. One patient received both aspirin and clopidogrel as part of their treatment, whereas the other patient was administered aspirin and warfarin. The dosage of aspirin and clopidogrel had been predetermined, and the dosage of warfarin was adjusted according to the international normalized ratio (INR) level. Among them, four patients had their lesions disappeared without any new-onset embolism during the follow-up period. One patient had a stable lesion without any significant changes or new-onset embolism, while another patient developed infarction of the inferior part of the right kidney during subsequent follow-up.

Out of the three patients who did not receive antithrombotic therapy, two showed stable thrombus without any significant changes or new-onset embolism. In one patient, the lesion disappeared without any distal organ embolism.

Only one case required another endovascular treatment for the progressively enlarged AAA, which was successfully treated during the surgery. The thrombus disappeared without any new embolism or thrombus during the follow-

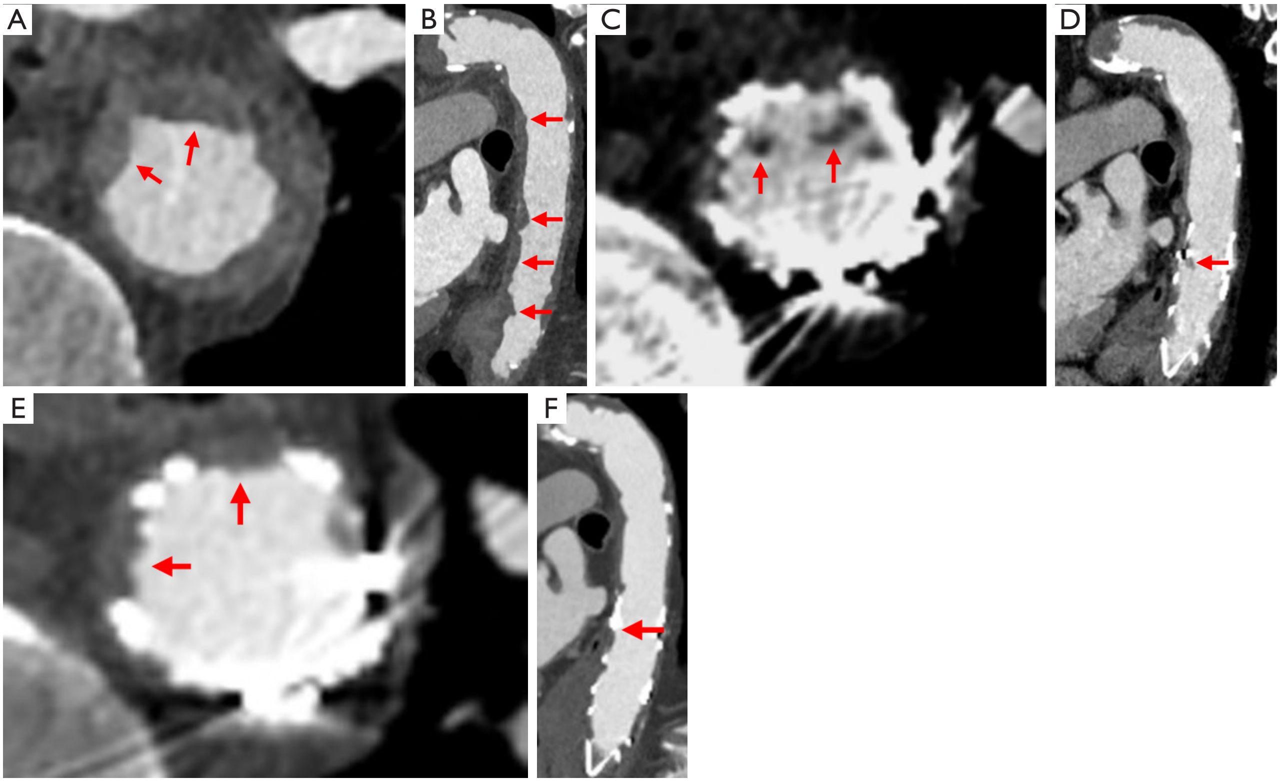

Figure 2 A 57-year-old male patient with AAA. CTA-MPR images revealed one stripe filling defect in the descending aorta post-treatment. Extensive atherosclerotic plaques were observed in the descending aorta before the surgery (A,B, red arrows). One and a half months after the surgery, an ASFT was found attached to the focal thickened wall, which was closely associated with the preoperative atherosclerotic plaque. (C,D, red arrows). Subsequent CTA examination performed 7 months later showed that the lesion had disappeared (E,F, red arrows). AAA, abdominal aortic aneurysm; ASFT, aortic in-stents floating thrombus; MPR, multi-planar reconstruction; CTA, computed tomography angiography.

up after the surgery as well (*Table 3*).

Discussion

The incidence of ASFT is rare, with only a few cases reported in previous studies. Song *et al.* reported only one case of ASFT out of 34 patients (10), while Yang *et al.* showed a much lower incidence rate of ASFT compared to primary aortic mural thrombus (0.45%) (5). Our study also identified a low incidence rate of ASFT (0.62%), highlighting the rarity of this disease. In this study, we identified the incidence and changes of image-based features of ASFT after the procedure and outlined a treatment strategy to ensure timely and effective treatment. Our findings serve as a valuable resource for radiologists and clinicians to better understand the post-procedural changes and improve patient outcomes.

ASFT can increase the risk of severe distal embolization, particularly in cases of pedunculated thrombus (6). Yang *et al.* proposed boRR to assess the stability of the floating mass, we found that the thrombus with an irregular appearance was difficult to define using this method (5), which limited its application in our study. Additionally, our cohorts only identified one patient with distal embolization during the follow-up period, therefore, the optimal threshold of the boRR for defining the risk of break is still uncertain. Further validation is necessary using larger clinical data sets.

In this research, it was observed that most ASFTs (18/21) had a striped appearance, which is a novel finding. The location of the thrombus was found to be closely related to that of the atherosclerotic plaque before treatment. Therefore, our speculation suggests a potential close association between the location and presence of the ASFT and the plaque, which has not been previously reported. Another possible hypothesis that cannot be excluded is

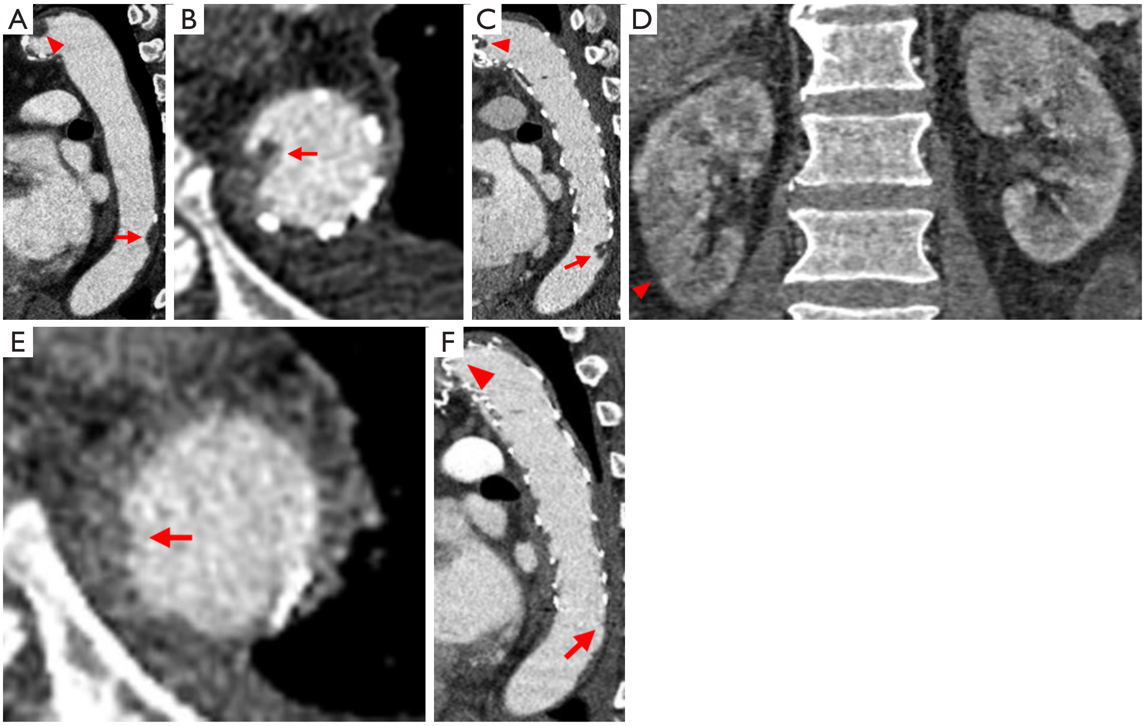

Figure 3 A 60-year-old male patient with AAD. At 1-month follow-up after the treatment, CTA-MPR images identified two stripe filling defects. The atherosclerotic plaque and mural thrombus were revealed before operation (A, red arrow, red triangle). During the follow-up period, one lesion bifurcated distally with a small branch (B,C, red arrows). One flaky filling defect was attached to the focal thickened wall (C, red triangle). At 2-month follow-up after the operation, the infarction of the inferior part of the right kidney was observed (D, red triangle), as well as the disappearance of both lesions (E,F, red arrows, red triangle). AAD, abdominal aortic dissection; CTA, computed tomography angiography; MPR, multi-planar reconstruction.

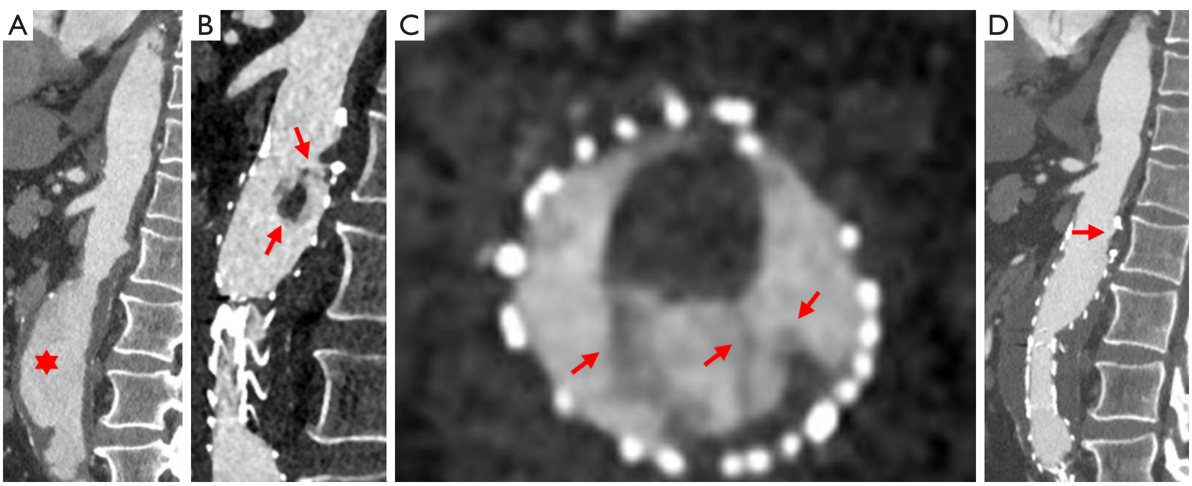

Figure 4 A 67-year-old male patient with AAA. Axial and sagittal CTA images confirmed a pedunculate mass (0.15 cm × 0.09 cm × 0.11 cm) in the stent. Diagnose of AAA was confirmed before the surgery (A, red star mark). At the 3-month follow-up, a pedunculated mass (B, red arrows) with three attachment points between the free-floating distal segment and the mural thrombus was observed (C, red arrows). The 9-month CTA examination after the procedure confirmed the disappearance of the lesion (D, red arrow). CTA, computed tomography angiography; AAA, abdominal aortic aneurysm.

Table 3 Imaging findings of the 10 patients with ASFT at the first diagnose on CTA examination

Case	Number of lesions	Diagnosis before the endovascular intervention	Thrombus location	Morphology/boRR	Mobilization dynamics	Concomitant embolism	Time interval between the endovascular intervention and the occurrence of the thrombus (months)	Treatment method	Follow-up
1	1	TBAD	Distal part of the stent	Striped in appearance, the head and the tail part connected to the inner wall of the stent while the middle part floating (0.32 cm)	Mainly stable state with partial components floating	–	25	Conservative treatment (clopidogrel)	Disappeared without new-onset embolism
2	3	TAAD	Original part of the stent	Two irregular, flaky filling defects (0.59 cm, 0.45 cm); multiple attachments to the stent inner wall with the distal segment free-floating in another one (1.62 cm × 0.60 cm)/2.7	Median partial component floating along with the blood flow	Partial splenic infarction	5	Conservative treatment (Warfarin, adjusted according to INR level; aspirin)	Disappeared without new-onset embolism
3	1	AAA	Original coarctation part of the stent	Pedunculated mass (0.15 cm × 0.09 cm × 0.11 cm) with three attachment points between the free-floating distal segment and the mural thrombus/4.3	Distal segment floating along with the blood flow	–	2.5	Conservative treatment (aspirin, clopidogrel)	Disappeared without new-onset embolism
4	2	AAD	Origin and distal part of the stent	Short and striped in appearance with a small branch distal to the lesion (0.48 cm, 1.39 cm)/1.2, 2.9	Along with the direction of the blood flow	–	1	Conservative treatment (clopidogrel)	Disappeared with infarction of the inferior part of the right kidney
5	3	TBAD	Original part of the stent	Striped in appearance, the head and the tail part connected to the inner wall of the stent while the middle part floating (1.36 cm, 1.17 cm, 0.73 cm)	Mainly stable state with partial components floating	–	24	Conservative treatment (aspirin)	Remained stable without significant changes or new-onset embolism

Table 3 (*continued*)

Table 3 (*continued*)

Case	Number of lesions	Diagnosis before the endovascular intervention	Thrombus location	Morphology/boRR	Mobilization dynamics	Concomitant embolism	Time interval between the endovascular intervention and the occurrence of the thrombus (months)	Treatment method	Follow-up
6	2	CoTA	Original part of the stent	Flaky filling defect (0.5 cm); striped in appearance (2.40 cm × 0.17 cm) and the head and the tail part connected to the inner wall of the stent while the middle part floating with multiple attach points between the distal segment and the thickened inner wall of the stent	Along with the direction of the blood flow	–	3	Regular follow-up without antithrombotic therapy	Remained stable without significant changes or new-onset embolism
7	3	Thoracic aortic ulcer	Middle part of the stent	Striped in appearance, the head and the tail part connected to the inner wall of the stent while the middle part floating (2.19 cm, 0.78 cm, 0.60 cm)	Perpendicular to the direction of the blood flow	–	4	Regular follow-up without antithrombotic therapy	Remained stable without significant changes or new-onset embolism
8	4	TBAD	Original part of the stent	Two irregular, flaky filling defects (1.19 cm, 1.97 cm); two striped in appearance, the head and the tail part connected to the inner wall of the stent (1.16 cm, 2.09 cm)/1.4, 1.7	Median partial component floating along with the blood flow	–	2	Conservative treatment (aspirin)	Remained stable without significant changes or new-onset embolism
9	1	AAA	Distal part of the stent	Irregular, short, flaky filling defects (0.94 cm)/1.3	Along with the direction of the blood flow	–	1	Regular follow-up without antithrombotic therapy	Disappeared without new-onset embolism
10	1	AAA	Distal part of the stent	Striped in appearance, the head and the tail part connected to the inner wall of the stent while the middle part floating (2.75 cm)	Along with the direction of the blood flow	–	18	Receiving thrombolysis in the process of EVAR for another AAA	Disappeared without new-onset embolism

ASFT, aortic in-stents floating thrombus; CTA, computed tomography angiography; boRR, break-off risk ratio; TBAD, type B aortic dissection; TAAD, type A aortic dissection; INR, international normalized ratio; AAA, abdominal aortic aneurysm; AAD, abdominal aortic dissection; CoTA, coarctation of the thoracic aorta; INR, international normalized ratio; EVAR, endovascular aortic aneurysm repair.

Table 4 Treatment details

Variables	Value
Operation time (minutes)	52.4±6.4
Stent type	
Aegis (Microport)	2
Talent (Medtronic)	1
Valiant (Medtronic)	7
Stent length (mm)	158±32.5
Oversizing (%)	10±5

Data are presented as mean ± standard deviation or number.

that the blood flow slows down in a certain area and clot formation occurs. The graft infolding due to excessive oversize may cause the disturbance of blood flow, which may lead to floating thrombus (11). It is not possible to investigate the oversizing ratio at the thrombus formation point and compare to that of non-thrombus area due to the limited sample size in this study. Further studies with larger cohorts are necessary to validate two hypotheses.

Accurate detection of ASFT is crucial for diagnosis, treatment, and prognosis improvement. With the advancements in CT technology, lesions inside aortic grafts could be clearly and tridimensionally demonstrated with greater spatial and temporal resolution, lower radiation, and powerful post-processing techniques. Aortic CTA examinations with electrocardiograph gating and multiplanar reconstruction of images can display graft and ASFT features such as morphology, size, location, and concomitant visceral or vascular embolism (12,13). This study accurately displayed stems and cross-linking sites by combining different sections and phases of CTA images. It is important to note that the complete features of the lesion cannot be visualized in a single-phase CT scan or a single image. This highlights the superiority of CT reconstruction technology. However, by obtaining cine images at intervals of 10% from 0% to 90% of the cardiac cycle, the lesion can be visualized. Cine-CT images, which are obtained using the retrospective ECG-gating protocol with the reconstruction of the multiphases axial CT data, can depict the motion of the thrombi over a cardiac cycle in an arbitrary plane. This helps to more fully characterize the ‘floating’ feature of the thrombi.

A variety of reasons that may lead to the formation of ASFT, including concomitant disorders such as atherosclerosis, hypercoagulable states in patients [especially those with aortic calcifications (5)], and potential vascular endothelial injury or abnormal hemodynamic properties following implantation of graft (14). This study found that four patients with confirmed atherosclerosis developed thrombus in the graft, indicating the need for early prophylactic anticoagulant therapy. Additionally, in six other patients, postoperative hemodynamic changes were likely the cause of ASFT due to increased pressure leading to stenosis. Abnormal blood flow conditions, such as turbulence and eddies, can also impact wall shear stress and result in local thrombosis at the site (5).

Currently, there are no established therapeutic protocols or guidelines for the management of ASFT. Treatment options are largely dependent on the patient’s condition and the clinician’s experience. Conservative medical treatment or invasive procedures such as interventional operations or surgery are possible therapies. However, previous studies had reported the occurrence of antiplatelet drug ‘resistance’ in patients receiving antiplatelet therapy. This meant that despite the medication, thrombotic events continued to occur and the patient did not benefit from the treatment (15). According to a study, 7% of patients on aspirin and 27% of patients on clopidogrel were found to be nontherapeutic (16). A laboratory test to evaluate platelet function can help identify these patients. For those patients, replacing the antiplatelet therapy with other drugs or increasing the dose of the original medication can be effective. In some cases, anticoagulant therapy may also be added if necessary.

The study has a few limitations. Firstly, although we highlighted the advantages of CTA examination, large-scale epidemiologic studies have not yet assessed the effects of exposure to multiple CT studies. The risks of radiation exposure and the use of iodinated contrast material should be carefully evaluated for each individual. Secondly, we did not compare different imaging modalities such as CTA, duplex ultrasonography, and magnetic resonance imaging (MRI) by evaluating their pros and cons. Finally, due to the low incidence rate of ASFT, the sample size was relatively small, which may result in an inevitable bias.

Conclusions

In conclusion, our research highlights the importance of recognizing ASFT as a rare yet significant source of peripheral embolism, which should be carefully monitored by clinicians and radiologists. Our study classified the imaging manifestation of ASFTs into two distinct types, with CTA examination proving to be a safe and preferred imaging modality for evaluating their evolution and prognosis. Conservative treatment may be an effective method for managing asymptomatic ASFT. Long-term individualized treatment and follow-up are crucial for improving patient outcomes.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://qims.amegroups.com/article/view/10.21037/qims-23-1446/rc

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://qims.amegroups.com/article/view/10.21037/qims-23-1446/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the ethics committee of Union Hospital, Tongji Medical College, Huazhong University of Science and Technology (2023-0815), and individual consent for this retrospective analysis was waived.

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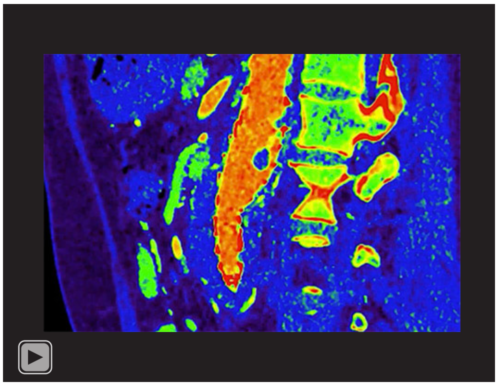
Supplementary



Video S1 The floating process of the aortic in-stents floating thrombus through the cardiac cycle on cine-computed tomography.

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