

 **Maastricht UMC+**
Heart+Vascular Center

i-MEET
NEXT GENERATION
Multidisciplinary European Endovascular Therapy

 **Maastricht UMC+**
Heart+Vascular Center

**WHAT IS THE BEST APPROACH TO
AORTIC MURAL THROMBUS ?**

Geert Willem Schurink

Barend Mees

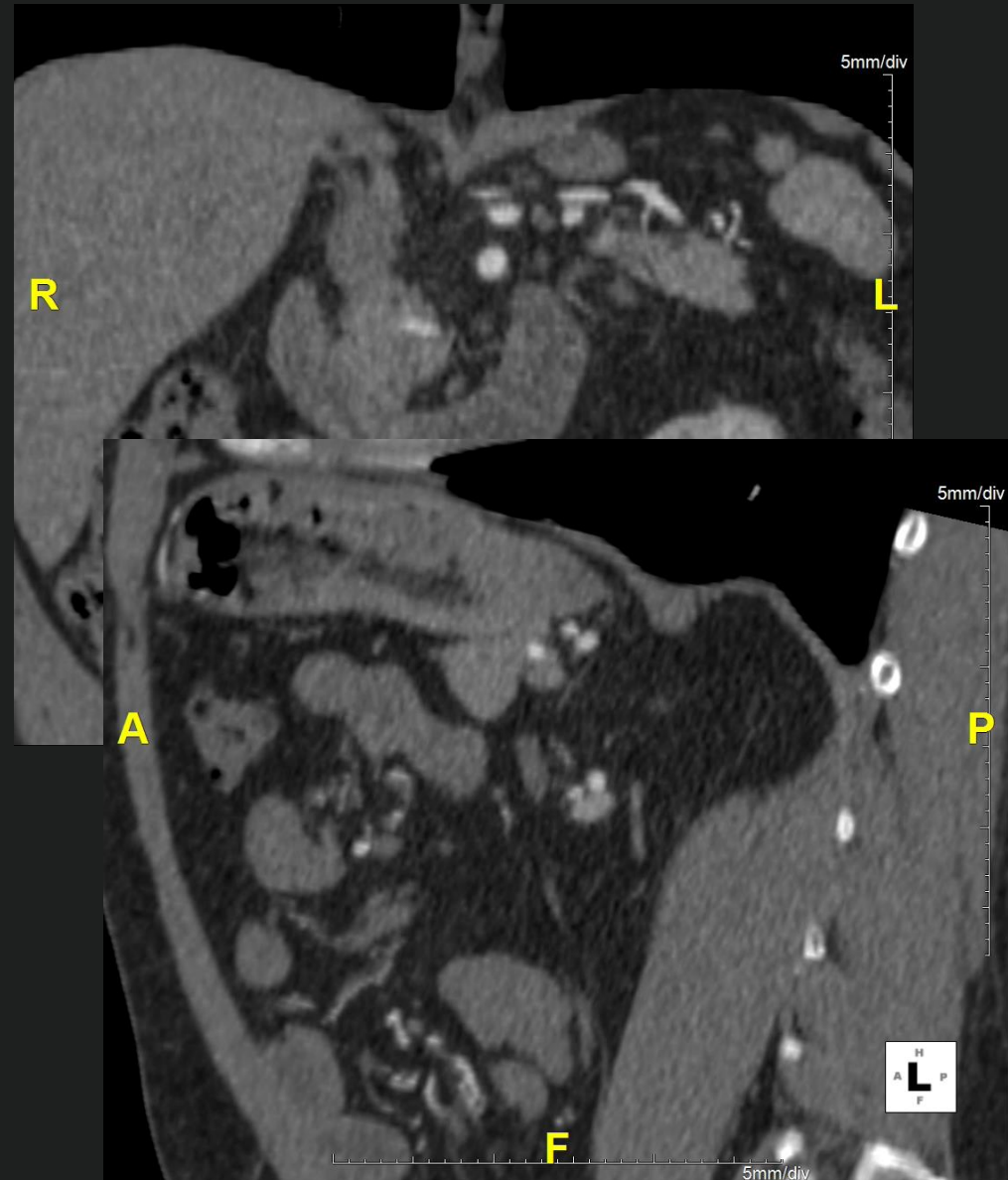
Michael Jacobs

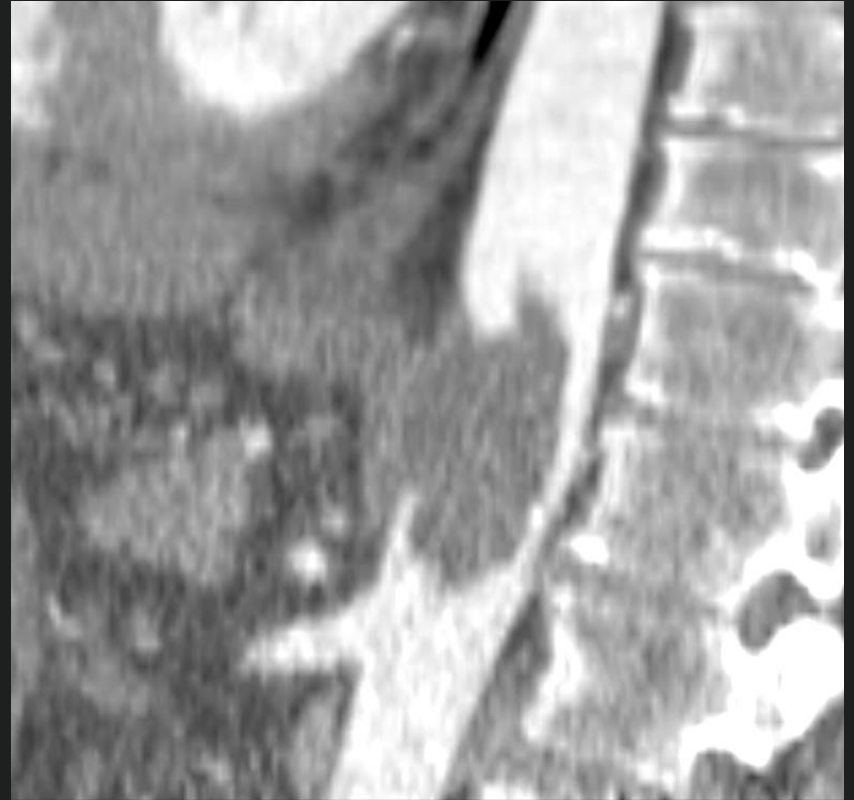
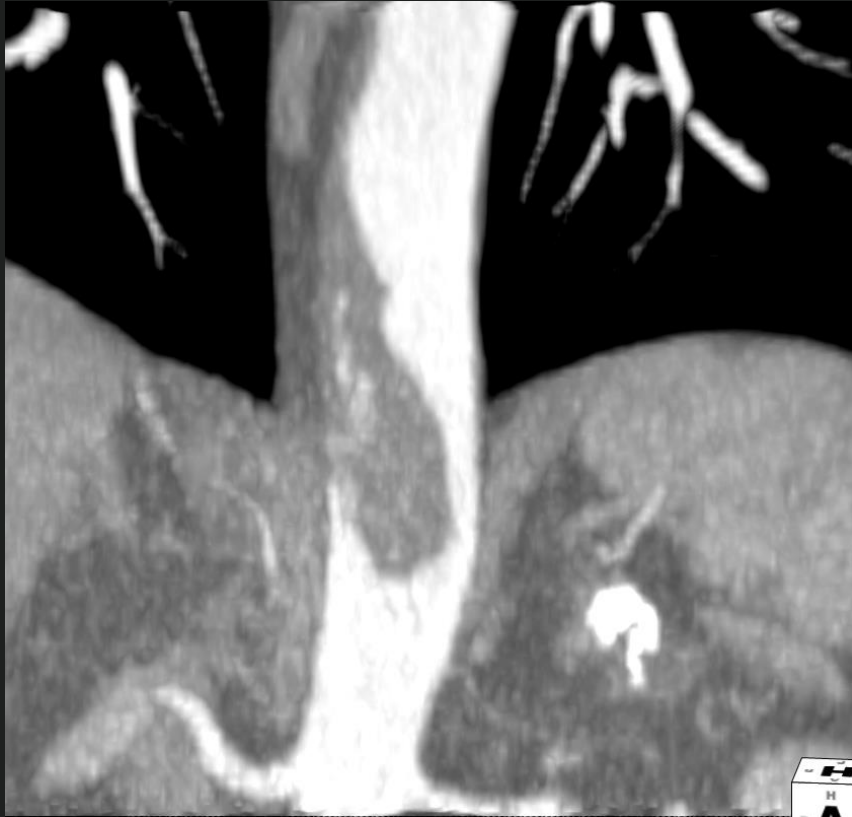
Maastricht University Medical Center, the Netherlands
European Vascular Center Aachen-Maastricht, Germany and the Netherlands

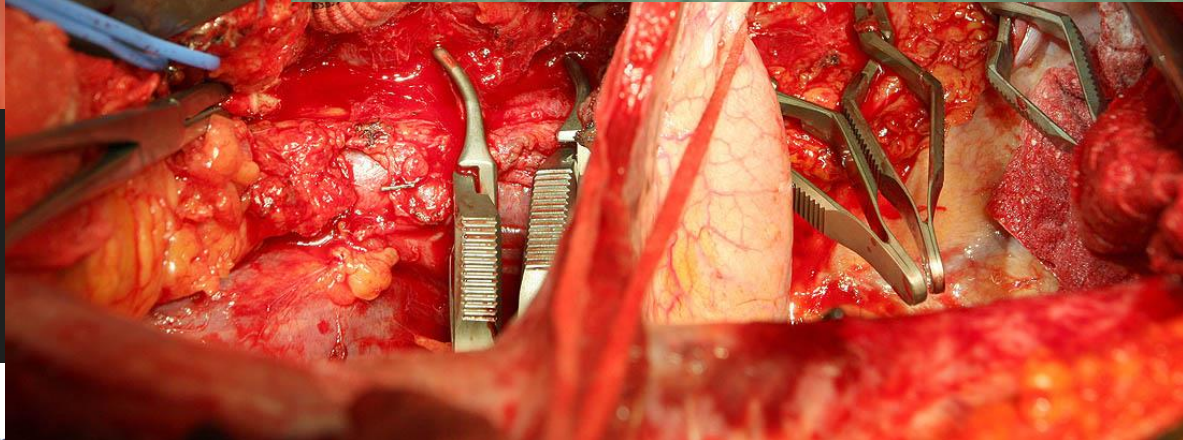
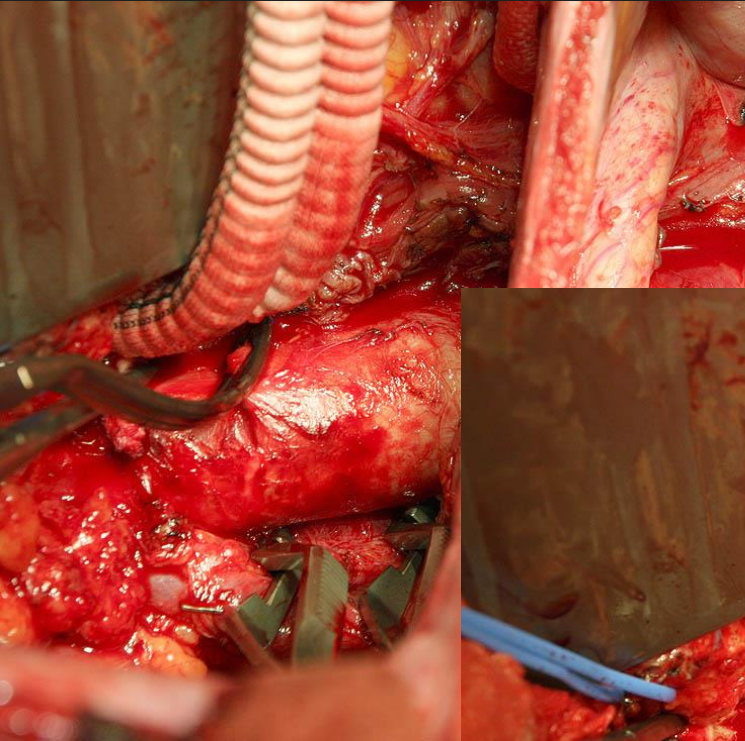
Disclosure of Interest

- None related to the subject

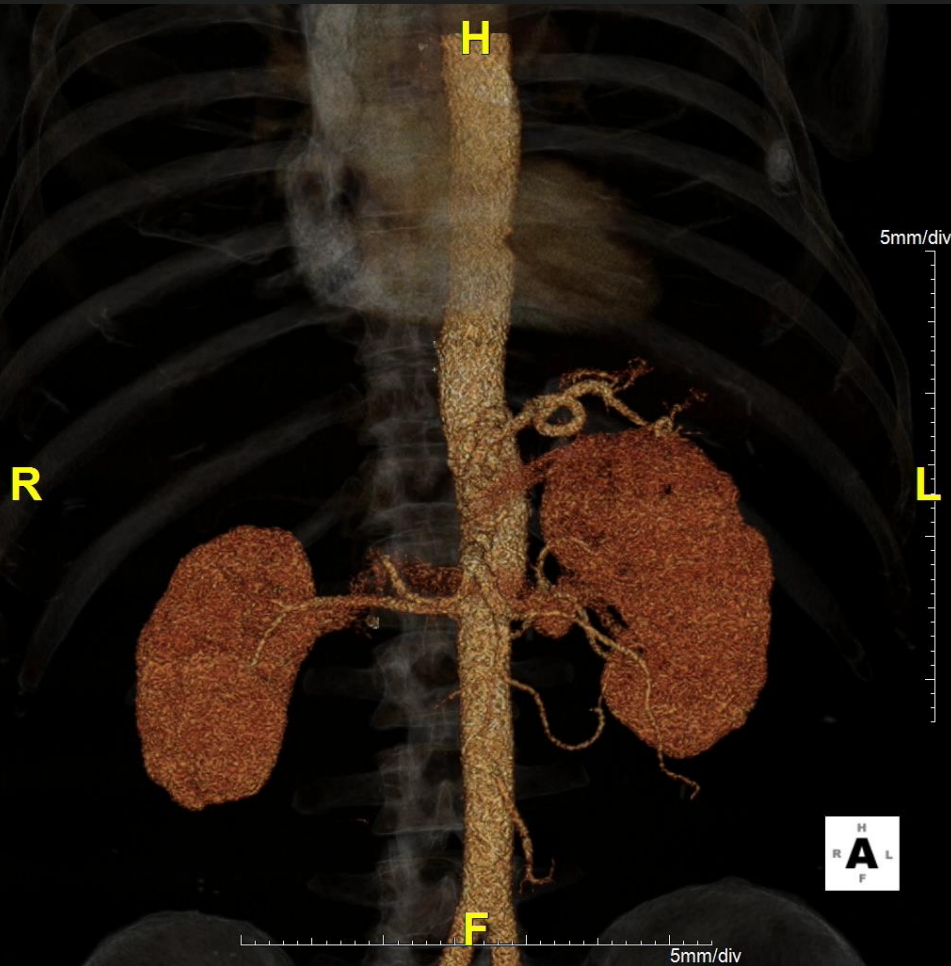
- 62 yr old male
- Smoking
- Crohn's disease (in the past)
- No intermitted claudication
- No abdominal complaints
- "possible leiomyosarcoma of the aorta"









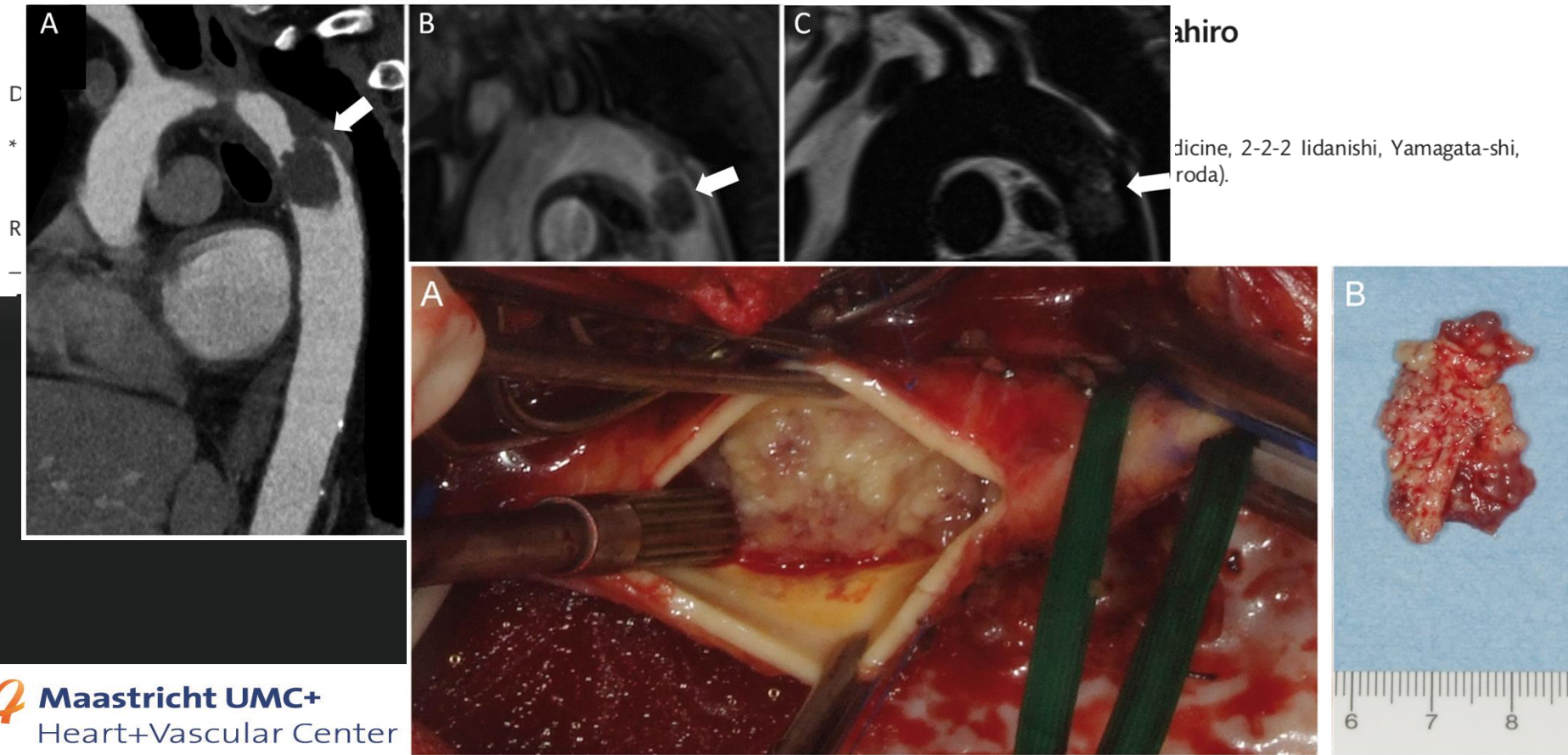


Histology:

- Thrombus initiated on atherosclerotic plaque
- no leiomyosarcoma

Cite this article as: Kuroda Y, Uchida T, Hayashi J, Sadahiro M. An intra-aortic floating metastatic malignancy of unknown primary origin. Eur J Cardiothorac Surg 2018;53:477–8.

An intra-aortic floating metastatic malignancy of unknown primary origin



Thrombus in Native Aorta

“non /rare -embolic events”

Intraluminal Thrombus in aneurysm



Thrombus in intramural hematoma



Thrombus in aortic dissections



Thrombus in Native Aorta

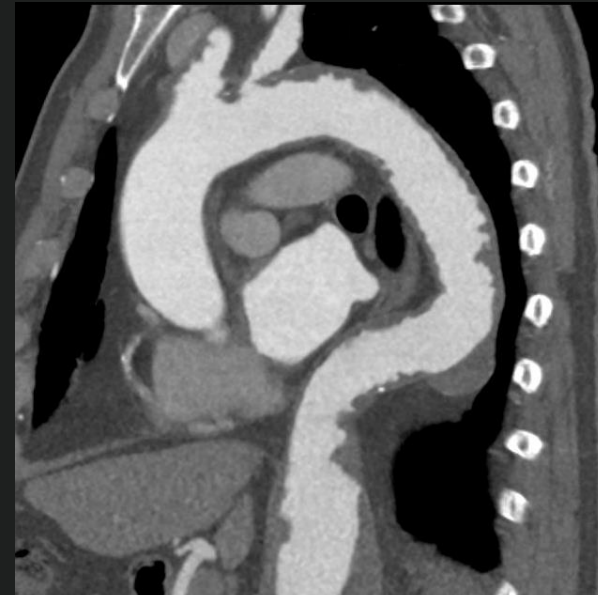
“embolic events”

Mural Aortic Thrombus



Macro-embolization

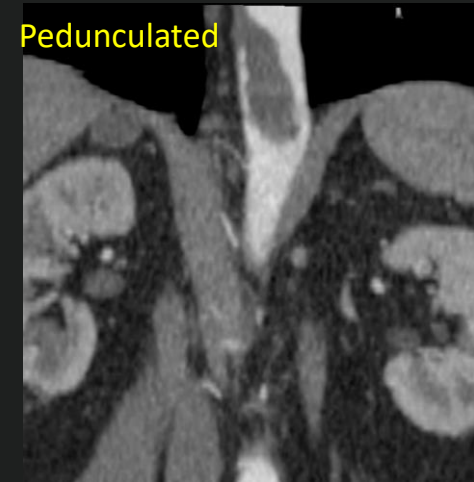
Shaggy Aorta



Athero(micro)-embolization

Aortic Mural Thrombus

- Definition:
 - Aortic thrombi that develop in the absence of preexisting aortic disease
- Symptomatic versus Asymptomatic
- Sessile versus Pedunculated
- “ Little available evidence to outline the best management strategy for this unusual problem.”



Aortic mural thrombus: An occult source of arterial thromboembolism

Herbert I. Machleder, M.D., Howard Takiff, M.D., Juan F. Lois, M.D., and Ernest Holburt, M.D., *Los Angeles, Calif.*

During a 28-year period from 1955 to 1983, two cases of massive repetitive arterial thromboembolism from nonaneurysmal aortic mural thrombus were diagnosed antemortem and successfully corrected at the University of California, Los Angeles Medical Center. Within the same time period, 48 cases of nonaneurysmal aortic mural thrombus were identified in 10,671 consecutive autopsies (0.45% incidence). Eight of these patients had evidence of distal embolization (17%), and three had major thromboembolic occlusions, which were considered the proximate cause of death (6%). The latter three patients represented 9% of autopsy-confirmed deaths from peripheral arterial thromboembolism. The diagnosis was established in a 49-year-old man and a 51-year-old woman after a long course marked by recurrent arterial embolization. Despite multiple evaluations, which included angiography, the diagnosis remained elusive until clinical suspicion resulted in complete biplane aortographic survey. Although the morphologic characteristics of this lesion are quite striking, subtle angiographic changes and lack of familiarity with the clinical presentation contribute to the difficulty and infrequency of diagnosis. This unique lesion comprises an important segment of the so-called cryptogenic sources of arterial embolization and can be corrected by a definitive surgical procedure. (*J VASC SURG* 1986; 4:473-8.)

10.671 consecutive autopsies from 1955 - 1983.

- 48 cases of non-aneurysmal aortic mural thrombus (0.45%)
- 17% with distal embolization
- 6% embolization considered the cause of death

Recognition and Embolic Potential of Intraaortic Atherosclerotic Debris

DEAN G. KARALIS, MD, KRISHNASWAMY CHANDRASEKARAN, MD,
 MARK F. VICTOR, MD, FACC, JOHN J. ROSS, JR., RCPT, GARY S. MINTZ, MD, FACC
Philadelphia, Pennsylvania

Atherosclerotic disease of the thoracic aorta is common in the elderly and patients with clinical coronary artery disease. Although embolization can occur from atherosclerotic debris within the thoracic aorta, it is not commonly considered in the differential diagnosis of the source of a systemic embolism. In the current study, the prevalence, clinical significance and embolic potential of intraaortic atherosclerotic debris as detected by transesophageal echocardiography was determined.

Intraaortic atherosclerotic debris was identified in 38 (7%) of 556 patients undergoing transesophageal echocardiography. An embolic event occurred among 11 (31%) of the 36 study patients with intraaortic atherosclerotic debris. The incidence of an embol-

ic event was higher when the debris was pedunculated and highly mobile (8 [73%] of 11 patients) than when it was layered and immobile (3 [12%] of 25 patients) ($p < 0.002$). Among 15 patients undergoing an invasive procedure of the aorta, the incidence of embolism was 27%.

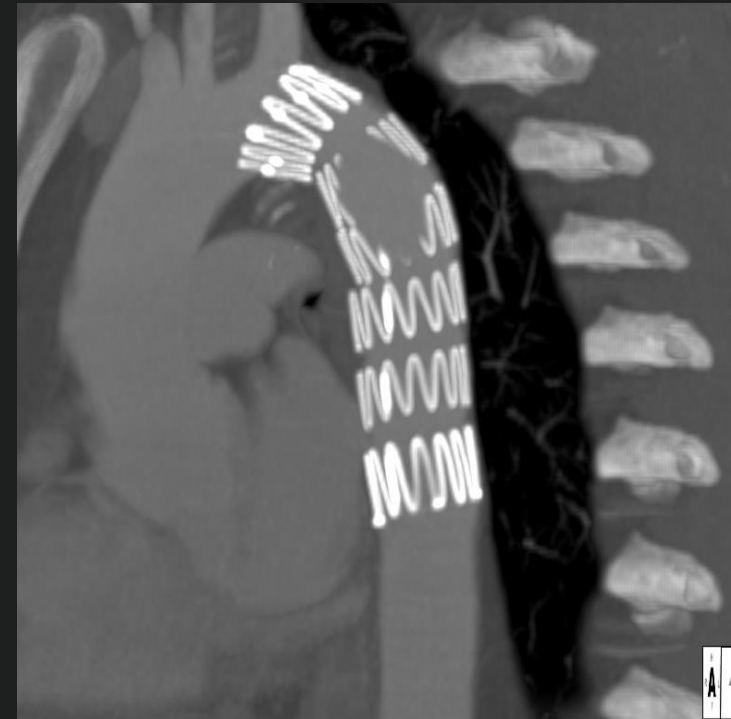
In conclusion, in a patient with an embolic event, the thoracic aorta should be considered as a potential source. Transesophageal echocardiography can reliably detect intraaortic atherosclerotic debris, and when it is identified, an invasive aortic procedure should be avoided if possible.

(J Am Coll Cardiol 1991;17:73-8)

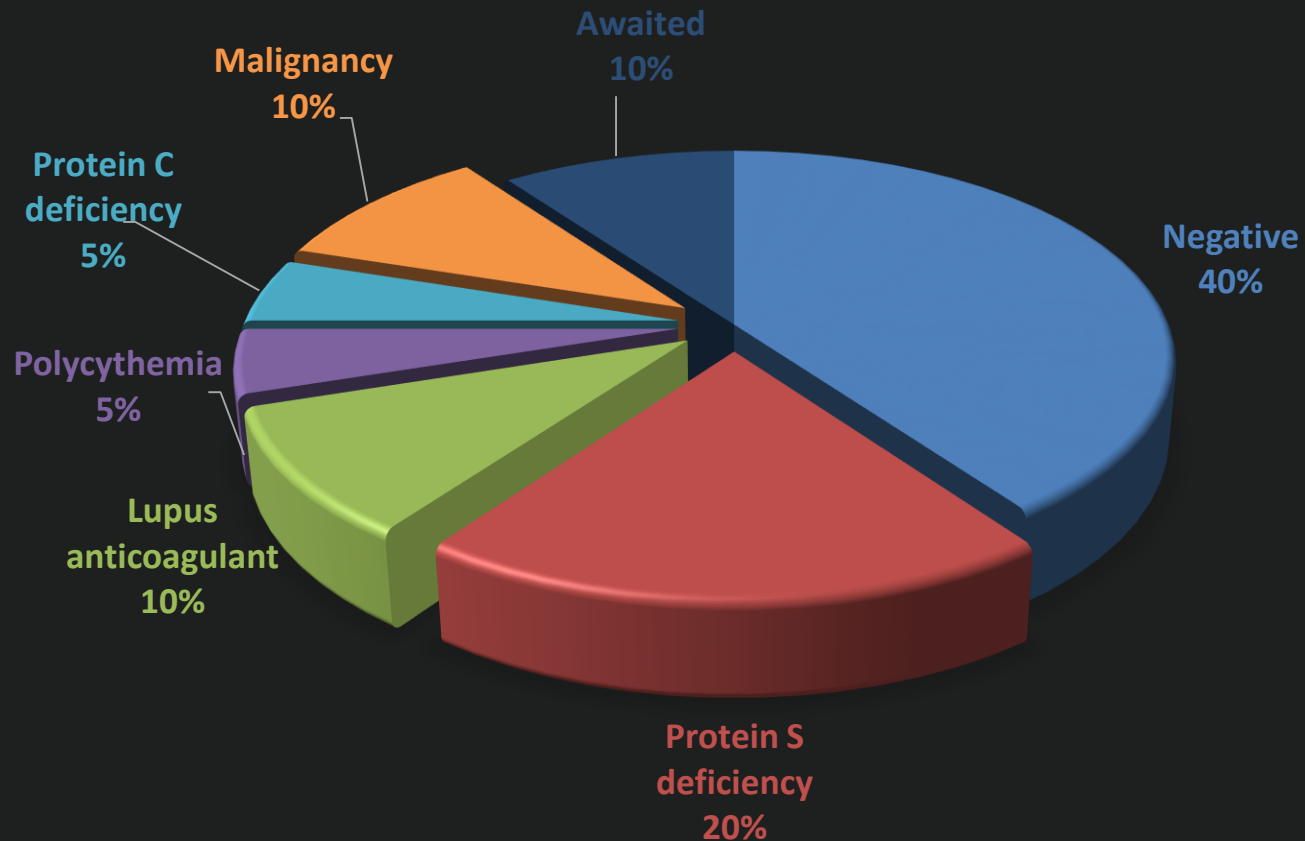
- 566 TEE in patients without embolic events.
- 7% AMT
- Pedunculated and highly mobile thrombi associated with higher risk of embolic events (73%) than layered and immobile thrombi (12%)
- 15 pt. with endovasc. procedures 27% embolic events (all highly mobile thrombi)

Etiopathogenesis of AMT

1. Local/ minor atherosclerotic lesion
2. Blunt aortic trauma
3. Use of steroids
4. Inflammatory bowel disease
5. Generalized hypercoaguation
6. Malignancy



Coagulation Disorders in AMT



Contemporary management of symptomatic primary aortic mural thrombus

Himanshu Verma, MBBS, MS, FEVS, Narendranadh Meda, MBBS, MS, Simit Vora, MBBS, MS, Robbie K. George, MS, DNB, FRCS, and Ramesh K. Tripathi, MD, FRCS, FRACS, Bangalore, India

Objective: Primary aortic mural thrombus (PAMT) is an uncommon condition but an important source of noncardiogenic emboli with a difficult diagnosis and a high rate of complications, including high mortality. We report our experience of thromboembolic disease from PAMT and review its contemporary management.

Methods: Retrospective analysis of prospectively collected data of all patients who presented with acute occlusion of a limb or visceral vessels between January 2011 and September 2013 was performed.

Results: A total of 88 patients presented with acute occlusion of the extremities or visceral arteries. All underwent extensive evaluation for the possible source of the embolism. Of these 88 patients, 19 patients (mean age, 41.2 years; male:female ratio, 1:2.1) were found to have aortic mural thrombus as the source of distal embolism. Thrombus was located in the thoracic aorta in 10 patients, in the perivisceral aorta in three patients, and in the infrarenal aorta in six patients. Thrombus in the thoracic aorta was treated with stent grafts in four patients, bare metal stents in three patients, and anticoagulation alone in two patients. In the suprarenal abdominal aorta, all three patients underwent trapdoor aortic thrombectomy. Infrarenal aortic thrombus was managed by aortobifemoral embolectomy in two patients, aortic stenting in two patients, surgical thrombectomy in one patient, and anticoagulation alone in one patient. Successful treatment, defined as freedom from further embolic events or recurrence of thrombus, was achieved in 14 of 19 patients (76.4%) with a mean follow-up period of 16.2 months (range, 2-28 months). There were four (21%) thrombus-related deaths, all due to primary thromboembolic insults. One patient needed a below-knee amputation because of a recurrent thrombotic episode.

Conclusions: Symptomatic primary aortic mural thrombus occurs more frequently in young patients and a safe procedure with good results in these vessels, it should be managed.

88 patients with acute limb ischemia or visceral ischemia

- 19 pt. (22%) due to embolization from AMT
- Location: 74% Arch & descending thoracic aorta
 14% Abdominal aorta
 12% Ascending aorta



ELSEVIER

Contents lists available at ScienceDirect

Clinical Radiology

journal homepage: www.clinicalradiologyonline.net

CrossMark

CT imaging features of symptomatic and asymptomatic floating aortic thrombus

E. Klang^{a,b}, A. Kerpel^{a,b}, S. Soffer^{b,*}, M. Zlotnik^{a,b}, O. Shimon^b,
U. Rimon^{a,b}, E. Konen^{a,b}, M.M. Amitai^{a,b}

^aDepartment of Radiology,
Israel

^bTel-Aviv University, School of Medicine

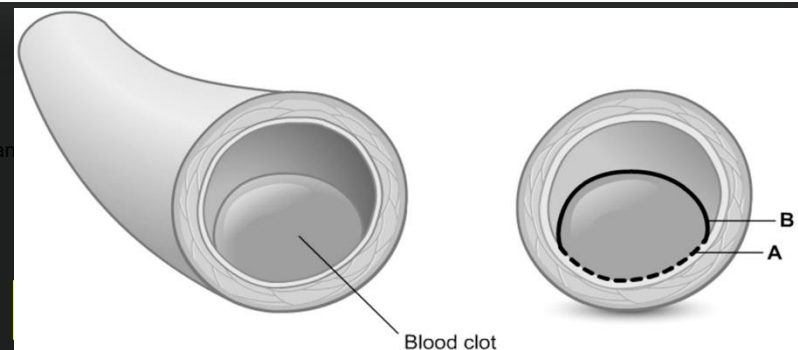
- A retrospective computerised search using the terms “floating aortic thrombus” and “mural aortic thrombus” between November 2012 to September 2016
- 15 patients.
 - 9 asymptomatic: no emboli during 9 month FU
 - 6 symptomatic: all had emboli

CT features of sympt. versus asympt. AMT

	Symptomatic group (n=6)	Asymptomatic group (n=9)	p-Value
Age	53.3±11.7 years	76.9±8.4 years	0.003
Gender	F:6, M:0 (100%)	F:2, M:9 (22.2%)	0.003
DM	2/6 (33.3%)	3/9 (33.3%)	1.0
Smoking	3/6 (50%)	6/9 (66.7%)	0.622
HTN	3/6 (50%)	4/9 (44.4%)	1.0
Dyslipidaemia	2/6 (33.3%)	3/9 (33.3%)	1.0
Malignancy	0/6 (0%)	6/9 (66.7%)	0.028
Immobilisation	2/6 (33.3%)	2/9 (22.2%)	0.633
PVD	1/6 (16.7%)	0/9 (0%)	0.400
Personal or familial history of thrombophilia	2/6 (33.3%)	0/9 (0%)	0.143

CT features of sympt. versus asympt. AMT

	Symptomatic (n=6)	Asymptomatic (n=9)	p-Value
Involvement of the ascending and arch	3/6 (50%)	2/9 (22.2%)	0.329
Non-calcified insertion site	4/6 (66.7%)	1/9 (11.1%)	0.011
Percentage of thrombus circumference attached to the aortic wall	31.8±8.4%	43.7±5.0%	0.003
Thrombus volume	1.8±2.5 cm ³	1.6±0.8 cm ³	0.456



Klar

Blood clot

Digital Embolization From Plaque-Related Thrombus in the Thoracic Aorta: Identification With Transesophageal Echocardiography and Resolution With Warfarin Therapy

JOSEPH L. BLACKSHEAR, M.D., ARSHAD JAHANGIR, M.D., W. ANDREW OLDENBURG, M.D., ROBERT E. SAFFORD, M.D., Ph.D.

Mayo Clinic Proceedings
Volume 88, Issue 1
DOI: 10.1016/S0025-

Clin. Cardiol. 19, 151–152 (1996)

Resolution of an Aortic Mobile Mass with Anticoagulation without Evidence of Arterial Embolism

T. PASIERSKI, M.D., S. JASEK, M.D.
National Institute of Cardiology



ELSEVIER



CrossMark

Summary: The prognostic significance of a mobile mass in the aorta is uncertain. A mobile aortic arch mass was found in a man with coronary artery disease, aortic valve disease, and with no evidence of embolism.

Anticoagulation Alone for Aortic Segment Treatment in Symptomatic Primary Aortic Mural Thrombus Patients

Andrés R. Enriquez

Background: Aortic mural thrombi (AMT) are rare. The appropriate indications and the efficacy of surgical thrombectomy, thrombolysis, and systemic anticoagulation remain controversial. **Methods:** This study, set in an academic medical center, was a retrospective review of five patients with AMT in the absence of aortic disease who underwent treatment between 1997 and 2001. The main outcome measures were morbidity, mortality, and treatment outcome. **Results:** Three patients were women, and ages ranged from 40 to 77 years. On admission, all patients had symptoms related to thrombus embolization (extremity pain or abdominal pain). Two patients had a history of venous thromboembolism (pulmonary embolism or deep venous thrombosis). Four patients had biochemical evidence of hypercoagulability, and the fifth had malignant disease. Coagulation disorders included increased homocysteine (n = 2) and factor VIII (n = 1), antithrombin III (n = 1) and protein C deficiency (n = 1), and familial dysfibrinogenemia (n = 1). AMT were located in the infrarenal (n = 1), suprarenal (n = 3), and descending thoracic (n = 1) aorta. One patient needed exploratory laparotomy and one needed lower extremity vascular procedures for visceral and limb-threatening ischemia, respectively. Treatment with systemic anticoagulation therapy resulted in complete resolution on follow-up computed tomographic scan or angiogram of the AMT at a median of 60 days. **Conclusion:** Most patients in whom AMT develops in the absence of underlying aortic disease have underlying coagulation disorders.

CLINICAL RESEARCH STUDIES

Anticoagulation is an effective treatment for aortic mural thrombi

Michael E. Bowdish, MD,^a Fred A. Weaver, MD,^a Howard A. Liebman, MD,^b Vincent L. Rowe, MD,^a and Douglas B. Hood, MD,^a Los Angeles, Calif

Background: Aortic mural thrombi (AMT) in the absence of aortic disease are rare. The appropriate indications and the efficacy of surgical thrombectomy, thrombolysis, and systemic anticoagulation remain controversial.

Methods: This study, set in an academic medical center, was a retrospective review of five patients with AMT in the absence of aortic disease who underwent treatment between 1997 and 2001. The main outcome measures were morbidity, mortality, and treatment outcome.

Results: Three patients were women, and ages ranged from 40 to 77 years. On admission, all patients had symptoms related to thrombus embolization (extremity pain or abdominal pain). Two patients had a history of venous thromboembolism (pulmonary embolism or deep venous thrombosis). Four patients had biochemical evidence of hypercoagulability, and the fifth had malignant disease. Coagulation disorders included increased homocysteine (n = 2) and factor VIII (n = 1), antithrombin III (n = 1) and protein C deficiency (n = 1), and familial dysfibrinogenemia (n = 1). AMT were located in the infrarenal (n = 1), suprarenal (n = 3), and descending thoracic (n = 1) aorta. One patient needed exploratory laparotomy and one needed lower extremity vascular procedures for visceral and limb-threatening ischemia, respectively. Treatment with systemic anticoagulation therapy resulted in complete resolution on follow-up computed tomographic scan or angiogram of the AMT at a median of 60 days.

Conclusion: Most patients in whom AMT develops in the absence of underlying aortic disease have underlying coagulation disorders.

Anticoagulation Alone for Aortic Segment Treatment in Symptomatic Primary Aortic Mural Thrombus Patients

Andrés Reyes Valdivia, Africa Duque Santos, Marta Garnica Ureña, Asunción Romero Lozano, Enrique Aracil Sanus, Julia Ocaña Guaita, and Claudio Gandaria, Madrid, Spain

- Jan 2011- sept 2016
- 8pt with sympt AMT
 - 4 pt: arch/desc
 - 1 pt: visceral
 - 3 pt: infrarenal
- 1 early death
- 7 treatment sympt and anticoagulation (heparine & acenocomarol)
- 5/7 complete resolvment of thrombus
- No recurrent emboli

CLINICAL RESEARCH STUDIES

Anticoagulation is an effective treatment for aortic mural thrombi

Michael E. Bowdish, MD,^a Fred A. Weaver, MD,^a Howard A. Liebman, MD,^b Vincent L. Rowe, MD,^a and Douglas B. Hood, MD,^a *Los Angeles, Calif*

Background: Aortic mural thrombi (AMT) in the absence of aortic disease are rare. The appropriate indications and the efficacy of surgical thrombectomy, thrombolysis, and systemic anticoagulation remain controversial.

Methods: This study, set in an academic medical center, was a retrospective review of five patients with AMT in the absence of aortic disease who underwent treatment between 1997 and 2001. The main outcome measures were morbidity, mortality, and treatment outcome.

Results: Three patients were women, and ages ranged from 40 to 77 years. On admission, all patients had symptoms

related to
 embolism
 ability, an
 VIII (n =
 were loca
 explorato
 respective
 tomograp
 Conclusio
 disorders.
 of end or

- Retrospective analysis 1997-2001
- 5 patients with sympt AMT
 - 1 thoracic/3 visceral/1 infrarenal
 - 4x hypercoaguability/ 1x malignancy
- Heparine i.v 6-21 days/ Coumarin (INR 2,5-3,5)
- Complete resolution of AMT in all (median 60 days (3-90))
- No recurrent AMT or embolic event (mean FU 29 ± 11 months)



ELSEVIER

Aortic Mural Thrombus in the Normal or Minimally Atherosclerotic Aorta

Ziad Y. Fayad, Elie Semaan, Bashar Fahoum, Matt Briggs, Anthony Tortolani, and Marcus D'Ayala, Brooklyn, New York

- Review of literature upto 2011 & meta-analysis
- Anticoagulation versus (open) Aortic Surgery
- 200 patients in 98 publications
 - 112x anticoagulation
 - 88x aortic surgery



ELSEVIER

Aortic Mural Thrombus in the Normal or Minimally Atherosclerotic Aorta

Ziad Y. Fayad, Elie Semaan, Bashar Fahoum, Matt Briggs, Anthony Tortolani, and Marcus D'Ayala, Brooklyn, New York

Table II. Distribution of aortic mural thrombus for the anticoagulation and the surgery group

Location of thrombus	Anticoagulation % (n)	Surgery % (n)	0.0002
Arch	26 (29)	48 (42)	
Ascending	7 (8)	17 (15)	
Descending	50 (54)	25 (22)	
Abdominal	17 (19)	10 (9)	

Treatment Outcome

	Anticoagulation	Aortic Surgery	
• Persistent/recurrent AMT	26.4%	5.7%	p<0.001
• Recurrent emboli	25.7%	9.1%	p=0.003
• Mortality	6.2%	5.7%	ns
• Complications	27%	17%	p=0.07
• Major Amputation	9%	2%	p=0.004

Descending thoracic aortic mural thrombus presentation and treatment strategies



Karol Meyermann, MD, Jose Trani, MD, Francis J. Caputo, MD, and Joseph V. Lombardi, MD, Camden, NJ

ABSTRACT

Background: Thoracic aortic mural thrombus (TAMT) of the descending aorta is rare but can result in dramatic embolic events. Early treatment is therefore crucial; however, there is not a consensus on ideal initial treatment.

Methods: A review of the literature using PubMed was conducted, and all relevant publications describing descending TAMT of the past 15 years were reviewed. Variables included for this analysis were presentation, initial treatment strategy employed, outcome measures of thrombus resolution or regression, recurrence of symptomatic emboli, and mortality.

Results: Seventy-four patients were included in this analysis. Women were significantly more likely to be described with descending TAMT. The majority (82.4%) of cases reported were diagnosed after an embolic event. Patients were equally likely to receive medical, open surgical, or endovascular therapy as the initial treatment modality. However, there is a trend within the past 5 years to report cases describing successful thoracic endovascular aortic repair for initial management. Of patients who initially underwent medical management, nine patients (34.6%) had persistent thrombus. Of the patients who initially underwent open surgical repair, six patients (31.6%) had persistent thrombus; of these patients, four underwent endovascular repair. Twenty-nine patients (39.2%) with descending TAMT initially underwent thoracic endovascular aortic repair. Twenty-seven (93.1%) had fully excluded thrombus at the time of the procedure, with no recurrence or evidence of embolism.

Conclusions: Where diagnosis of embolism is positive outcomes in

Review of literature on AMT in descending thoracic aorta

- 2001 - 2016
- 74 patients in 32 publications

Meyermann K, et al., J Vasc Surg. 2017;66(3):931-6.

Choice of Initial Treatment

	Medical	Open	TEVAR
2001-2005	22%	67%	11%
2007-2011	36%	40%	24%
2012-2016	38%	8%	55%

Meyermann K, et al., J Vasc Surg. 2017;66(3):931-6.

Choice of Initial Treatment

	Medical	Open	TEVAR	Cases
2001-2005	22%	67%	11%	9
2007-2011	36%	40%	24%	25
2012-2016	38%	8%	55%	40

Meyermann K, et al., J Vasc Surg. 2017;66(3):931-6.

Treatment Outcome

Initial treatment	No. of patients (N = 74)	Thrombus regression, resolution, or exclusion; no repeated embolic events	Persistent thrombus	Crossover to TEVAR	Death
Open surgery	19 (25.7) ^a	13 (68.4)	6 (31.6)	→ 4 (21)	0
TEVAR	29 (39.2) ^a	27 (93.1)	0	0	2 (6.9)
Medical	26 (35.1) ^a	17 (65.4)	9 (34.6)	→ 4 (15.3)	4 (15.4)

TEVAR, Thoracic endovascular aortic repair.

Values are reported as number (%).

^aStatistical analysis with χ^2 test for initial treatment modality, $P = .34$.

Conclusions

- Although AMT is uncommon, it must be considered in the differential diagnosis of embolic events. So, image the aorta.
- Hypercoagulability workup should be done in both symptomatic and asymptomatic AMT.
- There is no consensus regarding treatment of AMT (beside that emboli should be treated first).
- Risk of embolization of asymptomatic AMT is higher in more mobile AMT, younger patients and non-calcified insertion site. Primary (interventional) treatment can be considered.

Conclusions

- For the complete aorta:
 - Anticoagulation compared to aortic surgery has high recurrence rate of AMT (26% vs 6%) and emboli (26% vs. 9%) and should be reserved for high risk patients and AMT in more difficult locations
- For the descending thoracic aorta:
 - anticoagulation alone has compatible results as open aortic surgery
 - 30% persistent/ recurrent AMT in OR /AC
 - TEVAR performs best