2023 MID-ATLANTIC CONFERENCE

11th ANNUAL CURRENT CONCEPTS IN

VASCULAR THERAPIES

2023

Acute Blue Toes: Diagnosis and Plan

Samuel N. Steerman, MD, FACS, RPVI
EVMS Assistant Professor of Surgery
Sentara Vascular Specialists

FV

Disclosures

- BD – consultant and speaker
- Philips – consultant
- Abbott – consultant
- Medtronic – speaker

Outline

- What is Blue Toe Syndrome
- What isn’t Blue Toe Syndrome (Ddx for blue feet)
- Pathophysiology
- Presentation
- Diagnosis
- Treatment

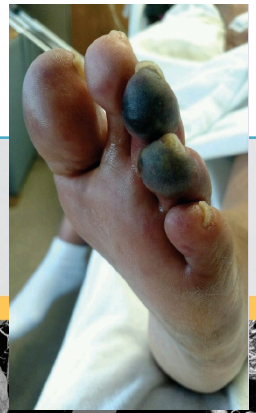
Blue Toe Syndrome

BTS is:

the acute onset of purple painful digits in the absence of evident trauma, cold-associated injury or disorders that induce generalized cyanosis.

Differential diagnosis of blue toe syndrome

Emboli from cardiac and arterial system	Hypercoagulability disorders	Peripheral vascular pathology and Other
Atrial fibrillation Endocarditis Left ventricular aneurysm Cholesterol crystal from PAD Penetrating ulcers or Aneurysms of the aorto-iliac-femoral arterial system Cardiac/vascular tumors (myxoma) Valvular heart disease Left atrial septal pouch Iatrogenic injury	Antiphospholipid syndrome Malignancy Thrombocytopenic purpura Disseminated intravascular coagulation Warfarin skin necrosis Cryoglobulinemia Myeloproliferative disorders	Raynaud's phenomenon Perniosis (Chilblains) Frostbite Infectious and noninfectious inflammation Medication-induced vasoconstriction Trauma Pressure necrosis



Adapted from: Pradhan et al. Thrombosis Journal (2020) 18:13
https://doi.org/10.1186/s12959-020-00226-x

SENTARA®

Perspective and History is Important

Pernio (chilblains)

- Inflamed swollen patches and blistering on the hands and feet
- Primary affects young, underweight women living in cold, humid climates
- Self limiting
- Avoiding cold temperatures and vasospastic factors

STAGES OF CHRONIC VENOUS INSUFFICIENCY

Normal veins | Spider veins | Varicose veins | Swelling & skin changes | Venous ulcer

Frostbite

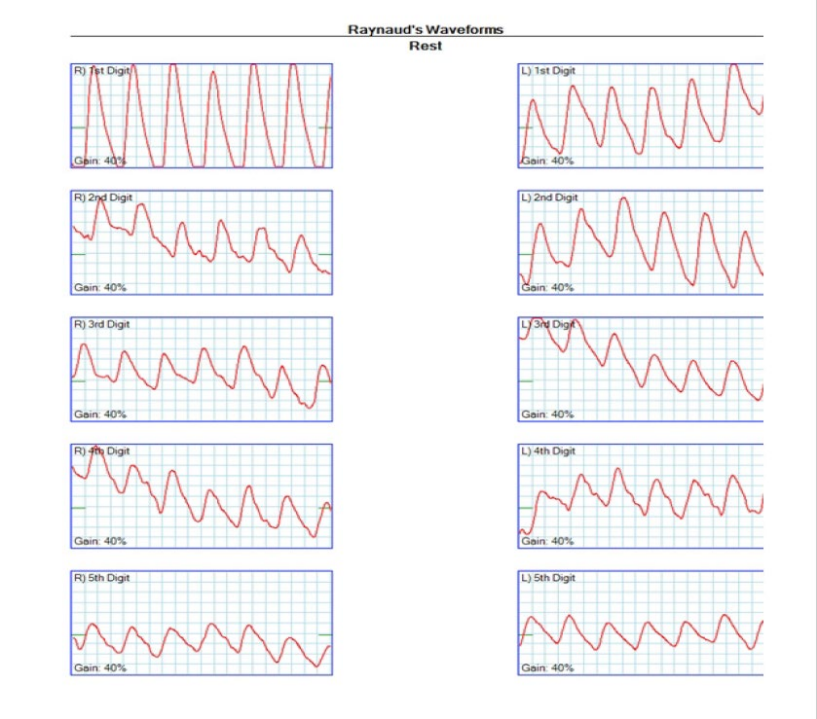
Acrocyanosis

- Painless disorder of decreased oxygen delivery
- Risk factors of acrocyanosis are:
  - cold climate
  - outdoor occupation
  - low body mass index (BMI)
  - major neurological deficit

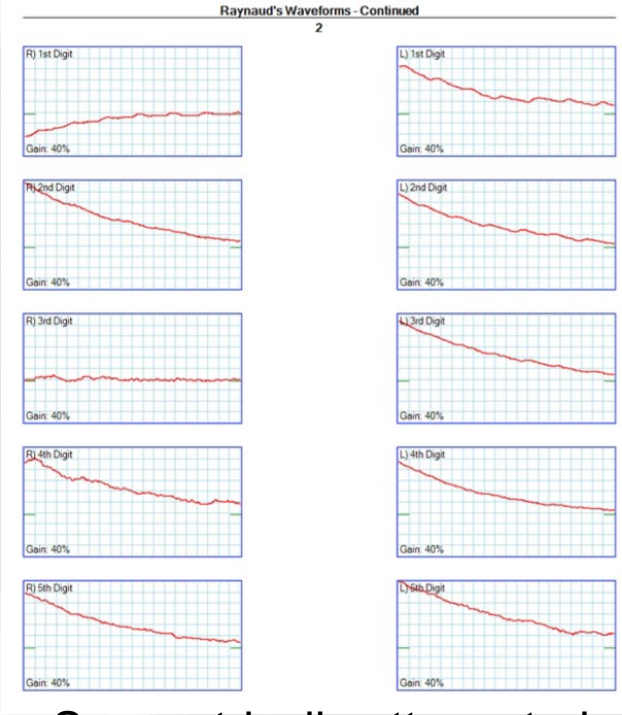
Raynaud's Phenomenon

- Vasospastic disorder, primarily of the distal extremities
- Attacks can be precipitated by environmental factors, such as exposure to cold or physical trauma. Smoking, heavy alcohol consumption, caffeine, or vasoactive medications can precipitate episodes

The Peripheral Vascular Lab:
Toe pressures



Normal toe pressures



Symmetrically attenuated toe pressures

Bluish purple ischemic discoloration of the second and fourth toes of the left foot consistent with blue toe syndrome

Epidemiology of BTS

- Process of emboli from proximal lesions produce ischemia in distal arterial beds
- Incidence
  - 0.18% - 2.4% in unselected autopsy series
  - 12%-77% in pt's after aortic manipulation

- The risk of atheromatous embolization is directly related to the severity of aortic atherosclerosis

Pathophysiology of BTS

The following 6 key elements are required for the development of cholesterol embolization syndrome:

1. Presence of a plaque in a proximal, large-caliber artery (such as the internal carotid artery, the iliac arteries, or the aorta)
2. Plaque rupture (spontaneous, traumatic, or iatrogenic)
3. Embolization of plaque debris (containing cholesterol crystals, platelets, fibrin, and calcified detritus)
4. Lodging of the emboli in small to medium arteries with a diameter of 100 to 200 microns, leading to mechanical occlusion
5. Foreign-body inflammatory response to cholesterol emboli
6. End-organ damage due to a combined effect of mechanical plugging and inflammation

Clinical Manifestations of Atheromatous Embolization

SKIN
- Purple or blue toes
- Gangrenous digits
- Livedo reticularis
- Nodules

RENAL
- Uncontrolled hypertension
- Renal failure

NEUROLOGIC
- Transient ischemic attack
- Amaurosis fugax
- Stroke
- Hollenhorst plaque

CARDIAC
- Myocardial infarction or ischemia

GASTROINTESTINAL
- Abdominal pain
- Gastrointestinal bleeding
- Ischemic bowel
- Acute pancreatitis

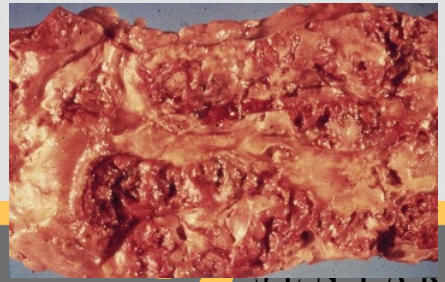
CONSTITUTIONAL SYMPTOMS
- Fever
- Weight loss
- Malaise
- Anorexia

Causes of Blue Toe Syndrome

- Risk factors
  - Established atherosclerosis
  - PaOD
  - HTN
  - Increased age
  - CAD
- Precipitating factors
  - Trauma
  - Vascular surgery
  - Angiographic or endovascular procedures
    - Now the most frequent cause
  - Anticoagulation – although controversial
  - Thrombolysis

Atheroemboli

- The thoracic aorta is the source of embolism in 10% to 15% of patients and is associated with nearly a 60% recurrence rate and significant mortality if untreated because visceral ischemia and renal failure are common.

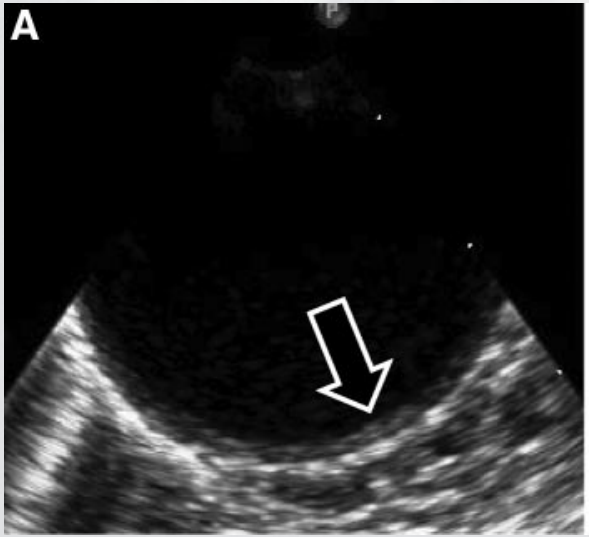


Gross Pathology

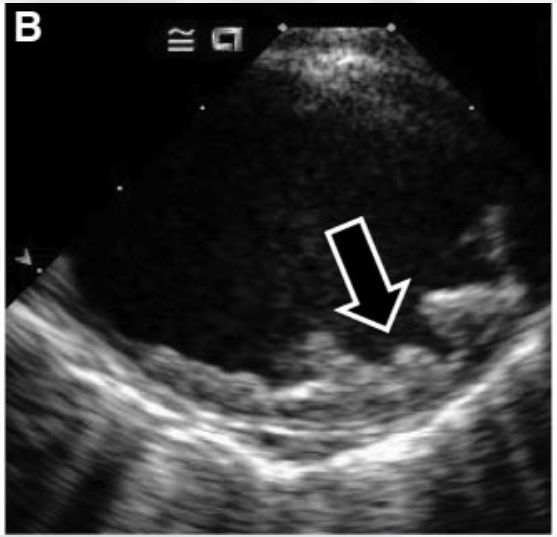
(a) Normal thoracic aorta in a child
(b) Severe atherosclerosis of the aorta in an old man.

Thiene G, Basso C, Della Barbera M. Pathology of the Aorta and Aorta as Homograft. *Journal of Cardiovascular Development and Disease*. 2021; 8(7):76. https://doi.org/10.3390/jcdd8070076

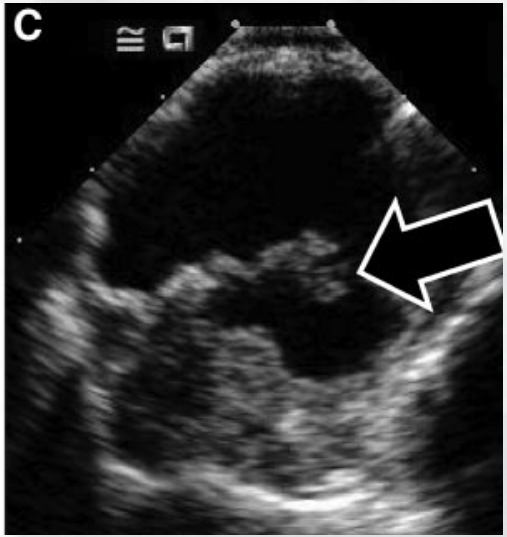
Aortic plaque in the descending thoracic aorta visualized by 2-dimensional TEE



Simple atherosclerotic plaque, measuring 2 mm in this patient.

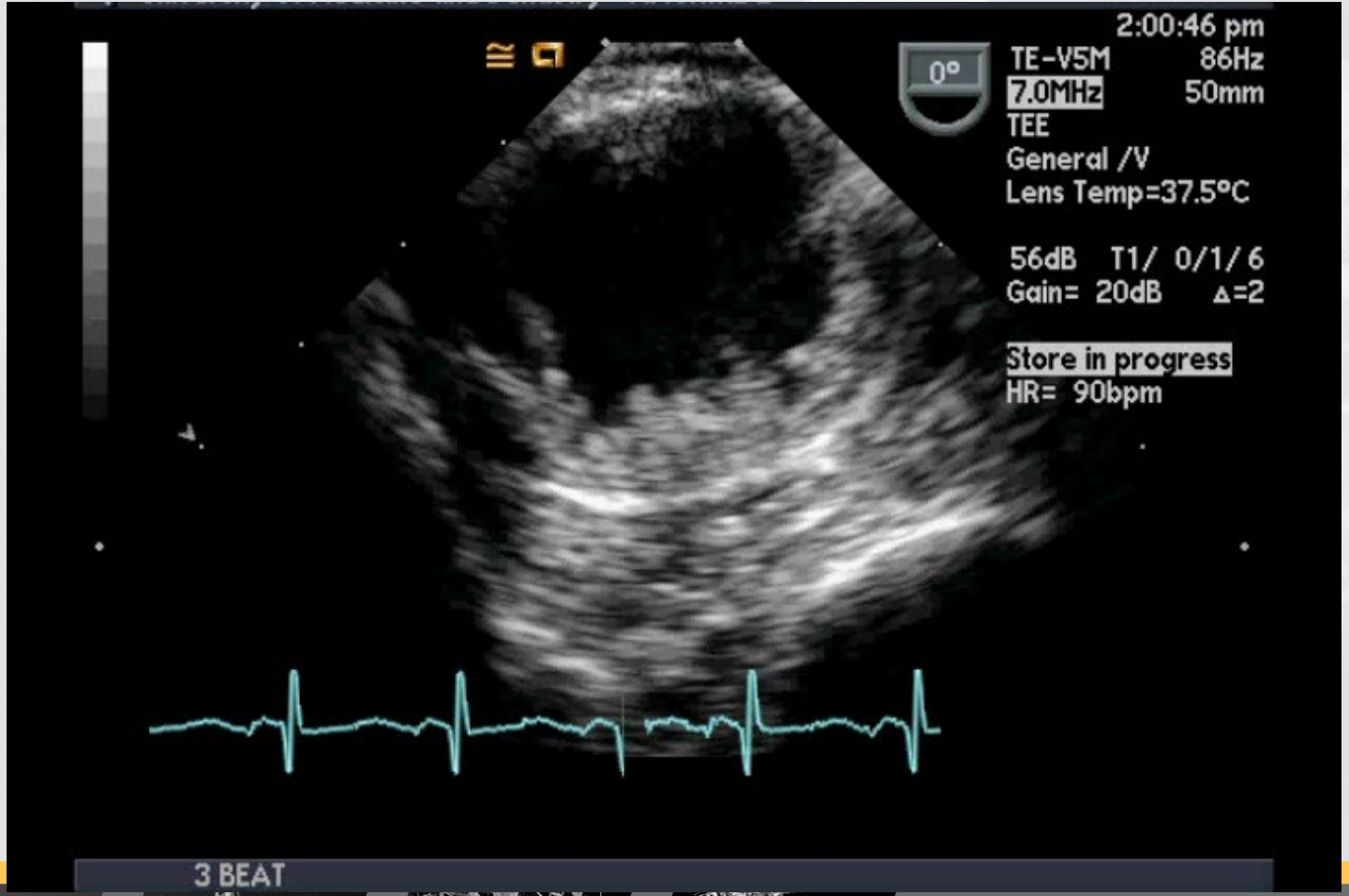


Complex atherosclerotic plaque with deep ulcerations (arrow).



Complex atherosclerotic plaque with a mobile component (arrow) that represents a thrombus.

Itzhak Kronzon, Muhamed Saric "Cholesterol Embolization Syndrome" 2010 Circulation 631-641, 122, 6 doi:10.1161/CIRCULATIONAHA.109.886465


2:00:46 pm
TE-V5M
86Hz
7.0MHz
50mm
TEE
General /V
Lens Temp=37.5°C
56dB T1/ 0/1/6
Gain= 20dB Δ=2
Store in progress
HR= 90bpm
3 BEAT

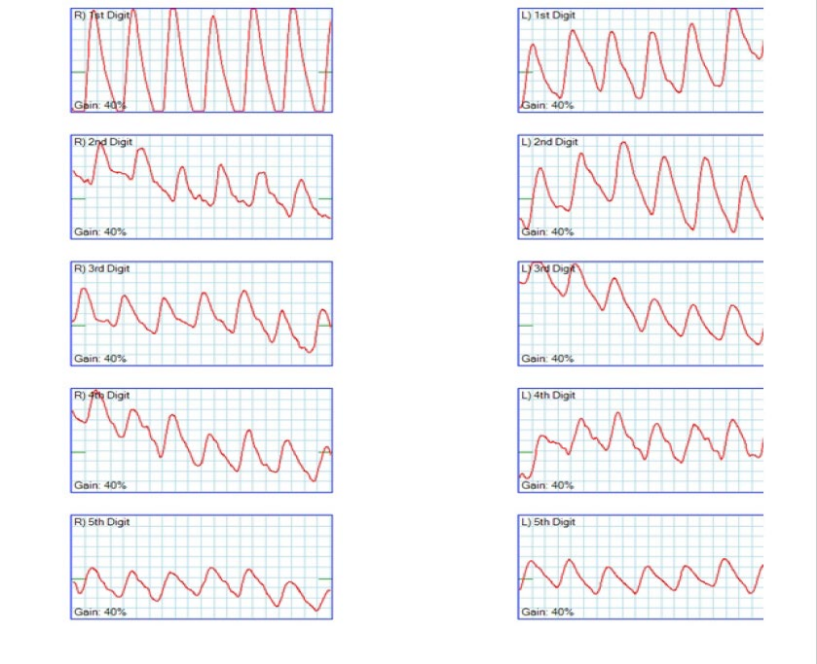
Findings

- Constitutional signs and symptoms (manifestation of the inflammatory response) such as:
  - Fever
  - weight loss
  - Anorexia
  - Fatigue
  - myalgias are frequent manifestation of the inflammatory response
- Laboratory tests may also show an abnormality in inflammatory markers such as:
  - a rise in leukocyte count
  - erythrocyte sedimentation rate
  - C-reactive protein
  - decrease in serum complement levels (hypocomplementemia)
  - Possible anemia or thrombocytopenia.

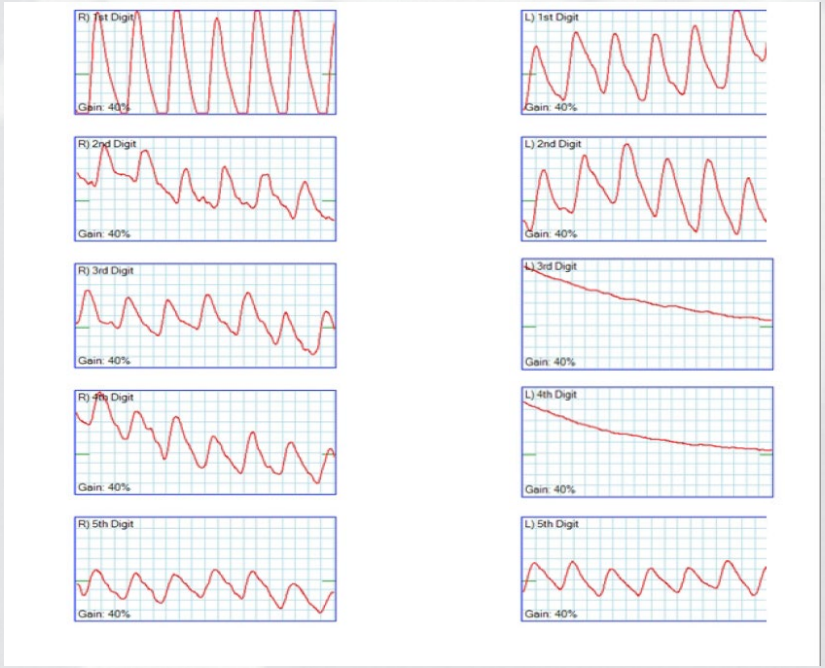
Diagnosis

- Histopathological confirmation by biopsy is the only definitive test for cholesterol embolization syndrome
  - Biopsy is performed rather infrequently because it may lead to poor healing at the sampling site
- Clinical Diagnosis
- Peripheral Vascular Lab (PVL)
  - Can present with decreased toe pressures

The Peripheral Vascular Lab:
Toe pressures



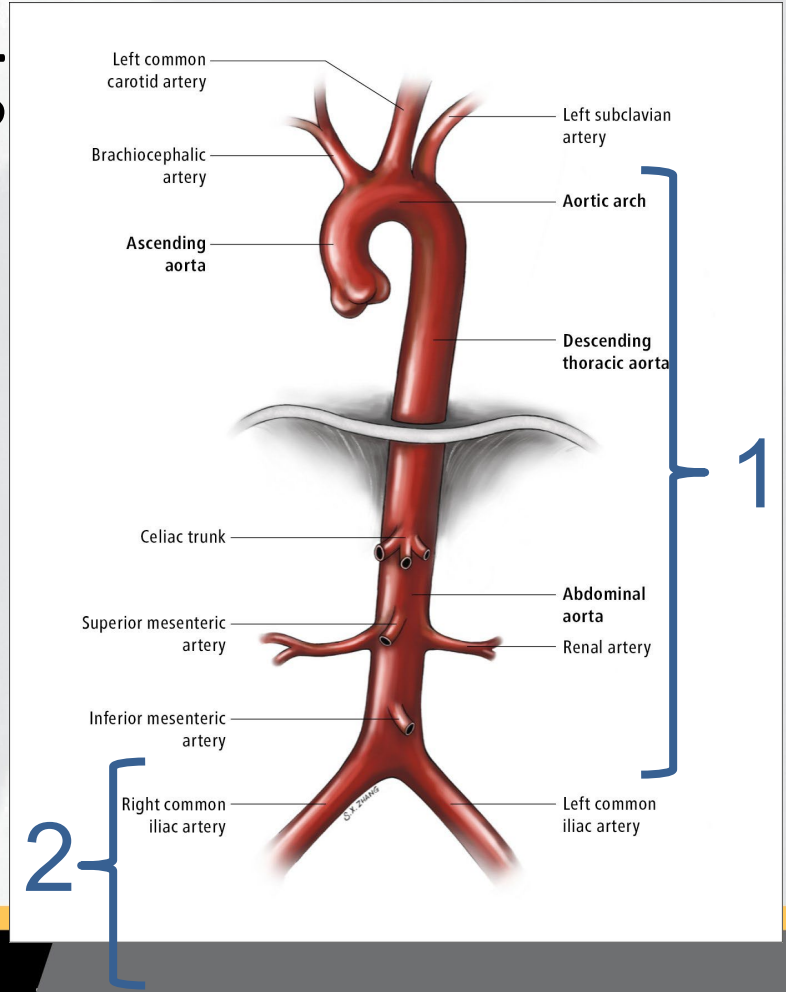
Normal toe pressures



Asymmetrical flat toe pressures

Diagnostic imaging

- Unilateral vs Bilateral
  - Bilateral – focus above aortic bifurcation
    - CTA C/A/P, Cardiac echo?
  - Unilateral – focus below the aortic bifurcation
    - Arterial duplex, CTA AA and run-off, less common angiogram



Characteristic superficial femoral artery atheroembolic lesion responsible for ‘blue toe syndrome."

Surgical management of atheroembolization J VASC SURG 1995;21:773-81.

Treatment

- Treatment goals are 2-fold:
  - supportive care for end-organ damage
  - secondary prophylaxis against another episode of cholesterol embolization syndrome.
- Modification of traditional risk factors:
  - Smoking
  - Hypertension
  - serum cholesterol
- Statins – weak evidence, but frequently used
- Antiplatelet agents –used presumptively
- ACE inhibitors or direct angiotensin receptor blockers can also be considered.
- Anticoagulation – very controversial

BTS presentations

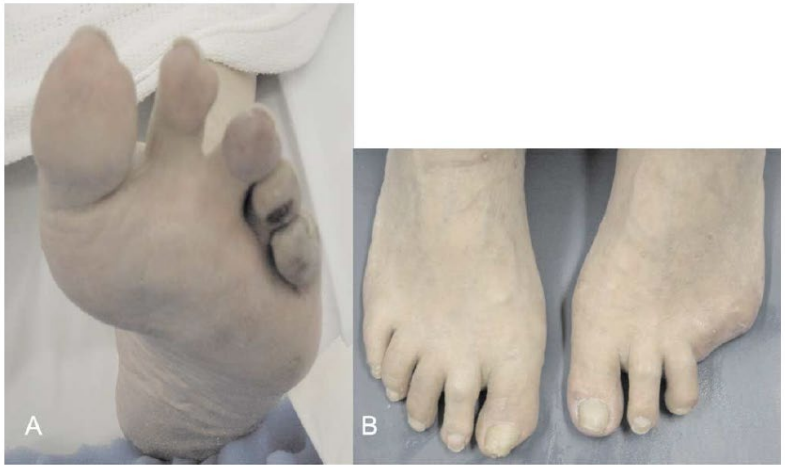
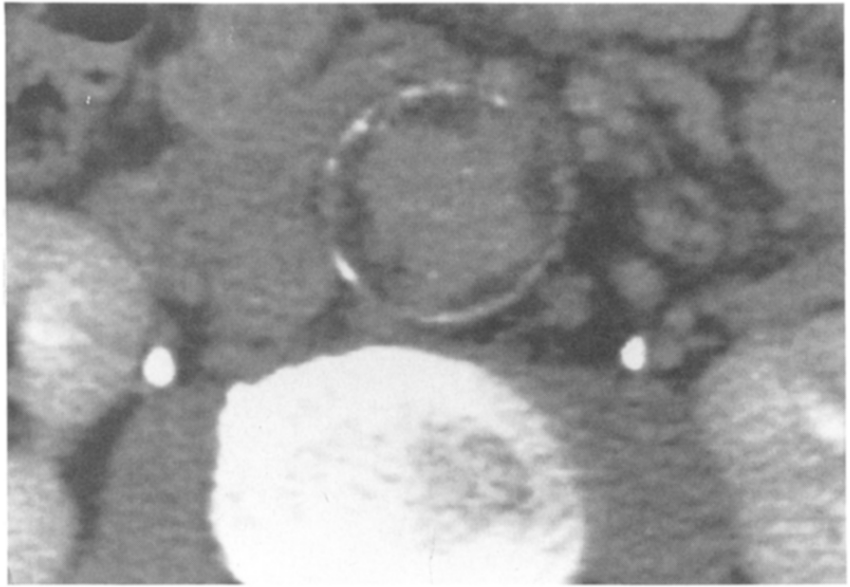
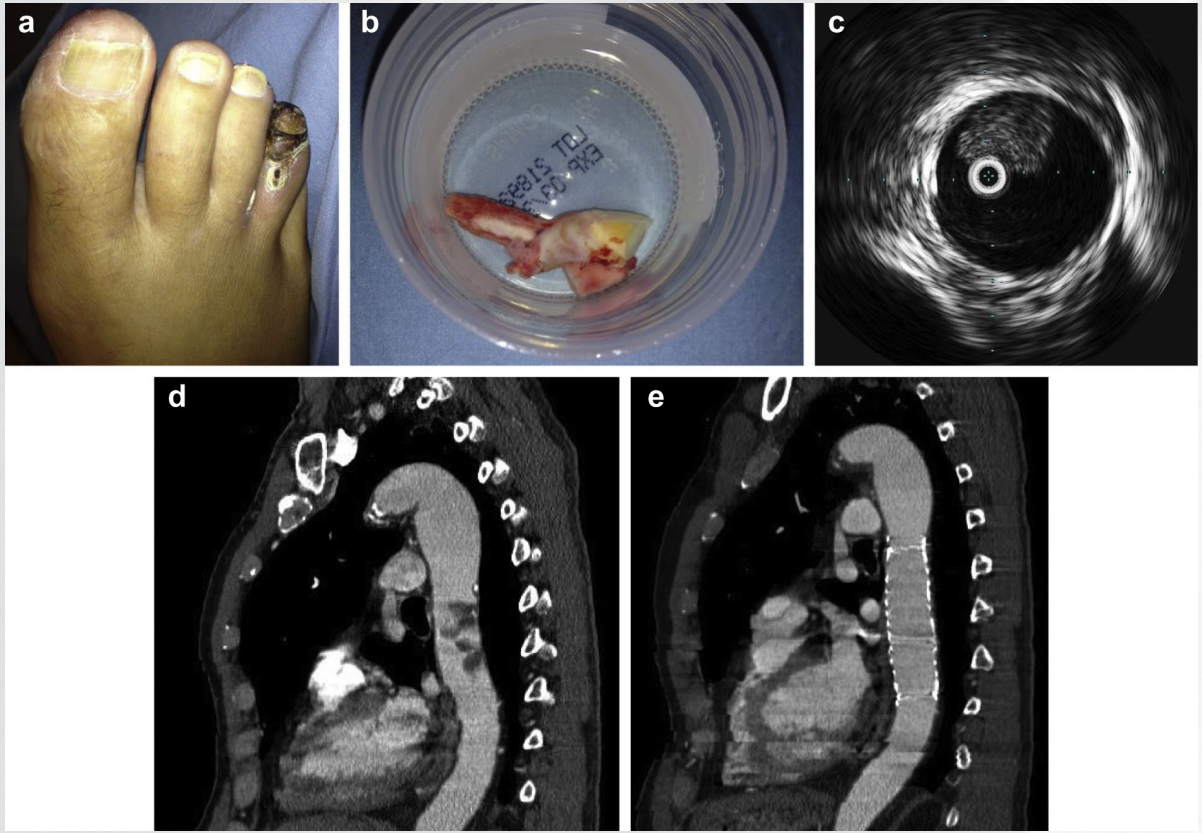


Fig 1. A, Photograph of a foot on presentation, with toe gangrene as manifestation of atheromatous embolization in a patient with AAA and palpable pedal pulses. **B,** Following stent-graft exclusion of AAA and amputation of gangrenous toes with no further evidence of embolization.



Star-shaped thrombus in small (3.7 cm) abdominal aortic aneurysm that presented with embolization. Characteristic operative findings in aneurysms that embolized was irregular, complex thrombus overlying ulcerative aortic plaque.

Surgical management of atheroembolization J VASC SURG 1995;21:773-81.

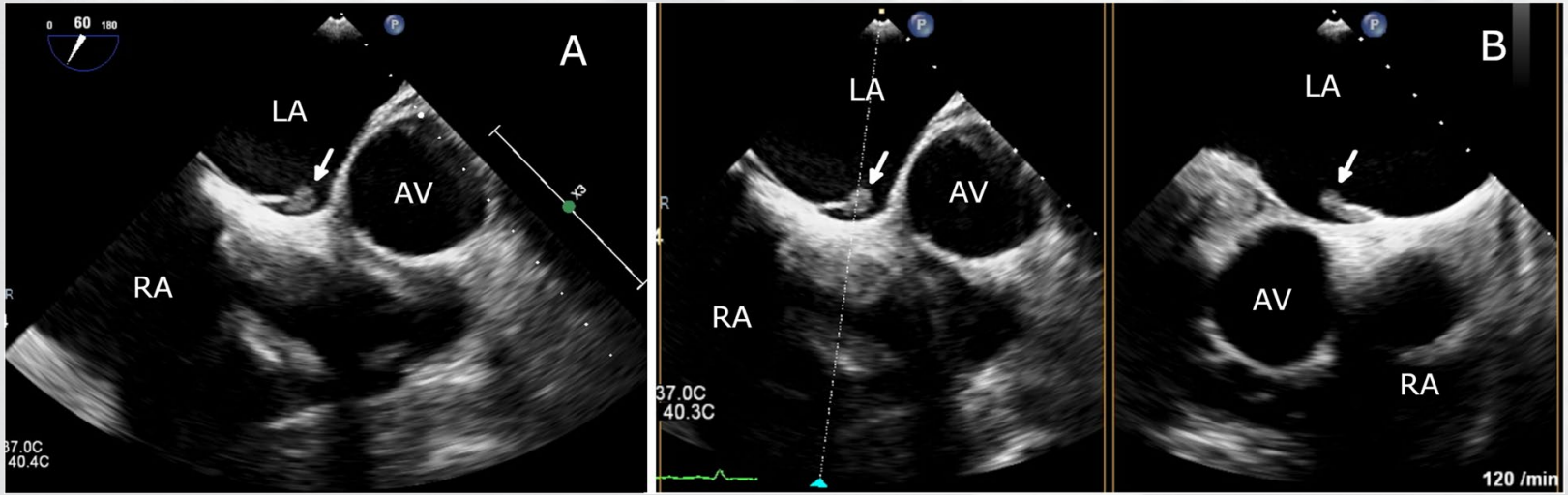


a.Toe gangrene as presenting symptom.
b, Chronic organized thrombus retrieved from iliac arteries.
c, Intravascular ultrasound (IVUS) image of eccentric thrombus in the descending thoracic aorta.
d, Preoperative computed tomography
(CT) shows descending thoracic aortic thrombus.
e, Postoperative CT with stent graft coverage of embolizing lesion.

Endovascular strategies for treatment of embolizing thoracoabdominal aortic lesions J Vasc Surg 2014;59:1256-64.

Pradhan et al. Thrombosis Journal (2020) 18:13
https://doi.org/10.1186/s12959-020-00226-x

Intra-cardiac thrombus



Transesophageal echocardiogram (TEE) showing Left atrial septal pouch opening into the left atrial (LA) cavity and a 7.7 × 3mm thrombus (arrow), with the site of attachment corresponding to the LASP. AV, aortic valve; LA, left atrium; RA, right atrium

Presentation

- 70 y.o. male with HTN, HLD, ESRD and hx TIA who has been suffering from bilateral lower extremity blue toe syndrome s/p cardiac catheterization for an MI in 5/25. He has progressively declined over the past few months with a 60 lb weight loss in the last 3 months due to loss of appetite. He also states he has no energy and is constantly sleeping because the pain in his feet are so severe. Pt reports some numbness/tingling of his bilateral toes but currently denies any other symptoms.

Physical

- BP 127/76 | Pulse 87 | Temp 95.4 °F (35.2 °C) | Resp 18 | Ht 5' 11" (1.803 m) | Wt 66.8 kg (147 lb 4.3 oz) | BMI 20.54 kg/m2 | SpO2 93%
- General: NAD, AAOx3, thin, Cachectic appearing Caucasian male
- HEENT: NC/AT, PERRLA
- Chest: no chest wall tenderness or deformities
- Lungs: CTAB
- CV: RRR, no M/R/G, no peripheral edema
- Neuro: AAOx3, sensation and motor intact
- Abd: soft, ND, NTD
- Rectal: deferred
- Ext: warm, intact distal pulses, doppler signals present bilaterally. **Bluish discoloration on plantar surfaces of bilateral toes with necrotic tissues on plantar surface of right 1st-3rd toes and left 2nd toes**

Pulses

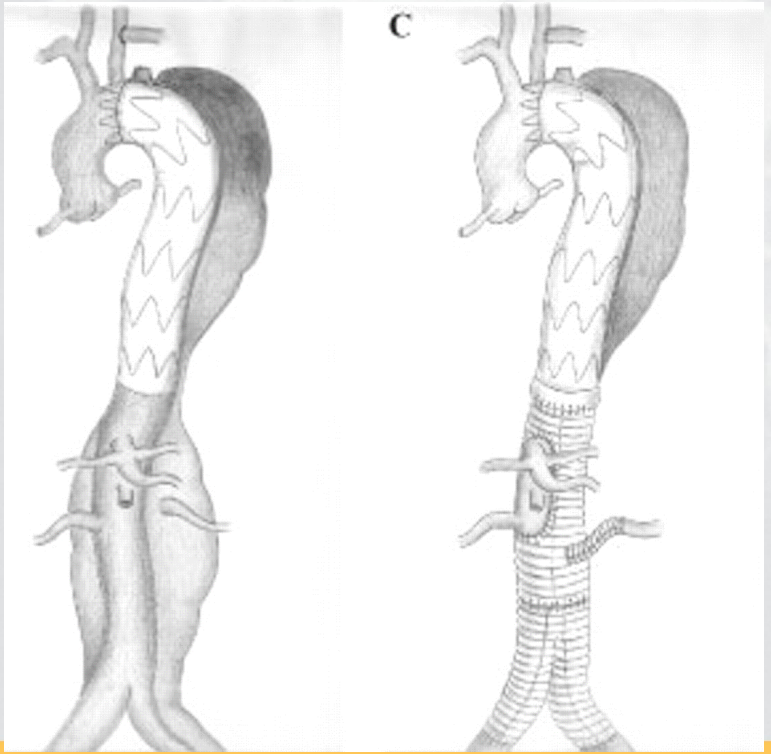
Right:

- **Carotid nml pulse**
- **Brachial 2+**
- **Radial 2+**
- **Femoral 2+**
- **Popliteal 1**
- **Dorsalis 1**
- **Post Tib 1**

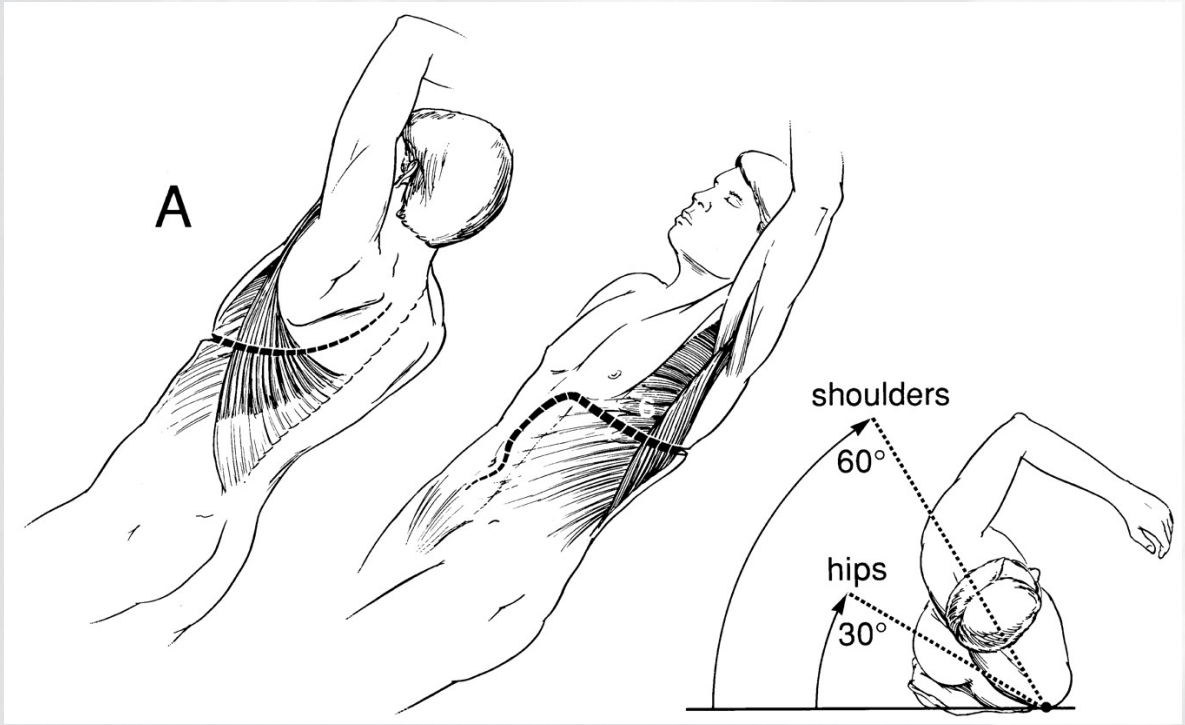
Left:

- **Carotid nml pulse**
- **Brachial 2+**
- **Radial 2+**
- **Femoral 2+**
- **Popliteal 1**
- **Dorsalis 1**
- **Post Tib 1**

Shaggy Aorta



Operative exposure



Conclusion

- Many etiologies have similar presentations to true cholesterol embolization syndrome
- Diagnostic studies is based on presumptive cause
- Treatment focuses on supportive care, medical stabilization of plaque and, possibly, treatment of source of embolization