ACUTE ARTERIAL OCCLUSION

Vascular Surgery Conference
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ACUTE ARTERIAL OCCLUSION

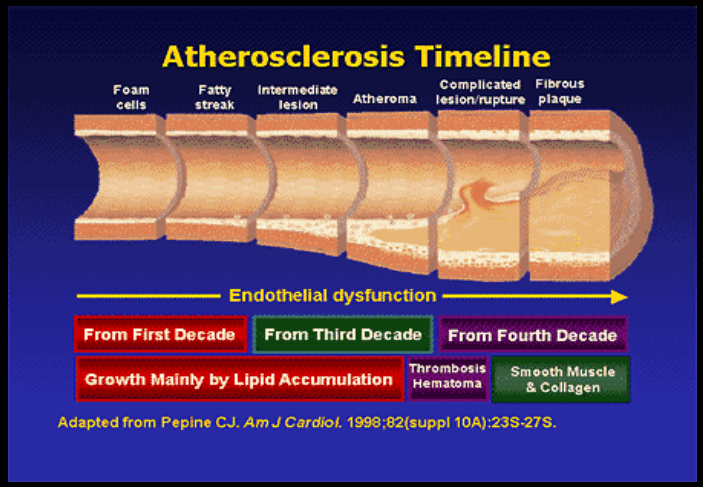
" The operation was a success but the patient died"

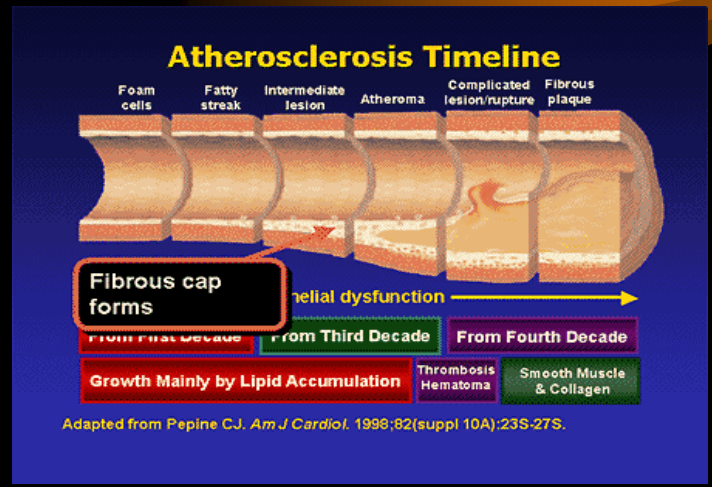
- High Morbidity and Mortality
  - Emergent operations in high risk patients
  - 20% mortality reported (Dale, JVS 1984)
  - Endovascular approaches may lower peri-procedural mortality while preserving outcomes

Etiology of Arterial Occlusion

- **Overview**
  - Atherosclerosis
  - Thrombotic occlusion
  - Embolic occlusion
  - Treatment Options

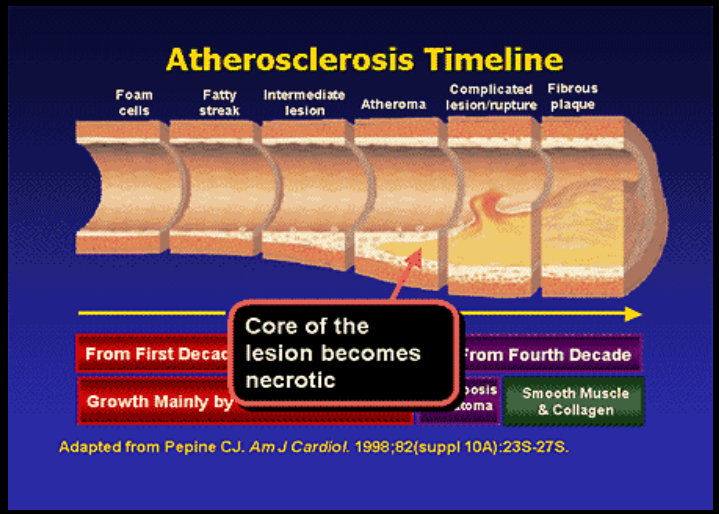
Evolution of Atherosclerosis

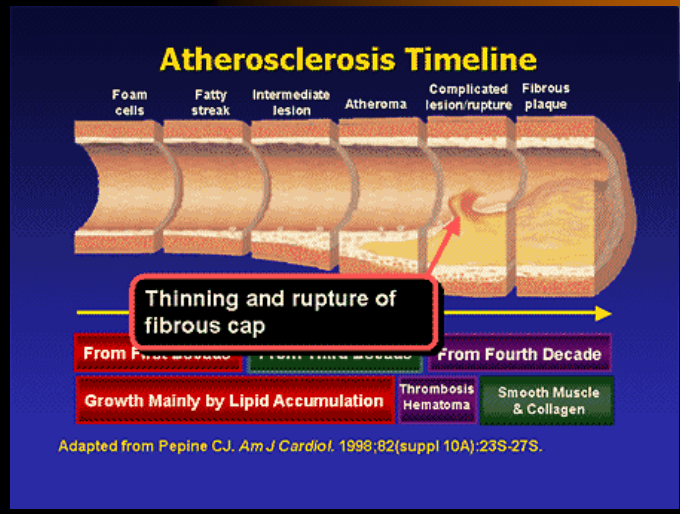




- Areas of low wall shear stress
- Increased endothelial permeability
- Sub-endothelial lipid and macrophage accumulation
- Foam cells
- Formation of Fatty Streak
- Fibrin deposition and stabilizing fibrous cap

Evolution of Atherosclerosis





- Necrosis
- Inflammatory environment
- Destabilization of fibrious cap

Evolution of Atherosclerosis

Rupture of Fibrous Cap

- Pro-thrombotic core Exposed to lumen
- **Acute thrombosis**
- **Embolization** of plaque materials and thrombus

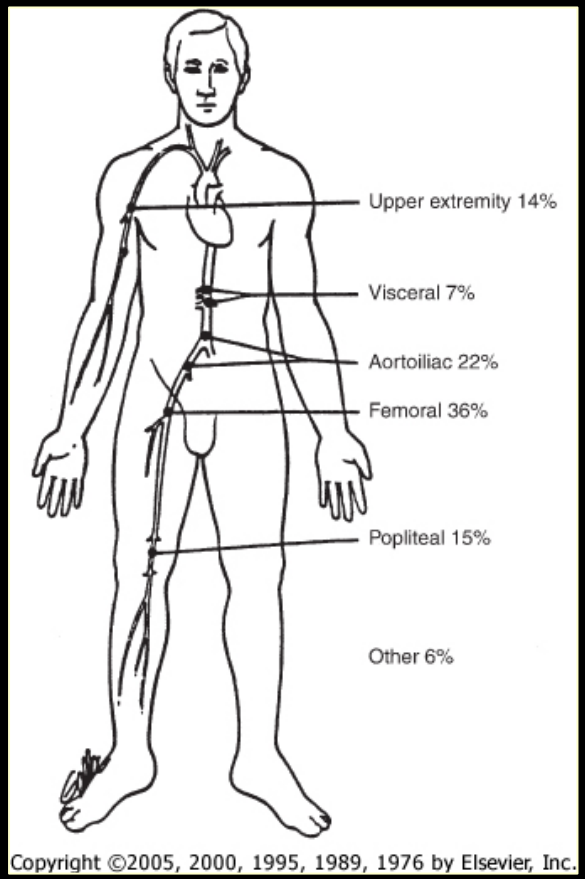
Thromboembolism

- Embolus- greek “embolos” means *projectile*
- Mortality of 10-25%
- Mean age increasing – 70 years
  - Rhumatic disease to atherosclerotic disease
- Classified by size or content
  - Macroemboli and microemboli
  - Thrombus, fibrinoplatelet clumps, cholesterol

Macroemboli

- **Cardiac Emboli**
  - Heart source 80-90% of thrombus macroemboli
  - MI, A.fib, Mitral valve, Valvular prosthesis
  - Multiple emboli 10% cases
  - TEE
    - Views left atrial appendage, valves, aortic root
    - not highly sensitive

Thromboembolism



- 75% of emboli involve axial limb vasculature
- Femoral and Polilteal
  - >50% of emboli
- Branch sites
- Areas of stenosis

Thromboembolism

Non-cardiac sources

- Aneurysmal (popliteal > abdominal)
- Paradoxical
  - Follows PE with PFO
- TOS
- Cryptogenic –5-10%
- Atheroemboli (artery to artery)

Atheromatous Embolization

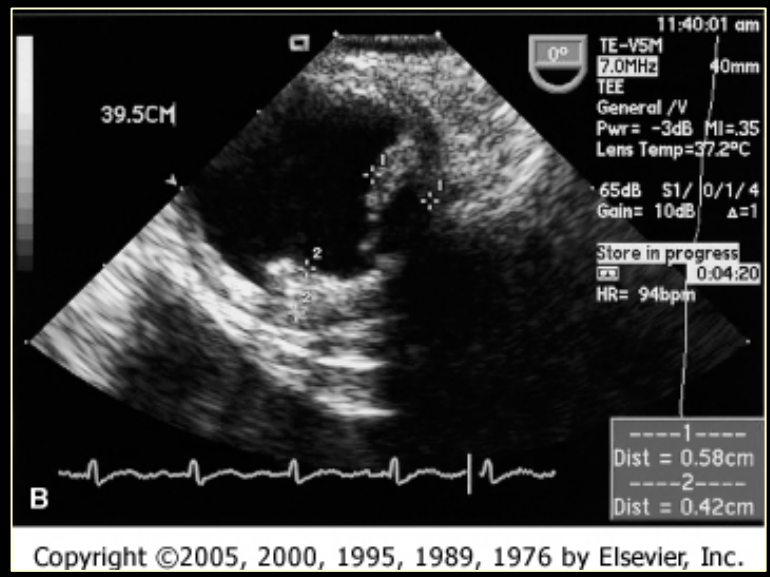
- Shaggy Aorta
  - Thoracic or abdominal
- Spontaneous
- Iatrogenic
  - 45% of all atheroemboli
- “Blue toe syndrome”
  - Sudden
  - Painful
  - cyanotic
  - ***palpable pulses***
- livedo reticularis

Atheromatous Embolization

- Risk factors: PVD, HTN, elderly, CAD, recent arterial manipulation
- Emboli consist of thrombus, platelet fibrin material or cholesterol crystals
- Lodge in arteries 100 –200 micron diameter

Atheromatous Embolization

- Affect variety of end organs
  - extremities, pelvis ,GI, kidney, brain
- Work-up:
  - TEE ascending aorta, CT Angio, Angiography
- Laboratory: CRP elevated, eosinophilia
- Warfarin my destablize fibrin cap and trigger emboli.



Atheromatous Embolization

- Reported incidence of 0.5-1.5% following catherter manipulation
  - Advance/remove catheters over guidewire
  - Brachial access? – controversial
- Limited Sx– Anti-coagulation/ observation
- Temporal delay up to 8 weeks before renal symptoms

Atheromatous Embolization

Therapy

- Prevention and supportive care
  - Statins, prostacyclin analogs (iloprost), ASA, Plavix
- Elimination of embolic source and reestablishing blood flow to heal lesions
- Surgical options: endaterectomy or resection and graft placement
  - Abdominal Aorta – Aorta-bi-fem bypass
  - Ligation of external iliac and extra-anatomic bypass if high risk
- Endovascular therapy
  - Angioplasty & stenting - higher rate of recurrence
  - Athrectomy – no data

Acute Thrombosis

- Graft thrombosis (80%)
  - intimal hyperlasia at distal anastamosis (prosthetic)
  - Retained valve cusp
  - Stenosis at previous site of injury
- Native artery
  - Intra-plaque hemmorhage
  - Hypovolemia
  - Cardiac failure
  - hypercoagable state
  - Trauma
  - Arteritis, popliteal entrapment, adventitial cystic disease

Acute Thrombosis

- Heparin Induced Thrombosis
  - White Clot Syndrome
  - Heparin dependent IgG anti-body against platelet factor 4
  - 3-10 days following heparin contact
  - Dx: thrombosis with > 50% decrease in Platelet count
  - Tx: Direct throbin inhibiors: Agartroban & Hirudin
    - Avoid all heparin products
  - Morbity and Mortality: 7.4-61% and 1.1-23%

Other causes of Thrombosis

- Anti-thrombin III Defiency
- Protein C & S Defiency
- Factor V Leiden
- Prothrombin 20210 Polymorphism
- Hyper-homocystinemia
- Lupus Anti-coagulant (anti phospho-lipid syndrome)

"The Cold Leg"

- Clinical Diagnosis
  - Avoid Delay
  - **Anti-coagulate immediately**
  - Pulse exam
  - 6 P's (pain, pallor, pulselessness, parathesias, paralysis,poiklothermia)
- Acute –vs- Acute on chronic
  - Collateral circulation preserves tissue
  - Traditional 4-6 hr rule may not apply

Diagnostic Evaluation

SVS/ISCVS Classification

- "Rutherford Criteria"

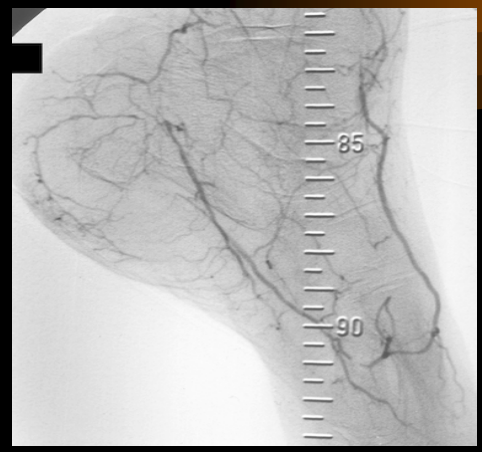
- Class I: Viable
  - Pain, No paralysis or sensory loss
- Class 2: Threatened but salvageable
  - 2A: some sensory loss, No paralysis >No immediate threat
  - 2B: Sensory and Motor loss > needs immediate treatment
- Class 3: Non-viable
  - Profound neurologic deficit, absent capillary flow,skin marbling, absent arterial& venous signal

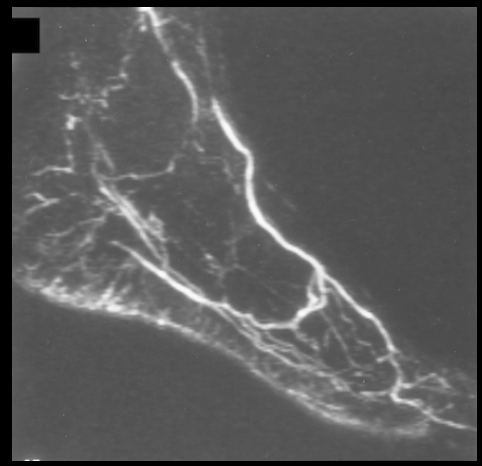
Therapeutic Options

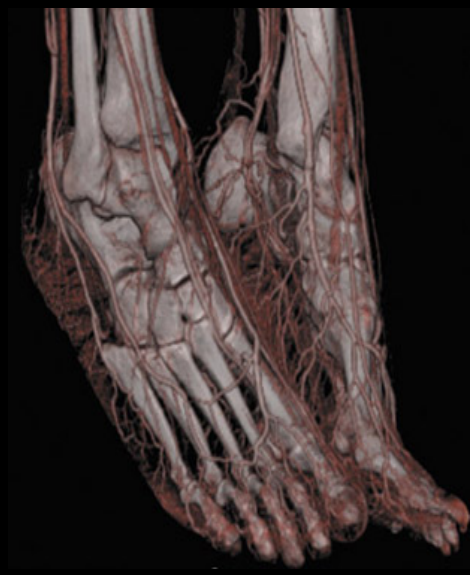
- Class 1 or 2A
  - Anti-coagulation, angiography and elective revascularzation
- Class 2B
  - Early angiographic evaluation and intervention
  - Exception: suspected common femoral emboli
- Class3
  - Amputation

Diagnostic Evaluation

- Modalities
  - Non-invasive:
    - Segmental pressure drop of 30mmhg
    - Waveforms
    - CTA / MRA : avoid nephrotoxity
      - Center dependent
      - Wave of the future?
  - Contrast Angiography
    - Gold Standard







Thrombotic –vs- Embolic

- **Thrombotic**
  - History
    - Claudication, PVD
    - Bypass graft
  - Physical
    - Hair loss, shiny skin
    - Bi-lateral Dz
  - Angiographic
    - Diffuse disease
    - mid vessel occlusion
  - PVD confuses diagnosis
- **Embolic**
  - History
    - Cardiac events
    - Acute onset
    - Hx of emboli
  - Physical
    - Normal contralateral exam
    - A.fib
  - Angiographic
    - meniscus Cut-off in normal vessel
    - Bifurcations affected

Determination of etiology possible in 85% of cases

Treatment Options

- Multiple options available
  - Conventional surgery
    - embolectomy
    - endarterectomy
    - revascularization
  - Thrombolytic therapy
  - Percutanious mechanical thrombectomy

- Native vessel thrombosis often require more elaborate operations

Treatment Fundamentals

- Early recognition and anti-coagulation
  - Minimizes distal propagation and recurrent emboli
- Modality of Tx depends on:
  - Presumed etiology
  - Location/morphology of lesion
  - Viability of extremity
  - Physiologic state of patient
  - Available vein conduit for bypass grafting

Treatment : Thrombosis

Separate graft thrombosis into early and Late groups

Early thrombosis

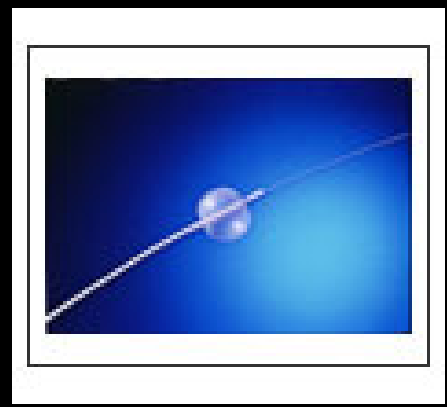
- Technical defect
- Repairable
- Avoid lytic Tx
  - 14 days vein
  - 30 days graft
- Explore both anastamosis
- On-table Angio
  - Twists, kniks,stenosis

Late thrombosis

- Duration & degree of ischemia
- Lytic Thearpy (clas1-2a)
  - Good 1st approach
  - Unmasks lesion (valve/stenosis)
  - F/u endo or open repair
- Open surgery (2b)
  - Thrombectomy/patch
  - Re-bypass

Embolectomy

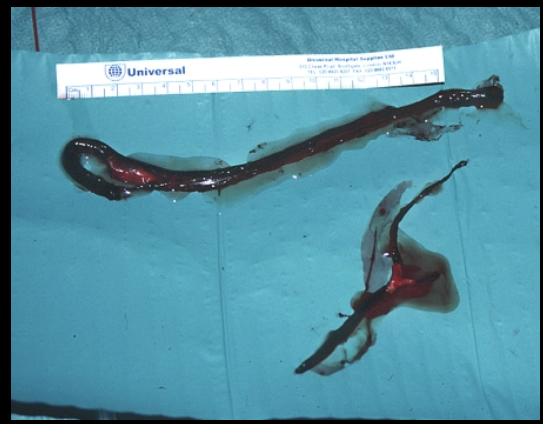
- Fogarty embolectomy catheter
  - Intoduced 1961
- Adherent clot catheter
- Graft thrombectomy catheter
- Thru-lumen catheter
  - Selective placement over wire
  - Administer: lytics, contrast



Embolectomy

Surgical Therapy

- Iliac and femoral embolectomy
  - Common femoral approach
  - Transverse arteriotomy proximal profunda origin
  - Collateral circulation may increase backbleeding
  - Examine thrombus



Embolectomy

- Popliteal embolectomy
  - 49% success rate from femoral approach
  - Blind passage selects peroneal 90%
  - may expose tibial-peroneal trunk & guide catheter
  - Idrectly cannulate distal vessels
- Distal embolectomy
  - Retrograde/antegrade via ankle incisions
  - Frequent Rethrombosis
  - Thrombolytic Tx viable alternative

Embolectomy

- Completion angiography
  - 35% incdence of retained thrombus
  - IVUS more sensitive then angio
- Failure requires
  - Thrombolytic thearpy
  - revascularization

Thrombolytic Therapy

Advantages

- Opens collaterals & microcirculation
- Avoids sudden reperfusion
- Reveals underlying stenosis
- Prevent endothelial damage from balloons

Risks

- Hemmorhage
- Stroke
- Renal failure
- Distal emboli transiently worsen ischemia

Surgery –vs- Thrombolysis

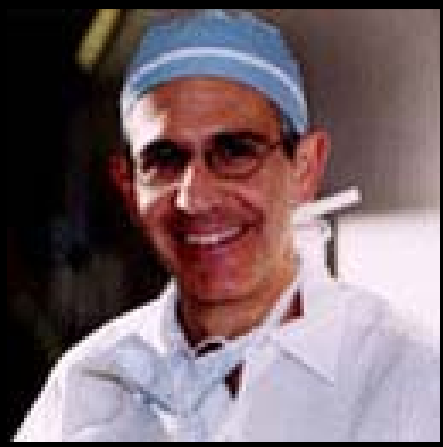
- STILE Trial
- Surgery vs Thrombolytics for Ischemia of Lower Extremity
  - 393 pts with non-embolic occlusion
  - Surgery vs r-TPA or r-UK
- Thrombolytics : improved amputation free survival and shorter hospital stay (0-14 days)
- Surgery: revascularization more effective for ischemia of > 14 days duration

Ann Surg 1994, 220:251

Surgery –vs- Thrombolysis

TOPAS Trial

- 2 phase
- 544 patients
- r-UK vs Surgery
- Need for surgery Reduced 55%
- Similar amputation and mortality rates



NEJM 338, 4/16/98

Indications for Thrombolysis

Category 1-2a limbs should be considered

- Class 2b : Two schools of thought
  1)“Delay in definitive Tx”
  2)“Thrombolytics extend window of opportunity”
- Clots <14days most responsive
  - But even chronic thrombus can be lysed
- Large clot burden
  - Better response to lytic tx than surgery
  - Requires longer duration of thrombolytics

Technique of Thrombolysis

- Guide Wire Traversal Test (GTT)
  - Abilty to traverse lesion best predictor of success
  - Use 0.035 in angled glide wire
  - “knuckling-over” indicates sub-intimal plane
  - Attempt pro-grade, Anti-grade, lytic bolus

Technique of Thrombolysis

- Catheter directed delivery
  1) Lace clot via catheter with side holes
  2) Pulse-Spray technique (mechanical component)
- Urokinase and TPA equally effective
- 4 hr treatment followed by angiogram
  - 4000IU/min x4hr, 2000Iu/M=min x 48h
    - r-UK (TOPAS Trial)
  - no improvement after 4hr >> surgery
- Continue Heparin gtt
- Fibrinogen levels

Mechanical Thrombectomy

- Percutaneous aspiration embolectomy
  - Viable alternative in selected patents
  - Varity of devises
  - Combines diagnostic and therapeutic procedure
  - Removes non-lysable debris
  - Effective in distal vessels
  - Risk distal embolization
    - Combine with lytic Tx

Reperfusion Syndrome

- Ischemic-reperfusion syndrome
  - **Local**: endothelial damage, capillary permeability, Transudative swelling, cellular damage
    - Compartment Syndrome
    - Tx: Fasciotomy
  - **Systemic**: Lactic Acidosis, Hyperkalemia, Myoglobin, Inflammatory Cytokines
    - Cardiopulmonary complications
  - Renal Tubular necrosis
    - Myoglobin precipitates
    - Tx: Volume, Urinary alklinization

Summary

- Thrombotic and embolic occlusions are separate processes with different presentations and treatments
- Treatment pathways in AAO are complex and vary depending on clinical situation
- Catheter-based treatments preserve outcomes with less overall morbidity