ACUTE LIMB ISCHEMIA

Thammawat Parakonthun
Nuttorn Boochangkool
Prawej Mahawithitwong
Khamin Chinsakchai
Content

- Basic Knowledge
  - Pathophysiology
  - Evaluation
  - Classification
- Management
  - Systemic Anticoagulation
  - Revascularization
    - Surgical revascularization
    - Endovascular
- Future management
Definition

- Acute limb ischemia (ALI) is any sudden decrease in limb perfusion causing a potential threat to limb viability.

- Presentation is normally up to 2 weeks following the acute event.

TASC II  Eur J Vasc Endovasc Surg Vol 33, Jan 2007
Timing of presentation

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Pathophysiology

- **Nervous tissue**: the most sensitive to ischemia
- **Skin and bone**: relatively resistant to ischemia
- **Muscle**: major structural component of the extremity, local and systemic manifestations of ischemia-reperfusion injury

*Sabiston Textbook of Surgery, 17th edition, 2004*
Acute arterial occlusion

Sudden decrease blood supply to distal

Functional change
- Circulation
- Peripheral nerve

Anatomical change
- Skin
- Muscle
History

- Leg symptoms in ALI relate to pain or function.
- Duration and intensity of the pain and presence of motor or sensory changes.
- Previous Hx of claudication, heart disease or aneurysm, and atherosclerotic risk factor.
Physical examination

- V/S, GA, CVS, Abdomen
- 6 Ps:
  - Pain
  - Pallor
  - Pulselessness
  - Paresthesia
  - Paralysis
  - Poikilo thermia
Investigations

- Basic laboratories
- Doppler U/S
- Duplex U/S
- CTA
- MRA
- Angiography
CXR
Echocardiography
Right ABI = ratio of
Higher of the right ankle systolic pressures (posterior tibial or dorsalis pedis)
Higher arm systolic pressure (left or right arm)

Left ABI = ratio of
Higher of the left ankle systolic pressures (posterior tibial or dorsalis pedis)
Higher arm systolic pressure (left or right arm)

ABI Clinical Significance

> 0.97  Normal (usually 1.1)
0.4– 0.8  Claudication
0.2 – 0.4  Rest pain
0.1- 0.4  Ulceration, Gangrene
< 0.1  Acute ischemia

Distal anastomosis of a reversed saphenous vein bypass graft
CTA
Site of occlusion

- Peripheral pulse
- Area of pain
- Area of ischemia
Table E2. Differential diagnosis of acute limb ischemia

*Conditions mimicking acute limb ischemia
- Systemic shock (especially if associated with chronic occlusive disease)
- Phlegmasia cerulea dolens
- Acute compressive neuropathy

Differential diagnosis for acute limb ischemia (other than acute PAD)
- Arterial trauma
- Aortic/arterial dissection
- Arteritis with thrombosis (e.g. giant cell arteritis, thromboangiitis obliterans)
- HIV arteriopathy
- Spontaneous thrombosis associated with a hypercoagulable state
- Popliteal adventitial cyst with thrombosis
- Popliteal entrapment with thrombosis
- Vasospasm with thrombosis (e.g. ergotism)
- Compartment syndrome

Acute PAD
- Thrombosis of an atherosclerotic stenosed artery
- Thrombosis of an arterial bypass graft
- Embolism from heart, aneurysm, plaque or critical stenosis upstream (including cholesterol or atherothrombotic emboli secondary to endovascular procedures)
- Thrombosed aneurysm with or without embolization

*Two of the three conditions (deep vein thrombosis, neuropathy) that may mimic arterial occlusion should be expected to have arterial pulses, except if occult chronic peripheral arterial disease existed prior to the acute event. Low cardiac output makes the chronic arterial ischemia more manifest in terms of symptoms and physical findings.
Phlegmasia cerulea dolen (blue leg)
Politeal adventitial cyst & Politeal entrapment syndrome

Fig. 2. Angiographic appearance of popliteal artery entrapment syndrome complicated by arterial occlusion. The popliteal artery is normal in appearance proximally but tapers with an occlusion in the popliteal fossa behind the knee joint. (Courtesy of Dr. Bruce H. Gray, Greenville Memorial Hospital System, Greenville, SC 29681.)

Fig. 3. Angiographic appearance of cystic adventitial disease. There is a smooth, concentric narrowing with an hourglass appearance of the popliteal artery due to extrinsic cystic compression. (Courtesy of Dr. Bruce H. Gray, Greenville Memorial Hospital System, Greenville, SC 29681.)
Etiology

- Arterial embolism
- Acute arterial thrombosis
- Arterial injury
- Acute arterial dissection
Arterial embolism (Thromboembolism)

- Embolic occlusion of a previously unobstructed vessel generally results in the most severe forms of acute ischemia.

- Suspected in patients with:
  - acute onset, no intermittent claudication
  - risk of embolism
  - unilateral abnormal finding
- Arteriographic findings
  - Meniscus sign
  - Lack of collaterals
  - Absence of atherosclerosis

- Paradoxical embolization in a patient with venous thromboembolism and a cardiac septal defect.
Source of emboli

- **Cardiogenic** 80%
  - Atrial fibrillation 50%
  - Myocardial infarction 25%
  - Other 5%

- **Noncardiac** 10%
  - Aneurysmal disease 6%
  - Proximal artery 3%
  - Paradoxical emboli 1%

- **Other or Idiopathic** 10%

*Sabiston Textbook of Surgery, 17th edition, 2004*
Blue toe syndrome
Acute arterial thrombosis

- Generally occurs in vessels affected by preexistent atherosclerosis
- Ischemia is often less severe than with acute embolism
- Location of occlusion may play a role in the severity of limb ischemia
Peripheral Arterial Disease

- Carotid artery (Brain)
- Aorta (To the body)
- Superior mesenteric artery & celiac artery (Intestines)
- Renal artery (Kidneys)
- Common iliac artery (Legs)

Ischemia:
decreased oxygen-rich blood to an area, which can cause pain and dysfunction.
B. Consequences of Atherosclerosis

- Residual lumen
- Plaque enlargement
- Ischemia
- Spasm
- Infarction

- Hypertension
  - Media damage
  - Nonatherosclerotic causes
- Rupture

- Dissecting aneurysm
- Embolism

- Thromboembolism

Rupture, occlusion of side branches, pericardial tamponade, aortic regurgitation, thromboembolism

Silbernagl/Lang, Color Atlas of Pathophysiology © 2000 Thieme
Table 10.2. History and clinical findings differentiating the etiology of acute ischemia

<table>
<thead>
<tr>
<th>Thrombosis</th>
<th>Embolism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous claudication</td>
<td>No previous symptoms of arterial insufficiency</td>
</tr>
<tr>
<td>No source of emboli</td>
<td>Obvious source of emboli (arterial fibrillation, myocardial infarction)</td>
</tr>
<tr>
<td>Long history (days to weeks)</td>
<td>Sudden onset (hours to days)</td>
</tr>
<tr>
<td>Less severe ischemia</td>
<td>Severe ischemia</td>
</tr>
<tr>
<td>Lack of pulses in the contralateral leg</td>
<td>Normal pulses in the contralateral leg</td>
</tr>
<tr>
<td>Positive signs of chronic ischemia</td>
<td>No signs of chronic ischemia</td>
</tr>
</tbody>
</table>

*Emergency Vascular Surgery, 1st Ed. 2007*
Acute embolism   Acute thrombosis
Acute embolism    Acute thrombosis
Arterial dissection
Thoracoabdominal dissection

MRA reveals dissection flap extending below the renal artery.
Severity of ischemia (Siriraj)

- **Reversible**
  - **Mild**: pain, pallor, poikilothermia
  - **Moderate**: paresthesia, paresis
  - **Severe**: analgesia, paralysis, muscle tenderness

- **Irreversible**
  - fixed staining skin, muscle rigor
Severity of ischemia (Rutherford)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description/prognosis</th>
<th>Findings</th>
<th>Doppler signals‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sensory loss</td>
<td>Muscle weakness</td>
</tr>
<tr>
<td>I. Viable</td>
<td>Not immediately threatened</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>II. Threatened</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Marginal</td>
<td>Salvageable if promptly treated</td>
<td>Minimal (toes) or none</td>
<td>None</td>
</tr>
<tr>
<td>b. Immediate</td>
<td>Salvageable with immediate revascularization</td>
<td>More than toes, associated with rest pain</td>
<td>Mild, moderate</td>
</tr>
<tr>
<td>III. Irreversible</td>
<td>Major tissue loss or permanent nerve damage inevitable</td>
<td>Profound, anesthetic</td>
<td>Profound, paralysis (rigor)</td>
</tr>
</tbody>
</table>

‡ Doppler signals: Audible, (Often) inaudible, (Usually) inaudible.
Severity of ischemia

- **Reversible**
  - Mild
  - Moderate
  - Severe

- **Irreversible**
Management
Management

- Systemic Anticoagulation
- Revascularization
  - Surgical revascularization
  - Endovascular
    - Thrombolysis
    - Percutaneous mechanical thrombectomy
Systemic anticoagulation

□ Goals of anticoagulation
  ▪ Decrease risk of thrombus propagation
  ▪ Prevent recurrent embolization

□ Unfractionated heparin
  ▪ Bolus dose 80 unit/kg
  ▪ Continuous infusion 18 unit/kg/hr

□ Immediate after diagnosis
  ▪ Blood sampling before start
  ▪ Hold only if early angiography is available

Revascularization

- Surgical revascularization
- Endovascular procedures
  - Thrombolytic therapy
  - Percutaneous mechanical thrombectomy
Compare of surgery & endovascular procedures

- 3 RCT studies: Rochester, STILE, TOPAS
  - Limit by different in protocol and case mix
  - Only Rochester show advantage of CDT in event free survival but late end point favor Sx
  - Underlying disease vascular in CDT group mostly Rx with endovascular
    - PTA is not durable as bypass except for discrete lesion only

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Compare of surgery & endovascular procedures

- Advantage of CDT over Surgery
  - Reduced mortality rate
  - Less complex surgical procedure
  - Lower pressure reperfusion
  - Further defined underlying lesions by angiography

- Disadvantage of CDT
  - Higher rate of persistent/recurrent ischemia
  - Risk of amputation

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In Class I, IIa CDT offer lower risk opportunity for arterial revascularization

Potential follow by surgical as need
Immediate revascularization is indicated for:
- Class IIb
- Patients with rapid sensory and motor deficits

Rx of ischemic limb have priority over complex & time-consuming investigations

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Surgical Revascularization

- **Ideal Rx of arterial embolism**
  - Rapid diagnosis
  - Identified source of emboli
  - Rapid systemic coagulant
  - Surgical embolectomy

- **Embolectomy**
  - Timely operative is the goal
  - Preoperative preparation should minimal

ACS Surgery Principles and Practice – 2004
Iliac and Femoral Embolism

- Groin incision
  - Landmark – Mid-point from Pubic symphysis to ASIS
  - Local anesthesia and

Iliac and Femoral Embolism

- Expose & control common, superficial, deep femoral arteries.
Iliac and Femoral Embolism

- Femoral arteriotomy
  - Transverse
  - Longitudinal
  - Oblique
Surgical technique

- Insertion of balloon embolectomy catheter
  - Blind passage proximal and distal
  - Over-the-wire catheter + Fluoroscopy
    - Accurate direction without traumatic injury

Fogarty catheter

Technical consideration

- Proper sizing
- Length of passed catheter
- Same surgeon inflate and withdraw catheter

Technical consideration

- **Goals**
  - Inflow vessel
    - Forceful, Pulsatile blood flow
Technical consideration

- Goals
  - Inflow vessel
    - Forceful, Pulsatile blood flow
  - Outflow vessels
    - Several passes until no further thrombus is extracted
Avoid forceful attempt to pass catheter

Helpful maneuvers
- Varying angle of knee
- Creating a bend at tip of catheter + Rotate catheter during induction
- Fluoroscopically over-the-wire catheters

Always exam extracted thrombus
- Smooth taper
- Sharp, fragmented cutoff

Surgical technique

- Heparinized saline infusion after embolectomy
- Assess adequacy of revascularization
  - Completion angiography
  - Clinical examination
  - Segmental pressure / PVR
  - Intravascular ultrasound
- Additional step if incomplete removal
  - Intra-operative thrombolysis

**Category IIA ALI**
- Perform percutaneous mechanical thrombectomy.
- Perform thrombolysis with UK, t-PA, or rt-PA.

**Category IIB ALI**
- Perform surgical embolectomy.

**Embolectomy is successful**
- Obtain completion angiogram.

**Embolectomy is unsuccessful**
- Perform bypass of target vessel.
  - If revascularization is delayed, perform fasciotomy.

**Obstruction does not resolve**
- Perform surgical embolectomy, as for category IIB (see above, right).

**Obstruction resolves**
- If thrombosis rather than embolism seems likely, seek underlying lesion.
  - **Underlying focal lesion is found**
    - Treat with angioplasty or endovascular stenting.
    - If revascularization is delayed, perform fasciotomy.
  - **No underlying focal lesion is found**
    - Provide oral anticoagulation with warfarin and aspirin.

**Obstruction does not resolve**
- Give intraoperative lytic therapy.
  - If extensive lesion remains, perform bypass of target vessel.
  - If revascularization is delayed, perform fasciotomy.
Thrombolysis

- No role of systemic thrombolysis
- Catheter-directed thrombolytic therapy
  - Less invasive
  - Reduced mortality
- Initial Rx of choice in Class I and IIa
  - May Rx in more advanced degree of ischemia

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Thrombolysis

- **Advantages**
  - Reduced risk of endothelial trauma
  - Clot lysis in small branch vessels
  - Gradual low-pressure reperfusion

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Technique in Thrombolysis

- Perform angiography
  - Access from remote to intervention site
- Pass guide wire through the clot
- Placed multiple-sidehole catheter
- Infuse lytic agent
  - Prefer through sidehole “Coaxial infusion”
- Serial F/U arteriograms
  - If not progress, perform surgical intervention
  - Successful thrombolysis follow by Rx of any underlying
Contraindications of Trombolysis

- Absolute
  - CVA (include TIA) within 2 mo
  - Active bleeding diathesis
  - Recent GI bleeding within 10 days
  - Neurosurgery (intracranial, spinal) within 3 mo
  - Intracranial trauma within 3 mo
Contraindications of Thrombolysis

- Relative
  - CPR within 10 days
  - Major non-vascular Sx or trauma within 10 days
  - Uncontrolled HT (SBP >180, DBP >110 mmHg)
  - Puncture of non-compressible vessel
  - Intracranial tumor
  - Recent eye surgery

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Contraindications of thrombolysis

- **Minor contraindications**
  - Hepatic failure esp. with coagulopathy
  - Bacterial endocarditis
  - Pregnancy
  - Active diabetic proliferative retinopathy

- In CDT the only C/I in TOPAS is pregnancy
Percutaneous Mechanical thrombectomy

- Percutaneous aspiration thrombectomy (PAT)
- Percutaneous mechanical thrombectomy (PMT)

- Combination with CDT
  - Speed up clot lysis
  - Reduced dose of thrombolysis agent
Category IIa ALI
- Perform percutaneous mechanical thrombectomy.
- or
- Perform thrombolysis with UK, t-PA, or rt-PA.

Category IIb ALI
- Perform surgical embolectomy.

Embolectomy is successful
- Obtain completion angiogram.

Embolectomy is unsuccessful
- Perform bypass of target vessel.
- If revascularization is delayed, perform fasciotomy.

Obstruction does not resolve
- Perform surgical embolectomy, as for category IIb (see above, right).

Obstruction resolves
- If thrombosis rather than embolism seems likely, seek underlying lesion.

Underlying focal lesion is found
- Treat with angioplasty or endovascular stenting.
- If revascularization is delayed, perform fasciotomy.

No underlying focal lesion is found
- Provide oral anticoagulation with warfarin and aspirin.

Obstruction does not resolve
- Give intraoperative lytic therapy.
- If extensive lesion remains, perform bypass of target vessel.
- If revascularization is delayed, perform fasciotomy.
Management of graft thrombosis

At least one attempt to salvage graft should be done

- Goals in late graft thrombosis Rx
  - Remove clot
  - Correct underlying lesion that cause thrombosis

- Cause of thrombosis
  - Progress of atherosclerosis of inflow/outflow a.
  - Lesion intrinsic to graft
    - Venous graft stenosis, Intimal hyperplasia in prosthetic graft

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Management of thrombosed aneurysm

- Initial arteriography
Management of thrombosed aneurysm

- If distal tibial target present
  - Rx with bypass
- If no distal run off
  - Regional thrombolysis

Identified run off in >90% of cases and successful revascularization

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Amputation

- Complicate with bleeding
- Amputation site is often proximal
  - Ratio AK:BK = 4:1
  - Usual 1:1 in critical limb ischemia
- Incidence of major amputation up to 25%
  - 10% irreversible ischemia
  - 10-15% amputation after revascularization

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Reperfusion syndrome

- **Triad**
  - Hyperkalemia, metabolic acidosis and myoglobinuria

- **Pathophysiology**
  - Inc. capillary permeable
  - Local edema and compartment HT
  - Regional venule obstruction & Nerve dysfunction
  - Capillary and arteriolar obstruction
  - Muscle and nerve infarction

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Compartment syndrome

- Clinical presentation
  - Pain out of proportion
  - Paresthesia
  - Edema
- Compartment pressure $\geq 20$ mmHg
  - Clear indication for fasciotomy

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Compartment syndrome

- Fasciotomy following successful revascularization for ALI is about 5.3%
- In tertiary care about 25%

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Compartment syndrome

- Compartments
  - Anterior compartment is most common involved
  - Deep posterior is most functional

Approach through a double incision

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Rhabdomyolysis

- **Pathophysiology**
  - Tunular necrosis by myoglobin precipitate
  - Tubular necrosis due to lipid peroxidation and renal vasoconstriction

- **Clinical features**
  - Tea colored urine
  - Elevate serum creatine kinase
  - Positive urine myoglobin assay

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Rhabdomyolysis

- **Therapy**
  - Primarily hydration
  - Alkalinizing urine
  - Eliminate source of myoglobin
- Mannitol and plasmapheresis have no benefit
Future Management
Future management

1. Percutaneous therapy
2. Distal embolization protection device
3. Stenting
Currently available for dialysis graft declotting

Only 2 devices (Trellis, Angiojet) are approved for infrainguinal arterial use in USA

**Benefits**

- Minimally invasive nature of the procedure
- Rapid blood flow restoration
- Decrease in the dose and duration of adjunctive pharmacologic thrombolytic agents

TASC II. J Vasc Surg 2007;45(1 Suppl):S5-S67
Mechanical Devices

- **Contact devices**
  - The Amplatz thrombectomy device
  - The Arrow-Trerotola device
  - The Castaneda and Cragg brushes

- **Noncontact (Aspirating) devices**
  - The AngioJet system
  - The Hydrolyser
  - The Oasis (Boston Scientific) catheters
  - The Omnisonics devices
  - The Trellis thrombectomy devices

PMT Devices

Contact Devices

- Direct contact with the vessel wall
- Excellent and rapid removal of thrombus
- Significant vessel wall trauma
- Do not have a mechanism for extraction of the thrombotic material
- Potential for distal embolization
- Extensively use in the declotting of thrombosed AV access grafts and fistulas with good results
PMT Devices

Aspirating Devices

- Use a pressurized fluid to break up the clot
- Entrained into the catheter and extracted
Amplatz Thrombectomy Device

- Create a vortex that draws the thrombus surrounding the catheter tip where it is macerated into microscopic fragments

**Disadvantages**

- Tendency for the cable to break in acute angulations
- Hemolysis related to the activation time
- Lack of torque control
- Poor steerability
- Inability to aspirate thrombus
- The need to remove the guide wire before activation

Angiogram after mechanical thrombectomy with the Amplatz device and PTA.
Recanalized fistula with excellent postprocedural flow (arrows)
Arrow-Trerotola

- Currently recommended only for graft thrombectomy

**Disadvantages**
- Complete endothelial denudation in animal venous studies
- Distal embolization
- Large thrombus fragments
- Non-aspirating mode of action
- No data are currently available for peripheral arterial use

An adjunct to pharmacologic thrombolytic therapy
Decrease the dose and duration of thrombolytic agents

Disadvantages
Endothelial damage caused by wall contact
Possible distal embolization by mechanical dislodgment before adequate pharmacologic thrombolysis
No results of human peripheral arterial trials are available

Castaneda and Cragg brush
AngioJet System

- Utilizes a “backward pointing” jet of fluid flow to disrupt the thrombus
- Relying on the Bernoulli principle and the Venturi effect
- The device aspirates the particles into the catheter
- Can be used without subsequent administration of thrombolytic agents, especially in patients with contraindications to pharmacologic thrombolysis.
AngioJet System

- **3 major components**
  - The catheter
  - The pump set
  - The drive unit

1. Heparinized saline is drawn into the pump
2. Drive Unit activates pump to pressurize saline
3. Pressurized saline is delivered to the catheter to create the "Mechanism of Action"
4. Thrombotic debris is evacuated from the body and collected for ultimate disposal
Thrombotic debris removed from vessel via larger lumen

Catheter body tubing
Stainless steel tube
Catheter tip
Catheter tip is welded to stainless steel tube

Thrombotic debris
Saline in
Adhesive bond

Saline into Manifold

Department of Orthopaedics
Rheumatology and Rehabilitation Centre
Mechanism of action of the AngioJet Rheolytic Thrombectomy System
AngioJet System

Disadvantages

- Additional cost of the pump-drive unit
- Hemolysis and fluid overload are possible
- Caution should be exercised in patients with renal insufficiency or congestive heart failure and the pump-run should be kept to a minimum
Hydrolyser Catheter

- Multi-lumen over-the-wire device that uses the Venturi effect to fragment and remove thrombus

Disadvantages

- Possible fluid overload and hemolysis
- Use of a guide wire partially obstructs the outflow lumen, resulting in reduced thrombus extraction
- The eccentric location of the opening at the catheter tip, resulting in a suction vortex of less than 360° which may result in a tenting effect of the vessel toward the region of lower pressure, producing localized endothelial damage
Comparison

**In vitro** efficacy of the three rheolytic thrombectomy catheters showed significant performance differences

- The time for thrombectomy (0.018-inch guide wire)
  - AngioJet (37.73 sec) > Oasis > Hydrolyser (14.85 sec)
- The overall embolic particle weight
  - Oasis < AngioJet < Hydrolyser

## Treatment Data Comparing the Rheolytic Thrombectomy Catheters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AngioJet</th>
<th>Oasis*</th>
<th>Hydrolyser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time for thrombectomy (sec)</td>
<td>37.73 ± 3.31</td>
<td>16.17 ± 1.46</td>
<td>14.85 ± 1.72</td>
</tr>
<tr>
<td>Applied saline (mL)</td>
<td>39.30 ± 2.26</td>
<td>53.50 ± 4.72</td>
<td>66.80 ± 7.54</td>
</tr>
<tr>
<td>Aspirated fluid (mL)</td>
<td>38.30 ± 2.45</td>
<td>89.30 ± 8.15</td>
<td>71.50 ± 7.15</td>
</tr>
<tr>
<td>Overall emboli weight (mg)</td>
<td>22.99 ± 9.55</td>
<td>1.91 ± 1.14</td>
<td>66.50 ± 42.00</td>
</tr>
</tbody>
</table>

Note.—Values shown are with an 0.018-inch guide wire in place for the Angiojet and Hydrolyser and with a 0.014-inch guide wire in place for the Oasis catheter. Reproduced with permission from reference 34.

* Formerly called SET catheter.
OmniSonics device

- Uses therapeutic ultrasound to dissolve occlusive thrombus without the need for adjunctive thrombolytic agents.
- Vibrates at 20 kHz to create microcavitation bubbles along a titanium wire threaded into the thrombus, avoiding the necessity of thrombolytic agents.
- The thrombus is resolved into small particles enough to traverse the distal capillary bed without obstructive embolization.
- Begun earlyphase clinical trials.

The OmniSonics device, with a titanium wire that supplies acoustic energy to the thrombus, effecting dissolution.
The Trellis thrombectomy device

- Multi lumen catheter
- Inflation/Infusion reports
- Oscillation Drive Unit
- Isolated Treatment Zone

---

Diagram showing a multi-lumen catheter with an attached drive unit and isolated treatment zone.
Trellis thrombectomy

- Advanced Isolated Thrombolysis catheter
  - Two occluding balloons
  - Drug infusion holes between the balloons
  - Mechanical drug dispersion capabilities.
- Pharmaco-mechanical combination
- Focused treatment of thrombus within a targeted vessel
1. Standard percutaneous access

2. The Trellis catheter is advanced through the clot over a standard 0.035" guidewire
3. The distal occluding balloon is inflated.

4. After the proximal occluding balloon is inflated, delivery of the thrombolytic agent begins.
5. The Trellis dispersion wire is activated with the motor drive unit.

6. Clot dispersion continues.
7. After clot is dispersed, remaining material is aspirated through the Trellis catheter.

8. The Trellis catheter and guidewire are withdrawn when treatment is complete.
Outflow protection filters during percutaneous recanalization of lower extremities’ arterial occlusions: a pilot study

Dimitrios Siablis\textsuperscript{a,}\textsuperscript{,}\textsuperscript{*}, Dimitrios Karnabatidis\textsuperscript{a}, Konstantinos Katsanos\textsuperscript{a}, Panagiota Ravazoula\textsuperscript{b}, Pantelis Kraniotis\textsuperscript{a}, George C. Kagadis\textsuperscript{c}

\textsuperscript{a} Department of Radiology, School of Medicine, University of Patras, Rion GR 265 00, Greece
\textsuperscript{b} Department of Pathology, School of Medicine, University of Patras, Rion GR 265 00, Greece
\textsuperscript{c} Department of Medical Physics, School of Medicine, University of Patras, Rion GR 265 00, Greece

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Spider FX Embolic Protection Device
Cross lesion with separate, preferred guidewire.

Advance delivery end of catheter 4-5 cm beyond lesion remove guidewire.

Advance capture wire to align distal marker on filter with distal marker band on catheter.

Pull catheter proximally to deploy filter. Perform intervention.

Advance recovery end of catheter to retrieve filter.

Partial or full recovery available.
(a) SFA occlusion

(b) The Spider filter is deployed in PA after backward retraction of the delivery catheter (arrows point to the radiopaque markers of the filter)

(c, d) Control angiograms following completion of PTA and stenting of SFA

(e, f) Peripheral outflow after protection filter extraction without any signs of periprocedural distal embolization
Pilot study of outflow protection devices

- Safe, feasible and efficacious in hindering macroembolism complications
- Safeguarding the distal capillary bed during revascularization procedures of lower extremities’ arterial occlusions

Large scale double-blinded trials are necessary

- Find out statistically significant therapeutic worthiness
- Determine the optimal technical characteristics
- Assess the cost-effectiveness of the latest distal protection devices
Stenting in Acute Lower Limb Arterial Occlusions

Jowad Raja · Graham Munneke · Robert Morgan · Anna-Maria Belli

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Fig. 1
(a) Acute SFA and PA occlusion (white arrows)
(b) Following stenting, flow is restored

Fig. 2
(a) Acute Rt CIA and EIA occlusion (black arrows), with reconstitution of the CFA via collaterals
(b) Following stenting, flow is restored
4 cases acute embolic/thrombotic occlusions

- 1 iliac artery, 3 femoropopliteal arteries

Small case series:

- Excellent immediate and midterm results
- Suggest that stenting of acute occlusions of the iliac, superficial femoral, and popliteal arteries is a safe and effective treatment option
THANK YOU FOR YOUR ATTENTION