Complications of Endovascular Procedures

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October 27, 2016
case presentation
HPI
66yo Puerto Rican F with several year h/o bilateral claudication p/w worsening LLE rest pain and cool LLE.

PMHx: HTN, HLD, DM, COPD, PVD, schizophrenia

PSHx: flank sebaceous cyst removal

Meds: risperidone, sertraline, lantus, metformin, glucatrol, enalapril, cardizem, lipitor, singulair, atrovent, aspirin, prilosec

All: sulfa

SocHx: +tob >30pk yrs; lives alone with HHC in AM and children alternate care in afternoons
VS

HR 78  BP 163/81 RR 18

PE

LLE cooler than RLE, <1cm dry ulcer lateral left 5th metatarsal, delayed capillary refill L>R
pulses b/l DP/PT/pop nonpalpable, palpable b/l fem

Labs

9.29 > 10.8/32.2 < 341
140/5.3/101/19/38/1.18/234
PT 11.2/ INR 1.1
bilateral lower extremity angiogram

- severe diffuse disease in left external iliac and common femoral arteries
- severe disease in bilateral superficial femoral arteries
HD#7 (7/14)
cannulation of right femoral artery, attempted recanalization of left external iliac artery
• failed recanalization of left external iliac artery;
procedure aborted
HD#8 (7/15)

retrograde angioplasty of left common and external iliac arteries

- stent placement in left common and external iliac arteries

- sBP drop following sheath removal
- angiogram demonstrated contrast blush at puncture site
• manual compression

• heparin reversed with protamine

• CTA-pelvis
  - no contrast extravasation or retroperitoneal hematoma
  - iliac stent occlusion

• upgraded to SICU
left external iliac catheter-directed thrombolysis

- 1mg/hr tPA and 3000U/hr heparin
- overnight monitoring in SICU
thrombectomy of occluded left common and external iliac stents; attempted recanalization of occluded superficial femoral artery

- angio jet mechanical thrombectomy of left common and external iliac arteries

- sub-intimal dissection of chronic total occlusion of SFA without re-entry into true lumen
• hypotensive (sBP 70s-90s) at induction and persistent throughout procedure
• received 1700cc crystalloid, 1U pRBC without response
• started on levophed and brought to SICU
• CT-head
  ▪ negative for intracranial bleed
• CTA-pelvis
  ▪ negative for extravasation or hematoma
• troponemia
  ▪ cardiology consult; NSTEMI likely demand ischemia
• pan-culture
  ▪ UTI, klebsiella pneumoniae sensitive to ceftriaxone
HD#13 (7/20)

- weaned off levophed
- extubated
HD#14 (7/21)

• PE notable for loss of motor/sensation b/l LE

• MRI-spine
  ▪ spinal cord infarct T5 to conus medullaris
HD#15 (7/22)

left AKA

• monitored postoperatively in SICU
• downgraded to floor Monday 7/25
HD#19 (7/26)

- on floor noted with altered mental status; hypoxic, tachycardic and tachypneic

- EKG
  - sinus tachycardia

- CT-head
  - negative for intracranial bleed

- CTA-chest
  - negative for PE

- upgraded to SICU
• psychiatry consult
  – delirium of multifactorial etiology
  – hold psychiatric meds; haldol prn agitation
HD#22 (7/29)

- downgraded to surgical floor

- persistent leukocytosis (WBC 14-18)
- repeat pan-culture
  - UTI; enterococcus faecalis
- CT-abd/pelvis and LLE
  - foci of air in urinary bladder, heterogeneous fluid
HD#35 (8/11)

- code 66 for altered mental status
- stroke code for left facial droop

- neurology consult
  - no facial droop, +left NLF flattening

- CT-head
  - negative for bleed or infarct

- upgraded to SICU
HD#36 (8/12)

- code 88 for desaturation
  - intubated

HD#40 (8/16)

- palliative consult
HD#48 (8/24)

- terminally extubated and expired
Questions...??
endovascular interventions in peripheral arterial occlusive disease
lower extremity arterial disease

General principles
indications for intervention
• intermittent claudication
• critical limb ischemia
General principles

medical management

• risk factor modification
  ▪ smoking cessation, anti-platelet therapy, BP control, lipid-lowering agents, glucose control
• exercise therapy
• pharmacologic therapy for claudication
  ▪ cilostazol, pentoxifylline

limb amputation versus revascularization

endovascular versus surgical revascularization
General principles

endovascular versus surgical revascularization

Lancet. 2005 Dec 3;366(9501):1925-34.

Bypass versus angioplasty in severe ischaemia of the leg (BASIL): multicentre, randomised controlled trial.
Adam DJ, Beard JD, Cleveland T, Bell J, Bradbury AW, Forbes JF, Fowkes FG, Gillepsie I, Ruckley CV, Raab G, Storkey H; BASIL trial participants.
lower extremity arterial disease

General principles
endovascular versus surgical revascularization
preoperative considerations

- Trans-Atlantic Inter-Society Consensus (TASC) Guidelines
  - endovascular therapy preferred for type A and B lesions
  - surgery preferred for type D lesions and good-risk patients with type C lesions
- surgical risk, life expectancy, conduit availability

www.downstatesurgery.org
lower extremity arterial disease

endovascular therapy

- balloon angioplasty
- stenting
- mechanical thrombectomy
complications

access site related (1-3%)
- arteriovenous fistula
- pseudoaneurysm
- bleeding/hematoma
- thrombosis
- dissection
- distal embolization

angioplasty site related (1-5%)
- arterial rupture
- thrombosis
- dissection
- distal embolization
- stent fracture or migration
lower extremity arterial disease

complications

• systemic (<0.5%)
  ▪ renal failure; contrast-related nephropathy (0.2%)
  ▪ cardiovascular (0.2%)
arteriovenous fistula

• incidence
  ▪ 0.006-0.88%

• risk factors
  ▪ female gender, obesity, advanced age, hypertension, anticoagulation/antifibrinolytic, left-sided puncture, low site of puncture, multiple punctures, larger sheath size

• clinical features
  ▪ symptom onset in few days to few months
  ▪ abnormal vibration sensation, fatigue, new onset or worsened lower extremity ischemia, high-output heart failure

• diagnosis
  ▪ PE: pulsatile mass, bruit, lower extremity edema
  ▪ duplex US: low resistance flow, mosaic color pattern; arterialization of venous signal
arteriovenous fistula management

• observation

• surgical repair
  ▪ dissection proximal to distal, division of arteriovenous connection, suture closure of arterial and venous wall defects

• endovascular repair
  ▪ covered stent or embolization
• incidence
  ▪ 0.05-8%

• risk factors
  ▪ inadequate compression
  ▪ age >65yrs, obesity, hypertension, hemodialysis, large sheaths, anticoagulation/antiplatelet, cannulation of SFA

• clinical features
  ▪ symptom onset usually within 24-72hrs
  ▪ pulsatile mass, tenderness, neuropathy, skin necrosis

• diagnosis
  ▪ PE: tender pulsatile mass
  ▪ duplex-US: echolucent pulsatile sac with swirling to-and-fro flow pattern
treatment

• observation

• US-guided compression

• US-guided injection of thrombin

• open surgical or endovascular repair
- **risk factors**
  - female gender, age >65yrs, anticoagulation/antiplatelet

- **etiology**
  - unsuccessful access attempt(s), back wall injury

- **clinical features**
  - swelling, ecchymosis, pain, neuropathy, hypotension/shock

- **management**
  - conservative; manual compression, transfusion, hold anticoagulation, bed rest
  - exploration with evacuation
balloon angioplasty dissection
• high risk lesions are bulky calcified plaque especially proximal SFA, external iliac
• overdistention of balloon in normal vessel

wire, catheter, or device dissection

arteriography
• demonstrates luminal flap with contrast on both sides of dissection

management
• low-pressure angioplasty
• self-expandable or balloon-expandable stent
therapeutic subintimal dissection

- propagation too far distally results in two lumens
  - loss of side branches or outflow vessel or potential future surgical anastomotic site
- failure to recognize extraluminal position
  - vessel occlusion or perforation

management
- re-entry devices
- rarely open surgical correction
embolization

- prevention by early anticoagulation, identifying high-risk lesions, minimizing
  manipulation across high-risk lesions

- endovascular rescue with aspiration catheters, embolectomy, mechanical
  thrombectomy, or thrombolysis

- open surgical thromboembolectomy or bypass warranted for acute ischemia
  and unsuccessful endovascular intervention
wire perforation
- risk higher with stiffer wires and small highly diseased vessels
- fluoroscopy demonstrates travel outside normal course; wire tip curling; angiography demonstrates extravasation of contrast
- withdraw wire; usually seal with conservative management

angioplasty perforation
- overdistension of calcified low compliance vessel

atherectomy perforation

sheath-related perforation
- angiography demonstrates extent of rupture based on extravasation
- endovascular options include balloon tamponade, covered stents, coil embolization
- surgical options include interposition grafts, patch closure, bypass
stent/graft infection

• incidence
  ▪ aortic stent-graft 0.1-0.2%
  ▪ peripheral stent <0.1%

• pathogenesis
  ▪ perioperative contamination, bacteremia, mechanical erosion, contiguous spread

• risk factors
  ▪ procedure-related: emergent operation, extended length, re-operation
  ▪ patient-related: malnutrition, DM, ESRD, malignancy, autoimmune disease, etc

• microbiology
  ▪ S.aureus (25-50%); S. epidermidis and gram negative bacteria

• clinical features
  ▪ extracavitary: inflammation/cellulitis, sinus tract, pseudoaneurysm
  ▪ intracavitary: unexplained sepsis, abdominal distension, ileus
stent/graft infection

diagnosis
• ultrasonography, CT/MRI, arteriography

management
• device explantation with ex situ bypass
• in situ replacement with femoral vein or prosthetic graft
• endovascular repair
• graft preservation with parenteral antibiotics
device fracture or embolization

early device fracture/malfunction
  • fragment retrieval with endovascular snares or forceps
  • balloon expansion

late device fracture/malfunction
  • re-intervention
thrombolysis

- puncture site bleeding/hematoma
- retroperitoneal hematoma
- intracerebral bleeding
- distal embolization

- monitor serial Hct and coagulation studies
- CT a/p for drop in Hct and/or hypotension
- CT-head for change in mental status and/or hypotension
- concurrent heparinization to prevent embolization and rethrombosis
- surgical embolectomy or bypass for embolization with persistent ischemia
Spinal cord ischemia following external iliac artery angioplasty: a case report.

Bani-Hani MG, Friere V, Byrne BE, Plant GR, Moawad MR.
spinal cord infarction: anatomy

- anterior spinal artery
- posterior spinal artery
- radicular arteries
  - artery of Adamkiewicz
endovascular intervention in the thoracic and abdominal aorta
abdominal aortic aneurysms

General principles

indications for intervention

• symptomatic aneurysm
• asymptomatic aneurysm diameter > 5.5cm
• asymptomatic aneurysm enlarging ≥ 0.5cm within 6mo

medical management

• therapies to limit aortic expansion
  ▪ smoking cessation, exercise, antihypertensives, statin
• aneurysm surveillance
  ▪ annual ultrasound if <4.5cm and more frequent if larger
General principles
endovascular versus open surgical repair

DREAM trial
• perioperative morbidity and mortality significantly less for EVAR (4.6% vs 1.2% and 9.8% vs 4.5%)

EVAR1 trial
• perioperative mortality significantly less for EVAR (1.8% vs 4.3%)
• no difference in overall survival
• more frequent graft-related complications with EVAR

OVER Trial
• no mortality difference
• similar rates of secondary intervention
  ▪ majority of secondary procedures in EVAR group due to endovascular revisions compared with repair of incisional hernia in open group
General principles

endovascular versus open repair

preoperative considerations

• aneurysm neck
  ▪ 15mm length

• neck angulation
  ▪ ≤ 60 degrees

• iliofemoral access
  ▪ 15mm length
  ▪ CFA diameter ≥ 6mm
Descending thoracic aortic aneurysms and thoracoabdominal aortic aneurysms

General principles
indications for intervention
• symptomatic aneurysm
• aneurysm diameter > 6-7cm
• aneurysm in setting of genetic syndrome diameter > 5-6cm
• aneurysm expansion rate >1cm/yr if <5cm and >5mm/yr if >5cm

medical management
• risk factor reduction
  ▪ smoking cessation, anti-hypertensive therapy, statin therapy
• surveillance
  ▪ 4-5cm: annual CT or MR angiography
  ▪ 5-6cm: biennial CT or MR angiography

Endovascular versus open surgical repair
Five-year results of endovascular treatment with the Gore TAG device compared with open repair of thoracic aortic aneurysms.

- **mortality**

- **major adverse events**

Fig 1: freedom from aneurysm-related mortality at 5yrs

Fig 2: freedom from all-cause mortality at 5yrs

Fig 3: Freedom from major adverse events over time
endovascular repair of thoracic aorta

General principles
endovascular versus open surgical repair
preoperative considerations
• proximal and distal seal zones 20mm length
• sufficient arterial access size ($\geq$ 7-8mm)
• preoperative cardiopulmonary evaluation
EVAR complications

access site and delivery (9-16%)
• dissection
• thrombosis
• pseudoaneurysm
• arteriovenous fistula
• hematoma
• embolization

dendograft (11-30%)
• graft deployment and retrieval
• graft limb kink or thrombosis
• migration
• component separation
• endoleak
Type I
• graft attachment leak; proximal (IA) or distal (IB)

Type II
• retrograde blood flow from patent branches (inferior mesenteric, lumbar)

Type III
• graft defect; junctional leak/modular defect (IIIA) or fabric defect (IIIB)

Type IV
• graft fabric porosity

Type V (endotension)
• sac pressurization without direct evidence of endoleak
graft enteric fistula versus graft enteric erosion

etiology: infection, pulsatile pressure, technical error

clinical presentation: hemorrhage, sepsis; herald bleed

diagnosis: CT, EGD, angiography versus exploratory laparotomy

management: graft excision, in-situ replacement, graft excision and reconstruction with autogenous vein, extra-anatomic revascularization and graft repair, endovascular repair with lifelong antibiotics
EVAR complications

**systemic (3-12%)**

- cardiac (2-5%)
- pulmonary (3%)
- contrast-related nephropathy (1-2%) or allergy
- ischemic (9%)
  - intestinal, lower extremity, pelvic, spinal
  - dissection, thrombosis, embolism, impingement of vessel origin
early complications

Five-year results of endovascular treatment with the Gore TAG device compared with open repair of thoracic aortic aneurysms.

Table VI: Morbid events (by category) occurring ≤30 days.

<table>
<thead>
<tr>
<th>Category</th>
<th>TEVAR, % (No.)</th>
<th>Open, % (No.)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>15.6 (25/160)</td>
<td>44.3 (31/70)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>15.6 (25/160)</td>
<td>44.3 (31/70)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Renal</td>
<td>8.8 (14/160)</td>
<td>14.3 (10/70)</td>
<td>0.24</td>
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<tr>
<td>Gastrointestinal</td>
<td>6.9 (11/160)</td>
<td>7.1 (5/70)</td>
<td>&gt;.99</td>
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<tr>
<td>Neurologic</td>
<td>8.1 (13/160)</td>
<td>14.3 (10/70)</td>
<td>.15</td>
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<tr>
<td>Vascular</td>
<td>22.5 (36/160)</td>
<td>40 (28/70)</td>
<td>.01</td>
</tr>
<tr>
<td>Wound</td>
<td>6.3 (10/160)</td>
<td>4.3 (3/70)</td>
<td>.75</td>
</tr>
</tbody>
</table>
spinal cord ischemia

- thoracic/thoracoabdominal aortic aneurysm repair is the most common cause
- incidence usually reported 10%
- risk factors include advanced age, cerebrovascular disease, renal insufficiency, prior aortic surgery, more extensive disease, postoperative bleeding, intraoperative hypotension, sacrifice of intercostal vessels
- management strategies to reduce risk include lumbar drainage, reimplantation of intercostal arteries, intraoperative neurophysiologic monitoring, arterial blood pressure augmentation
References


