COMPLICATIONS AFTER AAA SURGERY

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Complications in AAA repair

- MI is the leading single-organ cause of early and late mortality.
- Huber and associates-
- Multisystem organ failure (MSOF) caused more deaths (57%) than cardiac events (25%)
- Visceral organ dysfunction was the most common cause of MSOF, followed by pneumonia
- Most patients with MSOF had associated cardiac dysfunction, which may have aggravated visceral ischemic injury.

Preoperative Cardiac evaluation

- CAD is the largest single cause of early and late mortality after AAA repair.
- Hertzer and colleagues: Did pre op coronary arteriographies
  - 6% of patients with AAA had normal arteries
  - 29% had mild to moderate CAD
  - 29% had advanced compensated CAD
  - 31% had severe correctable disease
  - 5% had sever uncorrectable disease

- Risk factors for increase post operative cardiac events:

- Angina
- History of MI
- Q wave on ECG
- Ventricular arrhythmia
- CHF
- Diabetes
- Increasing age

- High risk or intermediate risk patient should undergo:
- Radionuclide stress scanning (either exercise induced or dipyridamole induced)
- Stress echocardiography (dobutamine induced)
- If significant CAD or cardiac risk factors as valvular disease and CHF are identified pre op these are the possible management options
- Perform endovascular AAA repair
- Delay or avoid AAA repair
- Reduce risk before AAA repair with CABG, coronary angioplasty or coronary stenting.

Early (30 day) complications after elective AAA repair

COMPLICATION	FREQUENCY (%)
Death	<5
All cardiac	15
Myocardial infarction	2–8
All pulmonary	8–12
Pneumonia	5
Renal insufficiency	5–12
Dialysis dependent	1–6
Deep venous thrombosis	8
Bleeding	2–5
Ureteral injury	<1
Stroke	1
Leg ischemia	1–4
Colon ischemia	1–2
Spinal cord ischemia	<1
Wound infection	<5
Graft infection	<1
Graft thrombosis	<1

Cardiac complications

- Most cardiac ischemic events occur within the first 2 days after surgery
- Strategies to prevent this
  - Maximize myocardial function with adequate preload
  - Control oxygen consumption by reducing HR
  - Ensure adequate oxygenation
  - Establish adequate effective analgesia (reduce catecholamine stress response)
  - Keep hematocrit above 28%

Hemorrhage

- Proximal suture line bleeding, particularly posterior line is difficult to control specially on juxtarenal anastomosis – do temporary supraceliac aortic compression
- Friable aortic wall – use interrupted pledgeted sutures.
- Venous bleeding usually result from left renal or ileac veins – careful suture repair
- Diffuse bleeding after substantial blood loss is usually due to exhausted coagulation factors and platelets, combined with hypothermia – rewarm patient and replace coagulation factors

Hemodynamic Complications

- Aortic campling result in sudden increase in afterload, which can precipitate myocardial ischemia – do gradual clamp application coordinated with anesthetic and vasoactive drug administration.
- Sudden aortic declamping is often associated with significant hypotension due to a combination of reduced afterload, "washout" of potassium, acidic metabolites, myocardial depressant factors from reperfusion of ischemic legs - do gradual declamping!

Iatrogenic Injuries

- Ureteral injury – place double J and repair over it
- Splenic injury from excessive retraction – do splenectomy because late hemorrhage is poorly tolerated.
- Pancreatitis due to retractor injury – suspect this as a cause of prolonged post operative ileus

Distal embolization

- Lower extremity ischemia occurs usually from embolization of aneurysmal debris during aneurysm mobilization or aortic clamping.
- Usually are microemboli causing blue toe syndrome that are non amenable for surgical intervention. Some author recommends heparin but management is largely expectant.
- Larger emboli may require operative intervention and legs should be carefully inspected intraoperatively and post operatively for signs of ischemia

Paraplegia

- Resulting from spinal cord ischemia is rare after infrarenal AAA repair.
- Ligation of abnormally low origin of accesory spinal artery (arteria magna radicularis or artery of Adamkiewicz)
- Its important to preserve normal internal ileac artery perfusion of important spinal artery collateral vessels.
- **Paraplegia has been reported as the presenting symptom of infrarenal AAAs, suggesting that important spinal artery collateral flow originating from the distal aorta can be occluded by mural thrombus within the aneurysm or an actual aneurysm thrombosis!!!**

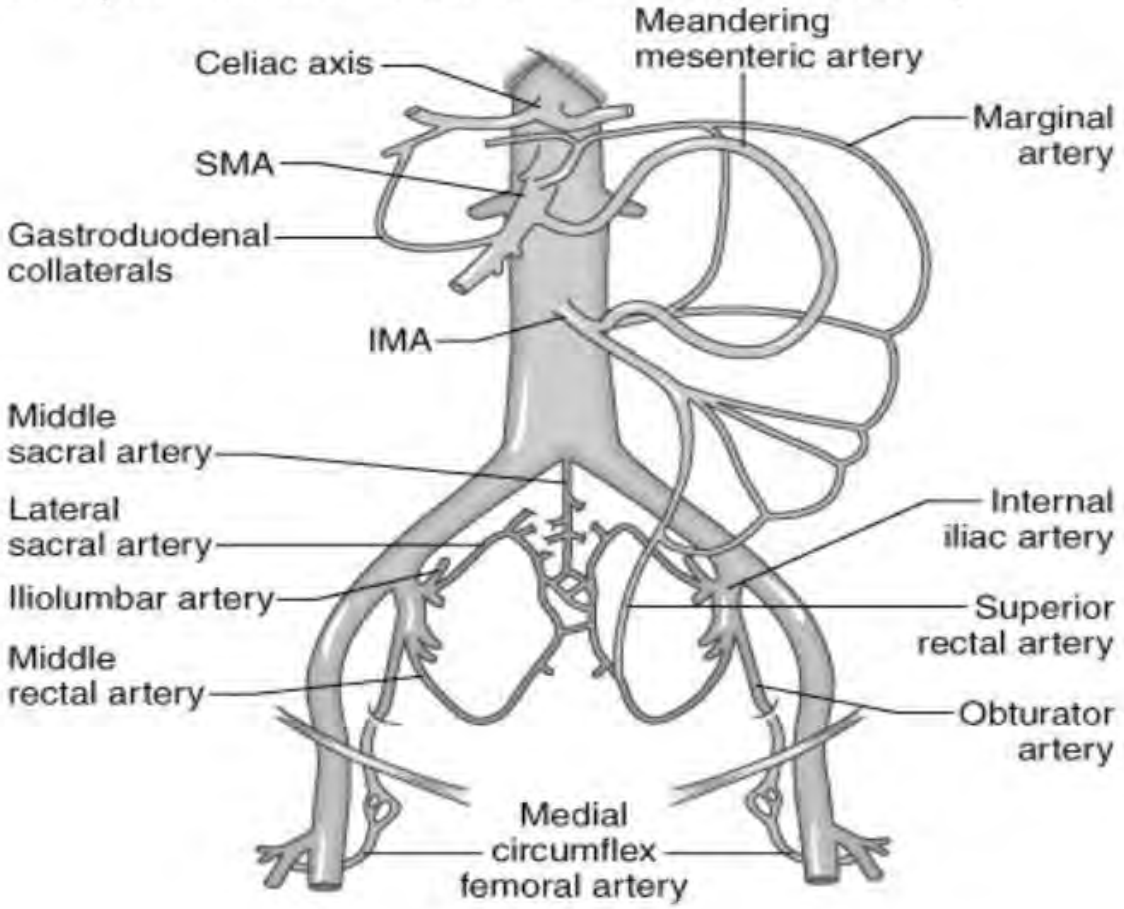
Impaired sexual function

- Impotence or retrograde ejaculation may result as a injury to autonomic nerves during dissection. Careful dissection!!
- Other cause is reduction in pelvic blood flow secondary to internal iliac occlusion or embolization

Colon Ischemia

- The meandering mesenteric artery is the most important connection between the SMA and IMA, connecting the left branch of the middle colic artery to left colic artery of the IMA
- The marginal artery of Drummond is of less hemodynamic importance but can provide important collateral if the meandering a. is absent or injured.
- The sigmoid can also receive important collateral circulation from the internal ileac artery via the superior rectal artery or even from the circumflex femoral branches of the profunda femoris artery if the internal ileac is occluded

Figure 100-13 Important collateral pathways for the sigmoid colon and pelvis. IMA, inferior mesenteric artery; SMA, superior mesenteric artery. *(From Bergman RT, Gloviczki P, Welch TJ, et al: The role of intravenous fluorescein in the detection of colon ischemia during aortic reconstruction. Ann Vasc Surg 6:74, 1992.)*



Colon Ischemia

- Ligation of a patent IMA or internal ileac artery, embolization of debris, prolonged hypotension, and retractor injury can jeopardize circulation to sigmoid colon.
- Incidence of clinically apparent colon ischemia is 1 – 2%, and 3-30% if ruptured AAA repair, with associated mortality from 40 to 100%
- Endovascular AAA repair can cause colon ischemia in 2.9% of patients

Colon ischemia

- Recognition can be difficult, the classic presentation of bloody diarrhea only occurs in 1/3 of patients and usually within 24 to 48 hrs of surgery
- Other signs: abdominal pain, distention, fever, oliguria, thrombocytopenia, and leukocytosis.
- Flexible sigmoidoscopy is a sensitive technique because 95% of ischemic colitis after aortic surgery occurs within the rectosigmoid colon.

Colon Ischemia types

Type	Pathologic Findings	Clinical findings	Clinical Outcome
I	Mucosal ischemia, submucosal edema or hemorrhage, mucosal slough ulceration may follow	Diarrhea with or without blood, presence or absence of fever, onset usually 24 – 48 hrs post op	Reversible, no sequealae, near zero mortality
II	As above, with penetration of muscularis	Symptoms may vary	Reversible, residual ischemic strictures possible
III	Transmural bowel involvement	Profound physiologic changes, sepsis, acidosis, cardiovascular collapse, may develop feculent peritonitis	Irreversible, mortality 80%

Colon ischemia

- Most surgeons judge the adequacy of collateral circulation by temporarily clamping a patent IMA during aneurysm reconstruction, then subjectively judging IMA backbleeding after restoring aortic flow. Pulsatile backbleeding through the IMA combine with normal inspection of sigmoid colon, generally allows safe IMA ligation.
- More sophisticated method: measurement of IMA stump pressure. Ischemia does not develop if IMA/systolic BP ratio is greater than 0.4

HIT review

- Occurs in 1.5 – 3% of patients that had any kind of heparin exposure.
- Type 1

- Associated with an early (within 4 days) and usually mild decrease in platelet count
- Typically recovers within 3 days
- Non-immunologic mechanism (mild direct platelet activation by heparin)
- Not associated by any major clinical sequelae
- Occurs primarily with high dose iv heparin

HIT

- Type II
- Substantial fall in platelet count (>50%)
- Count in the 50,000 – 80,000 range
- Typical onset of 4-14 days
- Occurs with any dose or type of heparin by any route
- Induced by immunologic heparin
- Rarely cause bleeding
- Potential for development of life-threatening thromboembolic complications (white clot syndrome)

HIT

- Effects on the coagulation system:
- Binding of heparin to platelet factor 4 (PF4) neutralizes the anticoagulant effect of heparin
- Immune complexes composed of heparin, PF4,and IgG binds to platelet Fc receptors, resulting in a strong platelet activation, and ultimate increase in thrombin generation
- Mortality of HIT is high (18%)

HIT

- Diagnostic test:
  - antibodies against heparin/PF4 complexes
- Management:
  - All sources of heparin must be discontinued
  - Direct thrombin inhibitors
    - Lepidurin
    - Danaparoid sodium
    - Argatroban

- What to do differently next time?
  - Not operate the patient?
    - 5.8 cm AAA not amenable for EVAR
  - Consult a different Cardiologist?
  - Place a bifurcated graft initially?
    - Risk of jeopardizing pelvic circulation in a AAA not involving the bifurcation
  - Re-implant the IMA after the bifurcated graft placement?
    - What about the ischemic small bowel, would that have been prevented?