# ANAESTHESIA FOR VASCULAR EMERGENCIES

Sunita Balla

10.07.2019

- Ruptured abdominal aortic aneurysm
- Acute ischaemic limb revascularisation
- Postoperative haematoma evacuation (CAE)

# PREOPERATIVE ASSESSMENT

Vascular surgery patients

- Older
- Comorbidities
- Atherosclerosis

Surgery

- Emergency vs elective- greater risk
- fluid shifts, blood loss

Risk assessment

- Age
- Preexisting risk factors
- Aerobic fitness

## Metabolic equivalents (METs) scoring system

| METs | Equivalent activity ability |
|---|---|
| 2 | Dress oneself or do washing up |
| 3 | Vacuum or do light housework |
| 4 | Climb a flight of stairs without stopping |
| 5 | Dig the garden |
| 6 | Run a short distance |
| 7 | Jog, swim or play tennis |
| 10 | Play a game of football or squash |

1 MET = 3.5 ml/kg/minute of oxygen consumed (equivalent to resting state).

**Table 4. Duke Activity Status Index**

| Activity | Weight |
|---|---|
| Can you… | |
| 1. take care of yourself, that is, eating, dressing, bathing, or using the toilet? | 2.75 |
| 2. walk indoors, such as around your house? | 1.75 |
| 3. walk a block or 2 on level ground? | 2.75 |
| 4. climb a flight of stairs or walk up a hill? | 5.50 |
| 5. run a short distance? | 8.00 |
| 6. do light work around the house like dusting or washing dishes? | 2.70 |
| 7. do moderate work around the house like vacuuming, sweeping floors, or carrying in groceries? | 3.50 |
| 8. do heavy work around the house like scrubbing floors or lifting or moving heavy furniture? | 8.00 |
| 9. do yardwork like raking leaves, weeding, or pushing a power mower? | 4.50 |
| 10. have sexual relations? | 5.25 |
| 11. participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football? | 6.00 |
| 12. participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing? | 7.50 |

Reproduced with permission from Hlatky et al.[133]

- Duke Activity Status Index (DASI) = sum of "Yes" replies _____
- VO2peak = (0.43 x DASI) + 9.6
- VO2peak = _____ ml/kg/min ÷ 3.5 ml/kg/min = _____ METS

# INVESTIGATIONS

- Exercise ECG
- Resting and Dobutamine Stress Echocardiography
- Dipyridamole thallium scanning
- B type natriuretic peptide
- CPET

## Preoperative cardiac investigations

| Investigation | Reason | Technique and risk | Diagnosis |
|---|---|---|---|
| Resting echocardiogram | • Undiagnosed murmur<br>• Assess established valve lesion<br>• Assess resting ventricular function | • Low risk, non-invasive and ultrasound based | • Presence and severity of valve lesions<br>• Resting ventricular function and hypertrophy |
| Dobutamine stress echocardiogram (DSE) | • Dynamically assess coronary perfusion | • Incremental increase in heart rate through dobutamine while assessing for new wall motion abnormality using echocardiography<br>• 1% risk of precipitating unstable acute coronary syndrome | • Identify territory and severity of cardiac ischaemia<br>• Dynamic assessment of cardiac reserve |
| Dipyridamole thallium scan (DTS) | • Dynamically assess coronary perfusion | • Heart rate increased by dipyridamole with uptake of thallium by myocardium in proportion to blood supply. Thallium scanning identifies areas of poor uptake and therefore perfusion with increasing cardiac work<br>• 1% risk of precipitating unstable acute coronary syndrome | • Identify territory and severity of cardiac ischaemia |
| Coronary angiography | • Assess resting coronary circulation and cardiac reserve | • Coronary circulation imaged using radio-opaque dye<br>• 1% risk of precipitating unstable acute coronary syndrome or stroke | • Mapping of stenotic lesions in coronary circulation<br>• Assess resting left ventricular function<br>• Facilitate preoperative percutaneous coronary intervention (PCI) |

CPET

- Exercising
- Incrementally harder
- Cycle ergometer(brake)/treadmill(speed,incline)
- Analysis inhaled/exhaled gas flow- $O_2/CO_2$
- Measure peak oxygen consumption($vO_2$)(ml/min) divide by 3.5 and then by mass(kg) gives the peak METs
- Expected peak METs average

  18.4- (0.16Xage) Men

  14.7-(0.13 X age) Women

Anaerobic threshold AT

Involuntary

↑risk AT < 10 ml/kg/min , $VO_2$ peak <15 ml/kg/min

1. Can determination of AT be subjective ?

*Two experienced assessors using the same rules for determining AT might disagree on an average by between 0.5ml/kg and 1.0ml.kgper minute for a CPET that elicits a peak $VO_2$ of 20 ml/kg/min.*

2. Can the assessor incorrectly identify an early spurious AT?

*When a hyperventilating cyclist excretes $CO_2$(bicarbonate)stores*

3. Hyperventilation can affect AT. True/False

*True..Hyperventilation before exercise depletes $CO_2$ stores , hence AT is delayed or obscured as anaerobic acid replenishes $CO_2$(bicarbonate) stores and is not excreted.*

# CARDIAC RISK SCORING SYSTEMS

RCRI Revised cardiac risk index

CPM Customised Probability Model

AHA/ACC consensus guidelines

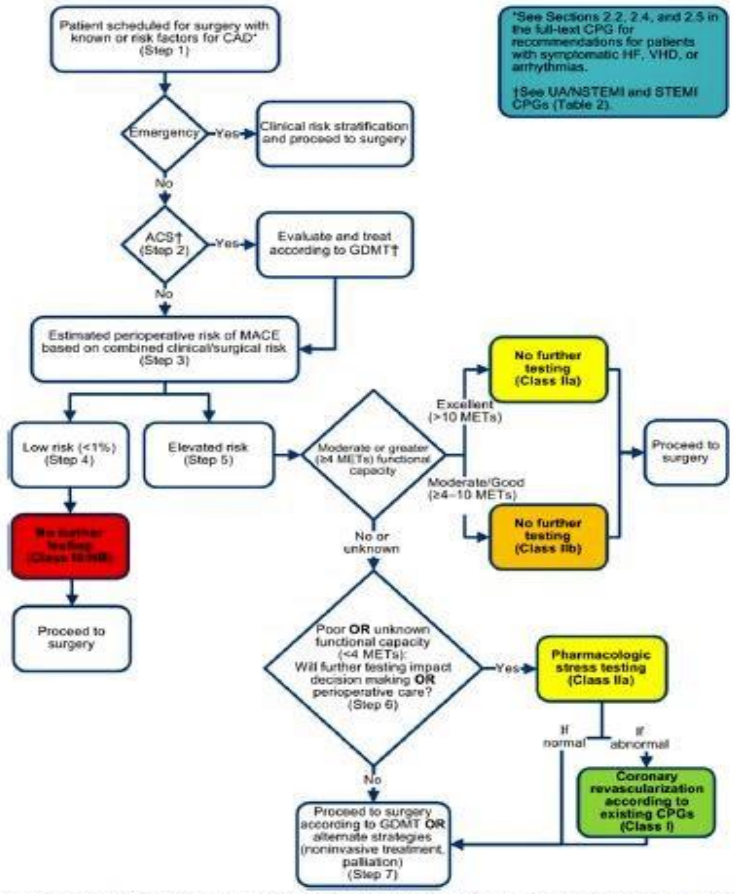
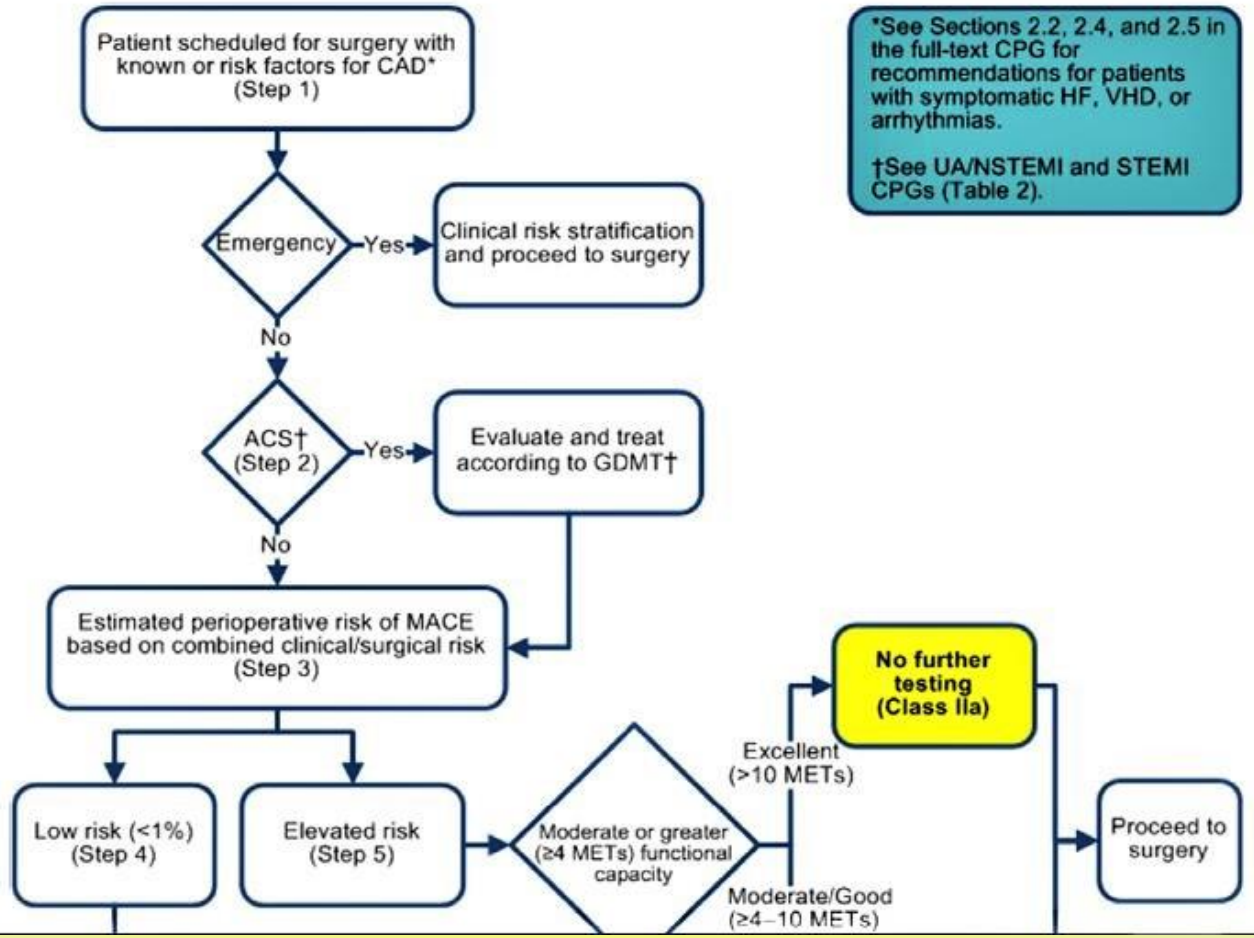
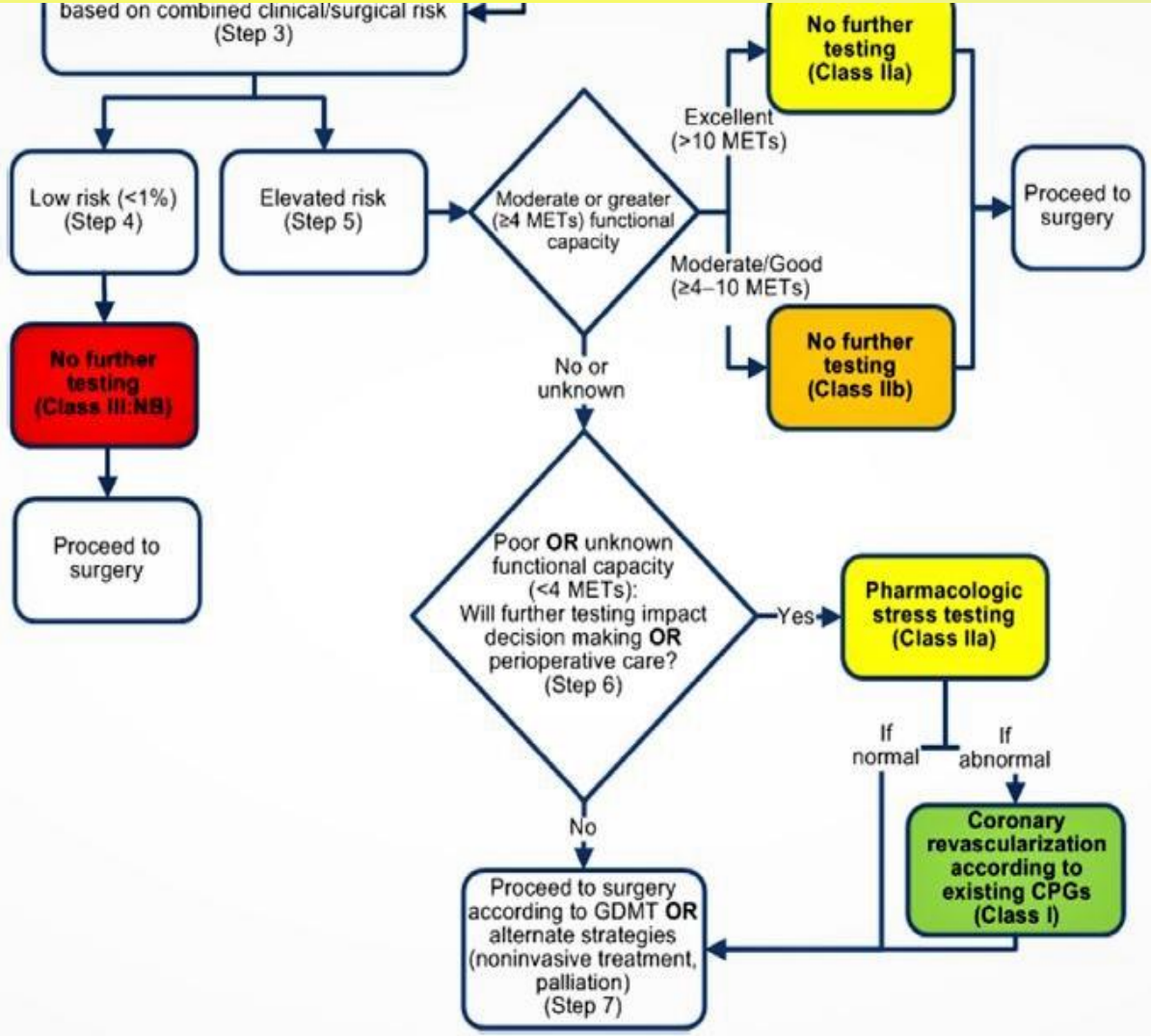


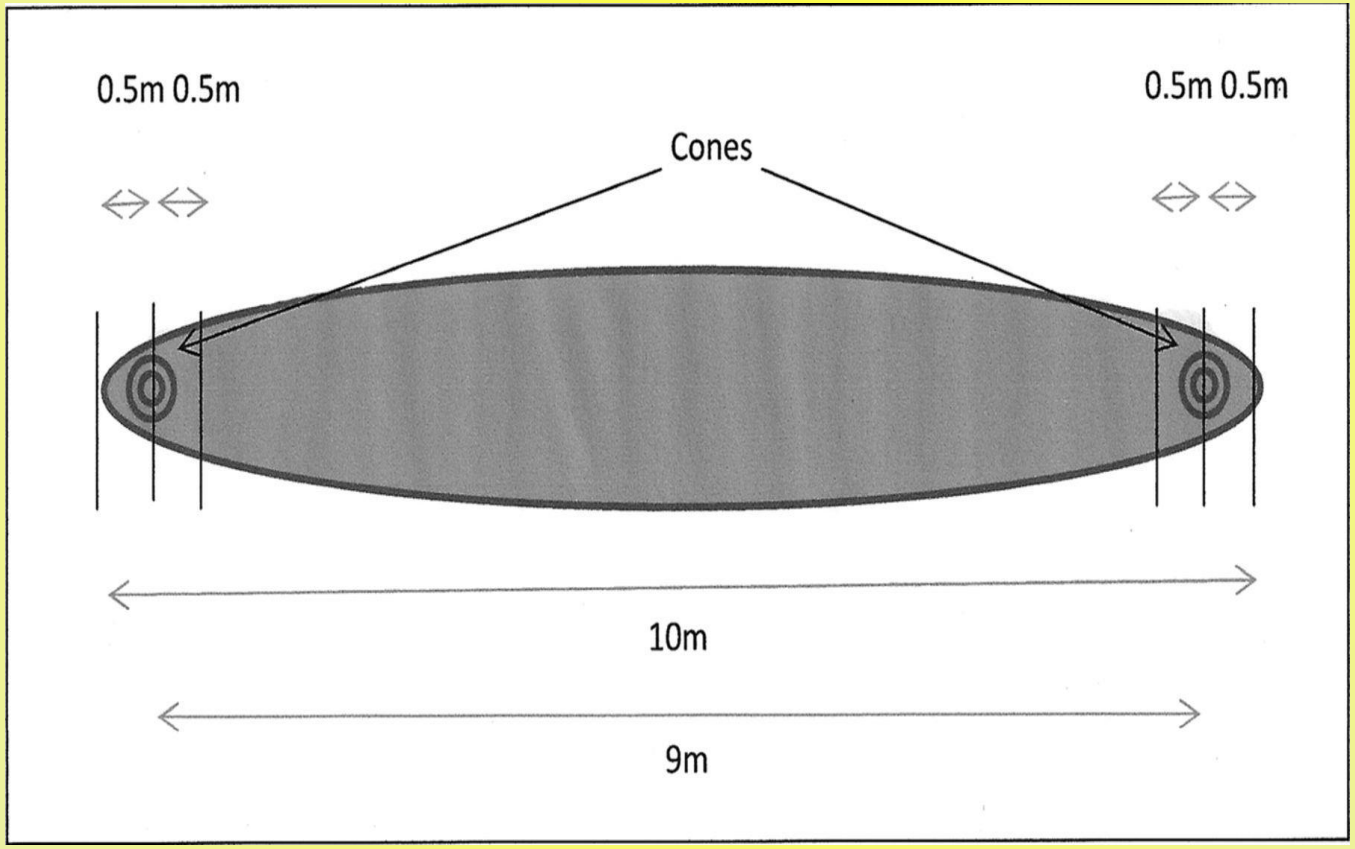

**Figure 1.** Stepwise approach to perioperative cardiac assessment for CAD. Colors correspond to the Classes of Recommendations in Table 1. **Step 1:** In patients scheduled for surgery with risk factors for or known CAD, determine the urgency of surgery. If an emergency, then determine the clinical risk factors that may influence perioperative management and proceed to surgery with appropriate monitoring and management strategies based on the clinical assessment (see Section 2.1 for more information on CAD). (For patients with symptomatic HF, VHD, or arrhythmias, see Sections 2.2, 2.4, and 2.5 for information on evaluation and management.) **Step 2:** If

Downloaded from http://ahajournals.org by on July 6, 2019


Patient scheduled for surgery with known or risk factors for CAD* (Step 1)
Emergency
Yes
Clinical risk stratification and proceed to surgery
No
ACS† (Step 2)
Yes
Evaluate and treat according to GDMT†
No
Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
Low risk (<1%) (Step 4)
Elevated risk (Step 5)
Moderate or greater (≥4 METs) functional capacity
Excellent (>10 METs)
Moderate/Good (≥4–10 METs)
No further testing (Class IIa)
Proceed to surgery
*See Sections 2.2, 2.4, and 2.5 in the full-text CPG for recommendations for patients with symptomatic HF, VHD, or arrhythmias.
†See UA/NSTEMI and STEMI CPGs (Table 2).




Downloaded from http://ahajournals.org by on July 6,


0.5m 0.5m
0.5m 0.5m
Cones
10m
9m

# AORTIC EMERGENCIES

- Ruptured or leaking aortic aneurysm
- Symptomatic aneurysm
- Acute occlusion of aorta with distal ischaemia

Classic presentation  Men > 60 years

Investigation –portable USG/emergency CT

Treatment – Repair(open/endovascular) palliative

| *Risk score* | *Formula* |
|---|---|
| Glasgow aneurysm score | Age + 17 for shock + 7 for myocardial disease + 10 for cerebrovascular disease + 14 for renal disease |
| Hardman index | Score from 1 to 5 depending on number of five risk factors present<br>Risk factors: age >76, electrocardiographic ischemia, creatinine >190 μmol/L, loss of consciousness, hemoglobin (g/dL) <9 |
| Vancouver score | $E^x/(1 + E^x)$, where x = (−3.44) + [sum of coefficients of significant variables]<br>Variable Coefficient<br>Age .062 × age<br>Reduced consciousness: Yes 1.14<br>Reduced consciousness: No −1.14<br>Cardiac arrest: Yes .6<br>Cardiac arrest: No −.6 |
| Edinburg ruptured aneurysm score | Score from 1 to 3 depending on number of three risk factors present<br>Risk factors: hemoglobin (g/dL) <9, preoperative Glasgow coma scale score <15, preoperative systolic blood pressure <90 mm Hg |

*RAAA*, Ruptured abdominal aortic aneurysm.

# OPEN ANEURYSM REPAIR

- transperitoneal approach, midline/transverse incision
- dissect and clamp neck of aneurysm, usually below renal arteries
- clamp both common iliac arteries, open aneurysm, evacuate contents
- end to end Y shaped graft to neck of aneurysm to form the top up anastomosis
- clamp the graft, upper aortic clamp is removed to test the anastomosis
- suture lower end of graft to aortic bifurcation or the bifurcation of each common iliac artery
- clamps are released on the iliac arteries one side at a time

# EVAR

- Haemodynamically stable, favourable anatomy
- Balloon is  inserted via femoral artery into the supracoeliac aorta
- Inflated to control bleeding
- Stent graft is deployed

## Flowchart / checklist for anaesthetic management of emergency open AAA repair

| | Preoperative |
|---|---|
| | High-flow oxygen |
| | IV access ×2 |
| | Tests: Cross-match, FBC, U&E, Ca, Coags, ABG, ECG |
| | Activate blood bank |
| | Monitoring: ECG, SpO2 NIBP |
| | Arterial line if time |
| | Permissive hypotension: SBP 80–100 mmHg<br>Low BP – fluid bolus 100–200 ml<br>High BP – consider cautious analgesia, GTN, β-blocker |
| | Evaluate: anaesthetic history, allergies, medications, co-morbidities, functional status |
| | Warming: limit exposure, environment temperature, warming blankets, fluids warmed |
| | Urinary catheter |
| | Anaesthetic team: machine checks drugs prepared blood products<br>rapid infusor cell salvage<br>Expedite transfer to theatre |
| | Surgical team: instruments checked, surgeon scrubbed, patient draped |

| Intraoperative |
| --- |
| Monitoring: 5-lead ECG, $SpO_2$, arterial line, temperature, ABG, Hemacue, TEG, bloods |
| Antibiotics |
| Cardiostable GA induction |
| Central line |
| Optimize volume status |
| Targeted transfusion aiming for<br>Hb >80–100 g/L PTR <1.5 Fib >2 g/L or normal TEG<br>Plt >100 × $10^9$/L APTTR <1.5 $Ca^{2+}$ >1 mmol/L |
| Consider Tranexamic Acid 15 mg/kg |
| During closing<br>Contact ITU and prepare for transfer<br>Intra-abdominal pressure measurement<br>Analgesic plan<br>Complete documentation |

Fall in BP after induction

- vasodilation
- ↓sympathetic tone & circulating catecholamine levels
- ↓venous return(IPPV)
- abdominal muscle relaxation(↓tamponade)

*"The anaesthetist should aim to maintain BP around the preinduction level (unless it was unacceptably low)avoiding or correcting large falls in pressure but not raising it to normal before the aorta is clamped."*

- *Fluids/Blood/Vasoconstrictor/Inotropes/Head down*

# Clamping

- ↑MAP above clamp(✓cerebral perfusion)
- ↑LV afterload( ↓EF, cardiac ischaemia)
- Severe HTN Beta blocker, GTN

## Unclamping

- Surgeon should notify anaesthetist
- Anaesthetist should preload , ready with drugs, to ↑MV
- Sudden ↓ MAP, ↓ LV afterload, ↑LVEF, ↓$SpO_2$, ↑$etCo_2$ and $PaCO_2$
- Give vasoconstrictors, inotropes
- Slow clamp release
- Reapply clamps if ↓↓↓ BP

Postoperative Care

- No more bleed
- Surgeon- haemostasis
- Anaesthetist - coagulopathy

Complications

- SIRS
- Multiorgan failure
- ARDS
- Coagulopathy
- Cardiac ischaemia, MI, cardiac failure
- Ileus, Ischaemic colitis
- Abdominal compartment syndrome
- AKI
- Lower limb ischaemia
- Stroke, paraplegia

## Flowchart / checklist for anaesthetic management of emergency EVAR

| | Preoperative |
|---|---|
| | High-flow oxygen |
| | IV access ×2 |
| | Tests: Cross-match, FBC, U&E, Ca, Coags, ABG, ECG |
| | Activate blood bank |
| | Monitoring: ECG, SpO2 NIBP |
| | Arterial line if time |
| | Permissive hypotension: SBP 80–100 mmHg<br>Low BP – fluid bolus 100–200 ml<br>High BP – consider cautious analgesia, GTN, β-blocker |
| | Evaluate: anaesthetic history, allergies, medications, co-morbidities, functional status |
| | Warming: limit exposure, environment temperature, warming blankets, fluids warmed |
| | Urinary catheter |
| | Anaesthetic team: machine checks, drugs prepared, rapid infusor, blood products |
| ✓ | Confirm surgical plan |
| ✓ | Brief surgeon on anaesthetic plan |
| ✓ | Expedite transfer to EVAR suite |
| | Surgical team: instruments checked, surgeon scrubbed, patient draped |

# EMERGENCY EVAR

- Favouring local/peripheral regional anaesthesia
  - Avoids muscle relaxants and loss of abdominal tone
  - Avoids hypotensive effects of anaesthetic
  - Provides analgesia for access site (misses abdominal or ischaemic leg)
  - Avoids intubation and weaning

- Factors contraindicating local/regional techniques
  - Local anaesthetic allergy
  - Anticipated prolonged duration
  - Severe abdominal pain
  - Agitation
  - Gross physiological instability, e.g. hypotension causing airway impairment
  - Anticipated secondary procedures, e.g. embolectomy or femoral—femoral crossover graft

# EMERGENCY EVAR

- Favouring GA
  - Still patient
  - No anxiety/agitation/intraoperative pain
  - Tolerance of long procedures
  - Easier respiratory manipulation, e.g. breath hold or hyperventilation
  - No need for conversion of technique mid-case
  - Allows transoesophageal echocardiography

- Other considerations
  - Patient preference
  - Initial haemodynamic status
  - Cardiopulmonary reserve
  - Coagulopathy (contraindicating neuroaxial techniques)

| | Intraoperative |
|---|---|
| ✓ | Nominate dedicated communication person (if not GA) |
| | Monitoring: five-lead ECG, $SpO_2$, arterial line, periodic temperature,<br>ABG, Hemacue, TEG, bloods |
| | Antibiotics |
| ✓ | Anaesthesia before proximal control<br>Surgical LA<br>Remifentanil if required (0.01–0.02 μg/kg/minute) |
| ✓ | Anaesthesia with proximal control<br>As per preoperative briefing |
| | Optimize volume status |
| | Targeted transfusion aiming for<br>Hb>80–100 g/L PTR<1.5 Fib>2 g/L or normal TEG<br>Plt>100 × $10^9$/L APTTR<1.5 $Ca^{2+}$>1 mmol/L |
| | Consider Tranexamic Acid 15 mg/kg |
| | During closing<br>Contact ITU and prepare for transfer<br>Intra-abdominal pressure measurement<br>Analgesic plan<br>Complete documentation |

# VASCULAR SURGERY ON THE EXTREMITIES

# ACUTE LIMB ISCHAEMIA

Causes

- Native thrombosis
- Embolism
- Reconstructions occlusion/graft thrombosis
- Peripheral aneurysm with thrombosis or embolus
- Trauma/iatrogenic (e.g. following arterial catheterisation)

| Fontaine stages[5] | Clinical | Rutherford category[6] | Clinical |
|---|---|---|---|
| I | No symptoms | 0 | No symptoms |
| IIa | Mild claudication | 1 | Mild claudication |
| IIb | Moderate to severe claudication | 2 | Moderate claudication |
| | | 3 | Severe claudication |
| III | Ischaemic pain at rest | 4 | Ischaemic pain at rest |
| IV | Ulceration/gangrene | 5 | Tissue loss (mild) |
| | | 6 | Tissue loss (major) |

Which is more common cause of acute limb ischaemia? Thrombus?Embolism?

**Table 1. Differentiating embolic versus thrombotic acute limb ischemia.**

| Embolic | Thrombotic |
|---|---|
| ***History*** | |
| Sudden onset, severe | Vague, progressive onset, less severe |
| Cardiac history | No recent cardiac events |
| No peripheral arterial disease | History of peripheral arterial disease symptoms |
| No prior vascular surgery | Often history of surgical or catheter-based interventions |
| ***Physical exam*** | |
| Arrhythmia | No arrhythmia |
| Severe signs of ischemia | Less severe signs of ischemia |
| Cold and mottled | Cool and cyanotic |
| May have normal contralateral limb without signs of chronic limb ischemia | Abnormal contralateral limb pulses often with signs of chronic limb ischemia |
| Clear demarcation | No distinct demarcation |

*Data taken from* [13].

## Clinical classification of acute limb ischaemia

| Category | Sensation | Paralysis | Suggested treatment |
|---|---|---|---|
| I (viable) | No loss of sensation | None | Not immediately threatened. Time to investigate |
| IIa (threatened) | Minimal loss (e.g. toe) | None | Urgent treatment needed for salvage |
| IIb (threatened) | More than toes and associated with rest pain | Partial | Immediate treatment needed for salvage |
| III (irreversible) | Profound, anaesthetic | Profound/rigor | Irreversible – primary amputation |

From Rutherford et al. Recommended standards for reports dealing with lower extremity ischaemia: revised version. *J Vasc Surg* 1997; **26**:517–538.

- Cat I iv Heparin and Analgesia
- Cat II as above with aim to reperfuse within 6 hours of onset of symptoms(Embolectomy)
- Cat III urgent amputation

## Embolectomy

- LA(monitored anaesthesia care) comorbidities, pain
- GA(uncooperative pt, extensive bypass/fasciotomy)

Surgical Revascularisation

T/F

1. The standard operation for aorto iliac disease is the *aorto-bifemoral bypass graft* (or *aorto unifemoral bypass graft* if only one iliac artery is diseased).

   T

2. Axillo-bifemoral (or uni-femoral )grafts are an alternative to the above

   T

3. Femoro-femoral bypass grafts are used to revascularize an ischemic leg that is caused by disease in one femoral artery when the contralateral femoral artery is relatively disease free.

   F

4. Femoro-popliteal Bypass is the most common surgical procedure performed to treat lower limb peripheral arterial disease.

1. T 2T 3 F 4T

## Anaesthetic management options for emergency revascularization procedures

| Mode of anaesthesia | Considerations |
|---|---|
| General (± regional) | Rapid sequence induction with cricoid pressure will be required in the unstarved patient<br>Controlled ventilation likely given prolonged surgery times and high incidence of cardiorespiratory disease |
| Regional (± sedation) | Main contraindications include:<br>• full heparinization/anticoagulation<br>• localized infection<br>• septicaemia<br>• hypovolaemia<br>• Patient refusal<br><br>Coagulation profile and platelet count must be reviewed pre-procedure<br>Epidural anaesthesia may improve graft flow and viability in the early postoperative period[8] |
| Local/nerve blocks | May be suitable for patients with major comorbidities undergoing single leg revascularization who may not tolerate neuraxial blockade induced hypotension<br>Consider:<br>• sciatic (± femoral nerve blocks) for lower limb procedures<br>• brachial plexus block for vascular procedures involving the upper limb<br>• continuous catheter techniques for prolonged procedures |

AMPUTATION

T /F

1. The incidence of amputation is the same for diabetic patients as compared to non diabetics after the age of 50.

   F

2. Lower limb amputation is assc with a low morbidity and mortality

   F

3. Risks are greater for above knee amputation as compared to below knee amputation

   T

1. These patients have a high incidence of coronary artery disease

   T

2. Mortality of patients undergoing major amputation is the same when performed ‘in hours’ as compared to ‘out of hours’

   F

3. Amputation carries a significantly higher mortality rate than most other vascular surgical procedures.

   T

# ANAESTHESIA FOR AMPUTATION

Aim

- CVS stability, normovolaemia, excellent post op analgesia
- Regional- Spinal/Epidural/USG guided femoral/popliteal catheters
- GA + peripheral nerve catheters

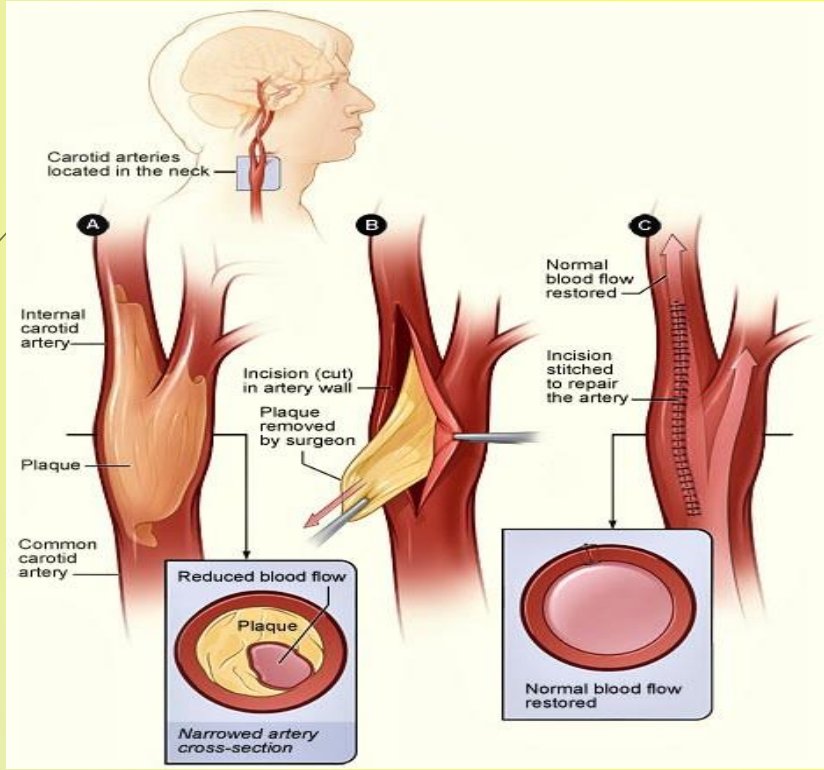
| Anaesthetic technique | Advantages | Disadvantages |
|---|---|---|
| Epidural | Analgesia preop ±postop<br>Slow rise of block(CVS unstable)<br>Early oral feed(DM) | Pre and postop care in HDU<br>Need to stop anticoagulants prior to surgery<br>Systemic sepsis is a C/I<br>Catheter, foreign body<br>Difficult to position pt for procedure |
| Spinal | Reliable rapid sensory/motor block<br>Excellent postop analgesia<br>Early oral feed(DM) | Careful monitoring(rapid autonomic block)<br>Need to stop anticoagulants prior to surgery<br>Systemic sepsis is a C/I<br>Difficult to position pt for procedure |
| GA | LOC is what pt wants<br>Avoids problems with regional techniques | Needs systemic analgesia ± peripheral nerve block<br>CVS changes(Laryngoscopy and Intubation)<br>Slow to feed<br>Postop resp complications |

T/F

1. Phantom limb pain is a significant complication of lower limb amputation
2. Amputation is minor when the aim is to preserve limb function and major when the aim is to save the limb.
3. Regional technique are better than GA
4. Severe pre and postoperative  pain may lead to a lasting somatosensory change or ‘memory” resulting in postamputation pain.

1T  2T  3F  4T

# EVACAUATION OF HAEMATOMA POST CAROTID ENDARTERECTOMY




Atheromatous plaque (common carotid bifurcation)

TIA, CVA

Complications post op

CVA

Cardiac complications

Cranial nerve damage(Hypoglossal/RLN)

Wound haematoma

# WOUND HAEMATOMA

Incidence 1-4%

Presenting feature –Progressive neck expansion, hoarseness, airway obstruction

Treatment

- Nebulised Adr , iv dexamethasone for airway oedema
- Call for help, Senior staff ,Difficult equipment
- Bedside evacuation of haematoma
- Direct laryngoscopy may be difficult
- Emergency cricothyroidotomy or surgical tracheostomy.
- ITU post op, ventilated(airway oedema)

Finally...

# POSTOPERATIVE CARE

Significance

Type and extent of surgery

Age and comorbidities

Aerobic Fitness

Emergency surgery

# CVS

1. Most common cause of death following vascular surgery is MI
2. By reducing myocardial oxygen demand, many complications can be averted.
3. Beta Blockers and Statins should be discontinued perioperatively.
4. Thoracic epidural analgesia in patients undergoing aortic surgery was assc with a ↓ incidence of postop myocardial infarction.

1 T 2T 3F 4T

# RENAL

Which of the following factors contribute to ↑ risk of AKI postop?

- Preexisting renal disease
- Emergency surgery
- Peripheral vascular disease
- Suprarenal aortic clamp
- Ruptured aneurysm
- Use of contrast
- Use of vasopressors

All of them….

# RESPIRATORY

- Preexisting risk factors
- Type of surgery
- Atelectasis
- Pneumonia
- Prolonged mechanical ventilation
- Reintubation
- Respiratory failure
- ARDS

- *The MASTER Trial of patients undergoing major abdominal surgery demonstrated a reduced incidence of respiratory failure in patients receiving epidural analgesia , compared to those receiving systemic opioids.*
- *A Cochrane Review of 2006 which analysed studies comparing epidural analgesia to other forms of postoperative analgesia in patients undergoing aortic surgery concluded that epidural analgesia reduced the incidence of prolonged postoperative mechanical ventilation.*

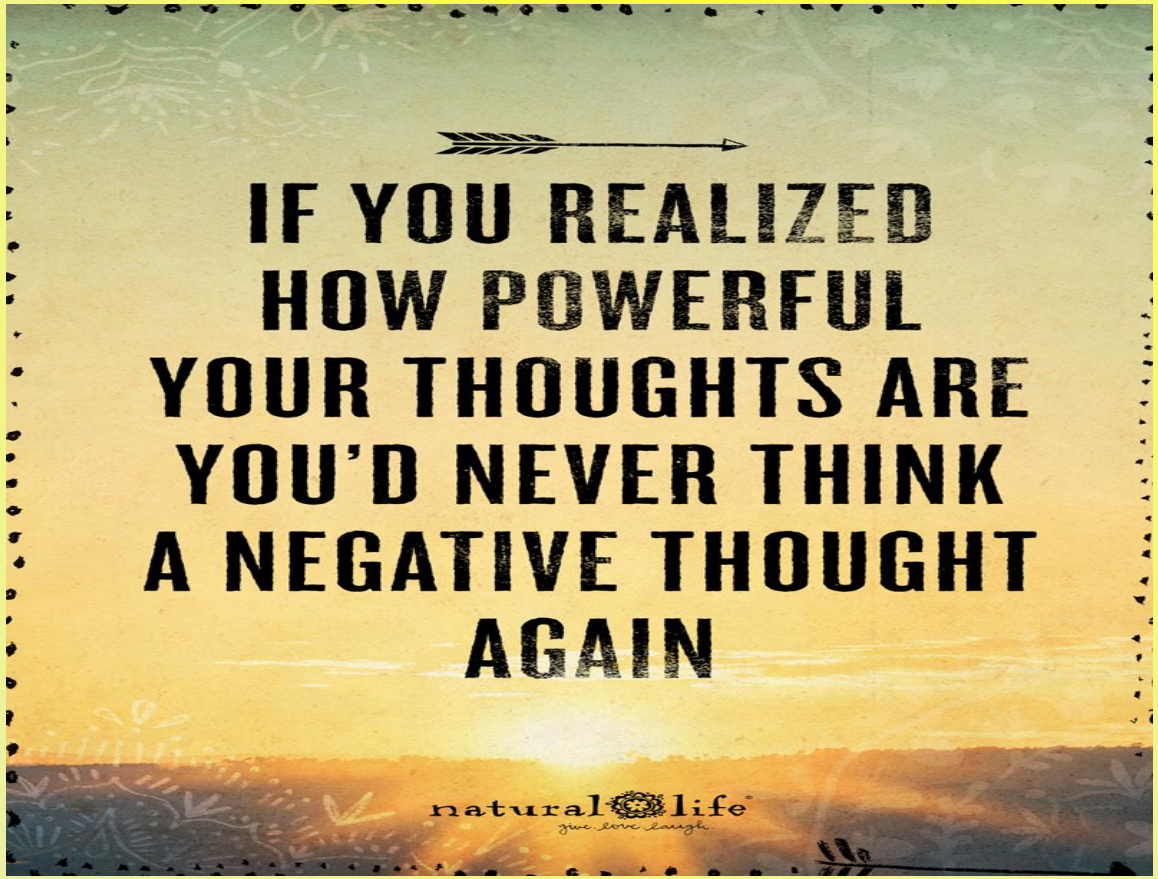
# GIT

- The two prominent git complications of open AAA repair are
- ✓ Bowel ischaemia
- ✓ Abdominal compartment syndrome
- How to suspect this ?
- ✓ Persistent acidosis
- ✓ High fluid requirements
- ✓ Refractory shock
- Treatment
- ✓ Decompressive laparotomy

# ANALGESIA

- Epidural(aortic surgery)
- Regional anaesthesia
- Nerve blocks


thanks


IF YOU REALIZED
HOW POWERFUL
YOUR THOUGHTS ARE
YOU'D NEVER THINK
A NEGATIVE THOUGHT
AGAIN
natural life
give love laugh