2024 MID-ATLANTIC CONFERENCE

12th ANNUAL CURRENT CONCEPTS IN

VASCULAR THERAPIES

2024

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Post Operative Care of Aortic Pathology

Inpatient & Outpatient

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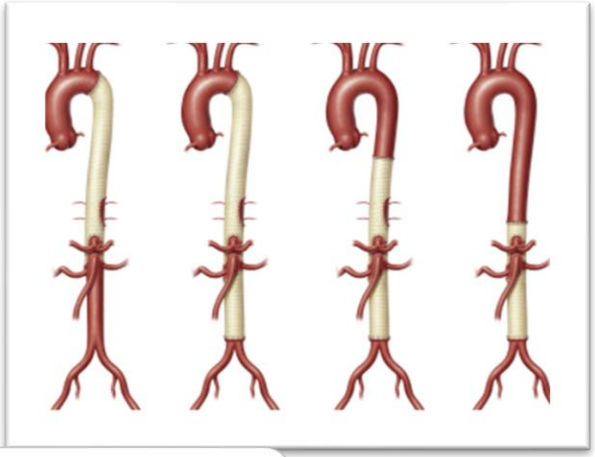
Disclosure

- Nothing

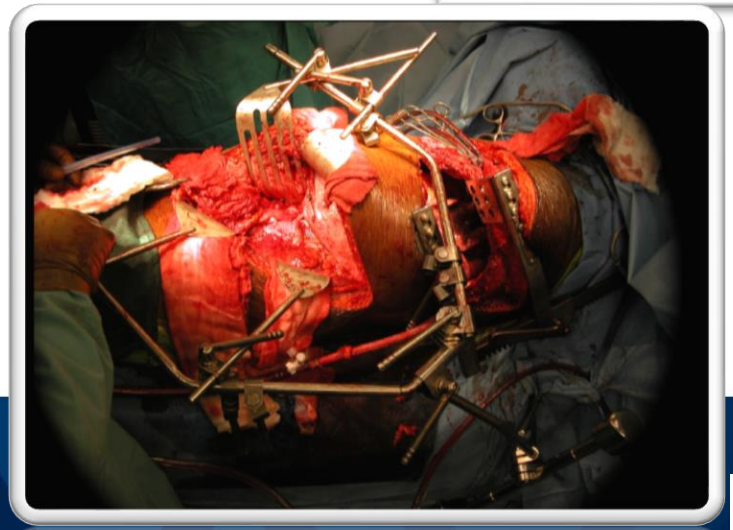
Post op Aortic care

- Why different
- What need monitoring
- Open vs Endo
- Inpatient – outpatient
- Dealing with complications

Aorta is different



- Type of Repair and Extent
  - Bypass, Aneurysm, Endo, Hybrid
  - Asceding/Arch, Descednding/TAAA, Pararenal or Infrarenal
- Cardiopulmonary tolerance of the procedure
- Concomitant procedures
  - renal- and mesenteric-vessel management
- Degree of bleeding
- Distal vascular pulse
- Spinal cord deficit (SCD)
- Acute kidney injury (AKI)
- Respiratory failure



Inpatient Care

- **Monitoring Vital Signs**:
  - Continuous monitoring of vital signs including blood pressure, heart rate, respiratory rate, and temperature is essential.
- **Pain Management**:
  - Administering pain relief medication as prescribed to keep the patient comfortable while ensuring they can participate in **breathing exercises and physical therapy**.
- **Fluid Management**:
  - Monitoring fluid intake and output to prevent **dehydration or fluid overload**. This is especially important in patients with compromised renal function.
- **Wound Care**:
  - Regular inspection and dressing changes of the surgical incision site to prevent infection and promote healing.

Inpatient Care

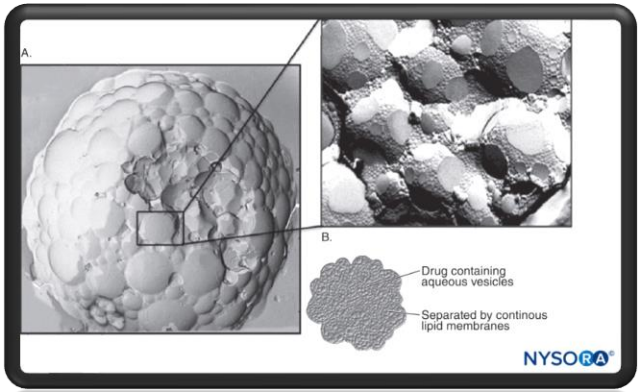
- **Respiratory Care**:
  - Encouraging deep breathing exercises and incentive spirometry to prevent respiratory complications such as pneumonia.
- **Activity and Mobility**:
  - Gradually increasing mobility and activity levels as tolerated by the patient to prevent blood clots and muscle weakness.
- **Nutrition**:
  - Providing adequate nutrition to support healing and prevent malnutrition.
- **Medication Management**:
  - Administering medications as prescribed, including antibiotics to prevent infection, anticoagulants to prevent blood clots, and medications to manage blood pressure and heart rate.
- **Patient Education**:
  - Educating the patient and their family about the surgery, potential complications, signs of infection, and the importance of follow-up care.

Multimodal analgesia and opioid reduction

- **Aggressive pain control is a must to decrease respiratory and cardiac complications**
- Liberal use of PCA. Opioid users vs naïve (background)
- Aggressive use Epidural anesthesia.
- Intercostal block intraop and post op.
- On-Q pain ball/catheter (sub fascial, intercostal)
- NSAIDs : useful but be careful.

Multimodal analgesia and opioid reduction

- **Liposomes**
  - microscopic spheres containing an aqueous core surrounded by a phospholipid bilayer.
- **LIPOSOMAL BUPIVACAINE**
  - Last 72 hours
- **DepoFoam technology**
  - lipid-based particles with polyhedral, nonconcentric, aqueous chambers that contain the medication.
  - DepoCyt(e)® (cytarabine liposome injection)
  - EXPAREL® (bupivacaine liposome injectable suspension)

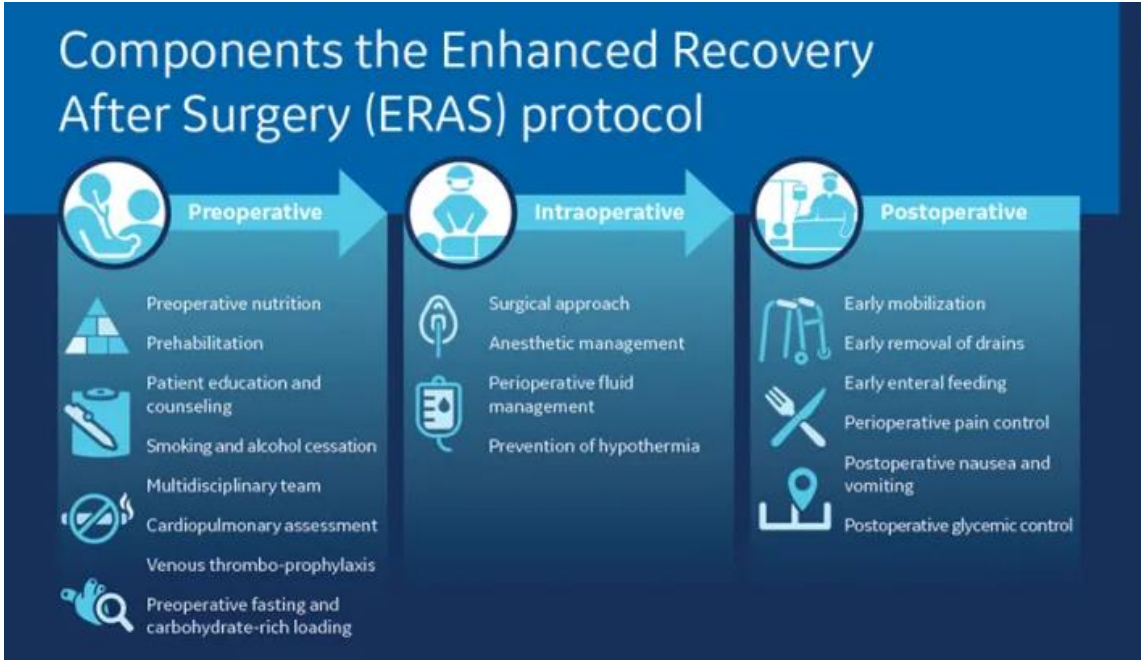


Nutrition and Hyperglycemia

- **NG tube** decompression for intubated patient.
  - ? No NG tube if retroperitoneal AAA or ABFBG
  - **Early oral feeding** : advance slowly. Better for infection control pulmonary and GI (c dif)
  - If too much bowel manipulation : wait
- **Hyperglycemia** : >180 mg/DL within 72hrs of surgery & associated with
  - increased 30-day mortality (5.7% vs 0.7%)
  - SSIs (5.7% vs 2.6%)
  - Acute renal failure, postoperative stroke, and need for readmission
  - Aggressive use of sliding scale insulin
  - Goal 140-180

ERAS protocol

- Goals:
  - Lower post op complications
  - Decrease LOS
  - Decrease readmission
  - Reduce cost
  - Improve patient satisfaction



Open vs Endo Aortic repair

- Cardiac complications: significantly reduced with endovascular repair
- Spinal cord ischemia is still a feared complication of aortic repair.
- The risk has significantly decreased with advances in surgical technique and spinal protection protocols, and is lower with endovascular repair.
- Endovascular repair avoids extensive aortic dissection and aortic cross-clamping and is generally associated with reduced blood loss and less coagulopathy
- Resp Complications : much less with endo

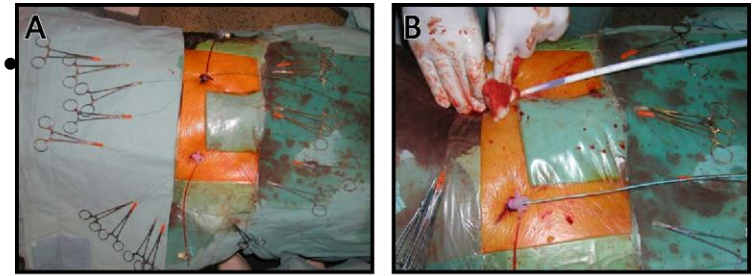
Open vs Endo Renal dysfx

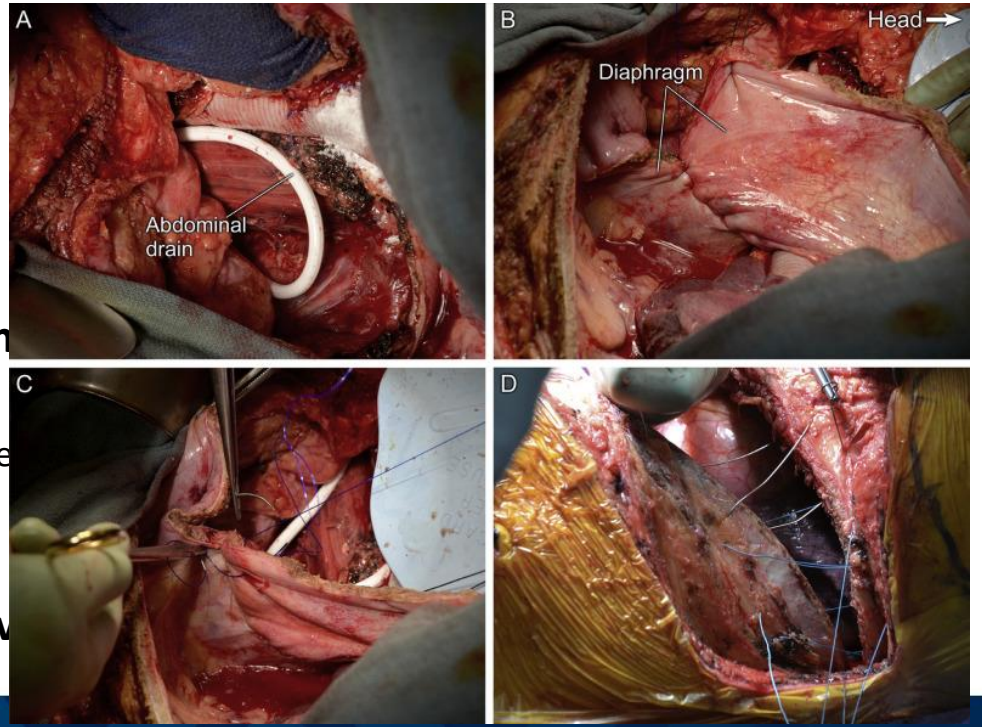
- Preoperative renal function and postoperative kidney injury are powerful determinants of short- and long-term outcome
- Intraoperative renal protection with selective renal and distal aortic perfusion is essential during open repair.
- EVAR has lower rates of postoperative renal failure compared to open repair
  - Approximately half the risk for acute kidney injury (AKI) and one-third of the risk of hemodialysis requirement.

Pulmonary care

- **Postoperative pulmonary complications (PPC)**
  - Atelectasis, pneumonia, respiratory failure defined as mechanical ventilation for longer than 48 hrs
  - Unplanned reintubation, ARDS, pulmonary edema, pleural effusion and hypoxia
- **Risk factors**
  - Age
  - poor functional status
  - Smoking
  - obstructive pulmonary disease (COPD) or other intrinsic lung disease
  - congestive heart failure (CHF), diabetes and renal failure

Pulmonary care





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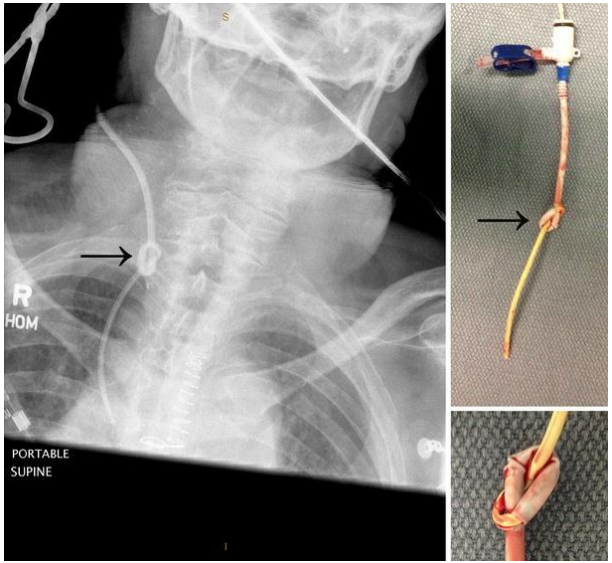
- **Open surgery 15% risk vs 3% in Endov**

Pulmonary care

- Postoperative strategies
  - **head-up positioning**, as part of the ventilator-associated pneumonia (VAP) prevention bundle and to reduce facial edema
  - **Prophylactic bronchoscopy** improves left lung function before extubation for prolonged one lung vent.
  - **Low Tidal volume** ventilation 6-8 ml/kg
  - **Early extubation** with **early mobilization**
  - Aggressive **pulmonary toilet** and incentive spirometry.
  - The application of nasal continuous positive airway pressure, with 10 cm H2O immediately after extubation
  - Adequate **pain control**

Hemodynamic And Pressure Monitoring

- Central Venous Catheters and Central Venous Pressure
  - CVP 6-12 mm
- Pulmonary Artery Catheters (Swan-Ganz)
  - Wedge pressure
  - Almost never used in aortic cases anymore ? Increase mortality
- Arterial Line
- TEE and TTE : Not routinely used unless indicated
- Intra Abdominal Pressure: normal <20mmHg… in compartment syndrome



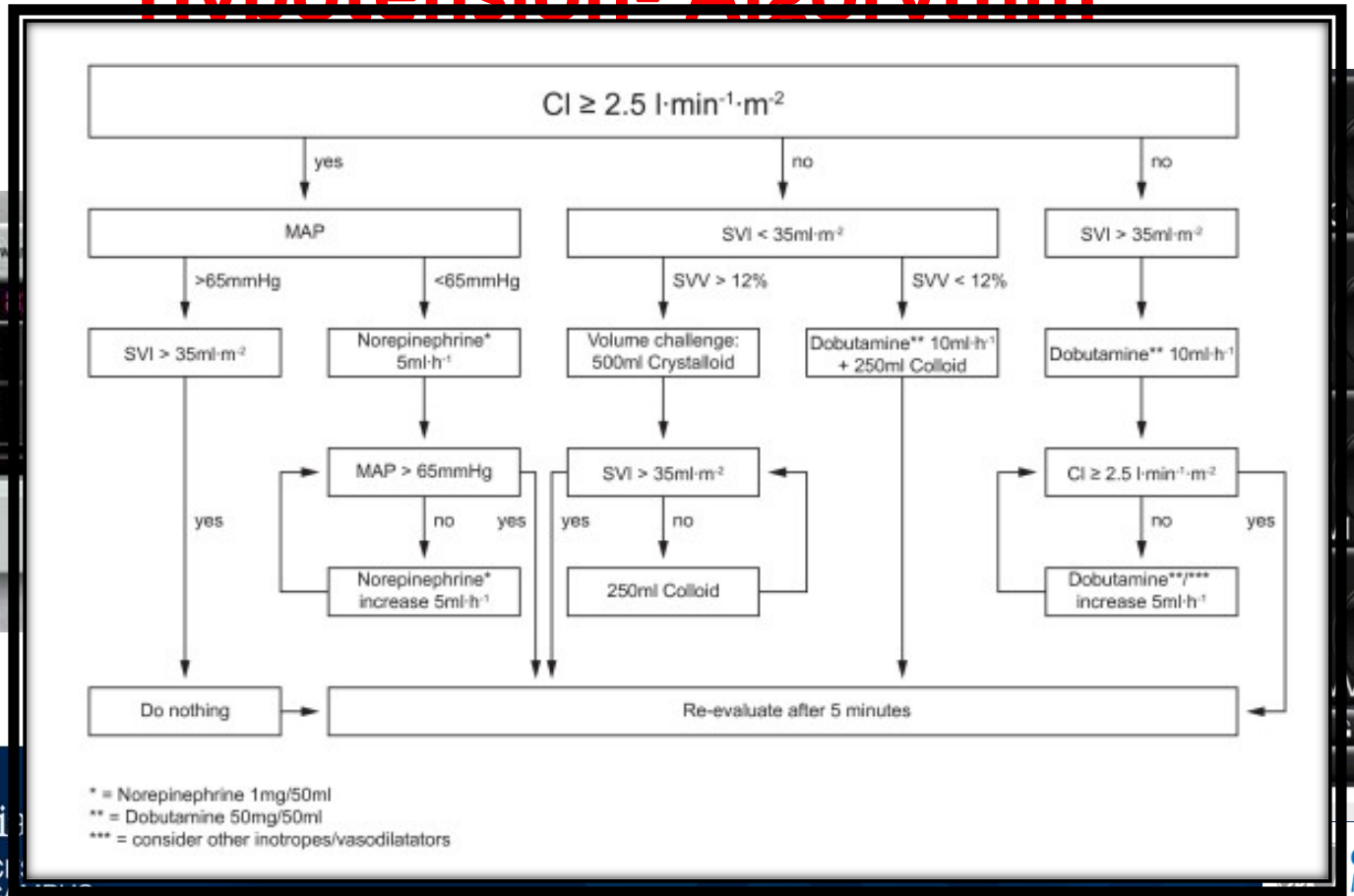
Cardiovascular Management

- **Hypertension:**
  - caused by hypoxia, hypercapnia, hypervolemia, hypothermia, gastric or bladder distention, agitation, and uncontrolled pain.
  - Rebound hypertension due to the failure to restart a patient's medications
- Problems
  - Increase bleeding
  - Increase oxygen demand and AMI
- IN HTN Emergency : decrease BP 10-20% in first hour then slowly over 6 hours

Cardiovascular Management

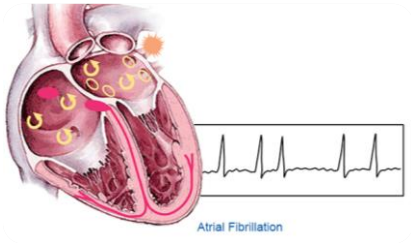
- **Hypotension**:
  - No definition ? SBP<90 , MAP <60.
  - Decrease coronary flow… AMI
  - AKI, Stroke, Bypass thrombosis and limb ischemia
- Causes:
  - Residual effects of anesthesia, hypovolemia, cardiac dysfunction, and a diffuse vasodilatory state with or without sepsis.
- Management : R/O bleeding
  - Fluids, Fluids…. ? Crystalloids, Colloids… Blood and Blood products
  - Vasoactive agents : Norepinephrine, Vasopressin, Epinephrine , Dopamine ?
- If Cardiac dysfx: Inotropes, Fluids? , IABP, ECMO

Hypotension- Algorythm



Arrhythmias

- **Tachyarythmias**
  - Common after open Aortic cases. Typically sinus tachy: pain control, hypoxia, electrolytes..
  - A.Fib, A flutter, MAT, VT… all need investigated…. r/o Cardiac ischemia.
  - B-Blockers, or CCB used first.
  - Amiodarone esp in hypotension
- Atrial Fibrillation
  - Most common arrhythmia 5-25%
  - Increase hospital stay, ICU stay and mortality. Hypotension/loss of Atrial Kick
  - Medical treatment in stable. Elective synchronized cardioversion
  - Unstable : Cardioversion
  - Anticoagulation

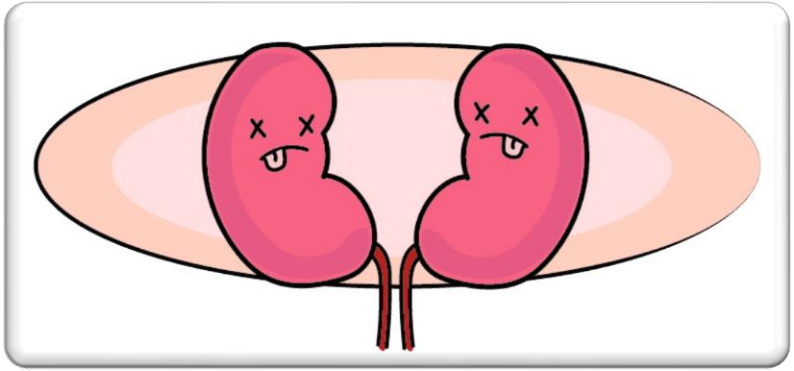


Coronary Ischemia

- STEMI:
  - Dx: Chest pain, EKG changes and elevated markers: CKMB and Trop I
  - Pain control, supplemental oxygen
  - B-Blockers & ***afterload-reducing agents***
  - Antiplatelet therapy, anticoagulation with unfractionated heparin (if at low risk for bleeding)
  - Urgent reperfusion therapy (PCI)
- Non-STEMI
  - As above .
  - No urgent PCI.
  - The more trop elevation, the more necrosis and higher mortality.

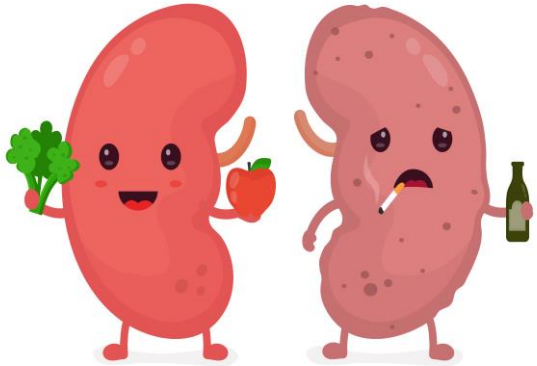
Renal Care

- Aortic procedures are at a high risk of postoperative acute kidney injury
- AKI is defined increase 1.5-fold increase in SCr within 7 days above the baseline value measured on admission(or >0.5 mg within 48hrs)
- Incidence 5-15%
- Preoperative predictors of renal failure
  - Preop renal disease (Creatinine >2.0) OR 2.75
  - age over 75 years (OR = 1.58)
  - Treated hypertension (OR = 1.87)
  - Hyperlipidemia
  - Diabetes (OR = 1.67)
  - Liver disease
  - High body mass index
  - Symptomatic AAA (OR = 1.77)
  - Supra/juxta renal AAA (O = 2.17)
  - Chronic obstructive pulmonary disease (OR = 2.08) and smoking



Renal Care

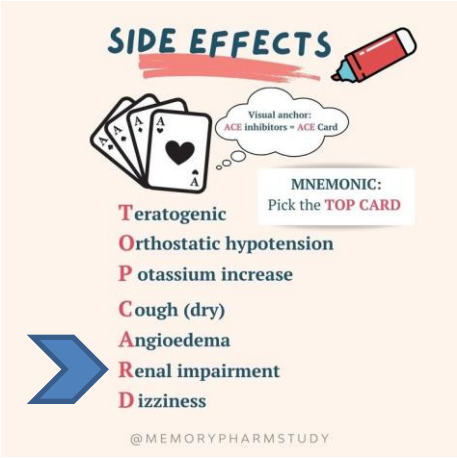
- **Pathophysiology of AKI:** Acute tubular necrosis caused by
  - Hypotension
  - Hypovolemia
  - atheromatous embolization
  - rhabdomyolysis
  - nephrotoxins, such as contrast agents, nonsteroidal anti-inflammatory drugs and aminoglycoside
- Open elective AAA repair is associated with risk of developing postoperative renal failure between 1% and 6%
- **In Elective AAA repair: aortic cross-clamping**
  - causes a decrease in renal blood flow of 45% with infrarenal clamping and up to 80% with suprarenal clamping



Renal Care

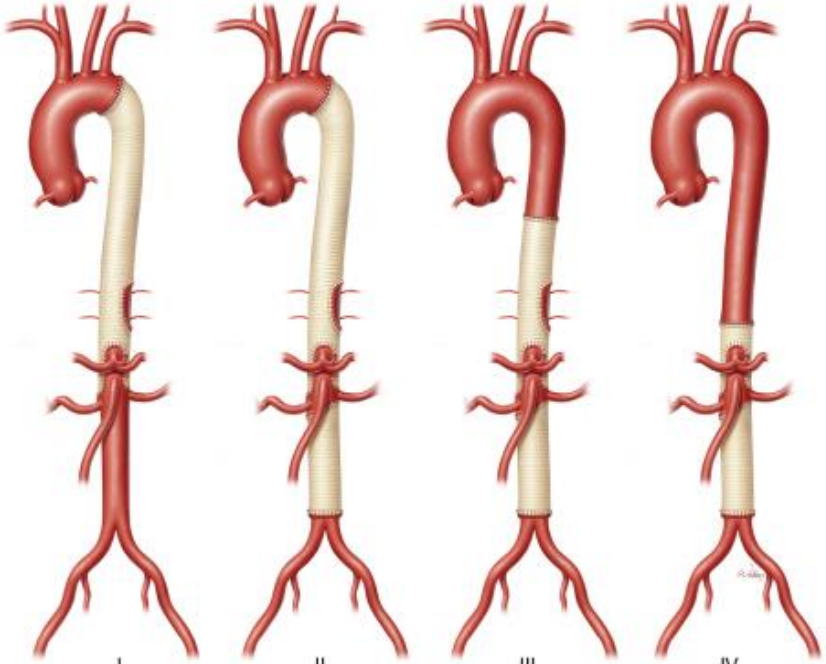
Common ACE Inhibitors	Common ARBs
Benazepril	Candesartan
Captopril	Eprosartan
Enalapril	Irbesartan
Fosinopril	Losartan
Lisinopril	Olmesartan

- Intraoperative strategies for renal protection
  - Minimizing renal ischemic time
  - Performing selective renal perfusion with cold protective solutions , Mannitol
  - Using distal aortic perfusion techniques during open surgery
- Post Op
  - Greater MAP and volume
  - Crystalloid fluid resuscitation is started at 1.5 to 2.0 mL/kg/h and decreased after 24 hours, guided by standard resuscitation parameters.
  - Patients commonly have a 6- to 8-L positive fluid balance in the first 48 to 72 hours.
  - Use diuretics cautiously to avoid sudden hypovolemia and resultant hypotension risking AKI
  - Low-dose loop diuretic infusions may be considered. Nevertheless, restoring euvolemia is critical to optimizing pulmonary function and mobility.
  - Avoid restarting renin–angiotensin antagonist medications for several weeks.



Spinal protection and Ischemia

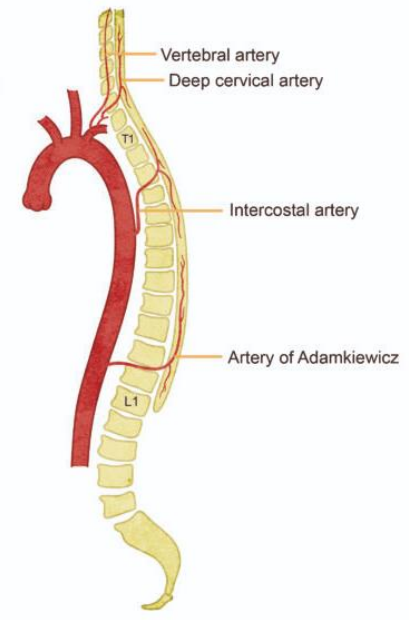
- Variable reported incidenceof postoperative SCI
- 20% of patients after conventional surgery and 0–13% in endovascular repair
- **More recent surgical techniques and protective strategies have reduced the reported incidence of SCI to 3–16%**
- Spinal cord Blood flow is extensive
  - One anterior and two posterior longitudinal spinal arteries that supply the anterior two-thirds and posterior third of the spinal cord
  - Branch vessels from the thoracoabdominal aorta form a collateral network to supply the spinal arteries.
  - The cervical and upper thoracic portion of the spinal cord receive vessels arising from the subclavian arteries
  - Thoracic cord from thoracic intercostal and lumbar vessels, arising from the aorta;
  - Lower end of the cord is supplied by branches of the lumbar, iliolumbar and sacral arteries.
  - The segmental anterior radicular branches are frequently variable and sometimes absent and a main segmental artery



Operative mortality	5.9%	9.5%	8.8%	5.4%
Persistent stroke	2.4%	3.4%	1.1%	1.3%
Persistent spinal cord deficit	3.4%	8.0%	7.0%	2.4%
Respiratory failure with tracheostomy	8.1%	12.3%	7.0%	4.5%
Acute kidney injury with dialysis at discharge	4.9%	9.6%	7.9%	7.6%

Spinal protection and Ischemia

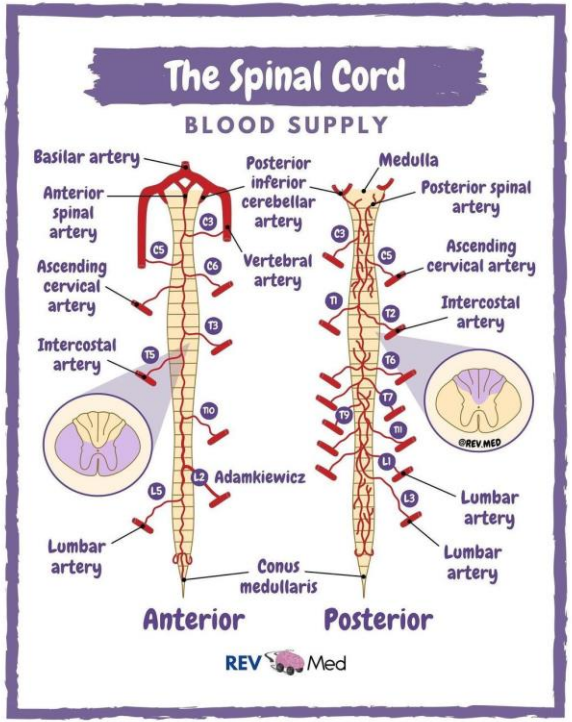
- The arteria radicularis magna of **Adamkiewicz**, often represents the **predominant blood supply to the lower two-thirds of the thoracolumbar spinal cord**.
- arises more frequently from the **left side** of the aorta in the **T8-L2 region**.
- Risk Factors:
  - Interventions involving **two aortic regions** (zone 2, subclavian artery, and zone 5, lower thoracic artery, proximal to celiac artery
  - **Anatomic**: prior abdominal aortic surgery, number of patent lumbar arteries, extent of aortic aneurysm
  - **Perioperative**: urgent/emergent repair, extent of coverage (total length, uncovered aorta, coverage of the left subclavian artery), endovascular landing zone 5–10 with coverage of artery of Adamkiewicz, procedure duration, general anesthesia and open surgery, hypotension, bleeding, arterial access site injury, degree of hypothermia
  - **Patient specific**: age, coronary artery disease, smoking, **chronic kidney disease**, chronic obstructive pulmonary disease, hypertension.



Spinal protection and Ischemia

- Pathogenesis of SCI
  - loss of spinal cord perfusion,
    - surgical exclusion
    - embolization
    - Hemodynamic instability.
  - Reperfusion injury and edema

- **Early vs delayed**



Intraop techniques

- Expeditious repair
- Mild passive hypothermia (32–34 ℃, nasopharyngeal)
- left heart bypass (LHB)
- Moderate heparinization (1 mg/kg)
- Sequential aortic clamping with distal aortic perfusion whenever feasible
- Judicious reattachment of intercostal and lumbar arteries
- CSF drainage

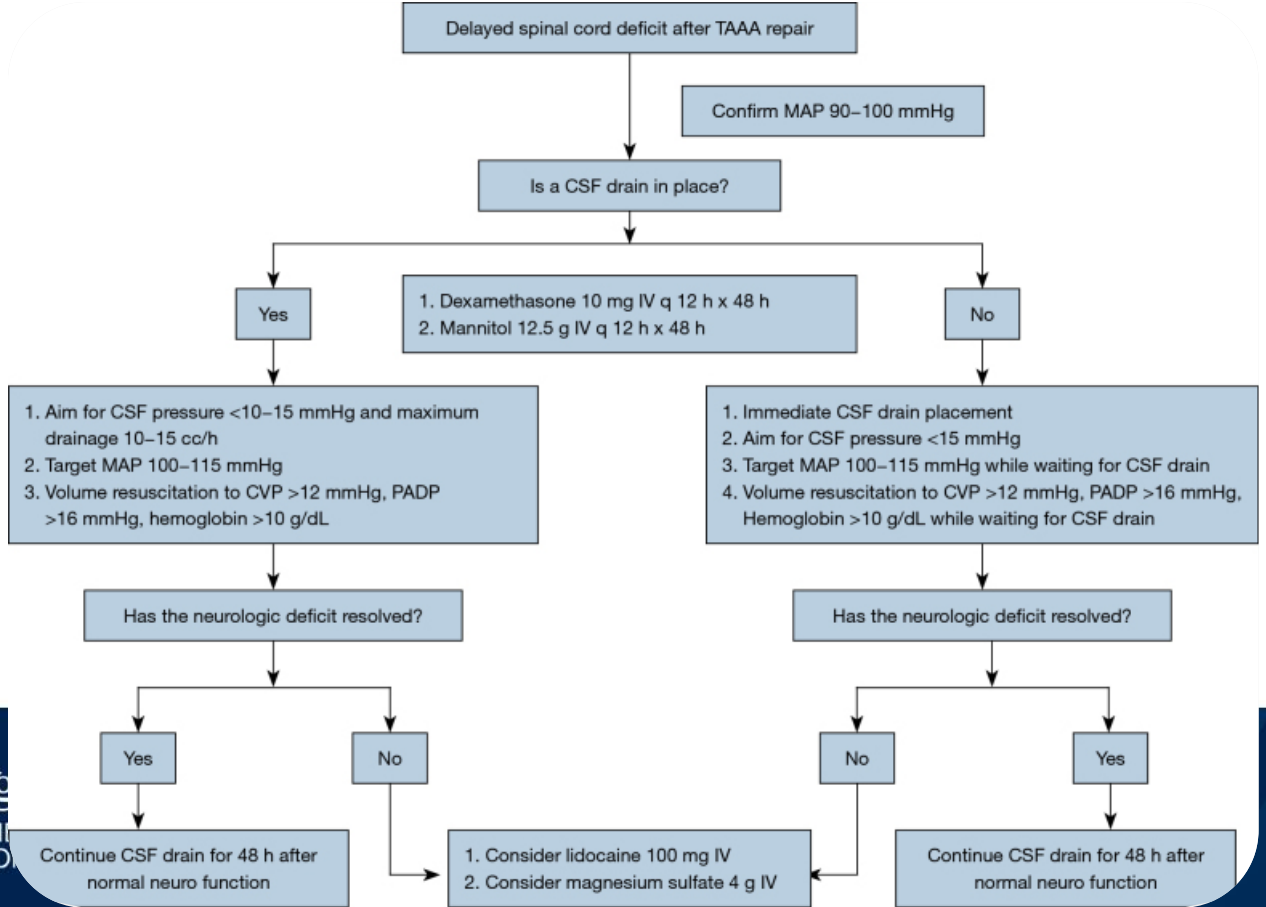
CSF drainage

- CSF pressure kept at <15 mm Hg. Target pressure >=12
- We avoid draining CSF at >150 mL/24 h, >25 mL/4 h, or >10 mL/h
- If signs of paraplegia or paraparesis appear, rescue measures must be initiated
  - Immediately confirm the MAP is 90 to 100 mm Hg.
  - Target CSF pressure is lowered to <10 mm Hg,
  - CSF drainage rate is cautiously increased to 10 to 15 mL/h, with a maximum of 50 mL/4 h.
  - Patient is placed in the Trendelenburg position
  - CVP to >10 to 12 mm Hg,
  - Hemoglobin level to >10 g/dL.
  - **The CVP should not be excessively increased because this could raise intracerebral and CSF pressure.**

Spinal protection and Ischemia

- **Postoperative management protocols**
  - Neuro check every hour even if sedated .
  - CSF pressure of 8–12 mmHg can be maintained, with a drainage of less than 20 mL per hour and no more than 40 mL during any 4 h period. If the neurological exam is normal, the drain can be closed after 24 h and removed after 48 h
  - MAP of 80–90 mmHg (or SCPP > 70 mmHg) in the first 48 h, using vasopressor agents if indicated. Fluid replacement must be judicious, because the increase in central venous pressure can reduce the SCPP.
  - optimal oxygen delivery, keep Hgb more than 10 g/dL;
  - optimal coagulation with **progressive rewarming** of the patient but careful not extensive warming (vasodilation)
  - pharmacological treatments for the reduction of cord edema, using mannitol or glucocorticoids, may be considered but are not recommended

Delayed SCI care



SCI after Discharge

- Avoid direct vasodilators : ACE inh, ARB, CCB for 4 weeks
- Avoid hot baths
- Keep SBP close to 140 when high risk for SCI
- Frequent BP checks

What need monitoring

Vital signs	**Restore normothermia**	Patient-warming devices Warmed fluids
Brain	Recognize focal neurologic deficits	Diagnostic imaging as needed
Spinal cord	Mean arterial pressure 85-100 mm Hg CSF drainage <15 mm Hg Lower-extremity movement	Volume resuscitation Vasopressors (norepinephrine, vasopressin) Vasodilators (nicardipine, Nitroprusside) Hourly check of CSF pressure and drainage as needed (<10 mL/h) Neurologic exam checks Suspect spinal cord deficit

What need monitoring

Pulmonary	Lung-protective ventilation Vocal cord function	Ventilator adjustment Direct laryngoscopy if vocal cord dysfunction suspected Injection laryngoplasty if movement impaired
Cardiovascular	Central venous pressure 8-12 mm Hg Pulmonary artery diastolic pressure 12-16 mm Hg Cardiac index ≥2.2 L/min/m^2 Restore sinus rhythm	Volume resuscitation Epinephrine, dobutamine infusion Amiodarone, cardioversion

What need monitoring

Renal, fluids, electrolytes	Adequate resuscitation crystalloid at 1.5-2.0 mL/kg/h Prevent acute kidney injury	Check serum lactate, base deficit, urine output Adequate volume and mean arterial pressure, rounding with pharmacy, medication adjustments, avoid nephrotoxins/contrast, avoid subclavian and peripherally inserted central catheters
Gastrointestinal	Return of bowel function	Nasogastric tube, cautious advancement of diet
Hematologic	Hemoglobin 9.5-10.5 g/dL Platelets ≥100,000 International normalized ratio ≤1.6 Fibrinogen ≥200,000	Transfusion as needed

Outpatient Care

- **Follow-up Appointments**:
- **Medication Management**:
  - Ensuring the patient continues to take medications as prescribed, and adjusting doses as necessary based on follow-up assessments.
  - Avoid CCB, ACE inh
- **Wound Care**:
  - Monitoring the surgical incision site for signs of infection or complications and advising the patient on proper wound care techniques.
- **Physical Therapy**:
  - Recommending ongoing physical therapy to improve strength, flexibility, and cardiovascular health.
- **Lifestyle Modifications**:
  - High protein diet with normal kidney fx.
  - Advising the patient on lifestyle changes such as diet, exercise, smoking cessation, and stress management to reduce the risk of further cardiovascular problems.

Outpatient Care

- **Long-term Monitoring**:
  - Monitoring the patient's cardiac function and vascular health through regular check-ups, imaging tests, and other diagnostic procedures as needed.
- **Psychosocial Support**:
  - Providing emotional support and resources for coping with the emotional and psychological effects of surgery and recovery.
- **Education and Support Groups**:
  - Offering educational materials and support groups for patients and their families to connect with others who have undergone similar procedures.
- **Emergency Plan**:
  - Discussing signs and symptoms of potential complications and instructing the patient on when to seek emergency medical attention.
- Both inpatient and outpatient care should be tailored to the individual patient's needs, taking into account factors such as age, overall health, and the specific type of aortic surgery performed. Close collaboration between the surgical team, primary care physician, and other healthcare providers is essential to ensure comprehensive and coordinated care throughout the recovery process.

Vandalia Health

Thanks

- Questions?