ANESTHESIA FOR LAPAROSCOPIC SURGERY

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INTRODUCTION

- Laparoscopy is the visualisation of the abdominal cavity through an endoscope
- It is a minimally invasive procedure
- Eg: appendectomy, inguinal hernia surgery, upper abdomen surgery, gynaecological procedures, urological procedures

ADVANTAGES OF LAPAROSCOPY

- Reduced stress response to surgery
- Rapid return of GI function
- Reduced postoperative pain and analgesia
- Improved postop respiratory function
- Reduced recovery time, early ambulation
- Cosmetic and less postop wound infection

Table 68–2 Operative procedures suitable for ambulatory surgery

Specialty	Types of Procedures
Dental	Extraction, restoration, facial fractures
Dermatology	Excision of skin lesions
General	Biopsy, endoscopy, excision of masses, hemorrhoidectomy, herniorrhaphy, laparoscopic procedures, varicose vein surgery
Gynecology	Cone biopsy, dilatation and curettage, hysteroscopy, laparoscopy, polypectomy, tubal ligation, vaginal hysterectomy
Ophthalmology	Cataract extraction, chalazion excision, nasolacrimal duct probing, strabismus repair, tonometry
Orthopedic	Anterior cruciate repair, arthroscopy, bunionectomy, carpal tunnel release, closed reduction, hardware removal, manipulation under anesthesia
Otolaryngology	Adenoidectomy, laryngoscopy, mastoidectomy, myringotomy, polypectomy, rhinoplasty, tonsillectomy, tympanoplasty
Pain clinic	Chemical sympathectomy, epidural injection, nerve blocks
Plastic surgery	Basal cell cancer excision, cleft lip repair, liposuction, mammaplasty, otoplasty, scar revision, septorhinoplasty, skin graft
Urology	Bladder surgery, circumcision, cystoscopy, lithotripsy, orchiectomy, prostate biopsy, vasovasostomy

TECHNIQUE OF LAPAROSCOPY

- Introduction of Veress needle and trocar :

✓Patient supine, elevation of anterior abdominal wall +/-

✓Abdominal wall is punctured with the needle directed toward the pelvis

✓Sometimes dissection under vision for placing Veress neeedle

- Tests for confirming intraperitoneal placement:

✓ Hanging drop of saline

TECHNIQUE OF LAPAROSCOPY

- Initial insufflation of CO_2 through Veress
- Veress replaced by access port to maintain insufflation during surgery
- Video laparoscope inserted through the port for visualization of operative field
- Additional access ports inserted through a number of small skin incisions - allow introduction of surgical dissection instruments

IAP

IAP is the steady pressure within the closed abdominal cavity

NORMAL values 0-5 mmHg

Optimal surgical conditions -10-13 mmHg

More than 15 mmHg compromises venous return

Initial flow : 4-6 L/min

Maintenance : 200-400 ml/min

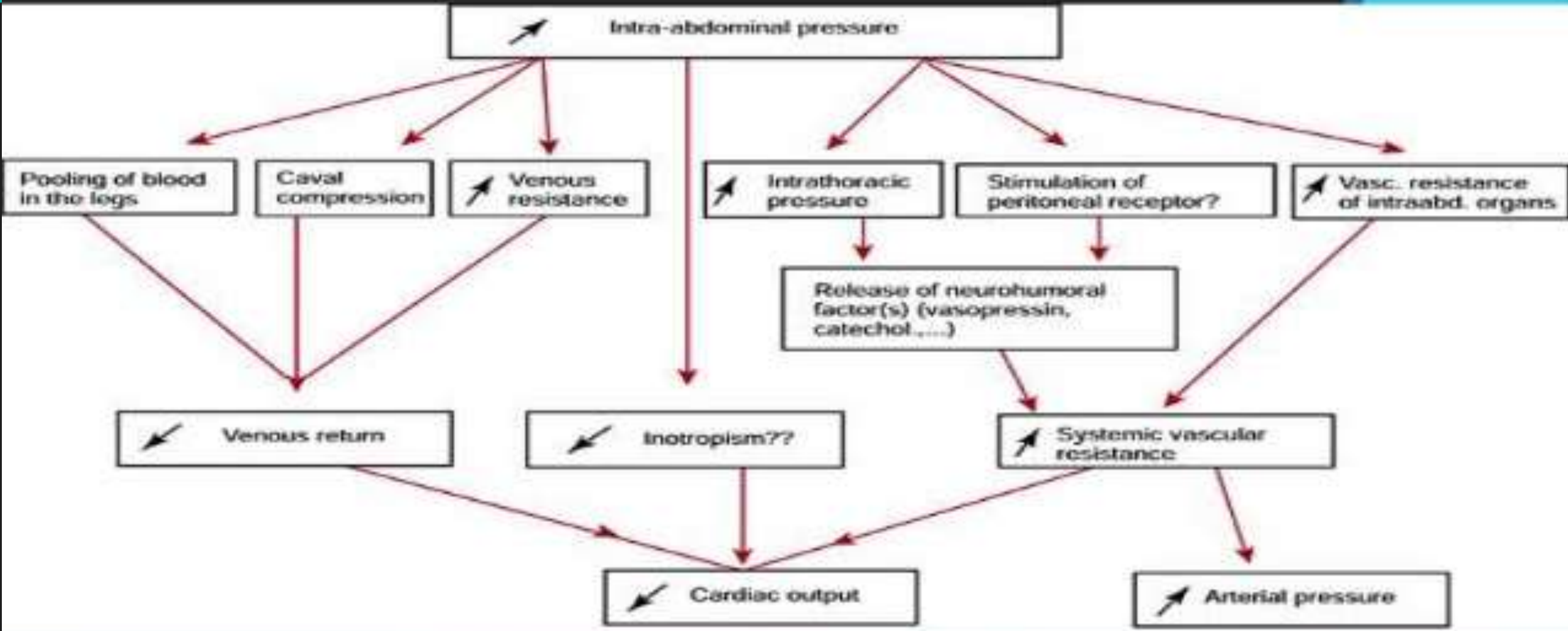
GASES THAT CAN BE USED

1. **CARBON DIOXIDE-** non combustible
2. AIR- combustible
3. NITROGEN- low blood solubility
4. NITROUS OXIDE- combustible
5. HELIUM- low blood solubility, costly
6. ARGON- low blood solubility, costly

PHYSIOLOGICAL EFFECTS OF CARBON- DIOXIDE

- 10-15 minutes after CO_2 insufflation - ↑ICP due to reflex vasodilatation
- For each 1mmHg ↑ in $PaCO_2$, CBF ↑ 1.8ml/100g/min and cerebral volume ↑ 0.04ml/100gm
- CO_2 produces excitation of the sympathetic nervous system
- The CVS effects of hypercarbia are the result of a balance between the direct cardio-depressant effect of CO_2 & increased activity of the sympathetic nervous system

EFFECT OF PNEUMOPERITONEUM ON CVS



MINIMISING HAEMODYNAMIC EFFECTS

- Prior to peritoneal insufflation-

✓Increase circulating volume

✓Increase filling pressures

- Achieved by-

✓ Fluid loading

✓ Tilt patient to slight head low position

Attenuates reduction in venous return and cardiac output

Pneumatic compression device & elastic bandages prevent pooling

EFFECT OF PNEUMOPERITONEUM ON RS

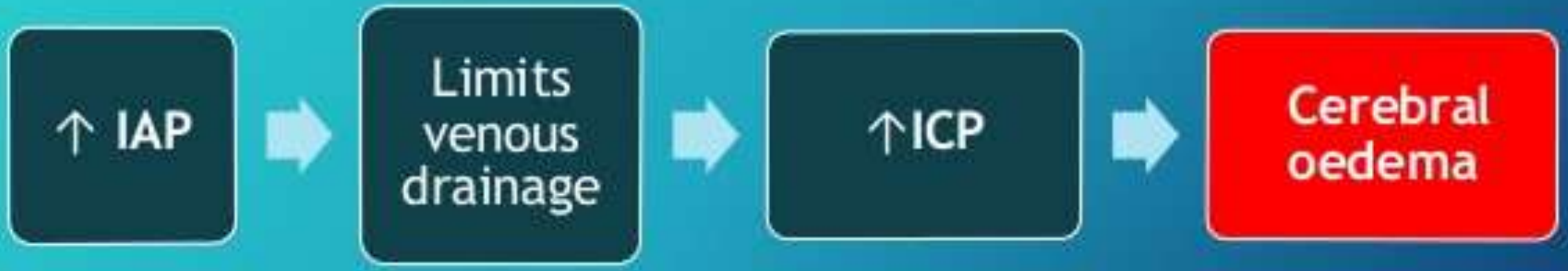
EFFECT OF CO_2 PNEUMOPERITONEUM ON RS

Insufflation ↓GA → Peritoneal capillaries absorb CO_2 → Progressive increase in $PaCO_2$ → Plateaus 15 to 30 min later

To correct increased P_aCO_2 - ↑ alveolar ventilation by10% to 25%

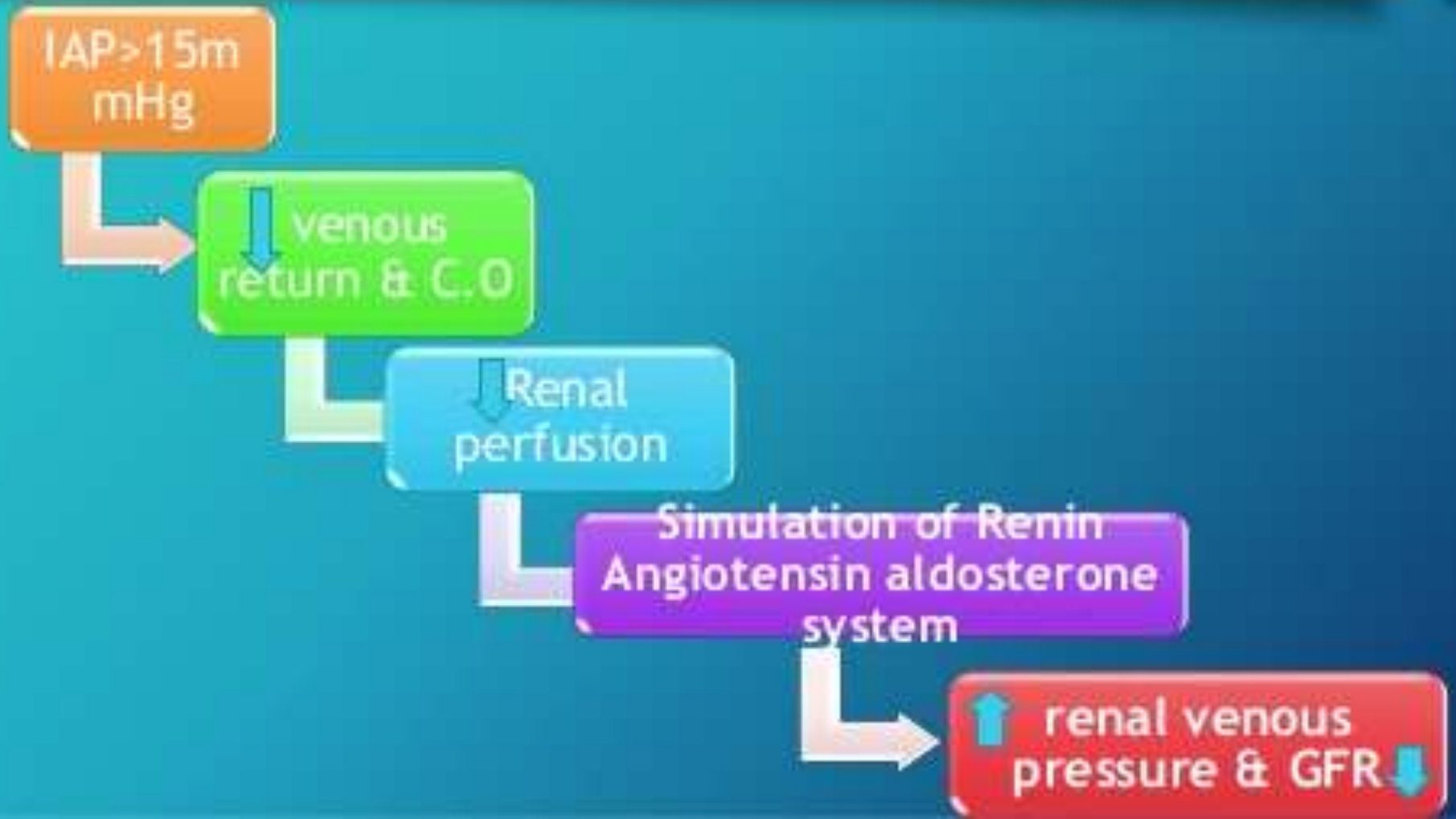
Enormous buffering capacity of the blood prevents excessive increase in P_aCO_2 under normal circumstances

EFFECTS OF PNEUMOPERITONEUM ON CNS



- Hypercapnia, high systemic vascular resistance and head low position combine to elevate intracranial pressure
- The induction of pneumoperitoneum itself increases middle cerebral artery blood flow

EFFECTS OF PNEUMOPERITONEUM ON RENAL SYSTEM



EFFECT OF PNEUMOPERITONEUM ON SPLANCHNIC PHYSIOLOGY

IAP 10- 15 mmHg → Transient ↑ venous return from splanchnic vessels → ↑ Cardiac output

Persistent IAPs over 20 mm Hg → 40% ↓ in mesenteric and gastrointestinal mucosal blood flow → progressive tissue acidosis

PROBLEMS WITH POSITIONING

- Extreme positions place the patient at risk of movement on the table.
- Patient should be securely positioned with vulnerable pressure points and eyes being protected throughout the procedure.
- No significant changes in shunt fraction or dead space ventilation occurs even in a 10^0 - 20^0 head up or head down position.

PROBLEMS WITH POSITIONING

TRENDELENBURG POSITION

Cephalad movement of diaphragm

Decreased FRC & V/Q mismatch	Endobronchial intubation	Cerebral edema & upper airway edema
Increases CVP	Increases cardiac output	Increased ICP Increased IOP

PROBLEMS WITH POSITIONING

- The extreme 'HEAD-UP' REVERSE TRENDELENBURG POSITION posture

Reduced venous return

↓

Hypotension

↓

Myocardial and cerebral ischaemia.

COMPLICATIONS

- Arrhythmias –junctional rhythm, bradycardia
- Subcutaneous emphysema
- Pneumothorax, pneumomediastinum, pneumopericardium
- Gas embolism
- Endobronchial migration of tracheal tube
- Aspiration of gastric contents
- Well-leg compartment syndrome

SUBCUTANEOUS EMPHYSEMA

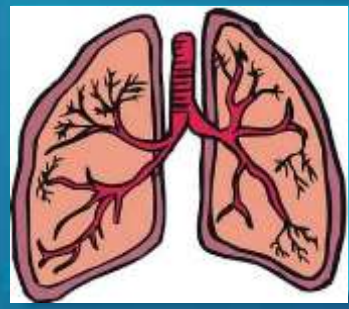
Subcutaneous emphysema

- pneumothorax
- pneumomediastinum
- pneumopericardium

Risk factors:

Repeated attempts
Improper placement of the trocar
Loose trocar fascia entry
Number of trocars >4
Size of trocars ≥10 mm
Torqueing with traumatic expansion of the fascia
Longer surgery time
Volume of gas ↑↑
High flow rate, High pressure

SUBCUTANEOUS EMPHYSEMA



DIAGNOSIS

- Crepitus
- Insufflation problems (flow and pressure)
- Hypercarbia- Intraoperative increase in partial pressure of end-tidal CO_2>50 mmHg
- Acidosis
- Change in lung compliance
- Cardiac arrhythmias, sinus tachycardia, and hypertension

SUBCUTANEOUS EMPHYSEMA SUSPECTED..

- Evaluate for a pneumothorax
- Check end-tidal CO_2 and arterial CO_2
- Increase ventilation rate and tidal volume
- Increase oxygen to 100%
- Ensure CO_2 absorber in the circuit
- Decrease IAP
- Discontinue N_2O (rapidly enters the area of tissue emphysema)
- Assess airway to ensure there is no compression before extubation

CO_2 SUBCUTANEOUS EMPHYSEMA

BP Stable, SpO2 normal

100% O_2 Temporarily stop surgery

Subcutaneous emphysema readily resolves once insufflation has ceased

Resume after correction of hypercapnia using a lower insufflation pressure

PNEUMOTHORAX, PNEUMOMEDIASTINUM, PNEUMOPERICARDIUM

- Embryonic remnants constitute potential channels of communication between the peritoneal cavity and the pleural and pericardial sacs which can open when intraperitoneal pressure ⬆
- Defects in the diaphragm or weak points in the aortic and esophageal hiatus allow gas passage into the thorax
- Pleural tears can occur during laparoscopic surgical procedures at the level of the gastroesophageal junction

ENDOBRONCHIAL INTUBATION

Pneumoperitoneum

↓

Cephalad movement of the carina & diaphragm

↓

Endobronchial intubation

↓

SPO2 ↓ Plateau airway pressure ↑

$EtCO_2$ normal/↓/↑

GAS EMBOLISM

$Etco_2$ decreases in the case of embolism

$\Delta a\text{-}EtCO_2$ increases.

Pulse oximetry is also helpful in recognizing hypoxemia

Aspiration of gas or foamy blood from a central venous line

Doppler and TEE are very sensitive

GAS EMBOLISM

Early events 0.5ml/kg of air

- Changes in doppler sounds
- Increased mean pulmonary artery pressure

Events occurring with 2 mL/kg of air

- Tachycardia, cardiac arrhythmias, hypotension, ⬆ CVP, alteration in heart tones, cyanosis, and ECG-right-sided heart strain

Rx

Stop insufflation Release pneumoperiton

Ventilate with 100% oxygen

Place patient in Durant position

Central venous line for aspiration of gas (?)

External cardiac massage- fragments CO_2 emboli

CPB of blood

HBOT for cerebral embolism

WELL LEG COMPARTMENT SYNDROME

WELL LEG COMPARTMENT SYNDROME

Impaired arterial perfusion to raised lower limbs

Compression of venous vessels by lower limbs supports

Reduced femoral venous drainage due to the pneumoperitoneum

CLINICAL FEATURES:

1. Presents after operation with disproportionate lower limb pain
2. Rhabdomyolysis
3. Myoglobin-associated acute renal failure

RISK FACTORS: Prolong Sx, obesity, PVD, hypotension

ASPIRATION OF GASTRIC CONTENTS

⇧ IAP

⇩

Changes of the LES

⇩

⇧Risk of regurgitation.

Head-down position helps to prevents regurgitated fluid from entering the airway.

PAE

Pneumoperitoneum stresses CVS & RS more.

- CARDIAC PATIENTS

Lee cardiac risk index can be used for quantification of cardiac risk

For patients with heart disease the postoperative benefits of laparoscopy must be balanced against the intraoperative risks

PAE

- COPD:

PFT,CXR,ABG, SpO_2 in addition to history and physical examination

Cessation of smoking, adequate bronchodilators, steroids and chest physiotherapy with incentive spirometry help to reduce post op pulmonary complications

CHOICE OF ANESTHESIA

Conventional GA / TIVA with muscle relaxation with ETT

Conventional GA / TIVA +/- muscle relaxation with supraglottic device

Regional Anaesthesia

IV Sedation + LA

GA

- Minimise BMV (↓ gastric insufflation)
- Maintain $EtCO_2$-30-35mmhg
- N2O +/-
- NG Tube
- Avoid Halothane

Muscle relaxants

Use of L.M.A

- Controversial.
- There is increased risk of aspiration

- Difficulties are encountered when trying to maintain effective gas transfer while delivering higher airway pressures required during pneumoperitoneum

Use of Proseal LMA

- Several randomized controlled trials assessing the use of Proseal LMA with data advocating the use of PS-LMA as effective and efficient for pulmonary ventilation in laparoscopic surgery has been published.

[Lim Y, Goel S. Proseal is effective alternative to laryngoscope guided tracheal intubation. Anaesth Intensive Care 2007; 35: 52-6]

Monitoring

1.Routine Patient Monitoring Include
Continuous ECG
Intermittent NIBP
Pulse oximetry (SpO2)
Capnography (EtCO2)
Temperature
Intra abdominal pressure
Pulmonary airway pressures

2. Optional Monitoring Include
IBP
Oesophageal stethoscope
Precordial doppler
Transoesophageal echocardiography

Pressure control Vs volume control..

Pressure controlled ventilation

- Affords higher instantaneous flow peaks, minimizing peak pressures
- Provide improved alveolar recruitment and oxygenation in laparoscopic surgery

Volume controlled ventilation

- Constant flow to deliver a pre-set tidal volume and ensure an adequate minute volume
- An increased risk of barotrauma and high inflation pressures.

PEEP

PEEP of 5 cm H_2O essential to decrease intraoperative atelectasis.

Addition of titrated levels of PEEP minimize alveolar de-recruitment.

Used cautiously as increasing PEEP may compromise cardiac output.

ANALGESIA

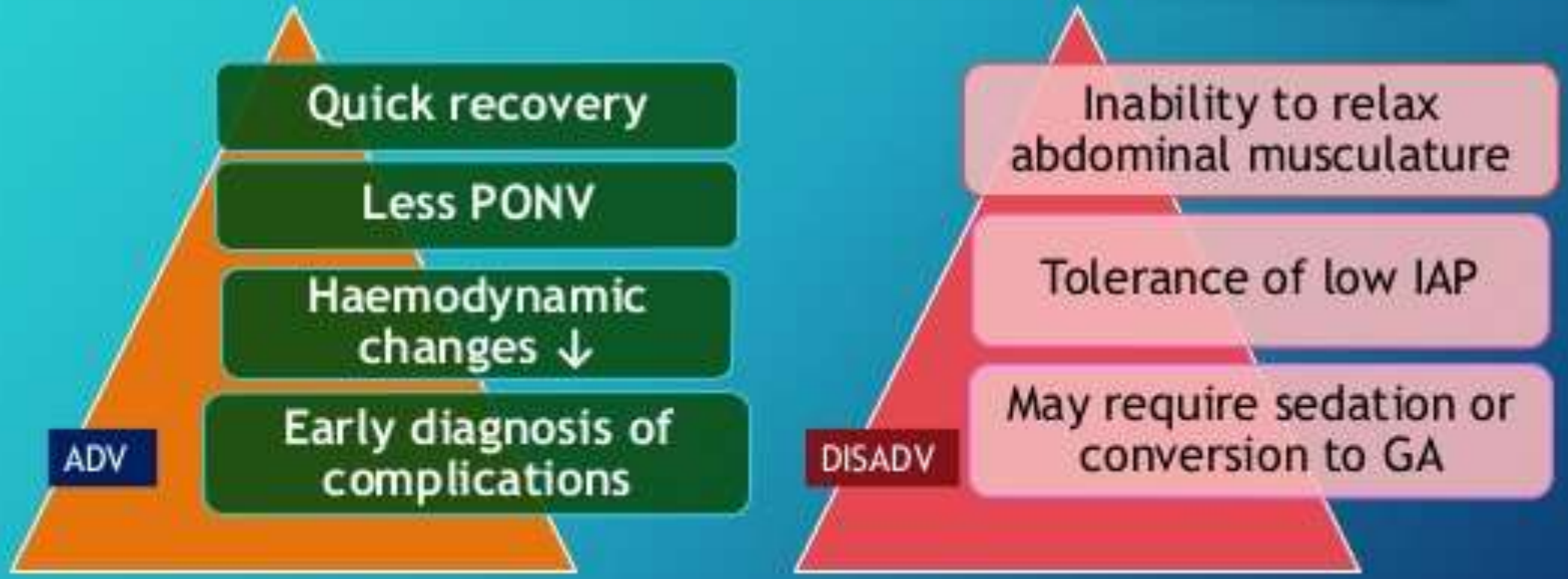
- Post op pain – short but intense
- 80% use opioid analgesia at some stage
- Shoulder tip pain may be there

REGIONAL ANAESTHESIA IN LAPAROSCOPIC SURGERY

EPIDURAL ANAESTHESIA: Good postop analgesia, less PONV, High level (T2-T4) required for intraoperative comfort, Shoulder tip pain NOT obliterated

SPINAL ANAESTHESIA: Level of block can migrate cephalad - hypotension, bradycardia

LOCAL ANESTHESIA



POSTOPERATIVE MANAGEMENT

Postoperative shoulder-tip pain

Require supplemental O_2

Alveolar recruitment technique using short term CPAP or high flow O2 delivery systems

PONV

Laparoscopy is associated with high incidence of PONV

↓

↑pain,↑ period of hospital admission for patients

Deflating the stomach → Good quality postoperative analgesia

Multi-modal regime such as ondansetron, cyclizine, and dexamethasone - effective

SPECIAL CONSIDERATIONS

Table 56–2. Management of Patients With Cardiac Disease for Laparoscopy

Preoperative evaluation: echocardiography
If left ventricular ejection fraction <30%
- Intraoperative monitoring
  - Intra-arterial line
  - Pulmonary artery catheter
  - Transesophageal echocardiography?
  - Continuous ST segment analysis?
- Gasless laparoscopy?
- Laparotomy?

Intraoperative management
- Slow insufflation
- Low intra-abdominal pressure
- Hemodynamic optimization before pneumoperitoneum (preload augmentation)
- Patient tilt after insufflation
- Anesthesia: isoflurane
  vasodilating drugs (nicardipine, nitroglycerin)
  cardiotonic agents
- Experienced surgeon

Postoperative care
- Slow recovery from anesthesia (benefit of clonidine)

COPD AND LAP SURGERY

1
2
- Duration of surgery should be limited to 2 hrs. Standard monitoring
- IAP less than 12mmHg

3
4
- GA with controlled ventilation
- Helium for pneumo peritoneum

5
6
- Monitor peak airway pressure to avoid barotraumas
- Minimal tilt & multimodal analgesia to prevent postop respiratory depression

LAPAROSCOPY IN THE ELDERLY

Age related physiological and pathological changes & co-morbidities

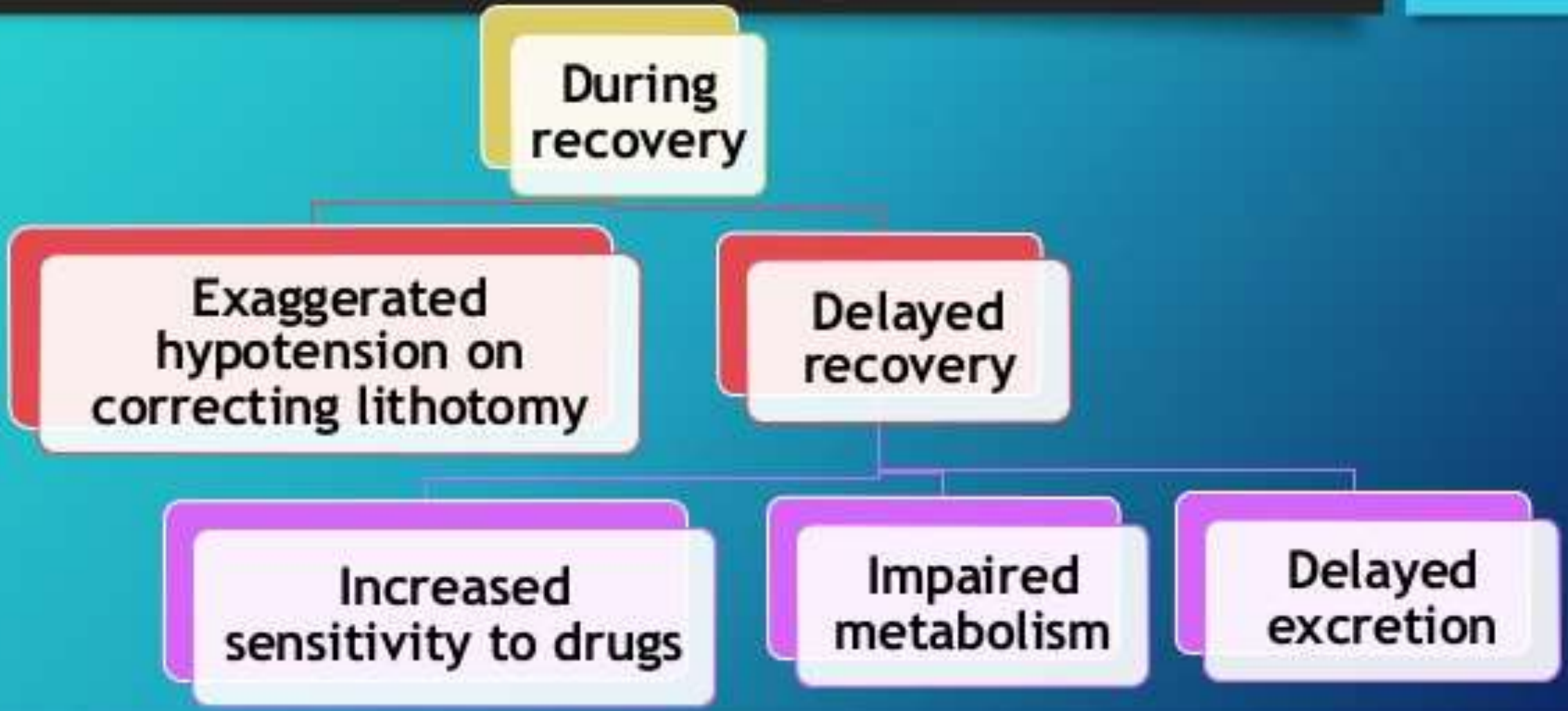
Narrow margin of safety

Decrease in organ reserve

Careful positioning

Prevent venous stasis

ANAESTHESIA FOR LAPAROSCOPY IN THE ELDERLY



LAP DURING PREGNANCY

INDICATIONS: Appendicectomy, Cholecystectomy, Ovarian cystectomy

- ↑Risk of acid aspiration
- ↑Risk of abortion/ miscarriage / premature
- More prone to hypoxemia- ↓FRC ↑O2 consumption
- ↑Vd due to in increased blood volume
- Chances for damage to gravid uterus by Veress needle
- Difficult airway
- Fetal acidosis

RECOMMENDATIONS FOR SAFE LAP IN PREGNANCY

- Operation in 2nd trimester before 24 wks
- Tocolytics therapy if risk of preterm labor
- IAP less than 12mmHg
- Continuous Fetal heart monitoring with trans vaginal USG
- $PaCO_2$ to be maintained at normal levels with the help of $EtCO_2$ monitor/ABG
- Mechanical ventilation to maintain physiologic maternal alkalosis (pH7.44)
- Pneumatic compression devices to calf muscles to prevent DVT

LAP SURGERY IN CHILDREN

LAP SURGERY IN CHILDREN

IAP= 10 - 12 mm Hg in older children.

Volume of gas for creation of pneumo peritoneum is less

Prone for hypothermia and PONV

Gasless laparoscopic surgery can be done in smaller children

LAP IN OBESE PATIENTS

- Detrimental effect in respiratory mechanics is due to supine position and increased weight
- Increased Carbon dioxide production and oxygen consumption
- Reduced chest wall compliance & decreased lung volumes
- Potential airway and intubation problems
- Difficulties during IV access, positioning, pneumoperitoneum induction, trocar access
- Umbilicus is located 3-6cm caudal to the aortic bifurcation, making trocar placement more difficult.

POST LAP IN OBESE

Oxygen therapy

Aggressive pulmonary care and positioning

Obese patients must have sequential compression devices on their lower extremities

Prophylactic anticoagulation to prevent pulmonary emboli

CONTRAINDICATIONS FOR LAPAROSCOPY

- Diaphragmatic hernia
- Acute or recent MI
- Severe obstructive lung disease
- V – P shunt
- Increased ICP
- CCF & Valvular heart diseases*

GASLESS LAPAROSCOPY

- Peritoneal cavity is expanded using abdominal wall lifter.
- This avoids haemodynamic & respiratory repercussions of increased IAP
- It increases technical difficulty


thank
you