IN THE NAME OF GOD

Laparoscopy and Anesthesia

Dr. Ghassem Oussia

MD- Anesthesiologist

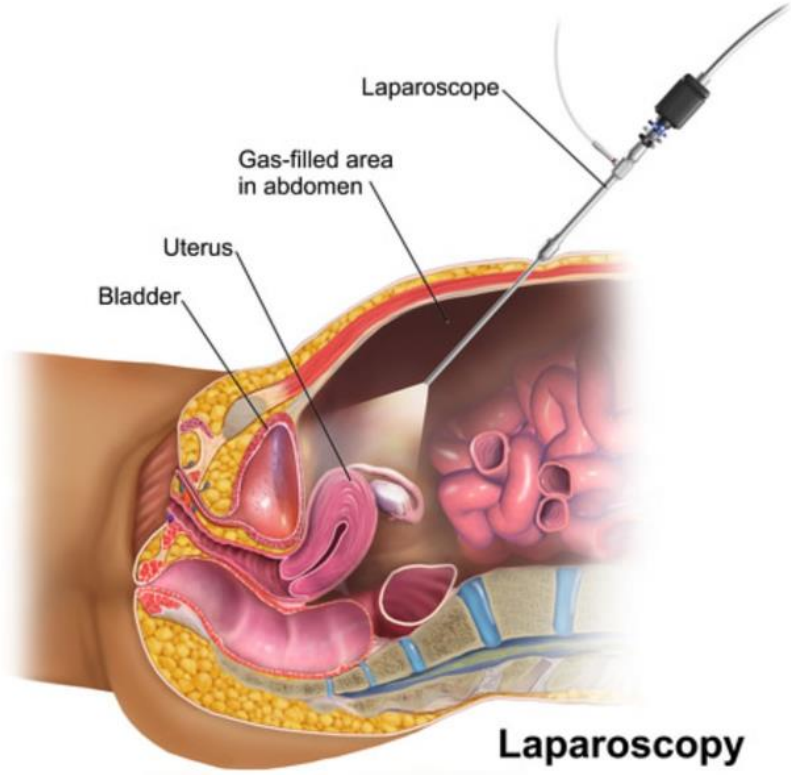
Definition

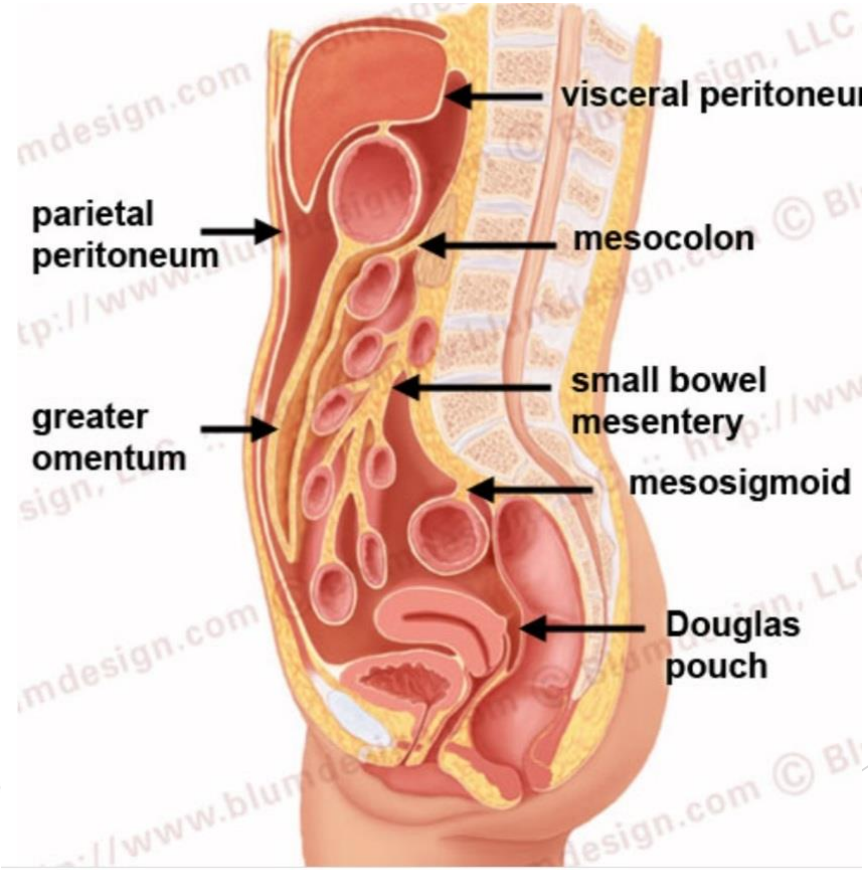
- It is a minimally access procedure allowing endoscopic access to peritoneal cavity after insufflation of gas to create space between the anterior abd. Wall & viscera for safe manipulation of instruments & organs.

TYPES

1. Intraperitoneal
2. Extraperitoneal
3. Abd wall retraction (gasless laproscopy)
4. Hand assisted (Hassans tech.)

Pneumoperitoneum pneumoretroperitoneum insufflation of CO2 in Laparoscopy





Pneumoperitioneum

Created by insufflations of gas in peritoneal cavity to provide sufficient space to ensure adequate visualization and manipulation

- Ideal gas for pneumo-peritoneum
  - Limited systemic absorption
  - Limited systemic effects if absorbed
  - Rapid excretion
  - High solubility in blood
  - Should not support combustion
  - Colourless, inert, non-explosive
  - Readily available, non explosive, nontoxic

Laparoscopy- Anesthetic issues

CO_2 pneumo peritoneum
Due to patient positioning
Cardiovascular effects
Respiratory effects
Gastro intestinal effects
Unsuspected visceral injuries
Difficulty in estimating blood loss
Darkness in the OR

Anesthetic Goals

- Accommodate surgical requirements and allow for physiological changes during surgery.
- Monitoring devices available for the early detection of complications.
- Recovery from anesthesia should be rapid with minimal residual effects.
- The possibility of procedure being converted to open laparotomy to be considered.

Carbon Dioxide

- -Advantages
  - does not support combustion
  - High solubility, eliminated by lungs
  - low risk of gas embolism, readily available ,less expensive
- -Disadvantages
  - Hypercarbia and acidosis
  - Sympathetic stimulation

Intra-abdominal pressure (IAP)

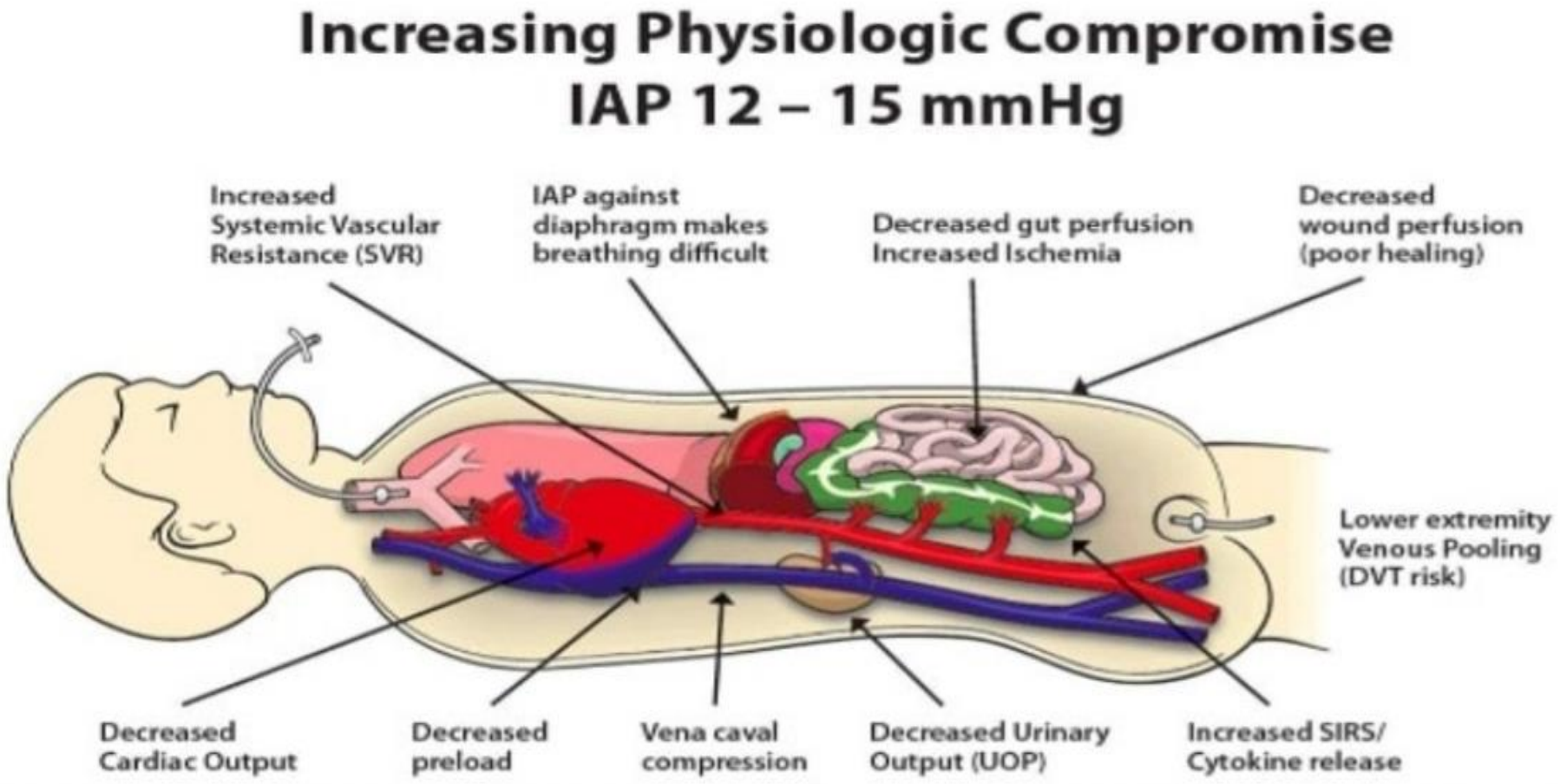
- IAP is the steady pressure within the closed abdominal cavity.
- normal values of IAP are 0-5 mmHg.
- values more than 12-14 mmHg compromises venous return.
- Initial flow : 4-6 L/min.
- Maintenance : 200-400 ml/min.

IAP Monitoring Device

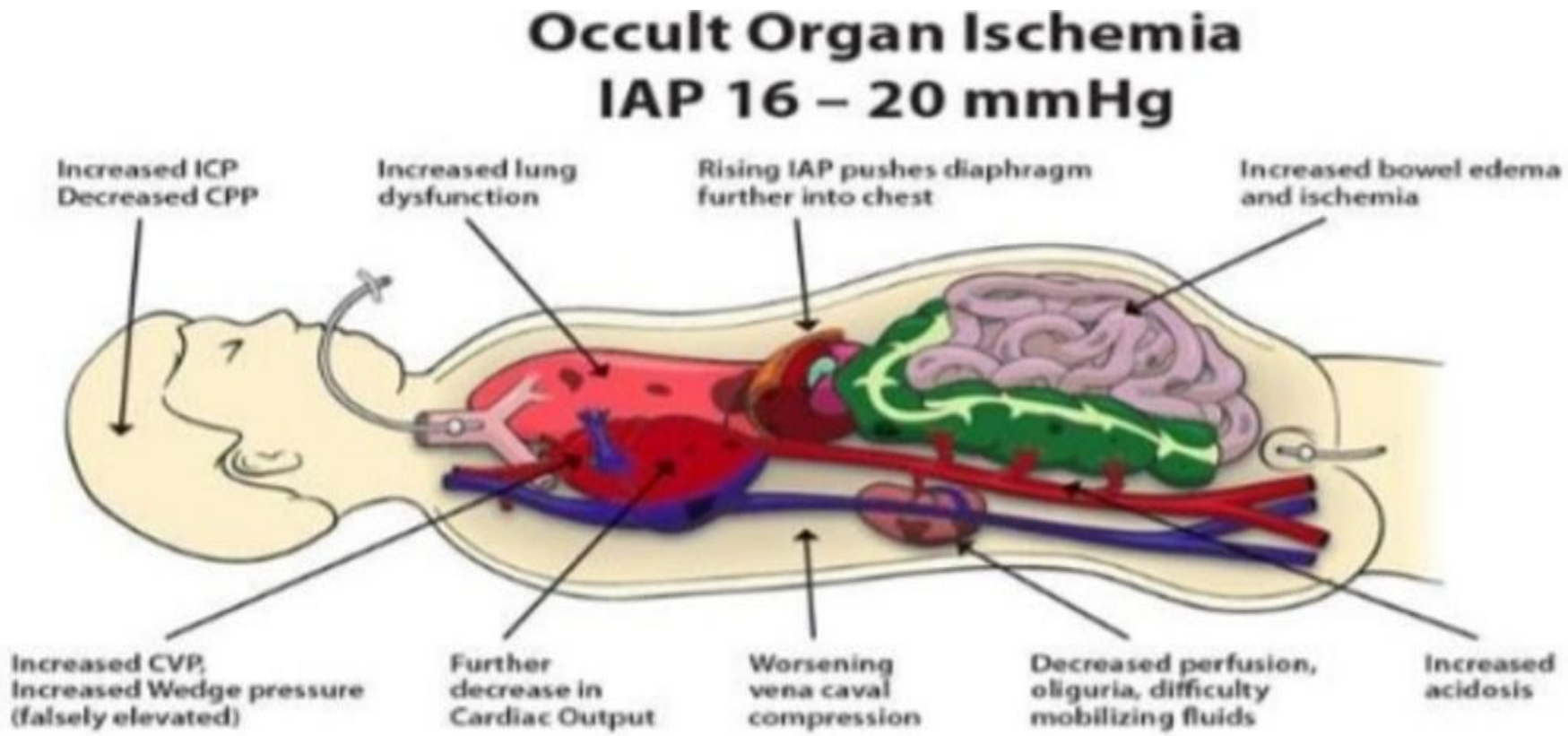
eBay

Karl Storz 264305 20 Endoscope SCB Electronic Endoflator | eBay

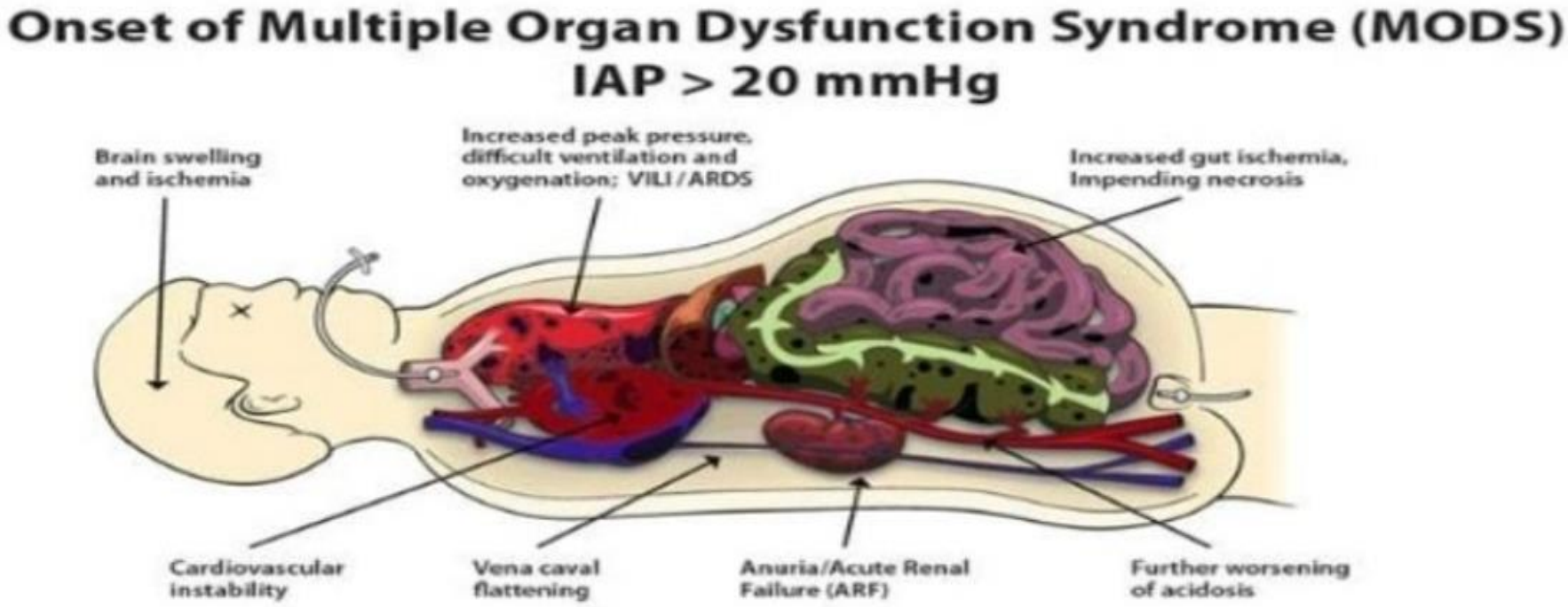
IAP: 12-15 mmHg



IAP :16-20 mmHg



IAP>20 mmHg


Onset of Multiple Organ Dysfunction Syndrome (MODS)
IAP > 20 mmHg
Brain swelling and ischemia
Increased peak pressure, difficult ventilation and oxygenation; VILI / ARDS
Increased gut ischemia, Impending necrosis
Cardiovascular instability
Vena caval flattening
Anuria/Acute Renal Failure (ARF)
Further worsening of acidosis

Intra abdominal pressure(IAP)

Intra abdominal pressure (IAP)

Normal IAP : 5-7 mmHg in the supine position

Intra abdominal Hypertension(IAH)
Sustained increase in IAP>12mmHg in supine position

Abdominal Compartment Syndrome (ACS)
Sustained increase in IAP >20mmHg in supine position (accompanied by newly developed organ dysfunction)

Abdominal Perfusion pressure(APP)(Vissceral Perfusion Pressure) = MAP-IAP DesiredAPP>60mmHg

Filtration Gradient=MAP-(IAP×2) Increase in IAP have a greater impact on GFR and Urine flow

Laparoscopy Operating Room

Benefits of Laparoscopy

- shortened recovery time and reduced morbidity
- reduced manipulation of the bowel and peritoneum, decreased incidence of postoperative ileus, early enteral intake and decreased requirements for iv fluids.

Benefits cont..

- laparoscopic wounds are smaller when compared to open techniques.
- complications associated with postoperative pain and wound healing will be minimal.
- Particularly useful in obese patients in whom open procedures would be technically challenging.

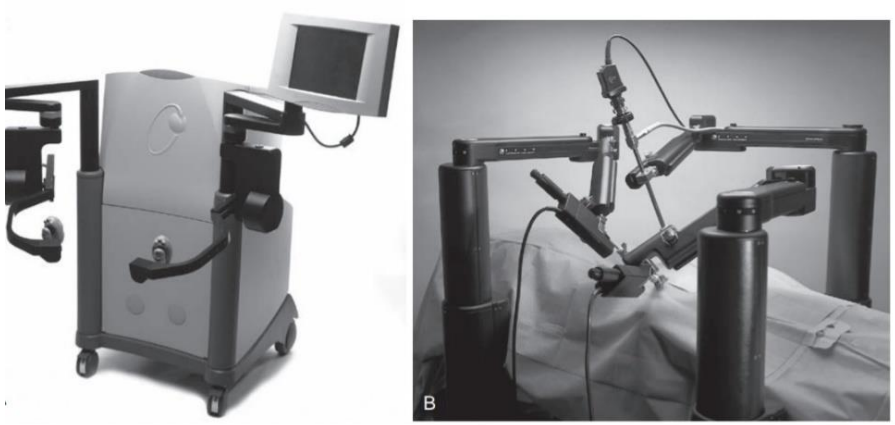
Risks of Laparoscopy

- Damage to solid viscera, bowel, bladder or blood vessels due to surgical instuments.
- Vascular injuries of large vessels.
- Venous gas embolism can result in catastrophic circulatory collapse.
- severity depends on the volume of CO_2 injected, rate of injection, patient position, and type of laparoscopic procedure.

Risks of Laparoscopy cont.

- Pnuemoperitoneum can cause ventilation-perfusion mismatch.
- ‘well leg compartment syndrome’.
- lower limb pain, rhabdomyolysis, and potentially myoglobin-associated acute renal failure.

Robotic Surgery



1 (A) The console of the ZEUS robotic telemanipulation system consists of a video monitor and two instrument handles that translate the ...'s hand motions into an electric signal that moves the robotic instruments. (B) Two table-mounted Automated Endoscopic System for Optimal ...ning (AESOP) arms hold instruments, and a third arm controls the camera. (Courtesy Computer Motion, Sunnyvale, CA, USA.)

2 The da Vinci Robotic Surgical System: two surgical consoles, patient-side cart with four mounted surgical arms, and an optical tower. (Courtesy ...Surgical, Sunnyvale, CA, USA.)

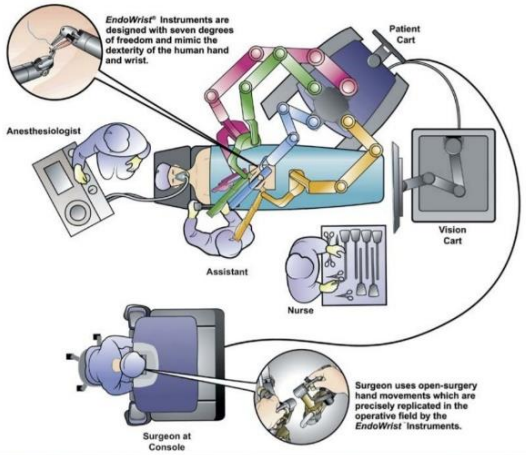


Fig. 71.3 Operating room schematic of the use of a robotic surgical system in general surgery. (Courtesy Intuitive Surgical, Sunnyvale, CA, ...

Fig. 71.4 The da Vinci Robotic Surgical System: the surgeon console. (Courtesy Intuitive Surgical, Sunnyvale, CA, USA.)

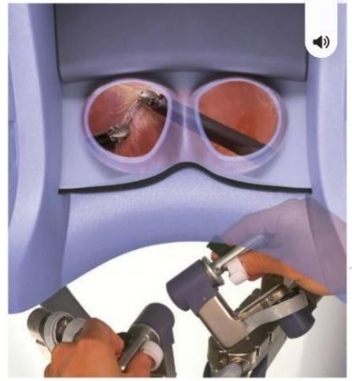


Fig. 71.5 The da Vinci Robotic Surgical System: stereo viewer that creates a virtual three-dimensional stereoscopic image. (Courtesy Intuitive Surgical, Sunnyvale, CA, USA.)

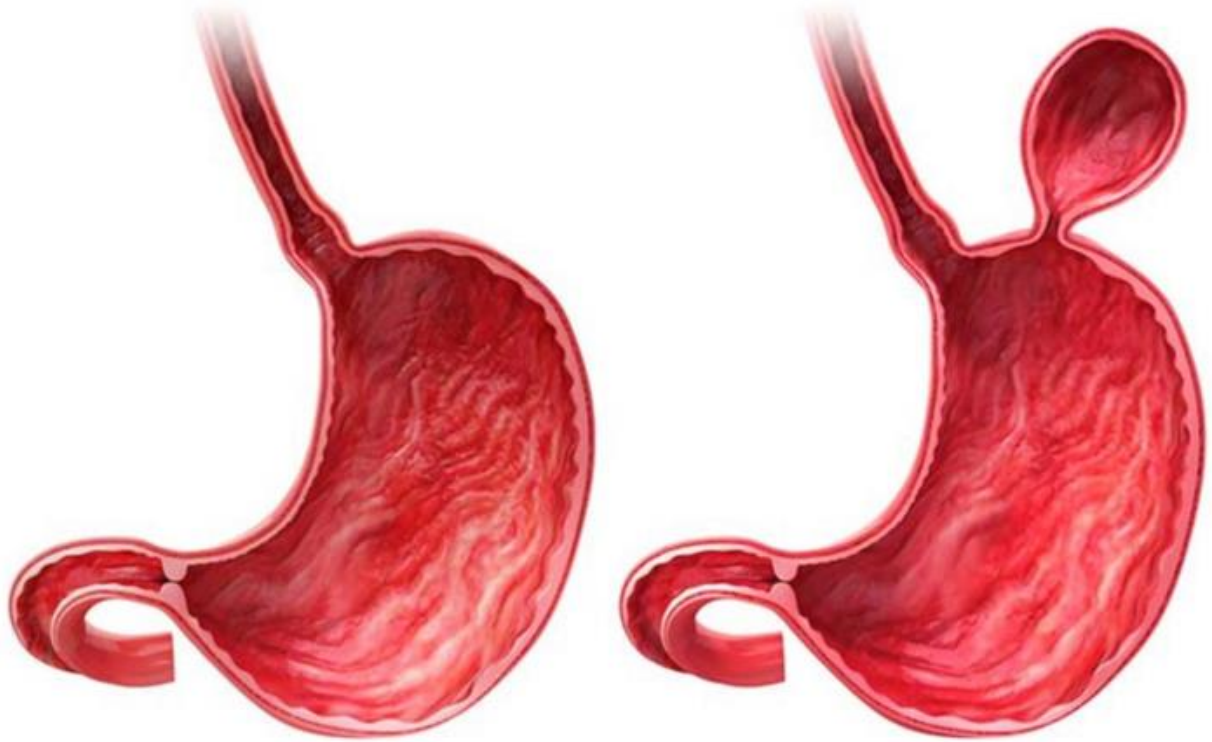
Anesthetic management in Laparoscopic robotic surgery

Prominent Surgical robotic equipment near the patient
Patient accessibility limitation in the case of Airway or Cardiopulmonaryemergency
patient positioning challenge
Ocular injury risk in Steep trendelenberg position
Accidental ETT dislodgement or facial injury need careful ETT taping and protective foam padding

Contra indication of Laparoscopy

- Diaphragmatic hernia
- Acute or recent MI
- Severe obstructive lung disease
- Increased ICP
- Hypovolemia
- CCF
- Severe Valvular heart diseases

Hiatal Hernia



Symptoms of Hiatal Hernia

Most small hiatal hernias cause no signs or symptoms. But larger hiatal hernias can cause:

- Heartburn
- Regurgitation of food or liquids into the mouth
- Backflow of stomach acid into the esophagus (acid reflux)
- Difficulty swallowing
- Chest or abdominal pain
- Feeling full soon after you eat
- Shortness of breath
- Vomiting of blood or passing of black stools, which may indicate gastrointestinal bleeding

Patient specific contra indication

- Laparoscopic surgery has traditionally been contraindicated in patients with severe ischaemic heart disease, valvular disease, significant renal dysfunction, or end-stage respiratory disease.
- Generally accepted contraindications include pre-existing raised intracranial pressure, severe uncorrected hypovolaemia, and patients with known right-to-left cardiac shunts or patent foramen ovale

ASA physical status classification

Table 13.1 American Society of Anesthesiologists Physical Status Classification System

ASA PS Classification[a]	Definition	Examples, including, but not limited to
ASA I	A normal healthy patient	Healthy, nonsmoking, no or minimal alcohol use
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but are not limited to) current smoker, social alcohol drinker, pregnancy, obesity (30 < BMI < 40), well-controlled DM/HTN, mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but are not limited to) poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥ 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA < 60 weeks, history (>3 months) of MI, CVA, TIA, or CAD/stents.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but are not limited to) recent (<3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARDS, or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but are not limited to) ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

Preoperative Diagnostic Testing Recommendation

Table 13.4 Preoperative Diagnostic Testing Recommendations[a]

Test	Clinical Scenario
Albumin	Anasarca; liver disease; malnutrition; malabsorption
β-hCG	Suspected pregnancy
CBC	Alcohol abuse; anemia; dyspnea; hepatic or renal disease; malignancy; malnutrition; personal history of bleeding; poor exercise tolerance; recent chemotherapy or radiation therapy
Creatinine	Renal disease; poorly controlled diabetes
Chest radiograph	Active, acute or chronic significant pulmonary symptoms such as cough or dyspnea; abnormal unexplained physical findings on chest examination; decompensated heart failure; malignancy within the thorax; radiation therapy[b]
Electrocardiogram	Alcohol abuse; active cardiac condition (new or worsening chest pain or dyspnea, palpitations, tachycardia, irregular rhythm, unexplained bradycardia, undiagnosed murmur, S_3, decompensated heart failure); implanted cardioverter-defibrillator (ICD); obstructive sleep apnea; pacemaker; pulmonary hypertension; radiation therapy[b]; severe obesity; syncope; use of amiodarone or digoxin
Electrolytes	Alcohol abuse; cardiovascular, hepatic, renal, or thyroid disease; diabetes; malnutrition; use of digoxin or diuretics
Glucose and/or HbA_{1c}	Diabetes; severe obesity; use of steroids
LFTs	Alcohol abuse; hepatic disease; recent hepatitis exposure; undiagnosed bleeding disorder
Platelet count	Alcohol abuse; hepatic disease; bleeding disorder (personal or family history); hematologic malignancy; recent chemotherapy or radiation therapy; thrombocytopenia
PT	Alcohol abuse; hepatic disease; malnutrition; bleeding disorder (personal or family history); use of warfarin
PTT	Bleeding disorder (personal or family history); undiagnosed hypercoagulable state; use of unfractionated heparin
TSH, T_3, T_4	Goiter; thyroid disease; unexplained dyspnea, fatigue, palpitations, tachycardia
Urinalysis	Urinary tract infection (suspected)

Recommendation for patient-specific Baseline Testing Before Anesthesia

Table 13.5 Recommendations for Patient-Specific Baseline Testing Before Anesthesia[a]

Procedure/Patient Type	Test
Injection of contrast dye	Creatinine[b]
Potential for significant blood loss	Hemoglobin/hematocrit[b]
Likelihood of transfusion requirement	Type and screen
Possibility of pregnancy	Pregnancy test[c]
End-stage renal disease	Potassium level[d]
Diabetes	Glucose level determination on day of surgery[d]

Pre anesthesia Medication Instruction(1)

Table 13.7 Preanesthesia Medication Instructions

Continue on Day of Surgery	Discontinue on Day of Surgery Unless Otherwise Indicated
Antidepressant, antianxiety, and psychiatric medications (including monoamine oxidase inhibitors[a])	
Antihypertensives • Generally to be continued	Antihypertensives • May consider discontinuing angiotensin-converting enzym inhibitors or angiotensin receptor blockers 12–24 h before surgery if taken only for hypertension; especially with lengthy procedures, significant blood loss or fluid shifts, us of general anesthesia, multiple antihypertensive medications, well-controlled blood pressure

Aspirin[b]
• Patients with known vascular disease
• Patients with previous cardiac stents
• Before cataract surgery
• Before vascular surgery
• Taken for secondary prophylaxis (vascular disease of any type)
	Aspirin[b]
	• Discontinue 5–7 days before surgery
	  • If risk of bleeding > risk of thrombosis
	  • For surgeries with serious consequences from bleedin
	  • If taken only for primary prophylaxis (no known vascular disease)

Asthma medications	
Autoimmune medications • Methotrexate (if no risk of renal failure)	Autoimmune medications • Methotrexate (if risk of renal failure) • Entanercept (Enbrel), infliximab (Remicade), adalimumab (Humira): check with prescriber (typically *not* stopped for inflammatory bowel disease)
β-Blockers	
Birth control pills	Birth control pills (if high risk of thrombosis)
Clopidogrel (Plavix)[a] • Patients with drug-eluting stents for <6 months • Patients with bare metal stents for <1 month • Before cataract surgery	Clopidogrel (Plavix)[a] • Patients not included in group recommended for continuation • Patients with drug-eluting stents for 3–6 months if risk of delaying surgery is greater than risk of stent thrombosis
Diuretics • Triamterene, hydrochlorothiazide	Diuretics • Potent loop diuretics
Eye drops	
Estrogen compounds • When used for birth control or cancer therapy (unless high risk of thrombosis)	Estrogen compounds • When used to control menopause symptoms or for osteoporosis
Gastrointestinal reflux medications • Histamine antagonists, proton-pump inhibitors, gastric motility agents	Gastrointestinal reflux medications • Particulate antacids (e.g., Tums)
	Herbals and nonvitamin supplements • 7–14 days before surgery
Insulin • *Type 1 diabetes*: take ⅔ one third of intermediate to long-acting (NPH, Lente) • *Type 2 diabetes*: take up to one half long-acting (NPH) or combination (70/30) preparations • Glargine (Lantus): decrease only if dose is ≥1 unit/kg • With insulin pump delivery, continue lowest nighttime basal rate • Discontinue if blood sugar level <100	Hypoglycemic agents, oral Insulin • Regular insulin (*exception*: with insulin pump, continue lowest basal rate—generally nighttime dose)

Contin

Pre anesthesia Medication Instruction(2)

Table 13.7 Preanesthesia Medication Instructions—cont'd

Continue on Day of Surgery	Discontinue on Day of Surgery Unless Otherwise Indicated
Opioid medications for pain or addiction	
Seizure medications	
	Nonsteroidal antiinflammatory drugs • Discontinue for 5 half-lives of the drug[c]
Statins	
	Topical creams and ointments
Steroids (oral or inhaled)	
Thyroid medications	
	Vitamins, minerals, iron
	Viagra or similar medications • Discontinue 24 h before surgery
Warfarin • Cataract surgery	Warfarin[d] • Discontinue 5 days before surgery if normal INR (international normalized ratio) is required

Positioning

1	Lap cholecystectomy	rTn & Tn
2	Urology	Tn,supine & lateral
3	OBG	Dorsolithotomy
4	Upper GIT & biliary	Head up
5	Thoracoscopy	lateral decubitus
	Nephrectomy	
	Adrenalectomy	

Trendelenberg and Reverse Trendelenberg Position

Trendelenberg	Rev Trendelenberg
• **15-20° head down**	• **20-30° head up**
• ↑VR,CBV,CO,MAP ↓VC,FRC,Compliance Paw (atelectasis)	• ↓ VR,CBV,CO,MAP • Improves diaph function
• Endobronchial intubation	• Predisposition to DVT

Trendelenberg Position

Reverse Trendelenberg

Prolonged steep Trendelenberg Position

- increases the risk of cerebral oedema, in addition to the risk associated with the pneumoperitoneum.
- Upper airway oedema which may present with stridor after operation.
- Functional residual capacity and ventilation and perfusion (V/Q) mismatch are worsened.
- cephalad movement of the lungs, the tracheal tube may migrate endobronchially.

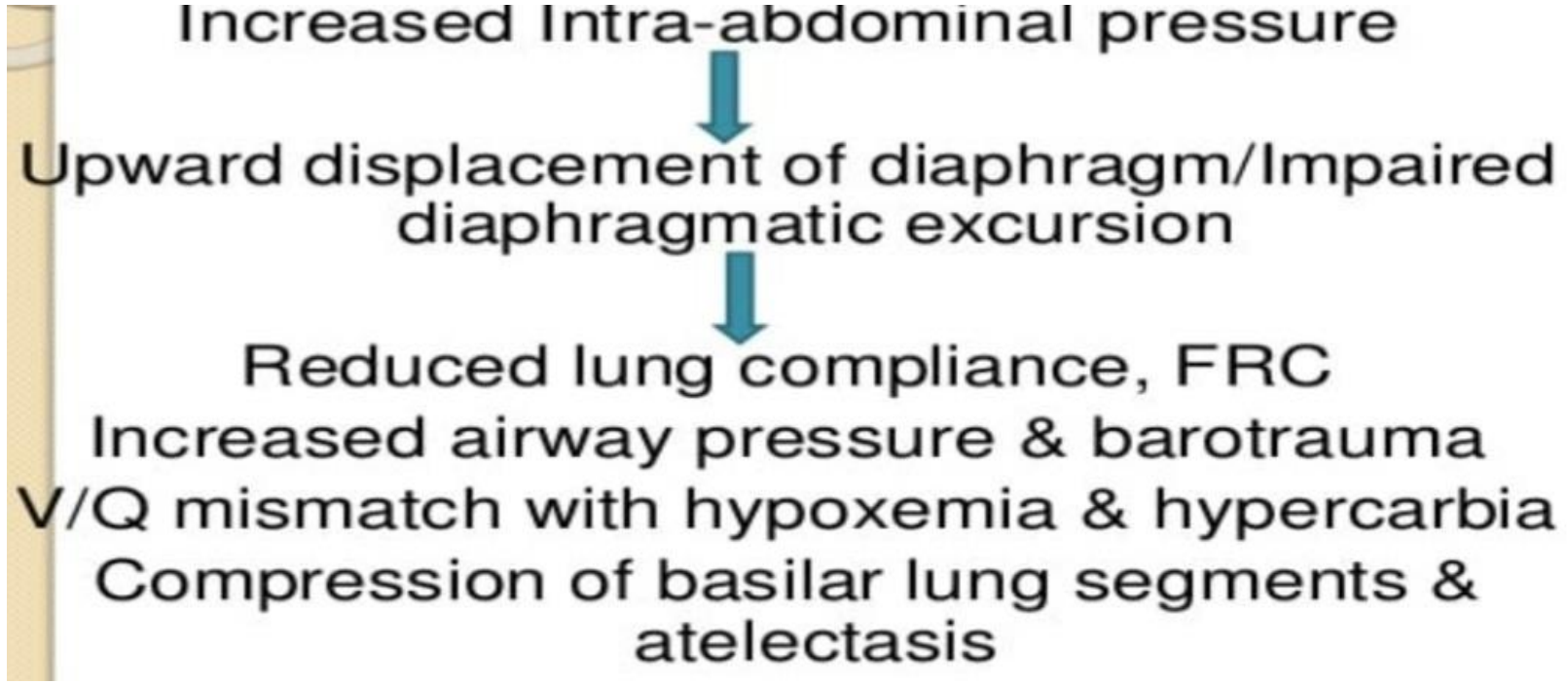
Reverse Terendelenberg Position

- The extreme ‘head-up’ posture results in reduced venous return, leading to hypotension and potentially myocardial and cerebral ischaemia
- Particularly vulnerable are the elderly, hypovolaemic patients, and those with pre-existing ischaemic heart disease or Cerebrovascular disease.

Reverse Terendelenberg position cont. ..

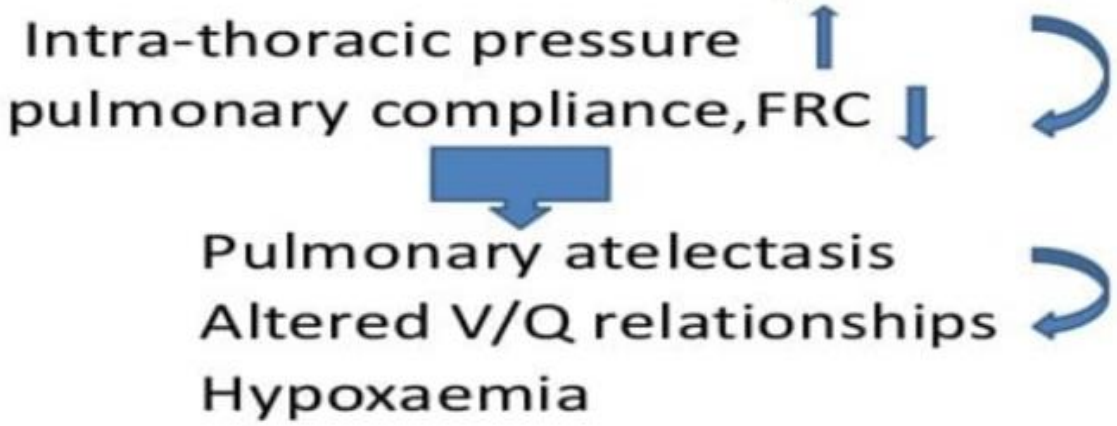
- Reverse Trendelenburg positioning may also result in hypotension due to the reduction in preload by venous pooling in the lower limbs and pelvis which in turn is exacerbated by reduced femoral venous flow secondary to raised IAP.

Respiratory & Ventilatory Changes

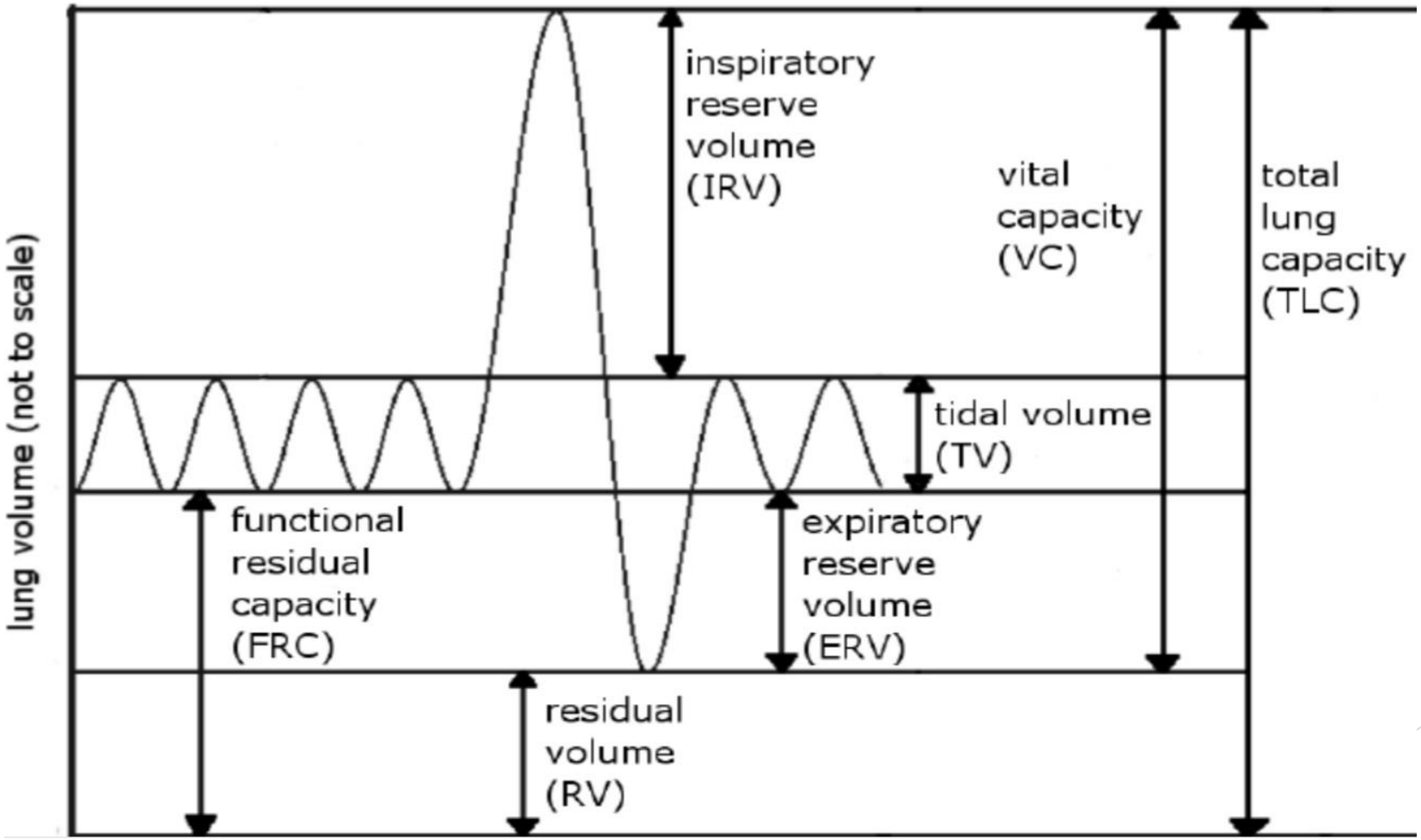


Respiratory Effects

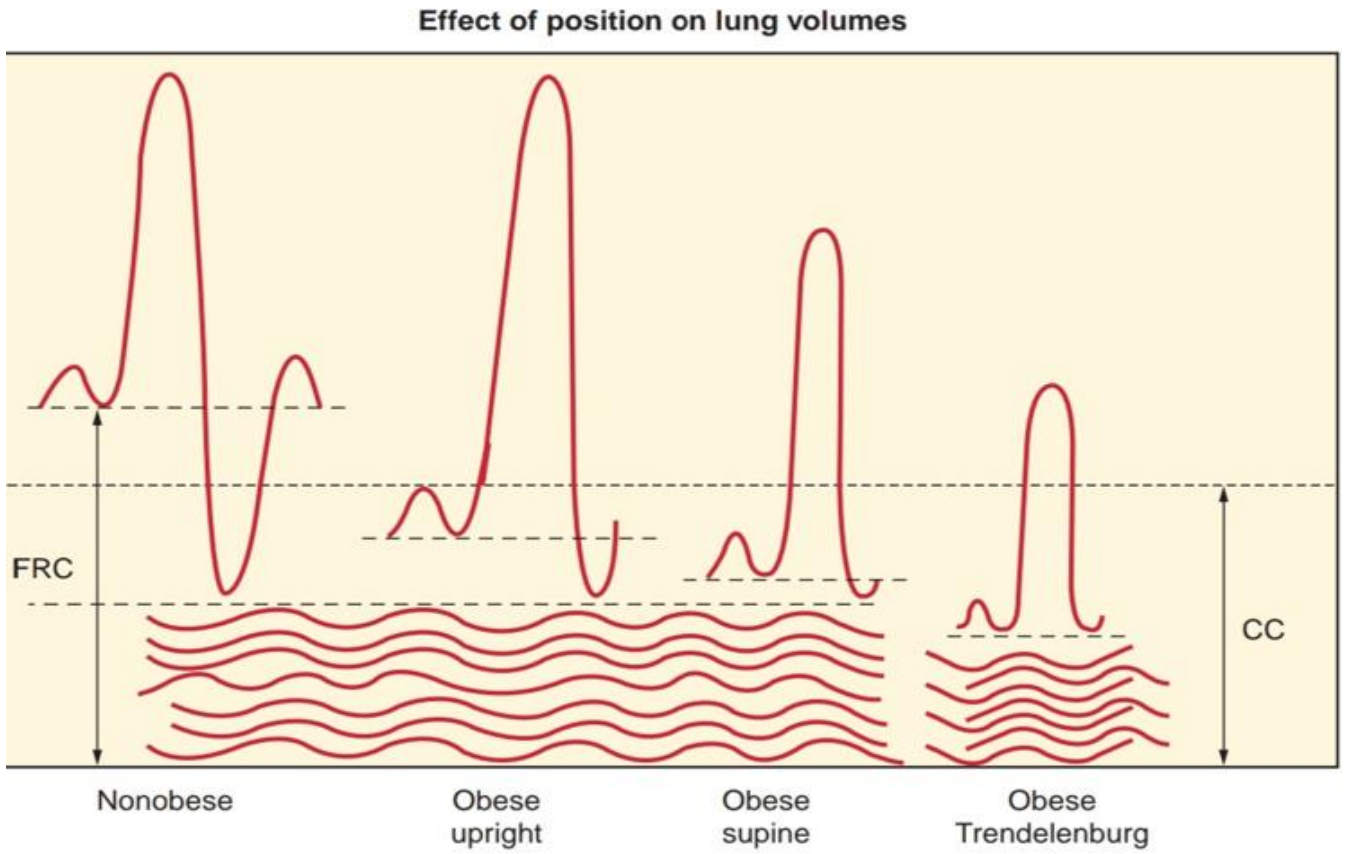
- Respiratory changes occur due to raised IAP and Trendelenburg positioning.
- abdomen is distended by CO2



Pulmonary Function Test (PFT)



Effects of Position on Lung Volume



When To Do ABG??

- After 30 minutes of pneumoperitoneum???
  - During laparoscopy an unsteady sate of CO_2 level exists between body compartments.
  - Rate of rise of PCO_2 is greatest during the first 20 – 30 minutes.
  - After 20 – 30 minutes, new equilibrium levels are reached between the different compartments, and the rate of PCO_2 rise is slower.

HYPERCARBIA

- Mild :
  - PaCO2: 45-50mmHg with mild hemodynamic changes
- Severe :
  - PaCO2 :55-70 mmHg with severe hemodynamic changes and Acidosis
  - Myocardial depression
  - Increased Pulmonary Vascular Resistance and Right Ventricular Resistance
  - Dysrhythmia (sensitivity to catecholamine)
  - Peripheral Vasodilation

CAUSES OF HYPERCARBIA

- 1-Absorption of carbon dioxide from the peritoneal cavity
- 2-V/Q mismatch :
  - Increased physiologic dead space
  - Abdominal distention
  - Position of the patient (e.g. ,, steep tilt)
  - Controlled mechanical ventilation
  - Reduced cardiac output
  - These mechanisms are accentuated in sick patient (e.g.,obese, ASA class II or III ….)

HYPERCARBIA (cont.,)

- 3-Increased metabolism (e.g.., insufficient plane of anesthesia)
- 4-Depression of ventilation by anesthetics (spontaneous breathing)
- 5-Accidental events
- Subcutaneous emphysema
- Capnothorax
- CO2 embolism
- Selective bronchial intubation

Hypoxemia during Laparoscopy

- 1-Preexisting comorbidities : Morbid obesity
  Cardiopulmonary disease (CHF,COPD)
- 2-Inadequate Gas Exchange : Hypoventilation , Atelectasis
  Endobronchial intubation
  Low FIO2
- 3-Low Cardiac Output State : Vena cava compression
  CO2 venous embolism
  Capnothorax (CO2 pneumoperitoneum)
  Capnomedistinum ,Capnopericardium
  Acute dysrhythmia
  Severe hemorrhage

Management of Hypoxemia in Laparoscopy

Hypoxemia in Laparoscopy

Management :

a) Quick to respond

b) Confirming O2 delivery and FIO2

C) Confirming ETT positioning

Refractory Hypoxemia Management

Immediate pneumperitoneum release

Natural positioning

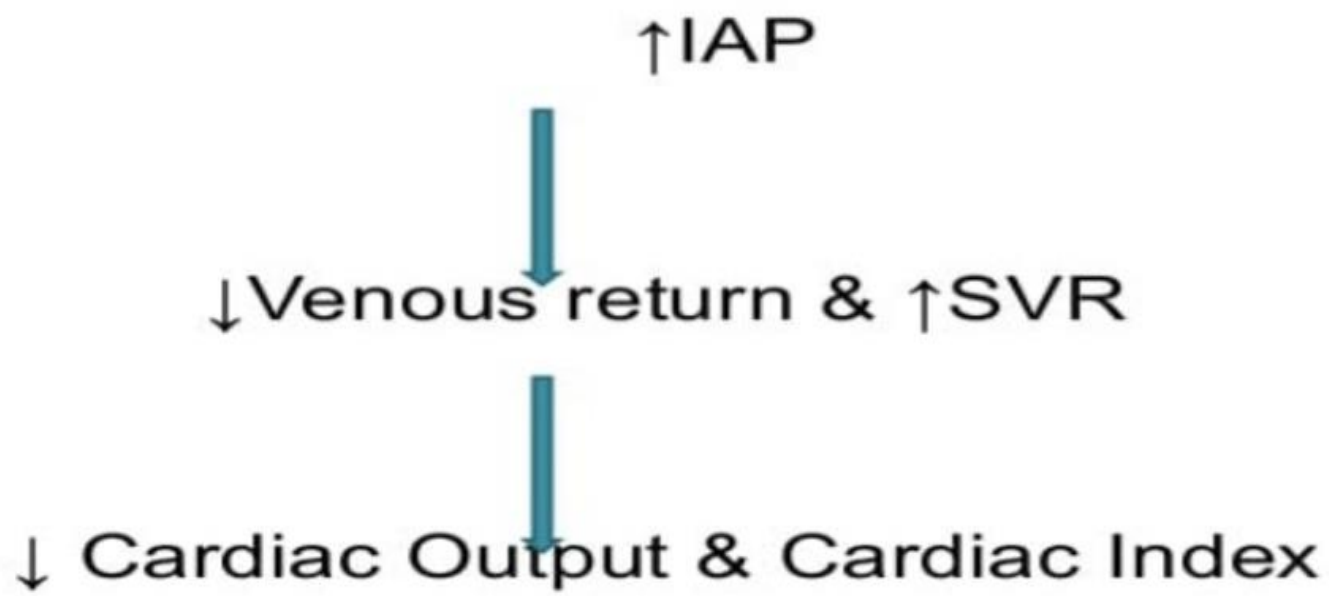
FIO2 : % 100

Physiological Effects

Cardiovascular effects depends on

- Patient's preexisting cardiopulmonary status
- the anesthetic technique
- intra-abdominal pressure (IAP)
- carbon dioxide (CO_2) absorption
- patient position
- duration of the surgical procedure

HEMODYNAMIC CHANGES



Regional Perfusion Changes During Laparoscopy

Regional Perfusion Changes During Laparoscopy

1-Cerebral

↑CBF ↑ICP

2-Systemic Vasculature

↓Femoral Vein Flow

IVC Compression

3-Pneumoperitoneum Hepatic and Renal Compression

↓HBF ↓RBF

4-Intestinal Blood Flow ↓ or | unchanged

Hypercapnic Mesentric Vasodilation

Pneumoperitoneum Bowel Compression

Response of Cardiac Output to IAP

- There is biphasic response on CO
- If IAP <10mmHg, milking effect on veins CO
- If IAP >15mmHg, 10%-30% reduction in CO
  - increase in systemic vascular resistance, mean arterial pressure, and cardiac filling pressures
  - more severe in patients with preexisting cardiac disease
  - significant changes occur at pressures greater than 12 - 15 mmHg

Cardiovascular Effects

- ↑ IAP → ↑ SVR

mechanical compression of the abdominal aorta and production of neurohumoral factors such as vasopressin and activation of the renin–angiotensin–aldosterone axis

- Compressionof the inferior vena cava → ↓ Preload → ↓ Arterial pressure → particularly if the patient is hypovolaemic.
- Cephalad displacement of the diaphragm which raises intra-thoracic pressure will agravate the reduction of blood pressure.

What can be done ?...

- Reduction in venous return and cardiac output can be attenuated by increasing circulating volume before the pneumoperitoneum is produced.
- Increased filling pressures can be achieved by fluid loading or tilting the patient to a slight head-down position before peritoneal insufflation.
- Pneumatic compression device & elastic bandages prevents pooling.

Management of Hypotension in Laparoscopy

Hypotension in Laparoscopy

a) Low Co and VR

Vagal stimulation and peritoneal insufflation

IPPV and Steep Reverse Trendelenberg Position

Hyper capnia in PH and RVF

increases PVR and Decreases VR

Treatment of Hypotension in Laparoscopy

Decrease depth of anesthesia , Volume expansion ,

Lower IAP insufflation , Short acting Vasopressors

Recurrent Hypotension

Conversion to open Laparatomy

Termination of Surgery

Refractory Hypotension

Immediate decompression

Natural Position

Exploration of occult life threatening condition

Severe Bleeding or Capnothorax

Proper Blood Pressure Cuff Size in Relation to Upper Arm Circumference

Upper Arm Circumference	Blood Pressure Cuff	
	Size	Dimensions
22 to 26 cm	Small Adult	12 × 24 cm
27 to 34 cm	Adult	16 × 30 cm
35 to 44 cm	Large Adult	16 × 36 cm
45 to 52 cm	Adult Thigh	16 × 42 cm

Management of Hypertension in Laparoscopy

Hypertension in Laparoscopy

High IAP: Increase in Preload and Co

Catecholamines Relese BP↑ Afterload↑

Treatment

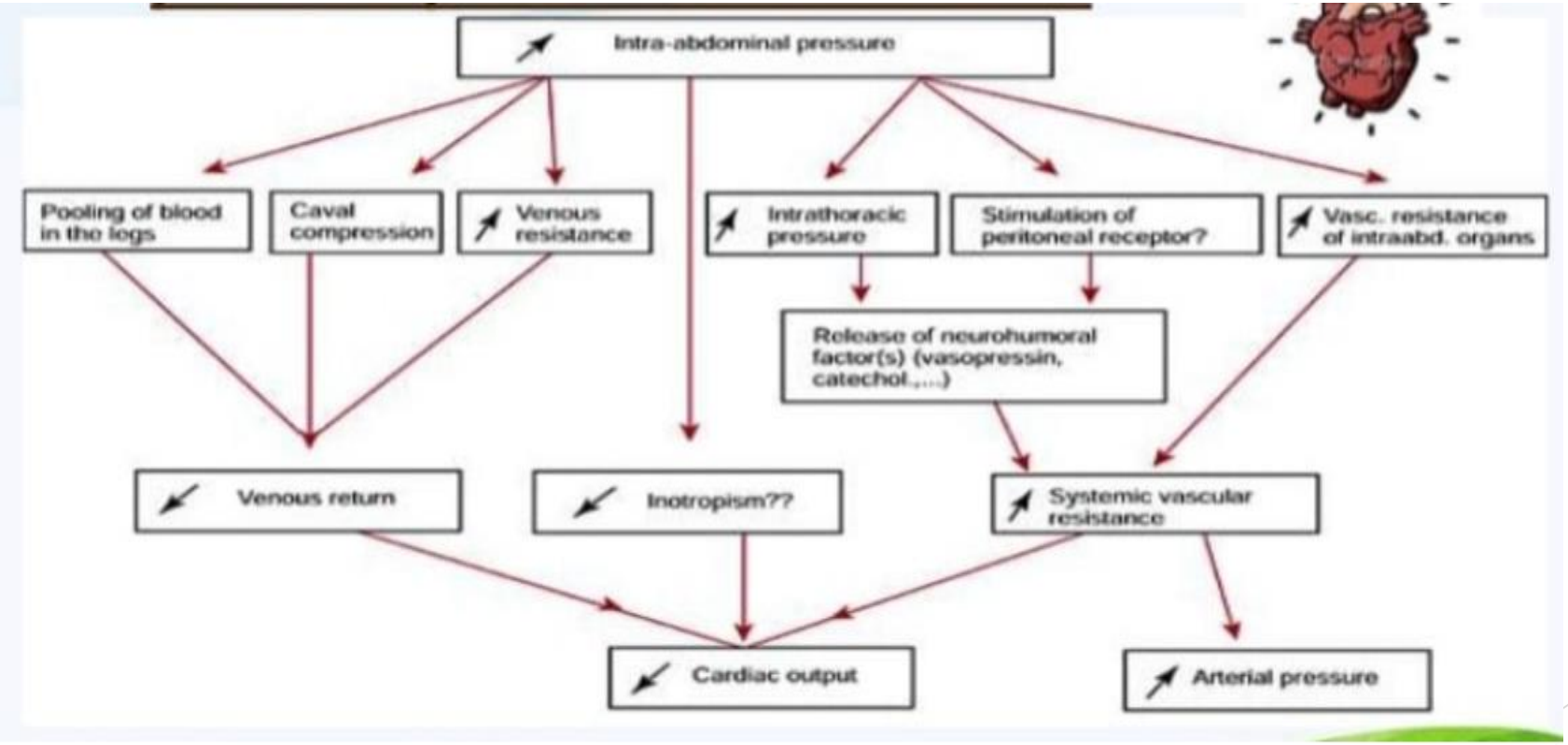
Acute Hypertension is often transient

Increase depth of anesthesia

Short acting vaso active Drugs in Severe cases

Prevention of Hypertensive Encepholopathy

Hemodynamic Effects of Pneumoperitoneum in CVS



RENAL Effects of IAP

- Decrease in renal blood flow when IAP >15 mmHg
  - Decrease in GFR
  - Decrease in urine output
  - Decrease in creatinine clearance
  - Decrease in sodium excretion
  - Potential for volume overload in the face of excessive fluid administration.

LOWER LIMB Effects of IAP

1) ↓ Femoral venous blood flow

2) Pooling of blood (Reverse Trendelenberg position)

↓

↑DVT

Effects of Pneumoperitoneum on CNS Physiology

- elevated IAP causes an increase in intra-cerebral pressure (ICP) by limiting cerebral venous drainage.
- the increase in ICP may lead to cerebral oedema
- clinical studies have suggested that cerebral perfusion pressure is maintained by the increase in mean arterial pressure that occurs with elevated IAP.

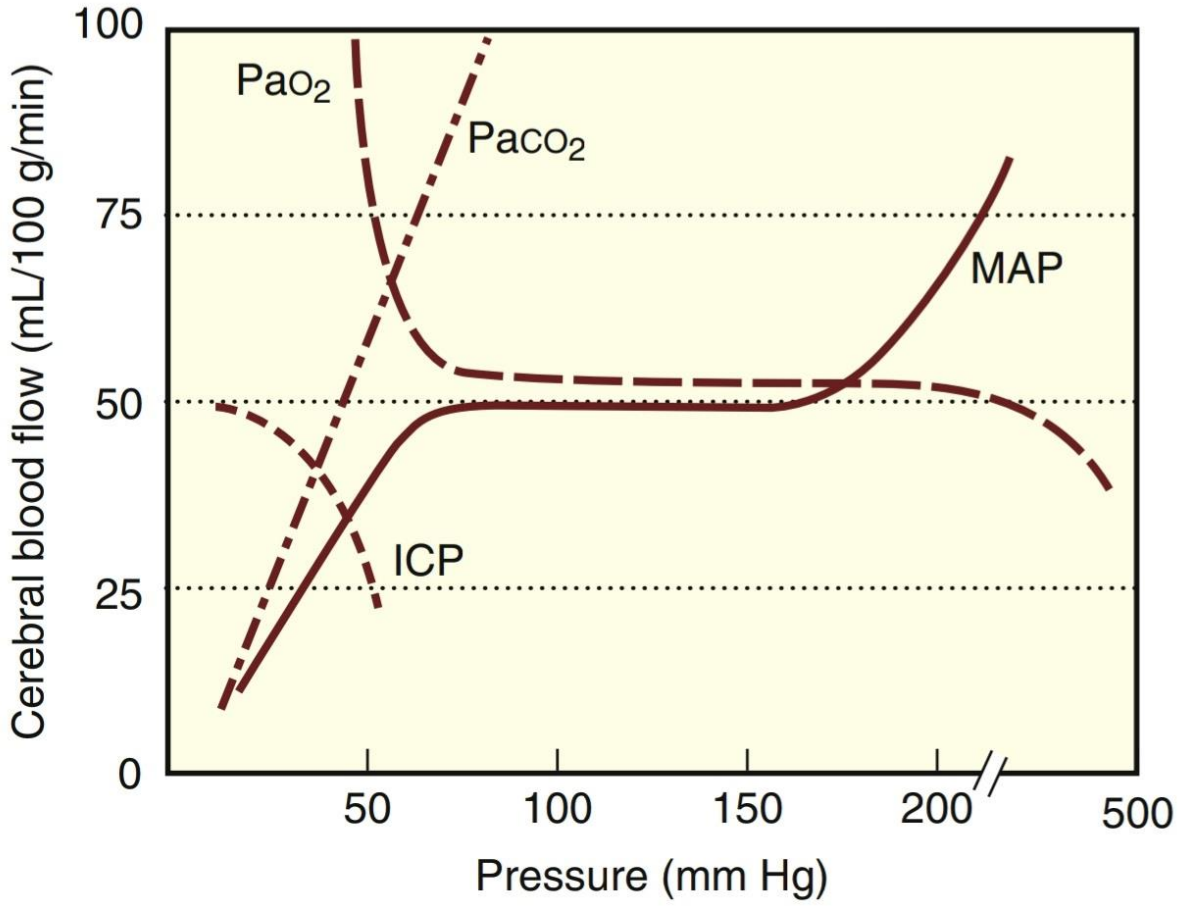
Cont….

Temporary neurological dysfunction that patients often experience on emergence from prolonged laparoscopic procedures, particularly those requiring extended periods of steep Trendelenburg positioning is due to cerebral oedema.

Cont….

- 10-15 minutes after CO_2 insufflation due to reflex vasodilatation, an increase in ICP is seen.
- For each 1mmHg increase in $PaCO_2$, CBF increases 1.8ml/100g/min and cerebral volume increases 0.04ml/100gm.

Effects of PaO2,PaCO2,MAP and ICP on CBF



Sympathetic Nervous Changes in Hypercapnia

- CO_2 produces excitation of the sympathetic nervous system
- High levels of CO_2 influence the release of catecholamines from the adrenal medulla.

Sympathetic over activity in Laparoscopy

- Release of Catecholamine
- Stimulation of Renin angiotensin aldosterone system
- Release of Neurohypophysial Hormone (Vasopressin)
- Increase in MAP , LV Afterload and SVR (Severe Vasoconstriction)
- Increase in Myocardial Work and LV Wall tension for stability of CI

Laparoscopy

PREMEDICATION

1. NPO
2. Complete bowel preparation
3. Antibiotics as per surgical team
4. Awareness about post op shoulder tip pain
5. Written informed consent for laparotomy
6. Anxiolytics/antiemetics/H2 receptor antagonist/analgesic
7. Antisialagogue (glyco-P) and vagolytic may be administered at induction of anaes.
8. DVT prophylaxis (rTn, pelvic Sx, long duration, malignancy, obesity)
9. clonidine/ dexmetetomidine to decrease stress response

MONITORING

1. HR
2. NIBP
3. Continous ECG
4. Pulse oximetry
5. Capnography
6. Temperature
7. Airway pressure
8. IAP

If required, ABG, precordial doppler,TEE may be instituted.

General Anesthesia (GA) for Laparoscopy

1. **Preloading**- 5-10 ml/kg to prevent hemodynamic changes during pneumoperitoneum
2. **Induction**- propofol, thiopentone Na, TIVA (propofol+fentanyl)
3. **Msl relaxation** – Scoline (RSI) for antireflux surg.
   NDMR
4. **Maintainence** – O2 +? N2O + sevo/iso

Cont..

4. Folleys catheter and NG tube insertion to avoid bladder/bowel injury (↓PONV, improve surgical view)
5. **Ventilatory settings-** To maintain normocarbia (ETco2 34-38 mm Hg)- ↑RR rather than TV as the lung compliance is low.
6. **Positioning** – gradually, tilt < 15-20°, check ETT position, padding at pressure points.
7. **Gas insufflation** – slow (1-1.5 →1-2.5 L/min)
   IAP<15 mm Hg (10-12)
   check ETT position

cont.....

8. **Prevent hypothermia**
9. **Analgesic / antiemetic**
10. **Postop recovery-** monitor vitals
    O2 supplementation

Lidocaine infusion effects in Laparoscopy

Early Postoperative Pain reduction

Earlier return of GI motility

Dexmedetomidine infusion effects in Bariatric surgery

Reduce fentanyl use

Reduce PONV

Reduce PACU length of stay

Remifentanyl infusion effects in Laparoscopy

- Suppress of sympathetic stimulation
- Suppress of Nero endocrine stress response
- Remifentanyl act Without Respiratory effects

Lung protective strategy in Laparoscopy

Pressure Controlled Ventilation
Low TV(6-8cc/kg)
PEEP(5-10cmH2O) : improve Oxygenation and V/Q matching
Controlled Ventilation for ETCO2 : 35-40 mmHg
COPD or history of spontaneous Pneumothorax , bullous
Emphysema : Increasein RR rather than of TV in Hypercarbia

Mechanical Ventilation in Laparoscopy

GETA (PEEP+ PC ventilation or PEEP + VC Ventilation)

Steep trendelenberg position

- VOLUME Controlled
  - TV: constant ,PIP: increase , compliance : Decrease
- Pressure Controlled
  - Peak Inspiratory Pressure : Constant , TV: Decrease

Reverse Trendelenberg Position

- Opposite Ventilatory effect
- Lower Peak Airway Pressure , Compliance Increase
  - Pressure Controlled
    - Increase TV

Pressure control Vs. Volume control

- The use of pressure controlled modalities affords higher instantaneous flow peaks, minimizing peak pressures, and have been shown to provide improved alveolar recruitment and oxygenation in laparoscopic surgery.
- Volume control modalities use constant flow to deliver a pre-set tidal volume and ensure an adequate minute volume at the expense of an increased risk of barotrauma and high inflation pressures.

Volume Controlled and Pressure Controlled Ventilation

Switch from VC to PC in Terendelenberg Position :

Dynamic Lung Mechanic improvment

No effect in : CVP , MPAP , PCWP , CI ,VD , PaO2 and MAP(mean Airway Pressure)

Beach Chair Position + PEEP for improvement of ventilation and oxygenation in Laparoscopy

FIUIDS

- U/O Reduced → using it as a guide → Patient overloading
- Stroke volume variation or Pulse pressure variation referred
- Steep trendelenberg Position that cause Pulse Pressure Change:
- Suggest Low Preload state
- Need for Volume Overload

Modifier of Mechanical Effect of Peunomoperitoneum

Volume Status ,

Baseline Comorbidity

Intra Vascular Volume Status:

Positioning ,

Surgical techniques

Intra vascular Volume Status

Intra Vascular Volume STatus

Modifier of mechanical effect of Pneumoperitoneum

Low RAP : low Cardiac filling volume , Pressure
Increase IAP may cause Pressure on IVC
Decrease VR and Cardiac filling Pressure
(without cardio Vascular disease)

High RAP : Hypervolumia
Increase in IAP to10 mmHg and Splancnic Compression
Rapid and transient Increase in VR

PEEP use in Laparoscopy

- Various studies support that a PEEP of 5 cm H_2O should be considered essential during laparoscopic surgeries to decrease intraoperative atelectasis.
- Addition of titrated levels of PEEP can be used to minimize alveolar de-recruitment.
- But must be used cautiously as increasing PEEP may further compromise cardiac output.

Indication for conversion from Laparoscopic to open surgery

1. Failure to establish an adequate pneumoperitoneum
2. Hemodynamic adverse reaction to pneumoperitoneum
3. Intra abdominal adhesions precluding safe access or presenting excessive difficulty to access abdomen
4. Hepatomegaly such that retraction is not feasible or even with retraction , organ visualization is obscured
5. Intraoperative complication such as Hemorrhage that are best managed with an open surgery
6. Exceedingly thick body wall precluding adequate trocar access or manipulation
7. Existing large upper abdominal wall Hernia that optimally can be repaired simultaneously using the same incision

Arrhythmia in Laparoscopic Surgery

- Hypercapnia is the major cause
- hypoxia , hemodynamic changes
- Vagal reflexes [stretching of peritoneum and fallopian tube clamping]
- Depth of anesthesia
- Halothane
- Arrythmia may be first sign of gas embolism

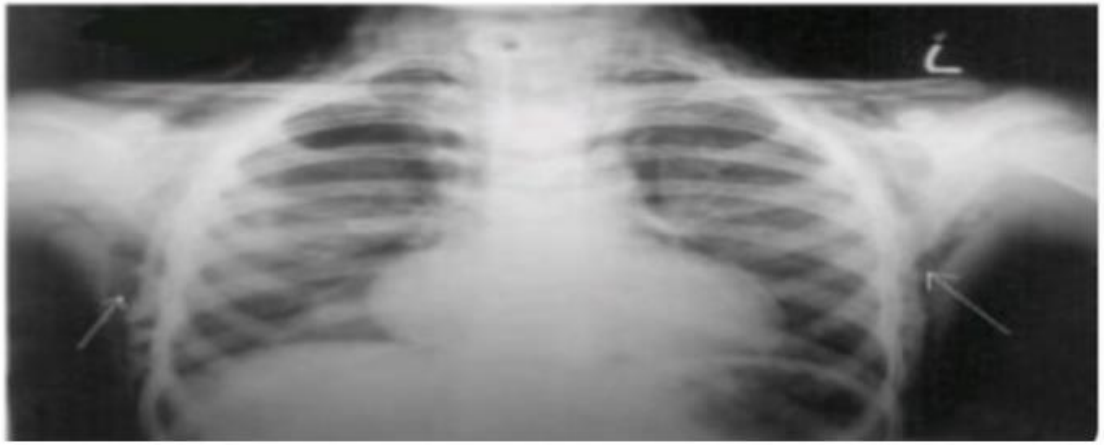
CO2 subcutaneous Emphysema

Cause a) accidental extraperit insufflation (malpositioned verris needle)

b) deliberate extraperit insufflations- retroperit surg, TEPP, fundoplication, pelvic lymphadenectomy

Diagnosis ↑ETCO2 -cannot be corrected by adjusting ventilation -↑ even after plateau reached

ABG, Palpation



Cont..

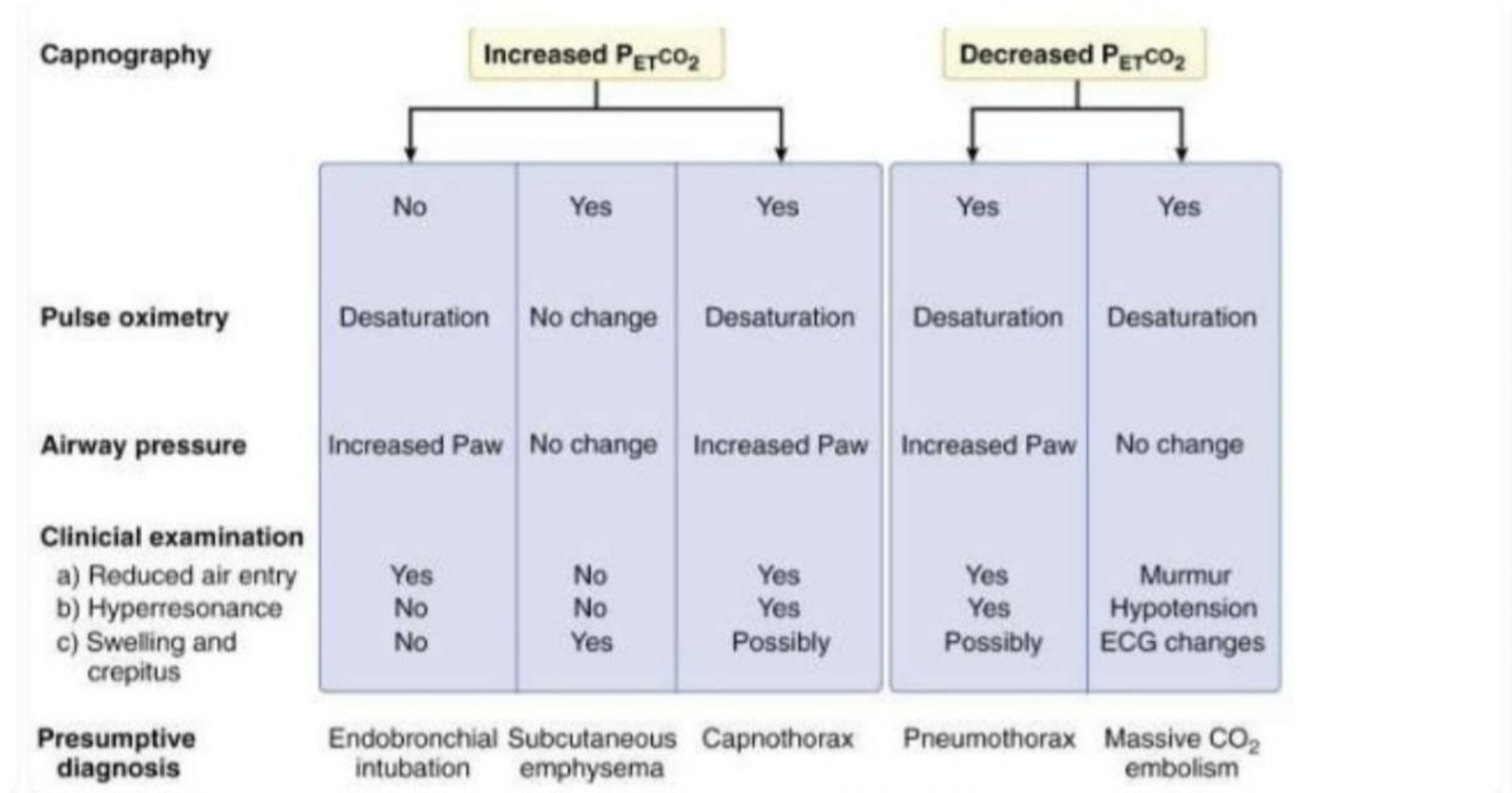
Treatment

1. stop CO_2 insufflation, interrupt lap temporarily
2. CMV continued till hypercapnia resolves
3. resume lap at low insufflation P thereafter

S/C Emphysema (Trapped Gas Pocket)

- Location
- Upper and Lower Extremity
- Neck and Face
- Large Cavity (Thorax , Mediastinum , Pericardium)
- Diagnosis
- $PaCO_2$ increases after Plateau level
- $EtCO_2$: increases , SpO_2 and airway Pressure: no change
- Chest X-ray in Neck or Face S/C Emphysema is needed (R/O Capnothorax or Capnomadiastinum)

Differential diagnosis of ETCO2 changes



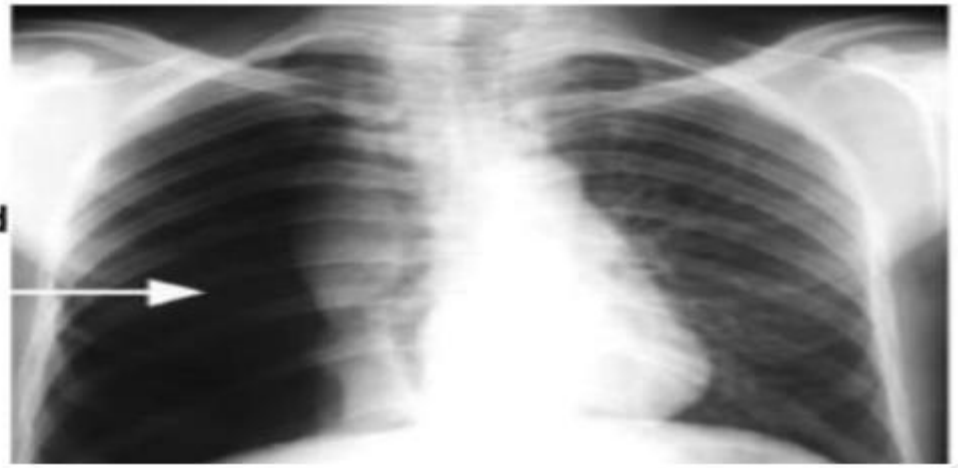
Pneumothoax/pneumomediastinum

Cause

1. pleuroperitoneal communications (R>L)
2. Diaph defects(aortic, esophageal, GE jn surg)
3. Rupture of preexisting bullae
4. Perf falciform ligament

Diagnosis –

↑airway P,
sudden ↓Sp O2 ,
sudden ↓/↑ETco2,
Abnormal motion of hemid
by laparoscopist



Capnopericardium

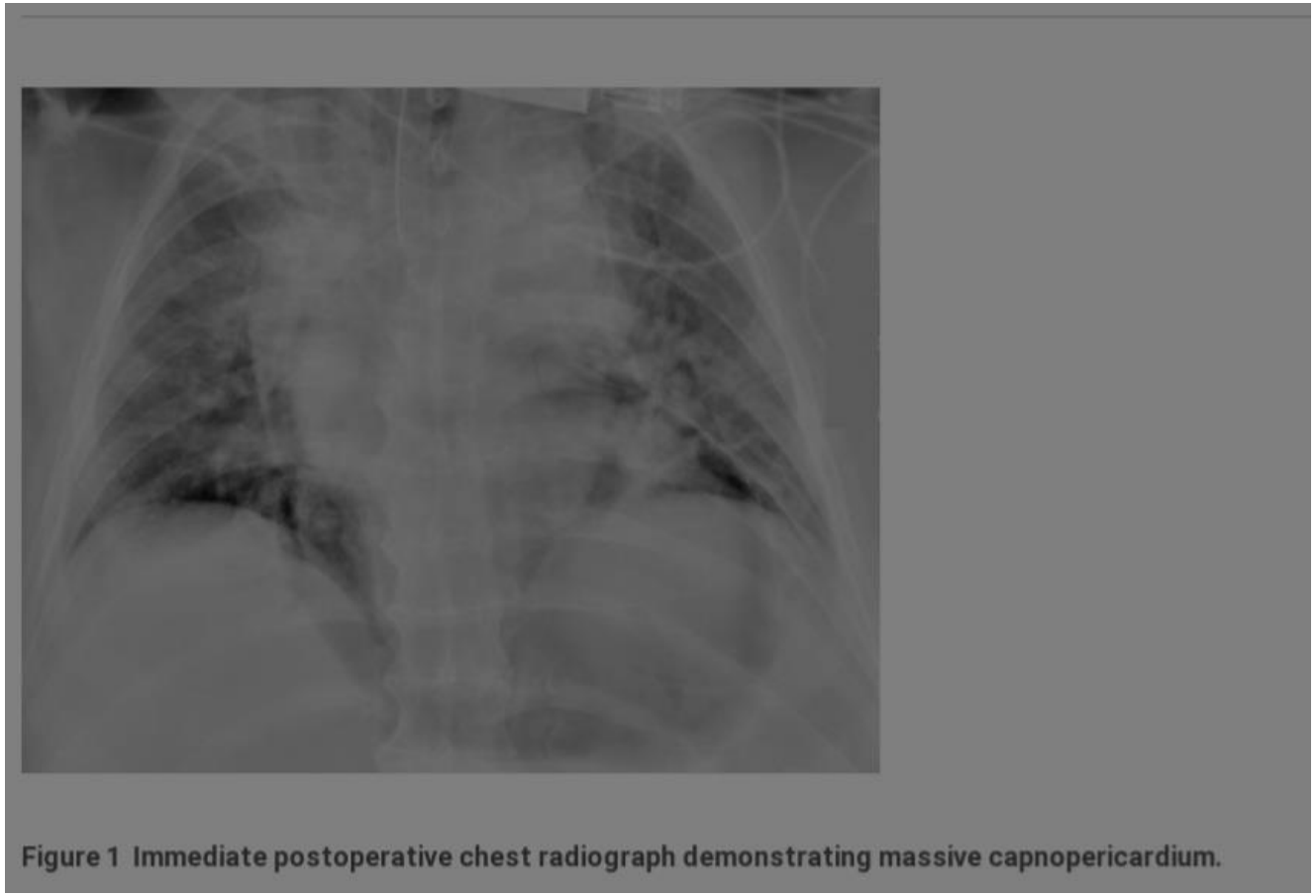
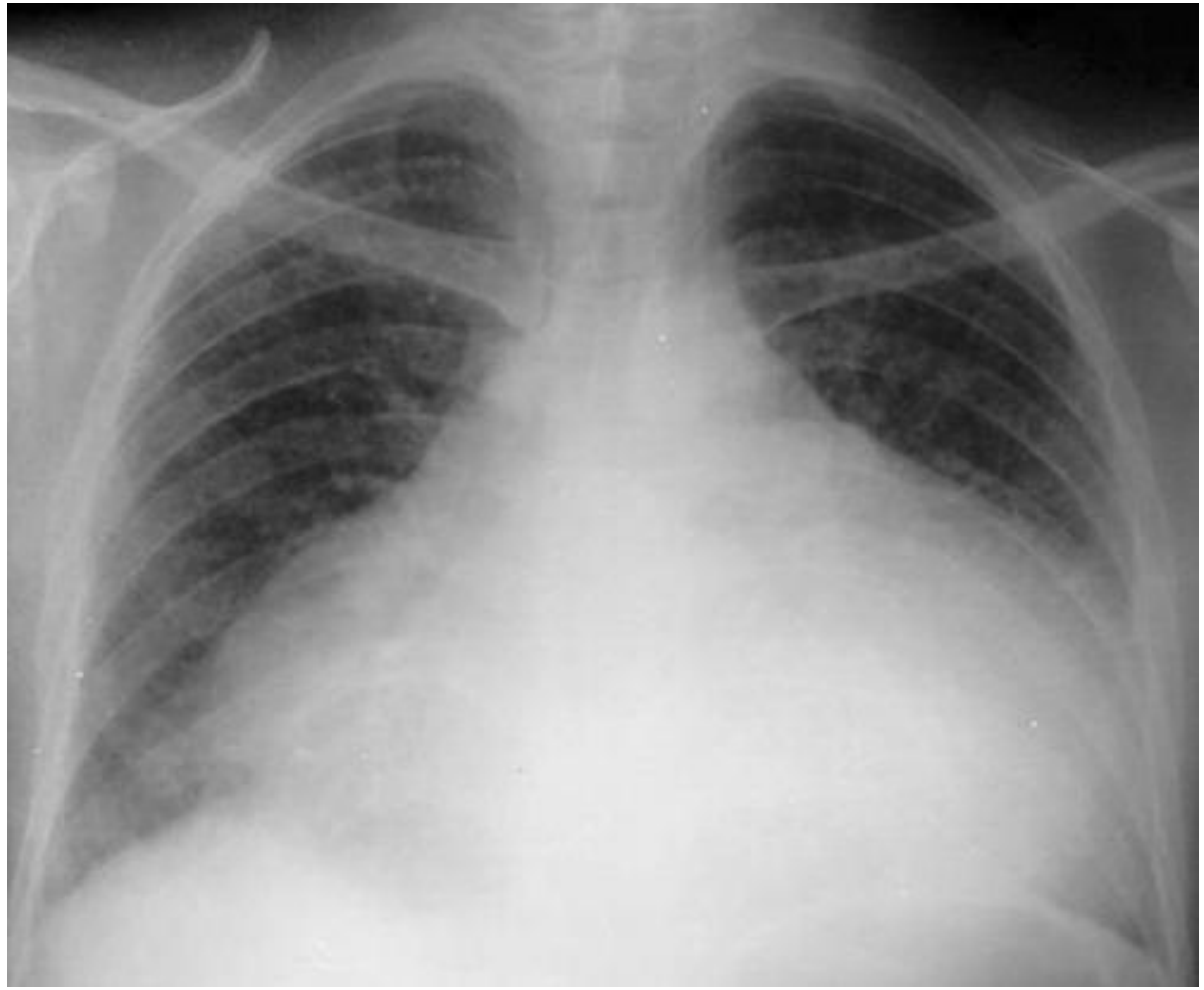
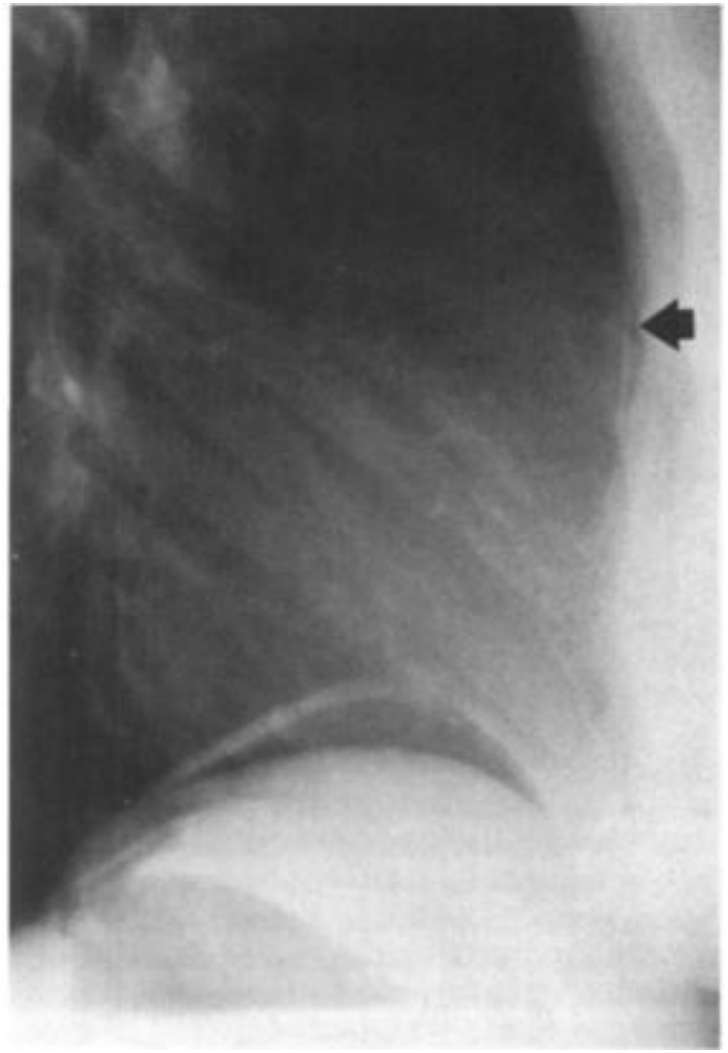


Figure 1 Immediate postoperative chest radiograph demonstrating massive capnopericardium.

Tamponade



Capnomediastinum



Capnomediastinum S/C Emphysema

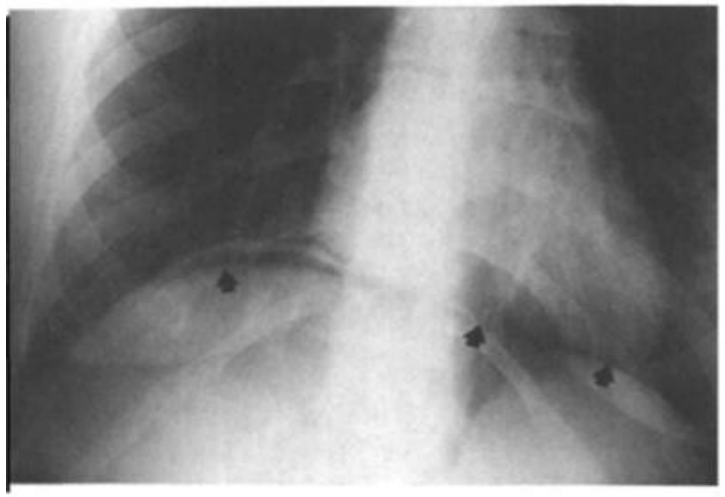
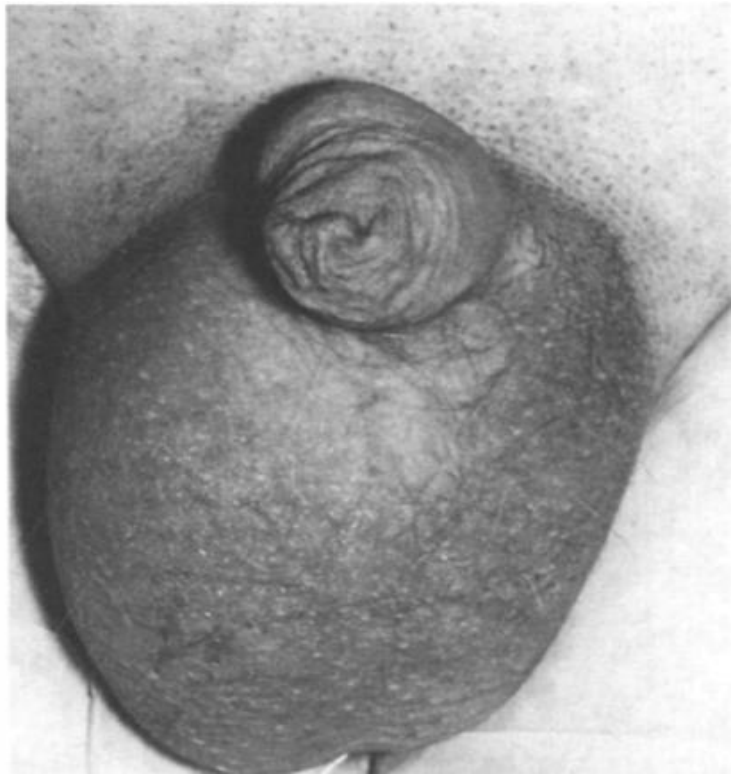


FIGURE 2 Case #2: Anteroposterior chest *x*-ray showing radiolucency consistent with air above the diaphragm, separating the cardiac silhouette from the diaphragm. This continuous diaphragm sign suggests air in the mediastinum.



S/C Emphysema Capnothorax Capnomediastinum

FIGURE 4 Case #3: Facial photograph of patient demonstrating left periorbital subcutaneous emphysema, extending from the adjacent left facial area.

Discussion

Improved laparoscopic techniques have revolutionized many surgical procedures. Although there is less pain, faster recovery and possibly less morbidity and mortality, laparoscopy is not a benign operation.[1,2] Injury to the common bile duct or intestine may be more common[4–6] than with an open cholecystectomy. Furthermore, this operation has different intraoperative anaesthetic considerations than a traditional open cholecystectomy.[3] Anaesthetic considerations for laparoscopic cholecystectomy are similar to those for other laparoscopic procedures and result from the creation of a pneumoperitoneum by in-

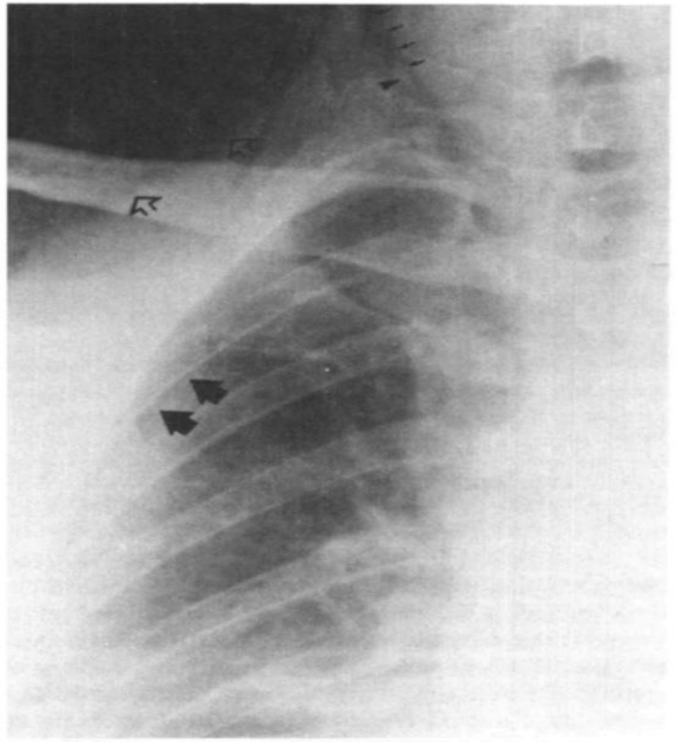


FIGURE 5 Case #3: Anteroposterior chest *x*-ray during expiration, showing small right pneumothorax (large, solid arrows), pneumomediastinum with air at the apex of the right lung extending into the neck (small, solid arrows), and subcutaneous emphysema of the soft

CO2 embolism

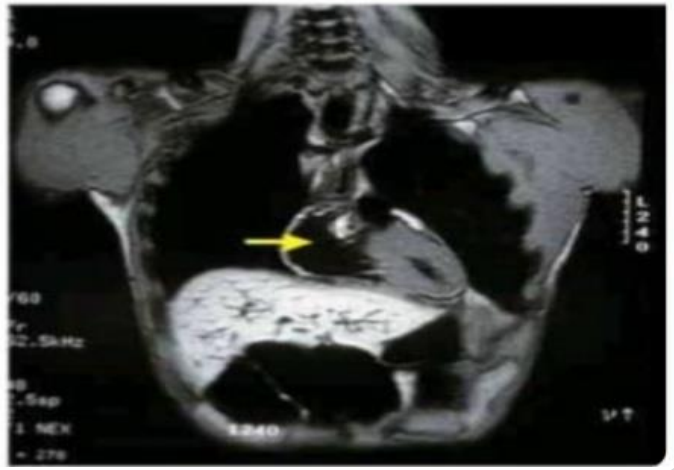
CO2 embolism (rare but potentially fatal)

Risk factors - hysteroscopies, previous abd surg, needle/Trocar in vsl

Consequences- GAS LOCK in vena cava ,RA → ↓ VR →© collapse
- Ac RV HTN → opens foramen ovale → paradoxical gas embolism

Diagnosis

↑HR, ↓BP,↑CVP, hypoxia, cyanosis,
ET CO2 biphasic change, ↑Δa ETco2
ECG- Rt heart strain, TEE, ↑pulm art.
aspiration of gas/ foamy bld from CVP line



Cont..

- I-Early events : o.5 ml/kg
- Changes in Doppler Sounds
- Increased Mean Pulmonary Artery Pressure
- II-Events Occurring With 2ml/kg
- Tachycardia , Arrhythmia , Hypotension , Cyanosis , CVP ,Hypoxemia
- Heart Tone Alteration , ECG : Right –sided heart strain , ETCO2
- Δ PaC02-ETCO2 Increases
- Doppler and TEE : Very Sensitive

TEE monitoring of VAE

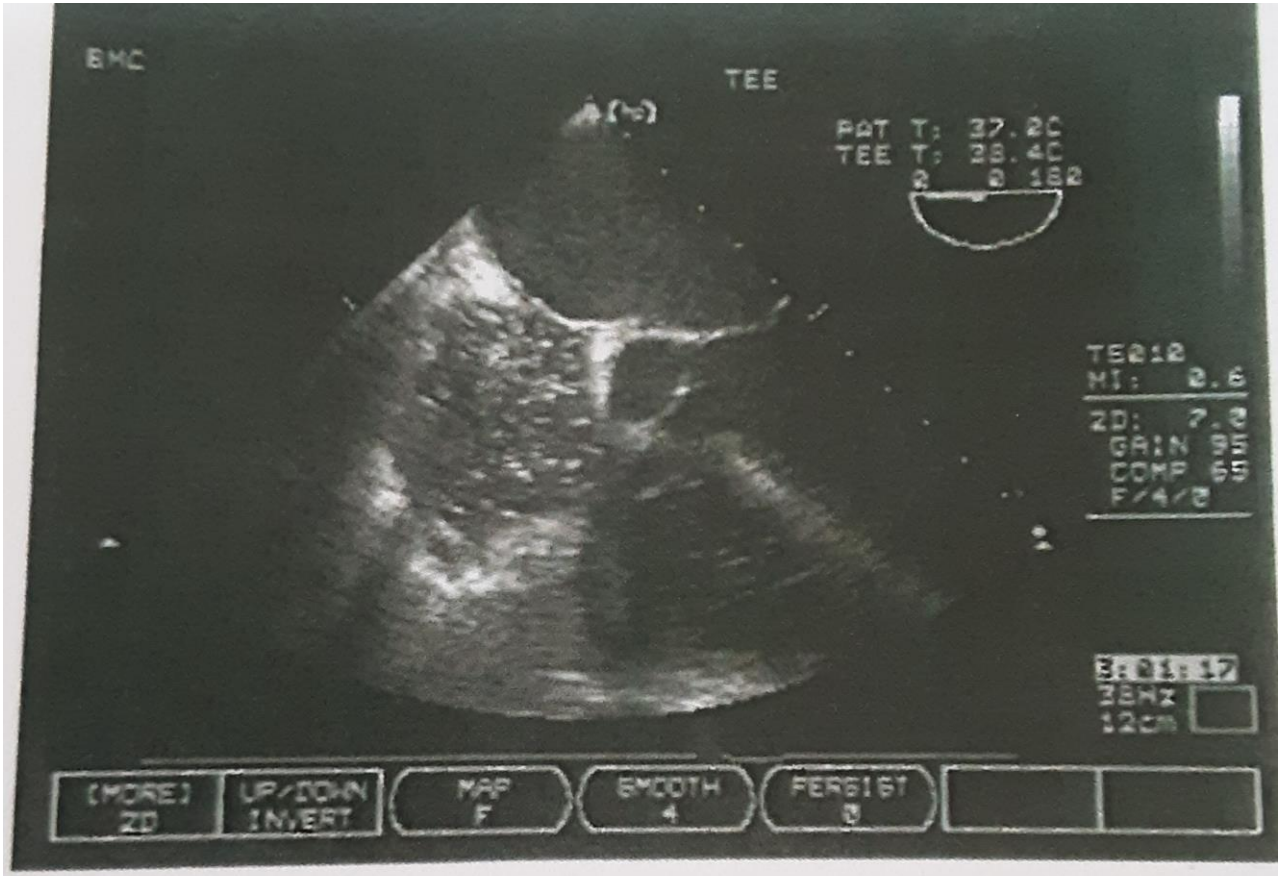
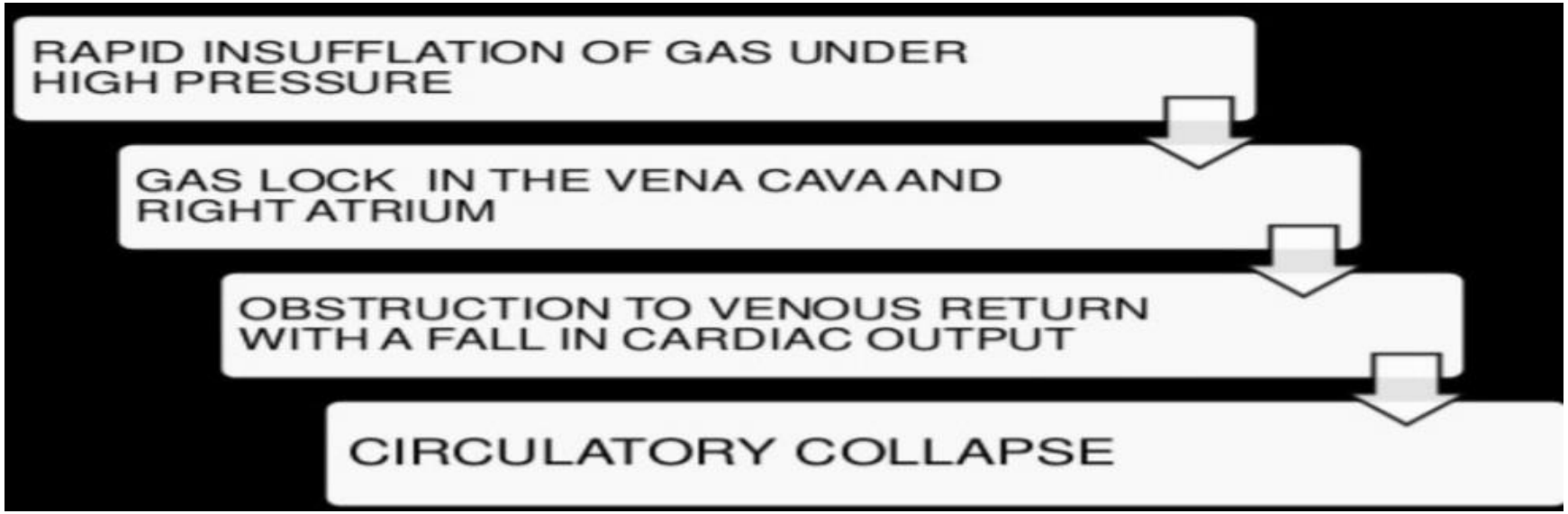


Figure 44-2 Venous air embolism of the right atrium visible with transesophageal echocardiographic monitoring.

Cont..


RAPID INSUFFLATION OF GAS UNDER HIGH PRESSURE
GAS LOCK IN THE VENA CAVA AND RIGHT ATRIUM
OBSTRUCTION TO VENOUS RETURN WITH A FALL IN CARDIAC OUTPUT
CIRCULATORY COLLAPSE

Cont..

Treatment

1. Release source (stop co2 + release pneumoperit)
2. position – steep head low + durant position
3. stop N_2O + 100%O_2
4. Hyperventilation
5. CVP/PA catheter to aspirate CO2
6. Cardiac massage may break embolus- rapid absorption
7. Hyperbaric o2 - cerebral embolism

DURANT POSITION

Differential diagnosis of hemodynamic collapse during laparoscopy

Differential diagnosis of hemodynamic collapse during laparoscopy

Decreased cardiac preload:
Hemorrhage
Positional blood pooling
Gas embolism
Excessive intraabdominal pressure
Capnothorax
Cardiac tamponade due to capnomediastinum or capnopericardium
Decreased cardiac contractility:
Anesthetic medication effect
Myocardial ischemia or infarction
Acidosis due to hypercarbia
Decreased SVR:
Anesthetic overdose
Acidosis due to hypercarbia
Anaphylaxis
Sepsis
Bradycardia:
Vagal stimulation

SVR: systemic vascular resistance.

Summary of Cardiovascular Collapse During Laparoscopy

- Profound Vasovagal Reaction
- Cardiac Dysrhythmia
- Excessive IAP
- Tension Capno (Pneumo) thorax
- Significant Gas Emboli
- Acute Blood Loss
- Myocardial Ischemia/Infarction
- Severe Respiratory Acidosis (Hypercarbia)
- Anesthetic Drug Overdose

Endobrochial intubation

Due to cephalad movement of diaph with **head down tilt and ↑ IAP**

Diagnosis - Sp O2 ↓, ↑airway P

Treatment – Repositioning of E⁻

Aspiration

- Mendelson syndrome
- At IAP>20 mmHg

Changes in LES due to ↑IA
that maintain transsphincte
gradient + head down pos
protect against entry of ga
content in airways

Aspiration of Gastric content

↑ IAP

↓

Change of the LES

↓

↑ Risk of regurgitation

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

Shifting and Falls in Laparoscopy

Shifting and Falls in Laparoscopy

Position

Steep trendelenberg Position

Steep Reverse Terendelenberg Positiin

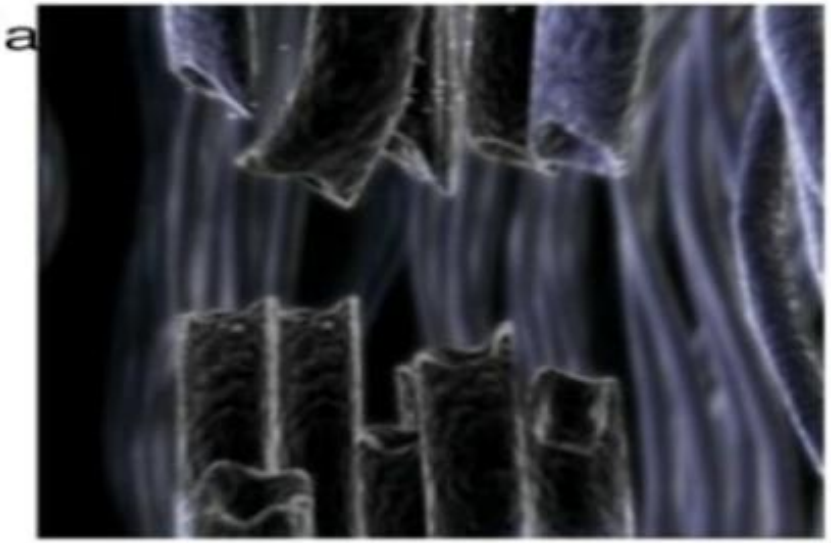
Prevention

1) Safe securment by using an Operative table belt strap
2)Under body gel pad for skid prevention
3)Attention to the pressure point of securing device
4)Lithotomy stirrups with velcro strap
5) Padded foot rest in Reverse Terendelenberg Position Attached to operating room table

Nerve injuries

Prevented by

- ✓ avoid overextension of a
- ✓ padding at P points



Cont….

- Mechanism of nerve injury: Excessive compression , Stretch , Ischemia
- Risk factors : Prolonged operative time ,High BMI , Arm tucking
- Inadequate padding , Steep trendelenberg position (Brachial
- Plexopathy in Laparoscopic Colo Rectal surgery)
- Prevention : Careful attention to Positioning

LOWER LIMB

1) ↓ Femoral venous blood flow

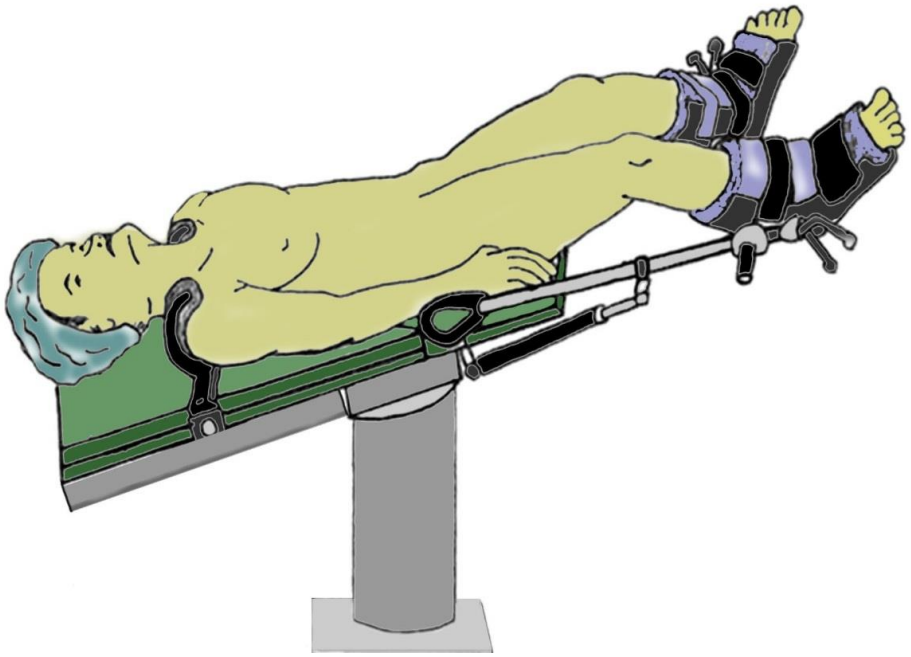
2) Pooling of blood (Reverse Trendelenberg position)

↑DVT

Well leg compartment syndrome

- Well leg compartment syndrome
- Risk factors include
  - Surgery > *4 h duration, muscular lower*
  - limbs, obesity, peripheral vascular disease, hypotension, and steep Trendelenburg positioning

LIOYD-DAVIS-STRIPPUS (Prevention of Well leg Compartment Syndrome)



Pharingo laryngeal and Airway Edema

Airway Edema and Pharingolaryngeal Edema

a) Prolonged Steep Trendelenberg Position
b)Large Volume Fluid Resusitation

May Result to

Airway Compromise Postoperatively

Expedite reversal of Edema Recumbent sitting Position

Severe Airway Edema at the End of Operation We must have a plan for continued intubation and ventilatory Support

Ophthalmic Changes in Laparoscopy

Ophthalmic change in Laparoscopy

Steep trendelenberg position +CO2 insufflation=
IOP (time dependent) and ICP increases

Increase in choroidal blood volume from absorbed CO2,
corneal abrasion , Ischemic optic neuropathy

Probably of acute Intra ocular Dearangement especially in
Glucoma,Diabetes melitus and Atherosclerotic disease

May Post operativeophtalmic ischaemia, Optic neuropathy

Rarely reported Postoperative blindness in Prolonged
Steep Trendelenberg position in colorectal surgery

Venous stasis and VTE in Laparoscopy

Venous Stasis and VTE in Laparoscopy

Mechanism

a) Coagulation Cascade Activation

b) Venous Outflow Obstruction

c) Modifier Factors :

Age ,Comorbidities,Obesity, Surgical disease

Obesity Hyper coagulation state

Especial high risk Surgery : Lymph node dissection in Radical Prostatectomy

Mechanical Thrombus prophylaxis

Effects : Promote Venous outflow

Indication:

I) Replacement for anticoagulant Drugs

a) high risk of Bleeding

b) Bleeding patients

II)Adjunct to prophylaxis with anti coagulation drug

Cont....

Methods of mechanical thrombo prophylaxis:
1)gradually compression stocking (Thrombo embolism dterent or TED Stocking) :

designed to create :
external pressure at the ankle (18mmHg)
extenal pressure at the knee (8mmHg)
10mmHg driving force for Venous outflow
Reduction in incidence of VTE :% 5o
TED Stocking Can not be used alone

Cont....

2) Intermittent Pneumatic compression (IPC)

Inflatable bladder connected to pneumatic pressure cavity

External compression pressure at the ankle : 35mmHg

External compression pressure at the knee : 20mmHg

15 mmHg driving force for Venous outflow

Repeating inflation and deflation : create pumpng action

IPC can be used alone

Laparoscopy in Pregnancy

Indications- appendicectomy
cholecystectomy

Risk – preterm labour, miscarriage, fetal acidosis

Timing – II trimester (< 23 wk)

Lap technique – HASSANS tech

Special considerations

1.prophylactic- antithrombolytic measures + tocolytics

2.operating time to be minimised

3.IAP as low as possible

4.Continous fetal monitoring (TVS)

5.Lead shield to protect foetus if intraop cholangiography needed

Cont….

Laparoscopy in Pregnancy
Open approach for entry of Laparoscope (Hanssen)
Direct puncture Laparoscopy
Height of Uterine fundus reaches to Umbilicus at 20 weeks
Position: slightly to left side (avoid IVC compression)
SCD are essential for all procedure(TE prevention)
Arterial PH of the fetus and mother relate linearly
Fetal acidosis may be prevented by avoiding Respiratory acidosis in the mother
Protection of the fetus against Intra operative X-rays
FHR Manitoring is imperative
Heart rate deceleration creates need to covert to open cholecystectomy or appendectomy
CO_2 pneumoperitoneum may induce Significant Fetal acidosis but if $PaCO_2$ is at normal level : Fetal placental Perfusion pressure , BF , PH, Blood gas tension are unaffected by insufflation or desufflation

Complication of Laparoscopy

- Thermal Injury of the Bowel
- Bowel injury
- Viscus Perforation
- Hemorrhage
- Vascular Injury
- Ureteral or Bladder Injuries
- Incisional Hernia
- Wound Dehiscence

Thermal Injury

- Delayed Development of Symptoms (Several Days or Weeks Postoperatively)
- Bilateral Lower Abdominal Pain , Fever ,Elevated WBC, Peritonitis
- X-ray : show an Ileus or free Air under the Diaphragm
- Management: Early Gynecology Consultation

Complication of Hysteroscopy (rare)

- Uterine Perforation
- Postoperative Bleeding (laceration or tears of uterus)
- Fluid Overload (absorption of distention media)
- Gas Emboli
- Infection

Pediatric Laparoscopy

Abdominal Wall is thinner in young Child

IAP of 8mmHg can provide adequate exposure

DVT Prophylaxis probably is unnecessary

Requires Specialized instrumentation

Instruments :shorter (15-20cm), Diameter (3-5mm)

Postoperative Pain Relief

- Preoperative administration of a non-opioid analgesic (e.g. NSAID, Paracetamol)
- Pre-incisional infiltration of trocar insertion sites with local anesthetics (e.g. 40 ml bupivacaine 0.25%, lidocaine 0.5%)
- Rescue medication with small doses of an opioid (e.g. morphine)
- Treat postoperative shivering with clonidine or pethidine.

Cont..

- Reduce Post Operative Pain:
- Lower IAP
- Shorter Duration of Penumoperitoneum
- Evacuation of Sub diaphragmatic CO2 gas (prior Wound closure)
- Post Operative Pain Management
- Parenteral Analgesic
- Regional Anesthesia
- Preferred Approach : Preemptive Multimodal Strategy
- Non Opioid : NSAID , COX2 inhibitor , Acetaminophen
- Minimal weak Opioid

Postoperative Laparoscopy Surgery

POST OPERATIVE LAPAROSCOPY SURGERY

I-Postoperative Complication

a) Respiratory complication

b) Venous Thrombosis

II-Postoperative Management

a) Acute Pain Management

b) Post Operative Nausea and Vomiting (PONV)

Postoperative Management

- Postoperative Shoulder -Tip Pain
- Require Supplemental O2
- Alveolar Recruitment technique using short term CPAP or High flow O2 delivery system

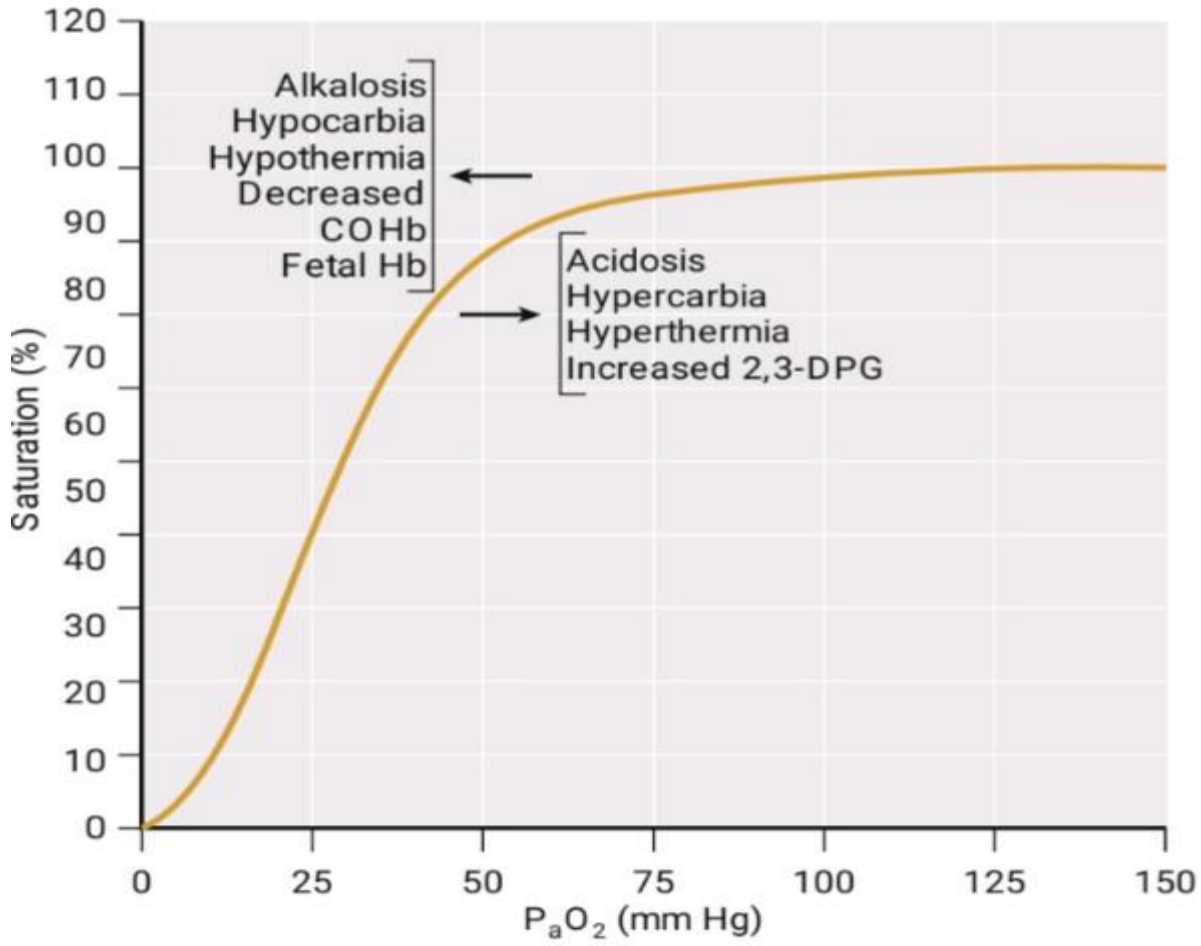
PONV

- Incidence as high as 42%.
- Inj Dexamethasone 4 mg iv at the time of induction.
- Inj Ondansetron 4 mg iv at the end of surgery.
- Third anti-emetic for rescue therapy.
- Adequate pain control.

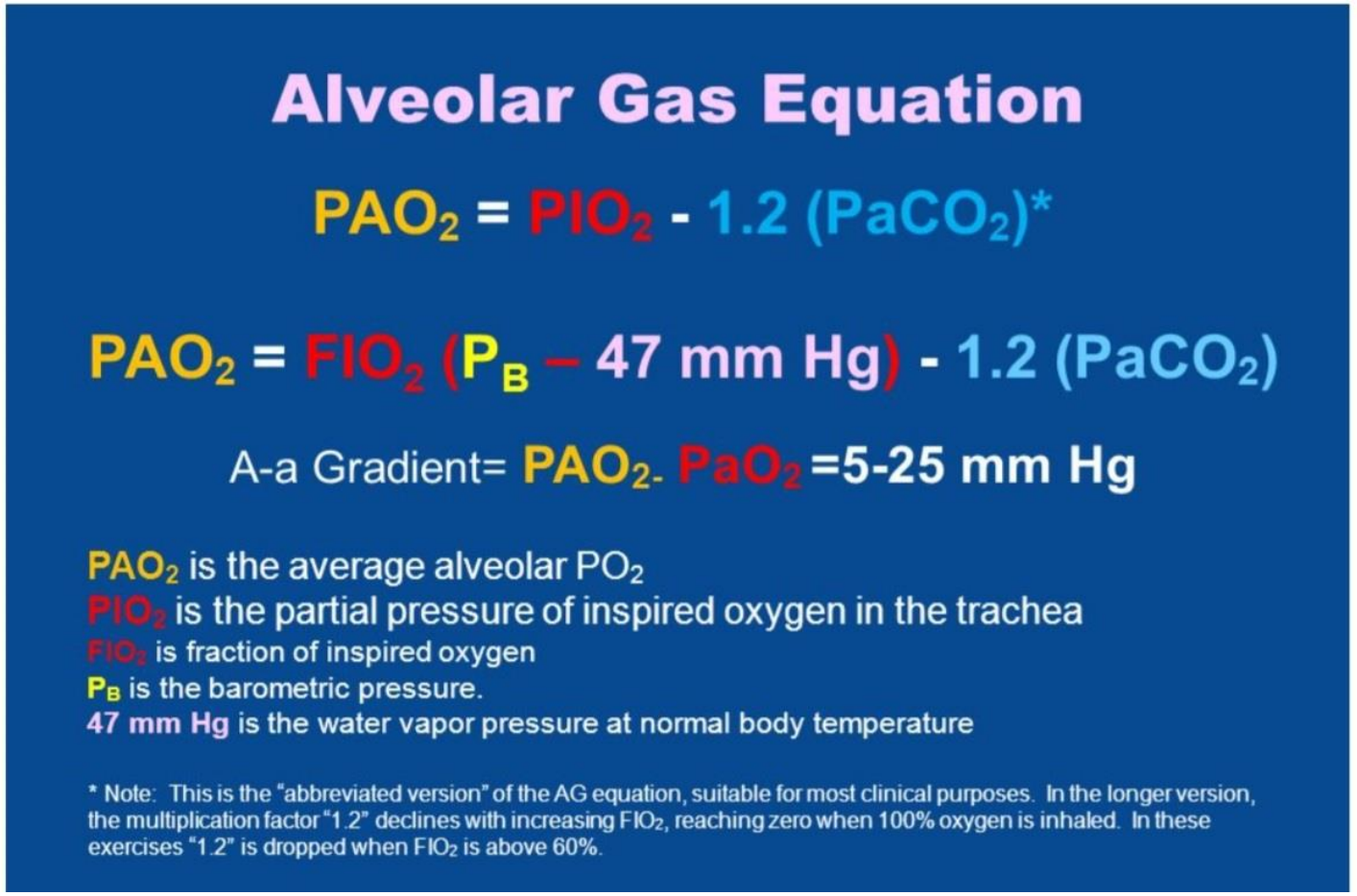
Postoperative Respiratory Dysfunction in Laparoscopy

a) Aspiration Event nespecially in Bariatric Surgery
b) Significant Sub cutaneous Emphysema
C) Diaphragmatic Dysfunction
D) Intra operative Pulmonary Challenge
E) Coexisting Disease

OXY Hemoglobin Dissociation curve



[A-a(PO2) Gradient] or (PAO2-PaO2)



Inadequate Tissue Oxygenation

Table 10.4 Markers of Inadequate Tissue Oxygenation

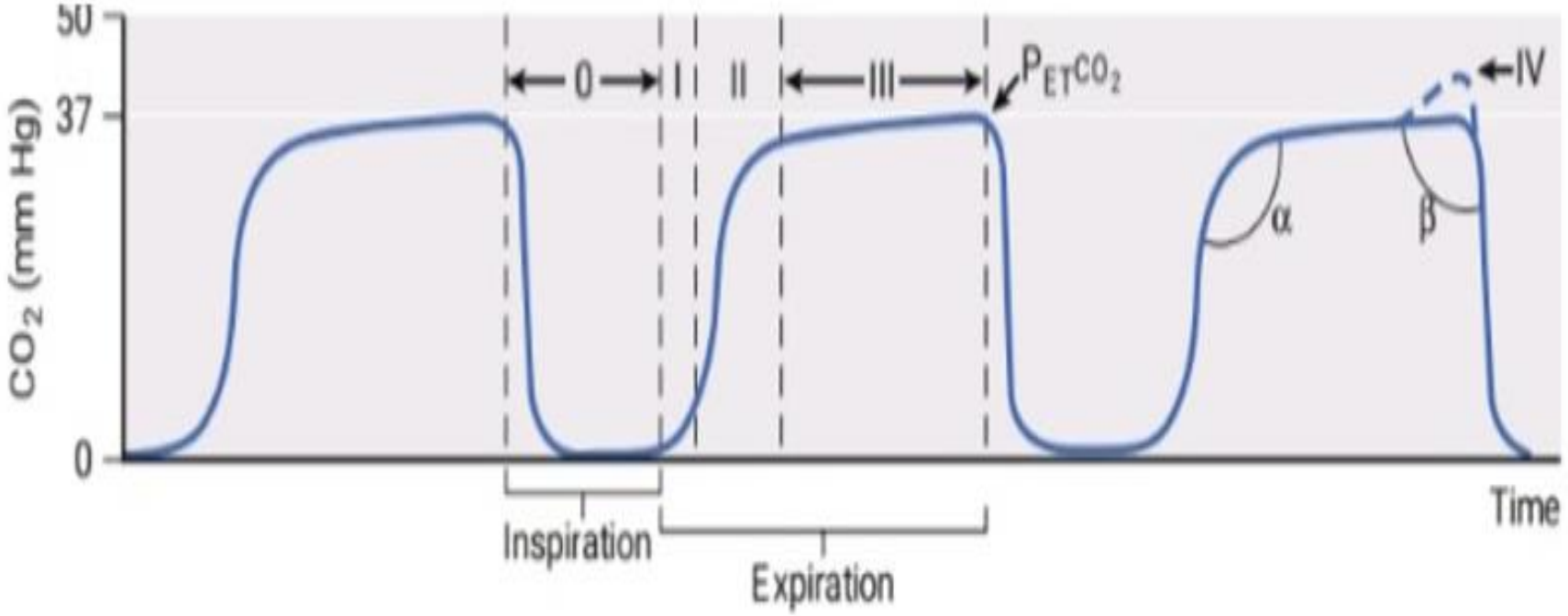
I. Oxygen Markers 1. $VO_2 < 200$ mL/min or <110 mL/min/m^2 2. $(SaO_2 - SvO_2) \geq 50\%$ 3. $SvO_2 \leq 50\%$
II. Chemical Markers 1. Serum Lactate >2 mM/L (or ≥ 4 mM/L) 2. Arterial Base Deficit >2 mM/L

P/F Ratio and Severity of Hypoxemia

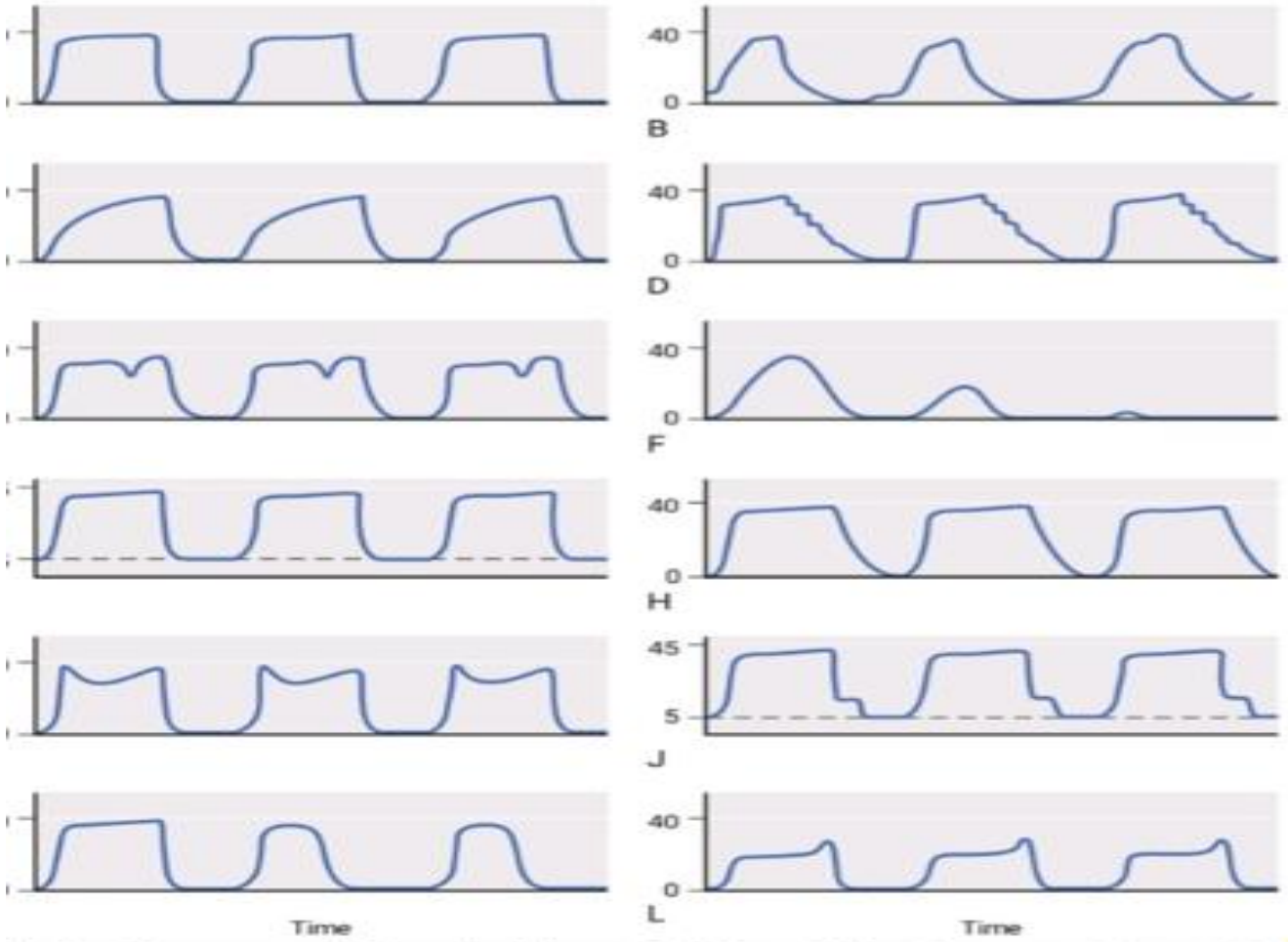
TABLE 83.1 Categorization of ARDS Severity With At Least 5 cm H_2O of PEEP

ARDS Severity	PaO_2/FiO_2
Mild	300-200 mm Hg
Moderate	200-100 mm Hg
Severe	100 or less mm Hg

CAPNOGRAPHY



cont.,..



tive Time Capnograms under Normal and Abnormal Conditions. (A) Normal capnogram during controlled n

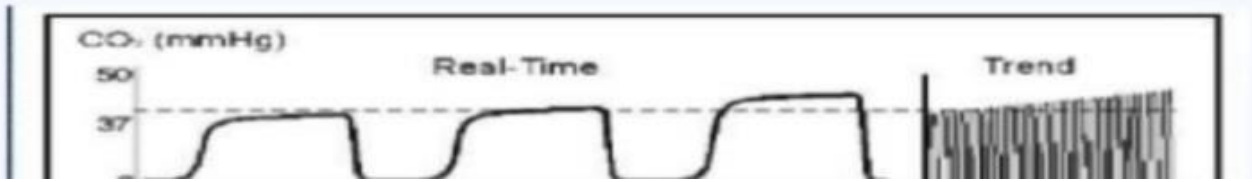
Cont..

What is the role of Capnography during laparoscopy

- It serves as a non-invasive monitor of $PaCO_2$ during CO_2 insufflation.
- helps in detection of accidental intravascular insufflation of CO_2.
- $EtCO_2$ increases in Endo-Bron.Intubation, Sub. Cut.emphysema & capnothorax and decreases in Pneumothorax & CO_2 embolism.

Cont.…

- Hypercapnia can develop, even in the absence of abnormal $EtCO_2$.
- Postoperative intra-abdominal CO_2 retention can result in increased respiratory rate and $EtCO_2$ of patients breathing spontaneously.



ETCO2 Changes in Laparoscopy

TABLE 25-2. FACTORS THAT MAY CHANGE END-TIDAL CO_2 ($ETCO_2$) DURING ANESTHESIA

Increases in $ETCO_2$	Decreases in $ETCO_2$
Elements that Change CO_2 Production	
Increases in metabolic rate	**Decreases in metabolic rate**
Hyperthermia	Hypothermia
Sepsis	Hypothyroidism
Malignant hyperthermia	
Shivering	
Hyperthyroidism	
Elements that Change CO_2 Elimination	
Hypoventilation	Hyperventilation
Rebreathing	Hypoperfusion
	Pulmonary embolism

Laparoscopy in Cardiac Disease

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)

Laparoscopy in COPD

- History and physical exam
- PFT,CXR,ABG,SpO2
- Cessation of smoking, adequate bronchodilators ,steroids and chest physiotherapy with incentive spirometry help to reduce post op pulmonary complications

COPD and Laparoscopy surgery

- Duration of surgery should be limited to 2 hours
- IAP less than 12 mmHg
- Standard monitoring
- GA with controlled ventilation
- Monitor peak airway pressure to avoid barotraumas
- Minimal tilt and multimodal analgesia to prevent postop respiratory depression

Laparoscopy in the elderly

- Age related physiological, pathological changes and comorbidities
- Narrow margin of safety
- Decrease in organ reserve
- Careful positioning
- Prevent venous stasis

Anesthesia for Laparoscopy in the Elderly

- Increased sensitivity to drugs
- Impaired metabolism and delayed excretion of drugs
- Delayed recovery
- Sensitivity to volume overload and hypovolemia , volume depletion
- Exaggerated hypotension on correcting lithotomy during recovery

CONT…

Insufflation of CO_2 in Elderly Patients at Supine Position

With Co existing Disease of

Hypertension Myocardial Ischemia

CAD HF

Results :

Decrease : EF ,CI

Increase : SVR

ECG : Ischemic change or no change

Cont…

Decreased mobility in Elderly
Improper Fluid manage intraoperatively

Pulmonary Complication
Urinary tract Sepsis
Congestive Heart Failure (CHF) or Myocardial infarction
Deep Vein Thrombosis(DVT)
Pulmonary Emboli

Laparoscopy in obese patients

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

Laparoscopic Ventilation problem in morbid Obesity and COPD

Intra operative Ventilation problems in morbid Obesity and COPD

Compensating for Hypercarbia

Managing Inspiratory Resistance

Maintaining Normoxia

Lean Body Weight

- Lean Body weight (Men) = (0.32810 × W) + (0.33929× H) - 295336
- Lean Body Weight (women) = (0.29596× W) + (0.41813 × H) - 43.2933
- Lean Body Weight= Total Body Weight- Adipose Tissue
- Lean Body Weight = Body cell mass + ECF + non fat connective Tissue
- (weights : kg , height :cm)

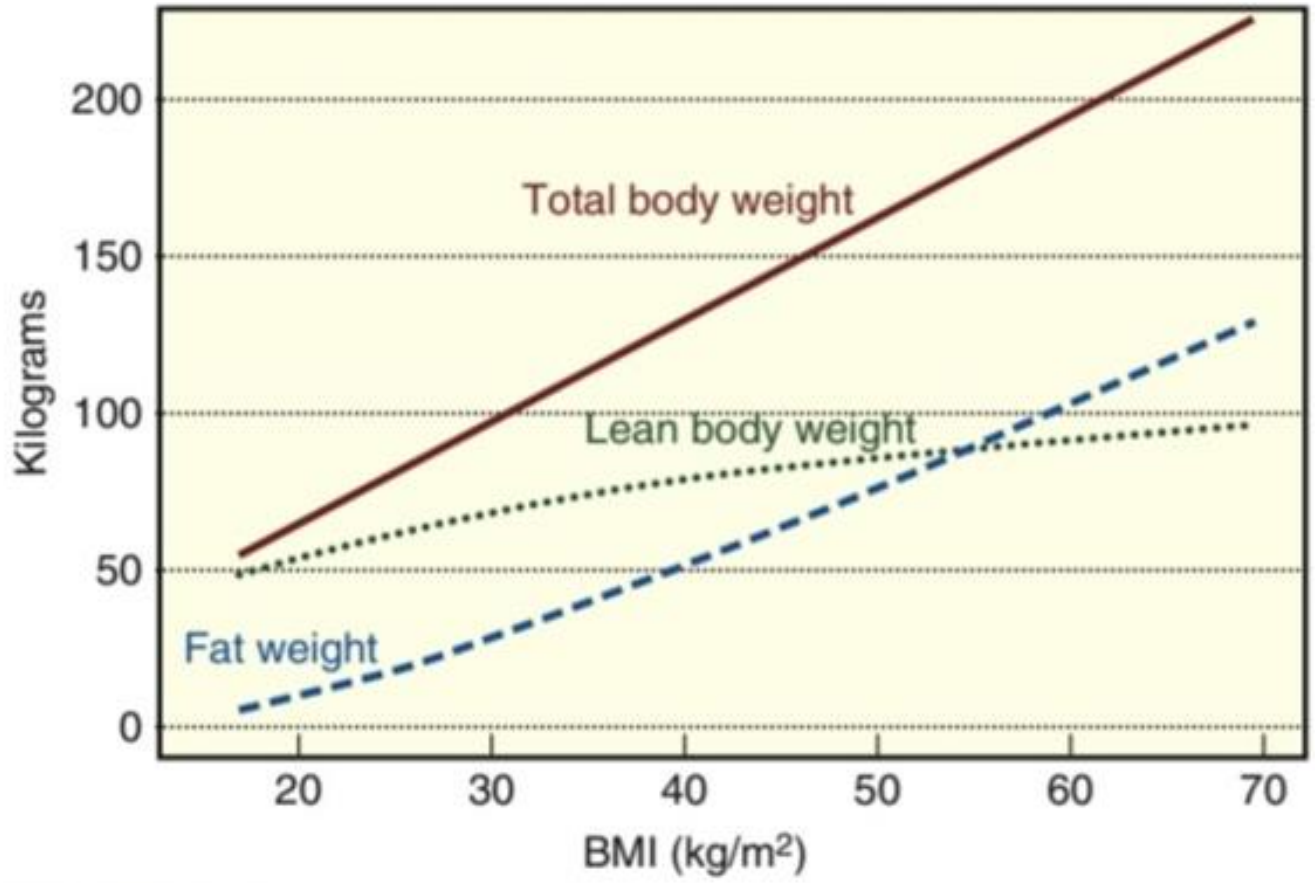
Ideal Body Weight

- IBW (Men)=50+ (0.91×[Height-152.4]) (ARDSnet) formula
- IBW(Women)=45.5+ (0.91×[Height- 152.4]) (ARDSnet) formula

OR

- Ideal BMI=22kg/m^2
- IBW= 22kg/m^2 × Height^2 (m^2)

Obesity : Fat weight , LBW , TBW ,BMI

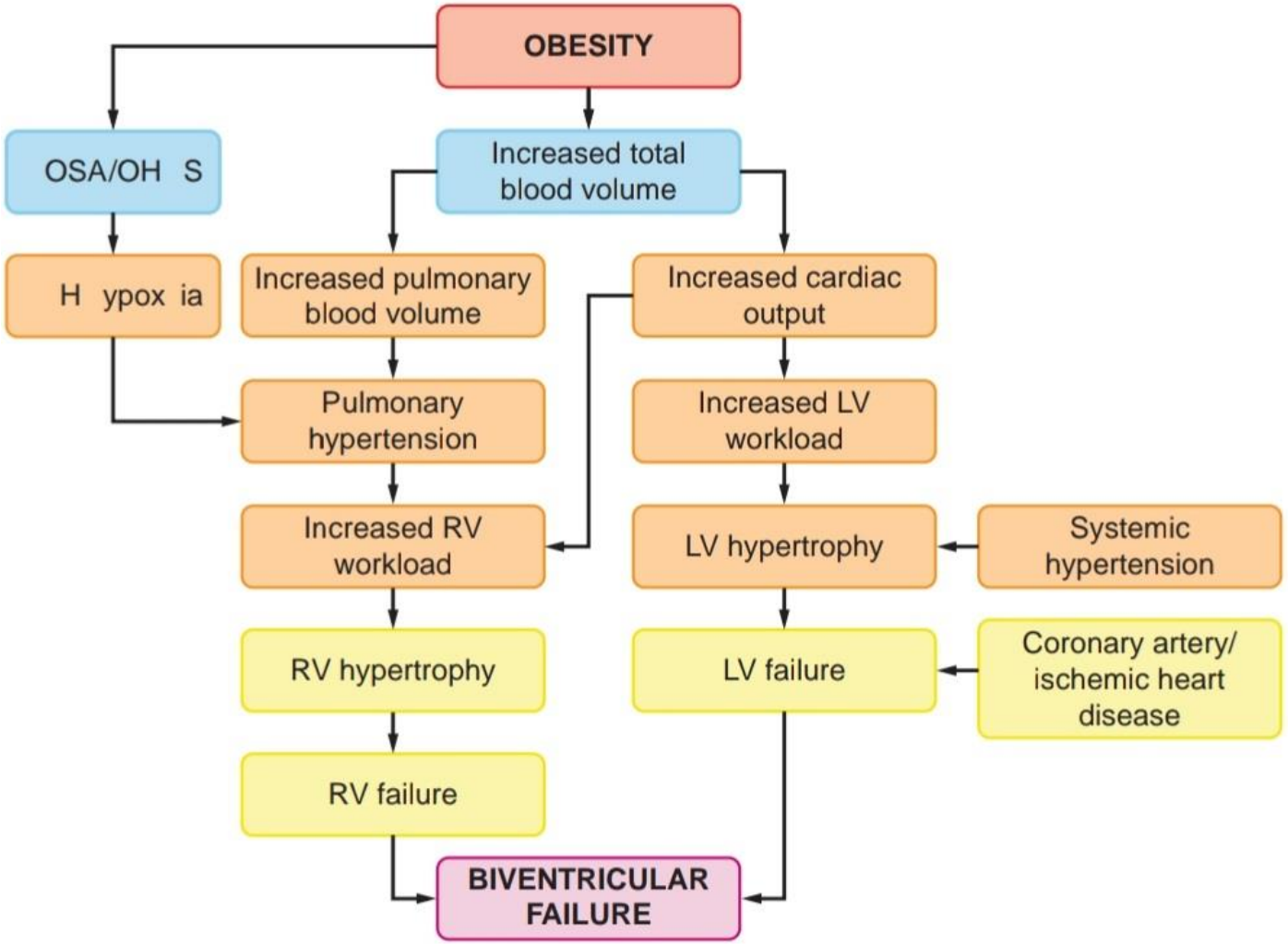


Health Problem with increasing BMI

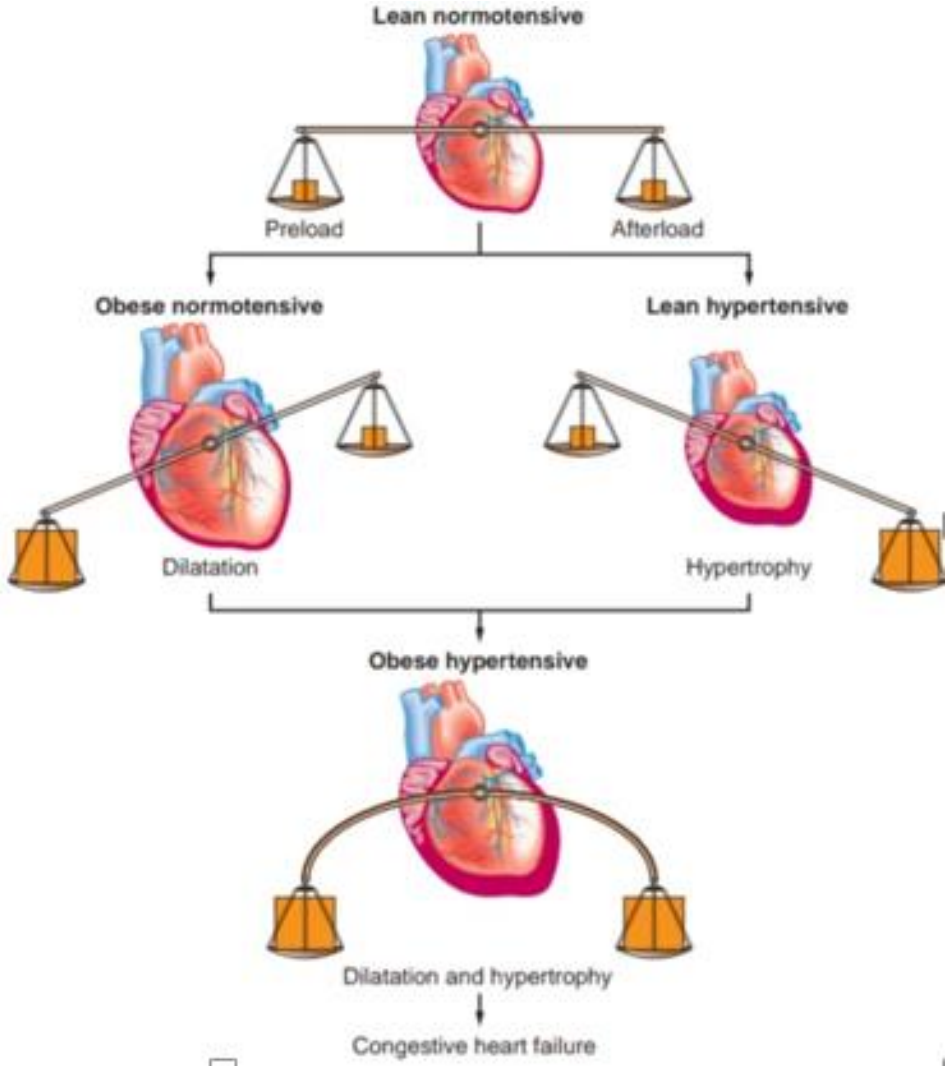
TABLE 58.1 Levels of Risk Associated With Increasing Body Mass Index

Classification	BMI (kg/m^2)	Risk of Developing Health Problems
Underweight	<18.5	Increased
Normal weight	18.5-24.9	Least
Overweight	25.0-29.9	Increased
Obese		
Class 1	30.0-34.9	High
Class 2	35.0-39.9	Very high
Class 3	40.0-49.9	Extremely high

Obesity and Cardiopulmonary Failure



Preload and Afterload changes in Obesity



Intra Operative Changes of Oxygen Delivery and Requirement

TABLE 5.7 Intraoperative Events That Influence the Balance Between Myocardial Oxygen Delivery and Myocardial Oxygen Requirements

DECREASED OXYGEN DELIVERY
Decreased coronary blood flow
Tachycardia
Hypotension
Hypocapnia (coronary artery vasoconstriction)
Coronary artery spasm
Decreased oxygen content
Anemia
Arterial hypoxemia
Shift of the oxyhemoglobin dissociation curve to the left
INCREASED OXYGEN REQUIREMENTS
Sympathetic nervous system stimulation
Tachycardia
Hypertension
Increased myocardial contractility
Increased afterload
Increased preload

METs

Box 13.1 Metabolic Equivalents of Functional Capacity

METs—Levels of Exercise

1—Eating, working at computer, dressing
2—Walking downstairs or in your house, cooking
3—Walking 1-2 blocks
4—Raking leaves, gardening
5—Climbing 1-2 flights of stairs, dancing, bicycling
6—Playing golf, carrying clubs
7—Playing singles tennis
8—Rapidly climbing stairs, jogging slowly
9—Jumping rope slowly, moderate cycling
10—Swimming quickly, running or jogging briskly
11—Skiing cross country, playing full-court basketball
12—Running rapidly for moderate to long distances

Dosing of anesthetic Drugs in Obese Patients

TABLE 20.6 Recommended Weight Basis for Dosing of Common Anesthetic Drugs in Obese Patients

Total Body Weight	Lean Body Weight
Propofol: loading	Propofol: maintenance
Midazolam	Thiopental
Succinylcholine	Vecuronium
Cisatracurium and atracurium: loading	Cisatracurium and atracurium: maintenance
Pancuronium[a]	Rocuronium
	Remifentanil
	Fentanyl
	Sufentanil

[a]Pancuronium requires higher dosing to maintain 90% depression of twitch height in obese patients but will also have a longer duration of action at higher dosages.

Metabolic syndrome

BOX 58.1 Features Associated With Metabolic Syndrome

Abdominal obesity
Atherogenic dyslipidemia (↑ TGs, ↓ HDL-C, ↑ ApoB, ↑ small LDL particles)
Elevated blood pressure
Insulin resistance ± glucose intolerance
Proinflammatory state (↑ hsCRP)
Prothrombotic state (↑ PAI-1, ↓ FIB)
Other (endothelial dysfunction, microalbuminuria, polycystic ovary syndrome, hypoandrogenism, non-alcoholic fatty liver disease, hyperuricemia)

Mallampati Airway Classification

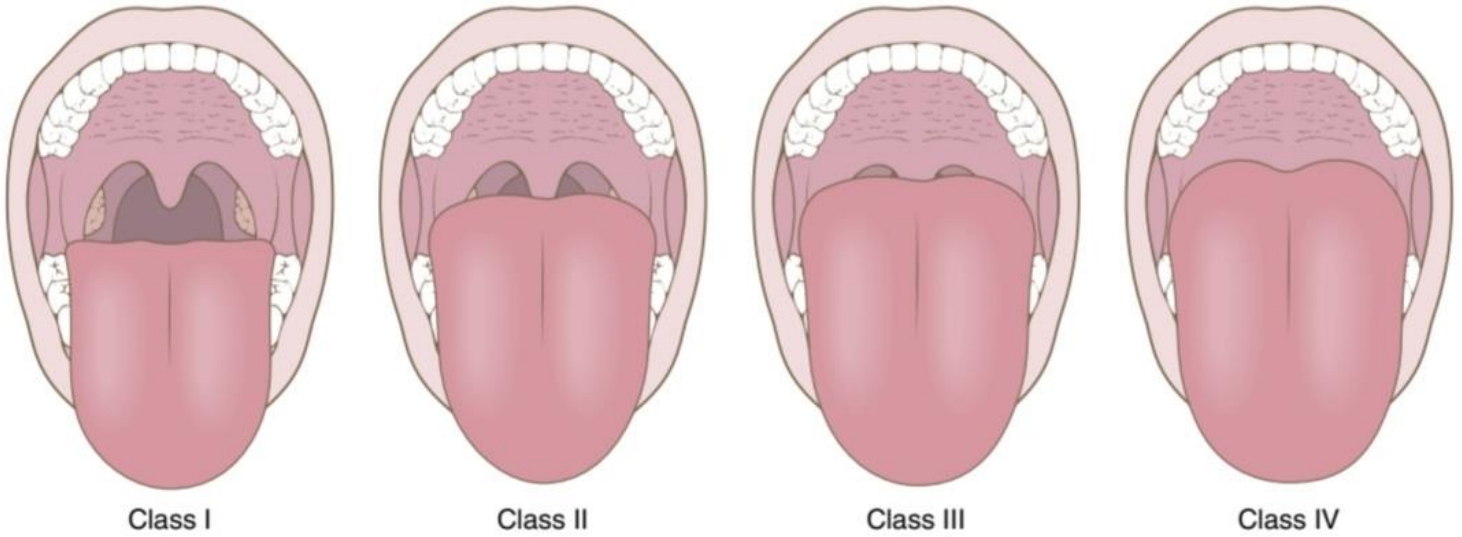


Fig. 13.1 The Mallampati airway classification is a clinical instrument used to assess the ease of obtaining an airway. Class I, visualization of the soft palate, fauces, uvula, and both anterior and posterior pillars. Class II, visualization of the soft palate, fauces, and uvula. Class III, visualization of the soft palate and the base of the uvula. Class IV (difficult), the soft palate is not visible at all.

Laryngoscopic View

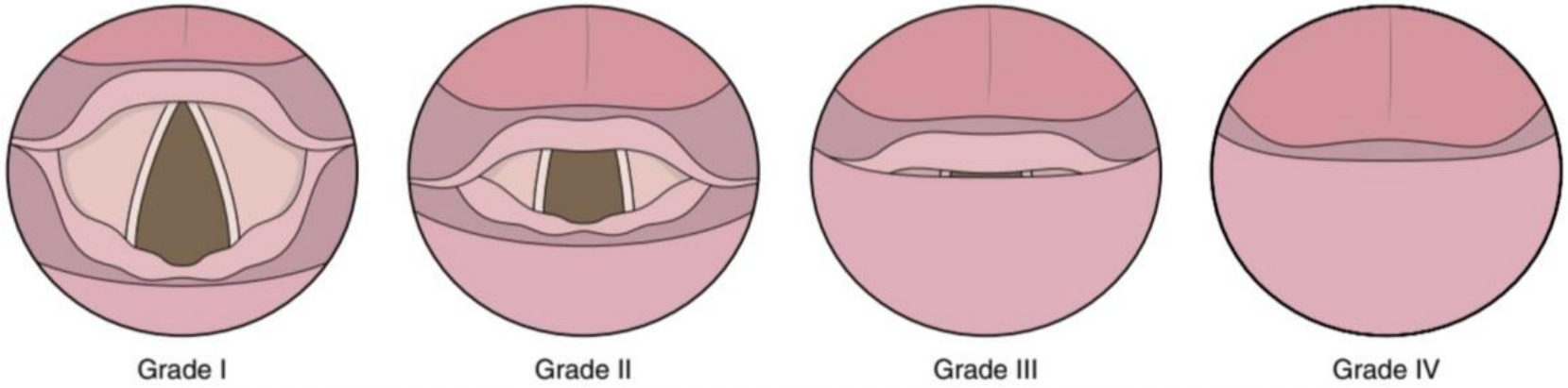


Fig. 16.12 Four grades of laryngoscopic view. Grade I is visualization of the entire laryngeal aperture, grade II is visualization of just the posterior portion of the laryngeal aperture, grade III is visualization of only the epiglottis, and grade IV is visualization of just the soft palate. (From Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. *Anaesthesia*. 1984;39(11):1105-1111.)

Ramping for Airway Management in Obesity

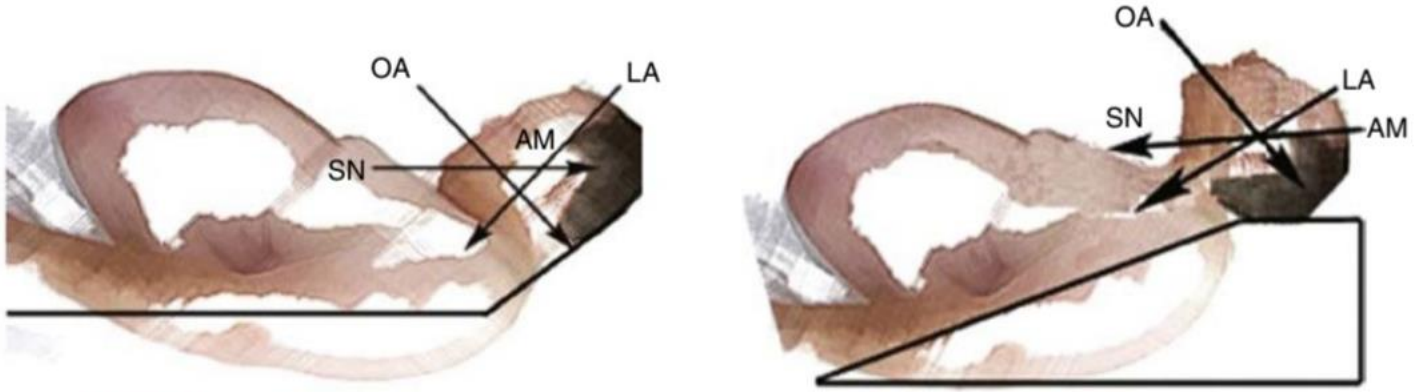


FIG. 20.4 "Ramping" to achieve proper positioning for airway management. *AM,* Auditory meatus; *LA,* laryngeal axis; *OA,* oral axis; *SN,* sternal notch. (Illustration by Brooke E. Albright, MD.)

Cont..

FIGURE 44-5. Ramped position with "stacking" of towels and blankets.

Sniffing Position

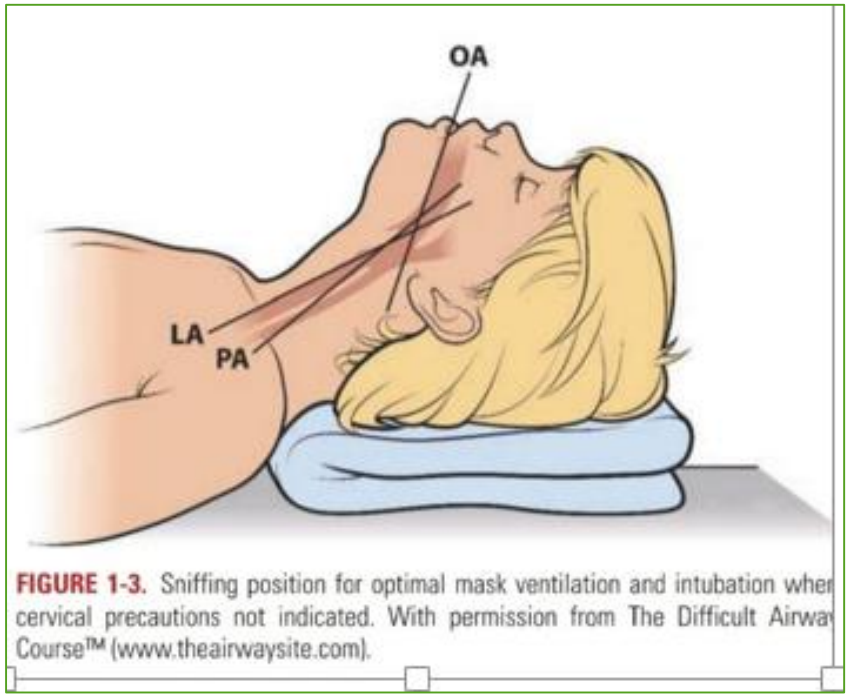


FIGURE 1-3. Sniffing position for optimal mask ventilation and intubation wher
cervical precautions not indicated. With permission from The Difficult Airwa
Course™ (www.theairwaysite.com).

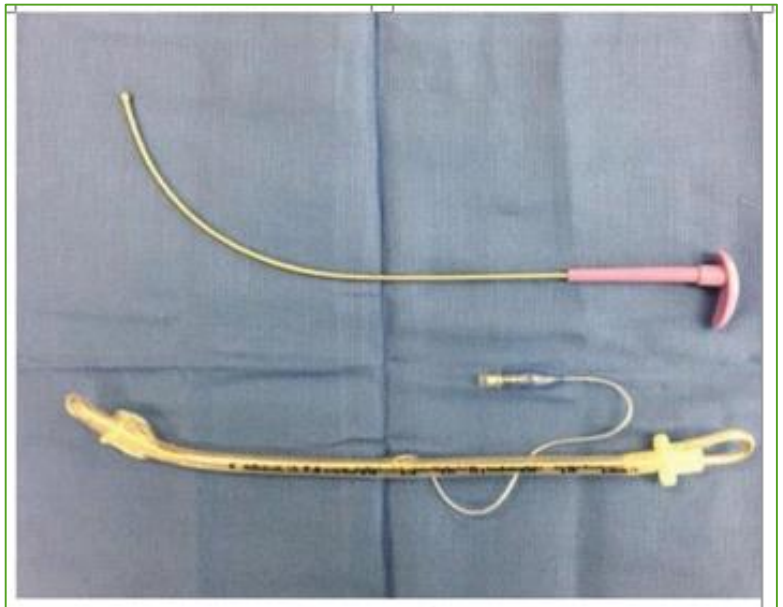


FIGURE 1-2. Top shows a stylet from Intubrite® intended for the hyperangulated vide
blade. Bottom demonstrates straight-to-cuff stylet shape for direct laryngoscopy.

Cricothyrotomy in Difficult Intubation

Laparoscopy in obese Patients (post operative)

- 1-Oxygrn therapy
- 2-pulse oximetry ,capnography ,ECG monitoring , ABG ,U/O
- 3-Level of consciousness
- 4-Prevention of hypothermia and falling
- 5-Argressive pulmonary care and positioning
- 6-Obese patients must have sequential compression devices on their lower extremities
- 7-prophylactic anticoagulation to prevent pulmonary emboli

Level of Sedation and Analgesia

TABLE 7-1 Levels of Sedation and Analgesia

	Responsiveness	Airway	Breathing	Circulation
Minimal sedation (aka "anxiolysis")	Normal but slowed response to verbal stimulation	Unaffected	Unaffected	Unaffected
Moderate sedation (aka "conscious sedation")	Purposeful response to verbal or physical stimulation	Usually maintained	Usually adequate	Usually maintained
Deep sedation	Purposeful response after repeated or painful physical stimulation	May be impaired	May be suppressed	Usually maintained

Sign and Symptoms of Hypoxia and Hypercapnia

Table 2. Signs and Symptoms of Hypoxia and Hypercapnia

Hypoxia	Hypercapnia
Mild	P_{CO_2} Above Baseline (in mm Hg)
• None or decreased efficiency only	+5: Hot hands +10: Rapid bounding pulse, small pupils +15: Engorged fundal veins, confusion or drowsiness, muscular twitching +30: Depressed tendon reflexes, depressed extensor plantar responses, and coma +40: Papilledema
Moderate • Mood changes: euphoria or depression • Decreased efficiency • Impaired judgment • Headache • Hypertension • Exertional dyspnea • Cyanosis • Hyperpnea, variable • Tachycardia • Polycythemia (chronic CO_2 retention)	
Severe • Hypertension or hypotension • Dimness of vision • Somnolence, stupor, coma	

Cyanosis

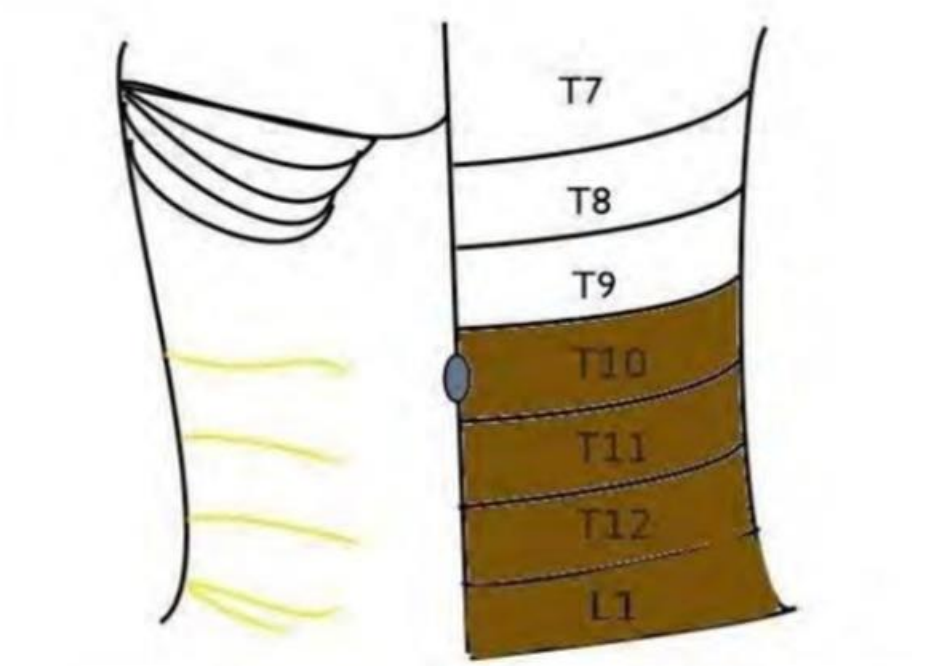
TABLE 29-2 Differential Diagnosis of Cyanosis

Central Cyanosis	Peripheral Cyanosis
Hypoxemia	Reduced cardiac output
Decreased fraction of inspired oxygen: high altitude	Cold extremities
Hypoventilation	Maldistribution of blood flow: distributive forms of shock
Ventilation–perfusion mismatch	Arterial or venous obstruction
Right-to-left shunt: congenital heart disease, pulmonary arteriovenous fistulas, multiple intrapulmonary shunts	
Abnormal hemoglobin	
Methemoglobinemia: hereditary, acquired	
Sulfhemoglobinemia: acquired	
Carboxyhemoglobinemia	

TAP BLOCK

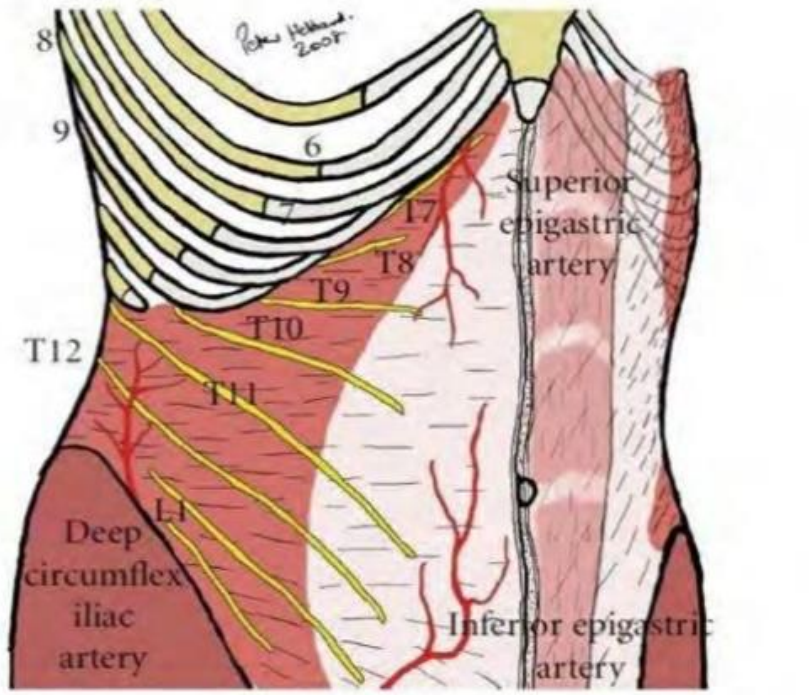
- Technique that provides analgesia to the parietal peritoneum as well as the skin and muscles of the anterior abdominal wall.
- Relatively low risk of complications and a high success rate using modern techniques but remain overwhelmingly underutilized.

Cont….



Cutaneous innervation of the abdominal wall . Coloured region is mostly blocked by a single injection posterior TAP block.

Cont….



Typical distribution of nerves in the TAP.

TAP Block

TECHNIQUE 2:
ULTRASOUND-GUIDED APPROACHES

CONT…

TECHNIQUE 1:
ANATOMICAL LANDMARK-BASED APPROACHES

- Rafi's classic description: needle insertion site within the lumbar triangle of Petit, and a single "pop" sensation served as an endpoint for appropriate needle depth.

Differential Diagnosis of Severe Hypotension In Postoperative Period

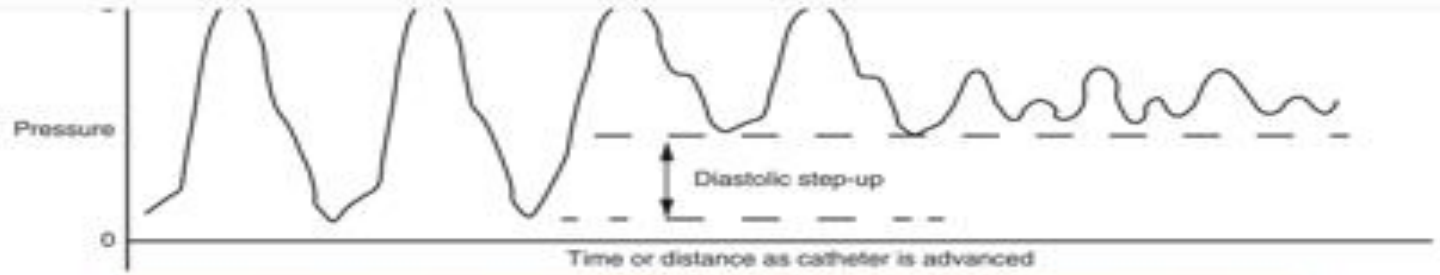


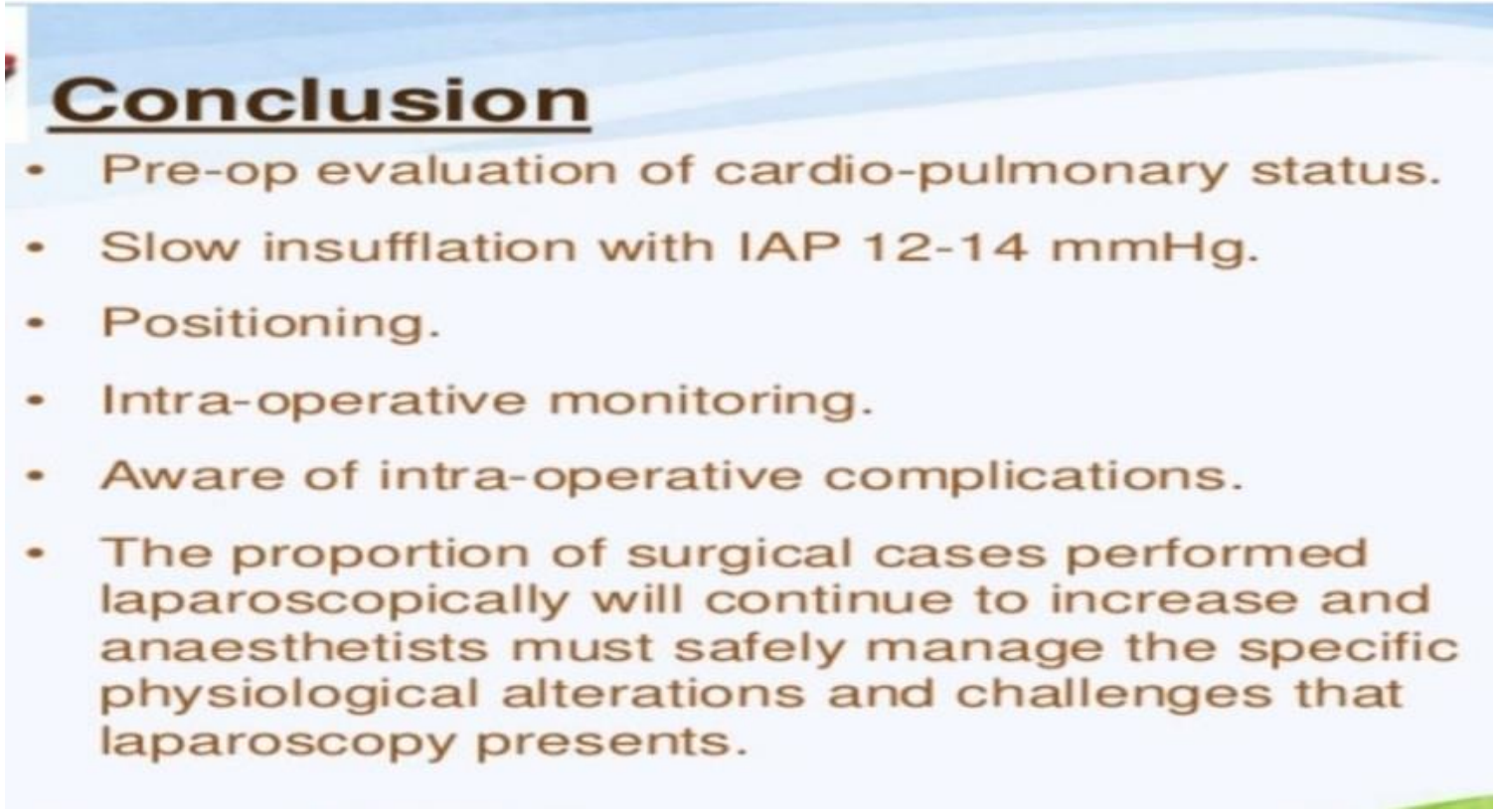
Fig. 20.16 A trace of pressure versus distance as a pulmonary artery catheter is advanced from the right atrium through the right ventricle (RV) into the pulmonary artery and ultimately resting in a wedge position in the pulmonary artery. Note as the catheter is advanced from the right ventricle into the pulmonary artery the diastolic pressure is cut off and rises to the PA diastolic, which is only slightly higher than the pulmonary artery wedge pressure. *PA*, Pulmonary artery; *PCWP*, pulmonary capillary wedge pressure.

Table 20.6 Differential Diagnosis of Severe Hypotension

Diagnosis	CVP	PAP	PCWP	CO	Airway Pressure
Pneumothorax	↑	↑	↑	↓	↑
Tamponade	↑	↑	↑	↓	--
Pulmonary embolism	↑	↑	↓	↓	--
Hypovolemic shock	↓	↓	↓	↓	--
Cardiogenic shock	↑	↑	↑	↓	--
Septic shock	↓	↓	↓	↑	--

The changes in invasive hemodynamic and airway pressures are associated with specific causes of hypotension.
CO, Cardiac output; *CVP*, central venous pressure; *PAP*, pulmonary artery pressure; *PCWP*, pulmonary capillary wedge pressure.

Conclusion


Conclusion
• Pre-op evaluation of cardio-pulmonary status.
• Slow insufflation with IAP 12-14 mmHg.
• Positioning.
• Intra-operative monitoring.
• Aware of intra-operative complications.
• The proportion of surgical cases performed laparoscopically will continue to increase and anaesthetists must safely manage the specific physiological alterations and challenges that laparoscopy presents.

References

- MILLER Text Book of Anesthesia ninth Edition 2020
- Anesthesia and CO-Existing Disease Seventh Edition 2018
- Clinical Anesthesia Eights Edition 2017
- Schwartz*s Principle of Surgery 11th Edition 2019
- Basics of Anesthesia Seventh Edition 2018
- Clinical Reports Intraoperative complication of Laparoscopic cholecystectomy Raymond Hasel md, Sunil K ARATA MBBS FFARCS , Donald R, Hickey MD FRCPC

THANKS