ANAESTHETIC MANAGEMENT OF LAPAROSCOPIC SURGERIES

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LAPAROSCOPY

Minimally invasive procedure allowing endoscopic access to the peritoneal cavity after insufflation of gas (CO$_2$) to create space between the anterior abdominal wall and the viscera. The space is necessary for the safe manipulation of instruments and organs.
• History
• Advantages over open methods
• Indications
• Contraindications
• Effects of patient positioning
• Effects of pneumoperitoneum
• Anesthesia for laparoscopy
• Complications
• Special situations
• Recent advances
History

• 1910 – Jacobaeus first laparoscopy – using cystoscope

• 1938 – Janos Veress introduced insufflation needle.

• 1960 – Automatic insufflator introduced by Karl Semm.

• 1987 - Philippe Mouret performed first laparoscopic cholecystectomy
Advantages of Laparoscopy

- Minimizes the abdominal incision
- Shorter hospitalization and convalescence
- Less post-operative ileus
- Early ambulation
- Economic benefits
- Decreased blood loss
- Less post-operative pain
INDICATIONS:

• General hospitals
  • Appendectomy
  • Cholecystectomy
  • Ectopic pregnancy
  • Heller myotomy
  • Common bile duct exploration
  • Tubal Ligation
  • Inguinal hernia repair

• Specialized Centres
  • Bariatric surgery
  • Donor nephrectomy
  • Radical prostatectomy
  • Splenectomy

• Thoracic sympathectomy
• Colorectal surgery
• Hepatic resection.
• Gastric surgeries
• Adrenalectomy
POSITIONING DURING ANAESTHESIA

• Trendelenburg position

• The reverse trendelenburg position for upper intestinal and biliary tract surgery

• Dorsolithotomy for gynecological surgeries

• Lateral decubitus position for nephrectomy and adrenalectomy.
Trendelenburg

Cardiac
\[ \uparrow \text{venous return, cardiac output} \]
\[ \downarrow \text{SVR, } \downarrow \text{Heart rate, } \downarrow \text{MAP} \]

Respiration
\[ \downarrow \text{Functional residual capacity, total lung volume} \]
\[ \uparrow \text{ventilation/perfusion mismatch} \]

GIT
\[ \uparrow \text{chances of regurgitation} \]

CNS
\[ \uparrow \text{Intracranial pressure} \]
\[ \downarrow \text{cerebral blood flow due} \]
Reverse Trendelenburg

**Cardiac**
- ↓ venous return, ↓ cardiac output

**Respiration**
- ↑ Functional Residual Capacity
- ↓ work of breathing

**Others**
- ↓ cerebral perfusion pressure
Ideal gas for creation of Pneumoperitoneum

- Colourless
- Inexpensive
- Non combustable
- Minimal peritoneal absorption
- Minimal physiologic effects
- Rapid excretion of any absorbed gas
- High blood solubility
- Minimal effects from intravascular embolization
• Absorption of gas from peritoneal cavity, depends on its *diffusibility and perfusion* of the peritoneal cavity, and capacity to store gas.
Why is CO₂ the gas of choice for laparoscopy?

- Nonflammable, does not combust.
- Readily diffuses across membranes.
- Rapidly removed from lungs.
- Highly soluble in blood.
- The risk of CO₂ embolization is small.
Various factors alter hemodynamics

- Effects of pneumoperitoneum
- Patient position
- Patients intravascular volume
- Preexisting cardiopulmonary status
- Neurohumoral factors
- Anaesthetic agents & Ventilatory strategy
Physiologic effects of Pneumoperitoneum
HEMODYNAMIC PROBLEMS

• Decrease in cardiac output

• ↑ Mean arterial pressure, systemic and pulmonary vascular resistance.

• *Threshold IAP that has minimal effects – 10mmHg*
Mechanisms leading to decreased Cardiac output

![Diagram showing mechanisms leading to decreased cardiac output](image)

*Fig. 60-6. Schematic representation of the different mechanisms leading to decreased cardiac output during pneumoperitoneum for laparoscopy. TRANSM RAP, transmural right atrial pressure.*
Respiratory effects of pneumoperitoneum
• • Vital capacity, ↓ Functional residual capacity, ↓ thoracopulmonary compliance

• ↑ Airway pressures

• ↑ ventilation and perfusion (V/Q) mismatch & ↑ physiological dead space
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Cerebral changes

- ↑ cerebral blood flow
- ↑ Intracranial pressure
- ↑ in ICP is proportional to IAP
- ↑ IAP → ↑ lumbar spinal pressure → ↓ drainage from lumbar plexus → absorption of CSF
GIT

- **Gastric intramucosal pH** is used as a monitor of splanchnic perfusion

- Intramucosal acidosis signifies inadequate perfusion

- **↓ splanchnic circulation** is mediated by mechanical as well as humoral factors (↑ADH) → vasoconstriction & local myogenic factors → vasoconstriction
Renal System

- ↓ renal artery & vein blood flow

- ↓ GFR, ↓ urine output & ↓ creatinine clearance

- Various neurohumoral factors influence renal perfusion and function

- ↑ renin, ↑ endothelin, ↑ ADH levels → vasoconstriction
Lower limb changes

• ↓ lower limb venous flow ↑ risk of Deep vein thrombosis.
• Regional blood flow changes have no clinical impact in normal healthy patients
• But these changes should be considered in critically ill patients
Contraindications
Contraindications …

**ABSOLUTE**

- Uncorrectable coagulopathy
  - Inability to tolerate general anaesthesia
  - ↑ Intra cranial pressure
  - ↑ Intra ocular pressure
**RELATIVE Contraindications**

- Morbid obesity
- *Pregnancy*
- Peritonitis
- Extensive adhesions from previous surgery
- *Severe cardiopulmonary disease*
- Intestinal obstruction & irreducible hernia
- Abdominal aneurysm
Anaesthesia for Laparoscopies
Anaesthesia for laparoscopy

• Pre operative evaluation with particular attention on cardiac and pulmonary status of patients

• Premedication drugs
  ✓ NSAID administration reduces opioid requirement
  ✓ Gastroprokinetic drugs – due to ↑ risk of regurgitation and aspiration
  ✓ DVT prophylaxis
MONITORING

- Heart rate
- Non invasive blood pressure
- ECG
- Pulse Oximetry
- Capnography
- IAP
- Urine output
CAPNOGRAPHY

- A – B Baseline
- B – C Expiratory Upstroke
- C – D Expiratory Plateau
- D ETCO$_2$ value
- D – E Inspiration Begins
Monitors For ASA III Patients

Central venous pressure,

Pulmonary artery pressure,

Pulmonary capillary wedge pressure

An arterial line
Advantages of General Anaesthesia

• Ability to control ventilation

• Protection from aspiration

• Good muscle relaxation & Still operative field
Scope of regional anesthesia

Scope of regional anaesthesia depends on creativeness of surgeons, anaesthetist and patient acceptance

Advantages
- Less emesis & Less postop pain (early discharge)
- Ability to be awake during surgery
- Cost effective

Disadvantages
- Needs a cooperative patient
- Degree of tilt to be minimized
- Insufflating pressures should be kept low
- Level of block should be high to prevent peritoneal discomfort.
Management of pain

- Less severe pain compared to open procedures
- *Diagnostic procedures are less painful*

**LOCAL ANAESTHESIA**

- Preemptive more effective

- *Simple skin infiltration of laparoscopy portals*

- In case of lap sterilisation, instillation of 5ml of 0.5% sensorcaine onto each tube reduced pain
Management of pain…cont..

- Paravertebral block
- Rectus sheath block
- Suprascapular N. block
- Catheter placed in pouch of douglas through the abdominal wall for repetitive administration of LA
- Injection of LA intra peritoneally into sub diaphragmatic area reduce shoulder pain
Post op nausea and vomiting

- **Major factor which delays discharge after outpatient surgery**

- Factors like peritoneal gas insufflation, bowel manipulation, pelvic surgery which are unavoidable contribute to nausea & vomiting

- Drugs → N₂O, opioids, neostigmine

- N₂O omission – decreased incidence of nausea & vomiting but *perioperative awareness is a problem*
Post op Nausea & vomiting...cont..

Antiemetic medications

- Metaclopramide 1µmg/kg
- Ondansetron 0.1mg/kg
- Droperidol 20 µg/kg
complications
Complications

Most commonly seen complications

- Inadvertent extraperitoneal insufflation

- Cardiovascular & Pulmonary complications
  - Pneumothorax, pneumomediastinum
  - Gas embolism
  - Vascular injuries, GI injuries & Bladder injuries
PNEUMOTHORAX

• Movement of gas during creation of pneumoperitoneum can produce pneumomediastinum, pneumopericardium and pneumothoraces.

• Embryonic remnants constitute potential channels of communication between peritoneal cavity and pleural and pericardial sacs, which can open when intraperitoneal pressure increases.

• Paco$_2$ and PETCO$_2$ increases whereas SpO$_2$ decreases.
Respiratory complications…conti…

Management of Pneumothorax

- Stop surgery and deflate the pneumoperitoneum
  1. *Increase FiO₂*
  2. *Stop N₂O*
  3. *Apply Positive end expiratory pressure*
  4. *Spontaneous resolution after exsufflation.*
Gas embolism

- Occurs due to inadvertent intravascular insufflation
- Lethal dose of embolized CO₂ is nearly 5 times that of air.
- When size of embolus increases tachycardia, cardiac arrhythmias, hypotension, increased central venous pressure, cyanosis may develop.
- Pulmonary edema may be an early sign
- Aspiration of gas or foamy blood from central venous line establishes the diagnosis
Management of Gas Embolism

• Release the pneumoperitoneum
• Keep the patient in steep head down and in left lateral decubitus (Durant position)
• Discontinue N₂O&Ventilate with 100%O₂
• External cardiac massage may be helpful in fragmenting CO₂ emboli into small bubbles.
• If these measures are not effective a central venous or pulmonary artery catheter is introduced for aspiration of gas.
• Cardiopulmonary bypass to treat massive embolism
• Hyperbaric oxygen therapy for cerebral gas embolization.
• Cephalad displacement of diaphragm during pneumoperitoneum leads to cephalad migration of carina in children and adults, leading to endobronchial intubation.

• It leads to decreased oxygen saturation and increase in airway pressure.
CO\textsubscript{2} SUBCUTANEOUS EMPHYSEMA

• It can develop as a complication of extraperitoneal insufflation of CO\textsubscript{2}.

• Unavoidable side effect of certain laparoscopic surgical procedures that require intentional extraperitoneal insufflation, such as inguinal hernia repair, renal surgery, and pelvic lymphadenectomy. During laparoscopic fundoplication for hiatal hernia repair, the opening of the peritoneum overlying the diaphragmatic hiatus allows passage of CO\textsubscript{2} under pressure through the mediastinum to the cervicoceophalic region.
Patient with subcutaneous emphysema extending to the face.
Laparoscopy must be temporarily interrupted to allow CO\textsubscript{2} elimination and can be resumed after correction of hypercapnia using a lower insufflation pressure.

Keep the patient mechanically ventilated until hypercapnia is corrected, particularly in COPD patients, to avoid an excessive increase in the work of breathing.
Cardiac Arrhythmias During Laparoscopy

- Sympathetic stimulation (Hypercapnia or light anaesthesia)
- Vagal stimulation (peritoneal distention or manipulation of intrabdominal structures)
- TREATMENT - correct underlying cause, administer appropriate antiarrhythmic drugs (beta antagonists or atropine)
Vascular injuries

- Major vessels - Aorta, Iliac vessels, IVC.
- Vessels in abdominal wall
- Laceration of mesentric vessels
- Disruption, division of cystic or hepatic artery
Complications…cont..

**GI injuries**
- Small intestine, colon, duodenum, stomach
- Lacerations of liver, spleen, and colonic mesentry
- *Risk factors*
  - Previous abdominal surgery
  - Metastatic disease
  - Gastric distension

**Urinary tract injuries**
- Injury to bladder
- Present as sudden deflation of abdomen, hematuria, and pneumaturia
LAPAROSCOPY IN SPECIAL SITUATIONS
• Most common non obstetric surgical procedures – appendectomy, cholecystectomy, Splenectomy, adnexial torsion etc.

**Timing of surgery** – (II is the best.)

- *Spontaneous abortions are less* compared to surgeries done during I trimester
- Procedures during III trimester are associated with *preterm labour & difficulty in visualization due to enlarged uterus*
the fetal heart rate and uterine tone should be monitored both pre/intra/post operatively.

Uterine Hyperstimulation

Uterine hyperstimulation is defined as greater than 5 contractions per 10 minutes (here 5 contractions in 7 minutes).
Tocolytic agents should not be used prophylactically, but should be considered when evidence of preterm labor is present.
Laparoscopy and paediatrics

- Procedures
  - Diagnostic & Therapeutic
  - A 10kg child needs only 0.9L of CO₂

- **CO₂ uptake is more efficient** due to smaller distance between capillaries and peritoneum

- *Greater absorptive area* of peritoneum in relation to body weight

- *Children have a high level of resting vagal tone*

- Measures to prevent heat loss
Gasless laparoscopy

- Lifting the abdominal wall with wire spokes
- Less analgesics, less time on bed.
- *Technically more demanding.*
Conclusion

Understanding of the pathophysiological consequences of increased intra abdominal pressure, carbon dioxide absorption into the systemic circulation & effects of Patient position.

Laparoscopic procedures are minimally invasive surgically but not physiologically
THANK YOU
Technique

- Veress needle introduced at 30 degree downward angle towards the pelvis and connected to insufflator
- $CO_2$ instilled at low flow of 1 litre per minute
- Veress removed and trocar inserted