Perioperative concerns for laparoscopic upper abdominal surgeries- RA vs GA

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Laparoscopic upper abdominal surgery

• Laparoscopic cholecystectomy
• Laparoscopic biliary surgery
• Laparoscopic pancreatic surgery
• Laparoscopic fundoplication
• Laparoscopic bariatric surgery
Physiological Effects of pneumoperitonium on the body

- Complications due to use of CO$_2$
- Respiratory
- Cardiovascular
- Risk of aspiration
- Effect on regional hemodynamics
- Endocrine effects
Complications due to insufflation with CO$_2$

- Pain in abdomen - peritonial irritation
- Shoulder pain - due to carbonic acid
- Lowering of threshold for arrhythmias
- Venous gas embolism
Respiratory effects

- Cephalad shift of diaphragm, reduced lung expansion, reduced diaphragmatic excursion
- Reduced FRC, TV, minute ventilation
- $\uparrow$ PVR $\rightarrow$ V/Q mismatch $\rightarrow$ Hypoxia, hypercarbia
Cardiovascular effects
Cardiac arrhythmias during laparoscopy

• Not related to level of PaCO2
• May occur early during laparoscopy
• Reflex ↑ Of vagal tone on stimulation of peritonium → Bradycardia, arrhythmias and asystole
• May be associated with gas embolism
Effect of pneumoperitonium on compromised patients

- In compromised patients, cardiorespiratory disturbances aggravate increase in PaCO2 and enlarge the gradient between PaCO2 and PeCO2
- Cardiovascular changes are enhanced in elderly patients and those with cardiovascular disease
Effect on regional hemodynamics

- Reduced splanchnic blood flow
- Reduced renal blood flow $\rightarrow$ ↓ urine output
Endocrine effects

- Endocrine response to laparoscopic and open cholecystectomy does not differ significantly
- Plasma concentrations of cortisol and catecholamines, urinary concentrations of cortisol and catecholamine metabolites, and anesthetic requirements are similar after both procedures
- Combined general and epidural anesthesia for laparoscopic cholecystectomy does not result in a decreased stress response compared with general anesthesia alone
- Pain and discomfort from peritoneal stretching, hemodynamic disturbances, and ventilatory changes induced by pneumoperitoneum may contribute to the stress response of laparoscopy
- Parietal afference, which is markedly reduced by laparoscopy, appears to be an important stimulus for postoperative hyperglycemia, visceral nociception, which is less affected by laparoscopy, may contribute more to adrenocortical stimulation
Complications of Laparoscopic surgery

- CO2 subcutaneous emphysema
- Pneumothorax
- Pneumomediastinum
- Pneumopericardium
- Gas embolism
Anesthesia for laparoscopic surgery

• “General anesthesia with endotracheal intubation and controlled ventilation is certainly the safest and most commonly used technique and therefore is recommended for inpatients and for long laparoscopic procedures “
General anesthesia

• The intraoperative stress response can be reduced by preoperative administration of $\alpha_2$-agonists

• 21-yr-old female with a fenestrated Fontan Goretex conduit
• Laparoscopic cholecystectomy under general anesthesia
Evidence of benefits of RA
Epidural anesthesia

- Laparoscopic Cholecystectomy in six patients (1 man and 5 women), with a median age of 56 years, under epidural anaesthesia over an 8-month period.
- All patients ASA grade III/IV with mean FEV\textsubscript{1}/FVC 0.52 (range, 0.4–0.68), due to chronic asthma (2 cases) and COPD (4 cases).
- Admitted a day prior to surgery for PFT, nebulisers, and chest physiotherapy.
- Epidural catheter introduced at T10/11 intervertebral space, bolus of 0.5% Bupivacaine administered.
- Incremental doses of 2 ml of 0.5% Bupivacaine with boluses of intravenous 100 mcg Alfentanil given to each patient.
- Surgery performed according to the standard technique with Low-pressure (10 mmHg) pneumoperitoneum.
- **Results:** All the patients tolerated the procedure well and made an uneventful postoperative recovery. Median operating time - 50 min; average length of hospital stay was 2.5 days. Epidural catheter removed the morning after the operation. Only one patient required postoperative opioid analgesia. Two patients complained of persistent shoulder tip pain during surgery and required intraoperative analgesia (Alfentanil). There was no change in the patient's cardiorespiratory status, including pO\textsubscript{2} and pCO\textsubscript{2}, and no complications occurred either intra- or postoperatively.

**Conclusions:** LC can be performed safely under epidural anaesthesia in patients with severe COPD. Intraoperative shoulder tip or abdominal pain does not seem to be a major deterrent and can be effectively controlled with small doses of opioid analgesia.

- Laparoscopic cholecystectomy performed ↓ Thoracic epidural anesthesia at T9-T10 level using 6mg/kg lignocaine 2% + adrenaline + fentanyl in 30 patients with COPD
- High incidence of shoulder tip pain
- No conversion to GA
- Good postop analgesia

- IV and inhalational anesthetic agents interfere with mucociliary transport, an important defense mechanism in COPD. Upper abdominal surgery has further adverse effects in patients with COPD
- Epidural anesthesia helps to:
  1. Avoid anesthetics that depress mucociliary transport
  2. Provides postop pain relief preventing deterioration of respiratory mechanics
  3. Ambulate the patient as soon as possible
Epidural anesthesia in complicated patients


- 28 years male with dilated cardiomyopathy. ECHO- Severe systolic dysfunction and generalized hypokinesia. EF-15%.
- Thoracic epidural catheter at D8-9
- In OT- BP- 110/70 mmHg and heart rate 76/min with oxygen saturation 99 % on oxygen mask
- Dopamine infusion drip started at dose of 5mic/kg/min through the central venous line
- Foley's catheter inserted
- The mean range of blood pressure intraoperatively was 94-110 mmHg and CVP ranged from 26-3 mmHg
- Sedation was achieved with 3mg i.v midazolam
- No invasive monitoring used

TEA can provide adequate block for surgery and excellent postoperative analgesia. Commonly laparoscopic cholecystectomy (LC) is performed under general anesthesia.
Spinal Anesthesia
Feasibility of SA for Laparoscopic cholecystectomy

• Fifteen ASA grade I or II patients underwent laparoscopic cholecystectomy with low-pressure CO\textsubscript{2} pneumoperitoneum under spinal anesthesia
• SA with 3ml 0.5 ml Bupivacaine (heavy) with 0.25 mg morphine and 20 mcg fentanyl at L2-L3 interspace
• SA in right lateral position followed by Trendelenberg tilt for 3 mins
• All operations were completed laparoscopically and conversion from spinal to general anesthesia not required in any of the cases

• Laparoscopic cholecystectomy with low-pressure CO\textsubscript{2} pneumoperitoneum can be successfully and safely performed under spinal anesthesia
• Spinal anesthesia is associated with minimal postoperative pain and at least an equally good recovery as with general anesthesia

- 300 patients selected prospectively for laparoscopic cholecystectomy under low-pressure (8 mm) pneumoperitoneum
- Spinal puncture with 25G spinal needle done between L1 and L2 space and 3.5 ml of 0.5% bupivacaine used for spinal anesthesia
- Patient kept in right lateral position for about 30 sec and then turned to supine with head end of the table tilted down 10-15° with a pillow under the head for 6-8 min
- Inj. Mephentermine used in single dose of 15 mg IV within 5-10 min of elevation of the head end of the table during the operation only in those patients where SBP fell below 80 mm of Hg despite adequate fluid infusion
- An OT sister always stood on the right side of the head end of the table, to assure the female patients and to massage the patients' right shoulder if they complained of right shoulder pain. Some patients required IV injection tramadol hydrochloride (100 mg) for unbearable shoulder pain even after massage
- Most of the patients were catheterized
- Five patients complained of post-spinal headache, especially where first spinal puncture was unsuccessful
Complications of cholecystectomy under SA are similar to standard laparoscopic cholecystectomy under GA.

Laparoscopic cholecystectomy under SA with low-pressure pneumoperitoneum by experienced surgeons is safe and cost-effective, associated with minimal postoperative pain and smooth recovery.

Segmental spinal anesthesia


- CSE with 16 G Touhy needle with 27 G needle through needle spinal anesthesia
- Level- T10
- 1 ml of plain bupivacaine 5 mg ml\(^{-1}\) mixed with 0.5 ml of sufentanil 5 µg ml\(^{-1}\) injected
- Epidural catheter then threaded into place
- Nasal oxygen 4 litre min\(^{-1}\) started
- One patient experienced paraesthesiae in the right leg on insertion (8 mm beyond the tip of the Tuohy) of the spinal needle
- Low incidence, and ease of treatment, of shoulder tip pain, a common problem after laparoscopic surgery

Mean systolic and diastolic blood pressures and heart rate plotted against time.
Words of Caution

• Puncturing the dura mater in the thoracic region can lead to needle damage to the spinal cord, avoidance of this risk being the main reason why spinal anaesthesia is traditionally performed at the lumbar level.

• Extensive thoracic nerve block produced might result in ventilatory impairment - The main inspiratory muscle, the diaphragm, will be unaffected as innervated from the cervical level.

• Forceful expiration and coughing will be affected because they are generated primarily by the muscles of the anterior abdominal wall which are innervated by the thoracic nerves.

• The use of very low doses of local anaesthetic should minimize the degree of nerve block, and thus muscle weakness, but the technique could have disastrous effects in an individual patient with a pattern of COPD dependent on active expiration to maintain lung ventilation.

• The pressure of the pneumoperitoneum also needs to be controlled carefully during surgery to ensure adequate diaphragmatic excursion.

• Patients receiving this technique must be assessed very carefully and managed by anaesthetists with considerable experience of regional anaesthesia.
• Seven cases described in which neurological damage followed spinal or CSE using atraumatic spinal needle
• All patients were women, six obstetric and one surgical
• All experienced pain during insertion of the needle at the L₂₋₃ interspace
• Free flow of CSF before spinal injection
• Unilateral sensory loss at the levels of L₄–S₁ (and sometimes pain) persisted in all patients
• Foot drop in six and urinary symptoms in three
• MRI showed spinal cord of normal length with a syrinx in the conus (n = 6) on the same side as both the persisting clinical deficit and the symptoms that had occurred at insertion of the needle
• Tip of conus usually lies at L₁₋₂, although it may extend further

Conclusion:
• Tuffier's line is an unreliable method of identifying the lumbar interspaces, and anaesthetists commonly select a space that is one or more segments higher than they assume
• Because of these sources of error, anaesthetists need to relearn the rule that a spinal needle should not be inserted above L₃
Spinal Anesthesia in complicated cases


• Patient with alpha-antitrypsin deficiency with severe emphysema
Conclusion

This approach requires:

• A co-operative patient
• An experienced laparoscopist amply skilled in precise and gentle surgical technique
• An enthusiastic anesthesiologist ever prepared to supplement it with intravenous adjuncts needed to convert the anaesthetic technique to general anaesthesia.
GA vs Spinal anesthesia
Objective: To compare spinal anesthesia with gold standard GA for elective Lap. Chole. in healthy patients

Results: All the procedures completed by the allocated method of anesthesia, as there were no conversions from SA to GA. Pain was significantly less at 4, 8, 12, and 24 hours after the procedure for the SA group compared with those who received GA. There was no difference between the 2 groups regarding complications, hospital stay, recovery, or degree of satisfaction at follow-up.

High incidence of hypotension requiring phenylephrine and shoulder pain requiring additional analgesia in SA group.

Conclusion: Spinal anesthesia is adequate and safe for laparoscopic cholecystectomy in otherwise healthy patients and offers better postoperative pain control than general GA without limiting recovery.

It is surprising that regional anesthesia has been successfully used for laparoscopic cholecystectomy in patients unfit to have the procedure under general anesthesia but has not been tested in healthy patients in whom any presumed risk would be theoretically much lower.
Spinal anesthesia vs GA

Imbelloni LE et al. General anesthesia versus spinal anesthesia for laparoscopic cholecystectomy. Rev. Bras.Anestesiol. 2010;60(3)

- ASA I or II, between 20 and 65 years, BMI ≤ 32
- After the second trocar, the subdiaphragmatic surface of the liver received more 100 mg of 1% lidocaine. If the patient still complained of shoulder pain after the administration of lidocaine, 50 µg of fentanyl were administered
- Criteria for conversion of the anesthesia: the need of a nasogastric tube, organ damage, difficult to control bleeding, or if the patient was not satisfied with the spinal anesthesia in any phase of the procedure.

Mehta PJ et al. Comparative analysis of spinal versus general anesthesia for laparoscopic cholecystectomy: A controlled, prospective, randomized trial. Anesthesia essays and researches, 2010 ;4(2) : 91-95
Management of complications
W Zhang, K S Ho, H J Han, C S Kong, K W Eu. Successful resuscitation after carbon dioxide embolism during laparoscopic-assisted abdomino-perineal resection. Singapore Med J 2005; 46(7) : 347

- Surgery ↓GA
- Resuscitated and gas aspirated through central line inserted immediately


- Series of 46 patients undergoing fundoplication under general anesthesia
- High incidence of pneumothorax
- Managed with PEEP
Complications of laparoscopic abdominal surgery


All cases under GA. Managed with IPPV with high oxygen concentration
Conclusion

- Regional anesthesia appears to be safe in ASA grade 1 & 2 patients but is associated with hypotension, shoulder tip pain and discomfort
- Needs experienced anesthetist to manage these
- Requires gentle and quick surgeon
- Low pressure pneumoperitonium
- Anesthetist should be prepared to convert to GA in case of complications
- Lack of evidence to support role of regional anesthesia in biliary, pancreatic, fundoplication and bariatric surgery