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Editorial

Anaesthesia Strategies in Cholecystectomy… The Search Continues…..

Laparoscopic Cholecystectomy (LC) is currently accepted as the gold standard for cholecystectomy. Conventional four port LC is being widely used as the primary treatment modality for gallbladder removal; nevertheless Single Site Laparoscopic Cholecystectomy (SSLC) is nowadays becoming more popular because of minimal pain, minimal scarring and better cosmesis.[1] Single Site Robotic Cholecystectomy using the robotic da Vinci system has recently been introduced to alleviate the technical challenges in SSLC. Studies have demonstrated that single port robotic cholecystectomy is safe, effective and improves precision in dissection[2]. Gasless laparoscopy is also developing.

The surgical procedure of LC has thus grown steadily; parallel to this growth, the anaesthesia techniques for LC have grown rapidly. From days gone by, a lot of research has been centered around anaesthesia techniques for LC. Traditional topics for research on this include the choice of insufflation gas, attenuation of the perioperative neuroendocrine stress response, hemodynamic changes during LC including the stress response to intubation, pneumoperitoneum and extubation, use of different drugs like clonidine, dexmedetomidine, fentanyl, magnesium to improve intraoperative hemodynamics, post-operative pain management using techniques like local wound infiltration, intraperitoneal local anaesthetics, port infiltration, the preemptive use of non-steroidal anti inflammatory drugs and pregabalin, prophylaxis of Post-operative Nausea and Vomiting (PONV), comparison between the efficacies of different types of Supraglottic Airway Devices (SGADs) and between SGADs and endotracheal tubes, the use of different intra-abdominal pressures for pneumoperitoneum and different methods of heating and humidification of the insufflation gas. Several Randomised Controlled Trials (RCTs), systematic reviews and meta-analyses have been published on these topics. There is a growing research interest nowadays on topics like the safety of day-stay LC, safety and efficacy of ventilatory strategies for LC, General Anaesthesia (GA) versus regional anaesthesia for LC, ultrasonography guided Transversus Abdominis Plane (TAP) blocks, abdominal field block, rectus sheath block, erector spinae plane block and paravertebral block for pain management in LC, multimodal enhanced recovery protocol and the off- label use of drugs like Intravenous (IV) magnesium and lignocaine to reduce the need for anaesthetics and to reduce postoperative pain.

A systematic review and meta-analysis of RCTs on a perioperative single dose of systemic dexamethasone (1.25-20 mg) for postoperative pain after LC has supported the use of single dose IV dexamethasone for PONV prevention and as a part of multimodal pain management[3]. There are several dose-finding studies on dexamethasone for this purpose with a raging debate on the minimum dose of dexamethasone effective in reducing postoperative pain and vomiting.

This issue of the Karnataka Anaesthesia Journal (KAJ) has an article on the effect of a single pre-operative dose of intravenous dexamethasone. According to the authors, 8 mg IV dexamethasone given 90 minutes before induction in LC is effective in facilitating post-operative recovery by decreasing post-operative pain, consumption of analgesics and the incidence of PONV with signs of improvement in post-operative pulmonary function[4].

The Carbon Dioxide (CO_2) pneumoperitoneum in LC by increasing the intra-abdominal pressure and producing a diaphragmatic cephalic shift alters respiratory mechanics by producing negative physiological changes like decrease in lung volume, increase in airway pressure, decrease in lung compliance, increase in End-tidal Carbon Dioxide ($EtCO_2$) tension, decrease in the functional residual capacity, increase in intrapulmonary shunt, increase in ventilation-perfusion mismatch, basal lung collapse and hypoxia[5].

Several authors have proposed different ventilatory strategies to reduce the negative respiratory effects in LC under GA. These strategies include the use of Pressure Controlled Ventilation (PCV), deep Neuromuscular Block (NMB), the application of Positive End Expiratory Pressure (PEEP), use of alveolar recruitment manoeuvres, alteration in inspiratory to expiratory time (I:E) ratio,

intra-operative low Tidal Volume (TV) ventilation, low TV with PEEP and a high respiratory rate.

A systematic review and meta-analysis of 12 studies found that deep NMB facilitates the use of low pressure pneumoperitoneum, improves surgical space conditions and reduces postoperative pain scores[6]; however a review by Kopman and Naguib found that there are little objective data to say that deep NMB improves surgical operating conditions and patient outcomes[7]. The benefits of deep neuromuscular block are thus not clear.

Whether the use of PEEP improves pulmonary mechanics in LC is debatable. Vega JVC[8] and co-researchers in their study on LC patients, found no significant differences in the gap between $EtCO_2$ and $PaCO_2$ (arterial blood pressure of carbon dioxide) when using mechanical ventilation with PEEP; however another RCT found that 8 cm H_2O PEEP in ASA I-II laparoscopy patients increased the pulmonary compliance and led to less impairment in the post operative pulmonary function tests compared to 0 and 5 cm of H_20 PEEP[9].

Some authors have suggested that prolonged I:E ratio ventilation might improve respiratory mechanics and oxygenation during LC but at the cost of hemodynamic compromise[5]; nevertheless a randomised trial in gynaecological laparoscopy cases in the Trendelenburg position found that a prolonged inspiratory time with a tidal volume of 6 ml/kg showed a beneficial effect on oxygenation with better CO_2 elimination. However another recent study found that equal ratio ventilation (I:E ratio 1:1) did not improve respiratory mechanics in the Trendelenburg position[10].

The role of lung protective ventilatory strategies using low tidal volume mechanical ventilation in LC has been assessed in various studies. Kokulu S. and co-researchers found that low tidal volume intraoperative ventilation did not decrease lung injury and inflammatory response during laparoscopic gynaecological surgery[11]. Arora V. and co-researchers in their study in LC cases too did not find any significant improvement in gas exchange, hemodynamic parameters and systemic inflammatory response with low tidal volume 6 ml/kg ventilation along with PEEP 10 cm of H_2O[12]. The benefits of low tidal volume ventilation during laparoscopic surgery are thus doubtful.

Volume Controlled Ventilation (VCV) is the most popular mode for intra-operative use and it aims at achieving a target tidal volume and ensures satisfactory minute ventilation. VCV can, however, cause excessive stretching of the lungs, alveolar rupture, volutrauma and inflammatory lung injury. It can decrease the lung compliance which is already decreased with the Trendelenburg position and pneumoperitoneum during LC. PCV limits inspiratory pressure, reduces the risk of barotrauma and delivers the tidal volume faster than VCV.

Wang J. P. and co-researchers performed the first meta- analysis of RCTs to compare the effects of PCV and VCV on respiratory mechanics and hemodynamic parameters during laparoscopy. They concluded that PCV may offer slightly better respiratory data but both ventilatory modes may be used during laparoscopic surgery[13]. This meta-analysis included 3 studies on obese patients. So the authors also concluded that PCV has a theoretical advantage over VCV in obese patients. The recently published systematic review by Youn Y. J. and Kwak H. J. concluded that PCV rather than VCV, application of PEEP and prolonged I:E ratio ventilation might improve respiratory mechanics during laparoscopic surgery, but if employed, one should look out for hemodynamic compromise[5].

As Wang and co-authors say, there are thus no clear guidelines in the literature on the use of VCV and PCV during laparoscopic surgery, however the selection of the optimal ventilation mode is important in morbidly obese and critically ill patients undergoing laparoscopic surgery.

An interesting cross-over study comparing respiratory mechanics with VCV versus PCV using proseal LMA during LC accompanies this issue of the KAJ. The authors have concluded that PCV is associated with lower peak airway pressure compared to VCV[14].

Anaesthesia technique for LC thus currently poses many interesting issues for debate. As I was going through the recent advances in surgical techniques, a new thing caught my attention- Natural Orifice Transluminal Endoscopic Surgery (NOTES). Removal of the gall bladder through transanal, transvaginal, transcolonic and transgastric access with flexible endoscopic instruments is now under development[2]. The per oral trans-gastric route for NOTES using the anterior wall of the stomach is fast growing. The port is placed in the antrum midway between the vascular arcades of the stomach for upper abdominal procedures like cholecystectomy. A standard wire-guided needle knife, using blended current, is used to create a stab gastrotomy. An adequate pneumoperitoneum is created through this stab which is further enlarged using a balloon for passage of a double channel endoscope. The gastric access is closed with endoscopic clips/

stapling devices. Robotic NOTES and EUS (Endoscopic ultrasound)-guided NOTES is also developing. Though NOTES is still largely an experimental field, clinical NOTES is gaining momentum mainly because of its less invasive nature. As some authors say, NOTES is potentially the next paradigm shift in minimally invasive surgery[15]. One cannot help but wonder whether our anaesthesia techniques devised for the routine surgical method of Laparoscopic Cholecystectomy will work for this kind of new surgical technique! It is said that NOTES can be done under conscious sedation rather than general anaesthesia. I suggest that high quality studies are warranted to provide better evidence for choosing the best anaesthetic technique in tune with the advances in surgical techniques for LC.

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