The anaesthetic management challenges of laparoscopy and thoracoscopy

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Learning outcomes:

1. Describe the potential impact of laparoscopic procedures on the cardiovascular and respiratory system
2. Understand the factors that contribute to post operative pain in patients that have had laparoscopic surgery

Minimally invasive surgical techniques are becoming more common in human and veterinary surgery. These techniques include laparoscopy and thoracoscopy and the benefits of these procedures include less post-operative pain, shorter hospital stays, fewer wound complications, faster return to normal function and improved cosmesis (Bleedorn et al. 2013). There are also limitations of these techniques as the learning curve for the surgeon is steep, at least initially, the equipment is expensive and specialised, and training opportunities for veterinary surgeons are limited. In addition, anaesthetic management of these cases is more challenging and requires more comprehensive intra-operative monitoring than a practice may be accustomed to.

In a recent survey minimally invasive ovariectiony by two port laparoscopy was the most popular choice among pet owning veterinary personnel for surgical spaying of dogs (Hsueh et al. 2018). This result suggests that familiarity and confidence in laparoscopic procedures is high, although the study was focused on university teaching hospital personnel where laparoscopic procedures are components of the surgery training programs.

During laparoscopic and thoracoscopic surgery carbon dioxide (CO₂) is used to insufflate the body cavity under positive pressure. Insufflation is required to provide space for both visualisation and instrumentation (Fransson et al. 2015). CO₂ is used for insufflation as it is highly diffusible. It is 20 times more diffusible than oxygen. In the blood CO₂ is carried in three forms: dissolved; as bicarbonate; and in combination with proteins as carbamino compounds.
Capnoperitoneum and capnothorax may cause significant alterations in heart rate, blood pressure, vascular tone and pulmonary compliance and the following physiological changes are reported (Fransson et al. 2015):

- Increased heart rate
- Increased systemic vascular resistance
- Increased arterial blood pressure
- Increased central venous pressure
- Decreased pulmonary compliance
- Increased risk of cardiac arrhythmias
- Decreased arterial pH

The magnitude of these alterations can be minimised by ensuring the intra-abdominal pressure is less than 15 mmHg and the intrathoracic pressure is less than 5 mmHg.

Anesthesia for thoracoscopy is based on one lung ventilation (Conacher 2007). The major implication of one lung ventilation and the creation of capnothorax is the development of an anatomical shunt due to continued perfusion of the non-ventilated lung. The following physiological changes are reported:

- Hypoxaemia
- Increased alveolar pressure
- Increased pulmonary vascular resistance
- Decreased cardiac output

Obligations of the person responsible for anaesthesia:

- Preparedness to convert to an ‘open’ procedure
- Adequate monitoring during anaesthesia
  - Capnography
  - Invasive blood pressure
  - Electocardiography
  - Pulse oximetry
  - Temperature
  - (Central venous pressure for higher risk patients)
Post-operative pain after laparoscopic surgery occurs because of tissues trauma at the incisions sites as the port sites penetrate muscles and ligaments causing nociceptive pain. If nerves are injury then neuropathic pain may result. Capnoperitoneum and surgery also cause inflammation so inflammatory pain occurs post-operatively (Sjovall et al. 2015). Consequently multi-modal analgesia should be administered, preventively, and for a long enough period of time after surgery. This pain is multifactorial and the causes of it include:

1. Distension-induced neuropraxia of the phrenic nerves
2. Insufflated gas
3. Residual volume of gas
4. Type and temperature of gas used – warm and humidified gas is less irritant
5. Acidic peritoneal fluid – CO₂ is acidifying
6. Size and number of the wounds
7. Presence of drains after surgery
8. Individual factors (Sjovall et al. 2015)

In humans capnoperitoneum is reported to cause dull pain in the shoulder area after surgery, which may be persist for up to 72 h (Sjovall et al. 2015). In horses this transient post-operative pain was investigated to determine if active desufflation of the abdomen after surgery was beneficial. The effects of active desufflation were not significant so there is no strong evidence to confirm that active desufflation decreases post-operative pain in horses (Devick et al. 2018).

The absorption of CO₂ from the peritoneal cavity is not linearly related to the insufflation pressure (in pigs) (Lister et al. 1994). Its absorption reached a maximum at relatively low insufflation pressures and then plateaued. However, further increases in PaCO₂ may occur as dead space ventilation increases with increasing intraperitoneal pressure. Judicious use of abdominal inflation pressures is important, along with continuous monitoring of expired CO₂, and in some cases intermittent arterial blood gas analyses.
References:


