GUIDELINES IN
ANAESTHETIC MANAGEMENT FOR ROBOTIC SURGERY
HOSPITAL KUALA LUMPUR

CONTENTS
Anaesthesia for Urological Procedures

1. Robotic prostatectomy/Cystectomy (and pelvic procedures)
   1.1. Anaesthetic Considerations
   1.2. Problems associated with Trendelenberg position
   1.3. Conduct of Anaesthesia
       1.3.1. Preoperative assessment
       1.3.2. Positioning
       1.3.3. Intraoperative management
   1.4. Ventilatory strategies and targets
   1.5. Fluid management
   1.6. Extubation and postoperative management

2. Robotic pyeloplasty/Nephrectomy
Anaesthesia for Urological Procedures

1. Robotic Prostatectomy/Cystectomy (and pelvic surgeries)
   - The most common procedure done and the most physiologically demanding for patients.
   - Surgically similar to laparoscopic technique with the difference of more precision and stability for dissection of critical structures due to the tridimensional view from the surgeon's console.
   - The problems associated are a consequence of 3 main factors.
     - Extreme steep Trendelenberg position
     - Insufflation of carbon dioxide (CO2)
     - Spatial restrictions due the bulk of the surgical cart

1.1 Anaesthetic Considerations
   - Altered Physiology due to steep Trendelenberg position
   - Access to patient
     - Restricted access due to the bulk of surgical cart and position of assistants and equipments
   - Airway
     - displacement of ETT due to mediastinal movement
     - oedema of the head and neck due to prolonged Trendelenberg position
   - Position of patients
     - supine with arms by the side and strapped to OT table or casted on a ‘bean bag’ (vacuum applied beaded mattress)
     - legs held apart in lithotomy position with padded leg rests
   - Problems due to laparoscopic procedures
     - Pneumoperitoneum
     - CO2 insufflation and hypercarbia
Three components of robotic operating module

Surgeons Console

Patient Cart

Vision Cart
- moderate hyperventilation may result in pneumothorax, pneumomediastinum and more commonly subcutaneous emphysema. (Due to hyperventilation at high inspired pressures with pneumoperitoneum)
- possibility of visceral injury

- Problems due to prolonged surgery
  - Hypothermia

- Monitoring of systems
  - A (airway)
  - B (blood gases)
  - C (cardiovascular system, central nervous system, CO2, compliance of the lung)
  - D (diuresis at the end of surgery)
  - E (entrapment of plexuses/nerves)
  - F (fluids consideration - type and volume)

- Venous Gas embolism

1.2 Problems associated with Trendelenberg position

1.2.1 Central Nervous System
- Increase in interstitial oedema with resultant cerebral oedema
- increased cerebral venous pressure
- reduced cerebral blood flow
- increased intraocular pressure
- overall increase in intracranial pressure
- a reported case of cerebral hemorrhage with neurological deficit
- clinical swelling of head and neck, oedematous face, conjunctivae and tongue is almost always observed.
1.2.2 **Respiratory System**
- abdominal contents push the diaphragm cephalad
- worsened by obesity
- mediastinum is displaced upward
- increased pulmonary blood content (increased capacitance and recruitment of intrapulmonary vasculature)
- reduced Functional Residual Capacity
- most vasculature in West zone 4 condition (Pa>Pi>Pv>PA)
- development of pulmonary interstitial oedema
- prone to atelectasis
- reduced lung compliance
- increased V/Q mismatch
- -causes an increase in PA-a gradient
- -displacement of ETT cephalad or distally (risk of dislodgement or endobronchial intubation)
- changes are made worse with pneumoperitoneum

1.2.3 **Cardiovascular System**
- decrease in heart rate as a result of vagal reflex
- increase in central venous pressure
- increased pulmonary capillary wedge pressure
- increased cardiac filling pressures and volume (increased venous return and stroke volume)
- increased myocardial oxygen demand
- decreased A-V oxygen difference
- cardiac output and mean arterial pressure may be unchanged or slightly increased
- caution in patients with myocardial disease
- changes are made worse with pneumoperitoneum
- increased systemic and pulmonary vascular resistance, mean arterial pressure and heart rate can be due to hypercarbia.

1.2.4 Gastrointestinal and metabolic derangement
- worsened with pneumoperitoneum
- reduced blood flow to organs
- Increase in lactate levels
- altered liver enzymes
- splanchnic ischaemia and reperfusion can lead to worsening acidosis and necrosis
- oliguria due to mechanical pressure on renal parenchyma

1.2.4 Peripheral nerve
- compressed or traction on nerve/plexus may cause neuropathy
- incidence of 0.25%
- lingual and buccal nerve neuropathy were documented
- common peroneal nerve can be injured due to inappropriate padding
- median nerve palsy being one of the more common lesions

1.3. Conduct of anaesthesia

1.3.1. Preoperative assessment
- All patients are reviewed and optimized clinically
- Special attention must be made to patients with myocardial and respiratory diseases.
  - Cardiac assessment with echocardiography, stress test or perfusion scan must be done for risk stratification.
  - Lung function test for patients with respiratory disease, bronchodilator therapy and aggressive lung expansion physiotherapy must be done preoperatively.
- Appropriateness for procedure must be discussed with the surgeons.
- Pre-emptive analgesia (NSAIDs) and acid prophylaxis to be given prior to surgery.

1.3.2. Intraoperative Management

- Induction of anaesthesia is via the intravenous technique using induction agents appropriate for the patient according to his clinical status.

- After induction, maintenance anaesthesia is via balanced technique with inhalational agent at 0.9-1.2 MAC in 50% 2L/min O2/air mixture with intermittent relaxant and opioid boluses.

- Two (2) 16G branulas are inserted with extension tubings of appropriate length, taped around the hands and brought upwards toward the head end. The tubings are positioned in such a way that they will not be kinked during positioning.

- A 12-14 Fr nasogastric tube and a temperature probe are inserted.

- An arterial line is inserted using a 20G branula under aseptic technique, and the monitoring line is also secured and positioned around the hands and brought towards the head end together with NIBP and pulse oximeter cables.

- Central Venous Pressure monitoring is inserted only if there is an indication.

- Both upper limbs are wrapped, sufficiently padded and strapped into position with the aid of vacuum-assisted beaded mattress. (bean bag).

- Temperature control is maintained with cotton wrappings of the extremities and blanket, with the aid of the Bair Hugger system.
IV lines and monitoring are secured and brought upwards to the head end.

Note how the monitoring lines and intravenous tubings are brought around the covered upper limb towards the head end.
1.3.3 Positioning of patients

- Patient is strapped supine with both arms by the side and the legs apart.

- Anaesthetic machine is positioned by the head end of patient.

- Intravenous lines with extension tubing and non-invasive/invasive monitoring are secured and brought to the head end.

- After surgical cleaning and draping, CO2 pneumoperitoneum is instituted at pressures between 15-20 mmHg for port insertion. These pressures will be reduced to 10-15mmHg once all the ports have been inserted.

- OT table is tilted up to -45 degrees by slow increments into Trendelenberg position and the robotic operating module (surgical cart) is docked over the perineum.
1.4 Ventilation strategy and targets

- Both volume /pressure control ventilation can be used.

- Ensure Peak Airway Pressure not exceeding 40mmHg (mean pressures < 25mmHg).

- Normal tidal ventilation at 4-7 ml/kg.

- Adequate minute ventilation to achieve EtCO2 not exceeding 40mmHg (to achieve normocarbia).

- If airway pressures approaching 40mmHg with respiratory rates of 18-20, our data showed that lengthening the inspiratory time and shortening the expiratory time (I:E ratio of 1:1.5 or higher), resulted in an increase in tidal volume and minute ventilation; thus bring CO2 to a more manageable level without further increase in airway pressures.

- In instances whereby peak airway pressures and or CO2 control is difficult; allow moderate hypercarbia (EtCO2 up to 45).

- If there is difficulty in achieving ventilatory target, rule out ETT migration, kinking or obstruction from secretions or spasm.

- Inform and discuss with surgeons if there is difficulty.

1.5 Fluid management

- Boluses of IV fluids to be preferably given while in supine position. (Which are in the beginning and towards the end of surgery).

- Injudicious fluid management during trendelenberg position will result in increase of likelihood of interstitial oedema. Urine production and leakage during bladder neck dissection will also obscure the surgical field.
- Limit fluid to 1-1.5 litres. (Korean experience: Robotic Radical Prostatectomy takes about 2.5-3 hours. Use infusion rate of about than 500 ml/hour.)

- Administering colloids will reduce the likelihood of oedema formation when compared to purely crystalloid infusions.

- The choice of solution between saline or lactate-containing solutions should be guided by frequent electrolyte analysis. (Lactic acidosis can be due to reduced organ perfusion during trendelenberg position with direct mechanical effect from pneumoperitoneum. This may need frequent fluid boluses intraoperatively).

- Be aware of haemodynamic changes which occur especially during initial stages of pneumoperitoneum and also during initiation of Trendelenberg position. These changes are usually transient and return to baseline gradually over the following twenty to thirty minutes. There has been a reported case of bradycardia and asystole following rapid change into Trendelenburg position.

- Bleeding may occur but it is rarely catastrophic. Generally it is within the range of 300-500 ml. Suction container is normally filled with blood, mixed with irrigation fluid and urine from bladder neck dissection. Be aware that stereoscopic view is magnified, and bleeding may be overestimated.

- The most common complication is head and neck oedema followed by subcutaneous emphysema. These complications are usually self-limiting and dependant on the duration of surgery.

1.6 Extubation and Post-Operative Management

- Airway oedema almost always occurs and a leak test must be performed to ensure safety for extubation. Re-intubation may be difficult if significant
airway oedema exists. In this case, it is advisable to keep the patient intubated and ventilated until oedema subsides.

- Conscious level may also be depressed as a consequence of cerebral oedema.

- Normal criteria for extubation apply and muscle relaxants need to be reversed.

- All extubated patients are given PCA morphine as per standard protocol.

- Acid prophylaxis (IV Ranitidine 50 mg 8H) is usually continued.

- Consider overlapping IV Paracetamol or IV Tramadol before discontinuation of PCA Morphine.

- At the moment, all robotic patients are being monitored in the Intensive Care Unit.

2. Anaesthesia for robotic pyeloplasty/nephrectomy

- All considerations are similar except for patient’s positioning.

- Pyeloplasty procedures are of a shorter duration and the patients are placed in the lateral position.

- Patients are more accessible to anaesthesiologists as the arms are placed on arm-boards and arm-rests to the patient’s contralateral side from the operating area.

- Ventilation pressures are much lower than prostatectomies. However, high enough pressures is still required to ventilate the dependent lung. V/Q mismatch can still occur.

- Fluid administration is as per normal requirement for surgery. (Intraoperative maintenance 2-4 ml/kg/hr)

- Bleeding is normally minimal with pyeloplasty, slightly more with nephrectomy.

- Analgesia is multimodal. Less is required compared to prostatectomies.

- All patients are normally extubated postoperatively.
References:

1. A brief review: anaesthesia for robotic prostatectomy

   Michael Irvine; Vishal Patil MD. Cont Edu Anaesth Crit Care & Pain.
   2009;9 (4): 125-129