ROBOTICS, LAPAROSCOPY & ENDOSURGERY

Mini-Review

ANESTHESIOLOGY IN ROBOTIC SURGERY AND ROBOTIC RADICAL PROSTATECTOMY

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ABSTRACT

Technological developments in surgery have risen expectations of surgeons. One of the most important recent developments to surgical practice has been the adoption of computer assisted robots. In order to appreciate anesthetic management in robotic surgery it is very important to understand surgical procedures. Several studies suggest that the robotic approach may offer significant benefits in clinical outcomes, as well as a decrease in the number of major and minor complications.Differences between robot-assisted and conventional laparoscopic surgery are minimal. RALP offers advantages over open radical prostatectomy after previous surgery. Although both techniques are associated with adequate surgical outcomes, RALP appeared to be preferable in our population of patients with previous prostate surgery.

Procedures in the pelvis such as prostatectomy are usually done in the lithotomy and steep trendelenburg position, while those in the upper abdomen and the diaphragm are best performed in the supine and reverse Trendelenburg positions.Anesthesist should avoid harmfull effects of Trendelenburg position. Anesthesia and the Trendelenburg position increased the CVP, PCWP and pulmonary arterial pressures and decreased cardiac output.

So anesthesic management should be concerned on positioning injuries, hemodynamic changes and adverse effects like venous gas embolism or pneumoperitoneum.

Key Words: Robotic surgery, Robotic radical prostatectomy, Anesthesia

Nowadays Robot-assisted surgery have an increasing popularity since laparoscopic surgery had some imagination and monitoring limitations.(1) Robotic surgery devices have ability to present control and accuracy like surgical instruments in minimally invasive procedures and microsurgery. Robots are complex inventions which need a lot of practice and technical expertise. Robotic surgery preparation have somemore professional teamwork and needs longer operating room time.(2) Devices have many pieces of equipment, each of them spread over in the operating room space.

Anesthesiologist must consider invasion of the anesthesia work space by the robot and also must be aware of the difficulty in accessing the patient intra operatively. The staff must be trained and prepared to quickly detach and remove the robot from the patient in the event of an emergency. Latent time is the major point to be attained that to monitorize and synchronise surgeon's movements with the robot(3). Humans can compensate for delays of less than 200 msec. Longer delays compromise surgical accuracy and safety. Incompatibility with imaging equipments is an area that needs attention.(4)

Prostate cancer is the second leading cancer that is diagnosed in male population and the sixth leading cause for death. GLOBOCAN Project has been completed at 2008 and this project approved that 899000 new prostate cancer diagnosis and 258000

Received : 15 August 2015
Accepted : 12 October 2015

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death due to prostate cancer worldwide.(5) On the otherhand according to data of American Cancer Society estimated that prostate cancer will be the first cancer seen in male population in 2015 with 26% and the estimated death rate due to prostate cancer will be 9% rate second after lung and bronchus cancer with 28% rate.(6)

According to data given by Intiutive Surgical which is the manufacturer of Da Vinci robotic system 98000 robot assisted prostatectomy surgery were performed in 2010. Robot assisted laparoscopic prostatectomy (RALP)replaces open prostatectomy in late 10 years because this operation provides good condition for tissue and nerve protection so relays much lower catecholamine levels. Blood loss and transfusion rate decreases, sexual and uriner functions stays protected.(7)

GENERAL CONSIDERATIONS IN ALL ROBOT ASSISTED SURGERIES

Selection of patients for robot assisted surgery is very important because clinical condition may not give permission for prolonged period in extreme position. For example significant cardiovascular comorbidity, cerebrovascular disease, poor pulmonary function, pulmonary hypertension and glaucoma are considered as independent risk factors for Robot assisted surgeries.(8)

Pre anesthetic evaluation is very important. Because the patients of this kind of surgery are approximately around 60 years aged optimization of cardiovascular, respiratory, metabolic and other systemic controls must be achieved clearly. Patients who has known airway difficulties might be some postoperative airway problems. Preexisting neurological deficits should be documented. In RALP surgery patients there is no clue for increased risk for ischaemic optic neuropathy but patients should be asked to an opthalmologist anyway.

Patients with significant cardiac disease should have further evaluation. Coronary artery disease patients who had stents should be concerned with cardiologist about antiplatelet and antithrombotic theraphy. One case of stent thrombosis during RALP has been reported whose antiplatelet theraphy has been stopped 7 days ago before surgery by his cardiologist. In these cases antiplatelet or antithrombotic therapy (replaced or stopped due to surgery) must be evaluated and started as soon as possible during perioperative period.(9)

Patients with severe chronic obstructive pulmonary disease should be consulted because of high airway peak pressures required intraoperatively. Patients who have bullous lung has contraindication due to rupture complication.

Severe hemorragies are hard to control in laparoscopic surgery . Patients who had abdominal surgery before the RALP operation may have critical adhesions in operation site so blood for transfusion should be available in every patient although it is rarely required.

Patient body mass index (BMI) is important because obesity is a significant concern. Obese patients may have difficult airway, higher incidence of cardiovascular , pulmonary diseases and diabetes mellitus.

ANESTHESIC CONCERNS

For anesthetic preparation; Electrocardiography (ECG), noninvasive blood pressure, pulse oximetry, end-tidal CO_2 and urine output is monitorized. Two wide intravascular cannulae with extension tubings should be placed to administer anesthetic drugs and fluids intraoperatively. Urine output can be unreliable in urinary tract procedures. A central venous catheter is placed for realisation for fluid balance for monitorization of central venous pressure (CVP). An arterial line must be conducted for continious monitorization of arteial pressure due to nature of surgery and the preoperative functional status of the patient. The patient should be well strapped to the table to prevent sliding after positioning. Table position should be done beforehand to check for any strain on monitoring cables, circuit and intravenous tubings. It is important to record the level of CVP and blood pressure after patient positioning. (9-11) A general anesthetic technique should be selected that takes into account the patient's history and comorbidities. An anesthetic with intravenous (IV) induction, maintenance with inhaled anesthetic agents, intermittent opioids and muscle relaxant is recommended. Muscle relaxation is especially important to prevent patient movement while the robot is docked to avoid accidental perforation of the myocardium, great vessels or other structures when the robot arms are engaged.

General anaesthesia and endotracheal entubation is needed due to pneumoperitoneum and steep Trendelenburg position . Anesthetic agent choice is dependent to patient' cardiovascular status and also presence of other co-morbidities. Since optimal pneumo peritoneum is needed muscle relaxation is essential for all intraoperative stage. Preoperative epidural catheterization for postoperative pain management may be beneficial but not a must for all cases. Standart monitorization is reliable and need for any additional monitors is dependent with the patient medical status.

Patients is placed in lithotomy position and arms preserved at the sides of table. Assistant surgeon places robotic arms and ports in sterile algorithm. Pneumoperitoneum is achieved and 35-45 degree Trendelenburg position is given to patient. The size and bulk of the robot over the patient and the significant draping on both the robot and patient make it difficult to access the patient intraoperatively. Anesthetic management

and access to patient may be a bit hard because of draping of patients. Entubation must be taken to hand very closely and secure airway must be provided by anesthesist. In adverse events some procedures require the patient's airway to be at a distance from the anesthesiologist and the anesthesia machine/monitor. Anesthesist must have all monitors and safety devices if necessary according to patient' medical status (defibrillator pad, Transesophageal echocardiography, Near infrared spectroscopy (NIRS), Bispectral index (BIS) in place before the Robot is conducted. Careful attention should also be given to prevent the robotic arms from injuring the patient. For example anesthetist should take his preventions against to brachial plexus injuries, ulnar neuropathies and lateral femoral cutaneous nevre injuries with shoulder braces, padded boot stirrups and other case specific support equipments. Cameras and light sources should never be kept directly on drapes or patient's skin.

Best mode of ventilation must be determined to achieve good gas exchange and respiratory mechanics. Barotrauma due to high peak inspiratory pressures (50-60 cm H_20) should be beared in mind in every stage of operation. Volume controlled ventilation may exceed some secure peak inspiratory pressures so pressure controlled but volume guaranteed modes can be applied to provide arterial CO_2 levels in reasonable state.

Achievement of fluid balance is a main point since excessive urine output might obscure operative field during vesicouretheral anastomosis. Since steep Trendelenburg position is prolonged , fluid restriction may decrease the incidence of laryngeal, pharyngeal and facial edema .But fluid restriction should not be aberrated. Anesthesist may also avoid postoperative oliguria.(12)

COMPLICATIONS AND MANAGEMENT STRATEGIES

Combination of pneumoperitoneum with steep and prolonged Trendelenburg position during RALP surgery may give rise cerebrovascular, respiratory, haemodynamic and hemostatic disorders.

Pneumoperitoneum inducing with CO_2 insufflation decreases blood flow to organs intraabdominal cavity by mechanical compression. In order to prevent adverse effects anesthetist should control insufflated gas pressure during operation time. RALP can cause many risk ranged from subcutaneous emphysema to ischemic optic neuropathy. (10,11)

Intra cranial pressure (ICP) increases during RALP procedure due to increased intraabdominal pressure that obstructs lumbar venous plexus venous return. Also Trendelenburg position increases ICP directly. Patients who had cerebrovascular ischemia or cerebrovascular disorders can develop severe complications result from both Trendelenburg position and pneumoperitoneum originated ICP increase. These may all give rise of detoriation of cerebral oxygenation . NIRS monitorization may be useful in these patients groups. Mechanical ventilation strategy should be registered as to preserve blood gases in normocapnic range so risk of increase in ICP is eliminated. (12,13)

Steep Trendelenburg position causes movement of abdominal structures into the thoracal space, diaphragm is pushed to cephalad way. In this manner functional reserve capacity is shrunked.(12,14) Compliance of lung is destorted and atelectasis risk increases. Pulmonary blood flow increases and mediastinal structures give rise this pressure increase in additional ways. Intraabdominal pressure is very important and should be kept 12-15 mmHg . Pneumoperitoneum always gives harm to respiratory mechanics.(15) Peak and plateau pressures should be stabilised in reasonable levels to prevent barotrauma but only to maintain a constant minute volume. Patel and colleaques reported that chest binding, steep 45 degree Trendelenburg position and high insufflation pressures decreases pulmonary compliance by %68 in their review referred to studies performed about 1500 RALP patients.(16)

D'Alonzo and his colleaques suggested only 800 ml up till the time surgeon completes vesicouretheral anastomosis and then infuse 700-1200 ml of fluid intravenously. This kind of strategies may keep on patient in good volume status.(17)

Hemodynamic effects can be arranged as increase in mean arterial pressure (MAP), systemic vascular resistance (SVR) during initiation of pneumoperitoneum, increased intraabdominal pressure compresses the aorta so afterload increases during RALP operations. . Cardiac output decreases but stays in reasonable levels in order to preserve optimal capacity but this balance can be destroyed in low cardiac reserved patients and can cause heart failure intraoperatively. Severe bradycardia has been reported in rare cases .(14,15)

Pneumoperitoneum causes subcutaneous emphysema (SCE) in about 0.3-3.9% cases. Risk factors for SCE are end tidal CO_2 levels overrides 50 mmHg, multiple operative ports, elongated operation times and old patients. SCE is usually an innocent complication but if SCE develops in prefascial planes it could be a messenger of a dangerous pneumothorax, pneumomediastinum and pneumopericardium. Patients who had a SCE complication must be followed in point of hypercarbia and clinician might keep the patient mechanically ventilated until hypercarbia is corrected so excessive increase in work of breathing is prevented.(13)

Also some authors reported venous gas embolism which has caused transient complete motor paralysis following RALP

surgery. Venous gas embolism may be a life threatening complication in some cases correlated with the size of the bubbles and the rate of their entry to circulation. Sudden cardiovascular collapse may occur with changes in caphnographic tracing. (8,17)

Anesthetic management of robotic surgery needs a serious attention in operation room recently there has been an increase in the number of adverse side effects reported from the use of the surgical robot systems including organ and blood vessel punctures, surgical burns and death.(18)

The robotic system provides many advantages: Three-dimensional vision, enhanced magnification, tremor filtering, motion scaling, the "endowrist" technology which helps in intracorporeal suturing and ergonomic comfort. It is important to assess true way according to patient's necessities and comorbidities for a surgeon. Anesthesiologist should control all perioperative period with great discipline. RALP is safe and effective procedure with excellent oncologic and functional results .

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