

Anesthetic Considerations in Patients Submitted to Assisted Robotic Surgery for Radical Prostatectomy: Case Report

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Abstract

Assisted robot surgery is a relatively new surgery as a procedure in our country. However, the procedures around the world are many especially in the first world where the experience is already great. The indications for performing this procedure have been extended, in terms of surgical specialties that can perform it, as well as the type of patient. Initially used in urological surgery, currently the assisted robot procedure is being used in minimally invasive thoracic surgery, oncological surgery and general surgery. It is therefore important to know the changes that these procedures cause in the anesthetized patient in order to successfully conduct the surgical anesthetic procedure. In the following article we present a case of assisted robot urological surgery (radical prostatectomy) and we review the anesthetic considerations for this type of procedures.

Keywords: *Pneumoperitoneum; Deep Trendelenburg; Volume-Controlled Ventilation; Pressure-Controlled Ventilation*

Abbreviations

VCV: Volume-Controlled Ventilation; VCP: Pressure Controlled Ventilation; PPEAK: Peak Inspiratory Pressure; PEEP: Positive Pressure at The End of Expiration; VRF: Functional Residual Volume

Introduction

With the introduction of new techniques and, therefore, technologies in the field of surgery, it is necessary for the anesthesiologist to know the physiological changes presented in patients in order to prevent complications and reduce hemodynamic changes that may occur during surgery intervention.

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From the first laparoscopic radical prostatectomy by Schuessler in 1991 and its subsequent development in the years 1997 - 1998 by Gaston, Guillonneau and Vallancien [1,2]. Thereafter, robotic techniques are increasingly being used for various urological procedures, including prostate resection, partial and total nephrectomy in addition to microsurgical procedures [1,2]. Assistance in urological procedures with robotic methods has increased significantly in recent years both in number and variety [3,4]. Radical robot-assisted prostatectomy has allowed urological surgeons to use a laparoscopic approach with more control and precision compared to open surgery, as it offers many advantages, including better visualization and more timely management of vessels and nerves [5].

Taking into account the new advances in technology that we have available, anesthetic considerations for various procedures are evolving which makes the anesthesiologist have to adapt and make modifications of specific techniques for these new surgical approaches. For this reason, we have decided to present the following case of assisted robot surgery for radical prostatectomy, and a review of the important anesthetic considerations for this type of surgery.

Case presentation

This is a 52-year-old male patient, with a diagnosis of prostate cancer programmed for radical assisted robot prostatectomy.

- **Family history:** No family history of cancer or chronic degenerative diseases. Pathological Personal.
- **Background:** The patient is diagnosed by prostate adenocarcinoma biopsy.
- **Surgical history:** Prostate biopsy under sedation, open right inguinal hernioplasty, tonsillectomy, colonoscopy polypectomy, without incidents or adverse events. Without current medication at the time of admission, refers allergy to piroxicam (presents rash / rash when consumed). Hematic biometrics, blood chemistry and coagulogram, which are normal and of no relevance to the current condition.

Physical examination

Blood pressure: 127/85 mmHg, FC 85 x', FR 20 x', temperature 36.0 ° C, size 172 cm, weight 85 kg, BMI 28.7 Kg / m2 with overweight. Alert, consciously oriented, with mobility of neck without alterations, Mallampati II, without deformities in facial massif with complete own denture, without beard. Normolynous thorax, auscultation without rales or wheezing, rhythmic heart sounds of good intensity and frequency. Abdomen with peristalsis present, masses are not palpated, or beats are perceived, right groin with surgical scar, genitals without alterations, upper and pelvic limbs without deformities or alterations apparent osteotendinous integer reflexes. Mini mental 30 points.

- **Assessment by internal medicine / cardiology:** Reported as: normal, ASA I Goldman II, without contraindication to the procedure.
- **Assessment anesthesiology / surgical anesthetic risk:** ASA II, Intermediate Cardiovascular Risk, Minor Mortality 5%, Cardiac Gupta: 0.04%.

2 Globular Packages, 2 Fresh Frozen Plasmas are prepared for the procedure. The patient is admitted 24 hours before the procedure and the nurse is requested to be admitted with two 18G peripheral catheters on each hand, with 1000 ml Hartmann solutions to maintain a permeable vein at 60ml / hr; Start with antibiotic Cefuroxime 750mg 1 hour before entering the operating room, TED stockings and fasting after 22hrs.

Anesthetic Plan: Under informed consent, the patient is told balanced general anesthesia plus intravenous and oral postoperative analgesia according to their own characteristics for the weight, size and available drugs.

Process

The CJC patient is admitted to the operating room, alert, conscious, oriented, monitored by electrocardiogram, non-invasive blood pressure in the upper left limb, pulse oximeter in the index finger of the right hand and a foley catheter for urinary expenditure. In the supine position, its vital signs are taken at admission: TA 140/80 mmHg, FC 85 x', SaTO2 98%. Anesthetic induction is initiated with FIO2 100% flow at 5lt / min, intravenous midazolam 3mg IV, fentanyl 200 mcg IV, propofol 100mg IV, and rocuronium 50 mg IV. The patient was intubated with a 4-leaf curing laryngoscope video with C-MAC at the first attempt with endotracheal tube 8.0, balloon with 5cc of air, with a distance of 21cm to the lips, mechanical ventilation is initiated in asystocontrol managed by volume 500ml of tidal volume, respiratory rate 15 per minute inspiration / expiration ratio 1: 2, PEEP 5 cmH2O. The patient is placed in Trendelemburg at 45 degrees. Maintenance with 2% sevorane (CAM 1.0) plus 650mcg fentanyl in continuous infusion at 2mcg / kg / hr supplemented with rocuronium in boluses (50mg + 50mg every hour) for a total of 100mg I.V. Initial entropy 100/100, maintenance in 40/40. Adjuvants are added: antibiotic Cefuroxime 750mg IV one hour before starting the procedure, dexamethasone 16mg IV, Ondansetron 8mg IV, Parecoxib 40mg IV, Etamsilate 500 mg IV, furosemide 20mg IV.

- **Transoperative water balance:** Total income: 2,000ml of Hartmann-type crystalloid solution, Total Expenditures: 2,140ml, Total Bleeding: 100ml. Blood products were not used. Total negative balance -140ml.
- **Emersion:** The position of Trendelemburg is changed to supine position. Muscle relaxant is reversed with sugammadex 400mg IV, gradual halogenated lysis, oropharynx is aspirated and extubated without complications after onset of spontaneous breathing, entropy in 90/90 vital signs at discharge TA 130/80 mmHg, FC 70x', SatO2 97% with nasal tips, Aldrete de 9, EVA 0/10, Ramsay II. Go to the post-surgical recovery room without complications.
- **Anesthetic time:** 3 hours. Surgical Time: 2hrs. Robot Assembly and Placement Time: 1 hour. Total Anesthetic-Surgical Time 3hrs.
- **Postoperative analgesia:** Paracetamol 1 gram IV every 8 hours plus Parecoxib 40mg IV every 24 hours. Rescue is also added in case of VAS greater than 4 of 2.5mg IV morphine administered by nurse on the floor. Hospital discharge at home 48 hours after the procedure without complications or incidents.

Anesthetic considerations for assisted robot surgery

Critical problems during the robotic procedure include the reverse Trendelenburg position, pneumoperitoneum, prolonged hypothermia in the room without sufficient external heaters, restricted venous access due to the position of the patient and the robot, gas embolism and subcutaneous emphysema, are key factors that the anesthesiologist must take into account [5,6]. The robotic surgical system commonly consists of a master console, surgical ports and a computerized viewing tower [5,6]. The operating room itself must be large enough not only to accommodate all the equipment and personnel involved, but also to provide adequate space for the movement and storage of these components [5,6].

This issue of room space is particularly important in case emergency access to the patient is required [5,6]. Cardiopulmonary resuscitation would be difficult, if not impossible, with the robot hooked. Once the robotic surgical manipulator is attached, the position of the operating table cannot be adjusted unless the robot is dismantled and removed [6]. The separation of the robot components is a multi-stage process, which if done correctly, can be completed in no more than 1 minute [5,6].

Patient position

The patient's position is the most critical part of the procedure. The placement of the arms in adduction and the flexion and abduction of the legs for prolonged periods can lead to significant physiological consequences [7,8]. The deep Trendelenburg position between 25 to 45° for a prolonged period of time, can lead cerebral edema due to the increase in intracranial pressure and the decrease in venous

return [7,8]. It is worth mentioning that the most vulnerable systems to the extreme head down position are the nervous, cardiac and respiratory [7,8]. Regarding the central nervous system, the position of deep Trendelenburg has caused in some patient's transient post-operative blindness due to cerebral edema and cranial nerves, especially those in brain and nerve areas related to vision due to increased intraocular pressure [9]. It should not be forgotten that prolonged lithotomy positions plus deep Trendelenburg are also related to partial and permanent peripheral nerve lesions [9].

Pneumoperitoneum and respiratory function

Maintaining adequate ventilation represents a great challenge for anesthetic management, this due to several factors among which are increased intra-abdominal pressure, pneumoperitoneum and patient position, changes in pulmonary physiology are difficult to predict requiring taking fast decisions in order to prevent alterations in blood gases [10]. The placement of the endotracheal tube as the beginning of the management of respiratory function must be taken into account precisely since anatomical changes have been observed during the presence of the pneumoperitoneum, where the distance of the vocal cords to the carina is reduced up to 1 cm during the trans-surgical process [11]. During pneumoperitoneum, large amounts of insufflated gas are absorbed through the peritoneal surface, as this CO₂ cannot be excreted, it causes an increase in ventilation per minute in the patient and as a consequence respiratory acidosis, in addition to lung volumes and capacities they are reduced by 50% [12,13]. This coupled with the increase in changes in maximum inspiratory pressure, plateau pressure in addition to exhaled carbon dioxide concentrations [12,13]. During anesthesia, loss of muscle tone combined with increased pressure in the peritoneal cavity, significantly reduce Functional Residual Volume (VRF), also alters the perfusion ventilation ratio, increasing the risk of atelectasis and hypoxemia. These effects can be quickly installed and maintained for several hours after the surgical procedure [14,15].

The Positive Pressure at the End of Expiration (PEEP) is used in patients under mechanical ventilation undergoing surgical procedures as a preventive maneuver in the formation of atelectasis, as well as to improve oxygenation levels [15-17].

On the most suitable types of ventilation for robotic surgery, the studies carried out are scarce, however it has been observed that both volume controlled ventilation (VCV) and pressure controlled ventilation (PCV) can be used without problems using the same tidal volume, although it has been seen that in the case of PCV, greater compliance and preservation of the ventilation-perfusion relationship is provided, reflected in an adequate minute volume compared to VCV in a series of 80 patients [9,18]. Using the VCV mode, the use of the 1:1 inspiration-expiration ratio is suggested as the peak pressure (P_{Peak}) decreases without hemodynamic instability during pneumoperitoneum [19]. This relationship should be used with caution because it is not recommended at all in obese patients or cardiovascular diseases [19].

In another series that included 50 patients, it was observed that patients with a high body mass index had a higher risk of presenting respiratory complications since they presented an increase in pressure on the airway plateau and a greater decrease in lung distensibility, in addition He observed that these values did not return to normal baseline values even after the withdrawal of pneumoperitoneum, which meant difficulties for postoperative management [12,20]. Although the procedure per se can present important changes in the physiology of the patient as we have highlighted, it is noteworthy that the presence of co-morbidities is not considered a contraindication for performing the procedure, and in those who will have to perform more studies for the appropriate treatment in the management of respiratory function [12,20].

In order to assist in an improvement in ventilation, anesthesia combined with thoracic epidural block have been carried out, which has allowed observing the decrease in P_{peak}, as well as an increase in the greater expiratory tidal volume, decrease in arterial lactate and better oxygenation by quantification of arterial gases [21].

Cardiovascular effects

The increase in intra-abdominal pressure, the position of Trendelenburg or deep Trendelenburg, and the anesthetic effects produce important pathophysiological changes, although they are well tolerated in minimally invasive surgery, they can lead to increases in morbidity and mortality in patients with limited cardiopulmonary reserve [22,23]. Among the best known within the changes produced by pneumoperitoneum, is the increase in mean arterial pressure (MAP), increase in systemic vascular resistance (SVR) and pulmonary (RVP). On the other hand, changes in position, mainly in deep Trendelenburg, have been associated with decreased right atrial pressure and preload. Both factors as well as those attributed to anesthesia have been shown to alter the cardiac index by up to 50% [22,23]. With the rapid increase in pneumoperitoneum, immediate gas embolism can occur and, in very rare cases, can cause severe cardiovascular failure and death [24].

Liquid handling

Relatively long surgical times, deep Trendelenburg position and pneumoperitoneum can make fluid administration a complex issue [25,26]. Due to gravitational effect, facial, pharyngeal, and / or laryngeal edema may occur, emphasizing during the post-extubation period, since these factors can influence in one way or another, can generate a compromise in the post-surgical ventilatory mechanics that merits emergency measures [25,26]. For these reasons, some centers specialized in the routine use of assisted robot surgeries have recommended keeping perioperative fluids restrictively, with an approximate < 2 L of crystalloids [25,26]. However, the postoperative effects of a restrictive therapy should be taken into account, even in conventional laparoscopic surgeries, renal plasma flow and glomerular filtration rate may decrease, in some cases presenting oliguria in this type of minimally invasive interventions [27,28].

Relative volume depletion in these patients after surgery often requires liquid boluses to support not only urine production but also the maintenance of normal hemodynamic parameters [27,28]. Therefore, a strategy should be included in the management of liquids carefully to ensure adequate renal function and volume status for urological patients [6].

Discussion and Conclusions

Robot assisted surgery initially begins with its use in urological surgery [1-3]. Currently its use and surgical criteria have been extended to address the patient by these methods. The ease of controlling the fine movements of surgeons combined with the better visualization of the structures makes this procedure greatly improve surgical times, thus reducing the morbidity of the patient. However, the procedure is not risk-free and anesthetic considerations are precise [5,6]. Of special interest to the anesthesiologist, it is to know beforehand after a good preanesthetic evaluation the conditions in which the patient arrives and as well as his comorbidities to be able to have an adequate work plan for the procedure. Once knowing our patient comes into play knowing the approach of assisted robot surgery. Very particularly in urological, pelvic or lower abdomen procedures the position of deep or exaggerated Trendelenburg implies many cardiopulmonary physiological changes that totally change the patient's status quo. Of special interest is the management of mechanical ventilation as well as the airway when the position is prolonged for several hours and the possible complications that may occur at the time of the patient's emersion or extubation.

The future of surgery is on this path, and it is our responsibility to learn more about the precise anesthetic considerations for these new approaches and those that have been added (thoracic, oncological, general surgery). Finally, we show the way in which the case finely selected for the surgery type, allowed the group of anesthesiologists to conduct the anesthetic procedure for this assisted radical robot prostatectomy, which had less bleeding and surgical time resulting in a procedure where the patient did not present complications cardiopulmonary or any other type. It remains on the horizon, to continue publishing in this environment in our country since assisted robot surgery is a reality, and we hope to contribute with comparative and observational studies in the future once the volume of procedures is sufficient to generate robust scientific evidence.

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