Anesthesia management for robotic assisted radical prostatectomy.

Single center experince

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AIM: *The aim of this study was to present our experiences for anesthesia management in patients undergoing robot-assisted radical prostatectomy (RARP) in light of current literature data.*
MATERIAL AND METHODS: *This clinical retrospective study included 103 patients who underwent robot-assisted radical prostatectomy. All patient data were obtained from the patient files and anesthesia follow-up forms. Demographic datas, intraoperative fluids, blood products requirement and blood gas parameters were recorded.*
RESULTS: *A total 15 of 103 patients data were lack, the remaining 88 patients were evaluated. Combination of crystalloid and colloid was used for intravenous fluid management. About 11% of patients required transfusion during surgery. The mean pH and pO_2 values of the patients were observed to decrease whereas pCO_2 and lactate values increased.*
DISCUSSION: *Radical Prostatectomy can be performed either using open technique as a traditional approach or laparoscopic or robot-assisted technique as a minimally invasive approach. Today, minimally invasive approaches have replaced traditional open prostatectomy. Anaesthesia management of these minimally invasive techniques is very different and challenging from open technique in many aspects.*
CONCLUSION: *Although minimally invasive techniques have good surgical outcomes such as less blood loss, smaller surgical incision, and shorter hospitalization, these techniques bring new problems that anesthesiologists have to deal with. Increased RARP operations has led to the anesthesiologists more likely to encounter perioperative problems.*

KEY WORDS: Anesthesia, Minimally invasive techniques, Radical prostatectomy

Introduction

There are different treatment options for localized prostate cancer (PCa), but radical prostatectomy is accepted as the standard treatment approach[1]. Radical prostatectomy can be performed either using open technique as a traditional approach or laparoscopic or robot-assisted technique as a minimally invasive approach. Today, minimally invasive approaches have replaced traditional open prostatectomy in PCa surgery due to undesirable consequences of the open technique such as higher rates of incontinence, impotence, and excessive blood loss[2]. Since the anaesthesia management of robotic assisted radical prostatectomy (RARP) is very different and challenging from open technique in many aspects, the anesthesiologists had to change their approaches. The major concerns regarding anaesthesia management include the long-term struggle with the physiological effects of extreme Trendelenburg position and pneumoperitoneum and restricted access to the patient during surgery[3].

The aim of this study was to present our experiences for anesthesia management in patients undergoing RARP in light of current literature data.

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Material and Methods

The current study included 103 patients who underwent RARP between January 2018 and September 2019. Ethical approval was obtained from the Institutional Ethical Committee (2019/15-19/346). All patient data were obtained from the patient files and anesthesia follow-up forms.

Following the routine preoperative anesthetic evaluation for the comorbidities, all RARP operations were performed under general anesthesia. In accordance with the American Society of Anesthesiologists (ASA) standards, electrocardiogram, pulse oximetry, and noninvasive arterial pressure monitoring were performed for the patients taken to the operating theatre. After cleaning the patient's forehead with alcohol-soaked cotton, two near-infrared spectroscopy (NIRS) probes were placed. After 16 or 18 GA intravenous cannula was placed, general anesthesia was induced with 1-2 mg/kg propofol, 1-2 mcg/kg fentanyl and 0.5 mg/kg rocuronium. Following endotracheal intubation, radial artery cannulation was performed from the non-dominant arm and invasive blood pressure monitoring was initiated. Furthermore, nasogastric tube was placed to prevent gastric distension. An oropharyngeal heat probe was placed for monitoring the body temperature during the operation. Ultrasound-guided right internal jugular vein cannulation was performed for all patients to monitor central venous pressure. Anesthesia was maintained with 1-2% sevoflurane in an air/oxygen mixture and 0.1-0.2 mcg/kg/min remifentanil infusion. Endotracheal tube (ETT) positions of all patients were re-checked through bronchoscopy when the patients were in the Trendelenburg position before docking. During the operation, 0.5 mg/kg rocuronium bolus doses were administered intermittently to prevent involuntary movement of the patients. Patients were placed in lithotomy position using boot-type stirrups. Both arms of the patients were tucked to prevent them from falling off the operating table with the help of a drape covering the arms and extending towards the bottom of the patient. In the Trendelenburg position, standard shoulder braces were placed to prevent patients from sliding. Gel pads were used to keep the head steady in the midline position. In the lithotomy position, the first pneumoperitoneum was performed while CO_2 insufflation was allowed to be performed at a pressure of 20 mmHg. However, the pressure was decreased to 12-15 mmHg after the patient was placed in Trendelenburg position at 30 degrees. At the end of the operation, the patients were intubated with remifentanil infusion and were transferred to the intensive care unit (ICU). The patients who were actively heated in the ICU were extubated when they were hemodynamically stable and their body temperature reached the normal range. Postoperative analgesia was provided by intravenous bolus morphine after skin sutures were placed in the operating theater and by continuing morphine infusion until the patients were extubated, starting after transfer to the ICU.

Statistical Package for the Social Sciences (SPSS) version 22.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Descriptive data were given as number, percentage and mean ± standard deviation. The Kolmogorov-Smirnov test was used to determine the normal distribution. Dependent sample t-test was used to compare the mean values of variables in two groups, and Chi-Square test was used to compare categorical data.

Results

A total of 103 patients underwent RARP in our clinic over a two-year period included to the study. 15 of them were excluded due to the lack of information. The data of the remaining 88 patients were evaluated. Demographic data are summarized in Table I.

Combination of crystalloid and colloid was used for intravenous fluid management. The distribution of intraoperative fluids and blood products is given in Table II. Of the 10 patients who needed blood products, seven received 1 unit of red blood cell concentration (RBC) and 1 unit of fresh frozen plasma (FFP) infusion, one received 2 units of RBC and 2 units of FFP, one received 2 units of RBC and 1 unit of FFP, and one received only 1 unit RBC.

The blood gases taken during arterial cannulation after anesthesia induction were compared with those obtained immediately after the patients were taken to ICU (Table III). The mean pH and pO_2 values of the patients were

Table I - *Patient characteristics and demographic data.*

Variables		Mean±SD or N(%)
Age (years)		63.59±5.98
Height (cm)		169.76±6.17
Weight (kg)		80±10.60
ASA n (%)	I	25 (28.4)
	II	56 (63.6)
	III	7 (8)
Anesthesia Time (min)		372.78±61.66

ASA: American Society of Anesthesiologists

Table II

Variables	Mean±SD or N(%)
Crystalloid infusion (mL)	2284.09±1002.29
Kolloid infusion (mL)	579.55±198.94
Blood Transfusion n (%)	10(11.3)
RBC n (%)	10(11.3)
FFP n (%)	9(10.2)

RBC: red blood cell, FFP: fresh frozen plasma

TABLE III - *The blood gas analysis.*

Variables	Initial ABG Mean±SD	ABG in ICU Mean±SD	p value
pH	7.38±0.5	7.30±0.7	<0.05
pO_2	190.73±89.19	156.40±54.84	<0.05
pCO_2	37.92±5.87	41.62±8.40	<0.05
Hemoglobin	14.87±1.64	13.92±1.63	<0.05
Hematocrit	45.57±4.93	42.76±4.91	<0.05
Lactate	1.16±0.48	2.02±1.36	<0.05

ABS: Arterial blood gas ICU: intensive care unit

observed to decrease whereas pCO_2 and lactate values increased. Although about 11% of patients required transfusion during surgery, their hemoglobin and hematocrit values were found to be significantly lower.

The mean body temperatures of the patients who were intubated and taken to the ICU were 34.25 ± 0.81. The mean extubation time was 200.74 ± 58.85 minutes after admission to the ICU.

Discussion

In this study we presented our experience of RARP anaesthesia management over a two-year period. We discussed the perioperative anesthesia management, measures taken for possible problems, and issues to be considered in patients that underwent RARP operations. Although minimally invasive techniques have good surgical outcomes such as less blood loss, smaller surgical incision, and shorter hospitalization, these techniques bring new problems that anesthesiologists have to deal with. These problems can be listed as physiological changes due to prolonged Trendelenburg position and pneumoperitoneum, nerve damage due to patient positioning, restricted access to the patient, and difficulties in providing ventilation.

Prolonged pneumoperitoneum and extreme Trendelenburg positioning reduce the venous return from the head region, resulting in increased intracranial pressure and laryngeal edema[4]. Increased intracranial pressure may lead to cerebral edema, potentially reduce brain perfusion and therefore, can impair cerebral oxygenation[5]. However, Closhen et al. performed cerebral oxygenation measurements using two different near-infrared spectroscopy (NIRS) devices in patients undergoing RARP and reported that cerebral oxygen saturation decreased by less than 5% and this rate was acceptable[6]. We similarly monitored the cerebral oxygen saturation of all our patients during operation by placing NIRS probes before anesthesia induction, and we did not notice a significant decrease in intraoperative NIRS values in any of our patients. However, we could not make any inferences in terms of NIRS values and postoperative results since we did not perform any mental state test preoperatively.

Another problem that occurs due to the prolonged pneumoperitoneum and Trendelenburg position combination that needs to be overcome is to provide adequate ventilation during surgery. Together with the increased intraabdominal pressure, the upside-down position causes the diaphragm to displace towards the cephalic region and a decrease in functional residual capacity and pulmonary compliance[7,8]. Pulmonary end-expiratory pressure (PEEP) is a common ventilation strategy used to cope with this situation at the present time[9]. Furthermore, studies investigating the effects of volume-controlled and pressure-controlled ventilation modes on respiratory mechanics have shown that these two modes are not superior to each other[10,11]. In the present study, we used volume-controlled ventilation mode with 5 cm H_2O PEEP in all of our patients. We adjusted the tidal volume to keep the end-tidal CO_2 level at 35–40 mmHg. However, we changed the inspiration/expiration (I/E) ratio by decreasing the tidal volume and increasing the frequency to prevent the excessive increase in peak-inspiratory pressure and allowed some hypercarbia in some patients. When the blood gases collected at the ICU were examined, pO_2 levels of our patients were found to be lower than the input blood gases whereas pCO_2 levels were higher. Although this was statistically significant, it did not indicate a physiological pathological condition. We believe that changes in pH and lactate values may be due to the fluids given during surgery, blood loss, and hypothermia.

Laryngeal edema may occur due to decreased venous return and can be a life-threatening condition in the early postoperative period, with an incidence reported to be 0.7% [12-14]. The presence of facial edema or conjunctival edema at the end of the operation may be an indicator in this regard[4]. Phong et al. reported that the presence of laryngeal edema can be identified via the ETT cuff leak test before extubation and that keeping ETT cuff pressure below 30 cmH_2O may reduce the risk of laryngeal edema[13]. Moreover, such patients are more likely to experience hypothermia due to prolonged operative duration and fluids given during the operation. In the present study, all patients were intubated before being transferred into the ICU due to the risk of prolonged extreme Trendelenburg positioning-induced laryngeal edema and the risk of re-intubation due to prolonged action of anesthetic agents because of hypothermia. Here, patients were extubated when adequate recovery was achieved after active heating and ETT cuff leak test was performed. None of our patients experienced respiratory distress that could require re-intubation in the early postoperative period thanks to this approach.

Another problem that may be encountered in terms of respiration is the displacement of ETT from the trachea into the bronchi after the Trendelenburg position. This may result in atelectasis and hypoxemia if not noticed in the early period in particular. In our study, bronchoscopic control was performed after the patient positioning. This control revealed ETT displacement to the right bronchi in three patients. Therefore, we strongly recommend that the ETT position should be confirmed via auscultation or bronchoscopy after the Trendelenburg position since the access to the patient is restricted after docking.

Regardless of how well the perioperative period is managed by the anesthesiologist and surgeon, postoperative neuropathies are the most important problems that may overshadow this success. Since RARP operations require prolonged Trendelenburg and lithotomy positions, they are surgical interventions that may pose a risk for the development of neuropathy. Common peroneal, lateral femoral cutaneous and obturator nerves are frequently affected by the lithotomy position[15]. During extreme Trendelenburg position, brachial plexus may be crushed between the first rib and the collarbone[16]. In the present study, extreme lithotomy position was avoided to prevent the development of such neuropathies. Furthermore, shoulder braces were placed so that the patient's head was fixed in the midline and the arms were tucked securely in adduction after being covered with a drape carefully.

The main limitation of the study was retrospective design. Another limitation was since we did not perform any mental state test preoperatively, we could not make any inferences in terms of NIRS values in postoperative period.

Conclusion

Increased RARP operations has led to the conclusion that anesthetists will be more likely to encounter perioperative problems in these cases. Therefore, the pathophysiological changes that may occur due to prolonged Trendelenburg and lithotomy positions, neuropathies that may occur depending on the position, and hemodynamic effects should be well known and recognized in the early period and preventive measures should be developed in this regard.

Riassunto

La prostatectomia radicale può essere eseguita utilizzando la tecnica a “cielo aperto” come approccio tradizionale o la tecnica laparoscopica o robot-assistita come approccio minimamente invasivo. Oggi, gli approcci minimamente invasivi hanno sostituito la tradizionale prostatectomia a “cielo aperto”. La gestione dell'anestesia di queste tecniche minimamente invasive è molto diversa e impegnativa rispetto alla tecnica a “cielo aperto” sotto molti aspetti.

Lo scopo di questo studio è quello di presentare le nostre esperienze sulla gestione dell'anestesia in pazienti sottoposti a prostatectomia radicale robot-assistita (RARP) e confrontarla con i dati attuali della letteratura.

Si tratta di uno studio clinico retrospettivo che comprende 103 pazienti sottoposti a prostatectomia radicale robot-assistita. Tutti i dati dei pazienti sono stati ottenuti dalle cartelle cliniche dei pazienti e dai moduli di follow-up sull'anestesia. Sono stati registrati dati demografici, infusione di liquidi intraoperatoriamente, fabbisogno di derivati del sangue e parametri dell'rmogasanalisi.

Mancano i dati di 15 sul totale di 103 pazienti, e la valutazione è stata fatta sui restanti 88 pazienti. Una combinazione di cristalloidi e colloidi è stata utilizzata per l'infusione endovenosa intraoperatoria. Circa l'11% dei pazienti ha richiesto trasfusioni durante l'intervento chirurgico. È stato osservato che i valori medi di pH e pO_2 dei pazienti diminuivano mentre aumentavano quelli della pCO_2 e del lattato.

Sebbene le tecniche minimamente invasive abbiano buoni esiti chirurgici come una minore perdita di sangue, una più piccola incisione chirurgica e un ricovero più breve, queste tecniche portano nuovi problemi che gli anestesisti devono affrontare. L'aumento delle operazioni RARP ha portato gli anestesisti ad avere maggiori probabilità di incontrare problemi perioperatori.

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