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Characteristics of patients undergoing robotic-assisted prostatectomy. Observational study

Características de pacientes sometidos a prostatectomía robótica. Estudio observacional

Guillermo Madrid[a,c,d]; Enrique Arango[a,c,d]; Leopoldo Ferrer[c,d]; Roberto Murillo[a,c,d]; Oswaldo Amaya[a,c,d]; Juan Cortés[a]; María Solórzano[a]; Luis Eduardo Ramírez[c]; Claudia Ariza[d]; María Camila Montoya[a]; Felipe Gómez[b]; Juan Ignacio Caicedo[b,d]; Fernando Raffán-Sanabria[a,c,d], Jairo Moyano[a,c,d]

[a] Anesthesia Department, Fundación Santa Fe de Bogotá. Bogotá, Colombia.
[b] Urology Department, Fundación Santa Fe de Bogotá. Bogotá, Colombia.
[c] School of Medicine, Universidad El Bosque. Bogotá, Colombia.
[d] School of Medicine, Universidad de los Andes. Bogotá, Colombia.

Correspondence: Departamento de Anestesia, Fundación Santa Fe de Bogotá, Carrera 7 # 117-15, Bogotá, Colombia.
E-mail: gamanesthesia@gmail.com

What do we know about this problem?

· Prostatectomy is the standard treatment for localized prostate cancer.
· Robot-assisted radical prostatectomy offers advantages such as less intraoperative bleeding, improved pain control and shorter hospital length of stay.
· This approach creates hemodynamic alterations in the patient and poses challenges for anesthetic management.

What is new in this study?

· It describes the experience of a center with an internationally accredited program for robot-assisted radical prostatectomy.
· It documents a low frequency of early perioperative complications related to the procedure.

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Abstract

Introduction

Prostatectomy is the standard treatment for patients with clinically localized prostate cancer. Currently, robot-assisted radical prostatectomy (RARP) is widely used for its advantages, as it provides better visualization, precision, and reduced tissue manipulation. However, RARP requires a multidisciplinary approach in which anesthesia and analgesia management are especially important.

Objective

This study aims to describe our experience delivering anesthesia for the first cases of patients undergoing RARP in a teaching hospital in Bogotá, Colombia.

Methodology

An observational study was conducted. We included all patients undergoing RARP from September 2015 to December 2019 at Fundación Santa Fe de Bogotá. All patients with incomplete data were excluded. Patient demographics were recorded, and significant perioperative events were reviewed.

Results

A total of 301 patients were included. At our institution, the mean age for patients undergoing RARP was 61.4 ± 6.7 years. The mean operative time was 205 ± 43 min and mean blood loss was 300 [200-400] mL. Only 6 (2%) patients required transfusion. Age and BMI were not associated with clinical outcomes.

Conclusions

An adequate perioperative approach in RARP is important to minimize complications, which in this study and in this institution were infrequent.

Keywords

General anesthesia; Analgesia; Prostatectomy; Robotic surgical procedure; Minimally invasive surgery.

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Resumen

Introducción

La prostatectomía es el tratamiento estándar para pacientes con cáncer de próstata localizado. Actualmente, la prostatectomía radical asistida por robot es ampliamente utilizada por sus ventajas en visualización, precisión y manipulación de los tejidos. Sin embargo, este abordaje requiere un manejo multidisciplinario, pues el enfoque analgésico y anestésico es fundamental para optimizar los desenlaces.

Objetivo

Describir los primeros casos de prostatectomía radical asistida por robot realizadas en un hospital universitario de cuarto nivel en Bogotá, Colombia.

Metodología

Estudio observacional en el cual se incluyeron todos los pacientes sometidos a prostatectomía radical asistida por robot (PRAR) en el hospital Fundación Santa Fe de Bogotá entre septiembre de 2015 y diciembre de 2019. Se excluyeron los pacientes con historia clínica incompleta. Se registraron los datos demográficos y se revisaron los eventos perioperatorios importantes.

Resultados

Se analizaron 301 pacientes. La edad media de pacientes sometidos a PRAR fue 61,4 ± 6,7 años. El tiempo quirúrgico promedio fue 205 ± 43 minutos y la pérdida sanguínea media fue 300 [200-400] mL. Solo 6 pacientes (2 %) requirieron transfusión. La edad y el IMC no mostraron una asociación relevante con los desenlaces clínicos.

Conclusiones

El adecuado abordaje perioperatorio en PRAR es importante para minimizar las complicaciones, las cuales en este estudio y en esta institución fueron infrecuentes.

Palabras clave

Anestesia general; Analgesia; Prostatectomía; Cirugía robótica; Cirugía mínimamente invasiva.

INTRODUCTION

Prostate cancer is the most frequent male neoplasm in the world. In Colombia, it is the cancer with the highest incidence and the second cause of mortality in men (1,2). Prostatectomy is currently the standard of care in localized cancer.

Since the introduction of robot-assisted radical prostatectomy (RARP) early in this century, its use has been growing as it offers advantages such as less intraoperative bleeding, improved pain control and shorter hospital length of stay (3). On the other hand, surgeons report enhanced operative field visualization, improved movement accuracy and greater comfort.

RARP creates certain challenges for the anesthetist, such as limited access to the patient because of the location of the robot, extreme Trendelenburg and lithotomy positions, CO_2 insufflation in the cavity, intraoperative fluid management and the use of multimodal analgesia (3,4). These characteristics may give rise to hemodynamic alterations, lung volume restriction, reduced compliance, hypercapnia from CO_2 uptake, increase in intracranial pressure, and peripheral neuropathy, among others (5,6). For this reason, familiarity with these changes is of paramount importance in order to create strategies to optimize comprehensive patient management.

In Colombia, the availability of this technology is limited due to high associated costs. The Fundación Santa Fe de Bogotá University Hospital is one of the few centers in the country that offers this approach. The robot-assisted surgery program was set up in this institution in 2015 and has received international accreditation. Close to 300 RARP interventions have been performed in the past four years. The main objective of this paper is to describe our experience. Moreover, it represents one of the first observational registries on this topic in Colombia.

METHODOLOGY

Observational study that included all patients undergoing RARP between September 2015 and December 20198 in a Level IV university hospital in Bogotá, Colombia. Patients with incomplete data in the clinical record regarding perioperative medical management were excluded. Data were taken from the digital clinical records included in a database to which only the researchers gained access. Demographic data and details on the perioperative management were collected. Approval was obtained from the institutional Research Ethics Committee (Resolution CCEI-7202-2017) in April 2017. This study was conducted in strict compliance with the Declaration of Helsinki.

In accordance with the policy statement of the Anesthesia Department, all patients had a preanesthesia assessment that documented age, history of disease

conditions, allergies and medication use. On physical examination, airway characteristics, weight, height, body mass index (BMI) and vital signs were assessed. Airway assessment was based on the Mallampati scale and other difficult airway predictors such as thyro-mental distance, protruding incisors, mouth opening, cervical mobility and neck circumference. Probable difficult airway was considered to exist if 1 or more predictors were present.

Perioperative management

Patients were treated by the Urology Department of Fundación Santa Fe de Bogotá University Hospital, a multidisciplinary team with international accreditation. Anesthesia was administered in accordance with the protocols of the Anesthesia Department, developed on the basis of the best available evidence.

After checking the robot, the patients were brought to the operating room where the clinical record, personal history, blood group and antibody test results were again reviewed. All patients received general anesthesia with basic monitoring (pulse oximetry, blood pressure, electrocardiogram, temperature and capnography), muscle relaxation monitoring (TOF) and depth of anesthesia with bispectral index (BIS). For anesthesia induction, propofol and a neuromuscular relaxant (rocuronium or cisatracurium) were used, the latter to maintain a TOF < 25% of the last twitch. The anesthetic technique, either total intravenous anesthesia (TIVA) or balanced anesthesia, was left to the discretion of the anesthetist to maintain the BIS between 40 and 60. Dexamethasone and/or ondansetron were used as antiemetics. Transition opioids were given 20-30 minutes before extubation (morphine, oxycodone and hydromorphone at equipotent doses). The anesthetist was free to choose other adjunct medications (lidocaine, ketamine, dexmedetomidine). Patients were transferred to the post-anesthesia care unit for nursing and anesthesiology monitoring. The decision to transfer patients to the ward was made by the treating anesthetist based on the Aldrete scale.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 25.0 was used for the statistical analysis. A univariate analysis was performed to describe the main characteristics of the patients. Normality was evaluated using the Shapiro-Wilk test, as needed. Continuous variables are presented as central trend and as scatter measurements, while qualitative variables are presented as absolute and relative frequencies. For the analysis, patients were divided into two groups, by age (≤60 and >60 years), given that it has been found that the risk of prostate cancer increases and patient prognosis is worse after 60 years of age (7). Likewise, they were divided into four groups according to body mass index: low weight (<18.5 kg/m2), normal (18.5-24.9 kg/m2), overweight (24.9-29.9 kg/m2) and obese (≥30 kg/m2).

A bivariate analysis was performed using the Chi-square, exact Fisher, Mann-Whitney and Student T tests, in accordance with the characteristics of contrasting variables, in order to explore associations between exposures and clinical outcomes. These analyses were intended to be exploratory only. A significance lower than 5% ($p<0.05$) was considered relevant.

RESULTS

Overall, 301 patients undergoing RARP were identified, and no patient was excluded.

Pre-anesthesia assessment

Patient mean age was 61.4 years, with a standard deviation of 6.7. All the patients were classified as ASA III because of their oncologic condition. Likewise, all patients had an intermediate surgical risk (cardiac risk <5%). The most frequent comorbidities were arterial hypertension, diabetes, dyslipidemia and gastroesophageal reflux, and 60.8% of patients had at least one of those comorbidities, although none exhibited decompensation. For that reason, there was no need to reschedule any surgery, and a very low percentage required additional assessment by a different specialty. The demographic data and the clinical characteristics of the patients are shown in Table 1.

Intraoperative management

The anesthetic technique used most often was balanced general anesthesia (78.7%)

Table 1. Characteristics of the pre-anesthesia assessment.

Variable	Total
Age (years)	61.4 ± 6.7
Age	
≤60 years	124
>60 years	177
BMI	
Low weight	1 (0.3)
Normal	119 (39.5)
Overweight	138 (45.8)
Obesity	43 (14.3)
Comorbidities	183 (60.8)
Mallampati	
1	149 (51)
2	109 (37.3)
3	33 (11.3)
4	1 (0.3)
Dental prosthesis	83 (28.2)
Difficult airway signs	56 (19)

Data are shown as *n* (%), mean ± SD.

BMI: Body Mass Index.

Source: Authors.

Table 2. General intra-operative management considerations.

Variable	Total
Anesthetic technique	
Balanced	237 (78.7)
TIVA	64 (21.3)
Airway management	
Direct laryngoscopy	277 (92)
Fiberoptic bronchoscope	9 (3)
Videolaryngoscope	15 (5)
Dexmedetomidine	190 (63.1)
Lidocaine	157 (52.3)
Ketamine	38 (12.6)
NSAIDs	84 (28)
Paracetamol	259 (86)
Hyoscine butylbromide	67 (22.3)
Opioid	285 (94.7)
Crystalloids* (mL)	1010 [720-1300]

Data are shown as *n* (%), median [IQR].
NSAID: Non-steroidal anti-inflammatory agents, **TIVA:** Total Intravenous Anesthesia.
*Crystalloids: Ringers lactate and 0.9% normal saline solution.
Source: Authors.

with remifentanil and inhaled anesthetic (7:3 desfluorane/sevofluorane ratio). The most frequently used muscle relaxant was rocuronium (92.4%). Muscle relaxants were used in boluses and only 17 patients (5.6%) received infusion; at the end, 93 patients (30.9%) required neuromuscular blockade reversal.

Only 3 patients (0.9%) required invasive monitoring (arterial line and central venous catheter), 1 patient because of pathological history and 2 obese patients due to difficult monitoring and venous access. Multimodal analgesia consisted mainly of opioids and paracetamol, plus the use of non-steroidal anti-inflammatory agents (NSAIDs), hyoscine butylbromide, ketamine, dexmedetomidine and lidocaine in a smaller proportion; 50% of patients received a low-potency vasopressor dose (phenylephrine and/or ethylephrine), and only 1 patient (0.3%) required noradrenaline administration, which was discontinued at the end of the procedure. Crystalloids were used for standard perioperative fluid management (7.1:1 Ringers lactate/saline solution ratio). There was no indication for the use of colloids.

Most of the patients were ventilated with pressure control-guaranteed volume ventilation, and conventional pressure control and volume control modes were also used with no difficulty. All patients were ventilated using protective ventilation parameters. Despite a high percentage of overweight and obese patients, there was not need for position adjustment, interruption of CO_2 insufflation, or conversion to open surgery. Intraoperative management characteristics are shown in Table 2.

There were 11 cases (3.7%) of perioperative complications, 3 due to air leaks through the orotracheal tube, 1 case of antibiotic-related anaphylaxis, 6 patients requiring transfusion of blood products (a maximum of two units of packed red blood cells) and 1 patient converted to open surgery due to severe adhesion syndrome. There were only three cases of difficult airways, although 56 patients had at least one clinical predictor identified during the preanesthesia assessment (Table 3).

Table 3. Complications during intra-operative management.

Variable	Total
Transfusion	6 (2)
Difficult airway	3 (1)
Low potency vasopressor*	148 (49.2)
Anesthetic complications	11 (3.7)
Conversion to laparotomy	1 (0.3)
Bleeding (mL)	300 [200-400]

Data are shown as *n* (%), median [IQR].
*Low potency vasopressor: ethylephrine, phenylephrine.
Source: Authors.

Postoperative anesthesia

All patients were extubated in the operating room and then transferred to the post-anesthesia care unit (PACU) where they were monitored by the treating anesthetist and the nursing team. The most frequent complication was nausea and/or vomiting, with antiemetic boost required only in 3.7% of patients. For pain management, rescue morphine (or equivalent opioid) was used at an average dose of 2-3 mg. The postoperative clinical outcomes are shown in Table 4.

Table 4. Postoperative outcomes in the patients included.

Variable	Total
Operative time (min)	205 ± 43
Nausea and vomiting	11 (3.7)
PACU length of stay (min)	106 [93-129]
Oral intake initiation (hours)	24.3 ± 7
Ambulation initiation (hours)	17.9 ± 6.6
Hospital length of stay (hours)	45 [2.8-52]

Data are shown as *n* (%), mean ± SD, median [IQR].
UCPA: Post-anesthesia care unit.
Source: Authors.

Age

The analysis by age showed that 41.2% of the patients were under 60 years of age. As expected, patients over 60 had a greater number of comorbidities (arterial hypertension, diabetes mellitus, dyslipidemia, gastroesophageal reflux and hypothyroidism). Clinical outcomes were similar when the two groups were compared (Table 5).

Table 5. Patient characteristics and outcomes according to age stratification.

Variable	≤60 years (*n*=124)	>60 years (*n*=177)	*p* value
Comorbidities	62 (50)	121 (68)	<0.01
Transfusion	4 (3.2)	2 (1.1)	0.23
Anesthetic complications	-	4 (2.2)	0.14
Difficult airway signs	19 (15.3)	37 (20.9)	0.29
Difficult airway	-	3 (1.7)	0.27
Vasopressor	55 (44.3)	93 (52.5)	0.19
Bleeding (mL)	300 [200-500]	300 [200-400]	0.64
Operative time (min)	220 [190-244]	215 [185-250]	0.92
Hospital length of stay (hours)	46.5 [2.3-52]	44 [2.8-51]	0.44

Data are shown as *n* (%), median [IQR].
Source: Authors.

Table 6. Patient characteristics and outcomes according to body mass index.

Variable	Low weight (*n*=1)	Normal weight (*n*=119)	Overweight (*n*=138)	Obesity (*n*=43)	*p* value
Comorbidities	-	69 (58)	85 (61.5)	28 (65.1)	0.81
Transfusion	-	2 (1.6)	3 (2.1)	1 (2.3)	0.98
Anesthetic complications	1 (100)	1 (0.8)	1 (0.7)	1 (2.3)	0.1
Difficult airway signs	1 (100)	16 (13.4)	23 (16.6)	16 (37.2)	<0.01
Difficult airway	-	-	1 (0.7)	2 (4.6)	0.06
Vasopressor	-	54 (45.3)	68 (49.2)	26 (60.4)	0.24
Bleeding (mL)	150	300 [200-400]	300 [200-400]	300 [300-500]	0.17
Operative time (min)	303	220 [185-245]	216 [195-256]	210 [180-239]	0.18
Hospital length of stay (hours)	42	45 [2.6-52]	45 [2.4-51]	43 [3.1-49]	0.95

Data are shown as *n* (%), median [IQR].
Source: Authors.

Body mass index (BMI)

Close to one-half of the patients were obese. There were no differences between the groups in terms of comorbidities, anesthetic and surgical complications. However, overweight and obese patients had a prevalence of difficult airway predictors, but which did not give rise to difficulties during intubation (Table 6).

DISCUSSION

Age and obesity are determinants in patients with prostate cancer because they are considered to be risk factors for the development of this disease and are also associated with a worse prognosis (8). Risk at 50 years of age is estimated to be 42% and reaches 70% by 80 years of age. In this group, the highest prevalence was found in patients over 60 years of age, although there was an important increase in the younger population. On the other hand, obesity is associated with a higher incidence of advanced prostate cancer due to late detection using blood hemodilution, difficulties with the digital exam, and a lower success in obtaining biopsies (8). In this study, overweight and obesity were prevalent in the patients included, but did not result in significant changes during anesthesia. Although it was clear that this group of patients had a higher prevalence of difficult airway signs, no important differences were found at the time of intubation.

Despite physiological changes associated with forced Trendelenburg position and prolonged pneumoperitoneum, there were no complications or need to transfer patients to the intensive care unit. Patient oxygenation and ventilation were adequate; protective ventilation parameters were used in all the patients and the most frequently used mode of ventilation was pressure control with guaranteed volume. Other basic ventilation modes were also used such as volume control and pressure control, with no ensuing problems. Although accurate data of dynamic compliance and airway pressures are not available, there were no cases where the procedure had to be suspended or where there was a need to restore prone position or convert to open surgery due to the inability to adequately ventilate the patient. Moreover, it is important to bear in mind that, in our study population, more than half of the patients were overweight or obese, leading to restrictive changes inherent to the patient.

In terms of the anesthetic technique, no differences have been found in oncologic outcomes, such as biochemical recurrence, between the use of balanced general anesthesia vs. TIVA. In a study that assessed biochemical recurrence after RARP in relation to the anesthesia maintenance technique, during an 8-year period, it was found that the effects on oncologic outcomes are comparable for TIVA as well as balanced anesthesia (sevoflurane/desflurane) (9). On the other hand, TIVA could offer certain advantages for patients

with a risk of postoperative nausea and vomiting and increase in intracranial pressure. Physiological changes associated with the forced Trendelenburg position required for this procedure include increase in intracranial pressure, reduction in cerebral perfusion pressure and increase in intraocular pressure (10,11). Choi et al. found that the diameter of the optic nerve sheath measured on ultrasound was smaller in the TIVA group as compared to the group that received balanced general anesthesia, suggesting that this technique could be a good option in patients at risk of cerebral hypoperfusion (12-15). Similar to other studies, the majority of patients in our sample received balanced anesthesia (5,9); however, we recognize the importance of TIVA in the setting of nausea, vomiting and glaucoma (16-18). On the other hand, there was a minimum prevalence of postoperative nausea and vomiting, with only 3.7% of patients requiring additional antiemetics, perhaps explained by the systematic use of prophylaxis during the procedure (19,20). As far as the ventilation mode is concerned, more than 50% of the patients in our center were ventilated using pressure control with guaranteed volume, allowing for the delivery of a constant tidal volume with constant inspiratory pressure. Although there is no clear advantage of pressure control over volume control, it appears that pressure control generates a lower peak pressure and greater dynamic compliance. However, it does not offer any advantage in terms of respiratory mechanics or hemodynamic stability (21).

Although considered a not very painful procedure (mild to moderate on the visual analog scale), analgesic control is critical for adequate patient recovery (22,23), hence the recommendation to use multimodal analgesia. The use of opioids and acetaminophen was almost constant, but other adjuncts were used such as ketamine, hyoscine butylbromide, NSAIDs, dexmedetomidine and, lidocaine infusion in a lower proportion, achieving adequate pain control with very low opioid doses in the PACU. In terms of muscle relaxants, mode of use (infusion or bolus) depended on the anesthetist's preference.

One of the limitations of our study is the inability to make accurate recordings of respiratory parameters such as peak pressure, plateau pressure, EtCO2 and PaCO2 to analyze potential associations, given that these are dynamic parameters and are influenced by patient position. Also, it is a single-center study with convenience sampling and completely exploratory analysis. Moreover, a high likelihood of information bias may limit the validity of our results. However, the study efficiently describes the current experience in the patients included.

Finally, knowledge of the physiological changes and the potential problems associated with robot-assisted prostatectomy allows for adequate planning of intraoperative management. There were no serious perioperative complications in this sample.

ETHICAL DISCLOSURES

This study was approved by the institutional Research Ethics Committee, in a meeting held on April, 2017, as recorded in act number CCEI-7202-2017.

Protection of human and animal subjects

The authors declare that no experiments were performed on humans or animals for this study. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics commit-tee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data

The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent

The authors declare that no patient data appear in this article. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

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Authors' contribution

- **MG:** Original project conception, study planning, data collection and analysis, interpretation of the results, writing and final approval of the manuscript.
AE, RSF y MJ: Study planning, interpretation of the results, writing and final approval of the manuscript.
- **FL:** Original project conception, study planning, interpretation of the results, writing and final approval of the manuscript.
- **MR and AO:** Study planning, writing and final approval of the manuscript.
- **CJ and SM:** Data collection and analysis, interpretation of the results, writing and final approval of the manuscript.
- **RLE:** Data collection and analysis, interpretation of the results, writing of the manuscript
- **AC:** Data collection and analysis, interpretation of the results.
- **MMC:** Data analysis, interpretation of the results, writing of the manuscript.
- **GF:** Original project conception, study planning, final approval of the manuscript.
- **CJI:** Original project conception, study planning, data collection, interpretation of the results, final approval of the manuscript.

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