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Robotic-assisted laparoscopic partial nephrectomy. Retrospective descriptive study over a 10-year period. Anesthetic experience

Nefrectomía parcial laparoscópica robótica. Estudio retrospectivo descriptivo durante 10 años. Experiencia anestésica

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What do we know about this problem?

Robot-assisted laparoscopic surgery is used to assist in laparoscopic partial nephrectomies (LPN) and is currently the surgical treatment of choice for small renal masses.

Robotic surgery offers advantages to the patient and the surgeon; however, it does represent some challenges for the anesthesiologist such as longer surgical times, patient's position and difficult access of the patient during the intraoperative period.

What new knowledge does this study contribute with?

RALPN is a safe and consolidated technique for the treatment of small renal tumors, even in patients with high anesthetic risk. In order to succeed with this approach, careful anesthetic management is required, preventive analgesia, teamwork planning and anticipating potential complications in order to accomplish the best results.

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Abstract

Introduction: Robot-assisted laparoscopic surgery is currently the surgical treatment of choice for small renal masses.

Objective: Reviewing the anesthetic management and perioperative morbidity of patients undergoing robotic-assisted laparoscopic partial nephrectomy (RALPN) from 2009 to 2019 at Hospital Universitario Donostia.

Methods: Retrospective, descriptive, observational study involving 343 patients.

Results: 95 % of the patients were ASA II-III. Transient renal artery clamping was performed in 91 %, with a mean ischemia time of 17.79 minutes. The mean duration of the procedure under balanced general anesthesia was 184 min. Standard monitoring was performed along with invasive arterial pressure monitoring (IAP), central venous catheter (CVC) and EV1000 platform (Edwards®) for complex patients. Complications were recorded in 40 patients (11.67 %). Patients under anti-aggregation therapy experienced more bleeding than non-anti-aggregation patients (p 0.04) but did not require more transfusions. Patients with a higher anesthetic risk did not experience more complications. No statistically significant association was found between worsening renal function and the occurrence of intraoperative complications. 21 patients (6 %) were readmitted due to complications; the most frequent complication was renal artery pseudoaneurysm that required endovascular embolization.

Conclusions: It should be highlighted that after ten years of experience with this technique, the patients with a higher anesthetic risk have not experienced serious perioperative complications. RALPN is a safe technique that demands a careful anesthetic support. A robot-assisted approach alone is not a guarantee for success without strong teamwork.

Keywords: Nephrectomy; Laparoscopic surgery; Robot-assisted surgical procedures; Kidney neoplasms; Anesthesia.

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Resumen

Introducción: La cirugía laparoscópica asistida por robot es actualmente el tratamiento quirúrgico de elección para masas renales de pequeño tamaño.

Objetivo: Revisión del manejo anestésico y morbilidad perioperatoria de los pacientes sometidos a nefrectomía parcial laparoscópica asistida por robot (NPLAR) desde 2009 a 2019 en el Hospital Universitario Donostia

Metodología: Estudio retrospectivo observacional descriptivo sobre 343 pacientes.

Resultados: El 95 % de los pacientes eran ASA II-III. En el 91 % se realizó pinzamiento transitorio de la arteria renal, con un tiempo medio de isquemia de 17,79 minutos. La duración media de la intervención bajo anestesia general balanceada fue de 184 minutos. Se realizó monitorización estándar junto con monitorización de presión arterial invasiva (PAI), catéter venoso central (CVC) y plataforma EV1000 (Edwards®) para pacientes complejos. Se registraron complicaciones en 40 pacientes (11,67 %). En los pacientes en tratamiento con antiagregantes hubo mayor sangrado que en los no antiagregados (p = 0,04), pero no requirieron más transfusiones. Los pacientes con un mayor riesgo anestésico no sufrieron más complicaciones. No se encontró asociación estadísticamente significativa entre el empeoramiento de la función renal y la existencia de complicaciones intraoperatorias. El 6 %, es decir, 21 pacientes, reingresaron por complicaciones de las cuales, la más frecuente fue el pseudoaneurisma de la arteria renal que necesitó embolización endovascular.

Conclusiones: Tras diez años realizando esta técnica se puede destacar que, aunque los pacientes presentan un riesgo anestésico elevado no han tenido complicaciones perioperatorias graves. La NPLAR es una técnica segura que precisa un cuidadoso soporte anestésico. La tecnología robótica no garantiza por sí misma el éxito sin un buen trabajo en equipo.

Palabras clave: Nefrectomía; Cirugía laparoscópica; Procedimientos quirúrgicos robotizados; Neoplasias renales; Anestesia.

INTRODUCTION

Kidney cancer accounts for 2 % of malignancies (1). It is twice as frequent in males than in females (2). It presents between the 6th and 8th decade of life and is rarely seen in people under 40 years old or in children (3,4). The survival of patients has doubled over the past 60 years: 34 % in 1954 to 75 % in the period from 2009-2015 (5,6).

The Da Vinci model S robot was introduced at the Donostia University Hospital in 2009 and it was updated to model Xi in 2018. Robot-assisted laparoscopic partial nephrectomy (RALPN) is currently the treatment of choice for small renal masses.

Robotic surgery is advantageous for the patient – faster recovery, less pain, lower infection rate, and less blood loss – and for the surgeon – improved precision and vision -; however, there are a few challenges for the anesthesiologist, including longer surgical times, patient's position and difficult access during the intraoperative period (7).

The purpose of this paper was to review the surgical and anesthetic treatment of all patients undergoing RALPN at the Donostia University Hospital from 2009 to 2019, through a retrospective observational study of the perioperative modality and the anesthetic management used. The idea was to analyze the experience of the anesthesiologists and identify potential aspects to consider in the future to optimize patient management.

MATERIAL AND METHODS

Design of the study

In order to comply with the objectives, a retrospective, descriptive, observational study was developed with a case series design that included a total of 343 patients diagnosed with renal neoplasms and treated with robot-assisted laparoscopic partial nephrectomy (RALPN), between 2009 and 2019. The study was approved by the Hospital Research Ethics (REC) (code: AAP-NPR-2019-01). The data were retrospectively collected from each patient's medical and anesthesia records.

Data collection

The following patient information was collected:

· **Demographic data:** age, gender, weight (kg), size (cm) and BMI (kg/m2).

· **Medical data:** classification based on the American Society of Anesthesiologists (ASA) risk scale, cardiovascular risk factors, preoperative assessment required, prior abdominal interventions, solitary kidney, preoperative and postoperative creatinine (mg/dL), preop and postop glomerular filtration rate (mL/min/1.73 m2), and quality of life assessment based on ECOG (Eastern Cooperative Oncology Group), in addition to tumor-related factors (size and localization).

· **Data associated with the anesthetic technique:** intraoperative monitoring (non-invasive, invasive, cardiac output

measurement, ventilation mode, use of positive end expiratory pressure (PEEP), use of vasopressors, need for blood products, length of stay in the post-anesthesia recovery room.

· **Surgery-related:** duration of surgery (min), arterial clamping and arterial ischemia time (min), conversion to radical nephrectomy or open surgery. Intra and postoperative complications over the next 30 days after the intervention, hospital stay (days), need and reason for readmission, relapse and follow-up time (months).

Statistical Analysis

The data were described using the most appropriate statistics based on the nature and measurement scale of each variable: absolute and relative frequencies in percentages and mean standard deviation for continuous variables or medians and interquartile rate, if appropriate for the distribution of the data. To explore the associations among categorical variables, a parametric Chi-square test was conducted, or its corresponding non-parametric Fisher's test, when the parametric test could not be administered. The Kolmogorov-Smirnov or the Shapiro-Wilks tests were used for normality of the distribution of the quantitative variables, and the Student-t test was used to compare measurements for independent samples or the corresponding non-parametric U Mann-Whitney test .

The level of significance was set at 0.05. The Statistical software STATA v.16 was used.

Bibliographic review

A bibliography search was conducted in the following databases: UpToDate, Medline, Embase, PubMed and Tripdatabase. The terms used for the search in English were: partial nephrectomy, laparoscopic surgery, robot-assisted surgery, anesthesia or anesthetic. Articles published over the past 15 years were included.

RESULTS

Demographic data of patients

The information is summarized in Table 1.

All the 343 patients — 230 males (67,06 %) and 113 females (32.94 %) — underwent RALN (Da Vinci) at the Donostia University Hospital between 2009 and 2019. The mean age was 61 years (18-85 years) and the mean BMI was 27.29 kg/m2 (16,97-47,46 kg/m2).

Medical Data of patients

The information is shown in Table 2.

Table 1. Demographic characteristics.

Variables	Values
n	343
Sex *Male (%)* *Female (%)* *Age (years)* *Weight (kg)*	 230 (67.06) 113 (32.94) 60.75 (18-85) 78 (44-160)
Size (cm)	169.5 (150-191)
BMI (kg/m2)	27.29 (16.97- 47.47)

Note: The data are shown as numbers (percentage) or means (minimum value – maximum value).

Source: Authors.

Table 2. Medical data.

Variables	Values
n	343
ECOG (%) ECOG 0. Asymptomatic ECOG 1. Intensive activity restricted ECOG 2. Able to ambulate and provide self-care	 299 (87.2) 37 (10.8) 7 (2)
ASA (%) ASA I ASA II ASA III ASA IV	 12 (3.51) 185 (53.8) 142 (41.52) 4 (1.17)
Cardiovascular risk factors (%) High blood pressure Dyslipidemia Diabetes 1-2	259 (75.51) 180 (52.48) 99 (28.95) 45 (13.12)
Smoker (%) Prior abdominal surgery (%) Anti-aggregation therapy (%) Anticoagulation therapy (%)	117 (34.11) 127 (37) 36 (10.5) 15 (4.37)
Solitary kidney (%)	10 (2.9)
Preoperative creatinine (mg/dL) Postoperative creatinine (mg/dL)	0.92 (0.41-8) 0.98 (0.48-9.58)
Preoperative glomerular filtration rate (mL/min/1.73 m2) Postoperative glomerular filtration rate (mL/min/1.73 m2)	85.89 (7-179) 79.5 (6-146)

The data are shown as numbers (percentage) or means (minimum value – maximum value).

Source: Authors.

Following a preoperative assessment, patients were classified based on the ASA scale to estimate the risk of anesthesia, considering: ASA I 3.51 %, ASA II 53.8 %, ASA III 41.52 % and ASA IV 1.17 %. Hence, 95 % of the patients were ASA II-III, while 42.69% exhibited a high anesthetic risk (ASA III-IV).

Of the 343 patients, 259 (75.51 %) had cardiovascular risk factors; hypertension (HBP) was the most frequent condition – 180 patients (52.48%) – followed by dislipidemia - 99 patients (28.95%), and diabetes types 1-2 in 45 patients (13,12 %). 117 patients were active smokers (34.11 %). However, the presurgical functional status and the patient's quality of life according to ECOG, was adequate: (ECOG 0) in 87.2 % (299 of 343 patients); there were no ECOG>2 cases.

Of the 343 patients, 36 (10.5 %) were with anti-aggregation acetyl salicylic acid therapy (AAG) and 15 (4.37 %) were anticoagulated (ACO), both with di-coumarinic drugs and with the new direct oral anticoagulants. Both groups were treated in accordance with the current preoperative management protocol for anticoagulated/anti-aggregated patients; those receiving anti-aggregation therapy continued with the drug until the day of surgery, except when it was a primary prevention measure and in that case the medication was discontinued.

The renal function indicators were recorded (plasma creatinine and glomerular filtration rate using the CKD-EPI formula), before and after surgery. He mean preoperative creatinine was 0.92 mg/dL (0.41-8 mg/dL) and the preoperative glomerular filtration was 85.89 mL/min/1,73 m2 (7-179 mL/min/1,73 m2). The mean postoperative creatinine was 0.98 mg/dL (0.48-9,58 mg/dL) and the postoperative glomerular filtration was 79.5 mL/min/1,73 m2 (6-146 mL/min/1.73 m2). There was no statistically significant association between the kidney function impairment and the development of intraoperative complications.

Table 3. Data relating to the anesthetic technique.

Variables	Values
n	343
Intraoperative monitoring (%) IBP CVC EV1000	 115 (33.5) 200 (58.3) 2 (0.6)
Ventilation mode (%) VCV PCV	 185 (53.9) 158 (46)
Tele Expiratory pressure (PEEP) (%) PEEP 0-5 cm H2O PEEP 6-10 cm H2O PEEP > 10 cm H2O	260 (75.8) 167 (64.2) 85 (32.7) 8 (3.1)
Need for vasopressors (%) Ephedrine Phenylephrine Noradrenalin	125 (36.4) 116 (92.8) 7 (5.6) 2 (1.6)
Need for blood products (%)	25 (7.29)

Notes: CVC: Central venous catheter; **EV1000:** Hemodynamic monitoring platform; **IBP:** Invasive blood pressure; **PCV:** Pressure controlled ventilation; **VCV:** Volume Controlled Ventilation.
The data are presented as numbers (percentage).
Source: Authors.

Data relating to the anesthetic technique.

Summary in Table 3. As far as the anesthetic technique is concerned, all patients received general anesthesia with orotracheal intubation. All patients received general balanced anesthesia (sevoflurane/desflurane + fentanyl/remifentanil). Rocuronium was used as muscle relaxant in continuous perfusion to ensure an adequate neuromuscular block under proper monitoring.

The patient was placed in lateral decubitus with 60-90 degrees flexion on the table. Special care was given to the spine and the arms to avoid nerve injuries. Eye and pressure points protection was used. The patients were monitored with 5-leads EKG, arterial pressure (invasive or non-invasive), pulse oximetry, capnography, temperature (thermal blankets and fluid warmers were used to maintain normal temperature), bladder catheter, Bispectral index and TOF (train of four) neuromuscular monitoring.

The decision to place a central line catheter was made based on the patient's characteristics. Although a central venous catheter (CVC) was placed in 200 of the 343 patients included in the review in anticipation to the need for hemodynamic support with vasoactive drugs, only 125 patients required vasoactive therapy, with 92.8% of the cases receiving isolated ephedrine boluses. 20-30% of the patients experienced a blood pressure drop as comparted to the baseline and 116 patients received isolated ephedrine boluses at some point during the surgical intervention and only 2 of the 125 patients who needed vasoactive support, required continuous noradrenaline perfusion. Invasive blood pressure monitoring (IBP) was conducted in 33.5 % of the patients reviewed and the trend is inversely proportional to the CVC, with increased used of IBP over time (none of the patients were catheterized in 2009

while in 2019, 80% of the patients received a central venous catheter

Lung-protective mechanical ventilation, whether volume or pressure-controlled (with or without guaranteed volume) was used, with optimal positive end of expiration pressure (PEEP) estimated for each patient. Alveolar recruitment was conducted before the pneumoperitoneum (in an attempt to avoid intra-abdominal pressures exceeding 12 mm Hg) and before awakening, aiming at a plateau pressure < 30 cm H2O. 50% FiO2, low flows, permissive hypercapnia and gasometric control was implemented for some patients during surgery. The analysis of the data collected indicated that the most frequently used ventilation mode was volume controlled (53.9 %) and in 260 (75.8 %) of the total number of patients the PEEP used was less than 6 cm H2O in 64.2 % of the patients, and between 6-10 cm H2O in 32.7 % of the patients. Only 3.1 % of the patients had a PEEP above 10 cm H2O. Pressure support ventilation was used before extubating. If the patient met the extubation criteria at the completion of surgery (adequate spontaneous breathing, TOF ratio > 0.9 after reversal of the neuromuscular block, normocapnia and hemodynamic stability) the patient was extubated and transferred to the post-anesthesia care unit before being transferred to the hospital ward. All patients in the trial were extubated in the OR. None of them required delayed emergence from anesthesia in the PACU due to intraoperative complications.

The intravenous (IV) intraoperative analgesia used included remifentanil (concentration of 20 µg/mL, in continued perfusion 0.05-0.2 µg/kg/min), fentanyl (4-6 µg/kg), paracetamol 1 gr, non-steroidal anti-inflammatory drugs (NSAIDs) (ibuprofen 400 mg or dexketoprofen 50 mg) and morphine chloride 4-6 mg IV. Regional analgesic techniques were not used, but the surgical entry sites were infiltrated with local anesthetic (levobupivacaine 0.25 % 10-20 mL) at the end of the intervention. IV morphine chloride in 2 mg boluses were administered as recue medication during the postoperative period, when the scores of the visual analogue scale were over 4, despite conventional analgesia (paracetamol IV alternating with IV NSAID). Clear fluids tolerance was initiated before transferring the patient to the hospital ward, with good results in most patients.

Data associated with the surgical intervention

Shown on Table 4. The mean duration of surgery was 184 minutes (60-360 minutes). There was a statistically significant reduction in the duration of the interventions after 2009, with a mean of 248 minutes (95 % CI [-117.96, -11.03]; p < 0.05). In the following years, the surgical time continued to drop progressively until reaching 176 minutes in 2019 (90-330 minutes).

Transient renal artery clamping was done in 312 interventions (90.96 %), with a mean ischemia time of 17.79 minutes (4-39 minutes). There was a statistically significant association between ischemia time and the presence of intraoperative complications (vascular injury, solid organ lesion, opening of the tumor or technical failure) (95 % CI [-8.28, -2.18]; p < 0.05).

Most of the interventions (88,33 %) were uneventful. Just two cases had to be converted to radical nephrectomy and on five occasions it was necessary to convert to open surgery. In the 40 cases where complications developed, the most frequent complications were vascular lesion in 20 cases (50 %), followed by solid organ injury in 6 patients (15 %). However, blood loss was mild (less than 500 mL) in 304 of the surgeries (88.63 %) and only 25 patients of the 343 patients operated on, required blood products transfusion during the first 24 hours after surgery.

Patients receiving anti-aggregation therapy experienced more bleeding

Table 4. Surgery and postoperative intervention data.

Variables	Valores
n	343
Tumor size (cm)	3.01 (0.7-18)
Surgical time (minutes)	184 (60-360)
Renal artery clamping (%)	312 (90.96)
Warm ischemia time (minutes)	17.79 (4-39)
Complications (%) Vascular lesions Solid organ lesion Opening of the tumor Technical failure Other	40 (11.7) 20 (50) 6 (15) 5 (12.5) 1 (2.5) 8 (20)
Hospital stay (days)	5 (2-99)
Readmission (%) Renal artery pseudoaneurysm Urinary tract infection Vascular lesion Other	21 (6) 9 (42.9) 1 (4.8) 2 (9.4) 9 (42.9)
Relapse (%)	15 (4.6)
Follow-up (days	34 (0-117)

Nota: The data are expressed as numbers (percentage) or means (minimum value_ maximum value).

Source: Authors.

than the non-anti-aggregation patients (statistically significant outcome, p = 0.04), but required no further blood transfusions; hence, bleeding was mild in 78 % of the cases (less than 500 mL). Neither were additional hemostats administered during surgery in the anti-aggregated and anticoagulated patients, versus the untreated patients (Table 5).

In 15 cases (4 %) the indication for partial nephrectomy was mandatory because these were solitary kidney patients or patients with bilateral neoplasia. With regards to the tumor characteristic, the average size was 3.01 cm (0.7-18 cm) and in 141 cases, the tumor was localized in the interpolar region (41.35 %). Histologically, 286 cases were malignant tumors (83 %), and the most frequent lineage was clear cell carcinoma (58.04 %).

The mean hospital stay was 5 days and only 21 of the 343 patients had to be readmitted with complications (6 %), the most frequent of which was renal artery pseudoaneurysm (42.9 %) mostly treated with selective embolization by interventional radiologists. The patients with high anesthetic risk did not exhibit a higher incidence of perioperative complications or readmissions.

Only 15 patients experienced a relapse, which accounts for 4.6 %. There were no deaths.

Table 5. Bleeding and need for blood products in anti-aggregated and/or anticoagulated patients.

Variables	Values
n	343
Bleeding > 500 mL	
Patients with AAG (%)	8 (22)
Patients with ACO (%)	1 (7)
Patients without AAG or ACO (%)	30 (10)
Blood products transfusion	
Patients with AAG (%)	3 (8)
Patients with ACO (%)	0 (0)
Patients without AAG or ACO (%)	22 (7)

The data are expressed as numbers (percentage). AAG: Anti-aggregated patients; ACO: Anticoagulated patients.

Source: Authors.

DISCUSSION

The hospital where the trial was conducted continues with the current trend and hence most of the small renal masses are treated with RALPN. The demographic characteristics of the patients were similar to those in other trials (8,9): mostly males in their 60s; but according to the ASA classification, the patients with a larger number of comorbidities has an increased risk of anesthesia (10).

In terms of the surgical technique, and although the current trend is to try to avoid warm ischemia to excise the tumor, a large number of patients underwent transient renal artery clamping (as was the case in this review, in which 312 of the 343 patients underwent renal artery clamping); however, in this trial the warm ischemia time (17.79 min) was shorter than the times described in different articles.

Furukawa et al. (8) published in 2020 the results of a sample with 804 cases and their ischemia time was 21 minutes. Likewise, 13 % of the patients experienced complications, versus 11.7 % in this study. The retrospective trial published by Young Dong Yu et al. (10) in 2019 reviewed 896 patients undergoing partial open nephrectomy or RALPN between 2004 and 2017. They compared the postoperative outcomes and analyzed the parameters affecting the acute kidney injury and the chronic progression of the disease. They concluded that the estimated baseline glomerular filtration rate, the ischemia time, and the type of surgery were independent predictors both for acute kidney injury as for chronic kidney disease progression; furthermore, RALPN was associated with less blood loss. Although that retrospective trial compared two groups of patients and therefore differs from the study herein described, it is consistent with the results accomplished in the RALPN group (less blood loss, fewer postoperative complications and preserved renal function).

Spana et al. (11) published a retrospective review of 450 RALPNs conducted between June 2006 and May 2009. They assessed the incidence of postoperative complications and found a total of 71 patients (15,8 %) with some sort of complication; intraoperative bleeding in 2 patients (0,2 %) and other 22 (4.9 %) during the postoperative period. Most of the postoperative complications were mild and could be managed conservatively. The RALPN converted to open laparoscopic or conventional surgery in 3 patients (0.7 %) and to radical nephrectomy in 7 (1.6 %). There were no deaths. These data are consistent with the results of this review, since the percentage of complications was 11.7 %, the conversion rate was very similar and the intra and post-operative bleeding was mild (<500 mL) in most patients. It was also noted that the appropriate preoperative management of anticoagulation in patients undergoing programmed surgery, based on the hospital protocol, failed to show a significant difference in terms of intraoperative bleeding, versus the patients that did not receive anticoagulation therapy. Neither were any deaths reported.

With regards to the management of anesthesia, currently no scientific evidence is available to favor one modality versus the

other (general balanced anesthesia, total intravenous anesthesia [TIVA], or inhaled anesthesia) in robot-assisted abdominal procedures (12). Lee et al. (13) in 2019 published an observational retrospective study aimed at analyzing the association between the choice of anesthetic agent for general anesthesia and the risk of acute kidney injury (AKI) and long-term renal disfunction following nephrectomy. They reviewed 1087 cases of partial or radical nephrectomy; they contrasted propofol vs. sevoflurane; propofol vs. desflurane and sevoflurane vs. desflurane. They found that propofol was associated with a lower incidence of AKI and a lower incidence of new onset chronic renal disease following nephrectomy. No significant differences were seen between sevoflurane and desflurane. Apparently propofol, as compared against the other volatile agents, could be a more suitable general anesthetic agent for nephrectomy when trying to attenuate postoperative renal dysfunction; however, no final conclusions can be made due to the limitations inherent to a retrospective study. The patients of the hospital where the study was conducted, the practice is to use propofol together with sevoflurane/desflurane.

A consensus document among various scientific societies has been recently published (14), with a view to standardize the anesthetic support provided to these patients. The recommendation to use PEEP in 78% of the patients in this study and the optimization of the targeted hemodynamic management as reflected In the recently adopted EV1000 (Edwards®) platform are to be emphasized. This platform has been adopted for complex patients, with a view to implementing a hemodynamic control with advanced parameters (CO, HR, SVV, SVR) in addition to targeted fluid therapy for enhanced fluid administration control and maintaining the patient within optimal intervals. In accordance with the current trend, the percentage of patients monitored with a CVC has been declining over the years, in contrast to increased use of IBP.

The review by Hsu et al. (15) in 2013 focused specifically on the anesthesia considerations associated with robotic surgery in urology. The difficulties for the anesthesiologist during the robotic procedure include the position of the patient, the physiological consequences of the pneumoperitoneum, a restricted access to the patient and the long duration of most of the procedures, in addition to the duration of anesthesia. Placement of the patient is the most critical aspect in any robot-assisted surgery. There were no complications recorded in this study related to the position of the patient, though there could have been complications, but were not mentioned in the medical record, indicating that they were probably minor. Moreover, Hsu et al. (15) insisted on the fact that good communication among the team members and a sound knowledge of the nuances of robotic surgery, improve patient outcomes and reduce both surgical and anesthetic complications. They also mentioned the potential advantages of robotic surgery because of the potential to improve the results and reduce the number of complications, in addition to enhanced team work.

This observational trial, although it involved a large series of patients, has some limitations in terms of its retrospective data collection, the subjectivity of the practitioners that conducted the trial, the potential inaccuracy in coding the data and the inability to make inter-group comparisons. A different kind of study, probably multicentric and prospective would be required in order to arrive at more final conclusions.

CONCLUSIONS

RALPN is a safe technique for the treatment of small renal tumors. After ten years of experience with this technique, although the patients studied represented a high risk of anesthesia, the incidence of perioperative complications was not significant. A successful outcome demands a good preanesthetic assessment identifying and optimizing the patient's comorbidities in order to anticipate potential complications. Likewise, careful intraoperative management is required, meticulous surveillance of the surgical position, and proper monitoring of the surgery and of the needs of each individual patient.

Preventive analgesia administered in the operating room contributes to an enhanced functional recovery of the patients after surgery. Working in synergy with the anesthesiologists of the post-anesthesia care unit is essential to promote a swift recovery of the patients (oral feeding tolerance and early mobilization) and shortened hospital stay. Robotic technology on its own does not ensure success, without a good teamwork. The anesthesiologists should partake in technological breakthroughs, evolve and adapt to the new developments in order to achieve the best results for patients.

ETHICAL RESPONSIBILITIES

Ethical committee endorsement

This study was approved by the research ethics committee in Gupuzkoa Public Health Area, at the meeting held on January 21st, 2020, as reflected under Minutes AAP-NPR-2019-01.

Protection of humans and animals

The authors declare that no human or animal experiments were conducted for this research. The authors declare that the procedures followed were pursuant to the ethical standards of the responsible human experimentation committee and in accordance with the World Medical Association and the Declaration of Helsinki.

Confidentiality of the data

The authors declare their adherence to the

protocols of their institution regarding the disclosure of patient data.

Right to privacy and informed consent

The authors declare that no patient data are included in this article.

The authors have obtained the informed consent of the patients and/or subjects described in the article. This document is the possession of the corresponding author.

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Contribution by the authors

AAP: Original project design, planning of the study, interpretation of the results and final draft of the manuscript.
AOL: Planning of the study, data collection, interpretation of the results and initial drafting of the manuscript.
BMB and BCP: Interpretation of the results and final drafting and approval of the manuscript.
MAA and ELO: Planning of the study and data collection.
NGJ: Final drafting and approval of the manuscript.

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REFERENCES

1. Redecan.org. Estimaciones de la incidencia del cáncer en España, 2020 [internet]. Madrid: Red Española de Registros de Cáncer; 2020. [cited 2021 Jan 12]. Available at: https://redecan.org/redecan.org/es/Informe_incidencia_REDECAN_2020.pdf

2. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2020. CA Cancer J Clin. 2020;70(1):7-30. doi: https://doi.org/10.3322/caac.21590

3. Siemer S, Hack M, Lehmann J, Becker F, Stöckle M. Outcome of renal tumors in young adults. J Urol. 2006;175(4):1240-4. doi: https://doi.org/10.1016/S0022-5347(05)00696-8

4. Thompson RH, Ordonez MA, Iasonos A, Secin FP, Guillonneau B, Russo P, et al. Renal cell carcinoma in young and old patients—is there a difference? J Urol. 2008;180(4):1262-6. doi: https://doi.org/10.1016/j.juro.2008.06.037

5. Kane CJ, Mallin K, Ritchey J, Cooperberg MR, Carroll PR. Renal cell cancer stage migration: Analysis of the National Cancer Data Base. Cancer. 2008;113(1):78-83. doi: https://doi.org/10.1002/cncr.23518

6. Hollingsworth JM, Miller DC, Daignault S, Hollenbeck BK. Rising incidence of small renal masses: A need to reassess treatment effect. JNCI J Natl Cancer Inst. 2006;98(18):1331-4. doi: https://doi.org/10.1093/jnci/djj362

7. Summet G, Priya A, Berend M. Anestesia en cirugía robótica. Miller, anestesia [Internet]. 2016. Capítulo 87, 2578-2594. [cited 2021 Jan 12]. Available at: https://www.clinicalkey.com/meded/content/toc/3-s2.0-C2014104330X

8. Furukawa J, Kanayama H, Azuma H, Inoue K, Kobayashi Y, Kashiwagi A, et al. 'Trifecta' outcomes of robot-assisted partial nephrectomy: a large Japanese multicenter study. Int J Clin Oncol. 2020; 25(2):347-53. doi: https://doi.org/10.1007/s10147-019-01565-0

9. Cacciamani GE, Gill T, Medina L, Ashrafi A, Winter M, Sotelo R, et al. Impact of host factors on robotic partial nephrectomy outcomes: Comprehensive systematic review and meta-analysis. J Urol. 2018;200(4):716-30. doi: https://doi.org/10.1016/j.juro.2018.04.079

10. Yu YD, Nguyen NH, Ryu HY, Hong SK, Byun S, Lee S. Predictors of renal function after open and robot-assisted partial nephrectomy: A propensity score-matched study. Int J Urol. 2019; 26(3):377-84. doi: https://doi.org/10.1111/iju.13879

11. Spana G, Haber G-P, Dulabon LM, Petros F, Rogers CG, Bhayani SB, et al. Complications after robotic partial nephrectomy at centers of excellence: multi-institutional analysis of 450 cases. J Urol. 2011;186(2):417-22. doi: https://doi.org/10.1016/j.juro.2011.03.127

12. Herling SF, Dreijer B, Wrist Lam G, Thomsen T, Møller AM. Total intravenous anaesthesia versus inhalational anaesthesia for adults undergoing transabdominal robotic assisted laparoscopic surgery. Cochrane Anaesthesia, Critical and Emergency Care Group, editor. Cochrane Database Syst Rev. 2017. doi: https://doi.org/10.1002/14651858.CD011387.pub2

13. Lee HJ, Bae J, Kwon Y, Jang HS, Yoo S, Jeong CW, Kim JT, Kim WH. General anesthetic agents and renal function after nephrectomy. J Clin Med. 2019;8(10):1530. doi: 10.3390/jcm8101530.

14. On behalf of Società Italiana di Anestesia Analgesia Rianimazione e Terapia Intensiva (SIAARTI), Società Italiana di Ginecologia e Ostetricia (SIGO), and Società Italiana di Urologia (SIU), Aceto P, Beretta L, Cariello C, Claroni C, Esposito C, et al. Joint consensus on anesthesia in urologic and gynecologic robotic surgery: specific issues in management from a task force of the SIAARTI, SIGO, and SIU. Minerva Anestesiol. 2019;85(8). doi: https://doi.org/10.3390/jcm8101530

15. Hsu RL, Kaye AD, Urman RD. Anesthetic challenges in robotic-assisted urologic surgery. Rev Urol. 2013;15(4):178-84.