MedNEXT
Journal of Medical an Health Sciences

REVIEW ARTICLE

DOI: 10.54448/mdnt25401

Anesthetic types and techniques in robotic surgery: a systematic review

Geovana Valença de Almeida Lima[1*], Louise do Livramento Mello[2], Dáfane Lima Miguel[1]

[1] Beneficência Portuguesa Hospital of São José do Rio Preto. Luiz Vaz de Camões Street, 3150, Vila Redentora, São Paulo, Brazil.
[2] Santa Casa Hospital of Votuporanga. Minas Gerais Street, Votuporanga, São Paulo, Brazil.

*Corresponding author: Geovana Valença de Almeida Lima.
Beneficência Portuguesa Hospital of São José do Rio Preto. Luiz Vaz de Camões Street, 3150, Vila Redentora, São Paulo, Brazil.
E-mail: geovana04almeida@gmail.com
DOI: https://doi.org/10.54448/mdnt25401
Received: 07-21-2025; Revised: 09-23-2025; Accepted: 09-25-2025; Published: 09-30-2025; MedNEXT-id: e25401

Editor: Dr. Idiberto José Zotarelli-Filho, MSc, Ph.D., Post-Doctoral.

Abstract

Introduction: In the context of robotic surgery (RS), approximately 1.5 million robotic surgeries have been performed worldwide in the last decade. Different anesthetic techniques can modify coagulation factors. Studies have investigated the effects of established anesthesia types on procoagulant, anticoagulant, and fibrinolytic factors in prostate cancer patients undergoing robotic surgery. **Objective:** It was to present a systematic review of the main approaches to anesthetic practices and types in robotic prostate surgery. **Methods:** The PRISMA Platform systematic review guidelines were followed. The search was conducted from March to May 2025 across the Scopus, Embase, PubMed, ScienceDirect, Scielo, and Google Scholar databases. Study quality was assessed using the GRADE instrument, and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** A total of 136 articles were found. A total of 64 articles were fully evaluated, and 31 were included in this systematic review. Considering the Cochrane risk of bias tool, the overall assessment resulted in 12 studies with a high risk of bias and 15 studies that did not meet the GRADE criteria. The reported scientific evidence points to some potential benefits of robotically assisted surgery compared to open surgery and laparoscopic surgery. Outcomes related to reduced blood loss and consequent reduced need for blood transfusions, as well as the preservation of sexual function, appear to be the most significant advantages over comparators. Improved urinary continence and shorter hospital stays due to lower perioperative complication rates are also noted in the studies. Furthermore, a single spinal injection of morphine and bupivacaine provided adequate analgesia in the early postoperative period and reduced the need for additional IV opioids in patients undergoing RALP. Despite this, the anesthetic techniques, total intravenous anesthesia with target-controlled infusion and balanced inhalation anesthesia, appear to significantly increase the risk of thrombosis in prostate cancer patients undergoing LRP, particularly when the robotic device was used, encouraging the use of perioperative thromboembolic prophylaxis in these patients. Finally, in robotic cystectomy, anesthesiologists should consider the changes in the cardiopulmonary system that occur when patients are placed in the Trendelenburg position and when pneumoperitoneum is created.

Keywords: Robotic surgery. Anesthetic techniques. Minimally invasive surgery. Prostate cancer. Prostatectomy.

Introduction

In the context of robotic surgery (RS), approximately 1.5 million robotic surgeries have been performed worldwide in the last decade, and 83% of prostatectomies were performed robotically in 2011, compared to only 17% just 6 years earlier [1]. In the years following 2007, the number of robotic-assisted procedures nearly tripled worldwide, from 80,000 to over 200,000. The number of da Vinci robotic surgical consoles grew 75% between 2007 and 2009 (from 800 to 1,400 in the US and from 200 to 400

internationally) [1-3].

RS has been widely adopted in various specialties, and in urology, it is used for reconstructive, pediatric, urogynecological, and, of course, oncological procedures. In 2014, the total volume of procedures in the US was 449,000, of which 20% were in urology, 52% in gynecology, and 24% in general surgery. The volume of international procedures was 1,121,000 in 2014, of which the majority were in urology [4].

In this scenario, the prostate is a gland located in the lower abdomen. It is a small organ located just below the bladder and in front of the rectum, surrounding the initial portion of the urethra [5,6]. In Brazil, prostate cancer is the second most common cancer among men (behind only non-melanoma skin cancer). In absolute terms, considering both sexes, it is the fourth most common type and the second most common among men. The incidence rate is higher in developed countries compared to developing countries [6].

More than any other type, it is considered a cancer of old age, as approximately three-quarters of cases worldwide occur after age 65 [7]. The observed increase in incidence rates in Brazil can be partially explained by the evolution of diagnostic methods, the improvement in the quality of the country's information systems, and the increase in life expectancy. Some of these tumors can grow rapidly, spreading to other organs and potentially leading to death. The vast majority, however, grow so slowly (about 15 years to reach 1 cm^3) that they do not show any signs during life or threaten a man's health [8].

According to the National Cancer Institute (INCA), the estimated number of new cases for 2016 was 61,200, and the number of deaths recorded in 2013 was 13,772. The risk of a man being diagnosed with prostate cancer during his lifetime is 16%, a figure that demonstrates the prevalence of this neoplasm. However, the risk of death from prostate cancer is only 3.4%, which reaffirms its indolence in a large proportion of cases [8].

In this sense, different anesthetic techniques can modify coagulation factors. Studies have investigated the effects of established anesthesia methods on procoagulant, anticoagulant, and fibrinolytic factors in prostate cancer patients undergoing robotic surgery. Furthermore, the analgesic efficacy of intrathecal morphine during open abdominal surgery is better than that of an intravenous (IV) opioid, but the incidence rates of side effects are comparable between the two pain control methods [9].

Another study of open abdominal surgery suggested that pain levels assessed using a visual analog scale at rest and during coughing are more satisfactory after intrathecal morphine administration compared with a wound infusion of ropivacaine [10]. In this regard, spinal analgesia appears to provide better outcomes in minimally invasive laparoscopy-based surgery than epidural and/or IV analgesia from the immediate postoperative period until the patient is considered clinically suitable for discharge and throughout the hospital stay, in terms of recovery of bowel function, pain scores, changes in lung function, and quality of life [11].

A combination of intrathecal morphine and bupivacaine has been reported to have additive impacts on early postoperative analgesia in patients undergoing gynecological surgery [12]. Therefore, intrathecal morphine and bupivacaine appear to be a potentially acceptable strategy to improve acute pain control after laparoscopic and robotic surgery. Despite this, available clinical evidence remains limited regarding the anesthetic management and outcomes of patients undergoing pure laparoscopic radical prostatectomy (LRP) and robotic-assisted LRP (RALP). Anesthesiologists can expect RALP surgery to be associated with less blood loss and a need for fewer blood products than traditional LRP surgery [13].

Therefore, this study aimed to systematically review the main anesthetic approaches and types of anesthesia in robotic prostate surgery.

Methods

Study Design

This study will follow the international model of Systematic Review and Meta-analysis, following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) rules. Table 1 shows the main variables of this study, which will be addressed according to the PICOS acronym classification (P = Patients; I = Intervention; C = Control; O = Outcomes; S = Study Design).

Table 1. PICOS framework (Patients; Intervention; Control; Outcomes and Study Design).

Patients	Pacientes submetidos a cirurgia robótica
Intervention	Tipos e técnicas anestésicas
Control	Cirurgias comuns, como laparoscópicas
Outcomes	Eficiência no tratamento da cirurgia robótica e dos atos anestésicos na redução do risco de vida e efeitos colaterais
Study Design	Estudos Randomizados Controlados; Prospectivos; Retrospectivos (observacionais/epidemiológicos)

Source: Own Authorship.

Eligibility Criteria

Clinical studies were included, involving randomized controlled trials, prospective and retrospective (observational/epidemiological), published from 2007 to 2023 on the main clinical outcomes of different anesthetic types and techniques in robotic surgery. Case reports, editorials, letters to the editor, review studies, and meta-analyses were excluded.

Quality of Scientific Evidence and Risk of Bias

The quality of scientific evidence in the studies analyzed was classified as high, moderate, low, or very low, based on the risk of bias in the body of evidence, clarity of comparisons, precision, and consistency in the effects of robotic surgery and anesthetic practices, according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) criteria. High-quality evidence was assigned to well-designed randomized controlled trials with consistent results. The quality of evidence was downgraded to moderate if one of the four quality criteria was not met, and lower if two or more were not met. Low-quality evidence was assigned to studies with inconclusive results. The Cochrane Instrument was used to assess the risk of bias of the included studies.

Data Sources and Search Strategy

The search strategies for this systematic review were based on the following descriptors (DeCS/MeSH Terms): *"Robotic surgery. Anesthetic techniques. Minimally invasive surgery. Prostate cancer. Prostatectomy."* The search was conducted from March to May 2025 across the Scopus, PubMed, ScienceDirect, Scielo, and Google Scholar databases. Furthermore, a combination of keywords with the Boolean terms "OR," "AND," and the "NOT" operator was used to target scientific articles of interest.

Table 2. Example of the search structure in PubMed.

PubMed	*Robotic surgery* ***OR*** *Anesthetic techniques* ***OR*** *Minimally invasive surger* ***OR*** *Prostate cancer* ***OR*** *Prostatectomy*
	AND
PubMed	*Randomized controlled trial* ***OR*** *Prospective study* ***OR*** *Retrospective study* ***OR*** *Observational/Epidemiological studies*
	NOT
PubMed	*Case reports* ***OR*** *Editorials* ***OR*** *Letters to the editor*

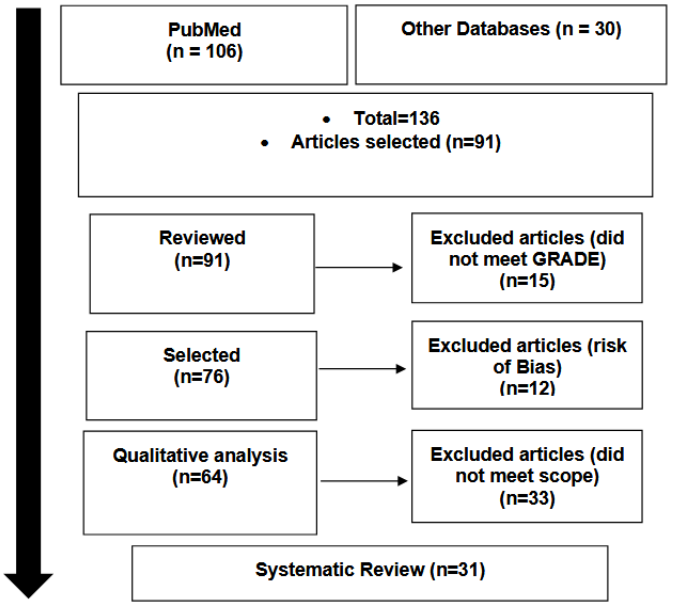
Source: Own Authorship.

Results and Discussion

Summary of Literature Findings

A total of 136 articles were found. A total of 64 articles were fully evaluated, and 31 were included in this systematic review, demonstrating high-quality scientific evidence in the studies analyzed, with a scientific evidence level IA, according to the GRADE criteria. Considering the Cochrane risk of bias tool, the overall assessment resulted in 12 studies with a high risk of bias and 15 studies that did not meet the GRADE criteria (Figure 1). Furthermore, the studies analyzed showed high homogeneity of results (high association of results = >50%) compared to studies with larger sample sizes (greater precision), with a 97.5% R-sq (R^2) value.

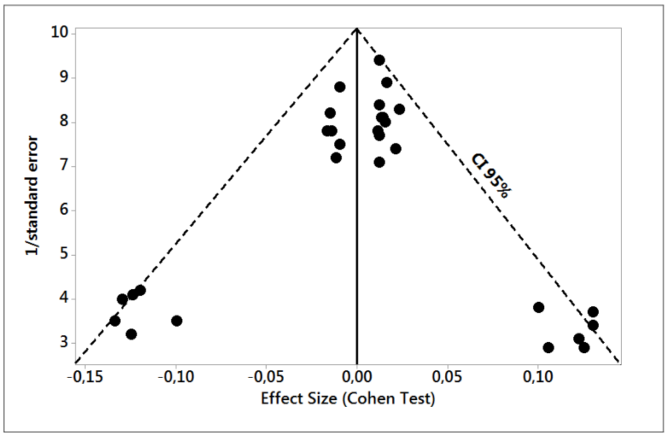
Figure 1. Flowchart showing the study eligibility process.



Source: Own Authorship.

Figure 2 presents the results of the risk of bias of the studies using the funnel plot, showing the calculation of the effect size (magnitude of the difference) using Cohen's d test. Precision (sample size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph displayed symmetrical behavior, suggesting no significant risk of bias, either among studies with small sample sizes (lower precision), shown at the bottom of the graph, or among studies with large sample sizes, shown at the top.

Figure 2. The symmetrical funnel plot suggests no risk of bias among the small sample size studies shown at the bottom of the graph. High-confidence and high-recommendation studies are shown above the graph (n=31 studies).



Source: Own Authorship.

Major Clinical Findings

Robotic-assisted surgery has rapidly spread as a technique for developing laparoscopic surgery through innovative technological improvements, such as 3D imaging with a high magnification lens and freedom of forceps to varying degrees, leading to improved safety and improved functional recovery. In the urological field, it has enabled highly precise surgery in a narrow field, such as the pelvic cavity or retroperitoneal space. Better results have been recognized, especially in perioperative complications and postoperative QOL recovery, than other procedures, such as open or laparoscopic. Robotic assistance has definitively brought about a paradigm shift in urological surgery [1,2,9].

In this regard, a study investigated the analgesic efficacy of intrathecal morphine and bupivacaine (ITMB) in treating early postoperative pain in adult patients undergoing robotic-assisted laparoscopic prostatectomy (RALP). A total of 50 patients were prospectively enrolled and randomly assigned to the non-ITMB (n=25) and ITMB (n=25) groups. The ITMB treatment regimen consisted of morphine 0.2 mg and bupivacaine 7.5 mg (total of 1.7 mL). All patients routinely received patient-controlled intravenous analgesia and were appropriately treated with intravenous (IV) rescue opioid drugs based on the discretion of the attending physicians, who were blinded to the group assignments. Demographic findings were comparable between patients who received and did not receive ITMB. The intraoperative dose of remifentanil was lower in the ITMB group than in the non-ITMB group. Pain scores at rest and during coughing, as well as cumulative IV opioid consumption, were significantly lower in patients who received ITMB than in those who did not in the postanesthesia care unit (1 h after surgery) and the ward (i.e., 6 and 24 hours after surgery). ITMB was significantly associated with postoperative pain scores of ≤3 at rest and during coughing (i.e., 1 h after surgery) before and after adjustment for cumulative IV opioid consumption. On the ward (i.e., 6 and 24 hours after surgery), ITMB was associated with postoperative pain scores of ≤3 at rest and during coughing before adjustment for cumulative IV opioid consumption, but not after. No significant differences were observed in complications, such as post-dural puncture headache, respiratory depression, nausea, vomiting, pruritus, or neurological sequelae, during or after surgery [14].

Furthermore, laparoscopic prostatectomy (LPR) can activate the coagulation system, influencing the risk of perioperative thrombosis in prostate cancer patients. Furthermore, different anesthetic techniques can also modify coagulation factors. Thus, a study investigated the effects of two established anesthesia types on procoagulant, anticoagulant, and fibrinolytic factors in prostate cancer patients undergoing elective LPR. A total of 102 patients with primary prostate cancer undergoing conventional LPR or robot-assisted laparoscopic prostatectomy (RALP) were studied and divided into two groups: total intravenous anesthesia with target-controlled infusion (TIVA-TCI) or balanced inhalation anesthesia (BAL) before surgery. Before induction of anesthesia (T0), 1 h (T1), and 24 h postoperatively (T2), some procoagulant factors, fibrolysis markers, p-selectin, and hemostatic system inhibitors were evaluated. Both patients with TIVA-TCI and BAL showed a marked and significant increase in procoagulant factors and a consequent reduction in hemostatic system inhibitors in the immediate postoperative period ($p \leq 0.004$ for each marker). The use of RALP showed a significant increase in prothrombotic markers compared to LRP. In patients with TIVA-TCI undergoing LRP, a significant reduction in p-selectin levels was observed between T0 and T2 ($p = 0.001$) compared to BAL, suggesting a better protective effect on platelet activation of the anesthetic agents used for TIVA-TCI [15].

A prospective pilot study evaluated the safety and feasibility of robot-assisted transperineal MRI-US stereotactic fusion under local anesthesia (LA) with sedation. Thirty patients undergoing robotic transperineal prostate biopsy were recruited. Intravenous paracetamol 1 g, with midazolam and fentanyl, was administered during positioning. After administration of 5 mL of 1% lidocaine to the perineal skin 2 cm above and lateral to the anus, a periapical prostatic block was administered with 10 mL of a mixture of 1% lidocaine and 0.5% Marcaine. The mean age of the patients was 66 years (range, 53-80 years). The mean dose of intravenous midazolam administered was 1.5 mg (range, 0-5 mg), and intravenous fentanyl was 75 mcg (range, 10–150 mcg). No patient required conversion. Two patients required motion compensation of 3 mm and 7.5 mm, respectively, due to minor movement. The immediate postoperative pain score

was 0 for all patients. Twenty-nine of 30 patients (96.7%) were discharged within 24 hours after the procedure. There were no immediate serious complications. Therefore, it was demonstrated that robotic transperineal stereotactic US fusion with targeted prostate biopsy fusion can be performed safely and accurately under LA with sedation [16].

A retrospective clinical study of 103 patients analyzed anesthesia management in patients undergoing robotic-assisted radical prostatectomy (RARP) in light of current literature data. After selection, the remaining 88 patients were evaluated. A combination of crystalloid and colloid was used for intravenous fluid administration. Approximately 11% of patients required transfusion during surgery. The mean pH and pO2 values of the patients were observed to decrease, while pCO2 and lactate values increased. Radical prostatectomy can be performed using the open technique as a traditional approach or laparoscopic or robotic-assisted techniques as a minimally invasive approach. The anesthetic management of these minimally invasive techniques is very different and challenging in many ways from the open technique [17].

Robotic cystectomy is becoming part of the standard surgical repertoire for the treatment of prostate cancer. A prospective observational clinical study described the respiratory and hemodynamic challenges and complications observed in patients undergoing robotic cystectomy. A total of 16 patients underwent robotic surgery. The main outcome measures were noninvasive monitoring, invasive monitoring, and blood gas analysis performed in supine (T0), Trendelenburg (T1), Trendelenburg + pneumoperitoneum (T2), Trendelenburg before deflation (T3), Trendelenburg (after deflation) (T4), and supine (T5). There were significant differences between T0-T1 and T0-T2, with lower heart rates. The mean blood pressure value at T1 was significantly lower than at T0. The central venous pressure value was significantly higher at T1, T2, T3, and T4 than at T0. There was no significant difference in the PET-CO_2 value at any time point compared with T0. There were no significant differences in respiratory rate at any time point compared with T0. The mean f values at T3, T4, and T5 were significantly higher than at T0. The mean minute ventilation at T4 and T5 was significantly higher than at T0. The mean plateau pressures and peak pressures at T1, T2, T3, T4, and T5 were significantly higher than the mean value at T0. Therefore, although most patients generally tolerate robotic cystectomy well and appreciate the benefits, anesthesiologists must consider the changes in the cardiopulmonary system that occur when patients are placed in the Trendelenburg position and when pneumoperitoneum is created [18].

In this setting, prostate cancer is the second most common cancer in American men, and new surgical techniques have led to less invasive options for prostate surgery. Innovations in robotic technology have allowed robotic systems to become a more common sight in operating rooms across the United States. Approximately 1,500 consecutive patients scheduled for elective robotic prostatectomy (RP) were reviewed. Patient demographics were recorded, and significant intraoperative and postoperative events were reviewed. At our institution, the mean age of patients undergoing RP is 60.3 (41-79) years; the mean body mass index is 27.3 kg m(-2). The mean operative time, defined as the time from the start of insufflation to closure, is 177.5 (81–365) min, and the mean blood loss is 109 (50-750) mL. There was a 1.3% incidence of postoperative anemia (hemoglobin <10 g dL) when patients required blood transfusions (15/1,500). Three patients were diagnosed with postoperative pulmonary embolism and were treated with IV heparin without further sequelae. The most common anesthesia-related complication was corneal abrasions, observed in 3% of cases. One patient required postoperative mechanical ventilation due to laryngeal edema secondary to multiple attempts at intubation of an unexpectedly difficult airway. Anesthetic and perioperative complications are rare in patients undergoing robotic-assisted laparoscopic prostatectomy at our institution. Our institution has performed more robotic prostatectomies than any other institution in the world, and we reviewed our experience in administering anesthesia for the first 1,500 patients undergoing this operation [19].

In this regard, a study presented simple single-port percutaneous transvesical prostatectomy using the novel SP® robotic surgical system. Ten patients underwent simple single-port transvesical prostatectomy between February and November 2019. Percutaneous access to the bladder dome was achieved, and all SP® instruments were inserted through the SP® multichannel cannula directly into the bladder. Prostate adenoma enucleation, hemostasis, and trigonization were performed according to the principles of the simple open prostatectomy technique. All procedures were successful, without the need for conversion to open surgery. The median estimated preoperative prostate size was 159 (IQR 108–223) grams. No intraoperative complications occurred. The median operative time and estimated blood loss were 190 (IQR 146-203) minutes and 100 (IQR 68-175) ml, respectively. The mean postoperative weight of the sample was 84.3 ± 34 grams. The median hospital stay was 19 (IQR 17-28) hours. All patients were satisfied with their urinary flow after catheter removal, with no

episodes of acute urinary retention from 1 to 6 months postoperatively. Therefore, simple single-port transvesical prostatectomy can be offered as an alternative treatment option for the surgical management of lower urinary tract symptoms associated with large prostate adenoma. Sparing the peritoneal cavity, minimal bladder dissection, and excellent visualization of the prostate fossa may be some of the potential advantages of this minimally invasive approach. Comparative studies with standard techniques are recommended to evaluate the surgical outcome and postoperative morbidity of each treatment modality [10, 20-28].

The Cochrane review was prepared to compare laparoscopic radical prostatectomy or robot-assisted radical prostatectomy with open radical prostatectomy in men with localized prostate cancer. Multiple database searches were conducted for randomized controlled trials (RCTs) or quasi-randomized trials (QRTs) published up to June 2017 that directly compared the technologies. Study selection, data extraction, and quality assessment were performed by two independent researchers. Only two RCTs were included: one compared laparoscopic prostatectomy with open surgery, and the other compared robot-assisted prostatectomy with open surgery in participants with localized prostate cancer [29]. This report considered only the results of the study evaluating robot-assisted prostatectomy. The outcomes of overall survival and prostate cancer-related survival were not assessed [30].

The duration of surgery (mean 202.03 minutes (standard deviation SD = 51.36) versus 234.34 minutes (SD = 37.07); p<0.001) and the time in the operating room (mean 246.08 minutes (SD = 55.12) versus 280.37 minutes (SD = 36.36); p<0.0001) were shorter for robot-assisted prostatectomy than for open prostatectomy, respectively. However, there was no difference between the groups in the time spent in recovery. The estimated total blood loss was lower for robot-assisted prostatectomy than for open prostatectomy (443.74 ml (SD = 294.29) versus 1,338.14 ml (SD = 591.47); p<0.0001 [30].

Another study showed that there were no differences between Robot-assisted prostatectomy and open prostatectomy in improving quality of life, urinary and sexual health, surgery-related complications, serious complications, and pain after 12 weeks of surgery. Robot-assisted surgery reduced hospital stays compared to open surgery [28]. Furthermore, a systematic review and meta-analysis conducted by the Austrian Ludwig Boltzmann Institute for Health Technology Assessment (LBI-HTA) in 2015 evaluated the efficacy, safety, and costs associated with the use of robotic surgery in selected indications. For radical prostatectomy, the comparators selected were open surgery and laparoscopic surgery. None of the identified studies showed an explicit benefit of robotic surgery for patients, including nephrectomy, adrenalectomy, prostatectomy, cystectomy, or hysterectomy. Specifically for prostatectomy-related outcomes, one randomized clinical trial and eight prospective cohort studies were included. The main results of the meta-analyses on radical prostatectomy Robotically assisted prostatectomy included in the systematic review for the following outcomes: urinary continence 6 and 12 months after surgery, sexual dysfunction, duration of the surgical procedure, and overall complications. The meta-analysis showed no statistically significant difference between robot-assisted and open surgery in the likelihood of patients having continence 6 or 12 months after surgery. Furthermore, there was relatively high heterogeneity (I^2 = 66 and 72%, respectively) between the studies. This study showed that robot-assisted surgery had a greater likelihood of maintaining preserved sexual function 12 months after surgery than open surgery (relative risk 1.59; 95% CI 1.28 to 1.99). Although with relatively high heterogeneity (I^2 = 73%), a shorter length of stay (1.5 days) was observed in robot-assisted prostatectomy compared to open surgery (p<0.0001). The studies, however, showed very high heterogeneity (I^2 = 99%) [31].

Conclusion

The reported scientific evidence points to some potential benefits of robotically assisted surgery compared to open surgery and laparoscopic surgery. Outcomes related to reduced blood loss and consequent reduced need for blood transfusions, as well as the preservation of sexual function, appear to be the most significant advantages over comparators. Improved urinary continence and shorter hospital stays due to lower perioperative complication rates are also reported in the studies. Furthermore, a single spinal injection of morphine and bupivacaine provided adequate analgesia in the early postoperative period and reduced the need for additional IV opioids in patients undergoing RALP. Despite this, the anesthetic techniques, total intravenous anesthesia with target-controlled infusion and balanced inhalation anesthesia, appear to significantly increase the risk of thrombosis in prostate cancer patients undergoing LRP, especially when the robotic device was used, encouraging the use of perioperative thromboembolic prophylaxis in these patients. Finally, in robotic cystectomy, anesthesiologists should consider the changes in the cardiopulmonary system that occur when patients are placed in the Trendelenburg position and when pneumoperitoneum is created.

CRediT

Author contributions **Conceptualization-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel; **Data curation-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel; **Formal Analysis-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel; **Investigation-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel; **Methodology-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel; **Project administration-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel; **Supervision-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel; **Writing - original draft-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel; **Writing-review & editing-** Geovana Valença de Almeida Lima, Louise do Livramento Mello, Dáfane Lima Miguel.

Acknowledgment

Not applicable.

Ethical Approval

Not applicable.

Informed Consent

Not applicable.

Funding

Not applicable.

Data Sharing Statement

No additional data are available.

Conflict of Interest

The authors declare no conflict of interest.

Similarity Check

It was applied by Ithenticate[@].

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

References

1. Blanco S, Grasso A, Sulmina E, Grasso M. Effectiveness and safety of spinal anesthesia in patients undergoing open radical retropubic prostatectomy. Arch Ital Urol Androl. 2023 May 29;95(2):11281. doi: 10.4081/aiua.2023.11281.
2. Sivaraman A, Ramasamy V, Aarthy P, Sankar V, Sivaraman PB. Safety and feasibility of freehand transperineal prostate biopsy under local anesthesia: Our initial experience. Indian J Urol. 2022 Jan-Mar;38(1):34-41. doi: 10.4103/iju.iju_222_21.
3. Awad H, Walker CM, Shaikh M, Dimitrova GT, Abaza R, O'Hara J. Anesthetic considerations for robotic prostatectomy: a review of the literature. J Clin Anesth. 2012 Sep;24(6):494-504. doi: 10.1016/j.jclinane.2012.03.003.
4. Carpenter BT, Sundaram CP. Training the next generation of surgeons in robotic surgery. Robot Surg. 2017 Apr 21;4:39-44. doi: 10.2147/RSRR.S70552. eCollection 2017.
5. Ahmed K, Abboudi H, Guru KA, Khan MS, Dasgupta P. Robotic surgical technology is here to stay and evolve. Trends Urol Men's Health. 2013;4:32–36.
6. Brasil, Ministério da Saúde, Secretaria de Atenção à Saúde, Instituto Nacional de Câncer José Alencar Gomes da Silva, Coordenação Geral de Ações Estratégicas, Coordenação de Prevenção e Vigilância. Câncer de Próstata, Estimativas e Tratamento. Rio de Janeiro: INCA; 2017. Disponível em: http://www2.inca.gov.br/wps/wcm/connect/tiposdecancer/site/home/prostata.
7. Brasil, Ministério da Saúde, Secretaria de Atenção à Saúde. Diretrizes Diagnósticas e Terapêuticas do Adenocarcinoma de Próstata. Brasília: 2016. Disponível em: http://conitec.gov.br/images/Protocolos/DDT/DDT_Adenocarcinoma_Prostata.pdf
8. Brasil, Ministério da Saúde, Secretaria de Atenção à Saúde, Instituto Nacional de Câncer José Alencar Gomes da Silva, Coordenação Geral de Ações Estratégicas, Coordenação de Prevenção e Vigilância. Cartilha sobre Câncer de Próstata, Vamos falar sobre isso? Rio de Janeiro: INCA; 2017. Disponível em: http://www1.inca.gov.br/inca/Arquivos/comunicacao/cartilha_cancer_prostata_2017_final_WEB.pdf.
9. Ko JS, Choi SJ, Gwak MS, Kim GS, Ahn HJ, Kim

JA, Hahm TS, Cho HS, Kim KM, Joh JW. Intrathecal morphine combined with intravenous patient-controlled analgesia is an effective and safe method for immediate postoperative pain control in live liver donors. Liver Transplant. 2009;15(4):381–389. doi: 10.1002/lt.21625.

10. Lee SH, Gwak MS, Choi SJ, Park HG, Kim GS, Kim MH, Ahn HJ, Kim J, Kwon CH, Kim TS. Prospective, randomized study of ropivacaine wound infusion versus intrathecal morphine with intravenous fentanyl for analgesia in living donors for liver transplantation. Liver Transplant. 2013;19(9):1036–1045. doi: 10.1002/lt.23691.
11. Levy BF, Scott MJ, Fawcett W, Fry C, Rockall TA. Randomized clinical trial of epidural, spinal or patient-controlled analgesia for patients undergoing laparoscopic colorectal surgery. Br J Surg. 2011;98(8):1068–1078. doi: 10.1002/bjs.7545.
12. Lui MW, Li TKT, Lui F, Ong CYT. A randomised, controlled trial of rectus sheath bupivacaine and intrathecal bupivacaine, without or with intrathecal morphine, vs. intrathecal bupivacaine and morphine after caesarean section. Anaesthesia. 2017;72(10):1225–1229. doi: 10.1111/anae.13998.
13. Yonekura H, Hirate H, Sobue K. Comparison of anesthetic management and outcomes of robot-assisted vs pure laparoscopic radical prostatectomy. J Clin Anesth. 2016 Dec;35:281-286. doi: 10.1016/j.jclinane.2016.08.014.
14. Shim JW, Cho YJ, Moon HW, Park J, Lee HM, Kim YS, Moon YE, Hong SH, Chae MS. Analgesic efficacy of intrathecal morphine and bupivacaine during the early postoperative period in patients who underwent robotic-assisted laparoscopic prostatectomy: a prospective randomized controlled study. BMC Urol. 2021 Feb 26;21(1):30. doi: 10.1186/s12894-021-00798-4.
15. Sofra M, Antenucci A, Gallucci M, Mandoj C, Papalia R, Claroni C, Monteferrante I, Torregiani G, Gianaroli V, Sperduti I, Tomao L, Forastiere E. Perioperative changes in pro and anticoagulant factors in prostate cancer patients undergoing laparoscopic and robotic radical prostatectomy with different anaesthetic techniques. J Exp Clin Cancer Res. 2014 Aug 17;33(1):63. doi: 10.1186/s13046-014-0063-z.
16. Yang X, Lee AY, Law YM, Sim ASP, Tay KJ, Lau WKO, Ho HSS, Yuen JSP, Chen K. Stereotactic robot-assisted transperineal prostate biopsy under local anaesthesia and sedation: moving robotic biopsy from operating theatre to clinic. J Robot Surg. 2020 Oct;14(5):767-772. doi: 10.1007/s11701-020-01052-z.
17. Ince ME, Ozkan G, Ors N, Zor M, Yıldırım V. Anesthesia management for robotic assisted radical prostatectomy. Single center experince. Ann Ital Chir. 2020;91:196-200.
18. Oksar M, Akbulut Z, Ocal H, Balbay MD, Kanbak O. Anesthetic considerations for robotic cystectomy: a prospective study. Braz J Anesthesiol. 2014 Mar-Apr;64(2):109-15. doi: 10.1016/j.bjane.2013.09.008.
19. Danic MJ, Chow M, Alexander G, Bhandari A, Menon M, Brown M. Anesthesia considerations for robotic-assisted laparoscopic prostatectomy: a review of 1,500 cases. J Robot Surg. 2007;1(2):119-23. doi: 10.1007/s11701-007-0024-z.
20. Shiroki R, Fukami N, Fukaya K, Takahara K, Kusaka M. Robotic Surgery for Urologic Malignancy - Prostate, Kidney and Bladder. Gan To Kagaku Ryoho. 2018 Dec;45(12):1706-1709.
21. Kaouk J, Sawczyn G, Wilson C, Aminsharifi A, Fareed K, Garisto J, Lenfant L. Single-Port Percutaneous Transvesical Simple Prostatectomy Using the SP® Robotic System: Initial Clinical Experience. Urology. 2020 Mar 11. pii: S0090-4295(20)30261-2. doi: 10.1016/j.urology.2020.02.024.
22. Kaouk J, Bertolo R, Eltemamy M, Garisto J. Single-Port Robot-Assisted Radical Prostatectomy: First Clinical Experience Using The SP Surgical System. Urology.2019 Feb;124:309. doi: 10.1016/j.urology.2018.10.025.
23. Kaouk JH, Sagalovich D, Garisto J. Robot-assisted transvesical partial prostatectomy using a purpose-built single-port robotic system. BJU Int 2018 Sep; 122(3):520-524.
24. Cooper MA, Ibrahim A, Lyu H, Makary MA. Underreporting of robotic surgery complications. J Healthc Qual. 2015;37:133–138.
25. Aghazadeh MA, Jayaratna IS, Hung AJ, et al. External validation of Global Evaluative Assessment of Robotic Skills (GEARS) Surg Endosc. 2015;29:3261–3266.
26. Smith R, Patel V, Satava R. Fundamentals of robotic surgery: a course of basic robotic surgery skills based upon a 14-society consensus template of outcomes measures and curriculum development. Int J Med Robot. 2014;10(3):379–384.
27. Garisto JD. Bertolo R, Kaouk J. Techinque for Docking and Port Placement Using a Purpose-built Robotic System in Human Cadaver.Urology. 2018. Sept; 119:91-96.

28. Chavali JS, Garisto J, Bertolo R, Agudelo J, Kaouk JH. Surgical Hints for Robot-assisted Transvesical Simple Prostatectomy. Urology 2018 Dec;122:185.
29. McVary KT, Dahm P, Kohler TS, Lerner LB, Parsons JK, Wilt TJ, Foster HE. Surgical Management of Lower Urinary Tract Symptoms Attributed to Benign Prostatic Hyperplasia: AUA Guideline Amendment 2019. J Urol. 2019 Sep, 202(3): 592-598. doi: 10.1097/JU.0000000000000319.
30. Sorokin I, Sundaram V, Singla N, Walker J, Margulis V, Roehrborn C, Gahan JC. Robot-Assisted Versus Open Simple Prostatectomy for Benign Prostatic Hyperplasia in Large Glands: A Propensity Score-Matched Comparison of Perioperative and Short-Term Outcomes. J Endourol. 2017;31(11):1164-1169.
31. Ilic D, Evans SM, Allan CA, Jung JH, Murphy D, Frydenberg M. Laparoscopic and robotic-assisted versus open radical prostatectomy for the treatment of localised prostate cancer. Cochrane Database of Systematic Reviews 2017, Issue 9. Art. No.: CD009625. DOI: 10.1002/14651858.CD009625.pub2.