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THE APPLICATION OF ROBOTIC SURGERY INPROSTATECTOMY: A LITERATURE REVIEW

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ABSTRACT

Robotic surgery or robotic-assisted surgery has an essential role in the surgical procedure. This technology in the health sector can help medical professionals to enhance the operations over other surgical techniques. Robotic prostatectomy has more benefits than open surgery. This literature review aims to observe various advantages of robotic surgery in prostatectomy. The method used in this articleis a literature review focusing on the application of robotic surgery in prostatectomy. Robotic surgery in prostatectomy has more advantages compared to the open surgery method. These advantages includereducing the length of stay (LOS), reducing readmission of inpatients with the same medical condition, preventing the high risk of venous thromboembolism (VTE), saving costs, and resulting in increased the function of the urinary system.

Keywords: *Robotic surgery, robotic-assisted surgery, prostatectomy*

INTRODUCTION

The development of technology is inevitable, including technology in the health sector. An example of the development in medical technology is a surgical technique. Starting from open surgery, developing into minimally invasive surgery, such as laparoscopy to robotic surgery, surgery using robot assistance.

The application of robotic surgery was first performed in 1985 when the Unimation Puma 200 was used as a drill guide for brain tumor biopsies (Bell et al., 2013). Continued with robotic intervention for prostatectomy; the first certified robot for use in Europe, ROBODOC, was created in 1996. It was used extensively in Germany and Western European countries (Bell et al., 2013). The utilization of robots is still developing nowadays.

Robot-assisted surgery is carried out in several operating departments, such as urology, cardiothoracic, orthopedic, neurology, and so on. It has been accepted in urological, colorectal, general surgery, cardiothoracic, orthopedic, maxillofacial, and neurological surgery (Connelly et al., 2021). One of the surgical procedures in urological surgery that frequently uses robots is radical prostatectomy.

Prostatectomy is a surgical procedure that aims to remove part or all of the prostate gland. Meanwhile, radical prostatectomy is the radical removal of the prostate, including the prostate capsule, seminal vesicles, and distal vas deferens, followed by anastomosis of the bladder with the urethral membrane (Hora & Dolejsová, 2021). Radical prostatectomy can be performed by open surgery, laparoscopic and robotic surgery. The application of robotic surgery is interesting to be applied and developed continuously. This encourages the researcher to conduct a literature review on robotic surgery in prostatectomy.

METHOD

This paper uses the literature review method. The data are obtained from a literature search of international journals using the Spingerlink, Taylor & Francis and Scopus databases. From the journal search using keywords robotic surgery and prostatectomy. 1,658 articles from 2013 to 2022 were obtained. Along with these, 17 articles are considered relevant. The articles were filtered again, and 10 articles were obtained. The focus of this study is the application of robotic surgery in prostatectomy and its advantages compared to open surgery and laparoscopy.

Table 1. Overview of Purpose, Method, and Results of the Journals

No.	Title	Authors Country	Purpose	Methods	Results
1	Patterns of adoption of robotic radical prostatectomy in the United States and England	Maynou et al. (2021) England	To compare the technological adoption pattern of minimally invasive surgery technology for radical prostatectomy in the United States and England.	Observational analytical	The results show that 66,879 radical prostatectomies were identified in England and 79,358 in the United States during 2005 – 2017. Open surgery abounded in both countries until 2009, when it was surpassed by robotic surgery. In the United States, the adoption of robotic surgery is getting more popular. When compared to open surgery, minimally invasive techniques result in shorter lengths of stay and 30-day readmissions. The robotic approaches were associated with a reduction in LOS, while the readmissions are contrasted with laparoscopic in the United States.
2	A Matched-Pair Analysis after Robotic and Retropubic Radical Prostatectomy: A New Definition of Continence and the Impact of Different Surgical Techniques	d'Altilia et al. (2022) Italy	To compare the recovery rate of continence after radical prostatectomy using a robot with open surgery was measured using 24 hours of pad weight and The International Consultation on Incontinence Questionnaire – Short Form (ICIQ-SF).	Cohort study	In terms of urinary continence and incontinence rates, radical prostatectomy using a robot showed significantly better results than open surgery. The benefit of objective measurement via the 24-hour pad weight and subjective measurement with the ICIQ-SF suggests an increase in the use of robotic surgery over traditional surgery.
3	Low Risk of Venous Thromboembolism After Robot-assisted RadicalProstatectomy Through Systemic Image Assessment: A Prospective Study	Meguro et al. (2021) Japan	To evaluate the risk of venous thromboembolism (VTE) after robot-assisted radical prostatectomy (RARP) and to discuss the appropriateness of giving uniform prophylaxis for VTE after radical prostatectomy in robotic surgery.	Cohort study	Of 209 RARP patients, 12 (5.7%) patients had VTE. None of the events were symptomatic, and the incidence of VTE did not differ significantly between the two types of surgery (p=0.90). Neoadjuvant androgen depriviation therapy (ADT) (p=0.006), D-dimer value on a postoperative day 1 (p=0.001), and lymphocele formation (p=0.043) were not significantly associated with VTE after RARP in multivariate analyses. The risk of VTE after RARP could be less high, and uniform prophylaxis may not be appropriate for RARP. Nonetheless, as risk factors for VTE after RARP, neoadjuvant ADT, high D-dimer levels after surgery and lymphocele formation should be considered.

4	Comparison of 1-Year Health Care Costs and Use Associated With Open vs Robotic-Assisted Radical Prostatectomy	Okhawere et al., (2021) United States	To compare how the healthcare costs and use 1-year after open radical prostatectomy (ORP) differ from the robotic- assisted radical prostatectomy (RARP)	Observational study	Of 11.457 patients who were hospitalized with prostatectomy, 1604 (14%) had ORP and 9853 (86%) had RARP, with the majority of patients (8467 [73.9%]) between the ages of 55 and 64. RARP patients had a higher cost at the index hospitalization compared to ORP patients, but the same total cumulative costs were observed within 180 days and 1-year after discharge. One year after discharge, the use of health care was significantly lower in the RARP than in the ORP in the number of emergency department visits and inpatient visits. The decreased healthcare utilization among inpatients with RARP could result in an additional savings of $2929 and an estimated 1.69 fewer days missed from work for healthcare visits.
5	Clinical Outcome of Endoscopic Enucleation of the Prostate Compared With Robotic-Assisted Simple Prostatectomy for Prostates Larger Than 80 cm3 in Aging Male	Hou et al., (2021) Taiwan	To investigate and compare the difference of the surgical outcomes using endoscopic enucleation (thulium : YAG laser and bipolar plasma; ThuLEP) with robotic-assisted simple prostatectomy (RASP) in the treatment of prostates larger than 80 cm3.	Cohort study	Data were obtained for selected patients with Bowel outlet obstruction (BPO) who were hospitalized with RASP, ThuLEP, or bipolar transurethral enucleation of the prostate (B-TUEP) from January 2014 to December 2020. The data on 396 inpatients with B-TUEP, ThuLEP, and RASP was assessed. A total of 112 patients met the inclusion criteria, with 85 completing the final visit (B- TUEP: 29; ThuLEP: 41; RASP: 15). 41; RASP: 15. The RASP group had significantly longer mean operation time and duration of postoperative hospital stays than the B- TUEP and ThuLEP groups. In terms of voiding improvement, the RASP group was superior to the other groups. There are three surgical methods (B-TUEP, ThuLEP, and RASP) that are effective and safe for the treatment of prostates larger than 80 cm3, with each offering unique advantages. B-TUEP has the shortest operation time, ThuLEP has the least postoperative pain, and RASP improves voiding function the best.

6	The 100 most infuential manuscripts in robotic surgery: a bibliometric analysis	Connelly et al., (2021) Ireland	To evaluate the top 100 cited robotic surgery manuscripts and discuss their content and impact on program changes.	Bibliometric analysis	Among 14,980 manuscripts that were obtained, 100 of them were chosen. The majority of the top 100 cited manuscripts appeared to be urological surgery (n=28), followed by a combination of results from various subspecialty surgeons (n=15) and colorectal surgery (n=13). Most of the manuscripts were in the form of case series/reports (n=42), followed by comparative studies (n=24). The 100 most cited manuscripts showed an increase in robotic surgery from the current basic instrument-holding using 3D technology instruments. From this multicenter study, the analysis showed that robotic-assisted surgery had been accepted in urological, colorectal, general, cardiothoracic, orthopedic, maxillofacial, and neurosurgery surgery.
7	Workplace absenteeism amongst patients undergoing open vs. robotic radical prostatectomy, hysterectomy, and partial colectomy	Pucheril et al., (2020) United States	To investigate how having robotic surgery, compared to open surgery, might influence the time that individuals who are employed return to work after undergoing major surgery.	Cohort study	From the 1157 health-insured patients, those who underwent open surgery, compared to those who had robotic surgery, had 9.9 more absences during workdays for radical prostatectomy (95% CI 5.0 to 14.7, p<0.001), 25.3 for hysterectomies/myomectomy (95% CI 11.0- 39.6, p<0.001), and 29.8 for partial colectomy (95% CI 14.8-44.8, p<0.001). For the three main procedures studied, robotic surgery was associated with fewer days missed from work than open surgery. This information helped payers, patients, and healthcare providers better understand some of the indirect benefits of robotic surgery relative to the costs.
8	Robotic-assisted simple prostatectomy versus open simple prostatectomy: a New York statewide analysis of early adoption and outcomes between 2009 and 2017	Ravivarapu et al., (2020) United States	To determine the distinction of the patient, provider, and facility levels as well as predictors in undergoing robotic- assisted simple prostatectomy (RASP) in contrast with open simple prostatectomy (OSP)	Cohort study	From 2009 to 2017, 1881 OSP and 216 cases of RASP were identified. RASP utilization increased from 2.6% of overall cases in 2009 to 16.8% in 2017. Patient demographics were similar between the two cohorts. The mean length of stay was shorter for RASP patients (3 vs 4 days, p<0.001), and OSP was associated with length of stay (>7 days) (p<0.001). No significant differences were found in 30 and 90-day hospital readmission or 1-year mortality rates. More OSP patients were discharged to continued care facilities (p=0.049), whereas more RASP patients were discharged home (p=0.035). Positive predictors for undergoing RASP included teaching hospital status, moderate and high hospital bed volume, high hospital operative volume, high surgeon volume, and surgeons who graduated within 15

					years of surgery. Since RASP shows positive perioperative outcomes, the diffusion of robotic technology and newer graduates entering the workplace can escalate the upward trend of RASP utilization.
9	Robot-assisted radical prostatectomy in the Middle East: A report on the perioperative outcomes from a tertiary care centre in Lebanon	Labban et al. (2020) Lebanon	Because there is a scarcity of reports on robotic surgical outcomes from the Middle East, the article is to report on the surgical, oncological, and early functional outcomes of robotic-assisted radical prostatectomy (RARP) that happen there.	Case report	A total of 250 patients underwent RARP, of which 182 (72.8%) underwent lymph node dissection. The median (interquartile range) anesthesia time was 330 (285-371) minutes, and the estimated blood loss was 200 (200-300) mL. The overall complication rate was 8%, with 2% Clavien-Dindo Grade III-IV complications. The PSM and BCR rates were 21.6% and 6.4%, respectively. 7.2% of patients received the ADT and EBRT adjuvants. Functional data were available for 11 patients. Continence was 68%, 82%, and 97% of the patients at 3, 6 and 12 months, respectively. For 65 patients who had the potency of bilateral nerve-sparing was 37%, 60% and 83% at 3, 6 and 12 months, respectively. The datapresented indicate that this is the biggest RARP series observed in the Middle East. The surgical, oncological and functional outcomes conform to those published in the studies. What has previously been mentioned validates the safety and efficacy of the application of robotic technology in our region at the time of the implementation phase.
10	Surgeon Automated Performance Metrics as Predictors of Early Urinary Continence Recovery After Robotic Radical Prostatectomy—A Prospective Bi-institutional Study	Hung et al., (2021) Germany	To find out whether clinical factors influence the ability of surgeons' performance metrics to predict recovery of urinary continence after robot- assisted radical prostatectomy (RARP).	Prospective Bi-institutional Study	The study included 193 RARPs performed by 20 surgeons. Concerning the patients, 56.7% (102/180) and 73.3% (129/176) individually reached urinary continence by 3 and 6 months after RARP. The results suggest that clinical factors influence surgeon performance metrics during the prediction of urinary continence recovery following RARP. However, numerous surgeon factors still contribute as independent predictors for early continence recovery. Ultimately, patient factors and surgeon kinematic metrics, documented during robotic prostatectomies, affect the early urinary continence recovery following robotic-assisted radical prostatectomy.

RESULTS

The Application of Robotic Surgery in Prostatectomy

Robotic surgery has been implemented in many surgical specialties, including urological surgery. Connelly et al. (2021), in their systematic review, state that robotic- assisted surgery has been accepted in urological, colorectal, general, cardiothoracic, orthopedic, maxillofacial, and neurological surgery. And prostatectomy is one of the urological surgery procedures that use robotic assistance. In late 2010, the number of robotic-assisted operative procedures performed worldwide increased by 347% since 2007, from 80,000 to 278,000. Of the total procedures, Intuitive Surgical estimates that 110,000 were hysterectomies and 98,000 were prostatectomies (Rabah & Al-Abdin, 2012).

Advantages of Robotic Assisted Radical Prostatectomy

There are several advantages of robotic- assisted radical prostatectomy. First, it can decrease the length of stay (LOS). According to research by Maynou et al. (2021), 66,879 radical prostatectomy procedures were identified in the UK and 79,358 in the US during 2005 – 2017. In these two countries, open surgery dominated until 2014, when it was overtaken by robotic surgery. The adoption of robotic surgery has more rapidly happened in the US. Minimally invasive surgical techniques indicated a decrease in length of stay (LOS) compared to open surgery. This also aligns with Rabah & Al- Abdin (2012) that robotic-assisted surgical techniques will result in shorter lengths of hospital stay.

Second, robotic-assisted radical prostatectomy can reduce readmissions. Maynou et al. (2021) reported that the robotic approach was related to lower readmission rates due to the same medical conditions compared to laparoscopy procedures in the United States. Readmission is a situation in which an inpatient with the same medical condition is allowed to return to the hospital to receive medical care.

Third, it can prevent the risk of high venous thromboembolism (VTE) not to happen. This is in line with research by Meguro et al. (2021), which states that the risk of VTE after robotic-assisted radical prostatectomy (RARP) is probably low.

Fourth, RARP can significantly save more medical costs. According to the study of Okhawere et al. (2021), from the total of 11,457 patients who underwent inpatient prostatectomy, 1604 (14%) underwent open radical prostatectomy (ORP) and 9853 (86%) underwent robotic-assisted radical prostatectomy (RARP) and most of the patients (8467 [73.9%]) were aged 55 to 64 years. In contrast with the patients who underwent ORP, those who underwent RARP had higher medical costs at the index hospitalization. Still, comparable overall cumulative costs were observed within 180 days and 1-year after discharge. The use of healthcare in one-year post discharge was significantly lower in the RARP, contrary to the ORP for the number of emergency department visits and inpatient visits. The reductions in healthcare utilization services among patients who underwent RARP could add up to $2929 in savings.

Fifth, robotic prostatectomy can improve the function of the urinary system. According to Hou et al. (2021), robotic-assisted simple prostatectomy (RASP) results in a positive increase in the function of the urinary system. In line with this study, the robotic prostatectomy can help early urinary continence recovery. The procedure of robotic prostatectomy impacts the recovery of early urinary continence (Hung et al., 2021).

DISCUSSION

The Definition of Robotic Surgery

The precise definition of a robot is a system or tool that can behave or imitate

human behavior to replace and facilitate human work/activities (Hakika et al., 2009). To be classified as a robot, a machine must appear with two kinds of capabilities: firstly, it should be able to get information from its surroundings, and secondly, it can do something physical such as moving or manipulating objects (Hakika et al., 2009). Recently, great developments have been made in medical robotics, with two specialty companies, Computer Motion and Intuitive Surgical, receiving regulatory approval in North America, Europe, and Asia for their robots in minimal surgical procedures use (Bell et al., 2013). The robots used for these surgical procedures are known as robotic surgery or robotic-assisted surgery.

Robotic Assisted Radical Prostatectomy is Proven Safe

Safety is the most important aspect of therapeutic management. Patient safety is a crucial point that health institutions must always prioritize in providing healthcare services. Then, how about the robotic prostatectomy? Does it guarantee safety for patients and also for healthcare service providers? The answer to these questions is supported by research by Labban et al. (2020) that confirms the safety and efficacy of implementing robotic technology in their region during the implementation phase.

The Development of Robotic Surgery

The development of information system technology is unstoppable. It will always evolve over time. And it will also occur in robotic surgery. Procedures with the help of robots will remarkably increase the development of robotic technology in medics as there are also many advantages. Based on research conducted by Ravivarapu et al. (2020), from 2009 to 2017, 1881 open simple prostatectomy (OSP) and 216 cases of robotic- assisted simple prostatectomy (RASP) were identified. RASP utilization increased from 2.6% of overall cases in 2009 to 16.8% in 2017. Furthermore, the researchers explained that RASP showed favorable perioperative outcomes, and the expansion of robotic technology and new graduates entering the medical communities could increase the trend of RASP utilization.

The fundamental aspect in the development of robotic surgery is the extent to which this technology provides benefits; if it provides many benefits, it will surely develop. According to Bell et al. (2013), the key to successful advances in surgical robotics is the added value for patients, surgeons, and the healthcare system in general. The cost-benefit ratio in this sector is somewhat tricky because benefits for patients are difficult to measure and offset compared to the direct costs associated with procuring and maintaining robotic systems. The point of interest is robotic systems that allow the execution of impossible procedures. In these cases, the benefits of the robot are much easier to demonstrate and offset than the costs of the whole system.

Robotic-assisted surgery has been implemented in developing countries as well as in Middle Eastern countries. According to Rabah & Al-Abdin (2012), there are 10 da Vinci robots in Saudi Arabia, with more than 35 professional surgeons. Despite the slow- moving development, they believe that robotic surgery is getting momentum, and its benefits and innovation will presently arrive at other countries in the Middle East.

Implications for Nursing Science

Information technology in the health sector is developing rapidly, including the field of surgery. As a result, the innovation of robotic-assisted surgery must be addressed positively. Nurses who are part of healthcare service providers will grasp the impact of the development of robotic surgery. For the most part, it will genuinely affect nurses who provide nursing care in the operating room. In the procedure, the scrub nurse holds a crucial role in an operation. As a member of surgical teams, the scrub nurse is in charge of setting up, operationalizing, and maintaining various surgical instruments. Thus, operations with the help of robots

clearly require the involvement of nurses. Nurses must be able to learn and practice using robotic technology in operation. In prostatectomy, as a scrub nurse, one must be able to work with other surgical teams in carrying out surgical procedures, either open, laparoscopic, or robotic surgery.

CONCLUSION

Robotic surgery, as one of the health information technologies, will always develop. It will undoubtedly progress as robotic-assisted surgical techniques guarantee many advantages compared to open surgery. In prostatectomy, robotic-surgical techniques can reduce the length of stay (LOS) and reduce readmissions, namely a situation when patients with the same medical conditions return back to the hospital to receive medical treatment. In addition, other advantages of robotic prostatectomy are to save costs and improve the function of the urinary system. Then, concerning the part of healthcareservice providers, nurses play a crucial role in dealing with the development of information technology, including robotic surgery. In brief, as scrub nurses who prepare, operationalize, and perform maintenance of surgical instruments, ones must be able to learn and practice information technology, including robotic surgery.

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