

Robotic surgery in gynecology: A review of literature

Cirugía robótica en ginecología: revisión de la literatura

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Abstract

Background: Robotic surgery carries with it the potential to transform laparoscopic surgery by providing, for the 1st time, instruments with distal ends that mimic the intricate movements of the human hand while at the same time providing the surgeon with a high-definition, three-dimensional view of the operative field. **Objective:** The objective of the study was to describe the clinical application of robotic surgery in benign gynecological conditions, as well as the components of the Da Vinci Si robotic system, analyzing the advantages and disadvantages of this type of surgical approach that it provides to the patient and in turn to the surgeon. **Methods:** Review of the literature in PubMed and UpToDate where the keywords of our review were searched. Inclusion criteria: articles of cases or series containing the sections of the application of robotic surgery in gynecology and clinical results. **Results:** We found 50 scientific articles that included in their titles the key words of our review. Twenty-two articles were discarded, 14 because they were inaccessible, 3 because they were published in bulletins without an impact factor, and 5 because no information was obtained about the researcher's results, their volume, visibility, and structure. A total of 28 articles were chosen for this review. **Conclusions:** Robotic surgery has evolved to be a separate field, with enormous potential for future development. The results show until now that this technology is applicable and capable of offering an adequate treatment to selected patients.

Key words: Robotic surgery. Gynecological surgery. Robotic hysterectomy. Infertility. Robotic myomectomy.

Resumen

Antecedentes: La cirugía robótica conlleva el potencial de transformar la cirugía laparoscópica al proporcionar, por primera vez, instrumentos con extremos distales que imitan los intrincados movimientos de la mano humana, mientras que al mismo tiempo proporciona al cirujano una alta definición con visión tridimensional del campo operatorio. **Objetivo:** Describir la aplicación clínica de la cirugía robótica en padecimientos ginecológicos benignos, así como los componentes del sistema robótico Da Vinci Si, analizando las ventajas y desventajas que este tipo de abordaje quirúrgico brinda a la paciente y a su vez al cirujano. **Método:** Revisión de la bibliografía en PubMed y UpToDate buscando las palabras clave de nuestra revisión. Criterios de inclusión: artículos de casos o series que contuvieran los apartados de la aplicación de la cirugía robótica en ginecología y resultados clínicos. **Resultados:** Se encontraron 50 artículos científicos que incluían en sus títulos las palabras clave de nuestra revisión. Se descartaron 22 artículos, 14 por ser inaccesibles, tres debido a que estaban publicados en boletines sin factor de impacto y cinco porque no se obtuvo información sobre los resultados del investigador, su volumen, visibilidad y estructura. Se escogieron para esta revisión 28 artículos. **Conclusiones:** La cirugía robótica ha evolucionado hasta ser un

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campo aparte, con un enorme potencial para su futuro desarrollo. Los resultados muestran que esta tecnología es aplicable y capaz de ofrecer un adecuado tratamiento a pacientes seleccionadas.

Palabras clave: Cirugía ginecológica. Cirugía robótica. Histerectomía robótica. Infertilidad. Miomectomía robótica.

Introduction

Minimally invasive surgery is at the forefront of technology, and robotic surgery is part of this new development.

This literature review includes the main gynecological surgeries that largely benefit from the use of this robotic technology, such as hysterectomy, myomectomy, tubal recanalization, sacrocolpopexy, endometriosis, and transabdominal cerclage. In addition, the advantages and disadvantages of this technology are analyzed, as well as the influence of the type of training and the learning curve in this type of surgical approach.

Laparoscopic surgery has rapidly evolved in several specialties. In the area of gynecology, robot-assisted surgery is used in different procedures, mainly in hysterectomies due to benign diseases and in myomectomies, as well as in cases of tubal recanalization, lymphadenectomy, endometriosis, and sacrocolpopexy.

Robot-assisted surgery was able to develop technical advances that go beyond laparoscopic surgery, such as¹:

- Three-dimensional (3D) vision.
- High visual definition on the console.
- Forceps movements similar to those of the doctor's hand.
- Better ergonomic position during surgery, which avoids fatigue.

Surgeons who practice robotic surgery for benign gynecological conditions agree that in some cases, blood loss and the need for transfusions are reduced, as well as hospital stay time and time to reintegration to daily activities, although, usually, surgical time for each surgeon's initial cases may be longer than that of laparoscopic surgery, depending on each one's learning curve¹.

There are different opinions regarding the advantages and disadvantages offered by robotic surgery versus laparoscopic surgery in benign gynecological conditions. Therefore, as in any other type of surgery, the advantages of this surgical system or approach and the potential risks inherent to any surgery should be known, and notified to the patient by means of an informed consent before the intervention.

As with any other surgical technique, it is important for the surgeon to be trained and certified according to the guidelines indicated by each hospital institution for the practice of robotic surgery, for him/her to be constantly updated through the tools provided by robotic surgery to ensure the correct use of this technology and always preserve the skills, seeking patient safety at all times¹.

The purpose of this literature review is to describe the clinical application of robotic surgery in benign gynecological conditions.

Methods

Literature review in the PubMed and UpToDate websites' databases, where the keywords of our review were searched.

Identification of studies

The search was carried out by two independent reviewers, initially searching for titles containing the keywords, and then the abstracts were analyzed. There were no controversies between the reviewers.

Inclusion criteria

- Full articles in English or Spanish since 1980.
- Articles on case reports or cases series containing sections of robotic surgery application in gynecology and clinical results.

Exclusion criteria

- Articles with incomplete information.
- Articles with no clinical application.

Study selection

The analysis and follow-up of scientific publications in journals indexed in the PubMed and UpToDate search engines were carried out for the 1980-2018 period. After the identification of 50 studies, a bibliometric review was carried out to identify the reference authors on the topics addressed in our review, the

language and the subject, and 22 articles were discarded: 14 because obtaining them were not possible during the literature review, and the remaining eight, because in the review, three were identified to have been published in bulletins without impact factor, and in the remaining five, information on the results of the researcher, their volume, visibility, or structure was not obtained. Finally, 28 articles were selected for this review.

Data extraction and analysis

During the research, titles containing the keywords were first searched in English, and later, the texts of the 28 articles selected for the review were qualitatively analyzed, confirming their scientific validity and, especially, their clinical application in our setting.

Results

Robotic surgery background

1. *A robot may not injury a human being or, through inaction, allow a human being to come to harm.*
2. *A robot must obey the orders given by human beings, except where such orders would conflict with the First law.*
3. *A robot must protect its own existence as long as such protection does not conflict with the First or Second laws.*

The above is a fragment of Isaac Asimov's futuristic novel *I, robot*, written in 1950, which shows how human beings have always had a special interest in the subject of robotics¹.

Initially, robots were developed to act autonomously by the Stanford Research Institute, Department of Defense, the National Aeronautics and Space Administration, to be able to remotely treat wounded soldiers from a safe place. With the passage of time, technology stopped being used for telesurgery and focused on improving minimally invasive surgery technique.

Robot-assisted surgery emerges as a solution to overcome the obstacles found in minimally invasive surgery, since surgeons opted for other surgical techniques when faced with the time implied by the learning curve, the surgical time often implied by the procedure and the physical fatigue entailed by having two-dimensional vision, as well as the degrees of movement limitation and physician's hand tremor replication².

Robotic surgery uses the basis of laparoscopic surgery, complementing it with distal ends that mimic hand movements and, in addition, provide high-definition 3D vision, making the technique even less invasive by making finer and more accurate incisions.

In 2005, gynecology procedures were started when the technique was approved by the Food and Drug Administration (FDA). As of that date, more than 2000 procedures are performed, with an annual growth of 25%, and with doctors and hospitals promoting robotic surgery and the development of technology in this field, which prompted the creation of the Committee on Gynecologic Practice at the Society of Gynecology Surgeons (SGS) to regulate the information provided to patients, as well as to evaluate practices, results, and data, always focusing on patient safety³.

The Da Vinci surgical system for gynecological procedures was introduced in Mexico in 2014, with the private sector so far being the main performer of this surgery. At present, Mexico has a Da Vinci robot in four private hospitals and four hospitals of the country's public network; there are six in Mexico City, one in Monterrey, and one in the State of Mexico.

Components of the robot

At present, the only platform approved by the FDA and by the Ministry of Health in Mexico is the Da Vinci model Si surgical system, manufactured by Intuitive Surgical (Sunnyvale, CA) (Fig. 1).

The Si robotic surgical system consists of the following components:

- A robot that has three or four interactive arms with stainless steel trocars, plus another arm that is not manipulated by the robot, but by the assistant (Fig. 2).
- A camera and vision system that allows seeing the 3D image of the pelvis, which improves the perception of depth (Fig. 3).
- Instruments that simulate the movement of the wrist (EndoWrist), that is, that translates the mechanical movements of the surgeon in real time within the patient (Fig. 3).
- A master console where the surgeon sits in front of the screen, next to the patient, and from there he controls the robotic instruments through forceps that he grabs with the fingers, and the camera with the combination of controls with the pedals and the clutch, with the following functions (Fig. 4):



Figure 1. Surgeon console.



Figure 3. Master console 3D viewer.



Figure 2. Robotic arms.



Figure 4. EndoWrist and pedals.

- Movements: right-left, up-down, in-out.
- Camera and focus control, repositioning of manual controls.
- Activation of the monopolar and bipolar power source.

During surgery, the physician is able to manipulate, reposition, cut, dissect, coagulate, and suture. Although the surgeon is practically autonomous, an assistant whose role is to perform exchanges, suction, and irrigation, as well as the introduction of sutures, is still necessary.

Advantages

Robotic surgery offers countless advantages over open surgery, and thus, it would not be a good point

of comparison. Robotic surgery must be compared with conventional laparoscopic surgery, over which it has several advantages:

- The ergonomic position of the physician during surgery, which reduces fatigue and discomfort. In some cases of laparoscopic surgery, the surgeon may have problems handling the instruments and reaching the patient abdomen; in contrast, in robotic surgery, the surgeon is comfortably seated at the console and manipulates the instruments using the forceps on his fingers and the pedals³.
- The capacity of the robotic system to reduce the effect of surgeon's tremor to zero, which adds precision and fineness to the surgical procedure³.
- Instruments that simulate the anatomy of the wrist by having seven degrees of freedom of

movement, which allows movements to be natural and in the direction desired by the doctor. This is called Wristed Instrumentation, which provides greater dexterity during surgery (Fig. 4)³.

- 3D vision and image magnification through the angle of the cameras, and high-definition images, which allows the surgeon to have an exact vision and identify tissue planes, blood vessels, and nerves. In comparative studies, these characteristics have been reported to facilitate a decrease in patient blood loss³.
- Using the screen, the physician can write and give instructions to the assistants any time during surgery. If a dual console system is available, the physician can signal and pass the control to the surgeon at the neighboring console to continue with the surgical procedure³.
- Capacity to control four surgical instruments, including the camera, which allows the surgeon to operate with very little assistance from the surgical team³.

Disadvantages

There are really few disadvantages when using the robotic surgical system once reaching the learning curve has been achieved. Maybe, putting aside the cost of the equipment in a developing country, one of the challenges for all surgeons is to change the paradigm of the lack of touch with the robot; that is, as in conventional laparoscopic surgery, the fact of not being able to touch and feel with the hands is changed by the exceptional vision that is attained using the Da Vinci surgical platform³⁻⁵.

Robotics in gynecological procedures

Robotic surgery has several indications in the field of benign gynecological diseases. In this review, we will focus exclusively on the six main procedures performed in benign pathology, which are hysterectomy, myomectomy, sacrocolpopexy, tubal reanastomosis, endometriosis, and transabdominal cerclage.

HYSTERECTOMY

Hysterectomy is the second most common gynecological procedure in the US, with approximately 433,000 cases per year. It can be carried out in several ways: vaginally, laparoscopically, or abdominally.

Although more than half of the cases are performed as abdominal surgery, since 2010, the trend is increasing toward minimally invasive surgery⁵. However, the budget for robotic surgery is limited, and in two randomized studies conducted by SGS in 2010 comparing it with laparoscopy in 148 patients, surgical time was significantly longer in robot-assisted hysterectomy (29 min with laparoscopic surgery vs. 77 min with robotic surgery). The study did not report differences in blood loss, hospital stay time, level of post-operative pain, or recovery time^{6,7}.

In another study carried out from 2007 to 2010 in 264,758 women with benign pathology undergoing hysterectomy in 441 hospitals, comparing robotic surgery and laparoscopic surgery, a hospitalization time of < 2 days was recorded (24.9% vs. 19.65%), although the study does not specify overall patient mean stay; however, the cost increased significantly with robotic surgery (approximately USD 2189 per case). There was no difference recorded in transfusion rates and hospital complications⁸.

A new study, using data of patients from 2009 to 2010, concluded that robotic surgery had a cost that was USD 2489 higher than laparoscopic hysterectomies, but transfusions decreased and cases of post-operative pneumonia also decreased in the group of patients operated on with robot-assisted surgery⁵.

Another comparative study between robotic and open surgery hysterectomy carried out by Silasi et al.⁹ in 2013, included 60 patients, 30 in the robotic surgery group and 30 in the laparotomy group, with ages ranging from 39 to 65 years, an average body mass index of 30 (obesity I) and uteri of more than 1 kg in both groups. Although robotic surgery cases required a longer operative time, in-hospital stay and intraoperative bleeding were observed to be significantly lower than with laparotomy⁶⁻⁹.

One study that was able to provide comparative data between robotic and laparoscopic surgery was that of Payne and Dauterive¹⁰, carried out in 2008. They retrospectively reviewed the last 200 consecutive cases. Between the groups of patients operated with laparoscopy and with robot-assisted surgery, no significant differences were found in operative time and bleeding, although in twice as many patients operated with laparoscopic surgery, the procedure had to be converted to laparotomy surgery¹⁰.

The American College of Obstetricians and Gynecologists and the SGS, after studying cases since 2007, recommend the registry of robot-assisted

procedures to report adverse events and to document advantages and complications of the technique¹⁰.

In an analysis with rigorous methodology that compared the results of 2300 robotic hysterectomies, 11,952 conventional laparoscopic hysterectomies, 5395 vaginal hysterectomies, and 9186 laparotomic hysterectomies in cases of benign gynecological pathology, it was concluded that, in the cases of robotic surgery whose surgeons and surgical team maintain a high volume of interventions (at least 20 surgeries per year), robotic surgery offers greater advantages than the rest of the options and surgical access routes¹⁰⁻¹².

Moawad et al.¹³, in a study where they compared the weight of the surgical specimens (uterus) from robotic surgery and conventional laparoscopic surgery, found that the laparoscopic surgery group had 47 more min of surgical time, a cost of USD 1648 more than the robotic surgery group and 3 times more likelihood that patients would have to be readmitted in comparison with the robotic surgery group. They conclude that, with a robotic surgery expert team, hysterectomy for uteri heavier than 750 g is associated with shorter surgical times and lower hospital cost¹³.

It should be noted that, in our opinion, as well as in several centers of the US, performing a hysterectomy for benign causes should be primarily vaginally or laparoscopically approached. Consequently, robotic surgery has been reserved for surgeries with a higher degree of difficulty, such as uteri with a considerable increase in size (> 14 cm) or with significant anatomical distortions, cases where significant pelvic adhesions are suspected, for example, with endometriosis, prior myomectomies, pelvic inflammatory disease, pelvic abscesses, or a history of uterine artery embolization, among others, where the required dissection is of high precision and robotic technology offers exceptional advantages, especially in visualization and advances in operative performance¹⁴.

MYOMECTOMY

With laparoscopic myomectomy, reducing post-operative morbidity has been possible and, as with hysterectomy, recovery time is faster in comparison with laparotomy.

Regarding the benefits of robotic surgery, such as faster recovery time, less post-operative pain, and prompt return to daily activities in comparison with laparotomy, laparoscopic surgery or laparotomy surgical time and hospital cost sometimes could turn out

to be higher than those of robotic surgery. It has not been demonstrated that there is less blood loss or that there are fewer complications with robotic surgery in comparison with laparoscopic surgery.

However, in a series of 872 patients, Pitter et al.¹⁴ pointed out that robot-assisted multiple myomectomy had comparable results to those of conventional laparoscopy, with a low < 35-week preterm birth rate (17%) and a single uterine rupture being reported (1%)¹⁴.

In our country, there has been good acceptance for the use of this platform in cases of myomectomy, including the full-term birth of babies without the fear of a major complication such as uterine rupture. This shows that robotic myomectomy is an accessible, efficient approach with promising results for patients with myomas who want to become pregnant^{15,16}.

Certain groups, with whom we fully agree, point out that robotic surgery is an effective surgical approach for those cases of higher complexity, either due to anatomical deformation or to the number of myomas, in which ergonomics, the EndoWrist system, and the unmatched vision provided by the robot would be essential for the proper development of each case in particular (Fig. 5)¹⁷.

TUBAL REANASTOMOSIS

The advantages of minimally invasive surgery, such as the precision of incisions, the 3D magnified vision system, and the articulated instruments allow tubal reanastomosis to have better probabilities.

In the year 2000, Degueldre et al.¹⁸ published a study of eight patients with previous laparoscopic tubal ligation to demonstrate the feasibility of robot-assisted tubal reanastomosis. All tubes were recanalized in all patients, and surgical time for each tube was 52 min on average. Five of the eight patients underwent hysterosalpingography, out of which four had bilateral and one unilateral patency. There were two pregnancies reported within the next 4 months after surgery. The authors pointed out that the time versus conventional surgery was favorable for robot-assisted surgery¹⁸.

In a second study with a larger number of patients, they evaluated the feasibility of robotic reanastomosis in comparison with laparotomic microsurgery and found that surgical time with the robot was longer (201 vs. 155 min with laparotomy). However, hospital stay was much shorter (4 h with robot vs. 34.7 h with laparotomy) and the return to daily activities was faster (11 days) with robotic surgery than with laparotomy

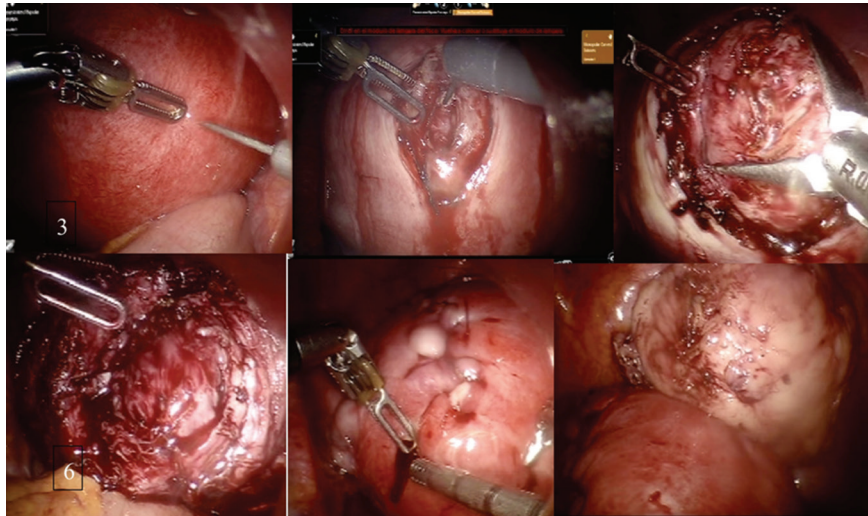


Figure 5. Myomectomy.

(28 days). The achieved pregnancies were also more with robot-assisted tubal reanastomosis (62.5% vs. 50% with laparotomy), but the group of robot-operated patients had a higher number of cases of ectopic pregnancy (4 vs. 1 with laparotomy). As for costs, there was no significant difference between both surgical techniques. This shows that tubal reanastomosis in the era of *in vitro* fertilization is a plausible procedure to restore fertility in selected patients who desire a pregnancy after bilateral tubal ligation¹⁹.

SACROCOLPOPEXY

Vaginal vault prolapse is an increasingly common event in the gynecological practice. Surgical vaginal reconstruction options, such as sacrospinous ligament fixation, uterosacral ligament suspension, and vaginally placed mesh procedures, are alternative treatments, but they have different levels of efficacy and are associated with risks and complications²⁰.

Robotic sacrocolpopexy has been developing in recent years to treat this type of conditions, since, in theory, performing this fixation would be easier than the conventional laparoscopic approach and, for obvious reasons, than open surgery. Geller et al.²¹ published a retrospective study 44 months after the intervention with 51 patients in whom they compared the results of robot-assisted or laparotomic sacrocolpopexy in pelvic organ prolapse. Twenty-three patients underwent robotic surgery and 28 underwent laparotomy. No significant differences were found between both groups of patients in terms of prolapse

improvement, sexual function, and pelvic floor function, but the robot-operated patients had less average blood loss (151 vs. 219 mL)²¹.

Carter et al.²², in another study with a 1-year follow-up, compared robotic and laparotomic sacrocolpopexy (n = 17 and n = 71, respectively) in patients with Stage III prolapse and found shorter times with robotic surgery (131 vs. 160 min), as well as lower rates of readmission, recurrence, days of hospital stay, and associated complications. If a surgical team is trained to perform robotic surgery and sacrocolpopexy, and only performs this type of surgery, the results are excellent in terms of operative time, which drops by almost half an hour when compared with the same procedure with surgical teams that are not exclusive for the procedure²².

ENDOMETRIOSIS

Endometriosis is an increasingly common disease in our society that afflicts millions of women all over the world, causing various symptoms such as pelvic pain, dysmenorrhea, abdominal-pelvic inflammation, and infertility. The gold standard for the diagnosis and treatment of endometriosis is laparoscopic surgery. In cases of deep endometriosis, treatment with conventional laparoscopic surgery requires a complex surgical procedure that has to be carried out mostly by a multidisciplinary surgical team. In these cases, robot-assisted laparoscopy could offer technical advantages, such as 3D vision, tremor filtering, and better surgical ergonomics²³.

Soto et al.²³ conducted a multicenter, randomized study that included 73 patients (35 in the robotic surgery group and 38 in the conventional laparoscopy group) who underwent surgery with a diagnosis of endometriosis. They found a slightly longer surgical time with robotic surgery (106 vs. 101 min) and did not observe significant differences in blood loss, intraoperative or post-operative complications, and conversion rate to laparotomy with both interventions. Furthermore, the improvement in quality of life was similar in both groups at the 6-month follow-up²⁴.

Chen et al.²⁴ conducted a meta-analysis of patients operated on for endometriosis, including studies that, like that by Soto et al.²³, evaluated the same parameters, and found a longer surgical time in the robot group than in the group with conventional laparoscopy, with no significant differences in both groups regarding estimated blood loss, complication rate, and hospitalization days. Thus, the benefits of robotic surgery versus conventional laparoscopy for the treatment of endometriosis should continue to be studied²⁴.

TRANSABDOMINAL CERCLAGE

Cervical insufficiency is defined as an asymptomatic dilation of the cervix, which occurs in the second trimester of pregnancy, mainly before week 24²⁵.

Indications for the placement of a transabdominal cerclage include a short cervix, either congenital or amputated, a cervical scar that would prevent a transvaginal approach, and a previous failed vaginal cerclage. At present, there are increasingly more reports on the performance of transabdominal cerclage with robotic platform assistance, with good intraoperative results being achieved and subsequently a full-term pregnancy being obtained. The results have been comparable to those of open surgery, with very similar costs for both surgical procedures²⁵.

Training and learning curve

With the introduction of robotic surgery, no clear guidelines describing how training should be and what it should consist of have been established²⁶.

For robotic surgery training, there are several aspects similar to those of laparoscopic surgery; however, quality of the images and intuitive movements of the instruments make training in robotic surgery more expeditious. We believe that it is essential and of vital

importance that, to be trained in robotic surgery, the surgeon should be trained in laparoscopic surgery²⁶.

Unlike laparoscopic surgery, the physician is more comfortable during the robotic procedure, since the ergonomic position, he sits in next to the patient reduces fatigue and tiredness, which allows him to train faster and pass the learning curve in less time, although it depends on his skill and ability²⁶.

Despite the rapid growth of robotic surgery, in our country, there are not many surgeons who have been trained to practice this technique, and thus, there are no conclusive data to demonstrate how the training should be, and the number of cases required for each surgeon to overcome the learning curve is not clear.

At present, training involves practice in an operating room adapted to robotic surgery for the surgeon to become familiar with the surroundings, as well as with the functions of the robot with regard to the arms, trocars, and console. Initially, the surgeon learns to perform simple maneuvers, either in a pig or in fresh human tissue, such as the grasp, cuts of various tissues, and the intracorporeal knot. It is suggested that the surgeon should practice at least 8 h on the robotic console and that it should be documented. Training should include surgical procedures in pigs or human cadavers^{3,27}.

Once the surgeon concludes the training, practicing movements on the console and in a practical fashion, he has to perform between two and four surgeries (depending on the requirements of the institution) under the supervision of an expert or proctor assigned by the institution where he carries out his practice (Fig. 5)^{3,27}.

The proctor is a doctor certified in robotic surgery who has complied with the number of cases established by the institution and has surpassed the learning curve. During surgery, he may occasionally sit at the console to counsel and advice the surgeon. The touch screen of the robotic tower, where writing and drawing can be done, is a useful tool that is applied in these cases^{3,27}.

A retrospective study evaluated the behavior when learning the technique in gynecological procedures. It was concluded that surgical times stabilized after 50 cases, but in a surgeon who performed 100 robotic hysterectomies, the times were found to decrease after the first 20 cases, as well as clinical complications²⁸.

Another advantage of the robotic platform is that, through a computer program included in the master console software, the physician can perform exercises and simulation surgeries, like an aircraft pilot, which provides huge advantages because it maintains the familiarity with the functions of the platform and helps for not losing skills and coordination with the robotic system²⁸.

There are factors that affect the learning curve, such as complexity of the cases, the experience the physician has had in laparoscopic and abdominal surgery, and the skills and abilities of the surgical team. Each institution has a minimum number of cases that each physician must complete to maintain the privileges to perform robot-assisted surgeries²⁸.

We believe that, as in other countries, from now on, it is the responsibility of surgeons, hospitals, and medical societies to determine the most profitable and productive use of this technology.

Conclusions

The use of minimally invasive surgery has grown exponentially in recent years. As technology continues to develop, surgical techniques for gynecology will continue to evolve. Further research on robotic surgery is essential to document clinical data and results that support the benefits and advantages, it can provide to patients in comparison with conventional laparoscopy or open surgery in specific conditions.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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Ethical disclosures

Protection of people and animals. The authors declare that no experiments were performed on humans or animals for this research.

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

Right to privacy and informed consent. The authors have obtained informed consent from the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

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