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Advances in Minimally Invasive Surgical Techniques for Gynecological Conditions

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Abstract:

Laparoscopic and endoscopic surgeries have revolutionized gynecological surgeries drastically as they provide the patient s better results and shorter hospital stays. This paper offers a systematic review on the various applications of laparoscopic surgery, robotic surgery, and vaginal natural orifice transluminal endoscopic surgery (vNOTES) in gynecology. Electronic databases used for the literature search involved Scopus, Web of Science, PubMed, with consideration of the recent publications up to 2024. The study revealed that Robotic surgery is an endoscopically performed operation through a robot-controlled arm while laparoscopy is a standard approach to performing gynecologic surgeries for diseases such as endometriosis, ovarian cysts, and fibroids among others. Laparoscopy's benefits include smaller cuts, minimal blood loss, shorter hospitalization, and quicker healing. It also has less infection rates and complications. vNOTES is another technique based on changing and adding techniques such as the vaginal approach to hysterectomy. It employs bipolar vessel-sealing energy devices that minimize blood loss and operation time; volume reduction methods such as coring and wedging. These minimally invasive techniques provide significant benefits such as painless surgical procedures, less hospital stay, and cosmetic benefits. This will help to gather valuable insights into the subject of application of these techniques in various gynecological disorders.

Keywords: Gynecological Surgery, laparoscopy, MIS techniques, robotic surgery.

1. Introduction

Over the last several decades, there has been an increase in the occurrence of tumors, hyperplastic processes, and female genital abnormalities, which have been linked to environmental degradation and stress. The global ageing of the female population necessitates a rethink of surgical treatment

options for elderly patients, particularly for complicated pelvic organ problems (stress urinary incontinence, pelvic floor relaxation, and uterine prolapse). Obstetric and pediatric patients with gynecological illnesses require specialized and careful treatment (Saridoğan et al., 2020).

The advancement in surgical gynecology care is due to the adoption of modern examination methods like magnetic resonance imaging (MRI) and computed tomography (CT) scans, less invasive procedures such as laparoscopy and hysteroscopy, and technologies utilizing different energies. More precisely, Mowat et al (2016) explain that in surgery, 'minimal invasiveness' involves reducing trauma for access to eliminate or correct a pathologic process, intervening less in the intraperitoneal environment, and preserving or returning anatomical relationships of pelvic structures to normal or close to normal after radical surgery.

Various, and frequently contradictory, approaches to surgical treatment of gynecological conditions have presented multiple challenges. Debates often arise regarding the effectiveness of conservative treatment compared to surgery, and the various surgical techniques used for conditions such as uterine myoma, ovarian cysts and tumors, endometriosis, tubal diseases, genital malformations, and prolapse (Sangri et al., 2017). Still, opinions on the possibility and economic repercussions of introducing new technologies, energies, barriers, adjuvant and suture materials, periodization, and drainage remain polarized. The formation of adhesion is a perilous outcome of all surgical procedures. Certainly, it could eliminate the expected positive result. Factors that initiate the adhesive process during laparotomy surgeries include peritoneal desiccation, ischemia, peritoneal cavity exposure to the external environment, and presence of foreign substances (Chen et al., 2023).

With the advent of new surgical methods and technological advancements over the last few decades, advanced gynecologic surgery has undergone tremendous change. Gynecologic surgery has undergone a revolution thanks to minimally invasive methods like robotic surgery and laparoscopy, which offer quicker recovery times, less discomfort, and fewer side effects than open surgery (La Verde et al., 2022). Following several years where laparotomic surgery was the primary method for treating gynecologic cancer conditions, the arrival of "traditional" laparoscopy, robot-assisted laparoscopy, and vaginal natural orifice transluminal endoscopic surgery (vNOTES) has resulted in a shift in surgical techniques. The use of Minimally Invasive Surgery (MIS) in Gynecology Oncology is a trending and relevant subject due to its increased occurrence in clinical settings (Karam & Dorigo, 2020). The main reason for the increasing popularity of MIS is the benefits it provides, such as reduced blood loss during surgery, shorter hospital stays, faster recovery, fewer complications both during and after surgery, and lower overall costs, all made possible by recent advancements in the field. Nevertheless, is ongoing discussion and disagreement regarding the use of minimally invasive procedures, particularly regarding ovarian and cervical malignancies (Chaccour et al., 2023).

In gynecology, MIS technique is presently the most widely used surgical intervention method. In order to limit stress to the body, MIS is performed in gynecology using a variety of procedures, including laparoscopy, hysteroscopy, cystoscopy, and vaginal surgery. Rather than using open abdominal techniques, these methods make up most cases that gynecologists undertake these days. But to maximize MIS, a distinct set of difficulties arising from the quick development of methodologies must be addressed (Antonilli et al., 2021).

MIS has advanced steadily since its contemporary origins in the 1970s, when a German gynecologist conducted the first laparoscopic appendectomy. Video cameras revolutionized MIS by allowing improved posture and visualization during surgical procedures. In Pennsylvania in 1988, the first laparoscopic hysterectomy took place. Following its FDA approval in 2000, the da Vinci Surgical System was heavily advertised to gynecologists (Scarpelli & Armano, 2022).

Hysterectomy has rapidly become one of the most frequently conducted MIS procedures in the United States. The American College of Obstetricians and Gynecologists (ACOG) suggests choosing laparoscopic hysterectomy over open abdominal hysterectomy for improved patient results. Compared to traditional open abdominal surgery, minimally invasive surgical treatments have been shown to result in shorter postoperative hospital stays and quicker recovery times. Less invasive options for hysterectomy have decreased the percentage of open abdominal hysterectomies from 65% in 1998 to 54% in 2010, while also seeing a rise in minimally invasive surgeries, especially laparoscopic and robot-assisted procedures (Pecorino et al., 2022).

The rate of minimally invasive hysterectomy procedures has been steadily increasing over the past decade; most US Obstetrics and Gynecology residents now use a minimally invasive approach for most of their hysterectomy patients. The Accreditation Council for Graduate Medical Education (ACGME) and ACOG recently adjusted the required number of hysterectomy cases for US residents to account for the rise in MIS surgeries. They accomplished this by reducing the needed amount of total abdominal hysterectomies and increasing the overall number of hysterectomies (Stewart& Fader, 2017). Consequently, MIS is increasingly viewed as an essential expertise for every gynecologist.

Materials and methods

A systematic search was conducted using selected keywords, such as "fungal pathogens, "MIS techniques", "Gynecological Surgery," "laparoscopy", "robotic surgery.", and " Transvaginal vNOTES". The publication date and language were included as additional parameters to help narrow down the search results. The databases Scopus, Web of Science, and PubMed were used for the literature search. These databases were picked because they provide a wide range of scientific literature coverage in different fields. The search was carried out through 2024 to include the most recent data that was accessible at the time of the investigation.

Results and discussion

Gynecology has been transformed by MIS, which provides less invasive options to traditional open surgery for various diseases. MIS procedures are often associated with fewer incisions, less stress to surrounding tissues, shorter recovery times, and less postoperative discomfort than standard open surgery. Technological advancements have enhanced these approaches, resulting in improved results and broader uses in gynecological surgery. Laparoscopy and robotic-assisted surgery are now common treatments for fibroids, endometriosis, ovarian cysts, and pelvic organ prolapse. The advantages that these techniques offer—less intraoperative blood losses, shorter hospital stays, quicker recovery after surgery, fewer peri- and post-operative adverse events, and, since that new developments have reduced operating costs—are the main cause of the growing usage of MIS (Li et al., 2017). But the usefulness of minimally invasive treatments is often debated and questioned, especially when it comes to ovarian and cervical cancers.

Generali et al. (2023) thoroughly analyze the role of MIS in treating ovarian cancer. The research concentrated on four areas: treating early-stage ovarian cancer with minimally invasive methods; using laparoscopy for pre-surgery planning; comparing MIS and open surgery for advanced tumors post-chemotherapy; and laparoscopy's impact on common ovarian cancer cases. The absence of randomized controlled trials prevents a definitive conclusion on the safety and effectiveness of using laparoscopy for ovarian cancer management, specifically for Primary Debulking Surgery (PDS) and Interval Debulking Surgery (IDS). Nevertheless, guidelines from National Comprehensive Cancer Network® (NCCN®) and ESMO-ESGO support its use for early-stage treatment.

Furthermore, the appropriateness of utilizing laparoscopy to assess cytoreducibility in advanced ovarian tumor cases is debatable; nevertheless, specific laparoscopic scores are presently employed to identify patients suitable for initial surgery over IDS. The minimally invasive procedure, as shown in a case report by Kang et al (2023), is deemed safe and efficient in treating recurrent ovarian disease. This is particularly true when the recurrence is limited to a few metastases. The primary concern in this case is the elimination of metastatic cancer that was confined to the spleen. The disease was diagnosed using the tumor marker CA125, and the laparoscopic approach's accurate magnification ability facilitated the removal.

Pados et al (2024) thoroughly examined this aspect in a review that concentrated on the utilization of MIS for assessing lymph nodes in endometrial cancer. Weng et al. (2022) conducted research on 18 females diagnosed with endometrial hyperplasia, collecting endometrial lavage samples as well as biopsy samples at the same time. Indeed, examination of endometrial tissues revealed genetic abnormalities in 72.7% and 44.4% of women with atypical and non-atypical endometrial hyperplasia, respectively, suggesting that MIS could be used for precise diagnosis. In their study, Cui et al (2023) investigated the efficiency of loop electrosurgical excision procedure (LEEP) conization. They discovered that LEEP can give a precise diagnosis for papillary squamous cell carcinoma in women, especially when pre-surgical imaging fails to detect cancer.

Overall, patients with gynecological disorders have benefited greatly from the development of MIS procedures, which have made surgery possible even for patients who are more susceptible. There are still several challenges with using MIS to treat gynecological tumors, particularly ovarian and cervical malignancies, which means that further viewpoints and randomized studies are needed to confirm its usefulness.

- **Laparoscopic surgery**

Laparoscopic surgery, sometimes known as minimally invasive surgery, has advanced significantly and transformed the way a wide range of surgical operations are performed. It is currently used in most surgical professions. Laparoscopic surgery in gynecology has evolved into a very complex and accurate technique of surgery. Many sophisticated gynecological treatments may now be completed safely and efficiently utilizing laparoscopic methods (Rudiman, 2021). In gynecologic surgery, laparoscopy has become a routine procedure for treating a variety of diseases, including fibroids, ovarian cysts, and endometriosis. Compared to open surgery, laparoscopy has fewer cuts, less blood loss, shorter hospital stays, and quicker recovery periods. Additionally linked to a decreased risk of infection and other problems is laparoscopy.

Laparoscopy is used for either diagnostic or surgical purposes. Diagnostic laparoscopy is a surgery that allows a clinician to directly examine the pelvic organs in order to analyze pelvic discomfort, infertility, probable ectopic pregnancy, endometriosis, and other conditions. It is frequently indicated when other diagnostic procedures, such as asking about symptoms, physical examination, ultrasound, or radiographic (X-ray) investigations, fail to confirm the cause or symptom of a condition. Operative laparoscopy enables doctors to perform gynecological procedures in a minimally invasive manner (Tonutti et al., 2017).

Laparoscopic surgery is conducted under general anesthesia. Before the laparoscopy, a tube (catheter) may be put into the bladder to drain urine during operation. A 10-mm incision is created in the umbilicus, and a Veress needle is introduced into the abdomen. The Veress needle is then linked to a carbon dioxide (CO2) insufflation tube. Gas is introduced into the abdominal cavity to dilate the abdomen, allowing the doctor to see the pelvic organs and execute the operation more readily. A 10 mm trocar (g) is inserted into the umbilicus, followed by additional 5 mm trocars put throughout the lower abdomen. A laparoscope linked to a video camera is inserted through the 10 mm port. The video camera's collected images are immediately shown on a video monitor. A bright light source is channeled into the abdominal cavity to provide lighting. The remaining 5mm ports are used to insert instruments such as laparoscopic scissors and graspers throughout the procedure. After the procedure, all of the equipment is withdrawn, and the CO2 gas is expelled. The incisions are either sutured or taped. In certain cases, a drainage tube is left in the pelvis to drain any fluid that may build following surgery (Togni et al., 2015).

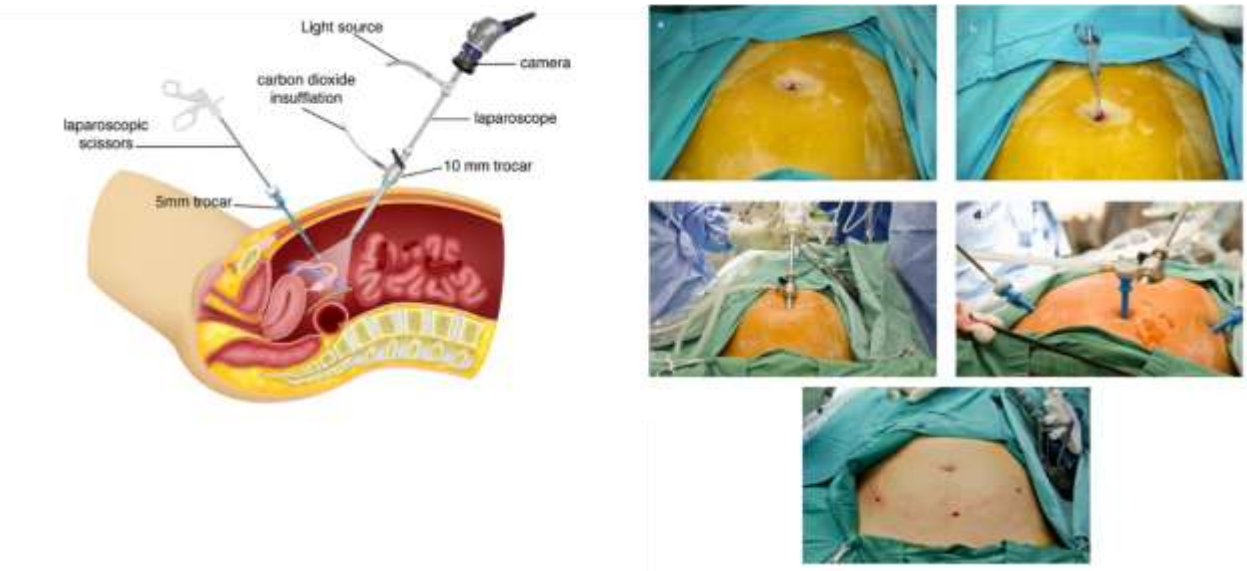

Figure1,2. Laparoscopic surgery procedures

It is widely believed that laparoscopy is the most efficient method to confirm the diagnosis of endometriosis. Following the diagnosis of endometriosis and the scheduling of laparoscopy, the preoperative assessment should focus on detecting concealed lesions or enhancing surgical preparation. Ultrasound can help evaluate adnexal masses and detect endometrioma (Kiesel & Sourouni, 2019). The existence of an endometriotic cyst should lead to a comprehensive assessment of both adnexa. Around one third of endometriotic cysts can be located bilaterally, with

a few being too small to be identified through physical examination alone as mentioned by Lier et al (2020).

Women experiencing symptoms like dysphagia, rectal bleeding, or thickening or nodules in the rectovaginal septum may find preoperative imaging helpful. These signs could suggest a recto-sigmoid issue, which may require surgical removal of a portion of the intestine and reconnecting the remaining parts. MRI, CT, or barium enema have historically been the favored options for detecting these abnormalities. In contrast, endorectal ultrasound may offer a benefit compared to MRI or CT as it involves less radiation and has demonstrated greater accuracy in identifying rectal endometriosis (Goncalves et al., 2021).

Laparoscopy offers a major advantage over medication for endometriosis as it provides both a conclusive histologic diagnosis and surgical treatment in one procedure. Only one conservative endometriosis surgery clinical trial has been conducted, following randomized, double-blind, placebo-controlled methods (Pascoal et al., 2022). In a study involving 63 women experiencing pelvic pain and stage I-III endometriosis, subjects were randomly placed into two groups: one receiving laser treatment for endometriosis lesions and laparoscopic uterine nerve ablation, while the other group underwent diagnostic laparoscopy only. Six months after the surgery, more than 63% of the intervention group saw an improvement or resolution of symptoms, while only 23% of the control group experienced the same. However, this research has notable drawbacks that reduce its generalizability. Endometriosis was not confirmed through histology; surgery included adhesiolysis and uterine nerve ablation (making it impossible to separate the individual effects of laser ablation on pelvic pain); and only 10% of women had stage III endometriosis according to reports. In spite of these constraints, the study affirms the effectiveness of conservative surgical treatment for pelvic pain related to endometriosis (Koninckx et al., 2021).

Currently, surgical removal is the only treatment for retained ovaries. The preferred surgical method is laparoscopy; however, because of significant adhesions, these surgeries are typically difficult and need extensive laparoscopic training. The available published data indicates a relatively limited degree of pain reduction after surgery. For example, a study conducted by Saturnino et al (2022) revealed that just 48% of females attained lasting pain relief after undergoing laparoscopic treatment for ovarian retention syndrome. Inguinal, femoral, and sciatic hernias can also be detected and repaired using laparoscopy. In a small study of 20 patients with sciatic hernias, Chihara et al (2023) discovered that laparoscopic surgery had a notable impact on reducing symptoms. In cases of persistent pelvic pain, hernias should always be taken into account, with laparoscopy being an essential technique for diagnosing and treating painful hernias.

In terms of indications, laparoscopy has progressed from a simple diagnostic tool for assessing acute and chronic pelvic pain, evaluating infertility, and assessing amenorrhea to a major surgical aid for treating a wide range of gynecological problems such as ectopic pregnancy, removal of lower abdominal masses, performing hysterectomies, and staging and treating gynecological cancers (Omokanye et al., 2017). Major laparoscopic operations have a higher incidence of problems (0.6%-18%), whereas small laparoscopic procedures have a rate of complications ranging from 0.06% to 7.0%. The reported total complication rate ranged between 0.2% and 10.3%.10 the majority of difficulties arise with the insertion of Verres' needle into the belly to induce pneumoperitoneum. Other modest hazards include surgical port hernias and site infections. Major consequences of laparoscopy include bladder injuries, intestinal damage, major blood artery

injuries, and anesthesia-related concerns such as aspiration and trouble breathing the patient (Akhtar et al., 2023).

Conditions that may make it impossible to do laparoscopic surgery Patients with the following conditions may not be suited for laparoscopic surgery (Chao et al., 2016). 1) Laparoscopic surgery may not be appropriate for people with bleeding problems, since it increases the risk of copious bleeding during the procedure. 2) Patients who have previously had laparotomy may not be candidates for laparoscopic surgery because scarring can cause pelvic and abdominal organs to cling to the abdominal wall. Separation of these scar tissues may cause difficulties. However, an expert surgeon can still undertake laparoscopic surgery on individuals with this disease. 3) Due to the larger uterus, trocar placement may cause unintended uterine damage.

Another issue that might arise because of CO2 insufflation is an acid-base imbalance caused by CO2 absorption, which could lead to hypercarbia (excess carbon dioxide in the bloodstream), endangering the fetus. However, with proper safeguards, laparoscopic surgery can be performed on pregnant women, particularly in the early stages of pregnancy. 4) Fibroids and adenomyosis can induce uterine enlargement. When the uterus is big, the surgeon may have less space to do the laparoscopic operation. It may be difficult for a surgeon to see all of the structures using a laparoscope. Overall, a doctor's abilities and expertise are critical in assessing whether can do a laparoscopic operation.

- **Robotic surgery**

Robotic surgery is becoming increasingly popular as a less invasive method in gynecology, particularly for gynecological tumors (Suzuki et al., 2023). With the robotic surgical system, physicians may perform their procedures while viewing a three-dimensional image of the operating field from the comfort of an ergonomic console. The surgeon's hands automatically align with his or her eyes as the fingers manipulate instrument controls beneath the display. The technology converts the surgeon's hand movements into accurate micro movements of a tool inside the patient in real-time. The surgeon performs surgery in a seated position; the robotic arms efficiently manage the camera and instruments, reducing pressure on both the surgeon and the assistant. The robotic arm has a wrist-like rotation function that offers 7° of flexibility and 90° of articulation, exceeding the human wrist's range of motion. Simultaneously, the robot arm can dampen vibrations, ensuring a more stable surgical process (Yan & Meng, 2023).

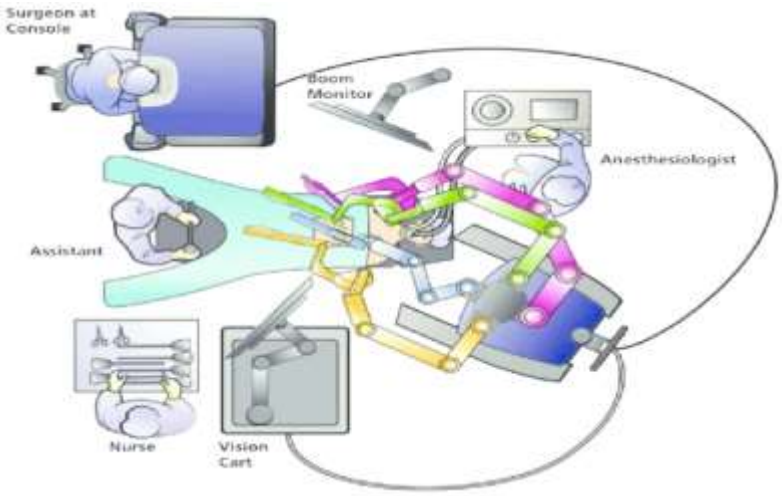

Figure3, 4. Robotic surgery procedures

Enhancing robots with computer assistance provides many advantages compared to traditional laparoscopy with straight instruments. The primary benefit appreciated by most surgeons is the capability to view the surgical area in high-quality 3-D with a stable camera platform controlled by the surgeon. Most current and future systems will see advantages in using wristed instruments that have advanced articulation for better manipulation, precise scaled motion, and the ergonomic benefit of sitting comfortably at a console instead of standing and trying to operate rigid instruments while watching a remote video monitor (Moon et al., 2020).

There have been various challenges in the development of robotic surgery in gynecology. The disadvantages of robotic surgery involve increased costs for the robot's equipment and operation, as well as a longer setup time for the robotic arm in comparison to traditional laparoscopy. The assistant is in charge of various tasks such as docking and undocking, changing tools, and placing and removing surgical materials. Surgeons are also concerned about the absence of tactile

sensation, which can result in technical errors, extended surgical durations, and difficulties in teach (Johansson et al., 2021).

Another drawback is the restricted capacity of the surgeon to communicate with the OR team while focusing on the tasks at the robotic console. Utilizing teamwork training strategies based on aviation industry's "cockpit communication" techniques can decrease this constraint (Rivers et al. 2003). Many contemporary robotic systems are currently utilizing an "unlocked" surgical cockpit to improve communication and situational awareness for the robotic surgeon during surgery. Surgeons who once hesitated to perform hysterectomies or other complex gynecological procedures using traditional laparoscopy now see that the robot allows them to convert the majority of open surgeries to minimally invasive procedures.

At first, the robot's primary benefit was its ability to make complex minimally invasive surgeries easier for surgeons compared to laparoscopy. Gynecologists have been using laparoscopy as a minimally invasive technique since the mid-1970s. In the 1980s, there was a rise in the number of intricate surgeries involving cutting and stitching, with Dr. Harry Reich successfully completing the first laparoscopic hysterectomy in 1989. Dr. Arnold Advincula, a pioneer in robotic gynecologic surgery, introduced the first robotic myomectomies in 2003, when many gynecologists were still performing them as open surgeries.

Gynecologists quickly adopted computer-assisted tele-surgery, leading to a major change in the approach to hysterectomies in the US. The use of robotic surgery in non-cancerous hysterectomies has become more debatable due to primarily financial reasons. Several research studies have indicated that robotic surgery costs more than traditional hysterectomy procedures (Rardin 2014). A widely known research conducted by Wright and team utilized a vast national payer inpatient database to demonstrate that for surgeons performing fewer than 12 procedures per year, the quality outcomes of robotic surgery were similar to laparoscopic surgery, however, robotic surgery was more expensive. The information in this research was analyzed while most of the robotic surgeons were still learning. Additionally, the robot's capital expenditures were considered, while the capital expenditures for laparoscopic equipment were not considered. Ultimately, this research examined surgeons who conducted an average of 10 procedures annually (Wright et al. 2013b). Newer research has shown that differences in costs between experienced high-volume robotic surgeons become less significant after surgeons finish their learning curves (Lim et al. 2016).

Previously, surgeons conducting diagnostic laparoscopy on patients experiencing chronic pelvic pain had few choices for addressing severe endometriosis and inflammatory adhesions, as standard laparoscopy and surgeon skill were limiting factors. Robotic technology may improve surgeons' ability to detect endometriotic lesions with advanced high-definition 3-D vision, providing an additional benefit of robotics over traditional laparoscopy in treating endometriosis. Recent research has explored the use of laser-activated dyes like indo-cyanine-green dye (ICG dye) to enhance the detection of endometriosis by highlighting vascular lesions and lymph nodes during surgery (Lenihan, 2023).).

The robot has proven beneficial in treating complex and large ovarian cysts, including dermoid cysts and other benign and malignant tumors (Liu et al., 2019). Compared to surgeons who use laparoscopy to simply remove the ovary, the robot enables numerous doctors to extract the cysts while keeping the ovary intact. The utilization of robotic techniques for functional and

hemorrhagic cysts has not been widely embraced, as most surgeons find it easier to manage these conditions using conventional laparoscopic methods. Additionally, since a lot of these treatments are innovative, numerous surgeons may be unable to use a robot in the evening after regular operating room hours.

A recent meta-analysis found that robotic-assisted myomectomy had superior results compared to open myomectomy in terms of challenges, estimated blood loss, blood transfusions, and hospital stay duration, although it did take longer to perform. Additionally, the rate of conversion to laparotomy was notably lower compared to laparoscopic surgery. The rate of complications is reduced in robotic-assisted surgery when compared to laparoscopic and open surgeries. This is because of the developed 3D vision system in the robotic surgical system, enabling more efficient and precise suturing with wrist instruments in a shorter amount of time (Lonnerfors, 2018). Moreover, the use of robots during myomectomy greatly improved the quality of life for patients. Nevertheless, more investigation is necessary to detect differences in long-term outcomes (such as post-surgery pain and ability to conceive). Although fertility rates did not differ significantly, surgeons may expect improved surgical techniques, reduced danger of difficulties, and other beneficial long-term results with increased skill in robotic-assisted surgery (Sheng et al., 2023).

Due to its high precision and reliability, robotic surgery is being used for the treatment of gynecologic cancers. Robotic surgery was used the most to treat endometrial cancer (51%), with cervical and ovarian malignancies being the next most common. The recent LACC clinical trial showed that for cervical cancer patients, laparoscopic surgery resulted in shorter disease-free survival and overall survival compared to open hysterectomy, especially in the early stages of the disease. Rates of cervical cancer are on the decline, according to Clair & Tewari (2020). In the future, robotic assisted minimally invasive surgery is expected to be the primary method used in gynecological surgery. Potential future areas of focus for advancement in robotic surgery include utilizing smaller robotic devices, implementing assisted docking, incorporating single-incision procedures, enabling remote surgery with robots, and reducing setup and surgical time (Park et al., 2023). Additional future studies are needed to provide more data on the extended results and cost efficiency of robotic-assisted surgeries.

- **vNOTES**

Kalloo et al. (2004) first documented natural orifice transluminal endoscopic surgery (NOTES) in a pig model, allowing peritoneal cavity access via natural openings like the mouth, vagina, urethra, and rectum. Next, Reddy and Rao and colleagues conducted the initial trans-gastric appendectomy in humans using a flexible endoscope, generating worldwide enthusiasm for NOTES. NOTES offers various benefits like reduced post-operative pain, quicker healing, decreased post-operative infections, and better cosmetic results. Ahn et al (2012) demonstrated that vNOTES is feasible and safe for gynecological procedures, setting the stage for further development of this technique. After this, s, many authors have recounted their experiences with utilizing vNOTES in gynecological procedures. However, the lack of established surgical guidelines and the novelty of the method have resulted in a significant variation in the studies. In this article, we discuss a case of tubal sterilization and aim to summarize the current research on the use of vNOTES in gynecological surgery.

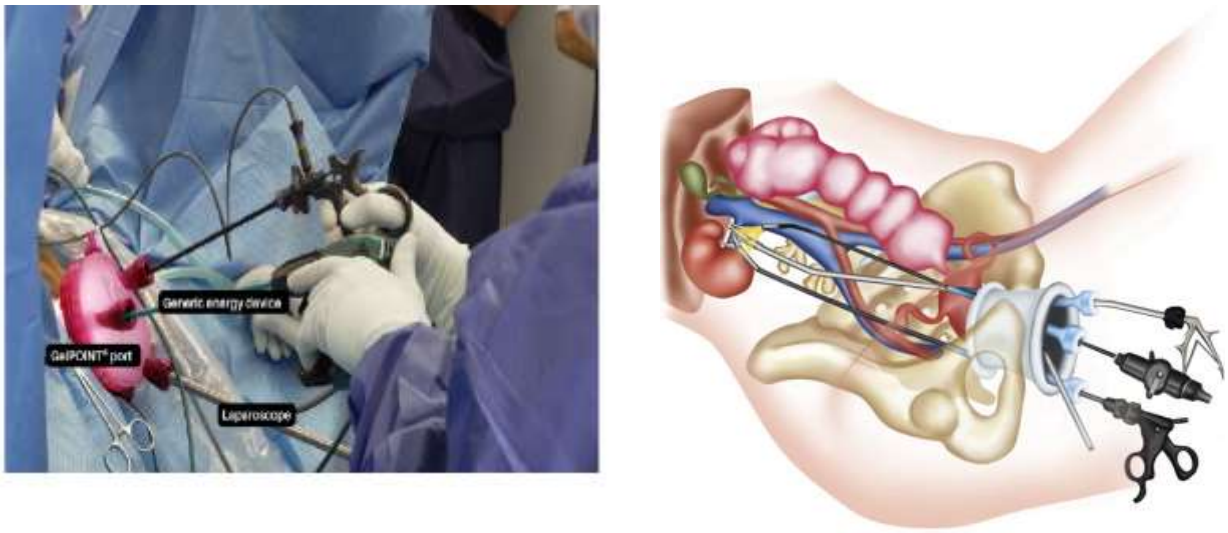

Figure5. vNOTES technique

Li& Hua (2020) suggested that the vNOTES technique could decrease issues at the insertion spot like infections and hernias, enhance patient contentment, shorten hospital visits, lessen post-surgery pain, and decrease the chances of hematoma and trocar wound adhesions. Ferro et al (2023) pointed out important concerns regarding vNOTES such as rectal wound, vascular wound, bladder wound, intra-abdominal abscess, urine retention, and dyspareunia. This research discovered a complication rate of 9.8% in total, most of which was attributed to the surgeon's expertise and experience level. Exclusions for vNOTES consist of previous rectal surgery, suspected rectovaginal endometriosis, suspected malignant tumor, past pelvic inflammatory disease, and ongoing lower genital tract infection (Hurni et al., 2022). Regarding antibiotic prevention, cefazolin should be given through injection before surgery, followed by cefazolin and gentamicin for one day post-surgery.

The use of vNOTES in gynecological surgery has risen in recent years, including a variety of procedures like salpingectomy, cystectomy, tubal sterilization, tubal patency assessment, ovarian drilling, hysterectomy, myomectomy, sacrocolpopexy, and lymphadenectomy (pelvic and retroperitoneal). The vNOTES techniques are also employed for hysterectomy, emergency surgeries on the adnexa (removal of ovarian cysts, fallopian tubes, ovaries), and uterosacral ligament suspension. These procedures are also used in various situations, such as overweight women, patients who have not given birth, large uteruses, and individuals who have had previous hysterectomies (Aharoni et al., 2021). This review will talk about how vNOTES is currently being used in modern gynecologic endoscopic surgery.

Raquet et al. (2023) discussed their initial encounters with utilizing vNOTES for managing noncancerous gynecological issues. None of the 32 patients who underwent the vNOTES procedure needed to be switched to laparotomy or conventional laparoscopy. While the vNOTES treatment is effective in managing adnexal diseases, the authors highlighted restrictions, including its applicability in women with prior caesarean surgery and a large uterus. Interdonato et al. (2022) studied 46 people who underwent vNOTES surgery for various gynecological issues including myomas, metrorrhagia, H-Sil/in situ cervical cancer, adenomyosis, BRCA 1-2 mutations (6.5%),

endometrial hyperplasia, ovarian cyst + history of breast cancer, metrorrhagia, and hydatidiform mole. The average surgery time was 91.1 ± 32.6 minutes, with only 2 complications noted post-surgery. The study group reported perioperative and postoperative data that aligned with earlier vNOTES research studies.

Jung& colleagues (2022) published the findings of a preliminary study that investigated the surgical outcomes of vNOTES in comparison to single-port access adnexectomy. The research included 12 female participants who had vNOTES adnexectomy and 55 individuals who had single-port access adnexectomy. Nevertheless, patients who underwent vNOTES experienced decreased postoperative pain levels and needed less pain medication, while other surgical results were comparable in both groups. According to Tekin et al (2023), the vNOTES method is feasible, well-received, and secure for performing hysterectomy, myomectomy, gynecological diagnostic procedures, and adnexal procedures. In their research, Gündoğdu et al (2023) examined the effectiveness and safety of spinal anesthesia in the vNOTES technique. In six patients studied, there were no cases of needing to switch to laparotomy or traditional laparoscopy. The researchers found that vNOTES surgery under spinal anesthesia is secure. The vNOTES method for hysterectomy showed reduced surgical time, faster gas expulsion, shorter hospitalizations, and lower pain ratings in comparison to trans-umbilical laparoscopic single-site surgery.

Conclusion

New trends in gynecological surgery include laparoscopic surgery, robotic surgery, and vNOTES which are minimally invasive procedures. These techniques advantages over the traditional open surgeries include minimal postoperative pain, less duration of hospitalization, shorter time to recovery and better aesthetic appearances. Laparoscopic surgery is a technique of performing surgery through small incisions by placing a laparoscope, which is a lighted and camera fitted tube, into the abdomen to carry out operations. Robotic surgery is an improvement to laparoscopy where detailed responses are made through the help of a robot mastermind holding surgical arms operated by him. vNOTES, on the other hand, enables surgery to access the abdominal cavity via the vaginal canal thus reducing the formation of a scar and incidence of infection that are common with incisions on the abdominal wall. Altogether it can be concluded that these minimally invasive approaches have enhanced the patient's report card and satisfaction in the management of fibroids, endometriosis, ovarian cysts, pelvic organ prolapsed and other gynecological disorders. With the enhancement of technology, the future of gynecological surgery remains bright with increased innovation and improved methods to augment patient care and satisfaction as well as for the efficiency of healthcare workers.

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