International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/

Vol. 48 No. 2 January 2025, pp. 42-59

Robotic Surgery for Endometriosis; A step to Future

Review

Maged Naser [1], Mohamed M. Nasr [2], and Lamia H. Shehata [3]

[1] Mazahmiya Hospital, Ministry of Health, Kingdom of Saudi Arabia, Department of ob/gyn,

[2] Consultant of General and Endoscopic Surgery (MD, FRCS)

[3] Care National Hospital, Department of Radiology

Corresponding Author: Maged Naser

Abstract – Endometriosis is a persistent condition influencing roughly 10% of women of reproductive age, prompting huge physical and emotional pressure. Therapies incorporate medical management and surgical interventions, with laparoscopic medical procedure being the highest quality level for eliminating endometrial tissue. The approach of robotic assisted laparoscopic surgery (RALS) has empowered more complex methods to be performed minimally invasively, expanding its utilization in high-difficulty surgeries . Created in the late twentieth century, Systems like the Da Vinci Careful Framework have changed a surgical procedure by upgrading accuracy, dexterity, and visualization. The most recent models, including the Da Vinci Xi and SP, offer high level elements, for example, upgraded arm mobility, fluorescence imaging, and single-port abilities. Comparative studies of RALS and conventional laparoscopy (LPS) for endometriosis show mixed results. While certain studies show no huge differences in complications or recovery results, others feature longer operative times and hospital stays for RALS. In spite of these disadvantages, RALS isn't second rate compared to LPS in general. The clinical advantages of RALS incorporate more prominent accuracy and exactness, diminished surgeon fatigue, and a quicker learning curve worked with by cutting edge ergonomic and control systems. Be that as it may, the significant expenses and broad foundation prerequisites limit the availability and accessibility of robotic surgery medical, especially in smaller or rural hospitals. The shortfall of tactile sensation stays a test, however impending advancement mean to address this. Proceeded with innovative work are crucial to make robotic surgery procedure more financially savvy and comprehensively open, guaranteeing its advantages can arrive at a more extensive patient populace. This theoretical exemplifies the vital parts of robotic surgery procedure's turn of events, comparative studies with conventional methods, and its clinical advantages and constraints, featuring the requirement for progressing upgrades and exploration.

Keywords – Endometriosis, Robotic Assisted Laparoscopic Medical Procedure, Conventional Laparoscopic Surgery.

I. Introduction

Endometriosis is an enigmatic illness of yet-obscure beginning and pathogenesis. It is supported by hypotheses from quite a while in the past, when Sampson (1) depicted it as ectopic inserts of menstrual shredding passed to the abdominal cavity through the Fallopian tubes. As of late, Brosens and Benagiano (2) proposed that it begins with neonatal hormonal deprivation bleeding that numerous newborn girls express in a retrograde design. Inserts would stay until pubescence. A celomic hypothesis expresses that early stage cells from the Müllerian ducts continue in ectopic areas. At pubescence, animated by estrogens, they grow to develop endometriotic lesions (3).As indicated by Nyholt et al. (4), endometriosis is a "heritable, hormone-dependent gynecological disorder". In their meta-examination, they distinguished five novel loci ward connected with the risk of creating endometriosis. Every one of the five are engaged with sex steroid pathways .There is no dependable serum creator for this sickness, imaging

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

actually leaves quite a bit of it undiscovered. Ultrasound (US) has a decent sensitivity and specificity for endometriomas (83% and 89%, respectively) (5). Sadly, on account of Deep Infiltrating Endometriosis (DIE), uterosacral tendons, rectovaginal septum, vagina, and bladder, the in general pooled sensitivity and specificity of US transvaginal studies (TVSs) range somewhere in the range of 53% and 93% (6). High-resolution magnetic resonance imaging (MRI) with bladder, vaginal, and rectal differentiation has been a leap forward as of late, as we demonstrated at the new XIII World Congress on Endometriosis (7,8).Is there a psychological trait common to women with endometriosis? A few studies look for indicators of psychological distress (9) however not many spotlight on the character of patients with endometriosis. Considerably less distinguish relationship with their mental perspectives. On persistent wellbeing questionnaires, women with endometriosis show a high recurrence of positive outcomes for mental issues fundamentally connected with pain seriousness (10). No personal traits permit us to recognize subjects inclined to foster endometriosis. Laparoscopy is the “gold standard” for the conclusion of endometriosis. Careful biopsies permit histological affirmation. Laparoscopy ought to be performed ideally by experienced surgeons. Expulsion of all illness present should be achieved in a similar method. The new World Endometriosis Society (WES) Agreement for the Ongoing Management of Endometriosis (11) expresses that "Individualized care benefits from a multi-disciplinary organization of surgeons adequately gifted in giving counsel on, and treatment of endometriosis and its related side effects, in view of the most ideal that anyone could hope to find information, their broad experience and their straightforward record of progress rates". Clinical management is a highlight. As per the Agreement, bygone era top choices, for example, danazol or gestrinone ought to be utilized exclusively without any incidental effects when different medicines have demonstrated insufficient (11). Progestagens have demonstrated viability (12), while gonadotropin-releasing hormone (GnRh) agonist treatment isn't suggested for long term use. Oral progestin-just pills have shown their capacity to control the degree of endometriotic lesions on a long term basis (13).

Combined oral contraceptives (OCs) give introductory help with discomfort, however the long term efficiency as a treatment for endometriosis needs clinical proof (13). In addition, there are even a few information’s supporting expected unfavourable impacts on the progression of the illness. Ulipristal involves uncommon however extreme risks like endometrial hyperplasia (14), endometrial carcinoma (15), and hepatic damage. As of late as August 2018, the US Food and Drug Administration (FDA) had not endorsed the utilization of this medication for the treatment of myomas (and endometriosis also). In June 2018, the European Medical Agency (EMA) supported its utilization as a preoperative treatment of fibroids .This momentary use before a surgery could be considered for endometriosis. Recently presented oral GnRh antagonist elagolix NR is related without many minor secondary effects (hot flashes), superb decrease of endometriosis-related pain, and capture of the progression of the disease when utilized for a long time of a year (16, 17) at a 200-mg everyday dose. A few moderate unfavourable consequences for bone thickness were accounted for (18), proposing that this medication ought to be utilized with a hormonal replacement .Surgery ought to be thought of, during laparoscopy, in the therapy of the disease. All lesions present ought to ideally be respected. The issue of endometriomas, a never-ending dilemma, is examined with sound proof from late writing. Infertility treatment for patients with endometriosis need exceptional thought. Surgery and assisted reproduction techniques (ARTs) get over as indicated by the various phases of the disease and the patient's age. Minimal and mild disease often benefit from expert surgery. Advanced moderate and severe stages usually require *in vitro* fertilization (IVF).DIE ought to be dealt with exclusively by expert surgeons, ideally by interdisciplinary groups. Whether or not it ought to be worked before infertility treatments remains controversial.

1. Pathogenesis

As per a new survey (19), there is developing proof that hormonal and immune variables make a supportive of pro-inflammatory microenvironment that works with the persistent of endometriosis. This connects with the illness' two primary symptoms: pain and infertility. New medications available (and in research) pharmacologically affect the endocrine and inflammatory capabilities ensnared in the pathogenesis of the disease. This will prompt new analytical pathways in the pathogenesis of endometriosis.

1.1 Implantation hypothesis

In 1927, Sampson (1) proposed a retrograde progression of the menstrual mix of blood and full endometrial tissue through the Fallopian tubes into the peritoneal cavity as the first phase in the development of the disease. Brosens and Benagiano (2) propose that the main retrograde bleeding happens at birth, when the new born girl has radical hormonal deprivation. Tight interior uterine

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

cervix os, thick cervical bodily fluid, or deformities obstruct the typical outside mixture of that combination, which Brosens and Benagiano think about of stem cells. This outcomes in the passage of that content into the abdominal cavity. These first implants will stay dormant as a result of the absence of estrogens in childhood. They will develop quickly after pubescence, when the ovaries begin to deliver sexual hormones.

1.2 Celomic hypothesis

As per Burney and Giudice (3), "celomic metaplasia includes the change of ordinary peritoneal tissue to ectopic endometrial tissue". Endocrine-disturbing synthetics could assume a significant part in such change. Tending to the hypothesis of Müllerian rests, the creators express that leftover cells from the early stage Müllerian tube migration "keep up with the ability to transform into endometriotic lesions affected by estrogens" (3).Endocrine, immune, and stem/progenitor cells and epigenetic modifications "should be viewed as with regards to hereditary background as well as stimulus driven reprogramming of the female reproductive tract" (3). Indeed, even extrauterine stem/progenitor cells got from bone marrow are proposed to be potential sources of ectopic endometriotic tissue (20).

1.3 Inflammatory disease

Dolski (referred by Burney and Giudice (3) proposes that there is proof that endometriosis is, as a matter of fact, a pelvic provocative condition. A "peritonitis without microorganisms"? The peritoneal liquid has an expanded grouping of actuated macrophages and an inflammatory profile in the cytokine/chemokine pivot. Zimmer, in the survey by Burney and Giudice, is accounted to connect a haptoglobin-like protein (that ties macrophages and lessens their phagocytic ability) to the beginning of endometriosis. Expanded creation of interleukin-6 (IL-6), macrophage relocation inhibitory element, tumor necrosis factor-alpha, IL-1b, IL-6, and IL-8 modifications is additionally depicted. Garget et al. (21) recommend that human endometrium recovers consistently intervened by endometrial stem/ progenitor cells like CD140b +, CD146 +, or SUSD2 + endometrial mesenchymal immature microorganisms (eMSCs). N-cadherin + endometrial epithelial progenitor cells and side populace cells would likewise add to the pathogenesis of the infection. They are planted retrogradely at the time of birth or at adolescence. The creators suggest that the eMSCs might play a part in the age of progesterone-resistance aggregate endometrial stromal fibroblasts. Stem/progenitor cell differences between healthy women and those with endometriosis have been demonstrated.

1.4 Endometriomas

On the beginning of endometriomas, a few hypotheses have been refreshed by Rizzolo and Coccia (22) :

1.Invagination: They are just pseudocysts delivered by the gathering of menstrual debris, which incorporate dynamic inserts at the site of reversal .

2.Celomic metaplasia: They start from invaginated ovarian celomic epithelium, which has metaplasia of its glandular epithelium and stroma.

3.Follicular: A few scientists recommended that endometriomas could begin from ovarian follicles, however not a great reason for this hypothesis was at any point given.

1.5 Aromatases

An uncommon case of postmenopausal hepatic flexure colon DIE, a formerly gone through complete in a woman hysterectomy and two-sided salpingoophorectomy, was as of late introduced by Snyder et al. (23). They suggest that autologous aromatase creation at the site led to a full-thickness invading nodule from ruminants or metaplastic endometrial tissues. They thought about this in the wake of actually taking a look at that, with no surgery by any means, the nodule vanished after prolonged anti- aromatase therapy.

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

1.6 Hormonal receptors

Nicole et al. (24) found "heterogeneity of estrogen receptor α and progesterone receptor dissemination in lesions of DIE in untreated women, or during exposure to different hormonal medicines". This could be on the grounds that DIE nodules are poor responders to various endocrine medicines.

1.7 Profound penetrating endometriosis

Petraglia and Capron (25) look at DIE as an alternate aggregate of a similar illness, imparted to endometriomas and peritoneal lesions. It incorporates two areas: anterior compartment disease (bladder) and posterior compartment disease (vagina, uterosacral tendons, rectum, and ureters). A few invasive systems characteristic for endometriosis, for example, the expression of matrix metalloproteinases and activins, are enhanced in DIE. Likewise, an exceptionally high expression of the various mechanisms of neuroangiogenesis (nerve growth factors, vascular endothelial growth factor, and intercellular adhesion molecule) is available. For them, other immunological variables (peritoneal macrophages, natural killer cells, and lymphocytes) are fundamentally changed in DIE. The agressive way of behaving of DIE might be made sense of by the exceptionally diminished apoptosis. A nuclear component kappa-light-chain-enhancer of actuated B cells (NF-κB), B-cell lymphoma 2 (Blc-2), anti- Müllerian hormone, and the expanded multiplication action connected with oxidative stress (NF-κB, responsive oxygen species, extracellular regulated kinase, and advanced oxidation proteins) additionally contribute.

1.8 Epigenetic modulators

In a new " master review ", Gordts, Koninckx, and Brosens elaborate two different pathogenic theories (26):

Speculation I: pathogenesis of beginning stage endometriosis by neonatal uterine bleeding with the cyclic period is the driving component for adenomyotic nodule development.

Speculation II: profound endometriosis is a particular sort of strange endometrium-like cell benign tumor.

As verification of this, the creators show that profound endometriosis is a particular disease, as reflected by the dispersion of profound lesions in all stages of the Revised American Richness Society grouping. It could impart to peritoneal or cystic endometriosis a same cell origin; however hereditary and epigenetic modulators initiate distinct presentations of the infection. Now and again, peritoneal endometriosis will prevail. With other epigenetic modulators, DIE will develop .They have common structures when dissected by the pathologist. These creators suggest that uterine adenomyosis and DIE have same starting points, as in the two cases glands are seen penetrating muscle tissue.

2. Diagnosis

2.1 Anamnesis

Pay attention to the patient. Carry on a detailed anamnesis in an exceptionally sluggish style. This straightforward activity gives us the best way to deal with the disease. She has such a great amount to tell, to show with her face and expression. As a rule, the disease can be seen by simply listening .The inescapable side effect is pain: cyclic pelvic pain, dysmenorrhea, periovulatory pain, persistent non-cyclic pelvic pain, dyspareunia (positional or long-lasting), dyschezia , and dysuria .There are numerous other pain introductions that no one even considers until defied with an endometriosis patient who, it just so happens, has precisely "that kind of aggravation". A young girl we worked last year alluded to right shoulder pain at period. At laparoscopy, a huge diaphragmatic series of blue and red lesions was extracted. She was feeling significantly better after surgery. A comparable case was accounted for as of late by Singh et al. (27). This distribution explains the utilization of MRI for the clinical diagnosis of endometriosis, which will be shown broadly in this audit. Involuntary infertility, in any event, when not the reason for consultation, ought to likewise be viewed as one of the regular side effects of endometriosis. Less as often as possible, cyclic nasal bleeding, umbilical bleeding, cyclic hemoptysis, cyclic constipation , and urinary urgency are accounted for by patients with endometriosis.

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

2.2 Pelvic assessment

Indeed, even today, with the progression of imaging finding, pelvic assessment (in master hands) keeps on being commended as a viable clinical tool for the conclusion of endometriosis. It ought to be finished with care, gradually, starting with abdominal palpation. Only after no pain is enrolled, continue to pelvic assessment. This ought to be finished with outrageous delicacy and regard. Bimanual palpation of the uterine/bladder pouch, the Douglas pouch, and adnexa can uncover perfectly excruciating locales typical of endometriosis. Fixed uterine retroversion is as often as possible due to uterosacral tendon compromise or adhesions at the Douglas pouch. Excruciating uterine activation is one more regular indication of endometriosis. Pressure of the uterine fundus is regularly agonizing when adenomyosis is present. Dyspareunia regularly compares with incredibly excruciating palpation of the uterine-sacral tendons. Continuously check out at your patient's face during assessment. Rictus of pain can't be stayed away from. It will tell you precisely where the aggravation is more extraordinary, serving to decide the degree of the disease clinically. Cautious and master pelvic assessment gives a lot of data for an exceptionally minimal cost.

2.3Biomarkers

Currently, despite numerous proposed biomarkers for endometriosis in peripheral blood and endometrial tissue, none have receive d validation for this condition (18). Factors such as patient selection, sample extraction, or analysis methods may contribute to thi s lack of validation. There is an urgent need to create a noninvasive diagnostic test for individuals suffering from symptomatic endometriosis.A dependable marker for the condition still eludes us. Ca 125, which is viewed as a biomarker for endometriosis, pr ovides utility solely in postoperative monitoring.Typically,its levels decline postsurgery and elevate when the condition recurs or worsens.

Clinical manifestations are diverse. The signs, symptoms, and biomarkers do not correlate strongly with disease extent, as noted b y Taylor et al. (19). In a study involving 58 consecutive endometriosis cases, Hirsch et al. (28) reported elevated Ca 125 levels. Th is group concluded that a Ca 125 level of at least 30 units per milliliter is “highly predictive of endometriosis” in symptomatic in dividuals (19). The authors suggest its necessity but consider it “incapable of ruling out endometriosis” (19).

Numerous studies highlight genetic abnormalities in endometriosis patients. While a comprehensive chapter could outline these fi ndings, none have been authenticated for the diagnosis of endometriosis.Such alterations have been documented over the past 15 t o 20 years, with some showing correlations to the disease. The plethora of varying strategies indicates that progress is still limited. In 2016, following a systematic literature review, Neil Johnson, Cyndy Farquhar, and the Cochrane Library team identified only t wo biomarkersPGP 9.5 (a neural fiber marker) and CYP19 (a hormonal marker)that demonstrated sufficient accuracy to potentiall y replace surgical diagnosis 29. Nonetheless, the authors remark, “we could not meaningfully statistically evaluate most of the bio markers reviewed in this study. Due to the low quality of many included studies, the results of this review should be approached with caution. Although PGP 9.5 fulfilled the criteria for a substitute test, it exhibited significant heterogeneity in diagnostic estima tes, the origin of which remains unknown” (29).

Blood, urine, and endometrial markerswhether assessed individually or in conjunction with imagingwere evaluated. The authors concluded that none could be appraised in a meaningful manner. They determined that the evidence was insufficient or of poor qu ality. A clear final recommendation emerged: “Laparoscopy remains the benchmark for diagnosing endometriosis, and any applic ation of noninvasive tests should strictly occur in a research environment” (29).

2.4 Genetics

For years, there has been a pursuit of genetic testing to identify a population at risk for developing endometriosis. A straightforwa rd search in the literature reveals over 3000 publications from 2018 connecting genetics to endometriosis. Recently, an Australian research group published a synthesis of 17,045 cases included in a meta-
analysis 30. In this analysis, 14 genomic regions were pinpointed, as corroborated by multiple studies. The group found that “no i ndependent associations were discerned from direct genotyping of common and low-
frequency proteincoding variants” 30. They assert that the primary genetic factors linked to endometriosis risk reside within regul atory DNA regions. This alteration affects gene transcription regulation. They conclude that the relevant genes are located on thre e chromosomal regions: “LINC00339 and CDC42 on chromosome 1, CDKN2A-
AS1 on chromosome 9, and VEZT on chromosome 12” (30).Utilizing singlenucleotide polymorphism (SNP) array technology, a

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

2017 study 31 detailed genomic abnormalities connected to the onset of endometriosis. These researchers conducted SNP array genotyping on pooled DNA samples from 100 endometriosis patients and 50 control subjects. They identified 49 copy numb er variation (CNV) loci that were prevalent in the endometriosis group but absent in controls.Six novel CNV loci were found in t he subtelomeric regions, representing both gains and losses. An intergenic locus on chromosome 19q12.1 exhibited a strong assoc iation with endometriosis. Like other biomarkers, we still lack a dependable genetic marker for endometriosis, and none of the su ggested genes or genetic alterations can be reliably utilized for precise diagnosis.

2.5 Imaging

Ultrasound. In 1979, Walsh et al. given their discoveries in 25 patients precisely affirmed endometriosis or adenomyosis or both (32). Sonolucent zones inside the uterus addressing blood lakes depicted adenomyosis. Different cases had cystic pictures, five of which were of blended qualities. Around then, "ultrasound alone couldn't separate endometriosis from illnesses, for example, tubo-ovarian abscess, ruptured ectopic pregnancy, other ovarian cysts or tumors" (32). The creators expressed that the clinical history added to the non-careful finding of endometriosis. Today, a few creators express that TVS "permits a superior precise determination of rectosigmoid endometriosis than MRI" (33). For this gathering, it is less dependable on account of uterine, Douglas pouch, and uterosacral tendon disease. In any case, they propose it as a first-line imaging procedure due to its minimal expense and possibility. The International Deep Endometriosis Analysis group (34), confronting the wide assortment of terms and portrayals used to distinguish endometriosis at TVS, proposes a few fundamental advances that ought to be followed at the time of assessment:

1.Routine assessment of uterus and adnexa (look for adenomyosis and presence, or nonappearance, of endometriomas)

2.Assessment of transvaginal sonographic delicate markers like specific tenderness and ovarian mobility.

3.Evaluation of the Douglas pouch status (sliding sign)

4.Appraisal for DIE nodules at the front and back compartments.

All means ought to be performed, however not be guaranteed to in a specific order, with a little fluid substance in the bladder. A unique assessment evaluating the continuous portability of the pelvic organs is obligatory in these cases. All this article incorporates a progression of drawings and photos that precisely depict the various photos connected with endometriosis in its presentations. For the people who practice the means referenced above, TVS is the first-line insightful device in quite a while with side effects of endometriosis. The ability exhibited by them to identify ovarian endometriomas and DIE on is documented. The expectation of the pouch of Douglas obliteration is exceptionally accurate. It assists with arranging multidisciplinary surgical groups in the most serious cases. They offer most significance to the sliding sign since it permits clinicians to anticipate the seriousness of the profound pelvic disease. One potential disadvantage is the issue of involvement: just the people who have performed beyond what 2500 scans can accomplish genuine capability in the sliding move, after around 40 assessments. Any prepared staff can deal with this non-invasive diagnostic strategy for different areas of Pass on aside from rectovaginal septum DIE. A situation for a standardized terminology of US findings is compulsory for this gathering. Another gathering introduced clear and sound pictures of DIE in a prospective report (35). They assessed the wall of the rectum and the lower sigmoid colon with two successive TVSs. The first was performed without past gut preparation, and the second following a 3-day low-residue diet and two 250-mL bowel enemas (12 and 3 hours before TVS). They exhibited that TVS after bowel preparation had a higher exactness, permitting the detection of DIE before a surgery. Transvaginal US is the primary choice for the imaging diagnosis of ovarian endometriomas. A 2002 meta-investigation performed by Moore and Kennedy et al. (36), checking on seven articles that satisfied the consideration models, exhibited that TVS is a useful test in case of ovarian endometrioma. In a review observational review, an Italian gathering (37) utilized TVS to assess 250 women of regenerative age (20 to 40 years) introducing endometriomas bigger than 20 mm in width. The mean endometrioma diameter was 40 mm. Bilateral disease was seen as in 25.5% of the patients, posterior rectal DIE in 21.5%, and the thickening of something like one uterosacral tendon in 35.4%. 73% of the patients gave bond indications, and 53% had simultaneous uterine adenomyosis. Just 15% of the concentrated on populace introduced a solitary segregated endometrioma with a mobile ovary and no different indications of further disease. This distribution features the utility of TVS for the diagnosis of endometriomas, adjacent existing together disease in different areas, and adherences. In 50 patients worked by laparoscopy, TVS

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

finding was affirmed. In 85% of the cases, endometriomas were related with different areas of endometriosis. Left-side cysts were all the more regularly connected with same-side uterosacral tendon invasion and DIE. Bilateral endometriomas generally obliterate the pouch of Douglas.

2.6 Computerized axial tomography.

" Computed tomography plays no part in the standard assessment of endometriosis besides in not many specific situations" (38). An inguinal endometriotic nodule and a case of round tendon endometriosis that seemed as though a hernia were the main references tracked down after a fast hunt of various data sets, including Medline, connecting endometriosis and Computed tomography scans. Contrast studies may be useful for the determination of ureteral stops, stenosis, or deviations in case of lateral pelvic side-wall DIE.CAT virtual colonoscopy can likewise be of help. A new report portrays its utilization before surgery for DIE (39). Related with MRI, the preoperative conclusion was affirmed in 71 patients who introduced a sum of 105 endometriotic bowel lesions. This gathering found 71.2% rectal nodules and 60% sigmoid nodules that penetrated the muscularis propria in extensions fluctuating from 25% to half of the circumference. Stenosis was available in 73% to 96% of the cases. “The concordance among intraoperative and preoperative discoveries concerning the presence of rectal nodules was high, at 0.88 when associated with CTC [computed tomography of chemiluminescence] with MRI, though each imaging method taken separately given lower concordance coefficients" (39). In this review, 80.3% of patients went through the methodology that had been preoperatively arranged. These creators suggest that the relationship of the two procedures works on the exactness of preoperative appraisal of colorectal DIE.

2.7 Magnetic resonance imaging

In 1999, a trailblazer article portrayed the utilization of MRI for the preoperative finding of endometriosis (40). The creators depicted, in 20 patients, MRI discoveries of DIE at the uterosacral tendons, the pouch of Douglas, the rectum, and the bladder that were histologically demonstrated at a surgery. Conclusion was exact aside from when differentiation was not utilized (two of three patients with rectal endometriosis).10 years prior, Arrivé et al. (41) distributed the principal report of MRI use for the clinical diagnosis of endometriosis. Utilizing just 0.35 Tesla, they prospectively concentrated on 30 consecutive women with symptomatic illness. In 25 cases, endometriosis was affirmed by a surgery. A sensitivity of 64% and a specificity of 60%, with a precision of 63%, were shown. Most endometriomas were accurately recognized. Just 14 of 29 cases of adhesions and 6 of 45 cases of peritoneal inserts were diagnosed by MRI. "MRI discoveries didn't connect with the precisely resolved seriousness of the infection" (41). In 1989, the creators presumed that MRI couldn't be utilized as the main study to recognize endometriosis. For their purposes, laparoscopy was the procedure of decision.Last years, at the XIII World Congress on Endometriosis, our gathering introduced three banners (42-44) that laid out an ideal connection of high-goal balance MRI with laparoscopic discoveries, utilizing 2-and 3-Tesla devices. Utilizing a resolution procedure (1-mm cuts), intravenous contrast (for bladder representation), and vaginal and rectal gel contrast (for better perception of the rectovaginal septum), we had the option to organize the disease before laparoscopy. We showed the unique capacity of this strategy to picture shallow inserts, attachments, uterosacral tendon penetration, rectovaginal septum invasion (including the profundity of rectal intrusion), bladder wall invasion, and ovarian disease. Images of ureteral compromise were additionally gotten (unpublished). Whenever the situation allows, MRI would be obligatory before laparoscopy. A new study (45) shows an interesting algorithm that permits clinicians to foresee the likelihood of bowel resection at the time of laparoscopy for DIE utilizing MRI. In 52 patients contemplated preoperatively, a positive predictive value of 87% and a negative predictive value of 83% were illustrated. This gathering determined the effect point and lesion size by utilizing a numerical calculation. In 2009, the PRISMA (Preferred Reporting Items of Systematic reviews and Meta-Analyses) bunch proposed a proof based least arrangement of things expected for revealing in efficient audits. A new study (46) assessed the utilization of TVS and MRI for the conclusion of adenomyosis, checking on proof as per PRISMA necessities. For TVS, they tracked down a high heterogeneity between studies. The pooled positive probability proportions for adenomyosis were 0.72-0.82, 0.85-0.81, and 4.67-3.7, an obviously diffuse assortment of data. Conversely, the pooled awareness for MRI was 0.77, the specificity 0.89, the positive probability proportion 6.5, and the negative probability proportion 0.2 for all subtypes of adenomyosis . This proposes that MRI is more valuable than TVS for the diagnosis of adenomyosis.

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

2.8 Laparoscopy

Laparoscopy is the " gold standard " for the diagnosis is of endometriosis. It guarantees the presence of the disease and its expansion. Through tissue biopsies and its pathological examination, the forcefulness of the lesions can be determined. It is likewise the valuable chance to play out the underlying treatment of endometriosis, as will be depicted later in this article.

3. Classifications

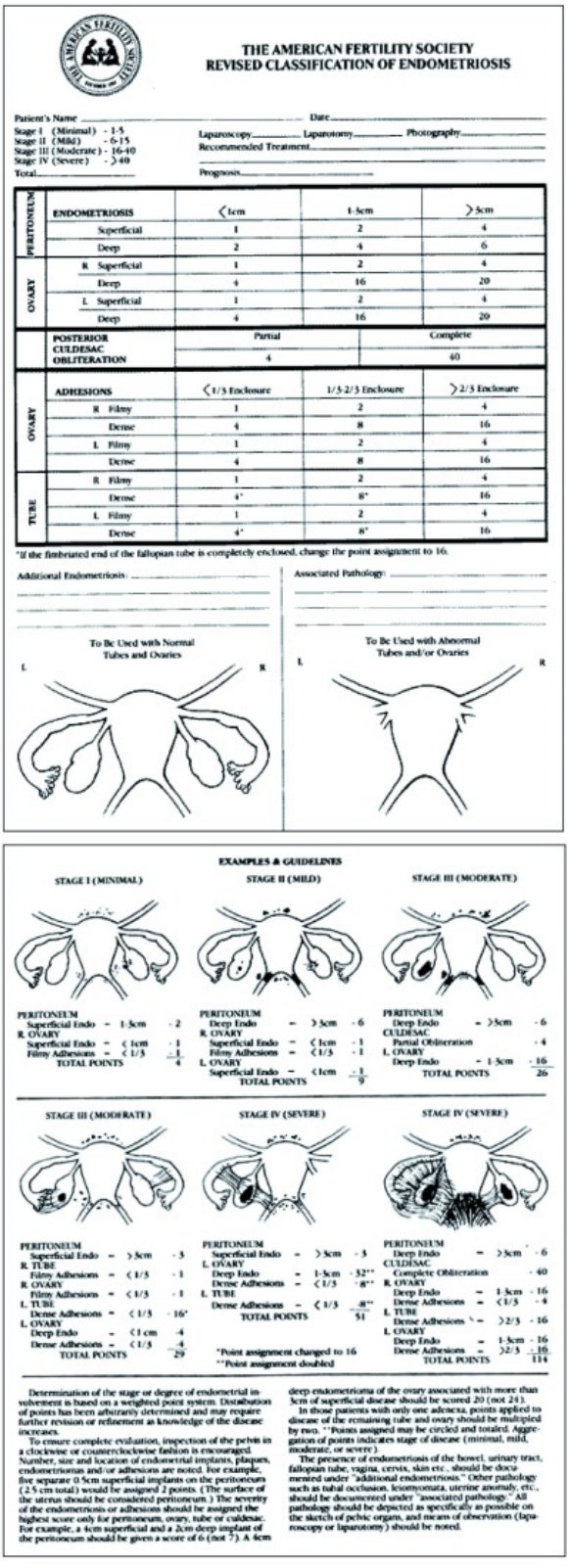
The WES (47) consensus on the classification of Endometriosis was held at the XII World Congress on Endometriosis in São Paulo, Brazil, in 2014. 55 delegates of 29 public and global, medical and non-medical organizations from a scope of disciplines contributed. It delivered an explanation that says: "until better classifications frameworks are created, we propose a classification tool box" (47). This incorporates the reconsidered American Society for Reproductive Medication (rASRM) order, the Enzian classification, and the endometriosis fertility index (EFI).The most utilized staging framework is the rASRM classification (1997), which overlooks DIE. Kecktein in 2003 and Haas in 2013 proposed the Enzian order for DIE as a supplement to rASRM. In 2010, Adamson and Pasta presented the EFI, despite the fact that it is completely connected with endometriosis-related infertility. That’s what the Consensus revealed "nonetheless, the classification frameworks in current use keep on drawing analysis from women with endometriosis and those giving consideration to them as a result of the unfortunate connection with disease side effects as well as an absence of predictive prognosis and, until this point, unclear pathways of treating pelvic pain and infertility based" on them (47).

3.1 Revised American Society for Reproductive Medicine classification

The rASRM classification is deployed. It was initially considered by Acosta et al. (48) of every 1973 while working with V. C. Buttram and subsequent to analyzing the aftereffects of 107 infertile patients worked for endometriosis. This gathering planned a basic plan that developed into the primary ASRM grouping. This grouping is planned basically to be utilized for those endometriosis patients counselling for infertility. DIE isn't viewed as in this plan.

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59



THE AMERICAN FERTILITY SOCIETY
REVISED CLASSIFICATION OF ENDOMETRIOSIS

Patient's Name _____ Date _____

Stage I (Minimal) - 1-5
Stage II (Mild) - 6-15
Stage III (Moderate) - 16-40
Stage IV (Severe) - >40
Total _____

Laparoscopy _____ Laparotomy _____ Photography _____
Recommended Treatment _____
Prognosis _____

		<1cm	1-5cm	>5cm
PERITONEUM	ENDOMETRIOSIS			
	Superficial	1	2	4
	Deep	2	4	6
OVARY	R Superficial	1	2	4
	Deep	4	16	20
	L Superficial	1	2	4
	Deep	4	16	20

		Partial	Complete
	POSTERIOR CULDESAC OBLITERATION	4	40

		<1/3 Enclosure	1/3-2/3 Enclosure	>2/3 Enclosure
OVARY	ADHESIONS			
	R Filmy	1	2	4
	Dense	4	8	16
	L Filmy	1	2	4
	Dense	4	8	16
TUBE	R Filmy	1	2	4
	Dense	4*	8*	16
	L Filmy	1	2	4
	Dense	4*	8*	16

*If the fimbriated end of the fallopian tube is completely enclosed, change the point assignment to 16.

Additional Endometriosis: _____

Associated Pathology: _____

To Be Used with Normal Tubes and Ovaries

L R

To Be Used with Abnormal Tubes and/or Ovaries

L R

EXAMPLES & GUIDELINES

STAGE I (MINIMAL)

PERITONEUM
Superficial Endo - 1-5cm - 2
R. OVARY
Superficial Endo - <1cm - 1
Filmy Adhesions - <1/3 - 1
TOTAL POINTS 4

STAGE II (MILD)

PERITONEUM
Deep Endo - >5cm - 6
R. OVARY
Superficial Endo - <1cm - 1
Filmy Adhesions - <1/3 - 1
L. OVARY
Superficial Endo - <1cm - 1
TOTAL POINTS 9

STAGE III (MODERATE)

PERITONEUM
Deep Endo - >5cm - 6
CULDESAC
Partial Obliteration - 4
L. OVARY
Deep Endo - 1-5cm - 16
TOTAL POINTS 26

STAGE III (MODERATE)

PERITONEUM
Superficial Endo - >5cm - 3
R. TUBE
Filmy Adhesions - <1/3 - 1
R. OVARY
Filmy Adhesions - <1/3 - 1
L. TUBE
Dense Adhesions - <1/3 - 16*
L. OVARY
Deep Endo - <1cm - 4
Dense Adhesions - <1/3 - 4
TOTAL POINTS 29

STAGE IV (SEVERE)

PERITONEUM
Superficial Endo - >5cm - 3
L. OVARY
Deep Endo - 1-5cm - 32**
Dense Adhesions - <1/3 - 8**
L. TUBE
Dense Adhesions - <1/3 - 8**
TOTAL POINTS 51

*Point assignment changed to 16
**Point assignment doubled

STAGE IV (SEVERE)

PERITONEUM
Deep Endo - >5cm - 6
CULDESAC
Complete Obliteration - 40
R. OVARY
Deep Endo - 1-5cm - 16
Dense Adhesions - <1/3 - 4
L. TUBE
Dense Adhesions - >2/3 - 16
L. OVARY
Deep Endo - 1-5cm - 16
Dense Adhesions - >2/3 - 16
TOTAL POINTS 114

Determination of the stage or degree of endometrial involvement is based on a weighted point system. Distribution of points has been arbitrarily determined and may require further revision or refinement as knowledge of the disease increases.

To ensure complete evaluation, inspection of the pelvis in a clockwise or counterclockwise fashion is encouraged. Number, size and location of endometrial implants, plaques, endometriomas and/or adhesions are noted. For example, five separate 0.5cm superficial implants on the peritoneum (2.5 cm total) would be assigned 2 points. (The surface of the uterus should be considered peritoneum.) The severity of the endometriosis or adhesions should be assigned the highest score only for peritoneum, ovary, tube or culdesac. For example, a 4cm superficial and a 2cm deep implant of the peritoneum should be given a score of 6 (not 7). A 6cm deep endometrioma of the ovary associated with more than 5cm of superficial disease should be scored 20 (not 24).

In those patients with only one adnexa, points applied to disease of the remaining tube and ovary should be multiplied by two. **Points assigned may be circled and totaled. Aggregation of points indicates stage of disease (minimal, mild, moderate, or severe).

The presence of endometriosis of the bowel, urinary tract, fallopian tube, vagina, cervix, skin etc., should be documented under "additional endometriosis." Other pathology such as tubal occlusion, leiomyomata, uterine anomaly, etc., should be documented under "associated pathology." All pathology should be depicted as specifically as possible on the sketch of pelvic organs, and means of observation (laparoscopy or laparotomy) should be noted.

Figure 1. American Culture for Regenerative Medication amended characterization.

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

3.2 Fertility index

Adamson considered the unfortunate fertility prognosis got from the selective utilization of the ASRM altered arrangement. In 2010, he presented the EFI, displayed in Figure 1 (49), as a supplement that permits a superior diagnosis of the endometriosis-related fertility status. Approved by a few different creators, for example, Vagabond et al. (50), this file incorporates not just the laparoscopic findings (least functional score toward the end of surgery) yet in addition different issues that influence fertility, like the length of infertility, patient's age, and previous pregnancies.

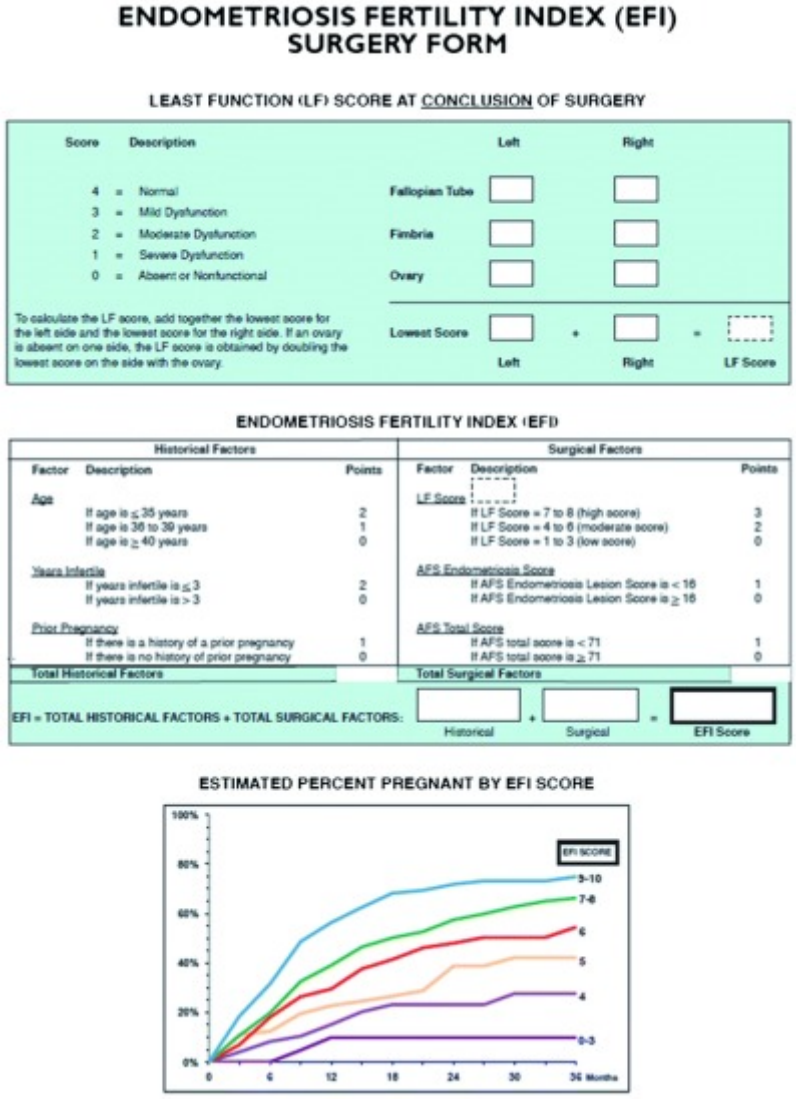


Figure 2. Endometriosis fertility index.

4. Current Application and Results on Endometriosis

4.1 Comparison of Surgical Results

There are many studies looking at robotic surgery and laparoscopic surgery. The majority of these studies are retrospective, with just three being planned. The principal forthcoming review is the LAROSE preliminary (51)The LAROSE (Laparoscopy versus Robotic surgery for Endometriosis) preliminary is one of the planned studies contrasting RALS and LPS. The review showed no tremendous contrasts in surgical time and complication rates between the two techniques, albeit robotic surgery was related with

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

expanded blood loss. Moreover, there were no tremendous contrasts in many parts of postoperative personal satisfaction. Taking into account that there were more patients with lower American Society of Reproductive Medication (ASRM) scores in the robotic gathering, this could propose that robotic surgery is inferior compared to laparoscopy. The second forthcoming review was accounted for in France in 2020, looking at the two gatherings in colorectal endometriosis (52). There were no distinctions in characteristics between the two gatherings. Albeit robotic surgery had a more extended working time, no different contrasts were noticed. The majority of the ongoing proof comes from retrospective studies, which give significant experiences into the careful results of RALS and LPS. These studies aggregately propose that while RALS might have longer operative times and expanded blood loss, it offers comparable or their improved results as far as recovery and complication rates. For example, Nezhat et al. showed equivalent results for blood loss and hospital stay among RALS and LPS (53). Chu et al. found no huge contrasts in most perioperative results between the two techniques (54). There is another review recommending that RALS could diminish recovery times in specific patient populaces. These findings feature the nuanced advantages and difficulties of RALS in endometriosis surgery (55). Notwithstanding the referenced studies, there are a few other retrospective studies on looking at the perioperative results of RALS and LPS in the treatment of endometriosis.

4.2 Fertility Preservation or Residual Ovarian Function

A contemporary review features the role of robotic assisted laparoscopy in reproductive surgeries. It talks about how robotic surgeries like the Da Vinci Surgical Systems give upgraded skill and accuracy, which are basic for preserving fertility and keeping up with ovarian capability during complex regenerative methodology. The review emphasizes that robotic surgery is related with better careful results in myomectomy and other fertility preserving surgeries contrasted with conventional strategies (56). Suggestions for the surgical treatment of ovarian endometriomas stress the significance of protecting ovarian reserve during surgery. Robotic surgery, with its high level accuracy and control, is recommended to potentially limit harm to ovarian tissue contrasted with LSP. The utilization of robotic systems can be valuable in complex surgeries where preserving ovarian function is critical (58).A study looked at robotic single-site (RSS) and single-port laparoscopic (SPL) surgeries concerning fertility preservation. It tracked down that the lessening in enemy of Müllerian hormone (AMH) levels, a mark of ovarian reserve, was essentially lower in the RSS group than in the SPL group. This proposes that robotic surgery may be more favourable in protecting ovarian function, particularly in complex cases like endometriosis or bigger, multilocular, or bilateral cysts with adhesion (58). Another new review explored the effect of laparoscopic versus robotic cystectomy on ovarian tissue and follicular loss in patients with endometrioma, utilizing AI-powered pathology analysis. The review, led on 28 patients, recommends that robotic cystectomy may bring about less ovarian tissue and follicular loss contrasted with laparoscopic techniques, especially in instances of bilateral disease and bigger cyst sizes. This study features the expected advantages of robotic surgery in protecting ovarian function during endometrioma cystectomy and recommends further studies to approve these findings (59). These articles give experiences into how robotic surgery can assume a valuable part in protecting fertility and keeping up with ovarian function, especially in complex gynaecological procedures.

4.3 Robotic Systems and Deep Infiltrating Endometriosis

Deep infiltrating endometriotic lesions frequently require meticulous analyzation and exact excision, tasks that are hard to perform with conventional laparoscopy because of restricted instrument mobility and visualization. RALS gives upgraded 3D perception, more noteworthy dexterity with articulated instruments, and further developed ergonomics for the surgeons. These elements make RALS especially appropriate for tending to the complexities of deep infiltrating endometriosis, possibly prompting more complete lesion removal and better persistent results. A meta-analysis contrasting RALS with LPS for treating deep endometriosis investigated fourteen investigations with a sum of 2709 patients (60). The findings demonstrated no massive contrasts among RALS and LPS as far as intraoperative and postoperative complications, conversion rates, or estimated blood loss. Notwithstanding, RALS was related with longer operative times and longer hospital stays. Regardless of these disadvantages, robotic surgery turned out not inferior compared to laparoscopy in overall surgery results. The study proposes the expected advantages of coordinating new advancements with robotic platform and improve scientific logical proof. Another systematic review and meta-analysis assessed the advantages of RALS contrasted with LPS in endometriosis surgery (61). It presumed that RALS didn't show huge benefits over LPS with regards to intraoperative and postoperative complexities, assessed blood loss, or length of hospital stay. RALS was found to have longer operative times. The study featured the requirement for additional complete assessments of long

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

https://ijpsat.org/
Vol. 48 No. 2 January 2025, pp. 42-59

time results, like pain relief, personal satisfaction, and fertility results. Moreover, there is a continuous ROB Endo trial, booked to be finished by 2026, looking at robotic and conventional laparoscopy in deep infiltrating endometriosis, led by a Finnish gathering (62). This prospective, randomized, controlled clinical trial will be led in a single centre setting. Patients with deep endometriosis checked by MRI and requiring a surgery will be thought of as qualified for the review. A sum of 70 patients will be dispensed in a 1:1 proportion to get either robotic-assisted or conventional laparoscopic surgery. The essential result will evaluate the surgical results concerning pain side effects. The consequence of this study is supposed to add to a superior comparison of robotic surgery procedure to laparoscopic surgery in the field of deep infiltrative endometriosis. Be that as it may, these information's are not fulfilling in light of multiple factors. Firstly, the seriousness of the disease shifts in each review, making it hard to be unbiased. Secondly, the information on conventional laparoscopy utilized in these studies for the most part come from currently experienced surgeons, making it difficult for the generally new robotic surgery to outperform that degree of proficiency. Thirdly, surgical results are not just about speed. Demonstrating the subjective parts of a surgery through these studies is troublesome.

5. Clinical Advantages of Robotic Surgery

5.1 Accuracy, Precision, and Ergonomics

RALS offers improved mastery and scope of movement, high level imaging, navigation frameworks, and optoelectronic following advances, taking into consideration more exact surgical manoeuvres (63). These progressions highlight the capability of robotic frameworks to improve surgical results, lessen recuperation times, and increment the safety and viability of complicated strategies. Studies have shown that robotic-assisted surgical procedures, for example, those performed with the Da Vinci and different frameworks, accomplish elevated degrees of exactness (64). For instance, robotic-assisted spinal medical procedures have demonstrated impressive precision in implant placement ,with altogether decreased error edges contrasted with conventional strategies (65). In endometriosis surgery, where the exact distinguishing proof and extraction of endometrial lesions are pivotal, amplification capacities and fine explanation upgrade the capacity to address profound infiltrating endometriotic lesions and lessen the risk of deficient injury evacuation and ensuing repeat. Ergonomic surgery is likewise an enormous advantage of robotic surgery. In LPS, while performing ureterolysis somewhere down in the pelvis, the encompassing bowel can raise worries about thermal damage, and on the left side, openness can be hindered by the adnexa. These are the disadvantages of utilizing non-articulating instruments. Nonetheless, in RALS, the strength of the automated arm and the usage of verbalization lessen the deterrents to the way to deal with the deep pelvis . These could be advantages of robotic surgery. Ergonomic advantage of robotic surgery (A) Using the strength of the robotic instrument to lift the uterus, the obliterated posterior cul-de-sac can be easily dissected, and prompt hemostasis can be accomplished utilizing the monopolar. (B) Even the hard-to-arrive at deep pelvis can be effectively gotten to utilizing the articulating instrument, with diminished worries about thermal damage to encompassing organs.

5.2 Reduced Surgeon Fatigue

Robotic surgery permits surgeons to work from a seated situation at a console, diminishing the actual physical burden contrasted with conventional laparoscopic surgery (66). This ergonomic benefit is critical in long and complex endometriosis surgeries, where supported focus and diminished fatigue can improve surgical performance and patient outcomes. Studies have shown that surgeons utilizing RALS experience lower feelings of anxiety and further improved pulse variability, with estimations demonstrating fundamentally lower physiological stress and decreased errors contrasted with conventional laparoscopic medical surgery. This upgrades the surgeon's performance as well as lessens the risk of errors because of exhaustion contrasted with traditional surgical methods. In general, these advantages are adding to the developing adoption of robotic-assisted techniques in various surgical specialities.

5.3 Fast Learning Curve

The expectation to learn and adapt for robotic surgery is frequently more limited and more proficient contrasted with conventional laparoscopy, particularly for complex strategies like endometriosis surgery. The intuitive control systems and upgraded expertise given by robotic surgery work with speedier ability securing and further developed surgical results (67). Studies have shown that utilizing a pelvic trainer and the Da Vinci Robotic Surgical System permits surgeons to get robotic -assisted laparoscopic abilities

more rapidly and with more prominent accuracy than manual laparoscopic abilities (68). Besides, experience in laparoscopic surgery significantly further develops performance in robotic surgery, demonstrating that surgeons can adjust to robotic systems all the more rapidly assuming they as of now have essential laparoscopic abilities (69). Accordingly, robotic surgery offers clinical benefits as well as works with quicker and more powerful preparation for surgeons, at last working on careful results and extending the capacities of minimally invasive surgery.

5.4 Utilization of Single-Site Surgery

Single-site a surgical procedure's constraints incorporate confined instrument movement, restricted triangulation, and expanded trouble in stitching and complex dissection. These variables can make single-site surgical procedure in fact testing and may restrict its viability in some complex cases. Be that as it may, the Da Vinci SP system offers improved mobility looking like multi-port surgery and mitigates a portion of these difficulties, causing it a practical choice for patients who to favor single-site surgery for cosmetic reasons, giving a plausible answer for complex endometriosis cases. Notwithstanding, information's introduced from Korea in 2018 (70) showed that affirming any huge benefits of robotic single-site surgery for cutting edge stage endometriosis was troublesome. More studies are expected to justify the non-inferiority of robotic-assisted surgical systems in the management of endometriosis.

6. Limitations and Challenges

6.1 Absence of Tactile Sense, Forced Feedback

One of the impediments of robotic surgery is the absence of tactile feedback, which is significant for separating fibrotic tissues in endometriosis. A review proposed a technique utilizing indocyanine green (ICG) in 15 regions to recognize deep endometriosis lesions during robotic surgery. Infusion of ICG intravenously takes into consideration better recognizable evidence of pelvic endometriosis, possibly overcoming the absence of tactile feedback (71). Reassuringly, headways, for example, the impending fifth-age Da Vinci system mean to address the shortfall of haptic sensation with new power input highlights, improving the surgeon's ability to recognize and excise endometriotic lesions (72).

6.2 Accessibility and Availability

The underlying obtaining cost of robotic surgical systems, like the Da Vinci system, is extremely high (73). These significant expenses and extensive infrastructure necessities limit the accessibility of robotic surgery, especially smaller or rural hospitals. Accordingly, robotic surgery systems are dominatingly found in well-funded hospitals and urban centres (74). This dissimilarity in accessibility implies that patients in provincial or underfunded regions frequently don't approach the advantages of robotic surgery, for example, diminished recuperation times and lower complication rates (75). Also, the set number of systems can prompt planning challenges, further limiting access for patients who could profit from these high level careful choices (76). Technological issues, for example, system malfunctions or the requirement for steady programming refreshes, can upset careful timetables and decrease generally speaking proficiency as well (77). Endeavours are continuous to make these innovations more practical and generally accessible, guaranteeing that the advantages of robotic surgery can arrive at a more extensive patient populace, including those with endometriosis.

II. Conclusion

Robotic-assisted laparoscopic surgery (RALS) for endometriosis offers significant benefits in accuracy, diminished surgeon fatigue, and a learning curve and adapt, at last improving careful results and effectiveness. Regardless of these advantages, the significant expenses and extensive infrastructure requirements of current robotic surgery limit their availability, particularly in smaller or rural hospitals. Also, the shortfall of tactile feedback in current systems presents difficulties, albeit upcoming advancements for example, the fifth era Da Vinci system are supposed to alleviate this issue. While robotic surgery has changed the way to deal with complex surgeries, it is basic to proceed with endeavours to make these innovations more reasonable and open. Future innovative work are fundamental to defeating existing impediments and guaranteeing that the advantages of robotic surgeries are accessible to a more extensive patient populace, remembering those for underfunded regions.

Abbreviations

ASRM; American Society of Reproductive Medicine

FDA; Food and Drug Administration

ICG; indocyanine green

LPS; conventional laparoscopy

RALS; robotic-assisted laparoscopic surgery

RSS; robotic single-site

SPL; single port laparoscopic.

Conflict of Interest

All authors declare no conflicts of interest.

Author Contribution

Authors have equally participated and shared every item of the work.

References

[1]-Allaire, Catherine, Mohamed A. Bedaiwy, and Paul J. Yong. "Diagnosis and management of endometriosis." *Came* 195.10 (2023): E363-E371.

[2]- Westwood, Shannon, et al. "Disparities in women with endometriosis regarding access to care, diagnosis, treatment, and management in the United States: a scoping review." *Cureus* 15.5 (2023).

[3]- Warzecha, Damian, et al. "The impact of endometriosis on the quality of life and the incidence of depression—a cohort study." *International journal of environmental research and public health* 17.10 (2020): 3641.

[4]- Kalaitzopoulos, Dimitrios Rafail, et al. "Treatment of endometriosis: a review with comparison of 8 guidelines." *BMC women's health* 21 (2021): 1-9.

[5]- Rimbach, S., U. Ulrich, and K. W. Schweppe. "Surgical therapy of endometriosis: challenges and controversies." *Geburtshilfe und Frauenheilkunde* 73.09 (2013): 918-923.

[6]- Cho, Angela, and Chul-Min Park. "Minimally invasive surgery for deep endometriosis." *Obstetrics & Gynecology Science* 67.1 (2024): 49.

[7]- Cela, Vito, et al. "The role of robotics in the management of endometriosis." *Minerva Ginecologica* 69.5 (2017): 504-516.

[8]- Sinha, Rooma, et al. "Robotic surgery in gynecology." *Journal of minimal access surgery* 11.1 (2015): 50-59.

[9]- Bramhe, Sakshi, and Swanand S. Pathak. "Robotic surgery: a narrative review." *Cureus* 14.9 (2022).

[10]- Reddy, Kavyanjali, et al. "Advancements in robotic surgery: a comprehensive overview of current utilizations and upcoming frontiers." *Cureus* 15.12 (2023).

[11]- Ngu, James Chi-Yong, Charles Bih-Shiou Tsang, and Dean Chi-Siong Koh. "The da Vinci Xi: a review of its capabilities, versatility, and potential role in robotic colorectal surgery." *Robotic Surgery: Research and Reviews* (2017): 77-85.

[12]- Kwak, Young Hwa, et al. "Da Vinci sp single-port robotic surgery in gynecologic tumors: Single surgeon's initial experience with 100 cases." *Yonsei Medical Journal* 63.2 (2022): 179.

[13]- Thomas, Benjamin C., et al. "Preclinical evaluation of the versius surgical system, a new robot-assisted surgical device for use in minimal access renal and prostate surgery." *European urology focus* 7.2 (2021): 444-452.

[14]- Ngu, James Chi-Yong, et al. "A narrative review of the Medtronic Hugo RAS and technical comparison with the Intuitive da Vinci robotic surgical system." *Journal of Robotic Surgery* 18.1 (2024): 99.

[15]- Cepolina, Francesco, and Roberto P. Razzoli. "An introductory review of robotically assisted surgical systems." *The International Journal of Medical Robotics and Computer Assisted Surgery* 18.4 (2022): e2409.

[16]- Cepolina, Francesco, and Roberto Razzoli. "Review of robotic surgery platforms and end effectors." *Journal of Robotic Surgery* 18.1 (2024): 74.

[17]- Giannini, Andrea, et al. "Robotic approach to ureteral endometriosis: surgical features and perioperative outcomes." *Frontiers in Surgery* 5 (2018): 51.

[18]- Soto, Enrique, et al. "Laparoscopy vs. Robotic Surgery for Endometriosis (LAROSE): a multicenter, randomized, controlled trial." *Fertility and sterility* 107.4 (2017): 996-1002.

[19]- Le Gac, Marjolaine, et al. "Comparison of robotic versus conventional laparoscopy for the treatment of colorectal endometriosis: pilot study of an expert center." *Journal of Gynecology Obstetrics and Human Reproduction* 49.10 (2020): 101885.

[20]- Nezhat, Camran, et al. "Robotic versus standard laparoscopy for the treatment of endometriosis." *Fertility and sterility* 94.7 (2010): 2758-2760.

[21]- Chu, C. M., S. C. Chang-Jackson, and F. R. Nezhat. "Retrospective study assessing laparoscopic versus robotic assisted laparoscopic treatment of severe endometriosis." *Journal of Minimally Invasive Gynecology* 18.6 (2011): S101.

[22]- Dulemba, John F., Cyndi Pelzel, and Helen B. Hubert. "Retrospective analysis of robot-assisted versus standard laparoscopy in the treatment of pelvic pain indicative of endometriosis." *Journal of robotic surgery* 7 (2013): 163-169.

[23]- Nezhat, Farr R., and Ido Sirota. "Perioperative outcomes of robotic assisted laparoscopic surgery versus conventional laparoscopy surgery for advanced-stage endometriosis." *JSLS: Journal of the Society of Laparoendoscopic Surgeons* 18.4 (2014).

[24]- Nezhat, Camran R., et al. "Robotic-assisted laparoscopy vs conventional laparoscopy for the treatment of advanced stage endometriosis." *Journal of minimally invasive gynecology* 22.1 (2015): 40-44.

[25]- Magrina, Javier F., et al. "Surgical excision of advanced endometriosis: perioperative outcomes and impacting factors." *Journal of minimally invasive gynecology* 22.6 (2015): 944-950.

[26]- Raimondo, Diego, et al. "Comparison of perioperative outcomes between standard laparoscopic and robot-assisted approach in patients with rectosigmoid endometriosis." *Acta Obstetricia et Gynecologica Scandinavica* 100.9 (2021): 1740-1746.

[27]- Hiltunen, Janika, et al. "Robotic-assisted laparoscopy is a feasible method for resection of deep infiltrating endometriosis, especially in the rectosigmoid area." *Journal of International Medical Research* 49.8 (2021): 03000605211032788.

[28]- Legendri, Sophie, et al. "Improvement of Post-Operative Quality of Life in Patients 2 Years after Minimally Invasive Surgery for Pain and Deep Infiltrating Endometriosis." *Journal of clinical medicine* 11.20 (2022): 6132.

[29]- Ferrier, Clément, et al. "Comparison of robot-assisted and conventional laparoscopy for colorectal surgery for endometriosis: A prospective cohort study." *The International Journal of Medical Robotics and Computer Assisted Surgery* 18.3 (2022): e2382.

[30]- Crestani, Adrien, et al. "Changes in hospital consumption of opioid and non-opioid analgesics after colorectal endometriosis surgery." *Journal of Robotic Surgery* 17.6 (2023): 2703-2710.

[31]- Verrelli, Ludovica, et al. "Robotic surgery for severe endometriosis: a preliminary comparative study of cost estimation." *Journal of minimally invasive gynecology* 31.2 (2024): 95-101.

[32]- Volodarsky-Perel, Alexander, et al. "Robotic-assisted versus conventional laparoscopic approach in patients with large rectal endometriotic nodule: the evaluation of safety and complications." *Colorectal Disease* 25.11 (2023): 2233-2242.

[33]- Bandala, Cindy, et al. "Efficacy between Conventional Laparoscopy and Robotic Surgery in Mexican Patients with Endometriosis: A Comparative Study." *Journal of Clinical Medicine* 13.12 (2024): 3576.

[34]- Jayakumaran, Jayapriya, et al. "Robotic-assisted laparoscopy in reproductive surgery: a contemporary review." *Journal of robotic surgery* 11.2 (2017): 97-109.

[35]- Hummelshoj, Lone, et al. "Recommendations for the surgical treatment of endometriosis—part 1: ovarian endometrioma." (2017).

[36]- Lee, Ju Hye, et al. "What is the role of robotic surgery in ovarian cystectomy with fertility preservation?." *Journal of Robotic Surgery* 17.6 (2023): 2743-2747.

[37]- Sinha, Rooma, et al. "Ovarian Loss in Laparoscopic and Robotic Cystectomy Compared Using Artificial Intelligence Pathology." *JSLS: Journal of the Society of Laparoscopic & Robotic Surgeons* 28.1 (2024).

[38]- Pavone, Matteo, et al. "Robotic assisted versus laparoscopic surgery for deep endometriosis: a meta-analysis of current evidence." *Journal of Robotic Surgery* 18.1 (2024): 212.

[39]- Csirzó, Ádám, et al. "Robot-assisted laparoscopy does not have demonstrable advantages over conventional laparoscopy in endometriosis surgery: a systematic review and meta-analysis." *Surgical Endoscopy* 38.2 (2024): 529-539.

[40]- Terho, Anna Maria, et al. "Protocol: Robotic versus laparoscopic surgery for severe deep endometriosis: protocol for a randomised controlled trial (ROBEndo trial)." *BMJ Open* 12.7 (2022).

[41]- Chatterjee, Swastika, et al. "Advancements in robotic surgery: innovations, challenges and future prospects." *Journal of Robotic Surgery* 18.1 (2024): 28.

[42]- Goh, Elizabeth Z., and Tariq Ali. "Robotic surgery: an evolution in practice." *Journal of Surgical Protocols and Research Methodologies* 2022.1 (2022): snac003.

[43]- Cunningham, Bryan W., Daina M. Brooks, and Paul C. McAfee. "Accuracy of robotic-assisted spinal surgery—comparison to TJR robotics, da Vinci robotics, and Optoelectronic Laboratory robotics." *International journal of spine surgery* 15.s2 (2021): S38-S55.

[44]- Hurley, A. M., et al. "SOS save our surgeons: stress levels reduced by robotic surgery." *Gynecological surgery* 12 (2015): 197-206.

[45]- Kim, Seongmin, et al. "Robotic single-site surgery versus laparo-endoscopic single-site surgery in ovarian cystectomy: A retrospective analysis in single institution." *Gynecologic Robotic Surgery* 1.1 (2019): 21-26.

[46]- Yohannes, Paulos, et al. "Comparison of robotic versus laparoscopic skills: is there a difference in the learning curve?." *Urology* 60.1 (2002): 39-45.

[47]- Kanitra, John J., et al. "Transference of skills in robotic vs. laparoscopic simulation: a randomized controlled trial." *BMC surgery* 21 (2021): 1-8.

[48]- Moon, Hye-Sung, et al. "The comparison of robotic single-site surgery to single-port laparoendoscopic surgery for the treatment of advanced-stage endometriosis." *Journal of Laparoendoscopic & Advanced Surgical Techniques* 28.12 (2018): 1483-1488.

[49]- Jayakumaran, Jayapriya, et al. "Robotic single-site endometriosis resection using near-infrared fluorescence imaging with indocyanine green: a prospective case series and review of literature." *Journal of robotic surgery* 14 (2020): 145-154.

[50]- Lee, Jihyun, and Seongmin Kim. "Is it the best option? Robotic surgery for endometriosis." *Life* 14.8 (2024): 982.

[51]- Singh, Sukhbir S., et al. "O-GYN-MD-126 primary efficacy and safety results from two double-blind, randomized, placebo-controlled studies of elagolix, an oral gonadotropin-releasing hormone antagonist, in women with endometriosis-associated pain." *Journal of Obstetrics and Gynaecology Canada* 39.5 (2017): 401.

[52]- Patel, Bansari G., et al. "Pathogenesis of endometriosis: Interaction between Endocrine and inflammatory pathways." *Best practice & research Clinical obstetrics & gynaecology* 50 (2018): 50-60.

[53]- Sasson, Isaac E., and Hugh S. Taylor. "Stem cells and the pathogenesis of endometriosis." *Annals of the New York Academy of Sciences* 1127.1 (2008): 106-115.

[54]- Cousins, Fiona L., and Caroline E. Gargett. "Endometrial stem/progenitor cells and their role in the pathogenesis of endometriosis." *Best practice & research Clinical obstetrics & gynaecology* 50 (2018): 27-38.

[55]- Rizzello, Francesca, and Maria Elisabetta Coccia. "Direct shedding of endometrioma contents through the follicle rupture: Insight on the pathogenesis of endometriosis." *European Journal of Obstetrics and Gynecology and Reproductive Biology* 223 (2018): 144-145.

[56]- Guerriero, Stefano, et al. "Systematic approach to sonographic evaluation of the pelvis in women with suspected endometriosis, including terms, definitions and measurements: a consensus opinion from the International Deep Endometriosis Analysis (IDEA) group." *Ultrasound in Obstetrics & Gynecology* 48.3 (2016): 318-332.

[57]- Ros, Cristina, et al. "Bowel preparation improves the accuracy of transvaginal ultrasound in the diagnosis of rectosigmoid deep infiltrating endometriosis: a prospective study." *Journal of minimally invasive gynecology* 24.7 (2017): 1145-1151.

[58]- Moore, J., et al. "A systematic review of the accuracy of ultrasound in the diagnosis of endometriosis." *Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology* 20.6 (2002): 630-634.

[59]- Exacoustos, Caterina, et al. "Isolated ovarian endometrioma: a history between myth and reality." *Journal of minimally invasive gynecology* 25.5 (2018): 884-891.

[60]- Hoyos, Luis R., Samuel Johnson, and Elizabeth Puscheck. "Endometriosis and imaging." *Clinical Obstetrics and Gynecology* 60.3 (2017): 503-516.

[61]- Mehedințu, Claudia, et al. "Does computed tomography–based virtual colonoscopy improve the accuracy of preoperative assessment based on magnetic resonance imaging in women managed for colorectal endometriosis?." *Journal of minimally invasive gynecology* 25.6 (2018): 1009-1017.

[62]- Kinkel, Karen, et al. "Magnetic resonance imaging characteristics of deep endometriosis." *Human reproduction* 14.4 (1999): 1080-1086.

[63]- Arrive, L., H. Hricak, and M. C. Martin. "Pelvic endometriosis: MR imaging." *Radiology* 171.3 (1989): 687-692.

[64]- Rolla, Edgardo. "Endometriosis: advances and controversies in classification, pathogenesis, diagnosis, and treatment." *F1000Research* 8 (2019).

[65]- Rolla, Edgardo. "Endometriosis: advances and controversies in classification, pathogenesis, diagnosis, and treatment." *F1000Research* 8 (2019).

[66]- Grammatico, D., et al. "Endometriosis: a correlation between high resolution nuclear magnetic resonance and laparoscopic findings." *13TH WORLD CONGRESS on ENDOMETRIOSIS*. 2017.

[68]- Bazot, Marc, and Emile Daraï. "Role of transvaginal sonography and magnetic resonance imaging in the diagnosis of uterine adenomyosis." *Fertility and sterility* 109.3 (2018): 389-397.

[69]- Johnson, Neil P., et al. "World Endometriosis Society consensus on the classification of endometriosis." *Human reproduction* 32.2 (2017): 315-324.

[70]- ACOSTA, A. ARNALDO, et al. "A proposed classification of pelvic endometriosis." *Obstetrics & Gynecology* 42.1 (1973): 19-25.

[71]- Adamson, G. David. "Endometriosis classification: an update." *Current Opinion in Obstetrics and Gynecology* 23.4 (2011): 213-220.

[72]- Hobo, Rutsuko, et al. "The endometriosis fertility index is useful for predicting the ability to conceive without assisted reproductive technology treatment after laparoscopic surgery, regardless of endometriosis." *Gynecologic and obstetric investigation* 83.5 (2018): 493-498.

[73]- Zizolfi, Brunella. "ENDOMETRIOSIS AND MULTIPLE SCLEROSIS: DIFFERENT PHENOTYPES WITH COMMON AUTOIMMUNE BACKGROUND?." (2021).

[74]- Tuttlies, F., et al. "ENZIAN-Score, eine Klassifikation der tief infiltrierenden Endometriose." *Zentralblatt für Gynäkologie* 127.05 (2005): 275-281.

[75]- Tuttlies, Frank, et al. "ENZIAN-score, a classification of deep infiltrating endometriosis." *Zentralblatt fur Gynakologie* 127.5 (2005): 275-281.

[76]- Koninckx, Philippe R., et al. "An endometriosis classification, designed to be validated." *Gynecological Surgery* 8 (2011): 1-6.

[77]- Worldwide, AAGL Advancing Minimally Invasive Gynecology. "NewsScope."