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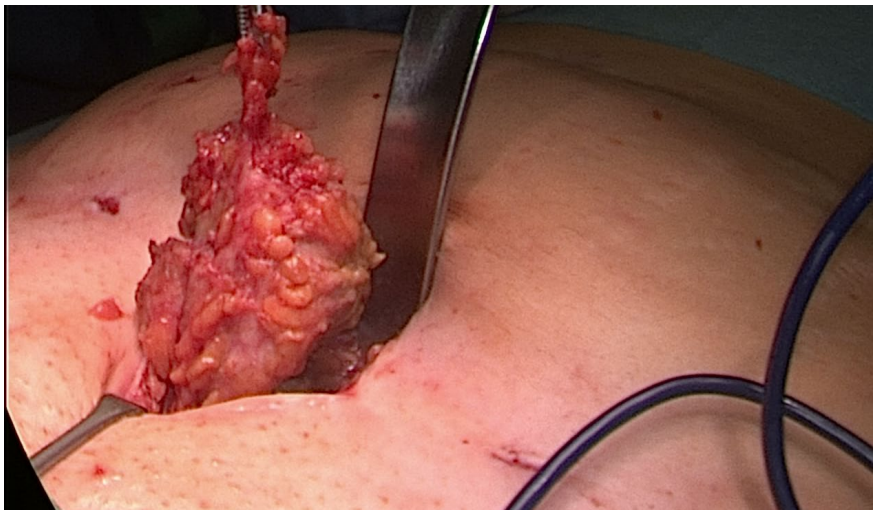

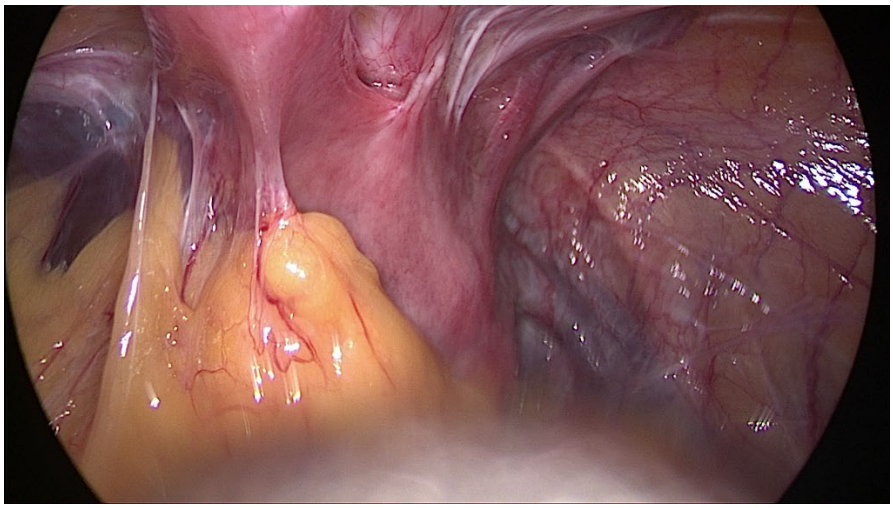

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The importance of ISGE for the future of global gynecological surgery.

The landscape of gynecological surgery has changed considerably. Over the past few decades, minimally invasive techniques, driven by advances in technology and surgical know-how, have drastically improved the outcomes and safety of gynecological procedures. One of the leading organizations advocating for these innovations is the International Society of Gynecological Endoscopy (ISGE). As the world faces increasing geopolitical instability, economic challenges, and competing global priorities – especially after wars and international conflicts – the role of ISGE becomes even more important. This essay examines the importance of ISGE for the future of gynecological surgery, especially in emerging, developing and developed countries, and examines how the challenging global context can shape the future of the discipline.

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1. **The need for ISGE in emerging and developing countries**

In emerging and developing countries, access to advanced medical technology and surgical training is often limited or impossible due to both financial and infrastructural challenges. Gynecological health, including the treatment of conditions such as fibroids, consequences of childbirth, endometriosis and cancer, often takes a back seat in countries struggling with basic health infrastructure. People who receive surgical treatment at all are often treated with traditional surgical methods, which can be more invasive, for cost reasons, even though these methods are often associated with longer recovery times, higher complication rates, and longer hospital stays.

The ISGE plays a dual role in tackling these problems. ISGE's commitment to educating surgeons in low-resource environments provides the skills and knowledge to perform minimally invasive surgeries. By promoting laparoscopic and endoscopic techniques, ISGE helps to reduce the negative side effects of open surgery and postoperative care, as well as costs in the long term. These techniques also lead to fewer complications and shorter recovery times, which is especially important in countries with limited health resources and long waiting times for treatment. In addition, ISGE's emphasis on improving surgical outcomes directly translates into a higher quality of care, allowing these countries to meet the growing demand for gynecological services.

ISGE's focus on global collaborations can help foster partnerships between developed and developing countries, which are critical to providing affordable solutions to underserved populations. The training offered and supported by ISGE is often less expensive than sending practitioners abroad, which reduces the financial burden on already overstretched health systems. An important contribution to this is that many members of the ISGE are willing to do voluntary work.

2. The role of ISGE in developed countries

In developed countries, the importance of ISGE extends beyond basic education to innovation, research, and patient-centered care. High-income countries often have more advanced healthcare infrastructures, but they also face unique challenges, such as rising healthcare costs, an aging population, and rising patient expectations. Minimally invasive gynecological surgery, which is a focus of ISGE, has proven to be an effective means of meeting these requirements. By allowing surgeons to perform complex procedures through smaller incisions, laparoscopy and other minimally invasive techniques reduce the risk of infection, shorten recovery times, and improve the overall patient experience. This shift towards less invasive approaches also helps to reduce the financial burden on healthcare systems, as patients can return to their normal lives more quickly and require fewer hospitalizations and less post-operative care.

In developed countries, where the focus is often on precision medicine and technological advancement, ISGE provides a platform for collaboration between practitioners, researchers, and medical device manufacturers. This collaboration is critical to developing new tools and techniques to ensure that gynecological surgery stays on the cutting edge and patients benefit from the latest innovations.

3. The Global Context: Geopolitical Instability and its Impact on Health Care

The challenging global environment, characterized by ongoing wars, international conflicts, and political instability, has far-reaching consequences for health systems, especially in countries that are already facing economic challenges. In recent years, conflicts in the Middle East, Africa and Eastern Europe have drained resources from health systems, leading to a deterioration in access to health care, a shortage of medical care and the displacement of health professionals. These situations often leave civilians, including women, vulnerable to inadequate gynecological care, and some even lack access to basic services.

As resources are diverted to military efforts and international conflicts, there is a real danger that global health initiatives, including advances in surgical techniques, could suffer. ISGE continues to seek to offer its expertise by providing training and educational resources through virtual platforms and mobile workshops, despite geopolitical and financial challenges, despite an increasingly challenging environment. The ability to adapt to changing circumstances and create accessible learning environments allows ISGE to reach a wider audience, even in conflict areas where traditional methods of education and training are not practical.

4. Conclusion: A vision for the future

The future of gynecological surgery is closely linked to the continuous efforts of organizations like ISGE to bridge the gaps between technological advancements, education, and accessible care.

With global challenges arising from geopolitical instability and conflict, ISGE's focus on accessible education and collaboration is more important than ever. Given the strain on resources caused by wars and economic crises, ISGE's commitment to expanding access to quality gynecological care despite financial and logistical barriers has the potential to change the future of gynecological surgery worldwide. Through the use of technology, fostering international partnerships, and continuing education, ISGE positions itself as a key player in ensuring that advances in surgery reach all corners of the world, regardless of the political or economic challenges ahead. Society's commitment to improving women's lives through innovative surgical care will remain a cornerstone of progress in both developed and developing countries, offering hope for better, more equitable healthcare in the years to come.

We are happy about any support through active volunteer work, donations or partnership, membership and everything that is conceivable to continue our work successfully. Thanks to all supporters of ISGE and we wish everyone a happy new year 2025.

Guenter Noé

Editor in chief

Index: Issue 4 Volume 5 TheTrocar: December 2024

The frontpage shows: 1. Caesarean scar Endometriosis; 2 Uterus stuck at the abdominal wall after caesarean section.

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TheTrocar Issue 4 Volume 5 / Page 1- 9 ISSN: 2736-5530

The Reproducibility of the Endometriosis Fertility Index: Inter- and Intra-Observer Variation in the Least Functional Score

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Abstract

Introduction: To evaluate intra- and inter-observer agreement in the Least Functional Score (LFS) component of the Endometriosis Fertility Index (EFI) amongst gynecologists. As a secondary outcome, we aimed to stratify results according to reviewer expertise.

Design: Prospective study (Canadian Task Force II-1).

Setting: A university hospital, two referral hospitals and two private sector clinics.

Method: Laparoscopic footage of 20 surgical procedures was recorded and presented to 20 gynecologists: 9 sub-specialists in infertility or endometriosis and 11 general gynecologists. Each reviewer was asked to watch and score all 20 videos using the Least Functional component of the Endometriosis Fertility Index on two occasions, more than a year apart.

Measurements and Main Results: Interclass correlation coefficient (ICC) and Weighted Kappa values were used to determine inter-observer agreement. Inter-observer agreement within our cohort was found to be moderate (ICC 0.5; κ 0.485) for the Least Functional score. This was true for the group as a whole as well as the sub-groups with an ICC of 0.53 vs 0.58 and κ 0.520 vs κ 0.565 for the sub- specialists and generalists respectively. While we observed a trend towards higher levels of agreement amongst the sub-specialist group for the individual structures, this did not reach statistical significance. With the exception of a single generalist, the observers in both groups achieved substantial intra-observer agreement.

Conclusion: This study found moderate inter-observer agreement with regards to the Least Functional Score component of the Endometriosis Fertility Index and substantial intra-observer

agreement for the majority of reviewers who took part in the follow-up study. We conclude that gynecologists of varying levels of expertise are equally capable of using the Endometriosis Fertility Index.

Key words: Endometriosis, Laparoscopy, Reproductive Surgery, Benign Gynecology, Assisted reproduction (IVF, ICSI, IUI)

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Introduction:

Endometriosis is a major contributor of gynecological morbidity, specifically with relation to sub-fertility and pelvic pain. It is therefore vital that we are able to scientifically explore this field. This necessitates collaborative efforts between clinicians and centers that may be separated, not only geographically, but also by terminology. Multicenter- and meta-analytical studies are dependent on our ability to uniformly classify disease and compare similar patients and stages in terms of management and outcomes. Currently the study of endometriosis is hampered by the lack of a descriptive classification system that is both scientifically sound and of prognostic value – with specific reference to fertility outcomes.

Most of the endometriosis classification systems historically and currently in use, have been aimed at predicting the likelihood of pregnancy for a given stage of the disease. However, most classification systems are not sufficiently predictive to be useful in clinical practice, as poor correlation is found between the extent of disease as classified and pregnancy outcomes in the older models including the American Fertility Society (AFS) score and its successor, the revised American Society of Reproductive Medicine (rASRM) score (1–3).

To address this, Adamson and Pasta collected prospective data on 801 consecutively diagnosed and treated patients and used regression analysis to derive the factors most predictive of pregnancy (4–6). These factors were then used to develop a system known as the Endometriosis fertility index (EFI). The Endometriosis Fertility Index is the first and only classification system that was developed using regression analysis of prospective data and has been proven predictive of fertility outcomes (4–8). It has been widely accepted by the academic community as illustrated by its incorporation into the World Endometriosis Research Foundation (WERF) Endometriosis Phenome and Biobanking Harmonization Project (EPHect) standard surgical form (SSF) as well as World Endometriosis Society Toolbox for surgical staging of endometriosis (9,10).

The EFI is intended for use with infertility patients who are surgically staged and assumes the presence of normal gametes and a normal uterus. It consists of historical factors as well as surgical factors. Surgical factors include the AFS score as well as the Least Functional score (LFS). The LFS is determined at surgery by evaluating and scoring the fallopian tube and ovaries. The

LFS component of the EFI has been shown to be the most predictive of fertility outcome and thought to reflect the function of the reproductive organs (5–7).

As of date, three independent investigators have assessed the EFI, all of whom found the EFI predictive of pregnancy rates (7,8,11). Adamson and Pasta did perform a sensitivity analysis to determine the effect of potential inter-observer differences in the LFS on the EFI during their original research (4). This was however based on statistical assumptions regarding the expected distribution of variability and has not been empirically tested. The historical component consists of objective factors and the AFS has previously been investigated in terms of reproducibility. The aim of this study was therefore restricted to the evaluation of inter-observer agreement in the scoring of the LFS. We also stratify our results by reviewer expertise.

Materials and methods:

The protocol for this study was approved by the Health Research Ethics Committee of the University of Stellenbosch prior to commencement (Ethics reference number: 14/02/041). The primary outcome was inter-observer agreement as measured by ICC and weighted Kappa scores. As a secondary outcome, the reviewers were stratified by expertise and the agreement within the two groups compared in terms of inter- and intra-observer variability.

Study-population:

The study involved a sample of patients and a selection of clinicians. The latter consists of two groups: general gynecologists and endometriosis/infertility specialists. The groups are delineated below. The sample sizes were determined after consultation with a medical statistician. It must be noted that power calculations for inter-rater studies require knowledge or assumption of the expected ICC. As the ICC for the EFI was not known (hence the need for this study), these calculations proved difficult. As a limited number of endometriosis/infertility specialists practice in the greater Cape Town area, we opted to approach them and match the willing participants with an equal number of general specialists. 20 videos, reviewed by 30 reviewers was calculated to adequately power the study (80%) to detect an effect of 0.2 in the Intra-class Correlation coefficient (ICC) (ICC 0.5-0.7).

Patients:

The clinical notes of patients booked for elective laparoscopic gynecological surgery at Tygerberg Hospital in Cape Town, South Africa were reviewed pre-operatively to identify patients suitable for inclusion into the study. On admission, these patients were counselled regarding the study and written consent obtained for inclusion. Patients were managed by their treating clinician and evaluated for surgery independently. The choice of operative route and surgical intervention lay with the treating clinician and was not influenced by the study.

Video-Footage:

During the surgery of the selected patients, the video output was recorded digitally. This was done at the end of the procedure when the pelvic structures were reviewed.

The footage was assessed by the primary author and deemed suitable if the visual quality was good and the adnexa clearly visualized. From the suitable footage, 20 videos representative of the spectrum of adnexal disease were selected.

Reviewers:

Reviewers were selected from gynecologists active at multiple centers affiliated with Tygerberg Hospital, Cape Town South Africa. This included gynecologists active in the

public health sector (Tygerberg hospital - which is an academic referral center, and two of its referring hospitals) as well as gynecologists from 2 clinics in the private health sector. Five centers were therefore involved. The reviewing gynecologists consisted of two groups namely generalists and sub- specialists. Sub-specialists: Individuals who are considered experienced in endometriosis and/or infertility surgery were identified. These individuals were qualified gynecologists who routinely perform laparoscopic surgery and are either advanced endoscopic surgeon (regularly performing excisional surgery for r-ASRM stage 3 and 4 endometriosis) or sub-specialists in reproductive medicine and therefore qualified in endometriosis surgery. 10 such specialists were identified and invited to join the study, of whom 9 enrolled and 8 completed the review process. 1 clinician did not respond and 1 enrolled but did not return any forms.

Generalists:

General specialists affiliated with Tygerberg Hospital were eligible. These were qualified gynecologists who perform laparoscopic surgery but do not perform excisional surgery for r-ASRM stage 3 and 4 endometrioses. Sub-specialists were excluded from this group. 15 general specialists were identified and invited to join the study, of whom 11 enrolled and 10 completed the review process. 4 clinicians did not respond. The reviewers in both groups were counselled regarding the purpose of the study and written consent was obtained for inclusion in the study. All reviewers were given a digital copy of the study videos and a scoring sheet for each video. Instructions on how to perform the scoring were included on the scoring sheet. In order to avoid bias no further instruction on how to perform the scoring was provided by the researcher. After one year, participants were asked to repeat the process. 7 clinicians (2 Sub-specialists and 5 general specialists) completed the second round within the allotted timeframe.

Data management and statistical analysis:

The data was analyzed with the help of a statistician from the Biostatistics unit, Centre for Evidence Based Health Care, Faculty of Health Sciences, University of Stellenbosch. Stata Version 13.1 was used. Interclass correlation coefficient (ICC) values were used to calculate the level of agreement within each group as well as agreement overall. We also represent our findings on intra- observer agreement by Kappa values for absolute agreement as well as weighted Kappa values for the weighted agreement.

Results:

A total of 20 clinicians were recruited in the first round. 1 reviewer submitted incomplete forms and 1 did not return any forms. These reviewers were excluded from the study. This brought the total to 18 reviewers: 8 in the sub-specialist group and 10 in the generalist group. Two sub-specialists and 5 generalists took part in the second assessment. Our findings are presented in Table 1 for weighted and absolute inter-observer agreement on the LFS.

Least Functional Score				
	Absolute Agreement		Weighted Agreement	
	κ - Value	95% CI	κ - Value	95% CI
Overall	0.148	0.107-0.213	0.485	0.351-0.651
Sub-specialists	0.214	0.157-0.290	0.520	0.339-0.732
General Specialists	0.143	0.099-0.216	0.565	0.417-0.753

Table 1 - Absolute and Weighted Inter-observer Agreement – Least Functional Score

Table 2 presents the results per anatomical structure. Table 3 summarises the results as ICC values. 95% confidence intervals are indicated. Tables 4 and 5 contains the agreement measures for the interpretation of Kappa values as per Landis and Koch and ICC values as per Koo and Li (12,13). In the first round, we found the overall inter-observer agreement for the Least Functional Score to be moderate (ICC 0.5). Both groups achieved moderate agreement for almost all structures by ICC. However, overall absolute agreement on the exact score along the nominal scale was, as expected, slight (κ = .148). For the second assessment, we found the overall inter-observer agreement for the Least Functional Score to be moderate (ICC 0.45). Both groups achieved moderate agreement for almost all structures by ICC. However, overall absolute agreement on the exact score along the nominal scale was again, as expected, slight (κ = .121).

With regards to the performance of the sub-specialists versus generalists; no statistically significant difference was detected for the LFS or for any of the adnexal structures. There is however a clear trend visible, with the sub-specialists consistently achieving higher Kappa values for all the structures. The generalists achieved slightly better agreement in the right LFS subtotal as well as in the Least Functional score, but this did not reach statistical significance. Apart from one generalist, all reviewers achieved substantial intra-observer agreement as indicated in Table 6.

Table 2 - Summary of Results per structure – Weighted Inter-observer Agreement

Weighted Inter-observer Agreement						
	Overall		Subspecialists		Generalists	
	Kappa	CI	Kappa	CI	Kappa	CI
Left Fallopian Tube	0.464	0.305-0.661	0.501	0.277-0.773	0.474	0.319-0.666
Right Fallopian Tube	0.614	0.460-0.812	0.706	0.513-0.939	0.579	0.425-0.774
Left Fimbria	0.529	0.353-0.747	0.612	0.363-0.919	0.51	0.368-0.687
Right Fimbria	0.578	0.389-0.813	0.689	0.483-0.944	0.513	0.324-0.744
Left Ovary	0.534	0.270-0.889	0.541	0.235-0.941	0.52	0.276-0.853
Right Ovary	0.572	0.350-0.872	0.59	0.347-0.897	0.543	0.305-0.868
Left LF Subtotal	0.488	0.333-0.676	0.55	0.364-0.771	0.534	0.411-0.687
Right LF Subtotal	0.599	0.476-0.753	0.625	0.422-0.860	0.633	0.496-0.804
LF Score	0.485	0.351-0.651	0.52	0.339-0.732	0.565	0.417-0.753

Table 3 - Summary of results per structure – Interclass correlation coefficient (ICC)

	Round 1		Round 2		Round 1		Round 2		Round 1		Round 2	
	Overall	95% CI	Overall	95% CI	Sub-specialists	95% CI	Sub-specialists	95% CI	Generalist	95% CI	Generalist	95% CI
Left Tube	0,51	(0.35-0.71)	0,41	(0,12-0,64)	0,56	(0.37-0.76)	0,73	(0,44-0,88)	0,49	(0.32-0.69)	0,33	(0,12-0,59)
Right Tube	0,63	(0.48-0.79)	0,44	(0,24-0,66)	0,72	(0.57-0.85)	0,71	(0,38-0,88)	0,59	(0.43-0.77)	0,35	(0,15-0,59)
Left Fimbria	0,55	(0.39-0.74)	0,50	(0,30-0,71)	0,68	(0.50-0.84)	0,73	(0,43-0,88)	0,52	(0.36-0.72)	0,42	(0,20-0,65)
Right Fimbria	0,61	(0.46-0.78)	0,46	(0,27-0,67)	0,76	(0.59-0.89)	0,81	(0,58-0,92)	0,53	(0.35-0.72)	0,37	(0,17-0,61)
Left Ovary	0,55	(0.39-0.74	0,33	(0,15-0,57)	0,56	(0.38-0.75)	0,59	(0,22-0,81)	0,53	(0.36-0.72)	0,24	(0,06-0,50)
Right Ovary	0,59	(0.43-0.77)	0,37	(0,18-0,61)	0,60	(0.42-0.78)	0,68	(0,35-0,86)	0,56	(0.39-0.74)	0,27	(0,07-0,52)
Left LFS Subtotal	0,50	(0.35-0.69)	0,48	(0,30-0,69)	0,56	(0.39-0.75)	0,64	(0,30-0,84)	0,55	(0.38-0.73)	0,40	(0,20-0,64)
Right LFS subtotal	0,61	(0.46-0.77)	0,47	(0,29-0,68)	0,64	(0.47-0.80)	0,93	(0,84-0,97)	0,65	(0.49-0.80)	0,35	(0,16-0,59)
LFS	0,50	(0.35-0.69)	0,46	(0,27-0,67)	0,53	(0.36-0.73)	0,85	(0,66-0,94)	0,58	(0.41-0.76)	0,38	(0,17-0,62)

Table 4 - Interpretation of Kappa Values as per Landis and Koch (12)

Kappa Score	Interpretation
<1	No agreement
0.0-0.2	Slight agreement
0.21-0,4	Fair agreement
0.41-0.6	Moderate agreement
0.61-0.8	Substantial agreement
0.81-1.0	Almost agreement

Table 5 - Interpretation of ICC values as per Koo and Li (13)

ICC	Reliability
<0.5	Poor
0.5-0.75	Moderate
0.75-0.9	Good
>0.9	Excellent

Table 6 Intra-observer reliability

			CI (95%)	
	Reviewer	Kappa	Lower	Upper
Subspecialist	A	0,81	0,68	0,94
	B	0,71	0,37	1,05
Generalist	C	0,81	0,68	0,93
	D	0,62	0,35	0,89
	E	0,76	0,58	0,94
	F	0,14	0,00	0,29
	G	0,89	0,82	0,96

Discussion:

Our aim with this study was to assess the reproducibility of the Least Functional component of the Endometriosis Fertility Index and as a secondary outcome, to stratify this by level of expertise. We found that weighted agreement was moderate (ICC 0.5; κ = .485) with no statistically significant difference in the performance of sub-specialists versus generalists. We only evaluated the LFS and not the complete EFI as the other components of the EFI are either objective, such as the historic factors, or previously studied, such as the AFS.

While the EFI differs from the r-ASRM in its design and aim, it is perhaps useful to compare the reproducibility of the two systems. The latter is widely used in the evaluation of infertility patients to assess structural damage that may impact on fertility, despite not having been

validated for this purpose. If the EFI is to challenge this status quo, it needs to be reproducible, in addition to being predictive of fecundity. Our findings on inter-observer agreement are similar to those of Schliep and colleagues' study from the 'Endometriosis: Natural History, Diagnosis and Outcomes study' group. They found moderate inter-observer reliability (κ = .44) for the r-ASRM comparable to our findings of moderate agreement (κ = .485) for the LFS (14). Schliep and colleagues found academic experts to be more reliable for the diagnosis of disease than the other experts. (κ = .79 vs. κ = .58) (14). We found no statistically significant difference between the generalist and sub-specialist groups. It must however be noted that our outcomes and the composition of our groups differed from theirs and our finding can therefore not be compared directly.

Our results on inter-observer agreement amongst the groups are in keeping with those of Buchweitz and colleagues who found no difference in the accuracy of specialists versus trainees in their study on the staging of endometriosis using the r-ARSM score (15). Our findings on agreement are also comparable to theirs in that they also found only marginal inter-observer correlation (Kendall coefficient of .14) It must however be noted that their study included no sub-specialists, therefore our groups were dissimilar to theirs and the results cannot be directly compared (15). With regards to intra-observer agreement, all but one reviewer achieved substantial or almost perfect agreement with kappa values between 0.62 and 0.89.

Conclusion:

We found the LFS component of the EFI to be moderately reproducible with no statistically significant difference in the performance of sub-specialists and general gynecologists. We therefore conclude that the EFI can be used in clinical practice by clinicians of varied levels of experience. Our findings may aid others in planning adequately powered studies involving the EFI.

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TheTrocar Issue 4 Volume 5 / Page 10-18 ISSN: 2736-5530

Salpingostomy instead of salpingectomy in the surgical treatment of ectopic tubal pregnancy: literature review and case report

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Abstract

Ectopic pregnancy is the leading cause of death in the first trimester of pregnancy. Its incidence has increased due to sexually transmitted diseases, the use of intrauterine devices and assisted reproduction techniques. Laparoscopic surgery has proved to be less invasive and traumatic. In addition to using vasopressin to control bleeding, additional techniques such as a precise incision with a fine monopolar cut may be considered. It is useful to make the incision in the anti-mesenterial region of the affected tube, starting from the proximal end of the ectopic pregnancy, and to avoid suturing the tube in the process. Laparoscopic salpingostomy not only maintains tubal patency, but also favors a better pregnancy rate after the procedure, so it is crucial to carefully select patients and perform rigorous follow-up to optimize long-term reproductive results. The article analyzes laparoscopic salpingostomy as an effective option to manage ectopic pregnancy, preserve fertility and minimize risks.

Key words: Pregnancy, ectopic, salpingostomy, fallopian tube, surgery

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Introduction:

Implantation of trophoblastic tissue outside the uterine cavity is a potentially life-threatening obstetric condition that occurs in approximately 2% of cases. Of these, 90% are located in the ampullary region of the fallopian tube and less than 1% in the intramural region, where the major complication is rupture and hemorrhage Interstitial ectopic pregnancies are documented in 2-3% of cases, where the blastocyst implants at the proximal end of the fallopian tube, penetrating the surrounding myometrium. This condition is responsible for 10-15% of pregnancy-related maternal deaths in developed countries, as well as the leading cause of death during the first trimester of pregnancy, accounting for 4-6% of all pregnancy-related deaths. Over time, there has been an increase in the incidence of these cases, attributed to the increase in sexually transmitted diseases, the use of intrauterine devices and assisted reproduction techniques. This anomalous implantation is usually the result of direct or indirect damage to the fallopian tubes (1). The pathophysiological mechanism leading to ectopic pregnancy is still not completely clear. However, several potential factors have been identified, such as defective ciliary movement and abnormalities in the muscular contractions of the fallopian tubes, as well as a proinflammatory environment associated with a history of infections or smoking. One proposed mechanism is the decrease in adrenomedullin, a calcitonin-related peptide expressed in the apical region of the fallopian tubes. This peptide plays a crucial role in stimulating ciliary movement and tubal contractions, and its reduction could contribute to the formation of ectopic pregnancies. Another factor implicated is the increase in interleukin 6 and interleukin 8, as well as tumor necrosis factor, which are elevated both in serum and in the tubes of patients with ectopic pregnancies. These inflammatory mechanisms alter embryo transport, favoring the adherence of the blastocyst to the tubal epithelium.

Historically, the treatment of ectopic pregnancy was exclusively managed by open procedures that carried a significant risk of morbidity and a prolonged recovery. However, the development of laparoscopic surgery in recent decades has revolutionized the management of this condition, offering a minimally invasive approach that considerably reduces recovery time, postoperative pain and complications, while preserving fertility in young patients (2). Currently, laparoscopy is considered the standard surgical approach for the management of ectopic pregnancy, and can be performed using two main techniques: salpingectomy (involving complete removal of the affected fallopian tube) and salpingostomy (incision into the tube to remove only the affected tubal tissue, allowing preservation of the tube). Although both procedures offer similar results, salpingectomy could present a potential disadvantage due to the interruption of utero-ovarian circulation and possible impairment of ovarian function, given that the tubal and ovarian arteries are close in origin (3).

Laparoscopic salpingostomy, in particular, has gained ground as a better conservative treatment option for women who wish to preserve their fertility, because as mentioned above it involves removing only the trophoblastic tissue, followed by secondary healing without the need for suturing, which helps maintain the anatomical and functional integrity of the tube. Several studies have shown that the rate of future pregnancies is significantly higher in women who undergo salpingostomy compared to those who undergo salpingectomy, as the latter

technique removes a critical part of the female reproductive system. In a retrospective cohort study conducted in Quebec, two groups of women were compared: one treated surgically for an ectopic pregnancy, and the second, with intrauterine pregnancies. Among patients undergoing salpingectomy, the risk of a second ectopic pregnancy was 14%, while for those treated with salpingostomy, the risk rose to 21.9%, regardless of age. In addition, the study revealed that 0.72% of patients treated with salpingectomy experienced a second intrauterine pregnancy, compared to 0.89% in the salpingostomy group (12). The main advantage of the above is the high surgical success rate, which reaches between 87% and 97%, even in hemodynamically unstable patients. This technique reduces operative time, which decreases the risk of thromboembolic events and bleeding, and contributes to fewer postoperative complications. In addition, it shortens the hospital stay, which reduces costs for both the patient and the institution. It also allows for faster recovery, less use of pain medications, and offers better cosmetic results (4).

Conservative management of ectopic pregnancy, however, is not without risks. Patients undergoing laparoscopic salpingostomy have a slightly higher risk of recurrent ectopic pregnancy, which requires careful postoperative follow-up to detect any early complications (5). Furthermore, it is important that patients be properly selected for this procedure, considering factors such as hemodynamic stability, desire for future fertility, and absence of severe tubal damage (4).

This article focuses on the use of laparoscopic salpingostomy as an effective and safe surgical strategy for the management of ectopic pregnancy, especially in young women who wish to preserve their fertility. Through the presentation of a clinical case and the review of existing literature, the benefits of this technique are discussed, as well as the clinical considerations necessary to optimize reproductive outcomes and minimize associated risks.

Case Report:

The case of a 23-year-old patient with a history of obstetric G4C1A2E1 who came to the emergency department due to a 6-day history of colicky pain is presented. The intensity of the pain was rated at 9 out of 10 on the visual analogue scale, located in the right iliac fossa and radiated to the right hypochondrium, accompanied by scant transvaginal bleeding. Relevant medical history includes a laparoscopic appendectomy performed 6 years ago and the use of combined oral contraceptives as a family planning method. The patient had never had a cervical cytology and her last menstruation occurred 2 months before her admission.

On the same day, an ultrasound was performed which showed endometrial thickening (11.2 mm), and no signs of intrauterine pregnancy. Subsequently, during her hospital stay, a new transvaginal ultrasound was performed, which revealed a hypoechoic mass of 24 x 24 millimeters in the right adnexa, with abundant free fluid in the posterior cul-de-sac. A pregnancy test was requested, which was positive, with a gonadotropin quantification of 1110.5 mIU/mL. The pelvic examination showed a painful abdomen, with signs of peritoneal irritation and transvaginal bleeding, as well as pain on cervical motion.

The Gynecological Endoscopy service evaluated the patient and recommended a laparoscopy with salpingostomy to preserve fertility and tubal patency. During surgery,

an enlarged uterus was found, with ectopic pregnancy located in the right tube, in the ampullary region, there was a ruptured ectopic pregnancy, measuring 2 x 2 centimeters and associated with a hemoperitoneum of approximately 100 milliliters. A salpingostomy was performed with removal of the embryonic tissue located at the anterior edge of the fallopian tube, using Grasper forceps and a suction and irrigation device. Vasopressin was infiltrated, diluting 20 international units in 100 milliliters of physiological solution, to minimize bleeding. The fallopian tube was then transected to extract the pregnancy using a 5-millimeter trocar, again using the Grasper forceps. In addition, multiple adhesions were identified and released. No intraoperative incidents were reported, as the procedure was performed by a surgeon experienced in minimally invasive surgery. Estimated bleeding during the procedure was 50 milliliters, and the approximate duration of the intervention was 60 minutes. (Figure 1-5).

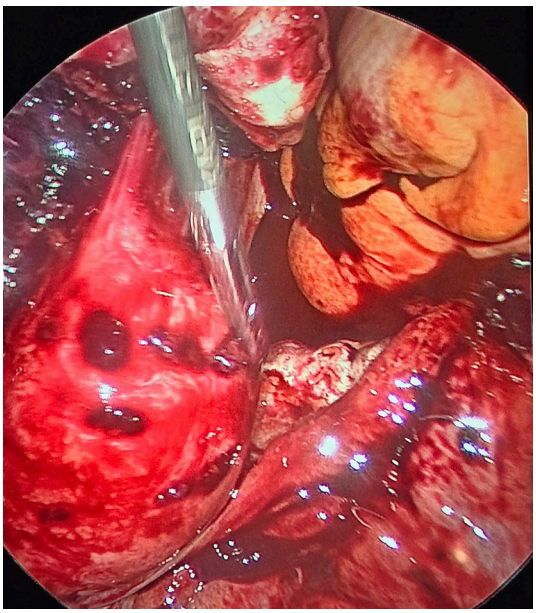

Figure 1: Ectopic pregnancy located in the right tube, in the ampullary region, there was a ruptured ectopic pregnancy, measuring 2 x 2 centimeters

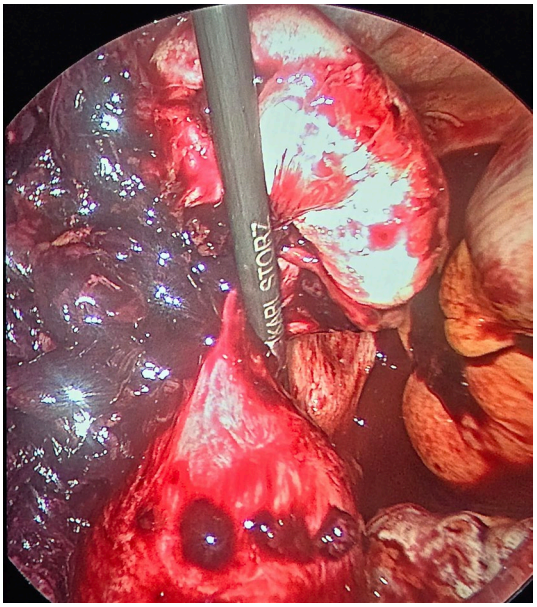

Figure 2: salpingostomy was performed with removal of the embryonic tissue located at the anterior edge of the fallopian tube, using a grasper forceps, a suction and an irrigation device

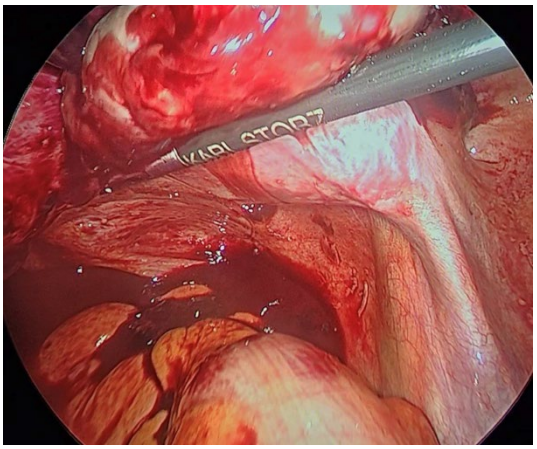

Figure 3: multiple adhesions were identified and released

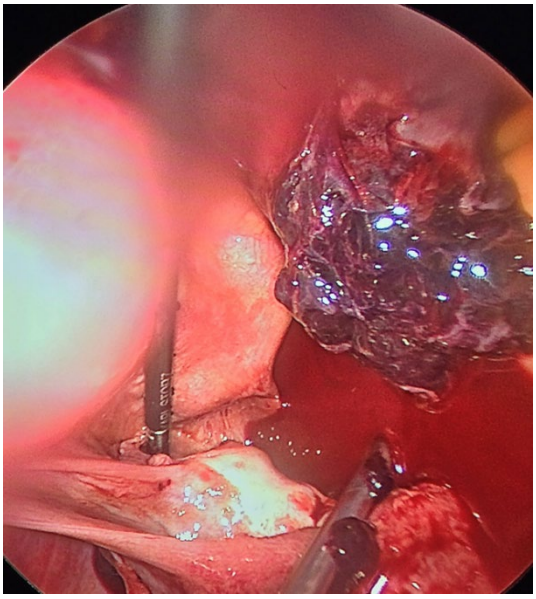

Fig 4: a hemoperitoneum of approximately 100 milliliters aspirated with 5 mm suction cannula

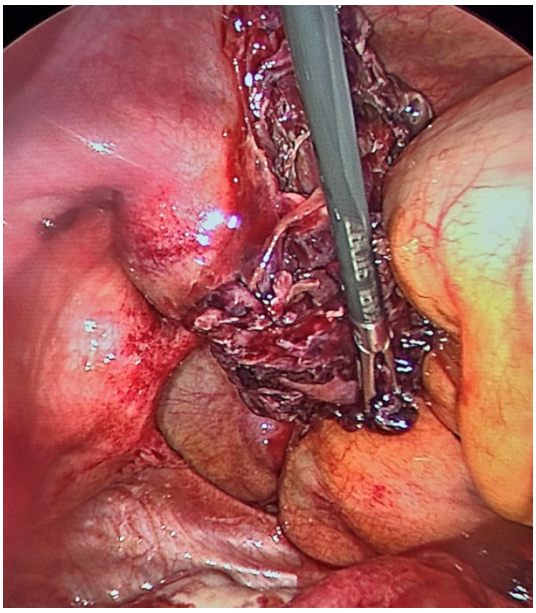

Fig 5: Incision of the fallopian tube to extract the pregnancy using a 5-millimeter trocar

The patient was discharged two days after surgery. During follow-up, laboratory studies showed a rapid decrease in human chorionic gonadotropin levels: 245.1 mIU/mL the next day and 32.29 mIU/mL six days after surgery (figure 6). This case illustrates the benefits of laparoscopic surgery over open surgery, such as a lower risk of complications, less intraoperative bleeding, reduced postoperative pain, and preservation of the fallopian tube, with an adequate decrease in human chorionic gonadotropin levels on the eighth postoperative day, without follow-up ultrasound to check tubal patency.

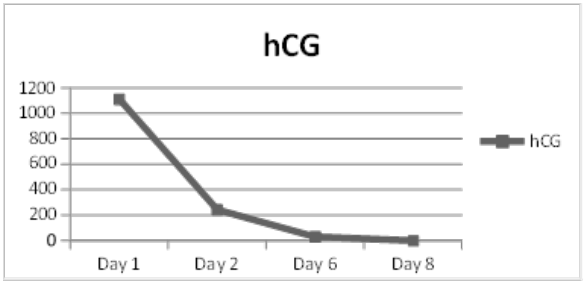

Figure 6: HCG course day 1 to 8.

Discussion:

With the development and improvement of laparoscopic technology, the advantages of laparoscopic surgery in the treatment of tubal pregnancy are being clinically recognized. The incidence of tubal pregnancy is gradually increasing and the number of patients with reproductive needs is also increasing, so protecting the reproductive function of patients after treatment has become a critical point. Laparoscopic salpingectomy and salpingostomy are the most common methods for the treatment of ectopic pregnancy.

However, the most viable treatment has been shown to be laparoscopic salpingostomy in order to preserve fertility in patients who wish to retain their reproductive capacity (6), this being a viable therapeutic option due to the skills of the operator (11) and its minimal invasiveness, resulting in an encouraging benefit for the patient (10).

Anatomically, the fallopian tubes are a tubular structure that extends from the horns of the uterus to the ovaries in the female pelvis. It is divided into four parts: the

infundibulum, the ampulla, the isthmus and the intramural portion. The ampulla is the widest segment and the most common site of fertilization and implantation of ectopic pregnancies due to its large lumen and highly folded mucosa, which provides a favorable environment for fertilization to occur. The fallopian tubes have an important role in the capture and transport of the egg, as well as in facilitating the meeting between the egg and the sperm. These receive their blood supply mainly through two arteries: tubal arteries and ovarian arteries. The tubal arteries branch from the uterine artery, while the ovarian arteries, which also provide blood supply to the ovary, arise directly from the abdominal aorta. These arteries form a vascular network that ensures adequate blood supply to both the tube and the ovary. The integrity of the utero-ovarian circulation is essential for ovarian function and fertility. (14)

During a laparoscopic salpingostomy, the goal is to remove the ectopic pregnancy from the fallopian tube without removing it completely. This is accomplished by making a small incision in the tube to remove the gestational tissue. Salpingostomy preserves the tubular structure of the tube and, most importantly, the vascular network that connects it to the uterus and ovaries is kept intact, thus preserving blood flow and therefore long-term ovarian function. Which is essential for young women who want to preserve their fertility, since not only the tubal transport capacity of the egg is maintained, but also the hormonal regulation that is vital for reproduction. (3)

In the case presented, the performance of laparoscopic salpingostomy allowed not only the effective elimination of the ectopic pregnancy, but also the conservation of the fallopian tube, thus preserving the patient's reproductive function by maintaining the tubal anatomy and the utero-ovarian circulation intact.

Also, the rapid decrease in human chorionic gonadotropin (hCG) levels postoperatively was a positive marker that all trophoblastic tissue was successfully removed. During laparoscopy, critical maneuvers such as vasopressin infiltration as a vasoconstrictor agent were performed to control intraoperative bleeding. Vasopressin is injected directly into the serosa of the fallopian tube before the incision is made. This local application causes constriction of blood vessels around the surgical site, significantly reducing blood flow to the area. By decreasing blood supply, vasopressin minimizes blood loss during the removal of gestational tissue, allowing greater visibility for the surgeon and a safer and more controlled intervention. Furthermore, the reduction in bleeding contributes to reducing postoperative complications and improving the patient's recovery, which is why its administration has proven to be safe and effective during the resection of ectopic pregnancy. (7).

Surgical findings of adhesions in the pelvic cavity were also addressed during the procedure, minimizing the possibility of future complications and improving the anatomical conditions for future pregnancies.

Laparoscopic surgery, compared to traditional laparotomy, significantly reduced recovery time, which was reflected in the rapid clinical evolution of the patient (8).

It has been shown that the pregnancy rate after laparoscopic salpingostomy is higher compared to those undergoing salpingectomy, this is because laparoscopic salpingostomy has been shown to better protect ovarian reserve function as well as endocrine function and provide favorable

conditions for a second pregnancy, therefore, patients with tubal ectopic pregnancy should give priority to laparoscopic salpingotomy for possibility of pregnancy (9).

The choice of surgical technique should be guided not only by the patient's hemodynamic stability, but also by her reproductive wishes and intraoperative anatomical evaluation. Laparoscopic salpingostomy, when technically feasible and clinically indicated, offers an excellent option for patients seeking to maintain their fertility while minimizing complications and improving postoperative quality of life (9).

However, conservative management of ectopic pregnancy, like any surgical procedure, is not without risk.

The possibility of a recurrent ectopic pregnancy remains a significant concern for patients who have experienced a previous ectopic pregnancy, especially in the context of conservative surgical techniques such as laparoscopic salpingostomy. This risk not only affects safety in future pregnancies, but also has emotional and psychological implications for patients who wish to conceive again.

According to a published meta-analysis that evaluated fertility outcomes after salpingectomy compared to salpingostomy in patients treated for tubal ectopic pregnancies. In randomized controlled trials, there was no significant difference in the odds of subsequent IUP in patients undergoing salpingectomy compared with those treated with salpingotomy (OR 0.97 CI 0.71-1.33). However, a significant and clinically meaningful difference was observed in cohort studies, in which patients had a lower probability of intrauterine pregnancy after salpingectomy (OR 0.45, CI: 0.39-0.52). With this meta-analysis we found that the probabilities of a repeat ectopic rate favor those patients who were treated with salpingostomy. (15)

Due to the risk of persistent ectopic pregnancy, it is essential to monitor hCG levels after salpingostomy. There are three main methods that use medical treatment, rather than performing a salpingectomy afterwards, due to the risk of PEP after a salpingostomy. The first method involves the routine administration of methotrexate (MTX) prophylactically in all cases, either systemically or locally in the tube; the second is to administer prophylactic MTX only if there are concerns about possible retention or incomplete removal of tissue; and the third is to apply MTX only in women whose hCG levels do not normalize after surgery. (16) Although the outcome in this case was positive, it is essential that further research be conducted on the long-term reproductive outcomes in patients undergoing this type of intervention.

Conclusion:

Laparoscopic salpingostomy is considered an effective and preferred technique for the conservative treatment of ectopic pregnancy, especially for patients who wish to preserve their fertility. This procedure not only allows the preservation of the fallopian tube, maintaining ovarian and endocrine function, but also offers the benefits of minimally invasive surgery, such as faster recovery and fewer postoperative complications, as shown in the case of our patient with a good postoperative evolution. However, careful patient selection is essential and rigorous follow-up is essential to optimize long-term reproductive results.

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Reduction of Post Surgical Pain and Additional Pain Medication with Superior Hypogastric Nerve Modulation in Minimally Invasive Hysterectomies

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Abstract

Study objective: To assess the efficacy of a superior hypogastric nerve modulation in reducing post-surgical pain and additional intake of pain medication after minimally invasive-hysterectomy.
Design: Patient blinded randomized controlled trial.
Setting: Multiple hospitals. One surgeon administered the anesthetic in his own surgeries.
Patients: Patients undergoing minimally invasive hysterectomies.
Intervention: Ropivacaine 20ml (0.2%) infiltrated in the retroperitoneal space overlying the superior hypogastric plexus, control of neuromodulation used at the completion of surgery.
Conclusion: The superior hypogastric nerve modulation used during a minimal invasion hysterectomy achieves better post-surgical pain management. It is a simple and effective

procedure that any gynecologist with minimal invasion experience can achieve due to its low difficulty level, and low risk.

Key words: Hypogastric nerve modulation, minimally invasive, hysterectomy, post-surgical pain, management, ropivacaine

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Introduction:

Hysterectomy is one of the most commonly performed gynecologic surgical procedures, with multiple benign indications such as dysfunctional uterine bleeding, endometriosis, and fibroids (1). However, it may also be performed for malignant conditions such as endometrial and cervical cancer in their early stages (2). The hysterectomy itself may be approached by multiple surgical techniques which in simple terms may be classified as minimally invasive (including robotic and laparoscopic approaches), abdominal hysterectomy and vaginal hysterectomy (including laparoscopic-assisted vaginal hysterectomy) (1). There are multiple advantages of the minimal invasión approach in modern gynecologic surgical procedures, such as a noticeable reduction in the amount of post-surgical pain experienced by the patient, earlier recovery and earlier return to he day-to-day routine. There´s also less surgical complications including less case reports of wound infection, fever, sepsis, deep venous embolism, and ileus. Also, minimally invasive hysterectomy may cut the duration of hospitalization to half in comparison to abdominal approach (3). The patient may even benefit from all of the previously mentioned advantages and more, by practicing the enhanced recovery after surgery (ERAS) pathway, which is specifically designed for patients who require any minimally invasive gynecologic surgery, including a hysterectomy. These guidelines are applied during the perioperative period with the purpose of mitigating the physiologic stress response to surgery and promote early recovery. It mainly consists in preoperative patient education, multimodal narcotic-sparing analgesia, nausea, thrombosis and infection prophylaxis, maintenance of euvolemia and liberalization of day-to-day activity (4).

A randomized controlled trial concluded that visceral pain is most significant in the first 24 hours after any surgical procedure. Pelvic visceral pain, specifically, is transmitted through the autonomic nerves, specifically the afferent fibers of the superior hypogastric plexus (SHP). This trial proved that a superior hypogastric plexus neuromodulation (19) reduces opioid medication requirements in the first 24 hours after surgery and is achievable by minimally invasive techniques, including laparoscopy and robot-assisted (5). A retrospective cohort study showed that after the infiltration of local anesthetic agents in the superior and inferior hypogastric plexus, the post-surgical pain scores given by patients were lower, and it also reduced the use of opioid medication, and helped shortening the time of early post-

surgical mobilization, favoring earlier discharge (6). Anatomy and Physiology of the Superior Hypogastric Plexus The superior hypogastric plexus, which is the continuation of the upper and lower mesenteric plexus, comes from the preaortic plexus, contains purely sympathetic nerves and is located at the level of the aortic bifurcation, over the sacral promontory. Caudally, this plexus then divides into a right and left segment, extending laterally and further down into the lesser pelvis. After the division, splanchnic lumbar nerves integrate the plexus, and contain sympathetic fibers, receiving the name of Inferior Hypogastric Plexus (IHP) which has both sympathetic and parasympathetic fibers (8). However, up to 40% of people present an anatomy variation, and this plexus may be found at the distal portion of the S1 vertebrae. From the lower hypogastric plexus, emerges an anterolateral branch which innervates the uterus and urine bladder, while the posteromedial branch innervates the rectum (9). Superior Hypogastric Plexus Neuromodulation In 1990, Plancarte et al. described the first SHP block guided by fluoroscopy, where they concluded that delivering local anesthetic to the SHP would lower the neoplastic chronic pelvic pain in the post-surgical period (10). Due to this trial, the primary indication for SHP block is visceral pelvic pain secondary to malignancy of the ovary, uterus, cervix, bladder, or rectum in the female patient.

In 2012, there was a Korean case report of a successful inferior hypogastric plexus neuromodulation with a coccygeal transverse approach technique, using lidocaine, bupivacaine and triamcinolone. They noticed that the classic trans-sacral technique had many secondary side effects and risks such as paresthesia, nervous and vascular damage, organ penetration, and postsurgical infection. So they came up with a new approach to this neurolytic technique. (12) Ultrasound-guided SHP block has also been described, in 2016 Gofeld et al., used the ultrasound as an imaging aid to perform an SHP neuromodulation on human cadavers in the supine position. They achieved bilateral spread by injection of the anesthetic by strict midline placement of the needle. (11) Aytuluk described for the first time a laparoscopic SHP neuromodulation in 2019 and concluded that the most efficient anesthetic to be used during this neuromodulation was bupivacaine, in order to reduce post-surgical pain. (13) However, that same year, Clark et. al concluded that even though and SHP block may reduce immediate post-surgical pain, in experience, it did not relieve pain for more than two hours and did not reduce the opioid consumption in the recovery ward. (14)

Materials and Methods:

Our main objective was to investigate the effect of a SHP neuromodulation on postsurgical pain in the first 24 hours after a minimally invasive hysterectomy. Our secondary objective was to evaluate the reduction of additional pain medication intake in these patients, including non-steroidal anti-inflammatory drugs (NSAIDs) or opioids. And lastly, our final objective was to reduce the amount of prolonged hospitalization stay. This was a patient-blinded, randomized, multiple-center study that ran from December 2022 to November 2023. The trial required 92 patients that went through a minimal invasion hysterectomy, in order to detect a reduction of post-surgical pain, additional pain medication intake and hospitalization stay. The patients were randomly assigned into the control and trial group using a computerized number generator. The statistical sample size was used to detect a 30% reduction in post-surgical pain, with an efficiency of 80% and a significance level of 5%. The final sample was of 92 patients; 18 patients in the control

group and 74 patients in the neuromodulation group. Participants were required to read and sign their written consent about the possibility of mixed anesthesia procedures that may be used before and after the surgical procedures, as well as their possible side effects: neuraxial injection, discitis, intraosseous injection, intravascular injection or intra-abdominal organ puncture (13, 15, 16, 17). The surgeon who administered de SHP neuromodulation remained a constant during the whole study and has over 10 years of experience in minimally invasive gynecologic surgery, including both laparoscopic and robot-assisted procedures. The surgeon, and the anesthesiologists who prepared the dosage for the SHP neuromodulation, as well as the rest of the theater staff were not blinded to the intervention, however the patients and the recovery nursing staff were unaware of the intervention.

The recruitment included patients who were undergoing laparoscopic hysterectomy for any benign indication. Patients with squamous intraepithelial lesión (I-III) were also considered for this study, and all of them presented a pathology report negative for malignancy. Patients needed to be aged above 18 years and be able to give informed written consent. The only exclusion criteria were allergy to the local anesthetic being used during the SHP neuromodulation (Ropivacaine). After recruitment and consent, baseline data was collected from the patient's digital file. Further data was collected intraoperatively, including procedure duration, blood loss and any possible complications or incidents during the procedure that may alter the results. All the patients in this trial received general anesthesia before the surgical procedure. (Table 1).

Medication	Dose
Midazolam	0.02-0.05 mg/kg
Fentanyl	3-4 mcg/kg
Propofol	1 mg/kg
Rocuronium	0.6 mg/kg
Dexmedetomidine	0.5 mg/kg
Lidocaine infusion	1 mg/kg/hr
Magnesium sulfate	20 mg/kg
Dexamethasone	8 mg
Parecoxib	40 mg
Acetaminophen	1 gr
Ondansetron	8 mg

Table 1. Medications and doses used to induce general anesthesia and additional medications administered by the anesthesiology team.

Two lateral 5 mm trocar and one 10 mm suprapubic trocar were needed in all of the procedures. Once the hysterectomy concluded, the patient remained in Lloyd-Davis position, the promontorium was located, and the surgeon managed to arrange the colon to the left in order to get a direct visión of the peritoneum. To administer the medication, two Croce Olmi forceps were used to grasp the peritoneum and tent it up (Figure 1), this way a laparoscopic needle was introduced through the central trocar loaded with ropivacaine 20 mL (0.2%) (Figure 2) and the anesthetic was infiltrated in the retroperitoneal space with the help of the forceps (Figure 3-4). After the withdrawal of the laparoscopic needle from the retroperitoneal space, the Croce Olmi forceps were used to keep the retroperitoneum tented and allow the anesthetic to properly infiltrate the retroperitoneal space (Figure 5). This procedure was performed under direct

laparoscopic vision at the end of the surgical procedure, right before the withdrawal of the laparoscopic instruments. This was done with the intention of not letting the surgical time be a biased element that may vary from patient to patient, decreasing the anesthetic effect during the post-surgical period. The anesthetic was successfully administered in all of the patients in the SHP group. There were no immediate complications reported in any of the procedures. Table 1. Medications and doses used to induce general anesthesia and additional medications administered by the anesthesiology team.

After the surgical procedure, we evaluated the effectiveness of the anesthetics during the first 24 hrs of post-surgical care in the recovery ward. We measured the pain using the visual analogue scale of pain, where the lowest score (0) meant painless, and the highest score (10) meant unbearable pain (7). Lastly, we registered the number of times the patient asked the nursing staff for additional pain medication, whether those may be opioids or NSAIDs, and logged the patients that requested an additional day of hospital stay due to pain. All of the patients were given 24 hours of postsurgical stay in the recovery ward. Patients were then discharged with oral NSAIDs and antibiotics, and scheduled for a general checkup 1 and 2 weeks later.

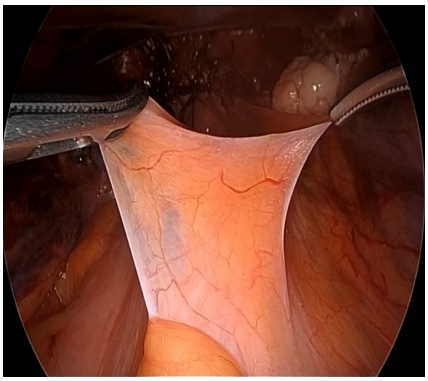

Figure 1. Using a grasper and a Maryland instrument to tent up the retroperitoneum.

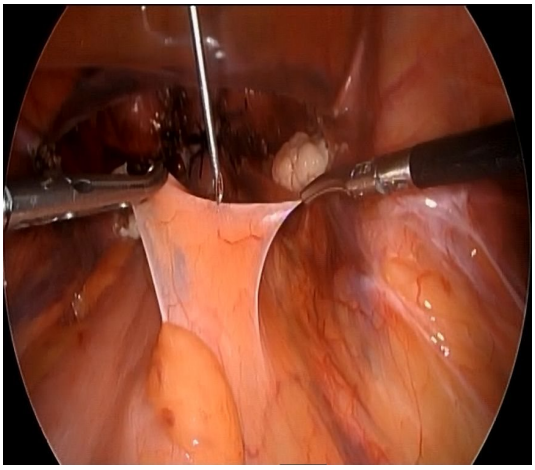

Figure 2. Introduction of a laparoscopic needle into the abdominal cavity to administer the anesthetic.

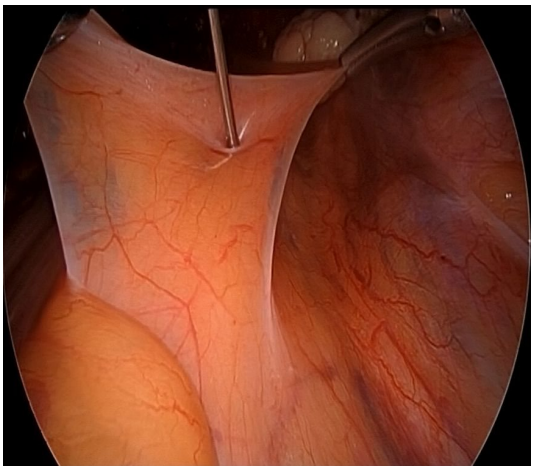

Figure 3. Beginning of the anesthetic infiltration.

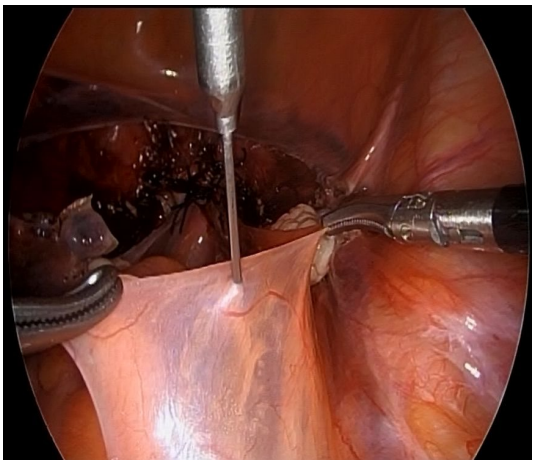

Figure 4. End of the anesthetic infiltration.

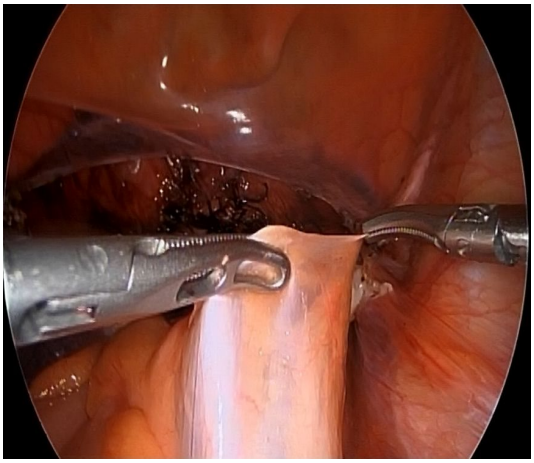

Figure 5. Keep the retroperitoneum tented in order to allow a proper infiltration of the

Results:

In order to control possible variable outcomes, we did a stratification based on age and the main indication for the hysterectomy. The mean age of the patients who participated in this trial was 44.3 years (Table 2). And the most common indication for the hysterectomy during this trial was uterine fibroids, whether it may be as the only indication, or mixed with other benign or early stage maligns indications (Table 3).

Age (years)	#
30-34	4
35-39	9
40-44	29
45-49	44
50-54	6
Total	92

Table 2: Age range

Indication	#
Uterine fibroids	70
Adenomiosis	12
Fibroids + NIC I	4
Fibroids + Adenomiosis	2
Adenomiosis + Endometrial thickening	2
Fibroids + NIC III	1
NIC III	1
Total	92

Table 3. Hysterectomy indication

Out of the 92 patients, 74 of them (80%) made up the SHP neuromodulation group and the other 18 patients (20%) only received the standard general anesthesia and intravenous acetaminophen during the first 24 hours after the surgical procedure. During these first 24 hours, 4 patients (3 from the control group (3%) and only one from the SHBP group (1%)) asked for additional painkillers during their stay in the recovery ward. However, no patients (from either group) required opioids or additional hospital stay due to additional pain management. The post surgical pain referred by the patients and the need of additional painkillers was statistically significantly lower in the SHP neuromodulation group, at an average of 2.88 in the pain scale with a standard deviation of 0.79, from 4.11 to 3.87 in comparison to the control group ($p<0.05$). Meanwhile, the control group reported an average of 4.11 in the pain scale with a standard deviation of 0.96. The average amount of pain reported by the control group was significantly higher in comparison, and the SD was lower in the neuromodulation group, meaning that the pain scale remained more constant to the mean, in comparison.

We also documented the following secondary effects in the neuromodulation group vs. the control group: nausea (10% vs 12%), hypotension (5% vs. 7%), and perilesional pain (5% vs. 7%). There were no severe complications reported in either group of patients.

Discussion:

This trial proved that the post-surgical pain experienced by patients may be lower in those who receive an SHP neuromodulation during their minimal invasion hysterectomy. Since 1990, there are records of the benefits that this neuromodulation can bring to lower the post-surgical pain in gynecologic oncology patients (10) and in 2013 the trans-surgical laparoscopic approach was firstly described (13) without needing alternate imaging aids (10,11). However, the surgical technique used during this trial was different because the laparoscopic needle was introduced through the suprapubic trocar port, instead of directly through the navel as other literature previously stated (13).

There already exists a well-known correlation between the multiple benefits for the patients and the use of the minimally invasive approach in all sorts of surgical procedures, including less post-surgical pain and early recovery (3), however, with the SHP neuromodulation there exists an even better postsurgical pain management that benefits the patient, and less need of addition painkiller medication needed to mitigate the pain, bringing and added economic benefit to both the patient and the surgical center. This is why we recommend that all gynecologists with minimal invasion experience can learn and dominate the SHP neuromodulation in order to offer their patients the least amount of post-surgical pain. Since the SHP doesn't have any motor fibers (8), this neuromodulation may be done without the fear of an accidental motor block. Ropivacaine is the optimal local anesthesia for this procedure, since it mostly works on the Aδ y C fibers which are in charge of pain perception, and it has close to no effect on the motor fibers (Aβ). Also, it has a longer effect compared to bupivacaine, and it has shown less risks of cardiovascular toxicity and secondary effects on the central nervous system (20). Previous trials that used ultrasound-guided administration of this local anesthesia proved that 20 ml were sufficient to achieve an optimal bilateral spread (11). We recommend doing the SHP neuromodulation at the end of the surgical procedure, so that the surgery duration does not affect the effectiveness of the neuromodulation, and so that the prolonged Trendelemburg position may not cause the cephalic dissemination of the anesthesia.

Since there were no prolonged hospital stays (more than one day) in either of the groups, we were not able to compare the economic benefits in that aspect. However, a short hospital stay is an already known benefit of the minimal invasion approach in any surgical procedure (8,9), so this trial may be replicated in patients who need a laparotomy approach hysterectomy in order to establish a shorter hospital stay benefit, obviously using direct vision to administer the SHP neuromodulation, due to the complications previously stated involving the trans sacral y coccygeal approach.

Conclusion:

The superior hypogastric nerve modulation used during a minimal invasion hysterectomy achieves better post-surgical pain management. It is a simple and effective procedure that any gynecologist with minimal invasion experience can achieve due to its low difficulty level, low risk and no need for any complex laparoscopic instruments; it is also a procedure that will not lengthen the surgery, since it can take up to only two

minutes to execute. It will benefit the patient by allowing her an early return to her day-to-day activities with the least amount of pain possible.

The technique used during this trial (direct administration through a laparoscopic needle) gives an advantage in comparison to other administration techniques, providing an easy and effective access to the hypogastric plexus, with the least amount of complications in comparison to extracorporeal needles or invasive imaging techniques, making this technique an effective way for every gynecologist with minimal invasion experience to provide a hysterectomy with a lower amount of post-surgical pain and less amount of additional pain killers.

I, corresponding author on behalf of all contributing authors, hereby declare that there is no conflict of interest regarding the publication of this paper.

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TheTrocar Issue 4 Volime 5 / Page 32-41 ISSN: 2736-5530

Role of Hysteroscopy in diagnosis and management of Adenomyosis: A review

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Abstract:

Background: The role of Hysteroscopy in common gynecological disorder is important. Adenomyosis is due the presence of ectopic endometrial glands and stroma within the myometrium. Hysteroscopy is not the first line treatment for Adenomyosis but it allows direct visualization of the uterine cavity. It helps in obtaining biopsy samples followed by further management.

Materials and methods: The literature was searched till June 2024 for the non-systematic review related to the role of Hysteroscopy in diagnosis and management of Adenomyosis. It was obtained from databases such as PubMed, Embase, google scholar, web of science, Science direct and Cochrane study.

Outcome: Due to the developed imaging techniques, it has become easier to identify Adenomyosis pre operatively. The underlying mechanisms of adenomyosis remain largely unclear, even though the condition is quite prevalent, there is potential for pre-histologic identification, and the symptoms can significantly affect women's health. The advantage of visualizing the uterine cavity directly is achieved through hysteroscopy. Resection may be carried out utilizing mechanical instruments and/or bipolar electrodes; however, this procedure is only suitable in instances where adenomyosis is observable via hysteroscopy. Intraoperative ultrasound in Hysteroscopy can help confirm the diagnosis of adenomyosis, these sings include a spherical uterus, marbled uterine surface or any cyst on the uterine wall. It is crucial to select appropriate patients for this office-based procedure, as it generally demands more time and may lead to increased discomfort.

Conclusion: Due to Hysteroscopy the management of Adenomyosis has been revolutionized. It allows biopsy from the particular area which increases the diagnosis of this problem. Finally operative Hysteroscopy can be done in superficial Adenomyotic nodules and for diffuse superficial Adenomyosis

Key words: Adenomyosis, Hysteroscopy, Classification, Management

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Introduction:

The term "adenomyosis" refers to the endometrial tissue (stroma and glands) existing within the myometrium; heterotopic endometrial tissue foci are linked to varying degrees of hyperplasia of smooth muscle cells (1). However, the definition of the disease still has no consensual definition yet. It can be as simple as disrupting the endometrial-myometrial junction to more than 8 mm depth, or it can even link the required invasion depth to the thickness of the myometrium (2). It can manifest as either localized or diffused, depending on the extent of myometrial invasion. Diffuse adenomyosis is characterized by a large intermingling of endometrial stroma and/or glands and myometrial muscle fibers, resulting in an enhanced uterine volume that is correlated proportionally with the lesion's extent. The focal adenomyosis is typically located in the myometrium as an aggregate of a single node, with a spectrum of histological characteristics that can range from mostly cystic ("adenomyotic cyst") to mostly solid ("adenomyoma") (3,4). Because adenomyosis could only be identified with certainty on histological specimens obtained following hysterectomy, the estimated incidence of the condition ranged between 5% and 70% in retrospective investigations (5). Pregnancy and prior uterine surgery appear to be risk factors for this condition, which is typically diagnosed in women of reproductive age.

Though the precise mechanisms underlying the development of adenomyosis remain unclear, current understanding holds that the deep endometrium, which invaginates between the bundles of smooth muscle fibers in the myometrium, is the source of adenomyosis or adenomyoma, primarily following uterine traumatic events (6,7). Therefore, it seems that uterine manipulations are a significant risk factor for invasion of endometrial cells in the myometrium (8). Given their shared embryological origin from the Müllerian ducts of the endometrium and the subjacent myometrium, endometrial tissue contains metaplastic myometrial cells leading to direct proliferation, which is believed to be a potential pathogenetic mechanism for uterine adenomyotic cysts. The endometrial tissue lining in these cystic structures is associated with myometrial tissue containing hemorrhagic material (7, 9).

Adenomyosis was recognized as a significant condition of the female reproductive system, and the use of ultrasound and magnetic resonance imaging (MRI) did start a significant shift in this understanding. By using these techniques consistently, it is possible to visualize the aberrations of the myometrial architecture without an invasive procedure and to differentiate between the

pathologies of the junctional zone and the outer myometrium. The junction zone differs from the outer myometrium both physically and functionally, and it is dependent on hormones, unlike the latter (7). The primary cause of uterine auto-traumatization has been observed to be deregulated in these contractions in adenomyosis and endometriosis patients, which results in hyperperistalsis and dysperistalsis (8). The pathophysiology of adenomyosis is poorly known, despite the great incidence of the condition, the potential for pre-histologic detection, and the severity of the symptoms that negatively impact women's health (10). The lack of proper classification is a result of this ignorance. Similar to endometriosis, adenomyosis can take many different forms, from straightforward thickening of the junction zone to localized, cystic, or widespread lesions. The well-defined focal lesions might manifest as either a muscular or a cystic lesion. Diffuse lesions have poorly defined borders that can affect both anterior and posterior uterine wall totally, increasing the volume of the uterus and producing an uneven appearance.

Symptoms

It is challenging to associate adenomyosis to a single pathogenic symptom. Adenomyosis symptoms include pelvic pain (including dysmenorrhea, persistent pelvic pain, and dyspareunia), decreased reproductive potential, abnormal uterine bleeding, and oedema; however, about 30% of individuals have no symptoms at all (11). Moreover, concurrent morbidities, of which endometriosis and fibroids are the most common, may conceal the causal relationship between the disease and the symptoms by having comparable symptomatology. It's unclear how common adenomyosis is as a stand- alone pathology; estimates range from 38% to 64% (12).

While there is disagreement over the precise correlation between adenomyosis and dysmenorrhea, reports of the condition's incidence range from 50% to 93.4% (13, 14, 15). Compared to women with just fibroids, an odds ratio of 3.4 (95% CI 1.8-6.4) was observed in women with adenomyosis and leiomyomas for having greater dysmenorrhea (14, 16). There was reported to be a linear relationship between the degree of dysmenorrhea and the level of adenomyosis (17). Although the exact cause of dysmenorrhea and pelvic pain in women with adenomyosis is unknown, prostaglandins may be a significant factor. In uterine adenomyosis, the existence of nerve fibers is still up for debate, although in severe endometriosis, their presence has been cited as a potential reason for discomfort (18, 19, 20).

The causal relationship between adenomyosis and co-existing morbidity, such as uterine fibroids and the inclusion of multiparous women, is difficult to establish. Nonetheless, it was reported that nulliparous women, who were diagnosed with diffuse adenomyosis, had an ultrasound examination indicating a higher frequency of irregular uterine bleeding (16). For every extra adenomyosis characteristic, there was a substantial 22% increase in menstruation [OR 1.21 (95% CI: 1.04–1.40) (12). An attempt was made to quantify the blood loss by classifying the clot size into four groups (21). A statistically significant association was observed between the degree of abnormal uterine bleeding (AUB) and the depth of adenomyosis (21).

The uterine myometrium consists of two distinct components: the outer myometrium and the inner myometrium, which is also referred to as the sub endometrial layer or junctional zone. The inner myometrium shares similarities with the endometrium

and experiences cyclical changes, originating from Müllerian tissue. In contrast, the outer myometrium is derived from non-Müllerian, mesenchymal tissue (22). Patients with adenomyosis and endometriosis experience dysperistalsis of cycle- dependent contractions of the junctional zone, which disrupts uterine tubal sperm transport and causes a more noticeable retrograde menstrual cycle (23). Evidence of effect of adenomyosis on fertility is increasing, especially in the face of disruption of the myometrial structure and altered endometrial function (24).

Material and methods:

A range of articles was evaluated for the non-systematic review concerning diagnosis and management of adenomyosis, focusing on the role of hysteroscopy. The literature was gathered through a comprehensive search of multiple databases such as PubMed, google scholar, Embase, Web science, Science direct and the Cochrane database. The selection process involved filtering articles based on the availability of the full texts, publication year and topic relevance up to June 2024. Studies detailing diagnosis and management of adenomyosis and its connection to hysteroscopic treatment were included in the review. The search utilized keywords such as Adenomyosis, Hysteroscopy, and role of Hysteroscopy in Adenomyosis.

Discussion Hysteroscopy

The benefit of direct uterine cavity vision is provided via hysteroscopy. It has been demonstrated that the technique can be performed in an outpatient setting with good tolerance by employing contemporary small barrel rigid hysteroscopes, the atraumatic vaginoscopy method, and a watery distention medium (25). Furthermore, in US patients, a study showed 27% of anomalies and no access failure or consequences. The interobserver difference, even across professionals, is a current limitation of hysteroscopy, making proper multicentered investigations to validate the significance of the disparate findings practically impossible (26). Hysteroscopic examination of the surface of endometrium can identify minor lesions that may be indicative of adenomyotic alterations in the myometrium, though their pathological significance has not yet been established.

The international federation of gynecology and obstetrics (FIGO) included important parameters in classification such as area affected, localization of adenomyotic changes, its pattern and type and volume (Table 1).

Table1: The international federation of gynecology and obstetrics group included important parameters in classification.

Parameter	Description
Affected area	Inner myometrium or outer myometrium
Localization	Anterior or posterior or fundus
Pattern	Diffuse or focal

Endometrial alterations such as increased vascularity, a strawberry-like appearance, defects within the endometrium, and the presence of submucosal haemorrhagic cysts are indicative of adenomyosis (27, 28). Transvaginal sonography revealed a cystic transparent region in the fundal area that looked like a protruding structure inside the uterus. Histology results from a biopsy of the cyst's bed revealed adenomyosis (28). As the

significance of the inner myometrium becomes more apparent, patients experiencing abnormal uterine haemorrhage, pain, or infertility should not only have their uterus explored; instead, their inner and outer structure of myometrium should be examined. The hysteroscopic examination reveals pathognomonic indications of adenomyosis, including endometrial implants on the pseudo-cystic wall and neovascularization, along with cysts filled with chocolate dye. It becomes necessary to combine hysteroscopy and ultrasound. Clinical classification of adenomyosis suggested the area involved in adenomyotic changes (Table 2).

Table2: Clinical classification of adenomyosis

Diffuse Adenomyosis	Involving large portion of myometrium
Focal Adenomyosis	adenomyoma-restricted area of myometrium with clear border cystic Adenomyosis
Polyploid Adenomyosis	
Endocervical Adenomyosis	
Retro peritoneal Adenomyosis	

By using a hysteroscopic technique, myometrial and endometrial samples can be taken with ultrasound or visual assistance. The spirotome can be inserted into the uterus cavity using the Trophy hysteroscope's diagnostic sheet as a guide. The corkscrew is precisely positioned in the direction of the sonographically suspicious location under ultrasound guidance. Following agreement on a position, the cutting tool is advanced and a one-centimetre cut biopsy is obtained. The results of an endo-myometrial biopsy revealed a poor sensitivity of 54.32% and a large percentage of false negatives in cases of profound adenomyosis.

The specificity of the biopsy was found to be 78.46% (29). Conversely, it has been found that the sensitivity of ultrasonography is 72% (30). It is possible to conduct a direct forwarded biopsy using the Spirotome (Bioncise) and get a representative tissue sample for additional analysis, because the diagnosis of adenomyosis appears to depend on the continuity of endometrial tissue infiltration into the myometrium, using the Spirotome to perform a biopsy provides the opportunity for additional research to identify potential differences between adenomyosis seen by imaging in patients of reproductive age and specimen in hysterectomy. It has been shown that by using spirotome under USG guidance, Adenomyotic cystic areas can also be addressed even in cases where intracavitary components are not visible (9). This device makes a channel and provides hysteroscopic access to the structure allowing further treatment with bipolar coagulation or resection to follow. The availability of direct access and the option for endomyometrial biopsies now allows for the correlation of ultrasound images with histological findings, eliminating the need for hysterectomy as required in earlier studies (31).

The hysteroscopic method for addressing adenomyotic lesions offers the benefit of preserving the outer myometrium (9). Unlike the hysteroscopic resection of uterine fibroids, which typically demonstrates complete healing of the uterine cavity during postoperative control hysteroscopy, follow-up examinations after adenomyomectomy or

the dissection of an adenomyotic cyst consistently reveal a defect in the uterus (31). The reason for this remains uncertain, but it may be related to the infiltrative nature of the condition, which leads to inadequate healing in the sub-endometrial area. The group of patients in which there is focal or localised adenomyotic, the benefits of hysteroscopic resection is superior to the risks involved than in diffuse adenomyotic changes (Figure 1), this also includes the reproductive functions. Molitor's criteria was suggested for Grading of adenomyosis (24). This grading suggested the degree of involvement of adenomyotic changes (Table 3).

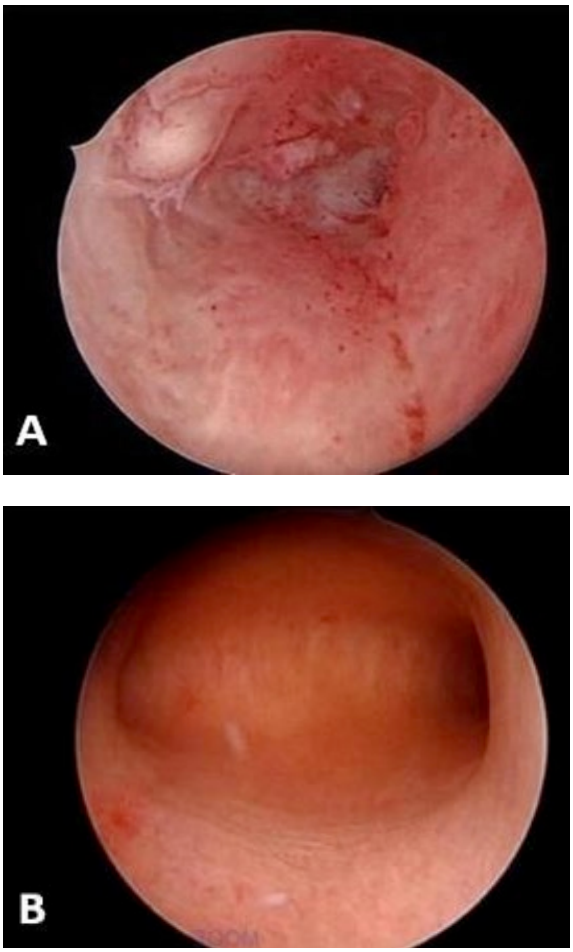

Figure 1: Adenomyotic changes seen on all four walls (A). Adenomyotic changes seen over fundus.

Table 3: Grading of adenomyosis (Molitor's criteria) (24).

Grade 1	Inner 1/3rd of myometrium
Grade 2	Middle 1/3rd of myometrium
Grade 3	Outer 1/3rd of myometrium
Degree of involvement	
Slight	1-3 glands/low power field
Moderate	4.9 glands/ low power field
Marked	10 or more glands / low power field

Office Hysteroscopy

Enucleation has been recommended as a treatment option for focal adenomyosis measuring less than 1.5 cm in diameter and located near the endometrial cavity (32). This procedure can be performed using mechanical instruments and/or bipolar electrodes, but it is only applicable in cases where adenomyosis is visible through hysteroscopy. The underlying principle is that adenomyosis can be removed with minimally invasive dissection, which can be conducted in an office environment utilizing mini- hysteroscopy and a resectoscope. The technique employed in outpatient settings mirrors that used for submucosal myomas with intramural components. Resectoscope excision can be achieved in an office setting with the use of a mini resectoscope; however, the available evidence regarding the effectiveness of this surgical approach for treating adenomyosis is limited (33).

In this context, it is important to identify patients who are suitable candidates for this procedure in an office setting, as it typically requires more time and may cause additional discomfort.

Conclusion:

Due to the imaging techniques, it has become easier to identify adenomyosis pre operatively. The junction zone is distinct from the outer myometrium in both its physical characteristics and functional roles and its properties are influenced by hormonal activity. The underlying mechanisms of adenomyosis remain largely unclear even though the condition is quite prevalent, there is potential for pre-histologic identification and the symptoms can significantly affect women's health. The absence of a comprehensive classification stems from this lack of awareness. Like endometriosis, adenomyosis can manifest in various ways ranging from simple thickening of the junction zone to localized, cystic or extensive lesions. Adenomyosis cannot be easily linked to a singular pathogenic symptom. The condition presents a range of symptoms such as pelvic pain (which encompasses dysmenorrhea, chronic pelvic pain and dyspareunia) reduced reproductive capacity, irregular uterine bleeding and swelling. Concurrent morbidities particularly endometriosis and fibroids can obscure the causal link between the disease and its symptoms due to their similar symptoms' profiles.

The advantage of visualizing the uterine cavity directly is achieved through hysteroscopy. Research has shown that this procedure can be successfully conducted in an outpatient environment with patients exhibiting good tolerance by utilizing modern small barrel rigid hysteroscopes, the atraumatic vaginoscopy technique and a fluid distension medium. The variability in observation among different professionals remains a significant limitation of hysteroscopy rendering it nearly impossible to conduct effective multicentred studies to confirm the importance of the varying results. While hysteroscopic evaluation of the endometrial surface can detect subtle lesions that might suggest adenomyotic changes in the myometrium, the pathological relevance of these findings has yet to be determined. Hysterectomy has traditionally been the most common approach for managing this chronic condition. There have been notable advancements in the diagnosis of adenomyosis prior to surgical intervention particularly in understanding the importance of tailored treatment strategies that take into account the patient's age, aspirations for future pregnancies and specific symptoms. Operative hysteroscopy may serve as a suitable therapeutic approach for superficial adenomyotic nodules and diffuse superficial adenomyosis (34). However clinical failure is high and this procedure reduces the chance of hysterectomy by only 30% (35). The accuracy of hysteroscopy in adenomyosis had sensitivity of 40.74% and specificity of 44.62% and adding endomyometrial biopsy to TVS improved specificity of 89.23% (36). As depicted in the below images, the adenomyotic changes are seen on all four walls (A) and adenomyotic changes seen over fundus (B).

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TheTrocar Issue 4 Volume 5 / Page 42- 44 ISSN: 2736-5530

Niche pregnancy complicated by bleeding: A case report (Video)

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Abstract

Background: Niche pregnancy, one of the rarest types of ectopic pregnancy, is a result of the placental implantation on the scar of a previous caesarean section or in the niche. Clinical symptomatology varies, although most patients are asymptomatic. Transvaginal ultrasonography remains the milestone in the diagnosis of niche pregnancy.

Objectives: The aim of the video is to demonstrate a niche pregnancy complicated by bleeding and managed by hysteroscopy and laparoscopic suture compression.

Materials and Method: A 37-year-old woman V. gravida, IV. Para, at 8+6 gestational age, and three caesarean sections in the past obstetric history (the last one performed five years ago) with an isthmocele pregnancy.

Result: Postoperative the patient was discharged in a stable condition and had no abnormal findings in the follow-up visits at our outpatient department.

Conclusion: The video shows that a laparoscopic suture compression could be a safe and efficient option towards bleeding control during the management of an isthmocele pregnancy.

Key words: niche pregnancy; isthmocele pregnancy; hysteroscopy; laparoscopy; bleeding

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Introduction:

Niche pregnancy, also known as isthmocele or caesarean scar pregnancy (CSP) is a rare type of ectopic pregnancy which occurs when the pregnancy implants on the uterine scar or in the niche after a previous caesarean section (CS) (1,2). The increasing number of caesarean deliveries worldwide cause a parallel increase of Niche pregnancies (3,4). There are several suggested classifications of CSP, with modified Delphi being the most frequently utilized (5). Clinical symptomatology varies, although most patients are asymptomatic. Transvaginal ultrasonography remains the milestone in the diagnosis of CSP pregnancy (5,6). More than 30 regimens, medical and surgical, have been described for the treatment of CSP. However, no standardized approach has been designed so far due to lack of consensus (7).

Patient and Method:

A 37-year-old woman V. gravida, IV. Para, at a gestational age of 8 weeks 6/7, and three CS in the past obstetric history (the last one performed five years ago) presented to the emergency department of the hospital with vaginal bleeding a few days prior to consultation. Clinical examination showed a closed external os and no vaginal bleeding.

Transvaginal ultrasonography revealed a 32 mm gestational sack with an embryo with positive heartbeat in the niche. According to the modified Delphi method this CSP was classified as Type 3 with a rest myometrium (RMT) OF 2,5mm. First of all, a mobilisation of the pregnancy was carried out, using the hysteroscope itself and a blunt dissector, followed by the removal of CSP by suction. Due to persistent intraoperative bleeding a foley catheter was placed for intrauterine compression followed by a laparoscopic compression suturing of the preexisting niche.

Results:

Postoperatively the patient was discharged the next day in a stable condition and had no abnormal findings in the follow-up visits at our outpatient department.

Conclusions:

Although CSP pregnancy is a rare entity, its early diagnosis and appropriate management are really crucial to prevent life-threatening complications and preserve the future fertility of the patient. As there is no consensus for the therapy of CSP, more randomised clinical trials (RCT) are needed to evaluate and standardize its management. However, as shown in the video, a combined hysteroscopic and laparoscopic approach seems to be a safe and efficient option towards bleeding control during CSP management.

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Antenatal Myomectomy

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Abstract

The prevalence of uterine fibroids of the female genital tract varies from 20–50% in women of the reproductive age group. Surgical management by myomectomy is usually reserved for the non-pregnant uterus. The complication rate in fibroids coexisting with pregnancy may be 10–30%, which are preferably managed conservatively. Red degeneration of fibroids during pregnancy is common, due to the hormonal effect, these in the majority of cases do respond to conservative management. For those not responding to conservative treatment, myomectomy may be an option. Myomectomy in pregnancy remains a controversial issue. Comprehensive peri-operative management is mandatory to minimize complications. A case of a symptomatic uterine fibroids diagnosed during pregnancy was successfully managed by antenatal myomectomy.

Key words: antenatal, diagnosis, myoma, Increase, myomectomy, laparoscopy, conversion

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Introduction:

Uterine fibroids are the commonest benign tumor in women, occurring in approximately 20-30% of women of reproductive age. These are therefore common in pregnancy (1). The prevalence of leiomyomas during pregnancy is reported as approximately 2% (2-4). Although during pregnancy leiomyomas may remain asymptomatic, the surge in placental hormone results in an increase of the fibroid

size, this increase may complicate the pregnancy and delivery in several ways; like, increased frequency of spontaneous abortions, fetal growth retardation, preterm labor, premature rupture of membranes, antepartum bleeding, placental abruption, malpresentations, and Cesarean delivery (5,6). Fetal anomalies, namely limb deformities and contractures, may occur as a result of leiomyomas. Myoma usually remain asymptomatic, but the syndrome of "painful myoma", due to red or carneous degeneration, occurs in approximately 5-8% of myomas in pregnancy (6,7). With adequate analgesia, most pregnancies have a favorable outcome, but in rare circumstances surgical intervention and myomectomy may be required (8).

Justifying myomectomy remains contentious; detailed assessment is important for risk stratification, to identify cases that will be benefitted from surgery and to take preventive steps to minimize complications that can lead to deleterious outcomes.

Case report:

A 30-year-old primigravida was referred to the hospital on 12 August 2024 gestational age of 13 weeks 4/7 days with the chief complaint of severe abdominal discomfort for one month. She was diagnosed as a case of uterine fibroid at the eight weeks of gestation when she did complain of severe pain in the abdomen. At that time an ultrasound was done and showed the presence of a myoma of size 7x10.2 cm, with few areas of cystic degeneration. She was being managed conservatively with analgesics and had minimal relief for her symptoms. She was referred to our center for further management. The Patient was admitted to the obstetric ward, on examination her vital parameters were was present, the height of uterus corresponded to 24 weeks of gestation. On vaginal examination the uterus could be felt separately and had a volume of about 12-14 weeks gestational size, beside this, a huge mass of about 15 cm diameter filling the whole abdomen was felt separately. Ultrasonography showed an intrauterine viable fetus of 13 weeks 3/7 days gestation with a large well defined hypoechoic mass arising from the fundus, measuring 7x 14cm cm with a cystic degeneration from right adnexa. As the myoma was fast growing with red degeneration associated with severe pain abdomen, patient was counselled regarding all possible outcomes of pregnancy along with this mass and she agreed to undergo a laparoscopic myomectomy with high-risk consent for spontaneous abortion, blood transfusion and on the rare possibility of hysterectomy.

During laparoscopy, the primary port was placed at the Lee Huang's point to avoid injury to pregnant uterus and a pneumoperitoneum was created with an intraabdominal pressure of 12 mmHg. On inspection a huge subserosal myoma with a broad base arising from fundus region of the uterus with a size 15x7x7 cm was found along with a 14-week size uterus. Three Secondary ports were placed under direct vision, two on left and one on right. A laparoscopic myomectomy was attempted by coagulation of the base of myoma, but had to be abandoned due to profuse bleeding from the base. The procedure was completed by a laparotomy with a Pfannenstiel incision. Clamps were placed at the base of the myoma and it was removed. Haemostasias was achieved by placing interrupted sutures with Vicryl No 1. Care was taken to avoid taking endometrium in sutures. Fetal monitoring by ultrasonography was carried out immediately after surgery and the fetus was

found to be viable. The postoperative period was uneventful and the patient was given tocolysis for 3 days with uterine relaxants and micronized progesterone was continued for four weeks. The patient was discharged on the 7th post operative day, with follow up advice for further antenatal check-ups.

Discussion:

Management of uterine myomas in pregnancy, especially those showing degenerative changes, remains controversial as there are concerns of detrimental effects on maternal health and of jeopardizing fetal viability and growth. Generally, conservative management is recommended in uncomplicated cases, however in symptomatic cases showing poor response to medical treatment, an invasive procedure is an option (9-14). The surgical removal of a myoma is generally delayed until after delivery, as mortality and morbidity are slightly higher at myomectomy in the gravid uterus compared to the non- gravid uterus (15). Myomectomy can be considered after comprehensive assessment and counselling to avoid untoward sequelae and the risk of litigation. Myomectomy is justified when there are degenerative changes of the fibroid in pregnancy causing intolerable pain. Heavy bleeding needing transfusion leading to risks of hysterectomy is a major concern in the myomectomy procedure though this was not demonstrated in certain studies (10,11). Additional to the general risks of myomectomy is the risk of abortion which occurs in 18% to 35% of cases[1].

Traditionally, laparoscopic myomectomy in pregnancy is believed to be associated with fetal acidosis, fetal loss and bleeding. This could be due to carbon dioxide retention following pneumoperitoneum at surgery (12). However, laparoscopy has become a trend with successful outcomes (13). A drastic improvement in the learning curve of this technique may have contributed to its popularity. In the present case this treatment method was used initially but was abandoned due to severe bleeding from the base of the fibroid. A meticulous surgery was performed to minimize hemorrhage, with double stitches suturing the peripheral feeding vessels. Haemostasias was secured before closure. As progesterone calms the myometrial activity and prevents premature labor, its use is strongly recommended. Large meta-analyses significantly revealed a reduction of premature birth before 34 weeks in high-risk cases (14-16). Mollica et al. (17) conducted a prospective study of 106 pregnant women with uterine myomas who were admitted with recurrent abdominal pain. This study shows that regardless of gestational age, the outcomes for all women who underwent myomectomy (n=18) was superior to those managed conservatively in terms of pregnancy loss (0% versus 13.6%), premature rupture of membranes (5.6% versus 22.7%), preterm labour (5.6% versus 21.6%) and post-Cesarean hysterectomy (0% versus 4.5%). However, in patients like our own a timely and well-planned myomectomy can be an option offered to the patient, avoiding morbidity and mortality associated with the myoma.

Conclusion:

The decision to perform a myomectomy during pregnancy should be based upon the symptoms, failed medical management, fibroid size, its location and its rapid growth to prevent various possible forthcoming adverse events. Therefore, a carefully planned myomectomy in huge myomas in selected cases is an appropriate low morbidity option which can be offered to the patient.

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Additional Figures:

Figure 1: Ultrasound of the myoma with necrotic zones.

Figure 2: Ultrasound of the mass filling the abdomen

Figure 3: Dimensions of the myoma

TheTrocar Issue 4 Volime 5 / Page 50-53 ISSN: 2736-5530

Deep Endometriosis with Intestinal Involvement (Video article/Case reprort)

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Abstract

Deep endometriosis is characterized by the infiltration of endometriotic tissue beyond the peritoneum, affecting not only reproductive organs but also nearby structures, including the intestinal tract. Surgical management becomes particularly challenging when the disease infiltrates the rectosigmoid colon, often requiring advanced surgical interventions. Intestinal surgical approaches, including segmental and discoid resections, are associated with significant risks and complications. The well-known and previously published “En Bloc Hysterectomy Technique” describes the simultaneous hysterectomy and the affected portion of the rectosigmoid through a segmental resection. This video article introduces a novel surgical approach, the ‘Modified En Bloc Hysterectomy’, designed for cases requiring hysterectomy with concurrent intestinal involvement classified as #Enzian C2. The ´Modified En Bloc Hysterectomy´ technique allows for simultaneous hysterectomy and intestinal discoid resections, enhancing intestinal-sparing surgery in patients where radical intestinal resection is not required. This surgical approach reduces the risk of complications by allowing dissection and visualization of healthy structures before reaching compromised areas. This reduces the risk of fistula formation and intestinal injury during surgery, as well as reducing overall intraoperative time.

Learning Objective: The present video aims to demonstrate the advantages of the ´Modified En Bloc Hysterectomy´ for deep endometriosis with intestinal involvement.

Key words: En Bloc Hysterectomy (EBH); Endometriosis

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Introduction:

Deep endometriosis is characterized by the presence of endometrial-like tissue infiltrating beyond the superficial peritoneum. It is a complex disease that affects not only the reproductive organs but also adjacent structures such as the intestinal tract. It is estimated that between 5% to 37% of patients with deep endometriosis present involvement of the rectosigmoid, being one of the most common extragenital locations. This condition not only causes severe pelvic pain but can also trigger severe digestive symptoms such as constipation, pain during bowel movements, and, in some cases, partial bowel obstruction. These surgeries present high complication risks, reaching 10–22% when colorectal resection is required. This is why these procedures should be carried out by highly trained surgeons with extensive knowledge of pelvic anatomy. The surgical approach when the intestine is compromised by endometriosis will depend on different factors such as the size of the lesion and the extent and depth of the wall involvement. Different strategies may be considered, ranging from conservative techniques such as rectal shaving, discoid resections, or a radical approach such as segmental resection.

Patient and Methods:

We present a case of a 40-year-old patient with symptoms of dysmenorrhea, chronic pelvic pain, dyschezia, and severe dyspareunia. Mandatory pre-surgical endometriosis mapping was realized, and the pelvic MRI findings revealed a 25mm nodular plate involving the uterine isthmus, retraction of the posterior vaginal fornix, and ovaries pulled toward the midline; bilateral endometriomas, three cm on the right side and five cm on the left side. An intramural endometriotic nodule of the rectum measuring 26 mm and located ten cm from the recto-anal junction. Diffuse posterior adenomyosis. #Enzian Classification: P0, O2/2, T3/3, A2, B2/2, C2, FA.

Main Outcomes:

Surgery lasted 158 minutes. The patient was monitored during hospitalization with vital signs, procalcitonin and C-reactive protein levels, as a parameter of colorectal anastomosis dehiscence, which remained within normal values. The patient was discharged from the hospital with adequate tolerance to a general anti-inflammatory diet after the second day of hospitalization, with no further complications.

Results:

The patient showed significant improvement of symptoms one month after surgery, along with an anti-inflammatory nutritional plan. Pathological anatomy revealed: Uterus with extensive diffuse adenomyosis; colonic muscular layer with chronic inflammation and edema, associated with a fibromuscular tissue nodule with endometriosis.

Thematic considerations:

As mentioned earlier, in our strategy the intestinal approach will depend on the size of the lesion and the extent of the intestinal wall involvement. The discoid resection involves the excision of a disc-shaped portion of the anterior wall of the bowel. This procedure is mainly used for deep but localized lesions, #Enzian C1-C2, meaning less than three centimeters in size. This technique is associated with less morbidity compared to segmental resections. Instead of removing a full intestinal segment, a disc of affected tissue is excised, minimizing damage to the intestinal structures, and preserving function. It allows for a quicker recovery with a lower risk of complications such as infections and postoperative obstructions. The segmental resection technique is used

when the disease significantly affects a large portion of the bowel circumference, #Enzian C3, or when there are multiple deep lesions, meaning a multifocal disease. In this case, a complete intestinal segment is removed, and a primary anastomosis is performed to reconnect the healthy ends. Segmental resection carries a higher risk of complications, such as fistulas or dehiscence.

According to the strategy of our center, intestinal endometriosis surgery, the priority is to adopt a conservative approach, aiming to preserve intestinal function. However, this approach is valid only if the complete removal of the disease can be ensured. Residual endometriotic tissue leads to persistence of the pathologic tissue, rising the risk of recurrence of symptoms and therefore, worsening the patient's quality of life. Thus, the surgical intervention applied to each patient is carefully evaluated based on the severity of the intestinal involvement, being therefore, an individualized decision. The Video Article "A novel Technique for En Bloc Hysterectomy in the Treatment of Deep Endometriosis #Enzian C3 Bowel Nodules" published in 2023 by Cabrera R and Kondo W describes the "EBH" technique for the treatment of deep endometriosis with rectosigmoid involvement, specifically #Enzian C3 nodules.

This technique involves the simultaneous resection of the uterus and the affected portion of the rectosigmoid through a segmental resection, reducing surgical time and providing a more efficient approach. The benefit of "EBH" technique is that it reduces the risk of complications by first accessing healthy planes of the recto vaginal space, until the clear visualization of the Denonvillier's fascia, before heading to the compromised areas, as it is clearly exposed in the Video. This ensures better visualization and careful separation of the structures, minimizing the risk of intestinal injury during the dissection. To perform "EBH" technique certain criteria must be met such as ensuring that the intestinal nodule is at least seven centimeters from the anal margin. This is because a sufficient healthy distal margin is needed to create the stapler line below the nodule. In this article, we developed a `Modified En Bloc Hysterectomy´ technique, as we are performing a hysterectomy combined with a conservative procedure, such as discoid resection instead of a segmental resection. Although the surgery applies an En Bloc approach until the step of the anterior colpotomy with the intestinal nodule adhered to the retro-uterine surface; once the healthy space of the rectovaginal septum is dissected and identified between the retro-uterine surface and the bowel, the uterus is carefully separated from the intestine, allowing to perform a discoid resection of the affected bowel. This modified technique allows for intestinal-sparing surgery in patients where radical intestinal resection is not required, while still maintaining the previously and already published benefits of En Bloc Hysterectomy for deep endometriosis surgery.

Conclusion:

The ´Modified En Bloc Hysterectomy´ technique seems to offer an effective, low-risk surgical approach for patients with deep endometriosis and intestinal involvement classified as #Enzian C1-C2. This technique emphasizes the preservation of function and minimizes complications, ensuring better visualization of vital structures, and significantly reducing intraoperative time. It is a promising option for cases of deep endometriosis that require intestinal resection.

Comment by Editor: We are publishing the surgical strategy shown by the authors because it appears to be a new and practical approach. However, we would like to point out that there is no study data on this and that this is a case report. We look forward to see further research on the publish strategy

Additional Figures:

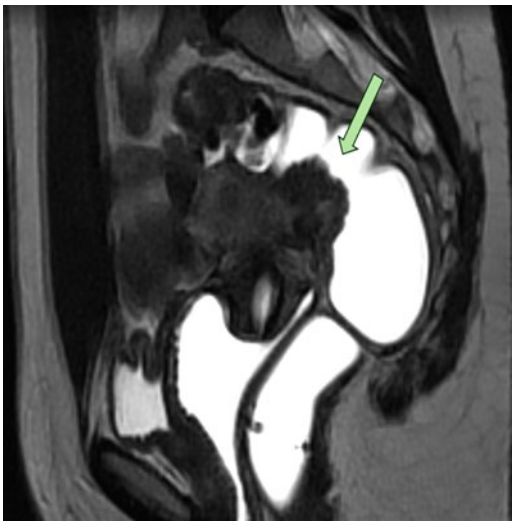

Figure 1: The intestinal nodule can be visualized located ten cm from the anal margin, measuring approximately 26 mm in diameter, with involvement of the rectal wall's muscular layer**.**

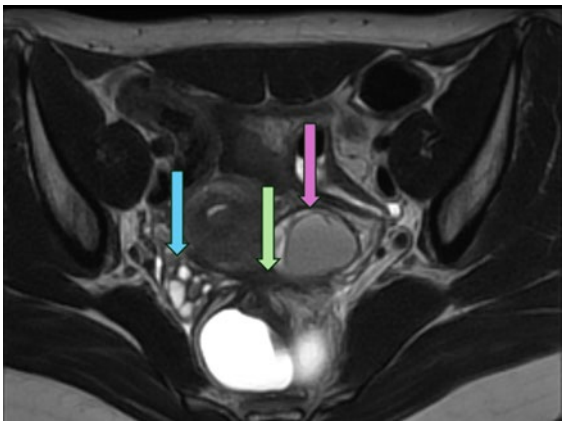

Figure 2: The pink arrow indicates a five cm endometrioma on the left ovary, with minimal healthy parenchyma remaining. The blue arrow points to multiple endometriomas in the right ovary. Both ovaries are retracted towards the midline. The green arrow indicates the retro cervical nodule that pulls the aforementioned structures and the rectosigmoid at that level.

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Applications of Lasers in Gynecology- A Comprehensive Review

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Abstract

The therapeutic use of lasers in gynecology has developed significantly in recent years. This article summarizes the numerous options and provides an overview of the applications.

Key words: Laser light, Co2 Laser, Nd:YAG laser, KTP laser, applications, gynaecology

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Introduction:

The use of laser technology in gynaecology has become widespread since the CO_2 laser s initially used by Kaplan and colleagues in 1973 for treatment of cervical erosions (1). Since then, many advancements in laser technology have been made, and several other types of lasers are now available, including the neodymium: yttrium- aluminium-garnet (Nd:YAG), potassium-titanyl-phosphate (KTP), and argon. At the same time, the laser has become a popular instrument in laparoscopy, especially in the area of infertility. Despite its popularity in the late 1980s, the early 1990s saw a push to reduce healthcare costs, which led to the adoption of less expensive alternatives like unipolar instruments and loop electrical excision. Despite this shift, laser technology continues to offer unique advantages for gynaecologists.

History:

Laser is an acronym that stands for light amplification by the stimulated emission of radiation, a concept that was developed by Einstein in 1917 (2). The first laser developed by Theodore Maiman in 1960 used a ruby as the active medium, and in 1961 the CO laser was introduced (3,4). The CO laser was used in gynaecology for the first time in 1973 for the treatment of cervical erosions, and later by Bellina for the treatment of cervical intraepithelial neoplasia (CIN), as well as for

microsurgery of the fallopian tube. The use of KTP, argon, and Nd:YAG lasers became popular in the early 1980s.

Laser Physics:

Lasers are named according to the medium that is activated. The common lasers in gynaecology are CO_2, argon, KTP, and Nd:YAG. Each medium produces light waves of specific wavelength giving it a characteristic colour (monochromatic). A simple way to understand how light is emitted is to look at an atom with its surrounding electrons (Fig. 1).

These electrons occupy discrete orbits that shift to higher orbits when they absorb energy (Fig. 2). Whenever the medium is activated, electrons are displaced to higher energy orbits. In the case of the CO_2 laser, activation of the gas particles is done by using electrical wall current. The electrons that are displaced quickly return to their resting orbits, releasing a package of energy in the process referred to as a photon (Fig. 3). This process of light generation is known as spontaneous emission. An example of this process is a light bulb, which emits light waves of different frequencies in all directions out of phase.

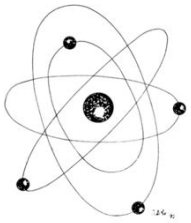

Fig. 1. Illustration of an atom with a nucleus and orbiting electrons.

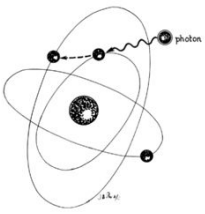

Fig. 2. Stimulated absorption occurs as a photon impacts on an electron, driving it into a higher orbit.

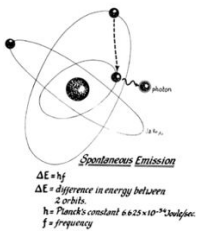

Fig. 3. Slow, natural decay causes an electron to drop into a lower orbit, resulting in a photon being emitted at a predicted frequency equal to the difference in energy between the two orbits.

In the laser, however, these photons can further stimulate an already excited atom in its path to release an identical photon that is in phase (coherent), has the same wavelength and colour (monochromatic), and travels in the same direction without divergence (collimated). This process is referred to as stimulated emission (Fig. 4)

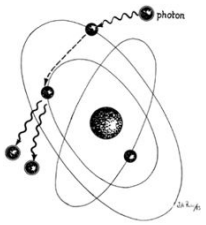

Fig. 4. The natural "slow" decay process may be stimulated by collisional processes, resulting in many photons traveling at the same frequency as the inducing photons.

Different colours are produced by different lasers. The argon laser produces a wavelength of 510 nm, making a blue-green light. The KTP produces a wavelength of 532 nm, making its light a green colour. The CO_2 laser, in contrast, produces a wavelength of 10,800 nm, which is in the nonvisible part of the electromagnetic spectrum, therefore, a helium–neon laser is simultaneously used, which produces a red light to identify the location of the CO_2 beam. The laser beam comes out of the port as an unfocused beam. A lens system is used to focus the laser to a focal point. With the hand-held attachment, the focal point is usually ten cm away from the focusing lens. At laparoscopy, the focal length is longer, taking into account the length of the laparoscope. Fine focusing can be done through a joystick or automatically with a coupler. Also, with the use of wave guides, one eliminates the problem of intermittent focusing of the beam that is associated with the joystick device. In contrast to the CO2 laser which is transmitted through long tubes and is reflected by mirrors, the argon, KTP, Nd:YAG and diode lasers are transmitted via a fibre (Figure 5).

Figure 5 – Flexible fibers used for laser surgeries

Laser Tissue Interaction:

There are three basic parameters that determine the amount of energy being delivered to the tissue. The first is the wattage. For most gynecologic procedures using the CO_2 laser, one rarely exceeds 20–30 W, which is used primarily for excision purposes. The second parameter is time. The longer the laser remains focused on one spot, the more energy is applied to that area. To limit tissue damage, especially in critical areas, one can simply move the beam back and forth, or select an intermittent, timed pulse mode, usually in fractions of a second. The third parameter that can be controlled is the spot size of the beam. As one gets closer to the target area, the spot size is made smaller, producing a more intense effect. The combination of watts (power) and spot size determines the rate of tissue interaction. The higher the power density, the greater the laser's ability to vaporize and cut. This concept is expressed in watts/cm^2 (unit/area) and referred to as intensity or power density. Power density is, therefore, inversely proportional to the area of the spot size and to the beam diameter. Doubling the beam diameter reduces the power density to one fourth. Conversely, by decreasing the diameter of the spot size, the power density is increased by 4. Of the various lasers available, the CO_2 laser remains the most versatile and is relatively safe because of limited depth penetration. The CO_2 beam is readily absorbed by tissue because of the tissue's high-water content. The instantaneous boiling of intracellular water causes cells to explode, forming steam. Depending on the power density, the CO_2 laser can be used effectively for vaporizing tissue, for excision, or for

incision. Bleeding is reduced with the use of the CO_2 laser because of its coagulating properties: it seals small vessels as it cuts. When compared with other lasers, the depth of penetration and the lateral thermal damage of the CO_2 laser are limited to less than 1 mm; thus, it can be used in areas of endometriosis on the pelvic side wall near the ureter. In contrast, the Nd:YAG laser has deeper penetration; thus, more caution is needed with its use (Table 1).

Table 1: Types of Lasers used in gynaecology

Type	Wavelength (nm)	Color	Fiber	Depth of penetration
Argon	488–512	Blue-green	Yes	0.5 mm
KTP/532	532	Green	Yes	1–2 mm
Nd:YAG	1,064	Infrared	Yes	3–4 mm
CO_2	10,600	Infrared	No	0.1 mm

Three types of tissue injury may be identified following a laser wound. The zone of vaporization is characterized by an absence of tissue and a V-shaped defect, because energy is greater in the center of the beam than on the perimeter. Immediately below the zone of vaporization is a fixed zone of stromal necrosis measuring (in cervical tissue) approximately 50–100 μm in depth, regardless of the crater's extent. Within this zone, small vessels (<1 mm) are sealed. The third zone is one of reversible injury or potential repair. Laser wounds are clean, produce minimal tissue damage, and cannot be compared with cautery wounds, in which substantial devitalized debris remains behind. Therefore, laser and scalpel wounds are similar. The CO_2 laser may serve three principal functions: as a cutting or excisional instrument, as a vaporizing or ablating instrument, and as a defocused cauterizing instrument.

CO_2 Laser:

Of the various lasers available, the CO_2 laser is the most versatile and is extremely safe because of its limited depth of penetration (0.1–0.5 mm) and lateral thermal damage (0.5 mm). This allows use of the CO_2 laser in delicate areas where cautery would be unsafe, such as the bladder, lateral side wall near the ureter, and bowel serosa. Besides vaporization, the CO_2 laser. can be used for excision or incision by increasing the power density. Disadvantages of the CO_2 laser include focusing of the helium–neon beam as well as production of smoke referred to as "plume," which needs frequent evacuation to allow adequate visualization of the target.

KTP- Argon Lasers:

The KTP and argon lasers have similar wavelengths, 532 nm and 514 nm, respectively, and are delivered via a fibreoptic fibre. They produce an intense green- blue light and can be transmitted through fibers of different diameter (400 μm and 600 μm), thus changing the spot size. The advantages of these lasers over the CO_2 laser include: a selective absorption by haemoglobin, less plume production, and an easy delivery system that uses lower power settings in the range of 5–10 W. The main disadvantage is the need to wear special glasses that distort the view of the pelvis and make it difficult to visualize small implants of endometriosis. Keye and colleagues have reported pregnancy rates following argon laser treatment for mild, moderate, and severe endometriosis to be 38%, 30%, and 20%.[7]

Nd:YAG Laser:

Nd:YAG lasers emit an invisible beam with a wavelength of 1064 nm and have to be guided similarly to the CO2 beam using a helium-

neon spot. The Nd:YAG wave is readily absorbed by tissue with a deep penetration of 3–4 mm. The energy emitted by the Nd:YAG laser is poorly absorbed by fluids and thus makes it an excellent tool for hysteroscopic surgery. In addition, the beam can be transmitted through an operating hysteroscope. There are two modes of delivery of the Nd:YAG laser: the bare quartz fibre and the quartz fibre that has a sapphire contact tip. The bare fibre on contact with tissue creates an area of coagulation that can extend 3–5 mm into the tissue, as well as peripherally. By using a sapphire tip at the end of the fibre, the laser energy can be focused and converted into heat. This results in the ability to vaporize without the extensive tissue coagulation caused by the bare fibre. Sapphire tips need to be cooled with a coaxial flow of gas or liquid through the fibre and are contraindicated for hysteroscopic surgery, but they can be safely used for abdominal surgery. Recently, it has been made possible to modify bare fibers for use in a contact mode by moulding the tip and creating sculptured tips of various types such as scalpel, tips, and balls. These fibers do not need to be cooled.

Laser safety:

Laser surgery in gynaecology has been used for 20 years with a good safety record. However, as with any device used in surgery, a laser has the potential to cause serious injuries. Gynaecologists requesting laser privileges should be certified for the specific type of laser used. Certification implies attendance of didactic instruction and practical use of the laser in the laboratory prior to its application in patients. When using the laser, an appropriate warning sign, such as “Laser in Use,” should be displayed on all doors of the operating room. Protective safety glasses appropriate for the laser in use should always be worn by surgeons and operating room personnel. When the laser is not being fired, it should always be on stand-by mode. Surgical drapes near the operating field have to be fire retardant and kept wet if possible. Adequate suction should be available to collect all plume produced by laser use, because intact viral DNA and papilloma-virus have been detected in the plume (8). When using various types of laser wavelengths, it is important to understand their specific tissue interaction to avoid undesired trauma. It is much easier to cause damage to a vessel or ureter when using deep penetrating energy such as that produced by the Nd:YAG laser than when using the CO_2 laser energy, if one is treating superficial endometriosis. In addition, fibers used for transmission of laser energy are delicate and can break. If one is unaware of a broken fibre, laser energy will be delivered at the point of breakage, potentially injuring the patient and/or staff.

Extraperitoneal Laser Surgery:

Cervix–Cervical Intraepithelial Neoplasia

Although treatment of cervical intraepithelial neoplasia (CIN) is now more commonly performed. Treatment of CIN can be performed by vaporization or by excisional conization using the laser as a substitute for the scalpel (9). The carbon dioxide (CO_2) laser is the laser of choice for this. The major advantages of the CO laser for the treatment of CIN include:

- High degree of clinical efficacy
- Bloodless field
- Microscopic precision
- Sparing of normal tissue
- Rapid healing with minimal scar formation
- Small number of complications
- Outpatient methodology

The main disadvantages of the CO laser include the absence of a histologic sample when vaporization is performed and the expense of the laser machine.

Vaporization:

Cervical erosions

When using the laser coupled to the colposcope, one should first define the extent of the lesion. One should keep in mind that endocervical glands may lie deep in the stroma to a depth of 6–7 mm therefore, treatment should be carried out to a minimum of 9–10 mm with a peripheral margin of 3 mm. This procedure is performed with 30–40 W of power with a 2-mm-diameter spot and takes about 5–10 minutes to complete under local anesthesia (10). Vaporization is performed to a minimal depth of 1 cm and ends at the level of the endocervical canal. The cervical defect should resemble a funnel, as if one performed a small cone biopsy. The operative site is circumferentially outlined with a 3- to 5-mm margin around the lesion. The cervix is then divided into four quadrants. Power is increased to 30–40 W. Beginning in the lower quadrants and using a circular pattern, vaporization is carried down to a depth of 1 cm. The endocervical canal is usually spared. Measurements are made at frequent intervals, relating the depth to the surrounding ectocervical surface. When the lower half of the cervix has been vaporized, a similar procedure is followed for the anterior surface.

The results of CO_2 laser treatment of intraepithelial neoplasia are very acceptable and comparable to loop excision. Baggish, Dorsey, and Adelson reported a series of 954 laser excisional cones with 97% showing no evidence of persistent recurrent disease (10). Four cases of invasive cancer were identified, and 73 women had disease extending to the margin; 44 of the latter were followed with no further treatment and remained free of disease. There were 25 women in this series with persistent disease requiring repeat cone or hysterectomy. Complication rates with laser cones are very low; cervical stenosis occurs in 1.3% of cases, cervical incompetence in 0.05%, and major bleeding in less than 1% of patients (11,12).

Vulvar Intraepithelial Neoplasia

Treatment of VIN in the past has included simple vulvectomy and skinning vulvectomy. These more aggressive and disfiguring procedures were replaced by wide local excision and laser ablative procedures of the affected vulvar area (13). Although the CO_2 laser has been used widely for ablation of VIN, it does not allow tissue specimen for determination of possible existing invasive disease and identification of margins. Instead of performing laser ablation in treating VIN, the surgeon can obtain laser thin sections (14,15). This method allows the intradermal removal of strips of vulvar skin affected by VIN and at the same time provides a tissue sample for the pathologist to inspect depth of penetration as well as the adequacy of surgical margins (16). With laser ablation for treatment of VIN, cure rates of approximately 80% can be expected (17,18,19). With thin section, these cure rates may exceed 90%. Careful long- term follow-up is imperative. Because vulvar carcinoma in situ is a disease predominantly of younger women, conservative methods of treatment that preserve functional anatomy should be offered to every patient. Even with extensive lesions, laser therapy compares favourably with other methods of treatment.

Condyloma Acuminata

The most common indication for CO_2 laser surgery in the lower genital tract is the treatment of condyloma acuminata (20). These lesions caused by the human papilloma virus (HPV) are most commonly found on the vulva, urethra and perianal skin. Although genital warts can cause irritation and some discomfort, they are not generally painful; most patients seek medical attention because of their unsightly growth. They spread principally by autoinoculation of the HPV virus and may undergo spontaneous regression. The indication for CO_2 laser ablation of genital warts is the presence of gross disease. Local anaesthesia may be used for small isolated vulvar warts. However, with

more extensive disease, general anaesthesia is preferred (21).

Warts should be vaporized no deeper than the level of the surrounding skin surface (Fig. 6) using a power level of 40– 60 W with a beam diameter of 3 mm. After complete vaporization of the genital warts is accomplished, the 1–2 cm of skin surrounding the individual lesions is brushed lightly with 10 W of power and a 2- mm diameter spot size to destroy subclinical HPV involvement and diminish the recurrence of the disease (22). Laser treatment of genital warts is effective; they are eliminated in over 90% of patients. For those patients who are immunologically compromised, chronic application of 5-fluorouracil cream has been recommended (23,24).

Figure 6- Laser treatment for urethral condyloma acuminate

Clinical applications of Laser in Intra-abdominal Gynecological surgery

Carbon dioxide lasers were first used by Bellina and associates in 1974 for intra-abdominal applications (25,26). With improvement in technology and increased experience performing laparoscopic procedures, the use of the laser for laparotomy has been replaced by an endoscopic approach.

Endometriosis

Areas of endometriosis can be vaporized or excised with the CO_2 laser depending on the depth of penetration of the lesion. Superficial areas of endometriosis in the cul-de-sac, uterosacral areas, or peritoneum in general can be vaporized with wattages of 10–20 W with spot sizes of 1 mm. With lesions larger than 5 mm, it is recommended that the surgeon cut through a healthy margin of the peritoneum and totally excise the lesion. This scalpel effect can also be accomplished with flexible laser fibers, as well as with electrosurgery and scissors. In addition, the wavelengths of the argon and KTP lasers have an affinity for pigmented lesions such as endometriosis, and these lasers have been used extensively and effectively by Keye and Dixon to heat and vaporize these lesions (27). The CO_2 laser, however, remains the most commonly used laser and is the method of choice for treating American Fertility Society (AFS) stage I to IV endometriosis. The main reason is its high margin of safety, which is due to its limited peripheral tissue injury and penetration. This makes it ideal for adhesion excision near ureters and bowel. Although the CO_2 laser is ideal for surgical treatment of endometriosis, it does not offer an increased pregnancy rate over other options, including sharp dissection with scissors or electrosurgery (28). Reported pregnancy rates after laser treatment of endometriosis are 57%, 53%, and 61% for mild, moderate, and severe disease, respectively (29,30). Initially, a small opening on the cyst wall is made to allow for aspiration of the chocolate contents and profuse irrigation with a 5-mm aspirator probe. With the CO_2 laser used intermittently at 10– 20 W, and with traction and countertraction of the forceps holding the ovarian cortex and endometrium cyst wall, the cyst can be stripped off. The base of the ovary after removal of the cyst wall can then be ablated by defocusing the beam and decreasing to 10 W of energy. This causes coagulation of small areas of oozing and destroys any small areas of cyst wall that may remain (31). The CO_2 laser is used to vaporize a lesion 1 cm in diameter by 1 cm in depth at the junction of the uterosacral ligaments to the posterior cervix. A comparison between the CO_2 laser and electrosurgery for treatment of

dysmenorrhea revealed a 50% relief of pain from both procedures (32).

Adhesiolysis

Pelvic adhesions are common sequelae to previous pelvic infections and pelvic surgery. Although Adhesiolysis is commonly performed with scissors or electrosurgery, the laser is another option and represents an ideal instrument for lysis of vascular adhesions, because excision and coagulation can be performed simultaneously while limiting peripheral tissue trauma. The use of graspers to apply tension on the adhesions maximizes the efficiency of the laser. The use of quartz rods, rods with backstops, and irrigation is recommended to avoid injury to adjacent normal tissue. The pregnancy rate outcome with the laser, however, does not significantly differ from that with other standard modalities used to treat adhesions (33).

Salpingostomy

Correction of distal tubal obstruction by salpingostomy was first reported in 1884 by Schroeder (34). Because of the dismal pregnancy rate, this procedure did not become popular until principles of microsurgery were emphasized. Despite improvements in surgical technique, pregnancy results remained low and dependent on the extent of tubal disease at the time of surgery. Laser salpingostomy is performed, with pregnancy rates similar to those with the laparotomy approach. Treatment of distal tubal blockage begins with lysis of peri tubal and ovarian adhesions until the fallopian tube is completely free and movable. The obstructed end of the tube can be assessed for diameter, presence or absence of fimbriae, and patency. With the CO_2 laser at 30 W, two linear incisions in the form of a cross are made in the distal obstructed end of the tube. The edges can then be everted by defocusing the beam on the serosa edges and lowering the energy to 5–10 W (35,36). Continuous irrigation is applied during the procedure. The pregnancy rate with the laparoscopic laser technique is not superior to that with the standard microsurgery technique, and patients remain at risk for ectopic pregnancy in contrast to the low pregnancy rate with neo salpingostomy, fimbrioplasty offers much better results in the 30–60% range because of the limited mucosal damage in these patients. In performing fimbrioplasty, the CO_2 laser is used in a continuous mode with 15–20 W of energy, with a backstop and irrigation used as needed. With a spot size of 0.5 mm, the adhesions are easily removed by vaporization (37).

Ectopic Pregnancy

The CO_2 laser offers another alternative to electrosurgery and scissors in the treatment of ectopic pregnancy by laparoscopy (38). A linear incision is made on the antimesenteric side of the tube over the dilated portion of the ectopic pregnancy using 30 W of energy with a finely focused beam. A dilute concentration of vasopressin can be injected into the mesosalpinx below the ectopic tissue and on the serosa overlying the ectopic pregnancy to decrease intraoperative bleeding (39). With the use of hydro dissection, the ectopic tissue is then gently lifted from its tubal bed. Small amounts of vascular oozing can be controlled with the laser, or alternatively with bipolar forceps (40,41).

Uterine Fibroids

Uterine leiomyomas are extremely common benign smooth muscle tumours occurring in 25% of women older than 30 years of age (42,43). Laser energy can be delivered through a handpiece for laparotomies or via the laparoscope. Small fibroids can be vaporized directly with 20–30 W of energy or can be shelled out in their entirety, as during conventional surgery. Although the laser is capable of coagulation, it is necessary to suture or coagulate larger vessels (greater than 0.5 mm) with electrical energy preferably bipolar. The advantages of the CO_2 laser for removal of uterine broids over scissors and standard electrosurgery are improved haemostasis, decreased tissue trauma, and decreased severity of adhesion formation. Approximately 50–60% of patients ultimately

achieve pregnancy with laser myomectomy (44).

Ovarian Wedge Resection

Ovarian wedge resection by laparotomy, once a popular treatment option for patients resistant to clomiphene citrate, is now rarely performed because of the development of severe postoperative adhesions. However, with strict adherence to microsurgical technique and the use of ne electrocautery needle tips or lasers, it is possible to perform ovarian wedge resection with pregnancy rates of 40%, which may be due to less adhesion formation (45). Once the ovaries are exposed, they are draped with moist sponges. With 30 W of energy, a focused beam of 0.5 mm can be used as a scalpel to remove a wedge of the ovary. To achieve the same endocrinologic effect of lower ovarian androgen levels and ovulation that occurs with laparotomy, laparoscopic electrocoagulation or laser coagulation of the ovary can be performed (46). With this technique, either each ovary is cauterized with a unipolar needle electrode, or laser energy is applied in multiple areas, causing small ovarian craters. (Fig- 7) The CO_2, KTP, argon, and Nd:YAG lasers have been used to treat polycystic ovaries with ovulation rates of 70% and pregnancy rates of 40% (45).

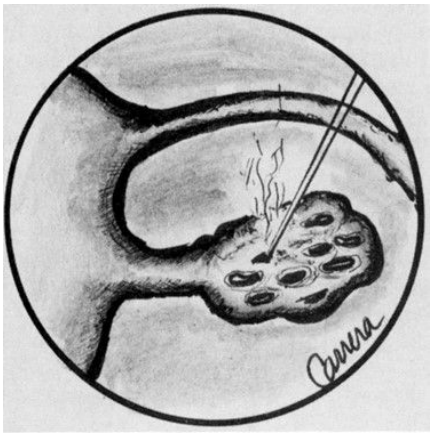

Figure 7- Ovarian wedge craters produced by CO_2 laser

Laser Hysteroscopy

The hysteroscope has been used for many years as a diagnostic instrument to evaluate the source of abnormal uterine bleeding. With refinement of light sources, the use of low-viscosity fluids, and newer operating hysteroscopes, it is now possible to use this technology as a therapeutic modality for patients with abnormal uterine bleeding. Various instruments can be used with the hysteroscope, including electrodes to cut and coagulate, operating graspers, scissors, as well as various laser fibers. The main laser delivery systems available for hysteroscopy are the Nd:YAG and KTP 532. Both of these lasers use a flexible fibre that can be passed easily through the operating sleeve of the hysteroscope.

Endometrial Ablation

Although there are many indications for hysterectomy, dysfunctional uterine bleeding is the indication given in as many as half of these procedures when there is no organic cause (48,49).

The purpose of an endometrial ablation is to destroy the entire endometrium and avoid future regeneration and menstrual bleeding. Patients are initially pretreated with a gonadotropin releasing hormone (GnRH) agonist or danazol for a period of four weeks to decrease the endometrial thickness to that seen in the menopausal state, thus facilitating the penetration of the energy to the level of the myometrium.

After adequate visualization of the entire uterine cavity, the laser fibre can be inserted through the operating channel of the hysteroscope. The Nd:YAG fibre can be used as either a touch or no touch technique. With the touch technique, the laser fibre is activated with 40–50 W of energy and dragged on the endometrial surface beginning on the fundus and traveling down toward the endocervix in successive strokes (Fig- 8). This is done in a systematic way so that the entire surface is eventually covered. With the no touch or

blanching technique, the laser fibre is placed a few millimetres away from the endometrial surface while the laser energy is activated. Of the two methods, the touch technique is preferred because penetration is deeper, extending 4–6 mm into the uterine wall. This depth is sufficient for destruction of the endometrium (50).

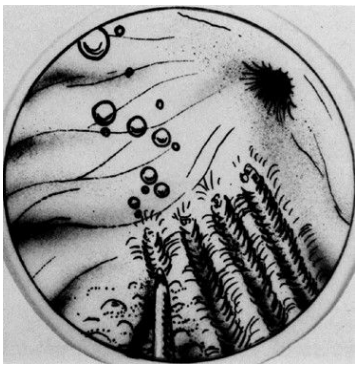

Figure 8- Endometrial ablation with Nd:YAG laser fibre.

Septate Uterus

The uterine septum is one of several congenital uterine abnormalities that arise from incomplete resorption of the Müllerian ducts, and it occurs in approximately 1–3.5% of women (51). The uterine septum is commonly associated with habitual miscarriage and is transmitted as a polygenic or multifactorial pattern of inheritance. Resection of a uterine septum can be performed with various instruments, including scissors, resectoscope, and Nd:YAG laser. The Nd:YAG laser fibre is usually set at 40 W and used by the touch technique, as if one were using a scalpel. The laser tip must be oriented so that it incises the septum at the midline and does not deviate from this line of incision (Fig. 9). This will ensure a relatively bloodless eld of incision and avoids injury to the myometrium. The laser incision is continued until there is uniformity in light transmission throughout the fundus as observed by laparoscopy, or until bleeding from the fundal myometrium is visualized. The advantage of the laser fibre technique over the scissor technique is primarily one of diminished bleeding. The procedure usually takes 20–30 minutes, with gratifying results such as a 70–80% delivery rates.

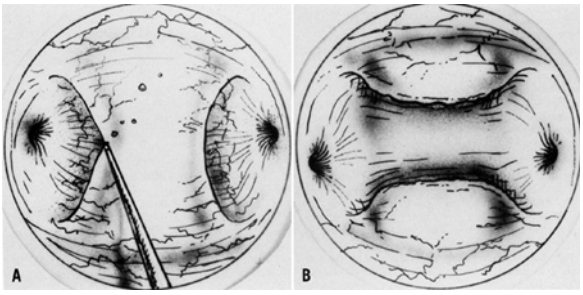

Figure 9 - Uterine septum treated with Nd:YAG laser.

Other clinical applications of lasers in gynecology and reproductive medicine

Laser treatment for genitourinary syndrome of menopause (GSM)

GSM is a chronic condition affecting approximately 40 %–60 % of postmenopausal women (52). The first line treatment is low dose vaginal oestrogens while vaginal moisturisers or oral ospemifene are the alternative options. Non-hormonal options such as intravaginal laser have potential when vaginal oestrogens are contraindicated or ineffective and for women who decline hormones (53). The safety of vaginal fractional CO2 laser therapy has been shown in several randomised controlled trials (RCTs)). The efficacy of the CO2 laser was found to be similar to vaginal oestrogens for GSM symptoms (54). However, RCTs comparing the micro ablative CO_2 laser with medical treatment have reported conflicting results. Salvatore et al. and Ruanphoo et al demonstrated the superiority of the laser while Li et al. and Page et al. showed that the treatment response after laser application was comparable to that of sham application (55 – 58).

Laser for vaginal laxity and pelvic organ prolapse (POP)

*Vaginal laxity is a poorly understood but common symptom of pelvic fl*oor dysfunction

that currently lacks a standardised definition. It may be considered a symptom of prolapse and it is a manifestation of levator ani hyper distensibility (59). The use of laser therapy for vaginal laxity and POP is still a relatively new approach, with limited available evidence for its efficacy and safety (60). Supervised pelvic floor muscle training and use of pessaries are established non-surgical options for treatment of POP. Ogrinc et al. evaluated the effects of non-ablative Nd:Yag in 61 women with a stage 2 to 4 cystocele (61). Follow-up visits were performed at 2, 6 and 12 months. The authors report a consistently significant anatomical improvement throughout the study period. Of note, a control group was not evaluated. Athanasiou et al. enrolled 30 postmenopausal women, who were awaiting surgery for a symptomatic stage 2/3 cystocele and/or rectocele (62). These were randomised to either non-ablative ND:YAG laser treatment or watchful waiting. A stage 0 or 1 POP ("objective cure") at 4 months following laser treatment was primarily evaluated. However, none of the patients were cured. In the laser group, the POP stage remained unchanged in 11/15 (74 %) of participants and decreased by one stage in 2/15 (13 %). There are no good quality studies to evaluate the use of laser for women with vaginal laxity.

Laser treatment for stress urinary incontinence (SUI)

The first line treatment for SUI is supervised pelvic floor muscle training. Due to the concerns about the use of synthetic mid urethral slings, vaginal lasers have been promoted as a potential treatment option for SUI. Recently, four RCTs have been published that have shown conflicting results. Regarding the ND:YAG laser, O'Reilly et al. conducted a multicentre sham-controlled trial including 110 women with urodynamic SUI (63). A standardised one-hour pad weight test was performed at baseline and at 6-month follow-up. A greater than 50 % reduction in the pad weight was considered as primary outcome. Of 89 women followed-up, treatment success was observed in 33/56 (59 %) in the active arm and 12/33 (36 %) in the non-treated arm. The authors conclude that women treated with ND: YAG laser had a three-fold higher chance of success, with an odds ratio of 3.6 (95 % CI: 1.3 – 11.2, p-value =0.02). Interestingly, women with mild to moderate SUI appeared to have benefitted from the laser treatment to a greater degree compared to women with severe SUI. These findings contrast with the results reported by a single site RCT from Canada which enrolled 134 women with a clinical diagnosis of SUI (64). Over 90 % of participants from either ND:YAG laser (67/73) and control (58/61) treatment were followed- up at 6 months. A self-reported symptom of no urinary incontinence with the International Consultation on Incontinence Questionnaire- Urinary Incontinence (ICIQ-UI) Short Form (SF) was evaluated as primary outcome. "Cure" was reported by one patient only in each group. Both laser and control groups showed an improvement in ICIQ-SF total scores at 6-months, but there was no significant difference in the changes from baseline between groups. There are also conflicting reports for the CO2 laser. A single centre RCT from Seki et al evaluated the subjective impression of improvement in SUI (Likert scale) an objective cure as primary outcomes (64). At 12-month follow-up, both outcomes were significantly better in the laser (n =38) when compared to the control (n =38) group.

Lasers in Reproductive medicine- Laser Assisted Hatching

Although ART has achieved a 30–50% average pregnancy rate, the embryo implantation rate (IR) remains low, at about 20–30%. Implantation, an extremely complicated biological process that consists of embryo hatching, localization, attachment, and invasion, is influenced by many factors. Hatching of a blastocyst is a critical step in the sequence of physiologic events culminating in implantation. Failure to hatch due to intrinsic abnormalities in either the blastocyst or the zona pellucida (ZP)may be one of many factors limiting human reproductive efficiency.

Assisted hatching (AH) involves artificial thinning or breaching of the ZP and has been proposed as one technique to improve implantation and pregnancy rates after in vitro fertilization (IVF). An increased implantation rate after mechanical opening of the ZP (partial zona dissection) was first reported in 1990. Lasers, chemical agents, and mechanical methods are often used to achieve ZP destruction, including thinning, drilling, and full-thickness removal (65). Laser-assisted hatching (LAH) first emerged in the early 1990s. Due to its accuracy, speed, and safety, LAH is the most common method. The use of AH is prevalent in clinical practice, accounting for nearly 44.8% of in vitro fertilization (IVF) cycles in the USA between 2000 and 2010. Historically, assisted hatching was performed before embryo transfer on days 3, 5, or 6 after fertilization using various methods, including creation of an opening in the ZP by thinning with acidified Ty- rode solution , partial ZP dissection with a glass microneedle, laser photoablation, or use of a piezo micromanipulator. Currently, AH is most commonly performed with full-thickness, laser-AH on the day of embryo transfer. Types of lasers used for ablating zona pellucida -

- Nd:YAG laser at 1064 or 534nm
- Tuneable Titanium: sapphire lasers at 650– 1080nm
- Semiconductor laser emitting at 1.48 mm, which is the highest standard for laser ART fulfilling all safety requirements for zona pellucida ablation.

Indications of assisted hatching:

1. Age of the women is older than 37 years
2. Woman with poor ovarian reserve: low AMH levels/ low AFC (antral follicle count)/ high levels of follicular stimulating hormone on day 2/3 of periods.
3. Women with poor-quality embryos. (excessive fragmentation or slow rate of cell division)
4. Zona factor-cases with thick outer shell (zona pellucida) 5. One or more previous failed IVF cycles

Laser Assisted hatching techniques:

Zona pellucida thinning and Zona pellucida drilling. Zona pellucida can be thinned for one quarter or half of the total circumference. Zona pellucida can be drilled with holes <10mm- >25mm diameter.

Complications of Laser hatching-

- damage to the embryo
- damage to individual blastomeres with reduction of embryo viability.
- Monozygotic twinning

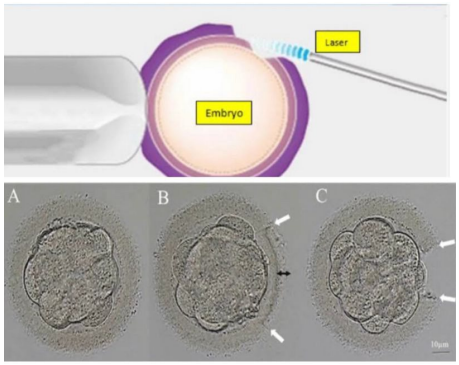

Figure 10: Laser Assisted Embryo Hatching

Laser acupuncture in Female Infertility

Needle and laser acupuncture are forms of complementary alternative medicine that are effective for treating a variety of conditions, such as chronic pain, wounds, inflammation, and depression. These treatments have also been used to improve the pregnancy rate. Infertility treatments increase psychologic stress, and several reports have indicated that acupuncture treatment alleviates emotional distress in infertile women (66). IVF-ET and ICSI involve a number of stressful aspects: daily injections; blood sampling; ultrasounds;

laparoscopic surgery; and the possibility of failure at any of the various stages. The stress experienced by infertile women changes over time. In the early stages of infertility, most of the stress these women experience derives from a physical inferiority complex, while, later on, they tend to become stressed about what others outside of their families will say. It has been also found that infertile women had persistently elevated stress and anxiety levels during IVF-ET.

Laser acupuncture activates the inferior parietal lobule, the primary somatosensory cortex, the praecuneus of the parietal lobe, and the medial and superior frontal gyri of the frontal lobe, which is associated with mood changes. Few studies show the use of laser and needle acupunctures in ameliorating emotional distress in women undergoing infertility treatments. This intervention before and after embryo transfer has resulted in higher implantation rates and live birth rates.

Lasers in Male Infertility (Low Level Laser Therapy)

Phototherapy with a low-level laser is referred to as photo- biomodulation. Motility is one of the most prominent characteristics of sperm associated with the fertilizing capability. The mitochondrial apparatus within the midpiece of the spermatozoa provides the required energy for movement of the flagellum or tail. Low- level laser irradiation induces the activity of the cytochrome c oxidase (COX). The COX complex is part of the mitochondrial respiratory chain and plays a critical role in the electron transport cascade. Modulation of this certain cytochrome oxidase activity leads to enhanced oxidative phosphorylation or adenosine triphosphate (ATP) generation. This process would subsequently augment the sperm motility. On the molecular level, the LLLT is mediated in the up- regulation of genes coding for a number of mitochondrial enzymes. Specifically, the subunits which are involved in the complexes I and IV of electron transport chain and ATP synthase. Phototherapy also increases ATP synthesis in the myotubes (67). It interacts with the endogenous cellular redox mechanisms. This effect is mediated through photoexcitation of cytochrome c oxidase in the mitochondrial electron transport chain. Laser light facilitates electron transferring to the oxygen molecules and production of the reactive oxygen species (ROS). These anions are categorized into three main types, namely superoxide, hydrogen peroxide, and hydroxyl radical. ROS are necessary for the process of spermatozoa maturation or capacitation. Low levels of reactive oxygen species (ROS) relatively enhance the sperm acrosome reaction. Photo-biomodulation resulted in a significant increase in the human sperm motility and capacitation toward activation of protein kinase A and sarcoma protein kinase, as well as the production of reactive oxygen species. Another aspect of photo-biomodulation is the effect of irradiation on the intracellular calcium ion levels, which has a fundamental impact on the sperm motility. Low-level laser therapy increases the calcium influx by means of cellular pumps. In this regard, Na+/Ca2+exchanger and voltage-gated calcium channel regulate the optimal intracellular calcium concentrations. LLLT prevents the calcium uptake by mitochondria of spermatozoa while enhancing the Ca2+ binding to sperm plasma membrane. On the other hand, laser light at higher doses causes an overload in the intracellular Ca2+ levels. Such a process leads to hyperactivation of the Ca2+-ATPase pump and exhausts the ATP reservoir of the cells. These particular reactions would ultimately increase the intracellular osmotic pressure and degenerate the spermatozoa. Effect of the laser therapy on the sperm parameters is directly related to the semen sample quality, irradiation methods, applied doses, wavelengths, and time intervals.

This fact emphasizes the importance of selecting the optimal output power Human sperm motility as well as velocity can be improved by Helium-Neon laser irradiation. It was found that irradiation of human sperm with broad band visible light (400–800 nm) caused a significant increase in hyperactivated

motility, but not in total motility, of human sperm. Biochemical and topological analysis evidenced that fertilizing increased in irradiated sperms. Helium-neon irradiation increased the sperm motility index, viability, and cell energy charge. Hence, might be a useful technique for enhancing the quality of semen in long-term storage. Significant increase in sperm motility was observed with irradiation of cells at doses of 4 and 6 J/cm2 at 60 and 45 minutes after irradiation.

Lasers in Cosmetic Gynaecology

Cosmetic gynaecology represents a rapidly advancing subspecialty, wherein the integration of laser technologies has significantly enhanced both the aesthetic and functional outcomes of various procedures. The precise, minimally invasive nature of laser-based interventions has transformed the landscape of cosmetic gynaecology, offering patients superior results with reduced morbidity and shorter recovery periods.

Vaginal Rejuvenation (68)

Vaginal rejuvenation, an umbrella term encompassing a spectrum of procedures aimed at enhancing vaginal tightness, improving sexual function, and ameliorating vaginal health, has been revolutionized by the advent of laser technology. The primary modalities employed are fractional CO_2 lasers and erbium lasers. These lasers induce controlled thermal injury to the vaginal mucosa and submucosa, leading to nucleogenesis and the remodelling of elastin fibers. The resultant tissue contraction and increased collagen deposition restore vaginal tone and elasticity, mimicking the effects of surgical tightening without the associated invasiveness.

The procedure itself is typically conducted in an outpatient setting, where a specially designed laser probe is introduced into the vaginal canal (Fig. 11). The probe emits laser energy circumferentially, targeting the entirety of the vaginal wall. This non- ablative approach is particularly advantageous in patients with mild to moderate vaginal laxity, those experiencing decreased vaginal lubrication, or individuals with stress urinary incontinence secondary to pelvic floor dysfunction. Post-procedural recovery is expedient, with minimal discomfort, and most patients can resume their routine activities, including sexual intercourse, within a week.

Figure 11: Vaginal rejuvenation

Labial Trimming (Labiaplasty)

Labiaplasty, or labial trimming, focuses on the aesthetic and functional refinement of the labia minora and, less commonly, the labia majora. Lasers have emerged as a superior tool in this context due to their precision, haemostatic properties, and reduced postoperative morbidity. The CO_2 laser is particularly favoured for its ability to precisely ablate the redundant labial tissue while simultaneously coagulating blood vessels, thereby minimizing intraoperative blood loss and reducing the risk of hematoma formation. Patients seeking labiaplasty may present with hypertrophic or asymmetrical labia minora, leading to physical discomfort during activities such as cycling, intercourse, or when wearing tight clothing. Beyond the physical symptoms, there is often a significant psychological component, with patients experiencing distress related to the appearance of their genitalia. The laser technique not only allows for the precise excision of excess tissue but also facilitates the sculpting of the labial edges to achieve a more aesthetically pleasing contour. The reduction in thermal spread afforded by laser technology

also contributes to faster wound healing and reduced scar formation, enhancing the overall cosmetic outcome. Postoperative recovery typically involves a few days of swelling and discomfort, with complete resolution within a few weeks.

Vulvar Melanosis Treatment

Vulvar melanosis, characterized by benign hyperpigmented macules on the vulvar skin, often presents a cosmetic concern despite its benign nature. Laser treatment has proven to be an effective method for addressing this condition, with Q-switched Nd and fractional CO_2 lasers being the most commonly utilized modalities. These lasers specifically target melanin within the pigmented lesions, resulting in selective photo thermolysis. The laser energy fragments the melanin granules without damaging the surrounding keratinocytes or dermal structures, allowing for a gradual lightening of the hyperpigmented areas. The procedure is typically performed under local anaesthesia, with multiple treatment sessions often required to achieve optimal results. Patients can expect significant improvement in the uniformity of the vulvar skin tone, with results being long-lasting. However, maintenance sessions may be necessary depending on the patient's propensity for pigmentation and external factors such as UV exposure. The post-treatment recovery is generally uncomplicated, with mild erythema or oedema resolving within a few days.

Liposuction of the Pubic Mound (Mons Pubis)

The reduction of the mons pubis, particularly when characterized by excessive adiposity, is another area where laser-assisted techniques have gained popularity. Excess fatty tissue in this region can lead to discomfort, altered body image, and difficulty with clothing fit. Traditional liposuction techniques, while effective, often result in significant tissue trauma and prolonged recovery. The introduction of laser- assisted liposuction, such as with the SmartLipo system, offers a minimally invasive alternative with enhanced outcomes. In laser-assisted liposuction, a fine laser fibre is introduced through a small incision, delivering targeted laser energy to the adipose tissue. This energy liquefies the fat cells, facilitating their removal via aspiration while simultaneously stimulating collagen synthesis within the overlying dermis. This dual action not only reduces the volume of the mons pubis but also contributes to skin tightening, addressing issues of skin laxity that may accompany fat removal. The procedure is typically performed under local anaesthesia, with patients experiencing minimal discomfort and a swift return to daily activities.

Vulvar Hair Removal

Laser hair removal has become a cornerstone in the management of unwanted vulvar hair, offering a long-term solution with significant advantages over traditional methods such as shaving or waxing. The diode, Nd:Yag and alexandrite lasers are the primary tools used in this context, each selected based on the patient's skin type and hair colour. These lasers operate by emitting light energy that is absorbed by the melanin within the hair follicles, leading to selective photo thermolysis. This process destroys the hair follicle while sparing the surrounding tissue, resulting in a substantial reduction in hair density and regrowth over successive treatments. Laser hair removal in the vulvar region typically requires multiple sessions to target all hair follicles during their active growth phase (anagen phase). The result is a marked reduction in hair growth, smoother skin, and a decreased incidence of folliculitis and ingrown hairs. The procedure is generally well-tolerated, with transient erythema and mild discomfort being the most common side effects, both of which resolve quickly.

Complications of Lasers in Gynecology

The application of laser technology in gynaecology has brought significant advancements in minimally invasive surgical techniques, but it also presents a range of potential complications that must be carefully

managed. These complications can manifest at various stages—immediate, short-term, or long-term—and require a deep understanding of laser-tissue interactions to minimize risks and ensure patient safety.

Thermal injury is one of the most immediate and significant complications associated with the use of lasers in gynecology. Lasers work by generating heat, which is precisely applied to target tissues for ablation, coagulation, or vaporization. However, when not adequately controlled, this thermal energy can cause unintended damage to adjacent tissues. This can result in superficial burns or deeper tissue necrosis, leading to pain, delayed wound healing, and scarring. The risk of thermal injury is heightened in areas where tissue layers are thin or highly vascular, requiring meticulous technique and precise calibration of the laser settings.

Another immediate concern during laser procedures is intraoperative bleeding, although lasers are often chosen for their ability to coagulate blood vessels effectively. In some cases, improper technique or excessive energy application can result in damage to blood vessels beyond the intended treatment zone, leading to bleeding. This is particularly problematic in areas with rich vascularization, such as the cervix or vaginal wall. Managing such bleeding during the procedure can be challenging and may necessitate additional interventions to control haemorrhage and maintain a clear surgical field.

Smoke plume inhalation is a less obvious but significant risk associated with laser use in gynaecology. The ablation of tissue by lasers generates a plume of smoke that contains not only carbonized particles and chemicals but also potentially infectious agents, such as viral DNA, including that of the human papillomavirus (HPV). Inhalation of this smoke can pose health risks to both the patient and operating room staff, making the use of effective smoke evacuation systems and appropriate personal protective equipment essential to minimize exposure.

In the short-term postoperative period, pain and discomfort are common complaints among patients undergoing laser procedures. The degree of discomfort varies depending on the extent of the tissue ablation and the individual patient's pain tolerance. This pain is often a result of the inflammatory response triggered by the tissue injury. Effective postoperative pain management, including the use of analgesics and anti-inflammatory medications, is crucial to enhance patient comfort and facilitate recovery.

Infection is another potential short-term complication following laser surgery. While laser procedures generally have a lower risk of infection compared to traditional surgical methods, the disruption of natural tissue barriers and alteration of local flora can still predispose patients to bacterial infections. This is particularly a concern in procedures involving the genital tract, where the natural microbial environment can be disturbed. Preventative measures, including the use of perioperative antibiotics and strict aseptic technique during the procedure, are essential to reduce the risk of postoperative infections. Delayed wound healing and scarring are further concerns, particularly in patients with underlying conditions such as diabetes or those who are immunocompromised. The precise nature of laser ablation means that while tissue damage can be minimal, the healing process may still be prolonged in certain individuals. Scarring can also occur, particularly if the laser energy is not appropriately calibrated or if the tissue response is more pronounced. This is of particular concern in cosmetic Gynecological procedures, where the aesthetic outcome is a critical component of patient satisfaction.

Long-term complications, while less common, can include persistent pain, chronic scarring, and functional impairments depending on the area treated and the extent of tissue involvement. For instance, in cases where deep tissue structures are inadvertently damaged, patients may experience chronic pain or sensitivity in the treated area.

Additionally, in procedures like vaginal rejuvenation or labial trimming, improper technique or excessive tissue removal can result in functional deficits, such as reduced elasticity or altered sensation, which can impact sexual function and overall quality of life.

Conclusion:

While lasers have significantly improved the precision and outcomes of gynecological surgeries, they are not without their risks. Complications such as thermal injury, intraoperative bleeding, smoke plume inhalation, postoperative pain, infection, delayed healing, and scarring highlight the importance of careful patient selection, meticulous surgical technique, and thorough postoperative care. Understanding these potential complications allows for better risk management and enhances the overall safety and effectiveness of laser use in gynecology.

New Avenues for research

Customized Laser Parameters: Research can enhance personalized laser settings (wavelength, fluence, pulse duration) for optimized selective photo thermolysis, reducing thermal damage, particularly in sensitive gynecologic structures.

Longitudinal Data on Aesthetic and Functional Procedures: Investigating long-term histological and functional outcomes of procedures like fractional CO_2 and Er lasers for GSM and vaginal laxity could validate durability and safety.

Minimally Invasive Laser Ablation for Endometriosis: Precision laser ablation (e.g., KTP, diode lasers) could become a conservative, fertility-preserving alternative for selective endometriotic implant treatment with minimal surrounding tissue impact.

Combination Laser-Adjuvant Modalities: Studying the synergy of laser with PRP or stem cell therapy for conditions like vulvovaginal atrophy and urinary incontinence could validate enhanced regenerative effects.

Robotic-Assisted Laser Surgery: Using robotics with CO_2 or thulium laser optics could refine complex gynaecological surgeries, such as nerve-sparing endometriosis excision or myomectomy, reducing complications and improving outcomes.

Photo biomodulation for Urogynecologic Disorders: Photo biomodulation (PBM) could support pelvic floor restoration by activating fibroblasts and enhancing tissue architecture, particularly for stress urinary incontinence and mild prolapse.

Photodynamic Therapy for Early Gynecologic Neoplasia: PDT with targeted photosensitizers could serve as a non-invasive option for early-stage cervical and vulvar neoplasia, preserving surrounding tissue.

Laser Therapy in Pediatric and Adolescent Gynecology: Trials on laser use for vulvar lichen sclerosus, genital warts, and labial adhesions in young populations are essential to establish safety and efficacy in this unique patient group.

Treatment for Vulvar Dermatoses and Vulvodynia: Lasers could be researched for pain modulation and collagen remodeling in chronic conditions like vulvodynia, lichen planus, and lichen sclerosus, addressing intractable symptoms.

Image-Guided Laser for Precision in Complex Pathologies: Integrating laser systems with real-time imaging (ultrasound/MRI) could enable precise ablation of fibroids and adenomyosis, preserving uterine integrity in challenging pelvic locations.

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An unusual case of bowel incarceration following uterine perforation

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Abstract

Uterine rupture with bowel incarceration after dilatation & curettage (D&C) is a rare clinical condition. Although there are risk factors such as increased intra-abdominal pressure, history of pelvic infection, history of pelvic surgery, uterine anomalies, no risk factor may be detected in most cases. Cases with abdominal pain and bleeding after uterine manipulation should suggest uterine perforation. Some cases may be asymptomatic and may be detected incidentally on imaging. Herniation / incarceration of intestines and other intra-abdominal structures from the perforated area are rare but may cause serious clinical conditions depending on the degree and location of the hernia.

Key words: Uterine Perforation, Intrauterine Devices, Incarceration, Laparoscopy, Complications

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Introduction:

Uterine perforation of the uterus may result in considerable morbidity and mortality. These outcomes are valid for both gravid and non-gravid uteruses. D&C is the most commonly used procedure for surgical termination of pregnancy and biopsy goals in a variety of gynecological conditions. It is well known that any intrauterine procedure, from a simple aspiration to a more complicated curettage, carries the risk of uterine perforation (1). Diagnostic and

therapeutic indications for D&C outside of obstetrics include a wide range of diseases accompanied by abnormal uterine bleeding, such as endometrial hyperplasia, prolonged heavy menstrual bleeding, or postmenopausal bleeding (2) Uterine perforation following D&C may affect intraabdominal structures/organs and their possible involvement or retraction into the uterine cavity (3–6). Damage to surrounding organs can sometimes lead to emergencies requiring immediate medical attention, threatening the patient's life. One of the rarest but still possible complications is the incarceration of the colon or other intestinal structures in the uterine cavity following uterine perforation during an intrauterine procedure. The symptomatology accompanying this condition is nonspecific and sometimes vague. The timing of a correct diagnosis sometimes varies from a few hours to several years from the time of the initial maneuver. To our knowledge, no case of uterine perforation after a surgical procedure with appendix epiploic and colon incarceration has been reported yet. The purpose of the current study is to examine the process, clinical presentation, imaging examination, and timing from D&C to the correct diagnosis of uterine perforation with appendix epiploic and colon incarceration and to evaluate its impact on women's health.

Case report:

A 39-year-old woman came to the clinic with a complaint of menstrual delay. An intrauterine pregnancy of 5 weeks + 5 days was detected by transvaginal ultrasonography. The cavity had irregular borders, but a positive fetal heartbeat was observed. Pregnancy was confirmed with beta hCG test. At the request of the patient and her husband, D&C was performed due to unplanned pregnancy.

The patient was scheduled for follow-up and control after one week. While no intrauterine images of retained products of conception were observed at ultrasonography, a polypoid lesion of approximately 1.5 cm was detected at the fundus level. There were no symptoms or additional findings at examination. The patient's medical history did reveal, that an endometrial sampling was performed in another center approximately four months prior due to abnormal uterine bleeding and histopathological diagnosed as caused by an endometrial polyp. During this period, the patient refused the hysteroscopic examination recommended to clarify the diagnosis. One week after the last check-up, she came to our clinic again for an intrauterine device (IUCD) containing levonorgestrel in view of her request for contraception and a history of abnormal uterine bleeding. Her medical state was fine, a body mass index of 22 was noted and she was a non- smoker. Her vital signs were normal, with a blood pressure of 110/70 mmHg, a heart rate of 90 beats per minute, and there was no abdominal distension or tenderness during the clinical examination of the abdomen. While there were no abnormal findings in the pre-procedural examination, there was a polypoid lesion around 1.5-2 cm at the fundal level at ultrasound. An ultrasonographic check was performed again one week after the IUCD was inserted into the patient, and no intrauterine device was observed in the uterine cavity, and no thread of the device was observed in the cervix at vaginal examination. By direct radiography, a density corresponding with the intrauterine device was present in the abdomen at the level of the pelvis. The decision was made to perform a diagnostic laparoscopy with the preliminary diagnosis of an IUCD migrating into the abdomen. At the same time, bilateral tubal ligation was planned, upon request, for sterilization. During surgery, there was a dense intestinal adhesion of around 2-3 cm at

the level of the uterine fundus. When the lesion was approached, it was observed that a segment of the intestine was attached to the uterus and further incarcerated into the uterus. The incarceration of the epiploic of the appendix was confirmed as a string of fibro-lipomatous appearance running from the uterine fundus. With the help of bipolar coagulation and dissection, the incarcerated large colon segment was removed from the perforated area. At first dissection with cold scissors was tried, but the herniated tissue was larger in diameter as compared to the perforated area, so switched to thermal dissection was preferred, foreseeing that tissues could be traumatized and even teared due to traction. The proximal part of the ascending segment and the bowel loop in the same region were inflamed and edematous. The perforated uterine area was closed with absorbable suture. The procedure was terminated after observing the uterus and colon for a while. The patient was discharged in good condition after gas and stool discharge were observed on the first postoperative day. The patient was checked again after 1 week and her general condition was good, and she did not have any active complaints.

Discussion:

Uterine perforation is a likely complication of the intrauterine maneuvers used for evacuation or sampling of the endometrial cavity. Although rare, it may determine immediate or distant severe results for the patient's health. There is a constant danger of iatrogenic trauma on the posterior fundal (in sometimes even lateral wall) of the uterine cavity. This trauma can happen any time that we use intrauterine instruments; there are two types of perforations: the ones that have been caused by cervical dilation and the ones that are secondary to the progression of sharp or blunt instruments, such as blunt curettes. The risk of bleeding depends on the anatomical location, more important if vessels have been involved, the instrument used (sharp, blunt, or with energy), and the intensity of the manipulation by the surgeon. It is crucial to understand that in some cases, perforation can lead to a significant bleeding and the urgent need for surgical stitching or repair under laparoscopic control. In addition, this iatrogenic condition, defined as a perforation and local destruction of the entire uterine wall, can compromise future fertility. Uterine perforation has been reported to be more frequent, secondary to an obstetric D&C. It can also occur in cases where a non-obstetric D&C or vacuum aspiration was applied. Uterine rupture usually indicates an injury of the uterine wall secondary to an iatrogenic insult. Perforation is believed to be severe and life-threatening if it leads to immediate heavy bleeding. Therefore, uterine perforation should be suspected in the presence of bleeding during or after D&C. A possible myometrial trauma or increased inflammation after the first curettage may have facilitated perforation with the second curettage. In addition, in the case presented a polypoid lesion present during the insertion of IUCD is a clear indicator that a possible cavitary herniation occurred after the first or second curettage.

The confirmed incidence of uterine perforation with omentum incarceration is unidentified and most probably higher than published. Because instrumental uterine perforation is rare, an unknown number of cases are not documented in the medical literature. Immediate intervention is crucial in complicated uterine perforations, unknown perforations without additional complications and investigations, and pre-hospital mortality in very low-income countries (1) Some risk factors have been reported that can contribute to the occurrence of uterine perforation:

complicated dilation of the cervix (primiparous or menopause), scarred cervix after surgical maneuvers or previous vaginal deliveries, malposition of the uterus, leiomyoma, adhesions, previous injury to the uterine wall, Cesarean section scar, conditions that diminish myometrial strength such as pregnancy, especially multiparity, uterine infections, advanced age, connective tissue disorders such as Ehler-Danlos syndrome, and the use of general anesthesia (7). The pelvic structures that can herniate into the uterine cavity are the omentum, the appendix, the small bowel, the ovary, or the fallopian tube (1,8–10)

Experienced clinicians suspect uterine perforation because of loss of resistance during instrument advancement. The diagnosis of uterine perforation may be suspected clinically if the patient presents with acute abdominal pain, heavy vaginal bleeding, or any signs of internal bleeding such as hypotension or tachycardia. Peritoneal free fluid may be detected by ultrasound. In rare cases, omental or bowel compression may occur. There are no reports of specific symptoms that would alert to the possible diagnosis of uterine perforation in association with these compressions.

The complete diagnosis of uterine perforation with organ incarceration should combine a detailed medical history with a thorough clinical examination and imaging evaluation, primarily using ultrasound evaluation. However, it should not exclude computed tomography (CT), magnetic resonance imaging (MRI), or radiographic evaluation. Abdominal X-ray is used to show hydro-aerial levels. Ultrasound has been the preferred initial imaging modality because it is readily available, affordable, does not involve ionizing radiation, and compact mobile machines can be used at the patient's bedside or in the operating room.

The transvaginal approach better evaluates the reproductive organs by locating the perforation site. In contrast, the transabdominal approach provides a broader view of the patient's condition, including estimating the volume of potentially associated hemoperitoneum. If ultrasound is negative or inconclusive, CT may be an additional imaging modality that allows visualization of all abdominal pelvic organs and the diagnosis of pneumoperitoneum. The fatty nature of the bowel mesentery can be well detected on CT (4,11–13). Surgery is the usual treatment for intestinal incarceration. The management of uterine perforations after intrauterine interventions is not standardized, with either conservative or interventional approaches. If the patient is stable and asymptomatic, observation with close monitoring may be an option. Some units support systematic exploratory laparoscopy.

Minimal perforations without bleeding may require no intervention, while extensive and hemorrhagic perforations can be managed by bipolar coagulation or suturing. The role of laparoscopy is valuable for rapid resolution and fewer complications if the team is compatible. Since the surgery we performed is a uterine and ovarian-protective intervention, the patient's future fertility will not be affected. Of course, since there is no colonic lumen intervention, no adverse bowel dysfunction was experienced in the early period and at the moment.

Conclusion:

In conclusion, laparoscopic exploration is the preferred method in the management of a patient with uterine perforation after D&C. Suturing of the perforated scar should be performed deep into the myometrium to stop the bleeding. Complications of uterine perforation can threaten the patient’s life. It is important to note that while rare, intestinal

incarceration is an exceptional but surgically critical complication. The surgeon's experience is crucial in preventing such complications.

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10.36205/trocar5.2024018	The Reproducibility of the Endometriosis Fertility Index: Inter- and Intra-Observer Variation in the Least Functional Score
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10.36205/trocar5.2024022	Antenatal Myomectomy
10.36205/trocar5.2024023	Applications of Lasers in Gynecology- A Comprehensive Review
10.36205/trocar5.2024024	An unusual case of bowel incarceration following uterine perforation
10.36205/trocar5.vid24006	Niche pregnancy complicated by bleeding: A case report
10.36205/trocar5.vid24007	Deep Endometriosis with Intestinal Involvement