



Laparoscopic bilateral uterine artery ligation for adenomyosis uteri during ICSI

Ahmed Dabash Abdel lateef¹, Al shymaa Ahmed Hussein²

1. Department of Gynecology & Obstetrics, Faculty of Medicine, Suez University, Egypt.
2. Department of Gynecology & Obstetrics, Qena Faculty of Medicine, South Valley University, Egypt.

Abstract

Background: Adenomyosis is still a scientifically hard problem in gynecology; adenomyosis has an adverse influence on fertility and might need surgery if being pregnant is wanted.

Purpose: The goal of this study was to assess the effects of bilateral uterine arteries ligation in treating the adenomyosis symptoms and the possible reproductive outcomes

Methods: This prospective pilot study involved (50) infertile adenomyosis uteri patients determined by ultrasound/ MRI and planned for Intracytoplasmic sperm injection (ICSI) technique. All patients laparoscopically ligated with hemoclips, and the bilateral uterine ovarian vessels were electrocoagulated, with follow-ups at three and six months for uterine volume, complaints, and adenomyosis scoring by ultrasound and MRI. ICSI was performed on six months after surgery in each patient, and the results were recorded.

Results: There was a substantial reduction in uterine volume among pre and postoperative ($P < 0.05$). There was a statistically significant reduction in postoperative period compared to preoperative period for diffuse, focal adenomyosis, and adenoma. Magnetic resonance imaging scans revealed a substantial variation in uterine volume before and after surgery for internal and external adenomyosis ($P < 0.05$). The fertility treatment success rate for primary infertility at 6 months after surgery was (42.42%), whereas secondary infertility had been (47.06%).

Conclusions: Bilateral uterine artery ligation enhanced adenomyosis manifestations and pregnancy results.

Key words: Adenomyosis, Fertility, Ligation, Uterine artery

Introduction:

Adenomyosis is the existence of endometrial glands randomly incorporated in the myometrium (Tsikouras et al., 2024). Adenomyosis is easily classified into two types: diffuse and focal. Adenomyosis is thought to be caused by the downward invagination of the endometrial basalis layer through the myometrium, which is linked to elevated estrogen levels and aromatase expressions (Wang et al., 2023).

Due to advances in imaging, adenomyosis may be identified now using noninvasive approaches. As a result, an innovative epidemiological scenario has emerged, with a growing amount of reproductive-age women receiving an adenomyosis diagnosis via ultrasound (US) or magnetic resonance imaging (MRI) (Chapron et al., 2020). Magnetic resonance imaging (MRI) is the technique preferred in an unreliable ultrasound because of its capacity for successfully distinguish tissue, that is additionally useful for focal adenomyosis and determining endometriotic lesions (Celli et al., 2022).

Adenomyosis affects 5% to 70% of females. It could have an enormous effect on their quality of life. Menorrhagia, painful menstruation, and fertility issues are common symptoms of disease (Barbosa-Silva et al., 2024; da Cunha Vieira et al., 2024).

Patients with adenomyosis possess greater frequency, broader, and stronger toned contractions of the uterus than women without it (Kaczmarek et al., 2020; Zhang et al., 2021).



Adenomyosis can also have adverse effects on fertility because dysregulation of myometrial arrangement may trigger a change in myometrial peristalsis and endometrial function. Defects in decidualisation (that decrease endometrial receptivity), stimulation of local and systemic inflammatory pathways, elevated levels of prostaglandins, and modifications in placentation have all been hypothesized to play a role (Barbanti et al., 2021; Mishra et al., 2023).

Laparoscopic bilateral uterine artery ligation minimized uterine volume, improved adenomyosis signs and symptoms, and resulted in acceptable results for fertility (El-Sayed et al., 2023).

Patients and methods:

The current study included (50) infertile adenomyosis uteri patients determined by ultrasound/MRI and planned for Intracytoplasmic sperm injection (ICSI) technique. All patients underwent laparoscopic uterine artery ligation, with follow-ups at three and six months for uterine volume, complaints, and adenomyosis scoring by ultrasound and MRI. ICSI was performed on six months after surgery in each patient, and the results were recorded.

Preoperative assessment involved the demographic and clinical data of the study population as follows: age, body mass index (BMI), clinical signs such as menstrual signs, pelvic pain, deep dyspareunia and infertility. 3-D Ultrasound was used to determine the volume of the uterus in addition to MRI and sonographic scoring of adenomyosis.

Operative assessment involved the bilateral uterine artery ligation method; laparoscopic intervention applied for other problems in the pelvis and the recorded complications.

Postoperative assessment was carried out after three and six month and involved clinical signs, the volume of the uterus, MRI and sonographic scoring. The outcomes of ICSI were reported six months after the operation.

Statistical analyses

Recorded data were analyzed using the statistical package for social sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA). The quantitative data were presented as mean± standard deviation and ranges when their distribution was parametric (normal) while non-normally distributed variables (non-parametric data) were presented as median with inter-quartile range (IQR). Also qualitative variables were presented as number and percentages. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk Test.

Results:

The results of the current study are displayed in the following tables and figures:

This study included (50) patients with mean age (31.7±5.3) years; (36.0%) were aged between (30-35) years and (64.0%) were aged between (36-41) years. The mean of BMI was (26.22±3.55) (kg/m²), ranged (24.76-34.31) (kg/m²) (Table 1)

Table (1): Demographic data of the patients (n=50)

	No.	%
Age (years)		
30-35	18	36.0
36-41	32	64.0
Mean ±S.D.	31.7±5.3	



Body mass index (BMI) (kg/m²)	
Range	24.76-34.31
Mean $\pm$ S.D.	26.22 $\pm$ 3.55

Table (2) shows that the menstrual symptoms included: dysmenorrhea in 46 patients (92.0%), heavy menstrual bleeding in 39 patients (78.0%) and intra menstrual bleeding in 27 patients (54.0%). Primary infertility was seen in 33 patients (66.0%) and secondary infertility was seen in 17 patients (34.0%). Deep dyspareunia was found in 44 patients (88.0%) and pelvic pain in 32 patients (64.0%)

The mean pre operative volume of uterus was (203.7 $\pm$ 33.8) cm³ ranged (160-240) cm³

Table (2): Clinical data of the patients (n=50)

Symptoms	No.	%
A. Menstrual symptoms		
Dysmenorrhea	46	92.0
Heavy menstrual bleeding	39	78.0
Intra menstrual bleeding	27	54.0
B. Infertility		
Primary	33	66.0
Secondary	17	34.0
C. Deep dyspareunia	44	88.0
D. Pelvic pain	32	64.0
Pre operative volume of uterus (cm³)		
Range	160-240	
Mean $\pm$ S.D.	203.7 $\pm$ 33.8	

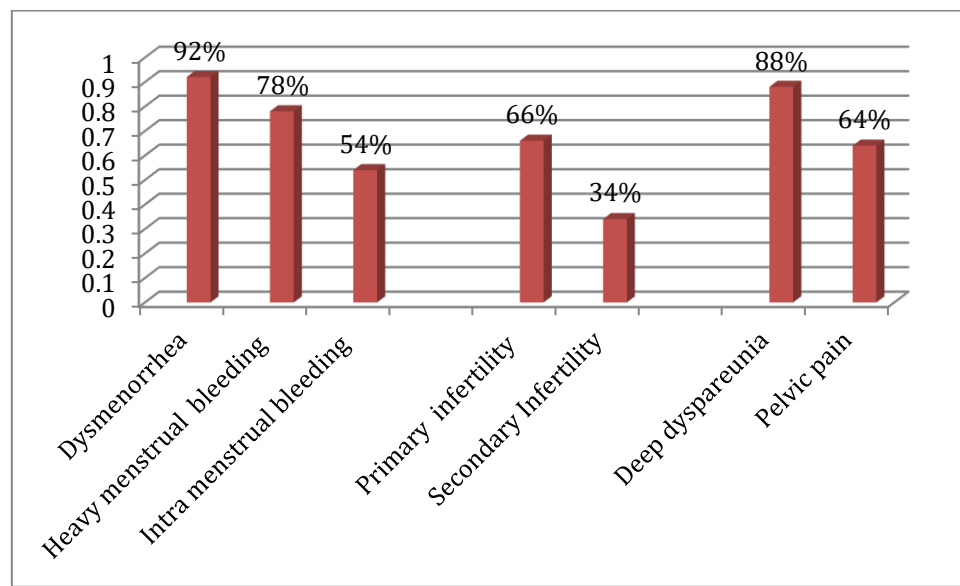


Figure (1): Clinical data of the patients (n=50)



Table (3) shows that diffuse adenomyosis outer myometrium (score 3) was recorded in 12 patients (24.0%) and inner myometrium (score 4) was recorded in 10 patients (20.0%). Focal adenomyosis outer myometrium (score 4) was recorded in 7 patients (14.0%) and inner myometrium (score 2) was recorded in 11 patients (22.0%). Adenoma was found in 10 patients (20.0%).

Table (3): Preoperative sonographic scoring of adenomyosis (n=50)

	No.	%
Diffuse adenomyosis		
Outer myometrium (score 3)	12	24.0
Inner myometrium (score 4)	10	20.0
Focal adenomyosis		
Outer myometrium (score 4)	7	14.0
Inner myometrium (score 2)	11	22.0
Adenoma	10	20.0

Regarding size of adenomyosis, internal adenomyosis A1, A2, and A3 that were reported in 11 patients (22.0%), no patients (0.0%) and 8 patients (16.0%), respectively. External adenomyosis B1, B2, and B3 were reported in 7 patients (14.0%), 17 patients (34.0%) and 7 patients (14.0%), respectively. **Table (4), Figure (2)**

Location of adenomyosis involved D1, D2, D3, D4, and D5 that were reported in 16 patients (32.0%), 12 patients (24.0%), 11 patients (22.0%), 6 patients (12.0%), and 5 patients (10.0%), respectively. **Table (4), Figure (3)**

Associated pathology included C0, C1, C2, C3, and C4 that were reported in 21 patients (42.0%), 19 patients (38.0%), 8 patients (16.0%), one patient (2.0%), and one patient (2.0%), respectively. **Table (4), Figure (4)**

Table (4): Preoperative MRI (n=50)

I. Size of adenomyosis	No.	%
A. Internal adenomyosis		
A1	11	22.0
A2	0	0
A3	8	16.0
B. External adenomyosis		
B1	7	14.0
B2	17	34.0
B3	7	14.0
II. Location of adenomyosis		
D1	16	32.0
D2	12	24.0
D3	11	22.0
D4	6	12.0
D5	5	10.0
III. Associated pathology		



C0	21	42.0
C1	19	38.0
C2	8	16.0
C3	1	2.0
C4	1	2.0

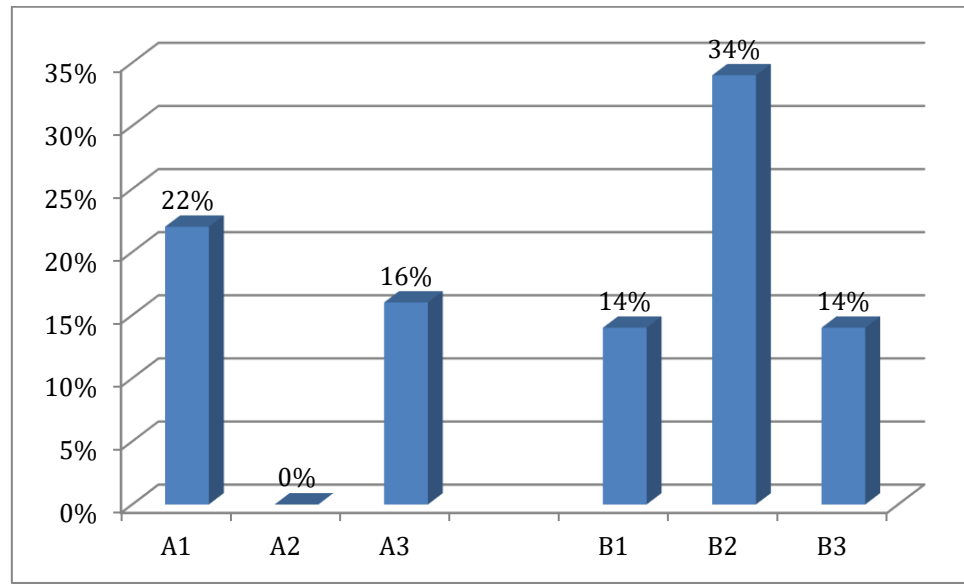


Figure (2): Size of adenomyosis

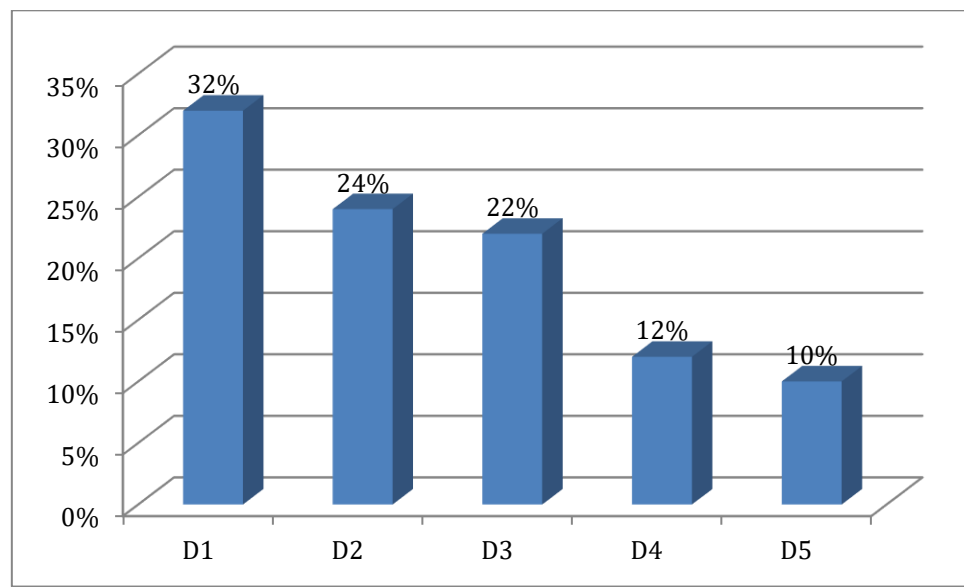


Figure (3): Location of adenomyosis

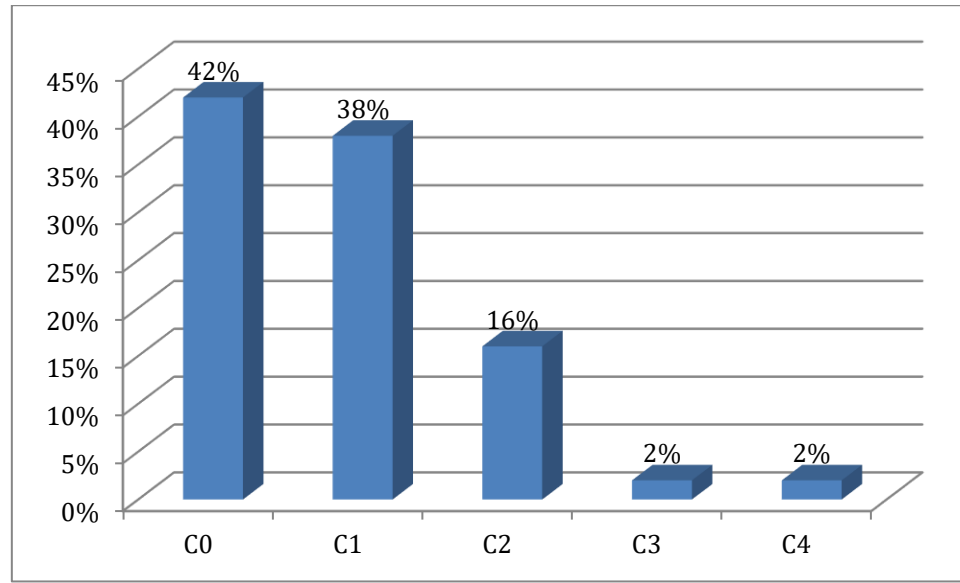


Figure (4): Associated pathology

Operative data of the patients were recorded in Table (5). Bilateral uterine artery ligation technique involved haemoclips in 14 patients (28.0%), electro coagulation in 33 patients (66.0%) and suturing in 3 patients (6.0%). **Table (5)**

Additional laparoscopic intervention involved electro coagulation of endometriotic peritoneal implants in 20 patients (40.0%), ovarian cystectomy in 11 patients (22.0%), and uterosacral resection in 4 patients (8.0%). **Table (5)**

Operative complications are anesthesia complications in 6 patients (12.0%), slipped ligature in 5 patients (10.0%), inferior epigastric vessels injury in 4 patients (8.0%), and wound infection in 8 patients (16.0%). **Figure (5)**

Table (5): Operative data of the patients (n=50)

	No.	%
I. Bilateral uterine artery ligation technique		
Haemoclips	14	28.0
Electro coagulation	33	66.0
Suturing	3	6.0
II. Additional laparoscopic intervention		
None	15	30.0
Electro coagulation of endometriotic peritoneal implants	20	40.0
Ovarian cystectomy	11	22.0
Uterosacral resection	4	8.0
III. Operative complications		
Anesthesia complications	6	12.0
Slipped ligature	5	10.0
Inferior epigastric vessels injury	4	8.0
Wound infection	8	16.0

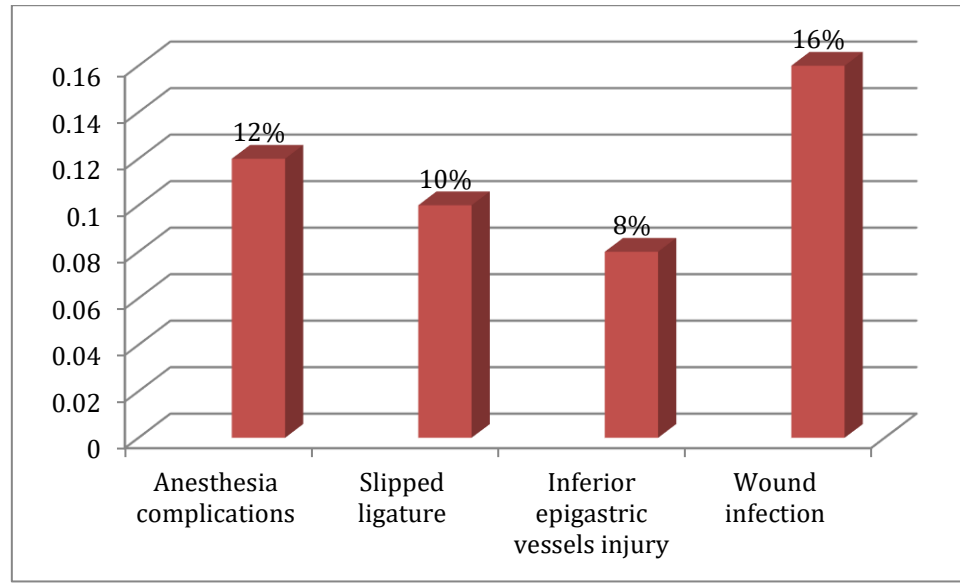


Figure (5): Operative complications

Table (6) shows statistically significant decline in dysmenorrhea at three months postoperative 26 (52.0%) than preoperative 46 (92.0%) and there was statistically significant decline at six months postoperative 13 (26.0%) than 3 months postoperative (P=0.002). There was statistically significant decline in heavy menstrual bleeding at three months postoperative 14 (28.0%) than preoperative 39 (78.0%) and there was statistically significant decline at six months postoperative 9 (18.0%) than 3 months postoperative (P=0.001).

There was statistically significant decline in intra menstrual bleeding at three months postoperative 7 (14.0%) than preoperative 27 (54.0%) and there was statistically significant decline at six months postoperative 4 (8.0%) than 3 months postoperative (P=0.012).

There was statistically significant decline in deep dyspareunia at three months postoperative 24 (48.0%) than preoperative 44 (88.0%) and there was statistically significant decline at six months postoperative 14 (28.0%) than 3 months postoperative (P=0.005).

There was statistically significant decline in pelvic pain at three months postoperative 19 (38.0%) than preoperative 32 (64.0%) and there was statistically significant decline at six months postoperative 14 (28.0%) than 3 months postoperative (P=0.016).

Table (6): Comparison of pre- and post-operative data at various follow-up periods

Symptoms:	Preoperative		3 months post operative		6 months post operative		P value
	No.	%	No.	%	No.	%	
A. Menstrual symptoms							
Dysmenorrhea	46	92.0	26	52.0	13	26.0	0.002*
Heavy menstrual bleeding	39	78.0	14	28.0	9	18.0	0.001*
Intra menstrual bleeding	27	54.0	7	14.0	4	8.0	0.012*
B. Deep dyspareunia	44	88.0	24	48.0	14	28.0	0.005*
C. Pelvic pain	32	64.0	19	38.0	14	28.0	0.016*

Table (7) showed statistically significant decline in uterine volume postoperative (141.5±19.4) cm³ than preoperative (203.7±33.8) cm³ (P=0.003).



There was statistically significant decline in postoperative period than preoperative period regarding diffuse adenomyosis in both (outer and inner) ($P=0.03$), focal adenomyosis in both (outer and inner) ($P=0.04$), and adenoma ($P=0.04$).

As regards size of adenomyosis by MRI, there was statistically significant decline in internal adenomyosis (A1, A2, and A3) postoperative than preoperative ($p=0.012$) as well as there was statistically significant decline in external adenomyosis (B1, B2, and B3) postoperative than preoperative ($p=0.04$)

Table (7): Comparison between pre and post operative volume of uterus, sonographic scoring and MRI results

	Pre operative		Post operative		P value
	No.	%	No.	%	
Volume of uterus (Cm³)					
Range	160-240		120-180		
Mean $\pm$ S.D.	203.7 $\pm$ 33.8		141.5 $\pm$ 19.4		0.003*
Diffuse adenomyosis					
Outermyometrium (score 3)	12	24.0	6	12.0	0.03*
Innermyometrium (score 4)	10	20.0	5	10.0	0.03*
Focal adenomyosis					
Outermyometrium (score 4)	7	14.0	3	6.0	0.04*
Innermyometrium (score 2)	11	22.0	6	12.0	0.04*
Adenoma	10	20.0	5	10.0	0.04*
MRI :					
I. Size of adenomyosis by MRI					
Internal adenomyosis					
A1	11	22.0	8	16.0	0.012*
A2	0	0	0	0	
A3	8	16.0	6	12.0	
External adenomyosis					
B1	7	14.0	14	28.0	0.04*
B2	17	34.0	16	32.0	
B3	7	14.0	5	10.0	

Table (8) shows that six months after the operation, 14 patients (42.42%) of primary infertility had successful ICSI and got pregnancy while 8 patients (47.06%) of secondary infertility had successful ICSI and got pregnancy with none statistically significant difference between primary and secondary infertility according to succeed rate in pregnancy ($p=0.359$).

Table (8): The results of ICSI six months after operation

	Preoperative		Six months after operation				P value
			Successful		Failed		
	No.	%	No.	%	No.	%	
Primary infertility	33	66.0	14	42.42	19	57.58	0.359 N.S.
Secondary infertility	17	34.0	8	47.06	9	52.94	



Discussion:

Approximately 24% of infertile women are identified as having adenomyosis, particularly individuals who suffer from recurrent implantation failures and frequent miscarriages, in addition to women identified with endometriosis or in their final period of being able to reproduce (**Park et al., 2016; Sharma et al., 2019**).

Generally, adenomyosis had an adverse effect on ICSI/FET results when thinking of clinical pregnancy rate; however, there was an important connection among GnRH agonist prior to treatment, conservative surgery, and the usage of GnRH agonist long protocol to enhance the pregnancy results in ICSI/FET cycle (**Sudhakar et al., 2022**).

In terms of preoperative adenomyosis symptoms, our results showed that dysmenorrhea was present in (92.0%) of patients, heavy menstrual bleeding in (78.0%) and intra menstrual bleeding in (54.0%). Primary infertility was recorded in (66.0%) of patients and secondary infertility in (34.0%) of patients. Deep dyspareunia was found in (88.0%) of patients and pelvic pain in (64.0%). A clinical manifestation of adenomyosis is excessive bleeding from the uterus, which is a significant indicator of damage to tissues (**Guo et al., 2015**). These findings are supported that of **Eisenberg et al., (2017)** who reported that adenomyosis symptoms and complaints included dysmenorrhea in (92.5%) of patients, dyspareunia (64.1%), urinary complaints (28.6%), gastrointestinal complaints (53.8%), and infertility (37.2%). Our findings disagreed with **Li et al., (2024)** who reported primary infertility in (36.4%) of cases and secondary infertility in (63.36%) of cases. Another study conducted by **Chen et al., (2019)** revealed that (71.8%) of patients complained of pain symptom, (68.0%) of patients presented dysmenorrhea and (8.2%) had dyspareunia.

The mean pre operative volume of uterus in this study was $(203.7 \pm 33.8) \text{ cm}^3$. This finding agrees with that of **El-Sayed et al., (2023)** who reported that the mean uterine volume in the studied cases was $(205.6 \pm 38.5) \text{ cm}^3$.

Adenomyosis was scored preoperatively in the studied cases as diffuse (44.0%), focal (36.0%), or adenoma (20.0%). This result disagrees with that of **Marcellin et al., (2023)** who reported that (15.8%) of patients presented diffuse adenomyosis, (39.6%) focal adenomyosis and (13.7%) both phenotypes.

The preoperative MRI scans of the current study patients revealed that 22.0% had internal adenomyosis (A1) and 34.0% had external adenomyosis (B2). This finding is supported with that of **Bourdon et al., (2021)** who found that (44.0%) of patients had external adenomyosis and (31.5%) had internal adenomyosis.

Regarding the associated pathology by MRI, our study revealed that (42.0%) had (C0) and (38.0%) had (C1). This finding agrees with that of **El-Sayed et al., (2023)** who found that (40%) of patients had (C0) and (35%) had (C1) in MRI findings.

In terms of the operative complications, this study results showed recorded wound infection in (16.0%) of patients, anesthesia complications in (12.0%), slipped ligature in (10.0%), and injury of inferior epigastric vessels in (8.0%) of patients. These findings are supported with that of **El-Sayed et al., (2023)** who found that wound infection was reported in (15%) of cases, Slipped ligature in (10%) of cases, anesthesia complications in (5%) of cases and injury of inferior epigastric vessels in (5%) of cases

The present study results revealed statistically significant decrease in dysmenorrhea ($p=0.002$), heavy menstrual bleeding ($p=0.001$), intra menstrual bleeding ($p=0.012$), deep dyspareunia ($p=0.005$) and pelvic pain (0.016) at three months and six months postoperative. These findings



agree with **Liu et al., (2014)** who recorded that postoperative dysmenorrhea and menorrhagia scores showed substantial improvements (all $p < 0.01$) at three twelve and thirty-six months in comparison to preoperative scores.

The current study found a statistically significant decrease in pre- and postoperative uterine volume ($P = 0.003$). There was a statistically significant decrease in postoperative period compared to preoperative period for diffuse, focal adenomyosis, and adenoma. MRI revealed a significant difference ($P < 0.05$) in uterine volume before and after surgery for internal and external adenomyosis. Similarly, **Liu et al., (2014)** results showed that the uterus volume was continually decreased at three, six, twelve and thirty-six months after surgery, and decreased by 58.3% at thirty-six months following surgery, in contrast to the preoperative volume.

Our results showed that (42.42%) of primary infertility had successful ICSI and got pregnancy, whereas 8 patients (47.06%) of secondary infertility had successful ICSI. This finding was consistent with that of **El-Sayed et al., (2023)** who found that the success rate for primary infertility after 6 months postoperative was 42.8%, while secondary infertility was 50%.

Tamura et al., (2017) published one of the most significant records on adenomyosis and fertility results. They contrasted three groups of adenomyosis patients (no pretreatment, medical treatment, and surgery) prior to starting infertility treatments. The twenty-three individuals who underwent conservative surgery for focal adenomyosis had a 39% pregnancy rate and no miscarriages. **Kishi et al., (2014)** studied the fertility results of 104 patients who underwent laparoscopic excisional uterine-sparing surgery for adenomyosis. Out of 102 patients who desired pregnancy, 36 (35.2%) were able to get pregnant.

Conclusion:

The current study found that laparoscopic bilateral uterine artery ligation substantially decreased uterine adenomyosis-related manifestations and volume while yielding appropriate results for fertility. More research studies are required for identifying the best fertility-preserving treatment for adenomyosis in women desiring pregnancy.

References:

- **Barbanti, C., Centini, G., Lazzeri, L., Habib, N., Labanca, L., Zupi, E., Afors, K., & Starace, A. C. (2021).** Adenomyosis and infertility: the role of the junctional zone. *Gynecological endocrinology: the official journal of the International Society of Gynecological Endocrinology*, 37(7), 577–583. <https://doi.org/10.1080/09513590.2021.1878131>
- **Barbosa-Silva, J., Avila, M. A., de Oliveira, R. F., Dedicação, A. C., Godoy, A. G., Rodrigues, J. C., & Driusso, P. (2024).** Prevalence, pain intensity and symptoms associated with primary dysmenorrhea: a cross-sectional study. *BMC women's health*, 24(1), 92. <https://doi.org/10.1186/s12905-023-02878-z>
- **Bourdon, M., Oliveira, J., Marcellin, L., Santulli, P., Bordonne, C., Maitrot Mantelet, L., Millischer, A. E., Plu Bureau, G., & Chapron, C. (2021).** Adenomyosis of the inner and outer myometrium are associated with different clinical profiles. *Human reproduction (Oxford, England)*, 36(2), 349–357. <https://doi.org/10.1093/humrep/deaa307>
- **Celli, V., Dolcianni, M., Ninkova, R., Ercolani, G., Rizzo, S., Porpora, M. G., Catalano, C., & Manganaro, L. (2022).** MRI and Adenomyosis: What Can



- Radiologists Evaluate?. International journal of environmental research and public health, 19(10), 5840. <https://doi.org/10.3390/ijerph19105840>
- Chapron, C., Vannuccini, S., Santulli, P., Abrão, M. S., Carmona, F., Fraser, I. S., Gordts, S., Guo, S. W., Just, P. A., Noël, J. C., Pistofidis, G., Van den Bosch, T., & Petraglia, F. (2020). Diagnosing adenomyosis: an integrated clinical and imaging approach. Human reproduction update, 26(3), 392–411. <https://doi.org/10.1093/humupd/dmz049>
 - Chen, Q., Li, Y. W., Wang, S., Fan, Q. B., Shi, H. H., Leng, J. H., Sun, D. W., Lang, J. H., & Zhu, L. (2019). Clinical Manifestations Of Adenomyosis Patients With Or Without Pain Symptoms. Journal of pain research, 12, 3127–3133. <https://doi.org/10.2147/JPR.S212117>
 - da Cunha Vieira, M., Andres, M. P., Riccio, L. G. C., Schlindwein, S. S., Arcoverde, F. V. L., Di Spiezio Sardo, A., & Abrão, M. S. (2024). Association of Uterine Tissue Innervation and Peripheral Nerve Density with Adenomyosis Related Pain. A Systematic Review. Reproductive sciences (Thousand Oaks, Calif.), 31(8), 2137–2149. <https://doi.org/10.1007/s43032-024-01587-8>
 - Eisenberg, V. H., Arbib, N., Schiff, E., Goldenberg, M., Seidman, D. S., & Soriano, D. (2017). Sonographic Signs of Adenomyosis Are Prevalent in Women Undergoing Surgery for Endometriosis and May Suggest a Higher Risk of Infertility. BioMed research international, 2017, 8967803. <https://doi.org/10.1155/2017/8967803>
 - El-Sayed , S., Galal , A.F. , & Tappozada, T.M.(2023). Laparoscopic bilateral uterine artery ligation in the treatment of patients with adenomyosis uteri undergoing ICSI. The Egyptian Journal of Fertility of Sterility 27(2):82-96.
 - Guo, S. W., Ding, D., Shen, M., & Liu, X. (2015). Dating Endometriotic Ovarian Cysts Based on the Content of Cyst Fluid and its Potential Clinical Implications. Reproductive sciences (Thousand Oaks, Calif.), 22(7), 873–883. <https://doi.org/10.1177/1933719115570907>
 - Kaczmarek, M. M., Najmula, J., Guzewska, M. M., & Przygodzka, E. (2020). MiRNAs in the Peri-Implantation Period: Contribution to Embryo-Maternal Communication in Pigs. International journal of molecular sciences, 21(6), 2229. <https://doi.org/10.3390/ijms21062229>
 - Kishi, Y., Yabuta, M., & Taniguchi, F. (2014). Who will benefit from uterus-sparing surgery in adenomyosis-associated subfertility?. Fertility and sterility, 102(3), 802–807.e1. <https://doi.org/10.1016/j.fertnstert.2014.05.028>
 - Li, J., Wei, J., Chen, S., Wang, X., Chen, J., Zeng, D., & Fan, L. (2024). Prevalence and risk factors for chronic endometritis in patients with adenomyosis and infertility: a retrospective cohort study. BMC women's health, 24(1), 403. <https://doi.org/10.1186/s12905-024-03245-2>
 - Liu, M., Cheng, Z., Dai, H., Qu, X., & Kang, L. (2014). Long-term efficacy and quality of life associated with laparoscopic bilateral uterine artery occlusion plus partial resection of symptomatic adenomyosis. European journal of obstetrics, gynecology, and reproductive biology, 176, 20–24. <https://doi.org/10.1016/j.ejogrb.2013.11.014>
 - Marcellin, L., Legay, L., Santulli, P., Millischer, A. E., Bordonne, C., Maitrot Mantelet, L., Maignien, C., Bourdon, M., Gaudet Chardonnet, A., Borghese, B., Goffinet, F., & Chapron, C. (2023). Magnetic resonance imaging presentation of



diffuse and focal adenomyosis before and after pregnancy. Reproductive biomedicine online, 47(1), 121–128. <https://doi.org/10.1016/j.rbmo.2023.02.008>

- **Mishra, I., Melo, P., Easter, C., Sephton, V., Dhillon-Smith, R., & Coomarasamy, A. (2023).** Prevalence of adenomyosis in women with subfertility: systematic review and meta-analysis. *Ultrasound in obstetrics & gynecology: the official journal of the International Society of Ultrasound in Obstetrics and Gynecology*, 62(1), 23–41. <https://doi.org/10.1002/uog.26159>
- **Park, C. W., Choi, M. H., Yang, K. M., & Song, I. O. (2016).** Pregnancy rate in women with adenomyosis undergoing fresh or frozen embryo transfer cycles following gonadotropin-releasing hormone agonist treatment. *Clinical and experimental reproductive medicine*, 43(3), 169–173. <https://doi.org/10.5653/cerm.2016.43.3.169>
- **Sharma, S., Bathwal, S., Agarwal, N., Chattopadhyay, R., Saha, I., & Chakravarty, B. (2019).** Does presence of adenomyosis affect reproductive outcome in IVF cycles? A retrospective analysis of 973 patients. *Reproductive biomedicine online*, 38(1), 13–21. <https://doi.org/10.1016/j.rbmo.2018.09.014>
- **Sudhakar, P., Manivannan, S., Kandasamy, D., & Jayapal, K. (2022).** Does Adenomyosis Influence ICSI Clinical Outcome? A Systematic Analysis and Impact of GnRH Agonist Pretreatment for Women with Adenomyosis in ICSI-FET Cycle: A Retrospective Cohort Study. *Journal of obstetrics and gynaecology of India*, 72(3), 236–242. <https://doi.org/10.1007/s13224-021-01504-y>
- **Tamura, H., Kishi, H., Kitade, M., Asai-Sato, M., Tanaka, A., Murakami, T., Minegishi, T., & Sugino, N. (2017).** Clinical outcomes of infertility treatment for women with adenomyosis in Japan. *Reproductive medicine and biology*, 16(3), 276–282. <https://doi.org/10.1002/rmb2.12036>
- **Tsikouras, P., Kritsotaki, N., Nikolettos, K., Kotanidou, S., Oikonomou, E., Bothou, A., Andreou, S., Nalmpanti, T., Chalkia, K., Spanakis, V., Tsikouras, N., Chalil, M., Machairiotis, N., Iatrakis, G., & Nikolettos, N. (2024).** The Impact of Adenomyosis on Pregnancy. *Biomedicines*, 12(8), 1925. <https://doi.org/10.3390/biomedicines12081925>
- **Wang, Y., Yi, Y. C., Guu, H. F., Chen, Y. F., Kung, H. F., Chang, J. C., Chen, L. Y., Chuan, S. T., & Chen, M. J. (2023).** Impact of adenomyosis and endometriosis on IVF/ICSI pregnancy outcome in patients undergoing gonadotropin-releasing hormone agonist treatment and frozen embryo transfer. *Scientific reports*, 13(1), 6741. <https://doi.org/10.1038/s41598-023-34045-7>
- **Zhang, X., Bao, P., Ye, N., Zhou, X., Zhang, Y., Liang, C., Guo, X., Chu, M., Pei, J., & Yan, P. (2021).** Identification of the Key Genes Associated with the Yak Hair Follicle Cycle. *Genes*, 13(1), 32. <https://doi.org/10.3390/genes13010032>