
Laparoscopic bilateral uterine artery ligation in the treatment of patients with adenomyosis uteri undergoing ICSI

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Abstract

Background: Adenomyosis is frequently detected in women of reproductive age. Although uterine artery ligation has minimal efficacy on its own, it can give appropriate therapeutic control when combined with other methods..

Patients and methods: This prospective pilot study involved 20 patients who had uterine adenomyosis confirmed by ultrasonography or MRI, complained of infertility, and were scheduled for ICSI. Laparoscopic ligation of both uterine arteries using hemoclips and bilateral electrocoagulation of uterine ovarian vessels was done. Intracytoplasmic sperm injection (ICSI) done six months postoperatively and recording the outcome. Moreover, recording the uterine size, the menstrual symptoms and the adenomyosis volume prior to ICSI.

Results: Generally, the all symptoms of the patients under the study were improved significantly postoperatively during follow up period after 3 months and 6 months respectively ($p < 0.05$). The uterine volume at preoperative period ranged from 160-240 cm³ with mean value (205.6±38.5) and in postoperative period ranged from 120-182 cm³ with mean value (142.6±21.3). There was a significant statistical decrease between preoperative and postoperative uterine volumes ($P < 0.05$). There was no statistically significant difference between preoperative and postoperative sonographic scoring of the patients. There was no significant difference between preoperative and postoperative MRI degree of adenomyosis but there was an improve in the grade of external adenomyosis.

The outcome of ICSI 6 months postoperatively was recorded in the patients under the study, as regards the primary infertility cases it was found that 6 cases from 14 cases (42.8%) were succeeded and became pregnant, while in the secondary infertility group 3 cases from 6 cases (50.0%) were succeeded and became pregnant.

Conclusion: Bilateral uterine arteries ligation significantly cause reduction in the uterine volume and improve the adenomyosis symptoms and the reproductive outcome.

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These parameters showed in PCOS patients on the level of TAC; all parameters have no significant effect except for age.

Keywords: Adenomyosis, Intracytoplasmic sperm injection, Uterine artery ligation.

Introduction

Adenomyosis is a common benign gynecological disorder marked by the presence of stroma embedded within the myometrium and ectopic endometrial glands.⁽¹⁾ It affects the archimetra or inner myometrium and is caused by basal endometrial infiltration of the myometrium, which causes smooth muscle hypertrophy and hyperplasia.^(2,3) In the past, adenomyosis was detected after histopathological examination of specimens following hysterectomies.⁽³⁾ In premenopausal women who had hysterectomies for a variety of reasons, multiple studies reported a rate of more than 30% of adenomyosis in hysterectomy specimens.^(4,5) However, the incidence of adenomyosis according to female's age, particularly in young women is still unclear.⁽⁵⁾ The following criteria are used in the histologic diagnosis of adenomyosis: the existence of penetrating glands at least in one low-power field from the endo-myometrial junction or 2.5 mm below the basal layer of endometrium or deeper than 25% of total myometrial thickness. Also, myometrial smooth muscle proliferation around endometrial islands is noticed in histological diagnosis of adenomyosis.^(21,29)

One third of cases with adenomyosis are asymptomatic, the other two third suffer from dysmenorrhea, menorrhagia, pelvic pain, uterine enlargement and chronic pelvic pain.⁽⁷⁾ Adenomyosis may have a deleterious effect on female fertility, according to current research. Adenomyosis, can have an effect on uterine peristalsis, sperm transportation within the uterine cavity, and embryo implantation, ultimately results in reduced fertility.⁽⁸⁾ Adenomyosis become related to decreased fertility and poorer results of in vitro fertil-

ization (IVF).^(7,8) Before recommending surgical or medicinal treatments, adenomyosis screening may enable subgroup identification and personalised therapy planning. However, there is currently no reliable diagnostic criteria, making adenomyosis difficult to be diagnosed, but in the hands of an experienced examiner, many diagnostic techniques such as clinical examination, transvaginal ultrasonography (TVUS), MRI, and hysteroscopic guided biopsy offer a high sensitivity and specificity.^(9,19)

Magnetic resonance imaging (MRI) and transvaginal ultrasonography (TVUS) are thought to be the two primary radiologic methods for adenomyosis diagnosis. To evaluate the severity and degree of uterine adenomyosis, a novel sonographic scoring system is created.^(9,10) The score system is a technique for categorising the illness into three types: adenomyoma, focal and diffuse adenomyosis of the external myometrium, and junctional zone (JZ). For each type of adenomyotic lesion and for JZ changes, a score ranging from 1 to 4 was assigned to the extent and myometrial involvement. The resultant numerical score was divided into three categories: mild (1–7), moderate (8–13), and severe (14–20).^(11,12,13)

MRI has a diagnostic accuracy of 85%, adding value in the confirmation of the diagnosis, defining the nature and degree of the disease, and detecting further uterine abnormalities.⁽⁵⁾ T2-weighted sequences of MRI are essential for detecting adenomyosis, since they highlight the uterine zonal architecture.⁽¹⁴⁾ Thickening of the junctional zone is the most frequent indicator of adenomyosis, with a thickness more than 12 mm being highly indicative of the diagnosis.^(13,14)

Some publications claim that a junctional zone thickness between 8 and 12 mm can be used to diagnose adenomyosis, but additional criteria are needed. That is a discrepancy of more than 5 mm between the junctional zone's maximum and minimum thickness in both anterior and posterior parts of the uterus.⁽¹⁵⁾

Adenomyosis has been controlled by GnRH agonist or levonorgestrel intrauterine hormonal treatments, surgical resection of adenomyomas, uterine artery embolization, or magnetic resonance-guided targeted ultrasound, several retrospective research and case reviews have found an improvement in fertility. Although uterine artery ligation has minimal efficacy when used alone to treat adenomyosis, it can give appropriate therapeutic control when combined with other methods.⁽¹⁶⁾

Patients and Methods

The study was conducted as twenty patients with adenomyosis uteri diagnosed by ultrasound/ MRI and complaining of infertility and scheduled for ICSI process. Laparoscopic uterine artery ligation was done for all the studied patients with follow up of all patients after 3, 6 months respectively as regards the uterine volume, symptoms of the patients, and scoring of adenomyosis by ultrasound and MRI. ICSI was done to all patients, 6 months postoperatively and recording the outcome was done.

Preoperative evaluation of all the studied patients included the basic demographic clinical data of the studied patients group,

symptoms including menstrual symptoms, infertility, deep dyspareunia, and pelvic pain. Moreover, preoperative recording of uterine volume by 3-D ultrasound, sonographic scoring of adenomyosis, and MRI findings of the studied patients group. The operative data of the studied patients group were recorded including the technique of bilateral uterine artery ligation, any additional laparoscopic intervention for any associated pelvic pathology, and any operative complications reported.

Postoperative evaluation of the all studied group were done after 3 months and 6 months respectively as regards symptoms of the patients, uterine volume, sonographic scoring, and MRI scoring of adenomyosis. Six months postoperatively, ICSI was done to all patients under the study and the outcomes were recorded. Prior to performance of ICSI ,all the patients who had surgery were subjected to three dimensional Doppler study of endometrial flow index (FI) and vascularization flow index (VFI) which are markers of endometrial receptivity and blood flow. Fortunately, the former markers were not altered by the surgical procedure and the recorded values permit ICSI process

The preoperative assessment and postoperative follow up by ultrasound and MRI were

	Score (1)	Score (2)	Score (3)	Score (4)
Diffuse adenomyosis of the outer myometrium	1 myometrial wall involvement with myometrial wall thickness ≤ 20 mm.	*2 myometrial wall involvement with wall thickness ≤ 20 mm. *1 myometrial wall involvement with wall thickness $< 20 \leq 30$.	*1 myometrial wall thickness < 30 mm. *2 myometrial wall involvement with wall thickness $< 20 \leq 30$.	* 2myometrial wall involvement with wall thickness < 30 mm. * All the uterus involvement with globally enlarged uterus.
Diffuse adenomyosis of the inner myometrium or junctional zone (JZ)	*Maximum JZ thickness $< 6 \leq 8$ mm in length. *Diffuse infiltration of the JZ ≤ 20 mm in length.	* Maximum JZ thickness < 8 mm *Diffuse infiltration of the JZ < 20 mm in length or $\leq 50\%$ of the uterus.	* Diffuse infiltration of the JZ $< 50\% \leq 80\%$ of uterus.	* 80% to total infiltration of the JZ.

Focal adenomyosis of the outer myometrium	*1focal intramyometrial lesion ≤10mm.	* ≥2focal intramyometrial lesion ≤10mm. *1focal intramyometrial lesions <10≤20mm.	* ≥2focal intramyometrial lesions <10≤20mm. * 1focal intramyometrial lesion <20mm.	* ≥2 focal intramyometrial lesion <20mm. * ≥3 focal intramyometrial lesions.
Focal adenomyosis of the inner myometrium or (JZ)	*1focal lesion of the JZ by hyperechoic tissue or cystic areas ≤10mm.	* ≥2 focal lesions of the JZ ≤10mm. * 1 focal lesion of the JZ <10≤20mm.	* ≥2 focal focal lesions of the JZ <10≤20mm. * 1 focal lesion of the JZ <20mm.	* ≥2focal lesions of the JZ <20mm. * ≥3focal lesions of the JZ.
Adenomyoma	*1 adenomyoma with largest diameter ≤20mm	* 2 adenomyomas with largest diameter ≤20mm * 1 adenomyoma with largest diameter <20≤30mm.	* 2 adenomyomas with largest diameter <20≤30mm . * 1 adenomyoma with largest diameter <30≤40mm.	* ≥3 adenomyomas. *1adenomyoma with largest diameter <40mm.

OAB syndrome is a widely prevalent and infollowed according to new sonographic scoring and MRI based classification that shown underneath in Table 1 and Table 2 respectively.

Table1: New Sonographic Classification of Adenomyosis (Journal of Minimally invasive Gynecology)⁽¹⁷⁾







		Size		
		1 (<1/3)	2 (<2/3)	3 (>1/3)
Affected area		Focal		Diffuse
A (Internal adenomyosis) Thickness of JZ > 12mm				
		Focal		Diffuse
B (External adenomyosis) Thickness of JZ < 8mm				
		Focal		Diffuse
The presence of concomitant pathologies		Localization		
C0	none	D1	Anterior	
C1	peritoneal endometriosis	D2	Posterior	
C2	ovarian endometriosis	D3	left lateral	
C3	deep infiltrating endometriosis	D4	Right lateral	
C4	uterine fibroids	D5	Fundus	
C5	others			

Table2: Magnetic resonance imaging based classification of adenomyosis (Journal of Obstetrics and Gynecology Research)⁽¹⁸⁾

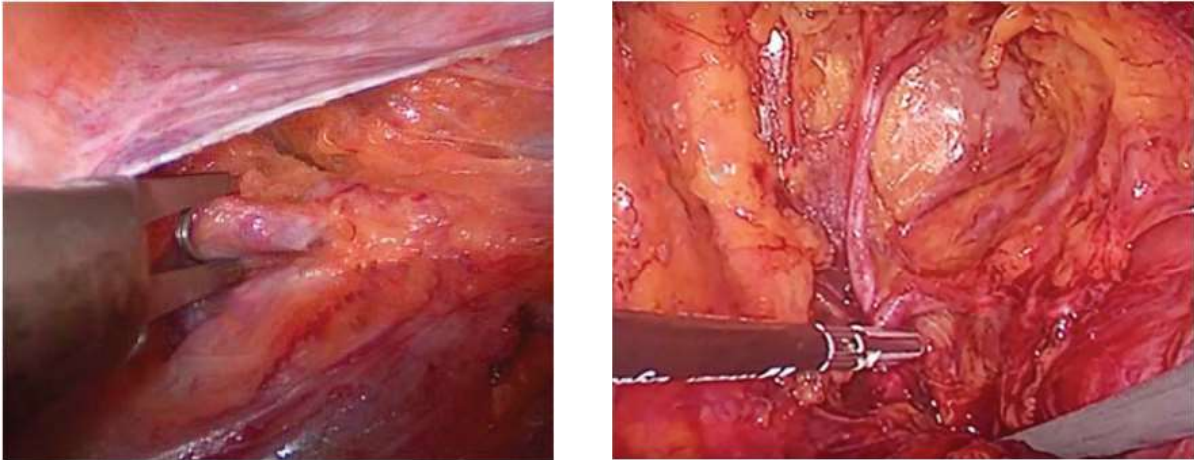


Figure (1)

Different operative methods of bilateral uterine artery ligation

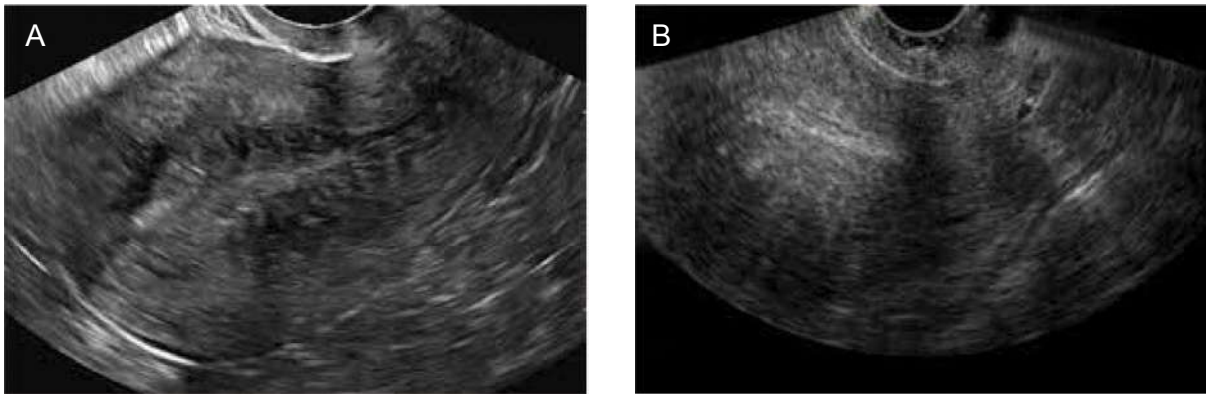


Figure (2)

(A) Preoperative ultrasound shows diffuse adenomyosis of inner myometrium score (4).
(B) Postoperative ultrasound follow up after 6months shows diffuse adenomyosis of inner myometrium score (2).

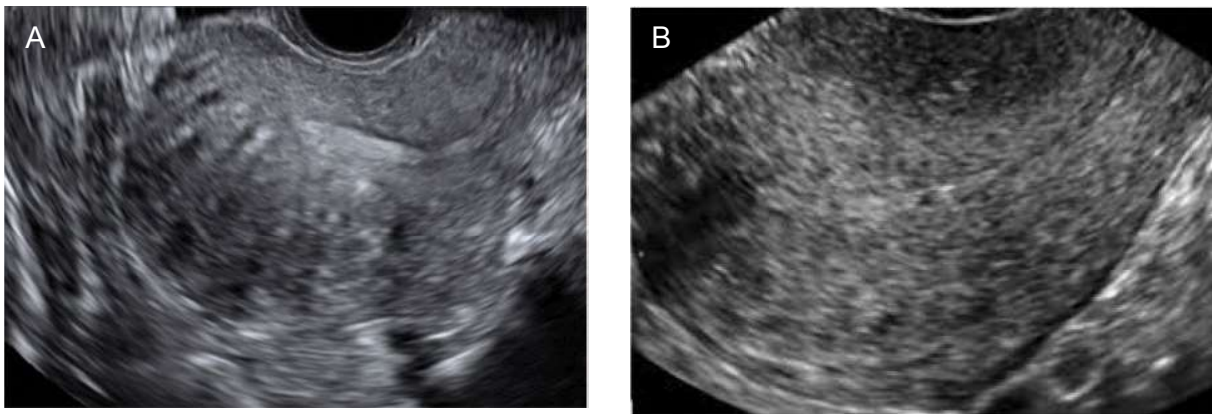


Figure (3)

(A) Preoperative ultrasound shows diffuse adenomyosis of outer myometrium score (4).
(B) Postoperative ultrasound follow up after 6months shows diffuse adenomyosis of outer myometrium score (2).

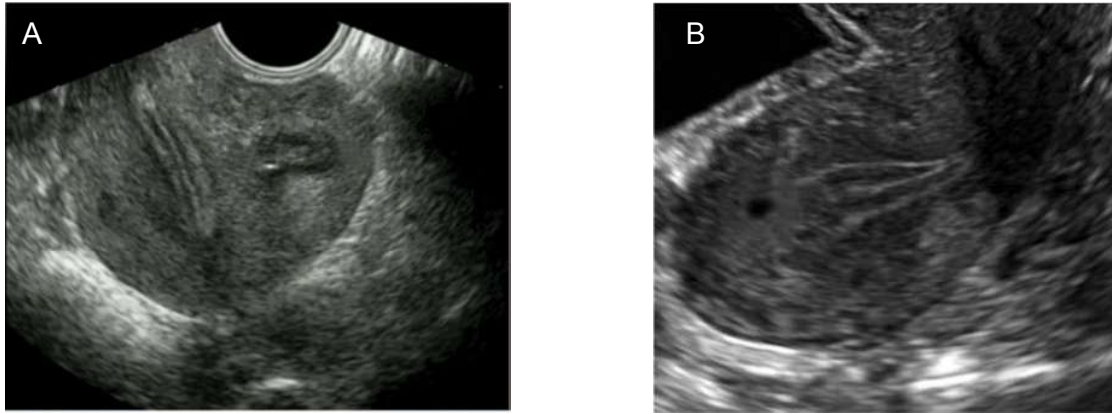


Figure (4)

(A) Preoperative ultrasound shows adenoma score (3).
 (B) Postoperative follow up ultrasound after 6 months shows adenoma score (1) with marked reduction of the uterine volume.

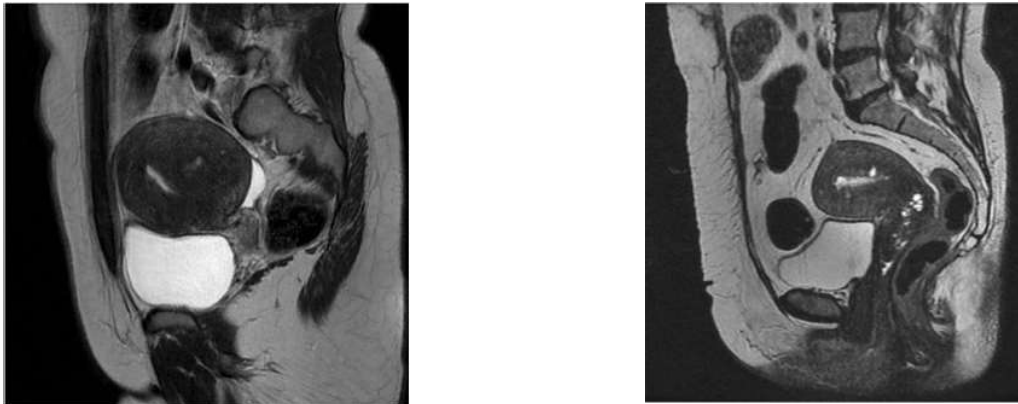


Figure (5)

(A) Preoperative MRI shows internal adenomyosis.
 (B) Postoperative follow up MRI after 6 months shows reduction in size of adenomyosis and the uterine volume

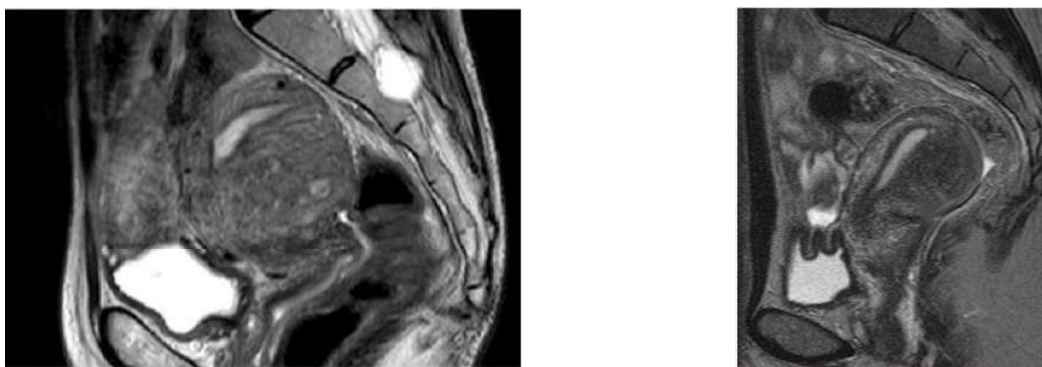


Figure (6)

(A) Preoperative MRI shows external adenomyosis.
 (B) Postoperative follow up MRI after 6 months shows reduction in size of adenomyosis and the uterine volume

The data was obtained and entered into the computer. Software called Statistical Package for Social Sciences (SPSS/version 24) was used for the statistical analysis.

The statistical test used as follow:

Arithmetic mean, standard deviation, and for normally distributed data, comparison between two independent populations were done using independent t-test. While the Chi square

	Number	Percent
Age		
29-34 years	11	55.0
35-40 years	9	45.0
Range	29-40	
Mean \pm S.D.	34.8 \pm 7.98	
Body mass index (BMI)		
25.5-29.5 (kg/m ²)	17	85.0
29.5-32.0 (kg/m ²)	3	15.0
Range	26.0-32.0	
Mean \pm S.D.	28.2 \pm 4.58	
Symptoms:		
A. Menstrual symptoms		
Dysmenorrhea	18	90.0
Heavy menstrual bleeding (HMB)	16	80.0
Intermenstrual bleeding (IMB)	11	55.0
B. Infertility		
Primary	14	70.0
Secondary	6	30.0
C. Deep dyspareunia	18	90.0
D. Pelvic pain	12	60.0

test was applied for categorised parameters. The significant level was 0.05.

Results

160-199 Cm ³	9	45.0
200-240 Cm ³	11	55.0
Range	160-240	
Mean \pm S.D.	205.6 \pm 38.5	

Our studied cases included 20 patients aged between (29-40) years with the mean age (34.8 \pm 7.98). The body mass index (BMI) of the studied patients ranged between (26.0 - 32.0) kg /m² with the mean BMI (28.2 \pm 4.58). Preoperative evaluation of the patient's symptoms revealed that, 18 patients (90%) complained of dysmenorrhea, 16 patients (80%) with (HMB), and 11 patients (55%) with (IMB). The Primary infertility was recorded in 14 patients (70%) while secondary infertility was recorded in 6 patients (30%). The deep dyspareunia was shown in 18 patients (90%) while pelvic pain was shown in 12 patients (60%). The basic demographic and clinical data of the studied patients group is shown in Table (3):

The uterine volume of the studied patients as being detected by 3-D ultrasound prior to surgery was ranged between 160-240 cm³ with a mean of (205.6 \pm 38.5). Preoperative uterine volume by 3-D ultrasound is shown in Table (4).

The preoperative sonographic scoring of adenomyosis of the studied patients group is shown in **Table (5):**

	Number	Percent
Diffuse adenomyosis		
Outer myometrium (score 3)	5	20.0
Inner myometrium (score 4)	5	20.0
Focal adenomyosis		
Outer myometrium (score 4)	6	30.0
Inner myometrium (score 2)	2	10.0
Adenoma	2	10.0

The preoperative MRI findings of the studied patients group is shown in **Table (6):**

I. Size of adenomyosis by MRI		
A. Internal adenomyosis		
A1	0	0.0
A2	7	35.0
A3	0	0.0
B. External adenomyosis		
B1	3	15.0
B2	7	35.0
B3	3	15.0
II. Location of adenomyosis by MRI		
D1	6	30.0
D2	5	25.0
D3	4	20.0
D4	3	15.0
D5	2	
III. Associated pathology by MRI		
C0	8	40.0
C1	7	35.0
C2	3	15.0
C3	1	5.0
C4	1	5.0

The operative data of the studied patients group is shown in **Table (7):**

	Number	Percent
I. Technique of bilateral uterine artery ligation		
Haemoclips	6	30.0
Electrocoagulation	12	60.0
Suturing	2	10.0
II. Additional laparoscopic intervention		
None	7	35.0
Electrocoagulation of endometriotic peritoneal implants	8	40.0
Ovarian cystectomy	4	20.0
Uterosacral resection	1	5.0

III. Operative complications		
Anesthesia complications	1	5.0
Slipped ligature	2	10.0
Injury of inferior epigastric vessels	1	5.0
Wound infection	3	15.0

Table (8), shows the symptoms preoperatively and at different period of follow up at 3 and 6 months postoperatively respectively. The dysmenorrhea was found in 90% of the patients preoperatively and decreased significantly after 3 months to be found in 50% of the patients only, finally after 6 months only 5 cases (25.0%) had dysmenorrhea ($p < 0.05$). Heavy menstrual bleeding was found in 80.0% of the cases preoperatively, and decreased significantly after 3 and 6 months to be 30.0% and 20.0%, respectively, of the cases only. The intermenstrual bleeding was found in 55.0% of the patients preoperatively that had been decreased significantly to be only 15.0% after 3 months and declined to 10.0% of the patients after 6 months.

The deep dyspareunia was found in 90% of the patients preoperatively and decreased significantly after 3 and 6 months to be found in 50.0% and 30.0% of the patients respectively. Finally, the pelvic pain was found preoperatively in 60.0% of the patients and decreased significantly to found in 40.0% of the patients after 3 months and in 30.0% of the patients after 6 months follow up.

Generally, the all symptoms of the patients under the study were improved significantly postoperatively during follow up period after 3 months and 6 months respectively. ($p < 0.05$).

Table (8): Comparison between pre and post operative data at different period of follow up.

Symptoms	Preoperative		3 months post-operative		6 months post-operative		P value
	No.	%	No.	%	No.	%	
A. Menstrual symptoms							
Dysmenorrhea	18	90.0	10	50.0	5	25.0	0.003*
Heavy menstrual bleeding (HMB)	16	80.0	6	30.0	4	20.0	0.001*
Intermenstrual bleeding (IMB)	11	55.0	3	15.0	2	10.0	0.013*
B. Deep dyspareunia	18	90.0	10	50.0	6	30.0	0.004*
C. Pelvic pain	12	60.0	8	40.0	6	30.0	0.017*

The uterine volume at preoperative period ranged from 160-240 cm³ with mean value (205.6±38.5) and in postoperative period ranged from 120-182 cm³ with mean value (142.6±21.3). There was a significant statistical decrease between preoperative and postoperative uterine volumes ($P < 0.05$).

The diffuse adenomyosis score 3 and 4 was found in 25% in both scores with non-significant decrease to be 10% postoperatively. The focal adenomyosis score 4 and 2 was found in 30.0% and 10.0% preoperatively with non-significant decrease to be 15.0% and 5.0% postoperatively. The adenoma was found in 2 patients preoperatively and was found in only one patient postoperatively. Also, there was no significant difference between pre and postoperative sonographic scoring of the patients.

Regarding MRI findings, the size of adenomyosis by MRI showed internal adenomyosis as type A2 in 7 cases (35.0%) preoperatively that changed to type A1 in 3 cases (15.0%) while the other 4 cases still type A2.

The preoperative external adenomyosis grade B1 was found in 15.0% of the patients, 35.0% of cases were B2 while 15.0% of cases were B3. Postoperatively, grade B1 was detected in 30.0% of cases and grade B2 was detected in 30.0% of cases while only 5.0% were grade B3. There was no significant difference but there was an improve in the grade of external adenomyosis.

Table (9): Comparison between pre and post operative uterine volume, sonographic scoring and MRI findings.

	Pre operative		Post operative		P value
	No.	%	No.	%	
Uterine volume Cm³					
Range	160-240		120-182		0.002*
Mean \pm S.D.	205.6 \pm 38.5		142.6 \pm 21.3		
Sonographic Scoring:					
1-Diffuse adenomyosis:					
Outer myometrium (score 3)	5	25.0	2	10.0	0.36
Inner myometrium (score 4)	5	25.0	2	10.0	0.36
2-Focal adenomyosis:					
Outer myometrium (score 4)	6	30.0	3	15.0	0.25
Inner myometrium (score 2)	2	10.0	1	5.0	0.40
3-Adenoma	2	10.0	1	5.0	0.40
MRI findings:					
Internal adenomyosis :					
A1	0	0.0	3	15.0	0.11
A2	7	35.0	4	20.0	
A3	0	0.0	0	0.0	
External adenomyosis :					
B1	3	15.0	6	30.0	0.34
B2	7	35.0	6	30.0	
B3	3	15.0	1	5.0	

Table (10) shows the outcome of ICSI 6 months postoperatively in both types of infertility recorded in the patients under the study, as regards the primary infertility cases it was found that 6 cases from 14 cases (42.8%) were succeeded and became pregnant, while in the secondary infertility group 3 cases from 6 cases (50.0%) were succeeded and became pregnant.

Table (10): Outcome of ICSI 6 months post operative.

	Preoperative		6 months post operative			
			Succeed		Failed	
	No.	%	No.	%	No.	%
Primary infertility	14	70.0	6	42.8	8	57.2
Secondary infertility	6	30.0	3	50.0	3	50.0

Discussion

As a result of the lack of standardized diagnostic criteria, adenomyosis continues to remain difficult to recognize, evaluate, and study, particularly in patients who want to keep their uterus (Loring et al., 2021).⁽¹³⁾

Adenomyosis and fertility problems have been linked on numerous occasions, owing to the anatomical and pathological symptoms that are caused by adenomyosis on the female genital tract (Squillace et al., 2021).⁽²⁴⁾

Regarding the preoperative symptoms of adenomyosis recorded in the current study, dysmenorrhea was reported in (90%) of the studied cases; heavy menstrual bleeding (HMB) in (80%); intermenstrual bleeding in (50%); primary infertility in (70%); deep dyspareunia in (90%) and pelvic pain in (60%) of the studied cases.

In agreement with our results, the most main signs of adenomyosis in women are pain, HMB, infertility, and miscarriage (Vannuccini et al., 2017).⁽³⁰⁾ Myometrial hypercontractility, as proposed by enhanced expression of oxytocin receptors (OTRs) and elevated contractile amplitude of uterine smooth muscle cells (uSMCs) in adenomyotic uterus, can clarify dysmenorrhea and dyspareunia (Nie et al., 2010).⁽²⁰⁾ The altered membrane depolarization of uSMCs caused by potassium channel disorder contributes to abnormal uterine contractility in adenomyosis (Brainard et al., 2007).⁽⁴⁾

Endometrium as well as myometrium have shown overexpression of endothelial nitric oxide (NO) synthase in women with adenomyosis-related HMB, confirming the importance of NO in controlling the amount of menstrual bleeding (Oh et al., 2013).⁽²¹⁾ Infertility and poor implantation consequences are very common in patients with adenomyosis, owing to changed uterine surroundings, dysfunctional uterine contractility, inflammatory responses, and irregular eutopic endometrial activity (Benagiano et al., 2014).⁽²⁾

In agreement with our results, Liu et al. (2014)⁽¹²⁾ discovered that dysmenorrhea was the most consistently reported sign by 81.7% of patients, either alone or in conjunction with other complaints. In Yildirim et al., (2022)⁽³⁵⁾; chronic pelvic pain (27.1%) and menometrorrhagia (22.2%) were the most main symptoms, and leiomyomas (29.4%) and abnormal uterine bleeding (AUB) (14%) were the commonest indicators for hysterectomy.

The mean uterine volume in the studied cases was (205.6±38.5). Also, in Miyagawa et al., (2021)⁽¹⁴⁾ study, the median uterine volume estimated from the long, short, and transverse uterine diameters were 217 (71-1400) cm³.

Preoperative sonographic scoring of adenomyosis in the studied cases; diffuse adenomyosis in (40%), focal adenomyosis in (40%), and adenoma in (10%) of the studied cases. In comparison with previous researches; preoperative (MR) images from 45 patients with pathologically proven adenomyosis in the study of Byun et al., (1999)⁽⁵⁾ revealed diffuse adenomyosis in 30 cases (66.7%) and focal adenomyosis in 15 cases (33.3%). In Salem et al., (2019)⁽¹⁵⁾ study (75%) were diffuse form and (25%) were focal form.

The thickening of the junctional zone is the most common feature for the assessment of adenomyosis, with a thickness greater than 12 mm being strong predictors of the diagnosis (Larsen et al., 2011).⁽⁹⁾

Preoperative MRI findings of the studied patients showed that (35%) had internal adenomyosis (A2), (35%) had external adenomyosis (B2). Regarding the MRI results in Tadjerouni et al., (2021)⁽²⁷⁾ study, 109 women (44.0%) only had external adenomyosis, while 78 (31.5%) only had internal adenomyosis. Our results regarding the associated pathology by MRI showed that (40%) had (C0) and (35%) had (C1). In MRI findings of Salem et al., (2019)⁽¹⁵⁾ study uterine fibroids were found in 11/24 cases (45.83%) and ovarian endometriosis in 2/24 cases (8.3%).

Regarding the operative complications in the current study, wound infection was reported in (15%) of cases, Slipped ligature in (10%) of cases, anaesthesia complications in (5%) of cases and injury of inferior epigastric vessels in (5%) of cases.

Laparoscopic surgery is linked to reduced complications, less postoperative pain, adhesions, and a faster recovery than laparotomy. However, laparoscopy has limitations such as inaccurate evaluation of the extent of adenomyosis and a limited motion range accessible to rebuild a myometrial defect without appropriate eradication of dead space. Laparoscopic surgery may be an option for treating small and localized adenomyosis, whilst open surgery is required for diffuse adenomyotic lesions across the uterus (Shim et al., 2019).⁽²²⁾

Laparoscopy is a viable route that should be used on a regular basis to treat the condition, with a lower risk of conversions and intra-operative side effects (Smith et al., 2018).⁽²³⁾

Our results showed statistical significant decrease in dysmenorrhea at 3 months and 6 months postoperative. Also, there was statistical significant decrease regarding heavy menstrual bleeding and intermenstrual bleeding at different period of follow up respectively ($P < 0.05$).

The beneficial effects of laparoscopic uterine artery ligation in adenomyosis was discussed previously in the study of Wang et al., (2002) (32), they explored the laparoscopic uterine artery ligation impacts in 20 women with symptomatic adenomyosis. Thirteen of the sixteen patients had bleeding control, and five had eumenorrhea or hypomenorrhea. Twelve of the sixteen patients had their dysmenorrhea under control, and six were analgesic-free. Nevertheless, nine women reported non-menstrual pain following surgery, with three requiring hysterectomy. Only 15% of patients were satisfied, and 45% were dissatisfied. The poor satisfaction rate suggested non effective treatment of symptomatic adenomyosis by laparoscopic uterine artery ligation.

There was statistical significant decrease between pre and postoperative uterine volume ($P < 0.05$). There was statistical significant decrease in postoperative period than preoperative period for diffuse, focal adenomyosis and adenoma. There was statistical significant difference between pre and postoperative uterine volume regarding internal and external adenomyosis by MRI ($P < 0.05$).

Similarly, the volume of the uterus was continuously reduced at 3, 6, 12, and 36 months postoperatively, and had shrunk by 58.3% compared to the preoperative volume at 36 months. At 36 months, only 1.7% of patients had undergone a hysterectomy. Furthermore, when compared to preoperative scores, patients' health-related quality of life scores were significantly higher ($p < 0.01$) (Takeuchi et al., 2014).⁽²⁸⁾

In Verit et al., (2019)(31) study, they discovered that the uterine artery blood deliver became now no longer compromised after bilateral uterine artery ligation (UAL). The end result is specially essential for younger ladies who're watching for destiny pregnancies, due to the fact it's miles well known that uterine blood glide is critical for selling a receptive endometrium, embryo implantation, trophoblast invasion, and a prosperous pregnancy.

Chang et al., (2009)⁽⁶⁾ suggested that bilateral UAL during laparoscopic myomectomy did now no longer lower uterine artery PI and RI values at three months after surgery. Uterine artery ligation is related to minimal side effects and is being preferred due to restoration of fertility even after surgery (Shaikh et al., 2021).⁽¹⁶⁾

The current study results showed that primary infertility that succeeded after 6 months postoperative was (42.8%) while secondary infertility was (50%).

The impact of adenomyosis treatment on pregnancy outcomes was discussed in previous researches. Sudhakar et al., (2022) (26) evaluated the impact of adenomyosis on pregnancy outcome in ICSI/FET cycles.

They found marked enhancement in clinical pregnancy rate after GnRH agonist pre-treatment, conservative surgery, or combination therapy. Younes and Tulandi, (2017)⁽³⁶⁾ came to the conclusion that adenomyosis was linked to lower fertility and poorer pregnancy outcomes in IVF. These consequences improved after adenomyosis treatment.

The outcomes of conservative surgery, which included laparoscopy or laparotomy, had been derived from research findings in women with adenomyosis. Laparoscopic cytoreductive surgery was considered to be appropriate for women with localized adenomyosis who have ended in failure standard medical interventions and assisted reproductive technology. One spontaneous pregnancy occurred 21 months after surgery, according to Wang et al., (2006)⁽³³⁾ study.

In subfertile women with adenomyosis, conservative surgery or combination therapeutic interventions had significant benefits not only for alleviating symptoms but also for continuing to increase the pregnancy rate in comparison to GnRH by itself (Al Jama et al., 2011).⁽¹⁾ When adenomyotic women who having undergone conservative surgery with or without GnRH-a were particularly in comparison to those that obtained GnRH-a alone for 6 months, the accumulated 3 years clinical total fertility rate and final successful delivery incidence were greater (Wang et al., 2009).⁽³⁴⁾ Two studies revealed a number of births (Takeuchi et al., 2006⁽²⁸⁾; Tadjerouni et al., 1995)⁽²⁷⁾ and one revealed a pregnancy rate (Strizhakov and Davydov, 1995).⁽²⁵⁾

The present study results revealed that laparoscopic bilateral uterine arteries ligation significantly reduced uterine adenomyosis-related symptoms, volume and achieved reasonable fertility outcomes.

The number of participants who participated in this study was small to draw definitive conclusions about our findings. Despite these limitations, we believe this study is a unique kind.

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