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Analysis of clinical factors in endometriosis of the abdominal wall

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Abstract

Background The abdominal wall is one of the rare sites of endometriosis, and its clinical incidence is increasing year by year with the increasing cesarean section rate nowadays.

Methods A retrospective analysis was made on patients with abdominal wall endometriosis who attended Changzhou Second Hospital of Nanjing Medical University from January 2013 to December 2022. They were grouped by depth of infiltration of lesion and direction of incision, and the differences between the groups were compared.

Results A total of 228 patients aged 32.7 ± 4.2 with abdominal wall endometriosis were included in this study, including 210 cases with a history of abdominal transverse incision surgery, 16 cases with a history of vertical incision surgery, 1 case with a history of uterine fibroids surgery, and 1 case with primary abdominal endometriosis, and 178 cases with the primary symptom of cyclic pain. The patients were classified as solitary and complex ones according to the number of lesions. Both groups were statistically significant for BMI, number of caesarean sections, operation time, bleeding, and postoperative hospital stay ($p < 0.05$). According to the depth of infiltration, the patients were divided into fascial, rectus abdominis, and peritoneal types, with differences in latency time, CA125, maximum diameter of the lesion, operation time, bleeding, and postoperative hospital stay ($p < 0.05$). The direction of incision for caesarean section had no significant effect on the development of endometriosis in the abdominal wall or whether the lesions were multiple ($p > 0.05$). On imaging, magnetic resonance imaging was more accurate for lesion typing.

Conclusion AWE should be diagnosed early and treated surgically. The clinical manifestations of the same type are different, and CA125 testing and abdominal wall ultrasound can be used preoperatively for lesion typing. Nuclear magnetic resonance (NMR) may be used to improve preoperative preparations for difficult diagnosis or typing.

Keywords Abdominal wall endometriosis, Lesion typing, History of abdominal wall surgery

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Background

Endometriosis refers to the location of the glands and mesenchyme of the endometrium outside the uterine lining, accompanied by cyclical pain during menstruation, and is one of the most common gynaecological endocrine disorders affecting approximately 5–10% of women [1]. Symptoms of endometriosis are varied depending on the location of the lesion. The symptoms are mostly characterised by a close association with the menstrual cycle. The most typical symptoms are secondary dysmenorrhoea, progressively worsening [2]. The location of the pain is mostly in the lower abdomen, lumbosacral region and central pelvis. Some patients also experience increased menstrual flow and prolonged periods. If the lesion is located in other specific areas such as the lungs, coughing up blood during menstruation may occur [3, 4]. The most common site of endometriosis is pelvis, with ovaries and vaginal-rectal fossa being the most common sites. It is less common to find endometriosis outside the pelvis, with abdominal wall endometriosis being the most common, with a prevalence of about 0.03–3.5% according to relevant studies [5]. Abdominal wall endometriosis (AWE) refers to the infiltration of endometrial glands and mesenchyme into the abdominal wall, mostly secondary to a history of gynaecological surgery such as caesarean section, uterine, and ovarian surgery. With the recent increase in caesarean section rate, the incidence of AWE has gradually increased, and the variability of its clinical manifestations, latency time, and other characteristics has gradually increased, making it difficult to distinguish AWE from lipoma, haematoma, granuloma, and other diseases. In addition, there are fewer research reports on the diagnosis and treatment of AWE. In this paper, by collecting and analysing the clinical data of abdominal wall endometriosis in our hospital from 2013 to 2022, we disscuss the aetiology, clinical characteristics, treatment and prognosis of abdominal wall endometriosis, hoping to provide new ideas for the clinical diagnosis and treatment of abdominal wall endometriosis.

Information and methodology

Data source

The data of a total of 228 patients with abdominal wall endometriosis who attended Changzhou Second People's Hospital affiliated with Nanjing Medical University from January 2013 to December 2022 were collected. All of them underwent resection for abdominal wall lesions in our hospital after excluding contraindications to surgery, and postoperative pathology suggested abdominal wall endometriosis. The extent of surgical resection is located at the margin of the lesion about 0.5–1 cm. Complete clinical and follow-up data are available.

All subjects signed an informed consent form before the examination. The retrospective study was approved by the Ethics Evaluation Committee of Changzhou Second People's Hospital affiliated with Nanjing Medical University. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Inclusion and exclusion criteria

Inclusion criteria: 1. age between 18 years and pre-menopausal;2. pathological histological examination suggestive of endometriosis of the abdominal wall;3. complete clinical history of diagnosis and treatment and follow-up information.

Exclusion criteria: (1) History of severe hepatic or renal dysfunction and autoimmune disease; (2) Pregnancy or lactation; (3) History of fibroids, adenomyosis, ovarian endometriosis or other malignant diseases.

Clinical information collection

The patients' age, number of pregnancies and births, number of caesarean sections, latency time, clinical symptoms, surgical history, BMI, CA125, lactate dehydrogenase, alkaline phosphatase, imaging, operation time, bleeding, and hospital stay were recorded. We divided the patients into three groups according to the depth of infiltration of lesion: fascial (infiltration into subcutaneous fat or superficial fascia), rectus abdominis (infiltration into the anterior sheath or muscle), and peritoneal (infiltration into the peritoneum) [6]. Based on whether the lesion was solitary or not, we classified patients into solitary and complex types.

Statistical methods

SPSS 26.0 statistical software was used, and measures conforming to normal distribution were described by $\bar{X} \pm S$. T-test was used for two groups of data, while ANOVA test was used for multiple groups of data. Measures not conforming to normal distribution were described as the median (P25-P75). The Mann-Whitney U test was used for two groups of data and the Kruskal-Wallis test for multiple groups of data. The relationships between two variables were analysed using linear regression correlation analysis, the Person chi-square test for unordered categorical variables, and ROC curves in the predictive model. Difference with $p < 0.05$ was considered statistically significant.

Result

General patient conditions

The mean age of onset was 32.7 ± 4.2 years old (23–51 years old) in the 228 patients with abdominal wall endometriosis. Among them, 226 (99.1%) had a history of caesarean section and 153 (67.7%) underwent a single caesarean section. The surgical scar was a transverse incision of the abdominal wall in 210 patients (92.9%) and a vertical incision of the abdominal wall in 16 (7.1%). Of

the remaining two patients, one had previous surgery for leiomyoma and one had primary abdominal wall heterotaxy. Pain in the abdominal wall scar during cyclic menstruation was the first clinical manifestation in 113 patients (77.9%). A palpable abdominal wall mass was the first symptom in 40 patients (17.5%). Heterotopic foci in the original surgical scar were found at caesarean section in 7 patients (3.4%). Pale bloody discharge from the abdominal wall during menstruation was the first symptom in 1 patient. 2 cases were due to the discovery of ectopic foci in the abdominal wall during ovarian surgery (see Table 1 for details).

Data comparison

Comparison of general information on solitary-type lesions and multiple-type lesions

The total number of solitary-type lesions was 188 (82.5%) and the differences in BMI, operation time, intraoperative bleeding, and postoperative hospital stay were statistically significant ($p<0.05$) compared with complex-type patients.There was no statistically significant difference ($p>0.05$) in age, latency time, duration of symptoms, CA125, LDH, ALP, PT, FIB, and maximum lesion diameter. Statistically significant difference in the number of caesarean sections between patients with multiple lesions and those with single lesions ($p<0.05$).See Table 2 for details.

Comparison of general information on different lesion types

Based on depth of infiltration of the lesions, abdominal wall endometriosis was classified into fascial, rectus abdominis, and peritoneal types. There was no statistically significant difference between the three types in terms of age, BMI, number of caesarean sections, duration of symptoms, LDH, ALP, PT, and FIB ($p>0.05$). The differences in incubation time, maximum diameter of the

Table 1 General information on the condition of patients with internal heterotaxy of the abdominal wall

Features	*n*(%)	X ± S (range)
Age (years)		32.7 ± 4.2(23–51)
BMI(kg/m^2)		22.75 ± 3.65(16.9–38.2)
CA125		27.28 ± 20.45
LDH		154.74 ± 23.14
ALP		60.79 ± 18.18
FIB		2.82 ± 1.67
PT		11.37 ± 0.62
Number of caesarean sections		
1 (case)	153(67.7%)	
≥2 (cases)	73(32.3%)	
Cesarean section incision		
Transverse incision	210(92.9%)	
Vertical incision	16(7.1%)	
Incubation period (years)		3.59 ± 2.04(1–9)
Symptoms to surgery (years)		0.96 ± 0.65
Clinical manifestation		
Cycle pain (cases)	178(78.1%)	
Abdominal masses (cases)	40(17.5%)	
Other symptoms (cases)	10(4.4%)	
Lesion depth		
Fascia type (cases)	99(43.4%)	
Rectus abdominis (cases)	108(47.4%)	
Peritoneal type (cases)	21(9.2%)	
Number of lesions		
Single hair type (cases)	188(82.5%)	
Complex type (cases)	40(17.5%)	
Imaging		
Ultrasound (cases)	218(95.6%)	
MRI (cases)	17(7.5%)	
Curing		
Preoperative drug treatment (cases)	8(3.5%)	
Surgical treatment (cases)	228(100%)	
Intraoperative mesh (cases)	4(1.8%)	
Postoperative medication (cases)	0%	

Table 2 Comparison of patient data for solitary versus complicated abdominal wall endometriosis (using Mann-Whitney U test; one-way ANOVA)

Lesion type	Single-incidence type (188 cases)	Complex (40 cases)	Statistic	*P*
Age (years)	32.81 ± 4.31	32.30 ± 3.79	F = 0.239	0.626
BMI	22.58 (20.8-24.98)	20.99(19.63–22.41)	Z=-2.543	0.011
Number of caesarean sections	1.37 ± 0.508	1.11 ± 0.315	Z=-2.184	0.029
Incubation period (years)	3 (2–5)	4(2–5)	Z=-0.683	0.495
Persistence of symptoms (years)	1 (0–1)	1(0–2)	Z=-1.463	0.143
CA125	20.75 (13.83–31.64)	25.57 (19.34–40.59)	Z=-1.704	0.088
LDH	152 (139–168)	147.45(139.85–162.5)	Z=-0.683	0.567
ALP	57.7 (50–69)	55.2 (47.95–67.9)	Z=-0.349	0.727
PT	11.3 (10.9–11.7)	2.66 (2.31–3.02)	Z=-1.218	0.223
FIB	2.52 (2.31–2.96)	2.66 (2.31–3.02)	Z=-0.936	0.350
Maximum diameter of lesion (cm)	2.5 (2–3)	2.9 (2.0–4.0)	Z=-1.778	0.075
Surgical time (min)	30 (20–45)	52.5 (31.25-75)	Z=-3.545	< 0.01
Bleeding volume (ml)	5 (5–10)	10 (5–10)	Z=-2.558	0.011
Post-operative hospitalisation (days)	4 (3–4)	4.5 (4–5)	Z=-4.109	< 0.01

lesion, CA125 level, operative time, haemorrhage and postoperative hospital stay were statistically significant in patients with the peritoneal type compared with the other two types ($p < 0.05$).See Table 3 for details.

Comparison of information on different incision types

Approximately 173 cases of transverse incision caesarean section were of the solitary type and 37 cases were of the complex type. Among the patients with vertical incision caesarean section, 15 cases were of solitary type and 6 were of complex type. The difference between the two was not statistically significant (see Table 4 for details). Among transverse incision cases, the likelihood of the lesion being on the right side was slightly higher than on the left side (see Table 5 for details).

Linear regression relationship between lesion diameter and clinical indicators

The maximum diameter of the lesion was related to the operation time, bleeding, postoperative hospital stay, latency time, CA125, and the type of lesion (see Table 6 for details). All of them showed a linear relationship (see Fig. 1).

Imaging

The 218 patients underwent preoperative ultrasound examination of the abdominal wall, and 17 of them were also given MRI examination. By comparing the ultrasound, surgical, and MRI data, we found no significant differences between the three in determining the maximum diameter of the lesion and whether the lesions were multiple ($p > 0.05$). There was a statistical difference in determining the depth of the lesion ($p < 0.05$) (see Table 7 for details).

Prediction

We used ROC curve for combined ultrasound and CA125 for prediction of peritoneal versus non-peritoneal lesions. The cut-off value was 25.27 U/ml, at which point the sensitivity was 88.9%, the specificity 97.6%, and the Yoden index 0.865.

Drug therapy, prognosis, and relapse

Eight patients were treated conservatively with GnRH-a medication prior to surgery, and after 3 courses of treatment, the size of the abdominal wall lesions decreased compared with that before medication, with no significant improvement in symptoms. Symptoms worsened after medication stopped and all of them were admitted to hospital for surgical treatment. All surgical patients

Table 3 Comparison of general data of patients with different lesion types (Kruskal-Wallis test; one-way ANOVA)

Lesion type	Fascial type	Rectus abdominis type	Peritoneal	Statistic	*P*
Age (years)	32.41 ± 3.86	32.80 ± 4.82	33.73 ± 2.05	F = 0.454	0.636
BMI	22.21	21.91	21.83	χ2 = 0.362	0.834
Number of caesarean sections	1.39 ± 0.492	1.28 ± 0.455	1.27 ± 0.647	χ2 = 1.911	0.385
Incubation period (years)	3 (2-4.5)	3 (2–5)	4 (4–6)	χ2 = 4.757	0.045
Persistence of symptoms (years)	1 (0–1)	0.5 (0–1)	2 (1–2)	χ2 = 6.196	0.093
CA125	14.75(11.31–25.86)	25.57(18.85–37.7)	35.96(19.87–62.60)	χ2 = 21.209	0.000
LDH	153(142-167.75)	149(138.2–168)	144.15(137.1-168.2)	χ2 = 1.647	0.439
ALP	57.85(53.08–70.08)	55 (45.9–68)	55.2(44.73–62.9)	χ2 = 1.677	0.432
PT	11.3 (10.9–11.7)	11.4(11.1–11.7)	11.45(10.93–11.55)	χ2 = 0.227	0.893
FIB	2.52 (2.27–3.02)	2.29(2.34–2.95)	2.57 (2.3–3.05)	χ2 = 0.025	0.987
Maximum diameter of lesion (cm)	2.0 (1.65-3.0)	2.5(2.0-3.125)	3.0 (2.5-4.0)	χ2 = 10.395	0.006
Surgical time (min)	30 (17.5–45)	35 (25–50)	55 (30–75)	χ2 = 9.522	0.009
Bleeding volume (ml)	5 (5–10)	5 (5–10)	10 (5–10)	χ2 = 6.824	0.033
Post-operative hospitalisation (days)	3 (3–3)	4 (4–4)	5 (5–6)	χ2 = 56.649	< 0.01

Table 4 Effect of Cesarean section incision orientation on lesion type (Person's chi-square test)

Direction of incision	Number of examples	Floppy	Complex type	Chi-square value	*P*
Transverse incision	210	173(82.4%)	37(17.6%)	1.374	0.241
Vertical incision	16	15 (93.8%)	1 (6.2%)		

Table 5 Location of lesions at different incisions

Direction of incision	Lesion location	Counting
Transverse incision	total	210(100%)
	left side	92(43.8%)
	interlocutory	4(1.9%)
	right side	114(54.3%)
Vertical incision	(grand) total	16(100%)
	top	4(25%)
	interlocutory	4(25%)
	bottom	8(50%)

Table 6 Linear regression relationship between lesion size and general patient information

Lesion size	Post-operative length of stay	Intraoperative bleeding	Surgical time	CA125	Incubation period	Age	Type of lesion
R^2	0.1718	0.1224	0.2571	0.092	0.06455	0.04178	0.0806
P-value	0.00	0.00	0.00	0.003	0.007	0.0292	0.002

received no medication treatment after surgery. During postoperative follow-up (11–131 months), except 49 patients who were lost to follow-up, 6 of the 179 patients (3.4%) had a recurrence. Among them, 4 cases were treated with surgery in other hospitals, 1 case was not treated due to minor symptoms, and 1 case was treated conservatively with medication.

Discussion

Endometriosis usually affects the pelvic organs (e.g. ovaries, uterine ligaments), but in about 1–5 per cent of cases it can occur in rare sites such as the lungs, diaphragm, abdominal wall, brain and even the extremities [1, 2]. Clinical manifestations of pleuropulmonary endometriosis are usually cyclical pneumothorax or coughing

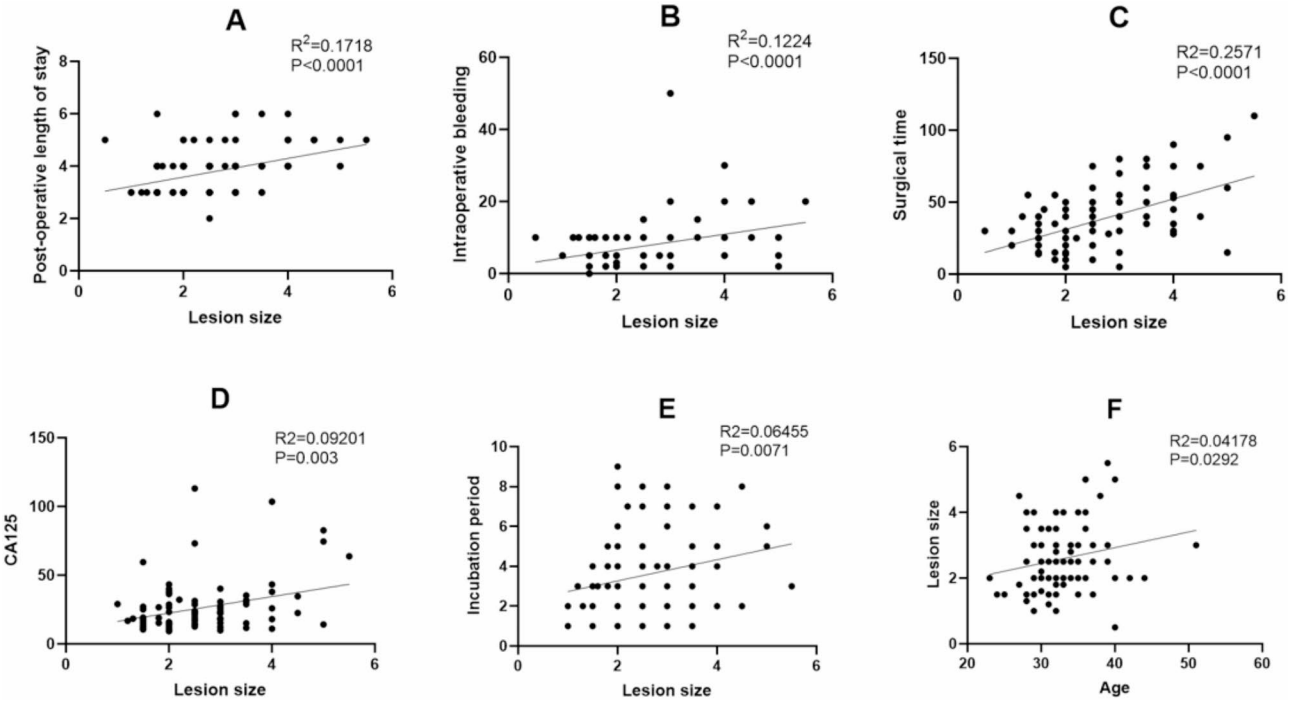

Fig. 1 Linear regression of lesion size with CA125, operation time, bleeding, postoperative hospital stay, age, and focus of infection range

Table 7 Comparison of imaging general patient data

General information	Ultrasound	Nuclear magnetic resonance (NMR)	Surgeries	*P*
Maximum lesion diameter (cm)	2.43 ± 1.11	2.53 ± 1.07	2.4 ± 1.16	0.961
Lesion depth				0.02
Fascial type (cases)	6(23.5%)	1(5.9%)	2(11.8%)	
Rectus abdominis muscle (cases)	10(70.6%)	10(58.8%)	10(58.8%)	
Peritoneal type (cases)	1(5.9%)	6(35.3%)	5(29.4%)	
Number of lesions				0.382
Single-shot	15(88.2%)	12(70.6%)	12(70.6%)	
Frequent	2(11.8%)	5(29.4%)	5(29.4%)	

up blood, which may coincide with the menstrual cycle, while endometriosis of the brain is extremely rare and may cause epilepsy or cyclical headaches [4]. The pathogenesis of these specialised areas is inconclusive, but most scientists believe that they develop as a result of a combination of theories in which immune dysfunction may play a key role [7]. The main theories are currently classified as retrograde menstrual flow and corpora cavernosa epithelial chemotaxis, vascular/lymphatic spread, immune regulatory abnormalities, stem cell theories and so on [7, 8]. The classic Sampson theory suggests that retrograde menstrual blood flow leads to implantation of endometrial cells, but does not fully explain thoracic or intracranial lesions. The abnormal immune regulation hypothesis is the mechanism thought to be central to the progression of endometriosis. This hypothesis suggests that there is a failure of immune surveillance in the patient, with a decline in the function of natural killer cells (NK cells), which are unable to effectively eliminate ectopic endometrial cells [9]; also that the inflammatory microenvironment in vivo, with the predominant polarisation of M2-type macrophages to promote angiogenesis and pro-inflammatory factors such as IL-6 and TNF-alpha to maintain the activity of the lesion; and that the production of autoantibodies may lead to immune escape by molecular mimicry of the attacking ectopic tissue [10].

The mechanism of endometriosis formation in the abdominal wall is not clear, and there are theories of local implantation, epithelial metaplasia, lymphatic, or blood dissemination [11]. Among them, the local implantation doctrine proposed by Sampson et al. is now widely accepted in clinical practices. This doctrine suggests that when patients with AWE undergo caesarean section or other uterine surgery, the endothelial tissue is implanted into the abdominal wall wounds, causing a local focal inflammatory response with hormonal fluctuations. 99.6% of patients in this study had a history of related surgery, which is consistent with the study by Zhang et al.

[12–14] and in line with this type of doctrine. In patients with primary AWE, epithelial hyperplasia, lymphatic or blood dissemination can better explain its formation.

The typical triad of AWE: history of previous caesarean section, localised abdominal mass, and cyclical pain [15]. Recent clinical studies confirmed caesarean section as an independent risk factor for AWE [16]. In this study, 99.1% of patients had a history of caesarean section, 178 patients (78.1%) had cyclical pain as the first symptom, and 40 patients (17.5%) had abdominal wall mass as the first symptom. Not all patients with AWE had this symptom. One patient in our study was admitted for menstrual fluid discharge from a primary abdominal wall wound, and nine were asymptomatic but confirmed due to other intraoperative findings. The local abdominal mass size may increase with the menstrual cycle, and the local skin colour changed to dark red in some patients [15]. Symptoms were different for lesions in different locations. Based on depth of infiltration of the lesions, abdominal wall endometriosis was classified into fascial, rectus abdominis, and peritoneal types. The first two are more common in the clinic and their clinical manifestations are more obvious. Patients of the peritoneal type often present localised wound discomfort because the lesion was deeper. In addition, this study found that the latency time of this type was also longer than the other two, which is also consistent with the study by Jiang et al. [17].

In addition to general physical examination, imaging is one of the most important modalities used clinically to diagnose AWE. Recent studies suggest that the diagnostic accuracy of abdominal ultrasound in AWE is 73.2–96.3% [18]. In this case, a total of 218 patients underwent preoperative abdominal ultrasound examinations, and all were consistent with postoperative pathology. Ultrasound can clearly delineate the border between the lesion and the surrounding tissue, and blood flow visualisation can show striated or punctate blood flow in or around the lesion [19]. It is widely used for preoperative diagnosis because it is convenient, non-invasive, and inexpensive. However, it is difficult to diagnose the extent and depth of lesion involvement using ultrasound. In this study, we compared the lesion with ultrasound and nuclear magnetic resonance (NMR) and found that NMR achieved better accuracy. In addition, when ultrasound cannot clearly diagnose the type of lesion, MRI proves to be more advantageous [20]. Apart from preoperative MRI to identify the depth of lesions, this study, like Guo et al. [21], found that CA125 is statistically significant for peritoneal lesions compared with the non-peritoneal types ($p < 0.05$). Using ROC curve for combined ultrasound examinations, we considered that the cut-off value was 25.27 U/ml, at which the clinical sensitivity and specificity reached the highest levels.

The main treatments for AWE are medication, surgery, cryoablation and high-intensity focused ultrasound(HIFU) [6].Cryoablation and HIFU are two emerging minimally invasive or non-invasive techniques for the clinical management of abdominal wall endometriosis. Cryoablation destroys the ectopic lesion using low temperature (-40℃ to -100℃), resulting in cellular ice crystal formation, membrane rupture and local ischaemic necrosis. It is suitable for patients with superficial lesions and clear localisation, but there are some risks such as nerve damage, skin frostbite and residual recurrence [22]. HIFU uses ultrasound to focus on the lesion, generating a high temperature of more than 65 ℃ to cause coagulative necrosis of the tissue, and it is suitable for patients with clear boundaries of the lesion, rich blood supply and not too deep location of the lesion, but there are some risks such as skin burns, pain and higher cost. Due to the narrower indications of these two modalities, their clinical use is still subject to certain limitations and long-term follow-up is required [23].

Pharmacological treatment includes progestins, short-acting contraceptives, and gonadotropin-releasing hormone analogues. Pharmacological treatment is usually less effective because the lesion is encapsulated by connective tissue.However, some researchers have suggested that preoperative medication can control symptoms and reduce the size of the lesion, facilitating surgery [24]. In this study, 8 patients were treated conservatively with GnRH-a, but the results were less satisfactory. Therefore, conservative treatment with medication is usually reserved in clinical practices for patients with contraindications to surgery. Surgery is the most important way to prevent recurrence of AWE, and whether or not the lesion can be completely removed during surgery largely determines whether AWE will recur. Surgery is usually performed through an incision in the original abdominal wall, and an ultrasonic knife is used to make a complete resection 0.5–1 cm from the edge of the lesion, and the existing scar on the abdominal wall should also be removed. For deeper infiltration of lesions, such as rectus abdominis or peritoneal lesions, placement of a drain after surgery may be considered to aid wound healing. For large, high-tensile lesions that are difficult to suture, we generally use intraoperative patch placement to cover the defect, reduce local tension, and beautify the wound. In this study, four patients with peritoneal lesions > 5 cm in diameter received intraoperative patches and postoperative negative pressure drainage, and the wounds healed well [25]. The maximum diameter of intraoperative peritoneal lesions was found to be significantly larger than that in the other two types. We believe that this should be due to its deeper location, longer latency time, and richer peritoneal blood supply. In addition, the operation time, intraoperative bleeding, and postoperative

hospital stay were statistically significant for this type. Therefore, patients with peritoneal abdominal wall endometriosis should be better prepared for surgery to better remove the lesions during surgery. Regarding whether postoperative medication should be used as a preventive measure, studies have shown that such medication won't reduce the recurrence rate [26, 27]. In this paper, 228 patients were not treated with postoperative prophylaxis and the recurrence rate after surgery was only 3.4%. There was no significant difference in AWE recurrence rate from that of postoperative medication. High-intensity focused ultrasound is a new clinical tool currently used to treat AWE. This treatment option has now been shown to be superior to traditional surgical methods in terms of operation time and bleeding. However, it can cause some damage to the surrounding tissues and has narrower indications, and the current clinical trial is relatively small, which requires further research [28].

To prevent AWE, the clinic should first control the rate of caesarean section and the indication for surgery. Isolation measures should be employed during surgery, such as placing sterile gauze or incision protectors over the wound, repeated irrigation of the pelvis and wound after suturing the uterus to avoid local endothelial implantation, and avoiding using the same suture when suturing the uterine incision and other tissues [29, 30]. AWE is most common in fascial and rectus abdominis types and occurs on both sides of the wound. It may be related to the limitations of the operation, resulting in the ease of implantation of endothelial tissue compared to other sites. Therefore, repeated irrigation prior to closure of the abdomen to release only the fascial layer is important. It has been suggested that by comparing cesarean transverse incision with straight incision, the latency time of straight incision is longer than that of transverse incision. It was suggested that straight incision in cesarean section is better than transverse incision for prevention of AWE [10]. This study compared the latency time between the two, 3.6 ± 2.02 years for straight incision and 3.5 ± 2.33 years for transverse incision, and found the difference to be statistically insignificant ($p > 0.05$). It was therefore concluded that the two approaches won't increase the likelihood of AWE, and a larger amount of data is still needed for further research.

In conclusion, with the increasing caesarean section rate in recent years, the incidence of AWE has gradually stepped up, so we are taking good intraoperative non-neoplasma measures. For patients with a clinical history of uterine surgery, abdominal wall mass, and cyclical pains, AWE should be highly suspected. In addition to ultrasound, CA125, and other auxiliary examinations, surgical treatment should be adopted earlier to avoid further increase of the lesion. The study sample in this paper is relatively small and the conclusions need to be confirmed by a larger amount of data.

Abbreviations

AWE	Abdominal wall endometriosis
NMR	Nuclear magnetic resonance
BMI	Body Mass Index
ALP	Alkaline phosphatase
PT	Prothrombin Time
FIB	Fibrinogen
HIFU	High-intensity focused ultrasound

Author contributions

Qiucheng Jia, Huimin Tang: Conception & Design of Study; Data Collection; Data Analysis & Interpretation; Responsible Surgeon or Imager; Statistical Analysis; Manuscript Preparation; Patient Recruitment; Wanying Chen, Weiwei Wei, Hong Zheng: Conception & Design of Study; Data Analysis & Interpretation; Arong Liu, Jiming Chen: Conception & Design of Study; Data Collection; Data Analysis & Interpretation; Responsible Surgeon or Imager; Statistical Analysis; Manuscript Preparation; Patient Recruitment.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

All subjects signed an informed consent form before the examination. The retrospective study was approved by the Ethics Evaluation Committee of Changzhou Second People's Hospital affiliated with Nanjing Medical University. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. Taylor HS, Kotlyar AM, Flores VA. Endometriosis is a chronic systemic disease: clinical challenges and novel innovations. Lancet. 2021;397(10276):839–52. https://doi.org/10.1016/S0140-6736(21)00389-5.
2. Bulun SE, Yilmaz BD, Sison C, et al. Endometr Endocr Rev. 2019;40(4):1048–79. https://doi.org/10.1210/er.2018-00242.
3. Allaire C, Bedaiwy MA, Yong PJ. Diagnosis and management of endometriosis. CMAJ. 2023;195(10):E363–71. https://doi.org/10.1503/cmaj.220637.
4. Mehedintu C, Plotogea MN, Ionescu S, Antonovici M. Endometriosis still a challenge. J Med Life. 2014;7(3):349–57.
5. Carsote M, Terzea DC, Valea A, Gheorghisan-Galateanu AA. Abdominal wall endometriosis (a narrative review). Int J Med Sci. 2020;17(4):536–42. https://doi.org/10.7150/ijms.38679. Published 2020 Feb 10.
6. Qiu Lingbing L, Jinbo C. Shuqin. Research progress of endometriosis in the abdominal wall[J]. Int J Obstet Gynecol 2023,50(05):545–9.
7. Rolla E. Endometriosis: advances and controversies in classification, pathogenesis, diagnosis, and treatment. F1000Res. 2019;8:F1000 faculty Rev-529. Published 2019 Apr 23. https://doi.org/10.12688/f1000research.14817.1

8. Mignemi G, Facchini C, Raimondo D, Montanari G, Ferrini G, Seracchioli R. A case report of nasal endometriosis in a patient affected by Behcet's disease. J Minim Invasive Gynecol. 2012;19(4):514–6. https://doi.org/10.1016/j.jmig.2012.03.005.
9. Alsahabi J, Dendini M, Al-Zahrani EF, Alosiami A, Bamanie E. Paraurethral endometriosis as a common pathology in an uncommon location: A case report and a review of the literature. Cureus. 2023;15(2):e35024. https://doi.org/10.7759/cureus.35024. PMID: 36938183; PMCID: PMC10022841.
10. Koninckx PR, Ussia A, Adamyan L, Wattiez A, Gomel V, Martin DC. Pathogenesis of endometriosis: the genetic/epigenetic theory. Fertil Steril. 2019;111(2):327–40. https://doi.org/10.1016/j.fertnstert.2018.10.013. Epub 2018 Dec 7. PMID: 30527836.
11. Horton JD, Dezee KJ, Ahnfeldt EP, Wagner M. Abdominal wall endometriosis: a Surgeon's perspective and review of 445 cases. Am J Surg. 2008;196(2):207–12. https://doi.org/10.1016/j.amjsurg.2007.07.035.
12. Zhang P, Sun Y, Zhang C et al. Cesarean scar endometriosis: presentation of 198 cases and literature review. BMC Womens Health. 2019;19(1):14. Published 2019 Jan 18. https://doi.org/10.1186/s12905-019-0711-8
13. Chen YWYW, Lin, et al. Analysis of clinical factors associated with 501 cases of abdominal wall endometriosis[J]. Progress Mod Obstet Gynecol. 2023;32(10):768–71. https://doi.org/10.13283/j.cnki.xdfckjz.2023.10.032.
14. Li R, Shi Shaole Z, Hui et al. Clinical analysis of 241 cases of endometriosis in the abdominal wall[J]. Progress Mod Obstet Gynecol 2021,30(07):508–13.https://doi.org/10.13283/j.cnki.xdfckjz.2021.07.038
15. ZHANG Wen,Leng Jinhua. Research progress in the diagnosis and treatment of endometriosis in the abdominal wall[J]. Progress Mod Obstet Gynecol 2019,28(05):391–2.https://doi.org/10.13283/j.cnki.xdfckjz.2019.05.017
16. Foley CE, Ayers PG, Lee TT. Abdominal wall endometriosis. Obstet Gynecol Clin North Am. 2022;49(2):369–80. https://doi.org/10.1016/j.ogc.2022.02.013.
17. Mengyu JIANG, Liuxia LI, Ying ZHU. Analysis of clinical characteristics and prognosis of 231 cases of abdominal wall endometriosis[J]. Chin J Practical Gynecol Obstet 2020,36(04):361–4.https://doi.org/10.19538/j.fk2020040116
18. Gong Xiaorong. Colour doppler ultrasound performance and diagnostic value of endometriosis in the abdominal wall[J]. Chin J Clin Med Imaging 2011,22(05):365–6.
19. Xu Y. Analysis of the diagnostic value of colour ultrasound on endometriosis in the abdominal wall[J]. China Mod Drug Application 2022,16(08):67–9.https://doi.org/10.14164/j.cnki.cn11-5581/r.2022.08.024
20. Chamié LP, Ribeiro DMFR, Tiferes DA, Macedo Neto AC, Serafini PC. Atypical sites of deeply infiltrative endometriosis: clinical characteristics and imaging findings. Radiographics. 2018;38(1):309–28. https://doi.org/10.1148/rg.2018170093.
21. Guo Ailian M, Dehua L, Caixia, et al. Pathogenesis characteristics and clinical diagnosis and treatment of 197 patients with endometriosis in the abdominal wall[J]. Shandong Med. 2021;61(04):69–71.
22. Welch BT, Ehman EC, VanBuren WM, Cope AG, Welch TL, Woodrum DA, Kurup AN, Burnett TL. Percutaneous cryoablation of abdominal wall endometriosis: the Mayo Clinic approach. Abdom Radiol (NY). 2020;45(6):1813–1817. https://doi.org/10.1007/s00261-019-02379-4. PMID: 31894380.
23. Cheng H, Zhu X, He Y, Liu M, Xue M, Sun X. Efficacy and influencing factor analysis of high-intensity focused ultrasound therapy for abdominal wall endometriosis: a case series. Int J Hyperth. 2024;41(1):2320416. Epub 2024 Feb 27. PMID: 38413385.
24. Rindos NB, Mansuria S. Diagnosis and management of abdominal wall endometriosis: A systematic review and clinical recommendations. Obstet Gynecol Surv. 2017;72(2):116–22. https://doi.org/10.1097/OGX.0000000000000399.
25. Deng Shan L, Jinhua. Lang Jinghe, feasibility analysis of preoperative predictive patching for abdominal wall endometriosis[J]. Int J Obstet Gynecol 2013,40(04):364–8.
26. Jiang Mengyu. Diagnosis, treatment and prognosis analysis of endometriosis in the abdominal wall[D]. Zhengzhou Univ 2021 DOI:https://doi.org/10.27466/d.cnki.gzzdu.2020.004473
27. Zhang Lu Z, Junda, Zhang S et al. Clinical analysis of 496 cases of endometriosis in the abdominal wall[J]. Progress Mod Obstet Gynecol 2017,26(08):599–602.https://doi.org/10.13283/j.cnki.xdfckjz.2017.08.009
28. Wang Sha D. Hua. Comparative study on the efficacy of high-intensity focused ultrasound ablation and surgical excision for the treatment of endometriosis in the abdominal wall[J]. Int J Obstet Gynecol 2023,50(03):261–5.
29. Qiang WEI, Xinghui LIU. Tumour-free defence issues in caesarean section - prevention of endometriosis in the abdominal wall[J]. Chin J Practical Gynecol Obstet 2023,39(01):31–4.https://doi.org/10.19538/j.fk2023010110
30. Poismans G, Tolbize N, Gielen F, Lipombi D, PRÉVENTION DE L'ENDOMÉTRIOSE, PARIÉTALE POST-CÉSARIENNE [POST-CAESAREAN ABDOMINAL WALL ENDOMETRIOSIS PREVENTION]. Rev Med Liege. 2016;71(4):193–7.

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