SHORT COMMUNICATION

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Adenomyosis and dysmorphic uterus: is there a correlation? Analysis of reproductive outcomes after hysteroscopic metroplasty

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ABSTRACT

Hysteroscopic metroplasty improves reproductive outcomes in women with a dysmorphic uterus, but the impact of adenomyosis in these patients is uncertain. We retrospectively analysed 69 women who underwent metroplasty for a dysmorphic uterus, with histological assessment of the excised tissue. Adenomyosis was more frequently identified at histology in patients with recurrent pregnancy loss compared to those with infertility/single miscarriage (54% vs. 27%, *P*=0.03). Following surgery, the clinical pregnancy rate in the overall cohort reached 65%, and the live birth rate (LBR) per pregnancy increased from 0% to 62% (*P*<0.01). Among patients with histological evidence of adenomyosis, the LBR was 43%, compared to 71% in those without adenomyosis (*P*=0.07). Hysteroscopic metroplasty appears to improve reproductive outcomes overall. Larger, prospective studies are needed to better define the role of adenomyosis in this patient population.

Keywords: Adenomyosis, metroplasty, recurrent pregnancy, uterus

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Introduction

The T-shaped uterus is a rare Müllerian anomaly first described by Kaufman in 1977 in women exposed to diethylstilbestrol (DES).[1] It is now classified as U1a within the broader category of dysmorphic uteri in the European Society of Human Reproduction and Embryology - European Society for Gynaecological Endoscopy (ESHRE-ESGE) system, alongside two other subtypes.[2] These anomalies are often associated with adverse reproductive outcomes, including infertility and recurrent pregnancy loss (RPL).[3] Proposed mechanisms include altered myometrial architecture, reduced uterine volume, and constriction rings that impair receptivity, implantation, and uterine expansion.[4] Although initially linked to DES exposure, cases are still reported in the post-DES era, suggesting alternative aetiologies, including acquired conditions such as adenomyosis.[3,5]

Adenomyosis has recently gained attention in the context of infertility. Mechanisms proposed include distortion of the uterine cavity, abnormal uterine peristalsis, altered sex steroid pathways, increased inflammation, impaired adhesion molecule expression, and dysfunction of implantation-related genes.[6] Junctional zone involvement has been linked to higher pregnancy loss rates.[7,8] Severe adenomyosis can even mimic the ultrasonographic appearance of a T-shaped uterus, raising questions about overlap with congenital anomalies, although data are still controversial.[5,9]

Hysteroscopic metroplasty has been shown to improve reproductive outcomes in women with dysmorphic uteri.[10] A newer technique using a bipolar 15 Fr mini-resectoscope allows reshaping of the uterine cavity while providing tissue for histological analysis, creating an opportunity to investigate coexisting uterine wall abnormalities and their contribution to reproductive dysfunction.[11]

The aim of this study was to assess the histological prevalence of adenomyosis in tissue excised during metroplasty for dysmorphic uterus in women with adverse reproductive outcomes and to evaluate obstetrical outcomes following the surgical procedure.

Methods

This retrospective observational cohort study was conducted at the Digital Hysteroscopic Clinic, Class Hysteroscopy, Fondazione Policlinico Gemelli in Rome, between January 2021 and January 2024. Eligible women had a confirmed diagnosis of dysmorphic uterus and a history of either RPL or infertility/single miscarriage. They all underwent hysteroscopic metroplasty.

Infertility was defined as no conception after ≥12 months of unprotected intercourse, and RPL as ≥2 consecutive pregnancy losses before 24 weeks.

Diagnosis of dysmorphic uterus was based on ESHRE/ESGE criteria (a narrow uterine cavity with thickened lateral walls) and fulfilment of at least two of the three CUME criteria (lateral indentation angle ≤ 130°, lateral wall thickness ≥7 mm, and T-angle ≤40°), acknowledging that discrepancies exist among current diagnostic systems for T-shaped uterus.[2,12,13] Y-shaped uteri were also included.[14]

All procedures were performed by a single experienced surgeon (UC) using a standardised minimally invasive technique with a bipolar 15 Fr mini-resectoscope (Karl Storz, Tuttlingen) under general anaesthesia. A Collins bipolar loop was used to incise the lateral walls and, when needed, the fundus; redundant fibromuscular tissue was then excised with a 90° angled loop.[11] Patients received one month of progestin pretreatment and underwent post-operative assessment with two-dimensional/three-dimensional ultrasound and office hysteroscopy at 30-40 days.

Adenomyosis was assessed by ultrasound (MUSA criteria) and confirmed histologically in excised tissue.[15] Other histological abnormalities were also recorded. Pre-operative and post-operative reproductive outcomes, including clinical pregnancy rate (CPR), live birth rate (LBR), and miscarriage rate (MR), were assessed. CPR was defined as any pregnancy confirmed by ultrasound for each woman. LBR was defined as the delivery of a live infant after 24 completed weeks of gestation, calculated per number of pregnancies. MR was defined as the spontaneous loss of a clinical pregnancy before 24 completed weeks of gestation, also calculated per number of pregnancies.

Descriptive statistics were applied; categorical variables were compared using chi-square or Fisher's exact test, and continuous variables with the Mann–Whitney U test. The agreement between ultrasound and histology for adenomyosis was assessed using Cohen's kappa. Pre- and post-operative outcomes were compared using the McNemar test. The association between adenomyosis and LBR was evaluated using univariate logistic regression, with results reported as odds ratios (ORs) and 95% confidence intervals (CIs). Analyses were performed

with NCSS v11 (Kaysville, Utah, USA). A *P* value <0.05 was considered significant.

The study was approved by the Ethics Committee of the "Comitato Etico Territoriale Lazio Area 3" (protocol number: 0001534/24, date: 11.09.2024; ClinicalTrials.gov ID NCT06610864). All participants provided written informed consent.

Results

Seventy-nine consecutive women with dysmorphic uterus were recruited; ten were excluded as they did not plan pregnancy postoperatively. Baseline and surgical characteristics are shown in Table 1. The mean age was 35.9±4.7 years; 47 women (68%) had infertility/single miscarriage, and 22 (32%) had RPL. On ultrasound, 34 patients (49%) exhibited at least one direct MUSA feature of adenomyosis, most commonly myometrial cysts. Indirect features alone were present in 21 women (31%), most frequently asymmetric wall thickening. Thirty-four uteri (49%) were classified as T-shaped and 35 (51%) as Y-shaped. Mean operative time was 24.8±9.8 minutes, with no complications. A normal, triangular uterine cavity was achieved in all cases.

Histological examination revealed adenomyosis in 25/69 patients (36%), as shown in Table 2. Prevalence was significantly higher in the RPL group (54%, 12/22) compared with infertility/single miscarriage (27%, 13/47; *P*<0.05). Leiomyomuscular hyperplasia was the most frequent additional abnormality, observed in 8/22 RPL (36%) and 24/47 infertility/single miscarriage patients (51%). Concordance between ultrasound and histology for adenomyosis was poor (Cohen's kappa 0.156).

After a median follow-up of 21 months, reproductive outcomes were assessed (Table 3). The overall CPR was 65% (45/69) and the LBR per pregnancy was 62% (28/45), a significant increase compared with preoperative rates (*P*<0.01). Seven ongoing pregnancies were recorded at the last follow-up. Overall, 53% of pregnancies occurred spontaneously and 47% through Assisted Reproductive Technology (ART). Caesarean delivery occurred in 35% of cases; no uterine rupture, placenta accreta, or cervical incompetence was reported. Two obstetrical complications (postpartum haemorrhage, placental abruption at 36 weeks) were managed without sequelae.

Among patients with histological evidence of adenomyosis, the LBR was 43%, compared to 71% in those without adenomyosis (*P*=0.07).

The LBR per pregnancy increased from 0% to 43% after metroplasty (*P*<0.05), with a LBR of 66% in women with infertility/single miscarriage and 25% in those with RPL. Although the LBR increased in women with adenomyosis, the improvement was less pronounced than in the non-adenomyosis subgroup, with 43% (6/14) vs. 71% (22/31), respectively. Similar to the adenomyosis group, the non-adenomyosis group also showed a better postsurgical LBR in women with infertility/single miscarriage compared to those with RPL (73% vs. 67%).

Logistic regression showed no significant predictors of LBR, although adenomyosis approached significance (*P*=0.07, OR: 0.31, 95% CI: 0.08-1.14).

Discussion

To our knowledge, this is the first study to specifically investigate the histological prevalence of adenomyosis in women with dysmorphic uterus undergoing metroplasty. The availability of excised endomyometrial tissue enabled systematic histological assessment, which has rarely been performed in this context. All procedures were conducted using a standardised, minimally invasive hysteroscopic technique, strengthening the consistency of the findings.

The study has several limitations. Its retrospective, single-centre design reduces generalisability, and the relatively small sample size, without a formal calculation, limits statistical power. The median follow-up of 21 months, although comparable to other series, does not allow long-term outcomes to be assessed.[16-18] Histological analysis was restricted to excised redundant tissue, so adenomyosis confined to deeper myometrium may have been missed, in line with the poor concordance between ultrasound and histology (Cohen's kappa 0.156). A control group was lacking, and post-surgical management was not standardised, with patients pursuing either spontaneous conception or ART. This heterogeneity reflects clinical practice but may influence outcomes.

Despite these limitations, our data provide useful insights. The higher prevalence of adenomyosis in women with RPL is consistent with reports of an association with pregnancy loss.[19] Adenomyosis has been linked to impaired implantation through disruption of the junctional zone, aberrant peristalsis, altered hormonal pathways, increased inflammation, and reduced endometrial receptivity.[6] Involvement of the junctional zone has been associated with higher MRs, underscoring its critical role in embryo implantation and placentation.[6] In our series,

Table 1. Baseline and surgical features of the study population.

	Total (n=69)	**Histological adenomyosis (n=25)**	**Non-histological adenomyosis (n=44)**	***P* value**
Age at surgery (years, mean±SD)	35.9±4.7	37.8±4.6	35±4.7	<0.05
BMI (kg/m^2, mean±SD)	22.6±3.6	22.6±3.7	22.5±3.6	0.43
Indications for surgery, n (%)				
Recurrent pregnancy loss (≥2)	22 (32)	11 (44)	11 (25)	0.11
Infertility or a single miscarriage	47 (68)	14 (56)	33 (75)	
Subtype of dysmorphic uteri, n (%)				
T-shaped	34 (49)	17 (68)	26 (59)	0.6
Y-shaped	35 (51)	8 (32)	18 (41)	
I-shaped	0 (0.0)	0 (0.0)	0 (0.0)	
Ultrasonographic features of adenomyosis (according to MUSA Consensus), n (%)				
No	14 (20)	3 (12)	11 (25)	0.23
Yes	55 (80)	22 (88)	33 (75)	
Direct features	34 (49)	15 (60)	19 (43)	
Indirect features	21 (31)	7 (28)	14 (32)	
Direct features				
Hyperechogenic islands	14 (20)	5 (20)	9 (20)	NA
Echogenic subendometrial lines/buds	2 (3)	2 (8)	0 (0)	0.30
Myometrial cysts	29 (42)	12 (48)	17 (39)	0.46
Indirect features				
Asymmetrical thickening	46 (67)	17 (68)	29 (66)	NA
Fan-shaped shadowing	22 (32)	9 (36)	13 (29)	0.60
Trans lesional vascularity	11 (16)	6 (24)	5 (11)	0.18
Irregular junctional zone	14 (20)	5 (20)	9 (20)	NA
Interrupted junctional zone	8 (12)	7 (28)	1 (2)	**<0.05**
Surgical time (min, mean±SD)	24.8±9.8	23.2±9.1	25.9±9.8	0.15
Second surgical step, n (%)				
Yes	1 (1.5)	1 (4)	0	0.34
No	54 (78)	18 (72)	36 (82)	
Fundal and/or lateral cuts (second-look hysteroscopy)	14 (20)	6 (24)	8 (18)	
Endometrial preparation, n (%)				
Yes	59 (86)	22 (88)	37 (84)	0.73
No	10 (14)	3 (12)	7 (16)	

SD: Standard deviation, BMI: Body mass index, min: Minimum, NA: Not applicable.

Table 2. Histological findings.

Histological findings (n=69)			
Histology, n (%)	**RPL (n=22)**	**Infertility/single miscarriage (n=47)**	***P* value**
Adenomyosis	12 (54)	13 (27)	0.03
Leiomuscular hyperplasia	8 (36)	24 (51)	0.377
Vascular congestion	4 (18)	7 (15)	0.734
Vascular hyperplasia	2 (9)	3 (6)	0.925
Sclerosis	2 (9)	9 (19)	0.477
Inflammation	0 (0)	1 (2)	1.0
Fibroids/leiomyoma	1 (4.5)	0 (0)	0.318

RPL: Recurrent pregnancy loss.

Table 3. Reproductive outcomes stratified by primary surgical indication (RPL or infertility/single miscarriage) and histological presence or absence of adenomyosis.

Reproductive outcomes	**Subgroup RPL (n=22)**			**Subgroup infertility/single miscarriage (n=47)**			**Overall population (n=69)**		
	Before	**After**	***P***	**Before**	**After**	***P***	**Before**	**After**	***P***
CPR (n, %)	22/22 (100)	17/22 (77)	/	15/47 (32)	28/47 (60)	<0.01	37/69 (53)	45/69 (65)	/
LBR per pregnancy (n, %)	0/22 (0)	8/17 (47)	<0.01	0/15 (0)	20/28 (71)	<0.01	0/37 (0)	28/45 (62)	<0.01
MR per pregnancy (n, %)	22/22 (100)	5/17 (29)	<0.05	15/15 (100)	5/28 (18)	<0.01	37/37 (100)	10/45 (22)	<0.01
Ongoing per pregnancy (n, %)	-	4/17 (24)	-	-	3/28 (11)	-	-	7/45 (16)	-
Hystological adenomyosis (n=25)									
CPR (n, %)	12/12 (100)	8/12 (67)	/	4/13 (31)	6/13 (46)	0.42	15/25 (60)	14/25 (56)	/
LBR per pregnancy (n, %)	0/12 (0)	2/8 (25)	<0.05	0/4 (0)	4/6 (66)	<0.05	0/15 (0)	6/14 (43)	<0.05
MR per pregnancy (n, %)	12/12 (100)	4/8 (50)	<0.05	4/4 (100)	1/6 (17)	<0.05	15/15 (100)	5/14 (36)	<0.05
Ongoing per pregnancy (n, %)	-	2/8 (25)	-	-	1/6 (17)	-	-	3/14 (21)	-
No adenomyosis (n=44)									
CPR (n, %)	10/10 (100)	9/10 (90)	/	11/34 (32)	22/34 (65)	<0.01	22/44 (50)	31/44 (70)	/
LBR per pregnancy (n, %)	0/10 (0)	6/9 (67)	<0.05	0/11 (0)	16/22 (73)	<0.01	0/22 (0)	22/31 (71)	<0.001
MR per pregnancy (n, %)	10/10 (100)	1/9 (11)	<0.05	11/11 (100)	4/22 (18)	<0.01	22/22 (100)	5/31 (16)	<0.001
Ongoing per pregnancy (n, %)	-	2/9 (22)	-	-	2/22 (9)	-	-	4/31 (13)	-

RPL: Recurrent pregnancy loss, CPR: Clinical pregnancy rate, LBR: Live birth rate, MR: Miscarriage rate.

histological abnormalities such as leiomyomuscular hyperplasia, vascular congestion, vascular hyperplasia, sclerosis, and inflammation were also observed. Although these findings were not significantly associated with outcomes, they may interfere with uterine function. Previous reports suggest that hysteroscopic removal of superficial adenomyotic tissue can improve reproductive outcomes, beyond anatomical correction.[8,20]

The outcomes observed are consistent with existing literature, which shows improved clinical pregnancy and LBRs and reduced miscarriage after metroplasty.[10,16-18] For example, a 2022 SWOT analysis reported LBRs rising from below 2% preoperatively to over 55% after surgery, with MRs falling from over 85% to approximately 20%.[10] Our findings confirm the beneficial effect of metroplasty, particularly in women with infertility or a single miscarriage.

Conclusion

In conclusion, this study has several clinical implications. Histological assessment of tissue resected during metroplasty may reveal pathological changes not detectable by imaging. Our data confirm that patients with dysmorphic uterus benefit from metroplasty, but suggest that adenomyosis might influence outcomes, although our study was underpowered to demonstrate a significant effect. Larger, prospective studies are needed to clarify its reproductive impact after surgery.

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Informed consent: Written informed consent to participate in the study was obtained from all patients.

Data sharing: Data are available from the corresponding author upon request.

Transparency: The data underlying this article are available from the corresponding author.

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