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Surgical Approaches to Correct Congenital Malformations of the Female Reproductive System

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Abstract:

Congenital malformations in the female reproductive tract (CMFRT) pose significant clinical challenges, manifesting as obstructive symptoms, pain, and reduced fertility. The objective of this study was to evaluate the surgical outcomes regarding safety, efficacy, and reproductive results following the repair of CMFRT in patients. A cross-sectional study was performed involving 66 patients who underwent surgery for the correction of congenital malformations affecting the female genital tract from March 2024 to March 2025. The ESHRE/ESGE system was used to group the anomalies. The main outcomes were the rates of complications during and after surgery (using the Clavien-Dindo classification), the success of the surgery in terms of anatomy, the resolution of symptoms, and the reproductive outcome for those trying to get pregnant. Abdominal pain that occurred on was the most common reported symptom (63.6%). Obstructive abnormalities (57.6%), as well as uterine septa (U2, 37.9%), were the most frequent findings and indications. Laparoscopic-assisted surgery was the most often utilized modality (43.9%). Postoperative complications were mostly minor (Clavien-Dindo I-II, 27.3%); intraoperative complications were observed in 16.7%, primarily hemorrhage (6.1%). In 100% of obstructive/neovaginal procedures and 87.9% of uterine procedures, anatomical success was attained. Dyspareunia (89.5%), pelvic pain (92.9%), and dysmenorrhea (92.1%) all showed notable symptom improvement. The incidence of conception was 71.4% and the rate of live birth was 80% among the 28 patients who sought to conceive. 10.6% had intrauterine adhesions. 87.9% of patients expressed satisfaction or high satisfaction with the results of their surgery. Surgical correction of CMFRT, by a variety of minimally invasive and open methods, is marked by high success in anatomical correction, complete cessation of symptoms, and favorable reproductive outcomes. Complications are usually minor, and satisfaction with the result is extremely high. Multidisciplinary individualized surgical treatment is effective in the management of these complex disorders.

Keywords: Congenital Mullerian Anomalies, Reproductive Tract Surgery, Septate Uterus, Obstructed Hemi-Vagina, Surgical Outcomes, Fertility Preservation

Introduction

In female patients with CMFRS, it was a series of developmental anomalies resulting from abnormal organogenesis of the paramesonephric ducts. These anomalies have an estimated occurrence of 4-7% in the general population and are substantially more frequent in populations with suboptimal reproductive performance, rendering a series of difficult logistical and therapeutic issues to gynecologists and reproductive surgeons [1, 2, 3].

The clinical appearance of these diseases is heterogeneous with the majority of cases being asymptomatic and discovered incidentally as part of evaluation of infertility or recurrent pregnancy loss, where can present as strikingly in adolescence, with obstructive symptoms, including primary amenorrhea, severe cyclical pelvic pain, or the emergence of endometriosis or hematemetra, with inherent and downstream implications for a young woman's reproductive health and overall quality of life [4, 5, 6], which as well as congenital malformations of the female reproductive system (CMFRS) are a group of developmental anomalies resulting from abnormal development of the paramesonephric ducts.

The abnormalities, which are usually found in about 4% to 7% of people, are, however, found more often than that in those populations where there are reproductive problems. Gynecologists and reproductive surgeons have to face difficult diagnosis and treatment issues as a result [4]. These are some of the health issues a person may encounter during life. There may be extreme differences in the way these conditions are expressed. They may not even have any symptoms and are often only discovered incidentally when undergoing tests for problems related to infertility or miscarriage. A person can, however, develop such obstructive symptoms, including problems like primary amenorrhea, debilitating cyclical pelvic pain, and the formation of endometriosis, which can not only affect the immediate future of a young woman but also the long-term consequences of her reproductive health and life quality [5, 6].

The embryological basis of the female reproductive system is a strictly coordinated mechanism involving the development, fusion, and later reopening of the two Müllerian ducts between the 6th and 22nd weeks of pregnancy. Any kind of interruption in this fussy arrangement—failed fusion, defective canalization, or the resorption of the intervening septum—can all result in a unique anatomical defect [7, 8]. This extensive range of potential outcomes can result in various malformations, the most common types being septate, bicornuate, and didelphic uteri, cervical agenesis or duplication, and vaginal obstructions such as transverse or longitudinal septa.

The high occurrence (close to 30%) of renal malformations, primarily to unilateral renal agenesis, which is the result of the need for comprehensive urological screening of these patients, is actually explained by the close embryogenesis of the Müllerian and Wolffian (mesonephric) ducts [9]. The evolution of classification systems for these anomalies has been like the crossing of different roads in an unknown terrain. From the historical American Fertility Society (now ASRM) classification to the modern and more complex European Society of Human Reproduction and European Society for Gynaecological Endoscopy (ESHRE/ESGE) system, the guiding vision has been to build a structured, objective, and clinically relevant framework that correlates anatomy with clinical outcomes and directs the treatment [10, 11].

By dividing abnormalities into Uterine (U), Cervical (C), and Vaginal (V) classes, along with subcategories that give an accurate anatomical description—a critical component for surgical planning and prognostic stratification—the ESHRE/ESGE system, in particular, provides a thorough, systematic approach. The alleviation of blockage and the optimization in reproductive capacity are the two main categories into which surgical intervention in CMFRS is often classified. Adolescent surgical crises are caused by obstructive abnormalities, including a transverse vaginal septum or an obstructed hemivagina within a didelphic uterus. If left untreated, they can impair future fertility by causing pelvic endometriosis, hematometra, hematosalpinx, retrograde menstruation, and persistent pelvic discomfort [12].

Materials and Method

Study Design and Patient Population

The medical records in 66 patients who had surgery among March 2024 and March 2025 to correct congenital malformations for the female reproductive system were reviewed in a retrospective cohort study. The surgical as well as gynecological databases of the Baghdad-Iraq hospital were used to identify the patients, where all female patients who received a primary corrective surgical procedure in our hospital and had a confirmed diagnosis with a congenital Müllerian anomaly, as defined by the ESHRE/ESGE system, met the inclusion criteria, which patients with acquired reproductive tract diseases as well as those with incomplete medical records were excluded.

Preoperative Assessment and Diagnostic Workup

To confirm the diagnosis and define the exact anatomy of the malformation, an evaluation was performed on each patient. In order to determine the type and duration of presenting symptoms, such as amenorrhea, dysmenorrhea, dyspareunia, or infertility, the diagnostic algorithm started with a thorough clinical history and physical examination, where magnetic resonance imaging (MRI) and high-resolution pelvic ultrasound comprised primary imaging, which was the basis for categorizing abnormalities using the ESHRE/ESGE system, as well as additional tests included renal ultrasonography to check for concurrent urological abnormalities, which are known to be common in this patient population, and diagnostic laparoscopy to evaluate for associated endometriosis.

Surgical Indications and Technique Selection

Based on each patient's unique symptoms and anatomical defect, the primary indication in surgery was established, where the main indications were the optimization of reproductive potential through restoring a normal uterine cavity, the diagnostic clarification of complex anomalies, and relief for obstruction presenting with cyclical pain, as well as the particular anomaly class was taken into consideration when selecting the surgical technique including the most common use of hysteroscopic surgery was to remove intrauterine septa (U2 abnormalities). For more complicated abnormalities that required simultaneous abdominal visualization, such as bicorporeal uteri (U3) or in situations where endometriosis was suspected, laparoscopic-assisted procedures were employed. For the excision of longitudinal or transverse vaginal septa, isolated vaginal approaches were used (V4, V5). Laparotomy and other combined abdominal, along with vaginal procedures were saved for the most complicated cases, such as those with significant associated pathology or a hemi-uterus with obstruction (U4).

Intraoperative and Postoperative Management

A dedicated group of pediatric as well as adolescent gynecologists, along with minimally invasive surgeons, carried out all of the surgeries while under general anesthesia. Preoperative prophylactic antibiotics were given as usual. Complications during surgery were carefully documented. When appropriate, postoperative care adhered to a standardized improved recovery following surgery (ERAS) protocol, emphasizing multimodal pain management and early ambulation. The surgical technique, patient recuperation, and pain management all influenced how long the patient had to stay in the hospital. Upon discharge, all patients received comprehensive counseling on wound care, activity limitations, and the value of follow-up.

Follow-up and Outcome Measures

Follow-up appointments with the patients were planned for six weeks, six months, and twelve months after surgery. At the 12-month mark, outcome measures were evaluated. Follow-up MRI or ultrasound imaging was used to assess anatomical success in order to verify that the obstruction had been removed and that the cavity anatomy had returned to normal. Through patient interviews measuring the alleviation of pain, dysmenorrhea, and dyspareunia, symptomatic success was

evaluated, where reproductive outcomes included pregnancy rates, method of conception, and obstetric outcomes, were recorded for patients who were trying to conceive, where follow-up hysteroscopy was used to determine the prevalence of serious complications, like the formation of intrauterine adhesions, in patients who had symptoms or whose imaging was concerning.

Furthermore, in term of reproductive outcomes, such as pregnancy rates, method of conception, as well as obstetric outcomes, were recorded for patients who were trying to conceive, as well as to determine the prevalence of serious complications, such as the formation of intrauterine adhesions, in patients who had symptoms or whose imaging was concerning using a standardized 5-point Likert scale questionnaire through gauge overall patient satisfaction during the 12-month follow-up visit, then, SPSS version 24.0 was used for all data analysis and design.

Results

The demographic characteristics of the study cohort, including age distribution and presenting symptoms, are summarized in Table 1.

Table 1. Patients Demographics (N=66).

Characteristic	n	[%]
Age at Surgery (years)		
< 18	18	27.3%
18 - 25	32	48.5%
> 25	16	24.2%
Presenting Symptoms		
Primary Amenorrhea	15	22.7%
Cyclical Abdominal Pain	42	63.6%
Infertility Workup	7	10.6%
Dyspareunia	19	28.8%

The congenital malformations were grouped according to the ESHRE/ESGE system, with uterine, cervical, and vaginal anomalies classified in Table 2.

Table 2. Classify of Congenital Malformations According to the ESHRE/ESGE System.

Anomaly	n	[%]
Uterine Anomalies (Class U)		
U1 - Dysmorphic Uterus	2	3.0%
U2 - Septate Uterus (Partial/Complete)	25	37.9%
U3 - Bicorporeal Uterus	8	12.1%
U4 - Hemi-uterus	12	18.2%
Cervical Anomalies (Class C)		
C1 - Septate Cervix	6	9.1%
C2 - Double Cervix	9	13.6%
Vaginal Anomalies (Class V)		
V4 - Transverse Vaginal Septum	14	21.2%
V5 - Longitudinal Vaginal Septum	11	16.7%
Associated Anomalies		
Renal Anomalies (e.g., agenesis)	13	19.7%
Endometriosis at Presentation	17	25.8%

The main indications for surgery, such as relief of obstruction and reproductive optimization, are detailed in Table 3.

Table 3. Primary Surgical Indication (N=66).

Indications	n	[%]
Obstructive Anomaly (Pain/Hematometra)	38	57.6%
Reproductive Optimization (Septum Resection)	21	31.8%
Diagnostic & Therapeutic Laparoscopy	7	10.6%

Different surgical modalities, including hysteroscopic, laparoscopic-assisted, and combined approaches, were employed as shown in Table 4.

Table 4. Surgical Modality.

Modality	n	[%]
Hysteroscopic Surgery Only	18	27.3%
Laparoscopic-Assisted Surgery	29	43.9%
Vaginal Approach Only	12	18.2%
Combined Abdominal/Vaginal (Laparotomy)	7	10.6%
Total	66	100%

The distribution of intraoperative complications across surgical techniques is outlined in Table 5.

Table 5. Intraoperative Complications.

Complications	Hysteroscopic (n=18)	Laparoscopic (n=29)	Vaginal (n=12)	Combined (n=7)	Total (n=66)
Uterine Perforation	2 [11.1%]	1 [3.4%]	0	0	3 [4.5%]
Bladder Injury	0	0	1 [8.3%]	1 [14.3%]	2 [3.0%]
Bowel Serosal Injury	0	1 [3.4%]	0	0	1 [1.5%]
Hemorrhage (>500ml)	0	1 [3.4%]	1 [8.3%]	2 [28.6%]	4 [6.1%]
Conversion to Laparotomy	N/A	1 [3.4%]	0	N/A	1 [1.5%]
Total	2 [11.1%]	4 [13.8%]	2 [16.7%]	3 [42.9%]	11 [16.7%]

Postoperative complications within 30 days, categorized by Clavien-Dindo grade, are summarized in Table 6.

Table 6. Postoperative Complications (Within 30 Days, Clavien-Dindo Grade).

Complication	Hysteroscopic (n=18)	Laparoscopic (n=29)	Vaginal (n=12)	Combined (n=7)	Total (n=66)
Grade I-II (Minor)					
Febrile Morbidity	1 [5.6%]	2 [6.9%]	1 [8.3%]	1 [14.3%]	**5 [7.6%]**
Urinary Tract Infection	2 [11.1%]	3 [10.3%]	2 [16.7%]	1 [14.3%]	**8 [12.1%]**

Transient Voiding Difficulty	0	1 [3.4%]	3 [25.0%]	1 [14.3%]	**5 [7.6%]**
Total Minor	**3 [16.7%]**	**6 [20.7%]**	**6 [50.0%]**	**3 [42.9%]**	**18 [27.3%]**
Grade III-IV (Major)					
Re-operation for Bleeding	0	1 [3.4%]	0	1 [14.3%]	**2 [3.0%]**
Deep Vein Thrombosis	0	0	0	1 [14.3%]	**1 [1.5%]**
Total Major	**0**	**1 [3.4%]**	**0**	**2 [28.6%]**	**3 [4.5%]**

Hospital stay duration following surgery is presented in Table 7.

Table 7. Length of Hospital Stay.

Duration	n	[%]
1 - 2 Days	41	62.1%
3 - 5 Days	20	30.3%
> 5 Days	5	7.6%

The anatomical success rates recorded at the 12-month follow-up are shown in Table 8.

Table 8. Anatomical Success Rate at 12-Month Follow-Up.

Outcome	n	[%]
Complete Resolution of Obstruction	35/35	100.0%
Normalized Uterine Cavity (by USG/MRI)	58/66	87.9%
Neovagina Functional Patency	10/10	100.0%

Improvements in symptoms such as pelvic pain, dysmenorrhea, and dyspareunia are reported in Table 9.

Table 9. Symptoms Resolution at 12-Month Follow-Up.

Symptoms	Resolved	Improved	Unchanged
Chronic Pelvic Pain (n=42)	28 [66.7%]	11 [26.2%]	3 [7.1%]
Dysmenorrhea (n=38)	22 [57.9%]	13 [34.2%]	3 [7.9%]
Dyspareunia (n=19)	12 [63.2%]	5 [26.3%]	2 [10.5%]

Reproductive outcomes among patients seeking conception are detailed in Table 10.

Table 10. Reproductive Findings in the Patients Seeking Conception.

Outcome	n	[%]
Achieved Pregnancy	**20**	**71.4%**
Spontaneous Conception	12	60.0% of pregnancies
Conception via ART (IVF/ICSI)	8	40.0% of pregnancies
Live Birth Rate	**16**	**80.0% (per pregnancy)**

First Trimester Loss	3	15.0%
Second Trimester Loss	1	5.0%
Ongoing Pregnancy	2	10.0%
Delivery Mode related to Live Births (n=16)		
Elective Cesarean Section	10	62.5%
Emergency Cesarean Section	3	18.8%
Vaginal Delivery	3	18.8%

The incidence of postoperative intrauterine adhesions is documented in Table 11.

Table 11. Incidence of Postoperative Intrauterine Adhesions.

Outcome	n	[%]
Developed Adhesions (on follow-up hysteroscopy)	7	10.6%
Required Second Surgery for Adhesiolysis	4	6.1%

Patient satisfaction levels one year after surgery are illustrated in Table 12.

Table 12. Overall Patient-Reported Satisfaction at 1 Year.

Satisfaction Level	n	[%]
Very Satisfied	38	57.6%
Satisfied	20	30.3%
Neutral	5	7.6%
Dissatisfied	2	3.0%
Very Dissatisfied	1	1.5%

Discussion

This cross - sectional cohort comprising 66 cases operated for congenital malformations of the female reproductive tract (CMFRT) demonstrated that a multidisciplinary surgical approach, tailored to each case, confers high anatomical success, symptom relief, and identity of reproductive conditions, while major complications are very rare, which cohort's demographics were typical for this patient population including mean age in adolescence and young adult (48.5% from 18 to 25 years) and predominant complaint of cyclical abdominal pain (63.6%), as well as obstructive anomalies frequently develop symptoms soon after menarche, resulting in diagnosis in the second decade [13, 14, 15], which a sizable fraction presenting with primary amenorrhea (22.7%) also obstruction were strong interference in the course of normal menstrual egress, well documented in agitating a person to medical attention [16].

Furthermore, a high prevalence of septate uterus (U2, 37.9%) was the most common anomaly has matched global literature, often naming it as the most frequent Müllerian defect [5, 11, 17], that gained a fair representation among more complex anomalies such as hemi-uterus (U4, 18.2%) and obstructive vaginal anomalies (V4/V5, combined 37.9%).

Moreover, the associations with renal anomalies (19.7%) and endometriosis (25.8%) were critically

validate two major embryological and pathophysiological theories [18]. A high occurrence of endometriosis in these subjects, found especially in those with obstructive anomalies, is a very powerful testament to retrograde menstruation, which is one of the main pathogenesis theories of endometriosis [12].

In addition, the majority with 43.9% of cases had underwent laparoscopic-assisted surgery, a truly modern trend in surgery that utilized the benefits of minimally invasive techniques including enhanced visualization, lesser postoperative pain, and faster recovery time, where this technique was especially useful when dealing with procedures including metroplasty for bicorporeal uteri (U3) or resection of an obstructed hemivagina, where combined intra-abdominal and intra-cavitary visualization is crucial, that we recorded excellent anatomical results of 100% in obstructive/neovaginal procedures and 87.9% in uterine ones, due to that, a meta-analysis reported that hysteroscopy restored uterine anatomy successfully in over 85% of cases of septate uterus in China [13, 14, 19], which further relieving obstruction with 100% success is of paramount importance, as it removes the cause of pain and, therefore, would preclude further complications such as endometriosis.

One of the main concerns is the safety aspect of these procedures. Our postoperative complication rate, which can range from 5% to 25% depending on the complexity of the cases, is 27.3% (mostly minor Clavien-Dindo I-II events like UTIs), and our overall intraoperative complication rate of 16.7%, which is dominated by manageable hemorrhage (6.1%), is encouraging [15]. The more complicated combined abdominal/vaginal procedures accounted for the majority of complications (42.9% intraop, 42.9% minor postop). The safety and effectiveness of a minimally invasive initial approach when carried out by skilled surgeons are strongly supported by the low conversion rate with laparotomy (1.5%) and the extremely low rate in major postoperative complications (4.5%). Most patients had a brief hospital stay (62.1% were released in 1-2 days).

The significant improvement in patients' reproductive potential and quality of life is arguably the study's most compelling finding. For these young women, symptoms such as dyspareunia (89.5%), dysmenorrhea (92.1%), and chronic pelvic pain (92.9%) are resolved or significantly improved. 87.9% of patients said they were satisfied and very satisfied with the results of their surgery, indicating high levels of patient satisfaction. Outstanding outcomes include a 71.4% pregnancy rate and an 80% live birth rate per pregnancy [20, 21]. The anatomical barrier to fertility is successfully removed by surgical correction. The fact that 40% of pregnancies were obtained through ART is significant because it suggests that although surgery improves the uterine environment, some patients might have concurrent conditions. Despite the prevalence of vaginal deliveries (18.8%), the high rate of elective cesarean sections (62.5% of live births) was a common recommendation after complex uterine surgery to prevent the stresses of labor over the repaired uterus.

Conclusion

Surgically correction of CMFRT is a very safe and successful procedure. These treatments effectively reduce crippling symptoms, avoid chronic illnesses like endometriosis, and—above all—restore the possibility of a healthy reproductive life. Women with these difficult congenital disorders are best managed with specialized surgical care, as evidenced by the high rates for anatomical success, symptom resolution, and patient satisfaction reported here. To further improve care for the patient population, future initiatives should concentrate on adhesion prevention, standardizing procedures, and monitoring long-term obstetric outcomes.

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