Management of Mullerian Development Anomalies: 9 Years’ Experience of a Tertiary Care Center

Lajya Devi Goyal1, Balpreet Dhaliwal1, Paramdeep Singh2,*, Sandesh Ganjoo1, Vikas Goyal1
Departments of 1Obstetrics and Gynaecology, 2Radiology and 3Surgery, Guru Gobind Singh Medical College and Hospital, Baba Farid University of Health Sciences, Faridkot, Punjab, India

Abstract

Objectives: This study aimed to analyze the clinical and imaging findings as well as the outcomes of patients with Mullerian duct anomalies.

Materials and Methods: A retrospective analysis of 41 patients with Mullerian development anomalies treated in a tertiary care center in the past 9 years was done. The presenting symptoms, radiological findings, management, and the outcomes were evaluated.

Results: According to the American Fertility Society’s classification, 11 patients presented in Class I, 6 in Class II, and 24 in Class III of the classification. It was found that some of the defects such as the unicornuate uterus, a unicornuate uterus with noncommunicating rudimentary horn, and longitudinal vaginal septum were usually asymptomatic whereas disorders such as Mayer-Rokitansky-Küster-Hauser (MRKH), cervicovaginal atresia, and transverse vaginal septum presented with the absence of menarche, cyclical abdominal pain, and abdominal mass, respectively. Defects such as the bicornuate uterus, didelphys uterus, and septate uterus present with poor reproductive performance. Unicornuate uterus with communicating horn presented with rupture of the horn in the antenatal period, which was managed vigorously. Vaginoplasty with a skin graft and amnion graft had excellent results in MRKH syndrome. Patients with cervicovaginal atresia had a poor prognosis and ultimately required a hysterectomy. Hysteroscopic septal resection improved the reproductive performance in the patients with septate uterus.

Conclusion: This study concluded that the management of uterine malformations is individualized depending on the symptoms and fertility concerns. Cervicovaginal atresia was associated with restenosis after surgery ultimately required a hysterectomy. MRKH had excellent results with McIndoe vaginoplasty. Optimal and timely management may lead to better outcomes.

Keywords: Anomaly, Mayer-Rokitansky-Küster-Hauser, Mullerian, uterus

INTRODUCTION

Development of the female reproductive tract commences in the early first trimester of pregnancy by a complex interaction, resulting in the fusion of Mullerian ducts (MDs) and urogenital sinus (UGS). MDs are mesodermal in origin and differentiate to form uterus, fallopian tubes, cervix, and upper one-third of the vagina. Lower two-thirds of the vagina is derived from UGS that has an endodermal origin. Mullerian developmental anomalies (MDA) arise whenever there is dysregulation or interruption in any of the processes of differentiation, migration, fusion and canalization of the two primary structures MD and UGS. Failure in the development of one or both MDs leads to uterine agenesis while incomplete development results in uterine hypoplasia or a unicornuate uterus. Mayer-Rokitansky-Küster-Hauser syndrome (MRKH syndrome) is a condition with the absence of uterus, cervix, and upper part of the vagina. Incomplete fusion of the caudal portion of the MDs results in lateral fusion defects, i.e., uterus didelphys, bicornuate uterus, and arcuate uterus. Failure of reabsorption of the central septum results in a septate and subseptate uterus, while vertical fusion defects

Address for correspondence: Dr. Paramdeep Singh, Department of Radiology, Guru Gobind Singh Medical College and Hospital, Baba Farid University of Health Sciences, Faridkot, Punjab, India.
E-mail: paramdeepdoctor@gmail.com

Access this article online

Quick Response Code:  
Website: www.e-gmit.com
DOI: 10.4103/GMIT.GMIT_13_19

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Goyal LD, Dhaliwal B, Singh P, Ganjoo S, Goyal V. Management of mullerian development anomalies: 9 years’ experience of a tertiary care center. Gynecol Minim Invasive Ther 2020;9:81-7.
lead to anomalies such as an imperforate hymen, transverse vaginal septum, oblique vaginal septum, or the absence of the cervix. Mullerian anomalies are rare and incidence rate varies from 0.1% to 3.4%. Mullerian anomalies are mostly asymptomatic and are often missed till puberty when the patient presents with primary amenorrhea, cyclical pain abdomen, or abdominal bulge. Vaginal agenesis presents with primary amenorrhea and dyspareunia. Hematometra and hematocolpos are frequent findings in cases with ductal anomalies with functional endometrium. A uterine septum is mostly diagnosed in patients with repeated miscarriages or infertility. Lateral fusion defects result in repeated miscarriages and preterm births. Earlier, laparoscopy in conjunction with hysteroscopy was used to confirm the diagnosis of MDA. However, now ultrasound and magnetic resonance imaging (MRI) has supplanted the need for these invasive procedures and MRI is the imaging technique of choice for the diagnosis of complex MDA. With the improvement in the technology of surgical equipment, the minimally invasive techniques such as laparoscopy and hysteroscopy have replaced the conventional surgical methods in correcting these defects as the later surgical approaches were frequently performed without any deliberation for future reproductive potential. However, the present minimally invasive surgical approaches take into contemplation the individual’s future reproductive choices as well as permit the patient to be engaged in such decisions. To be precise, the treatment in MDA cases is individualized, depending on the age, symptoms, and fertility concerns at the time of the diagnosis. We conducted this study to know the spectrum of Mullerian anomalies and to present our experience regarding the management of these anomalies in a tertiary care center over 9 years.

Patients and Methods
This retrospective case series study was conducted at a tertiary care teaching hospital in North India. A total of 41 cases of Mullerian anomalies that were diagnosed by clinical and radiological examinations and treated in the past 9 years from July 2009 to July 2018 were included in this study. The Scientific advisory and the Institutional Ethical committees approved this study (vide letter no. GGS/IEC/19/60, dated: February 22, 2019), and written informed consent was obtained from all the patients. Permission was also taken from the medical review board for the retrieval of case records for conducting this research. Detailed history, clinical findings, radiological investigations, and operative findings were noted. These patients were followed up for reproductive outcomes.

Imaging examinations
The patients underwent pelvic ultrasound examination by Philips Affinity 70 machine, and MRI examinations were performed on a 1.5 Tesla MRI (Magnetom, Avanto, Siemens, Erlangen, Germany) using an 8-channel body coil without intravenous contrast medium. Axial images were obtained using 256 × 256 matrix, 32 cm field of view and 4-mm slice thickness. Coronal T2-weighted image (T2WI) and short T1 inversion recovery (STIR), sagittal T2WI and axial T2WI, T1WI, Fat-suppressed T1W and STIR images were acquired. MRI data were analyzed for the presence or absence of the uterus, its size, delineation of its zonal anatomy, exterior fundal contour, assessing inter-cornual gap, the existence of any uterine or vaginal septum, and any associated other abdominal anomalies.

Clinical diagnosis
The final diagnosis was made in every case that was based on findings at history, clinical examination, imaging, surgical outcomes, and follow-up. These patients were classified according to the classification of the American Fertility Society.

Statistical evaluation
Data were analyzed using the SPSS version 17, and the level of statistical significance was fixed at \( P < 0.05 \).

Results
Our study included 41 female patients with ages ranging from 13 to 38 years old [Table 1]. They were referred with various clinical symptoms and signs, with the most common symptom being the primary amenorrhea followed by cyclical abdominal pain, recurrent abortions, and infertility [Table 2]. All of the patients underwent real-time gray scale ultrasonography and MRI. We encountered 41 cases with mullerian anomalies among a total of 14,778 admissions in the hospital with gynecological problems in 9 years, with an incidence of 0.002% among hospital admissions [Table 3]. There were eleven patients with MRKH syndrome (Class I) who presented with the absence of menarche, of which three patients had associated skeletal and renal malformations. A total of 10 patients underwent McIndoe’s vaginoplasty with 8 patients operated with a skin graft and two cases operated with amnion graft. One patient was married for 7 years, had acquired sufficient vaginal length with repeated dilatations of vagina and surgery was not required. All the patients had a successful recovery and on follow-up, sexual performance was satisfactory [Table 4].

Two patients had a transverse vaginal septum, and four patients had cervical and vaginal atresia (Class II). All these patients presented with cyclical abdominal pain at the onset of menarche with ultrasound and MRI revealing hematometra.
The septum was resected in patients with a transverse vaginal septum, resulting in a patent vagina and normal menstrual cycles. Patients with cervical and vaginal atresia underwent McIndoe’s vaginoplasty. The rudimentary part of the cervix was attached to the newly created upper vagina, and the hematometra was drained. Patients were advised to use vaginal dilators to keep the vagina patent. However, on follow-up, there was restenosis of the upper vagina with subsequent development of hematometra and hematosalpinx; hence, hysterectomy had to be done [Table 4].

In our study, five patients had a unicornuate uterus (Class III), of which three patients presented with recurrent preterm births. These patients were conservatively managed. In the other two patients, the condition was diagnosed during the cesarean section that was done for breech presentation.

We encountered eight cases of unicornuate uterus with a rudimentary horn [Figure 1]. One of the patients presented with an acute abdomen at 15 weeks gestation with the ruptured of rudimentary horn that was excised. In the other six patients, the rudimentary horn was diagnosed during cesarean section, and excision was done. There was a solitary case of uterus didelphys [Figure 2] with a history of primary infertility of 7 years. Metroplasty was done, but the patient did not conceive even after 3 years of follow-up.

There was one patient with bicornuate uterus with a history of anorectal malformations at birth that was repaired. She presented with recurrent first-trimester abortions. MRI findings were suggestive of a bicornuate uterus with left ovarian endometrioma that was confirmed intraoperatively. The patient had a normal reproductive course [Table 4].

One patient with infertility was diagnosed with Uterus didelphys with associated ovarian malignancy. The patient underwent exploratory laparotomy, followed by a total abdominal hysterectomy, bilateral salpingo-oophorectomy, and omentectomy.

There were five patients with a complete uterine septum. In one of the patients, it was an incidental finding during the cesarean section that was done for term breech presentation, while two of the patients presented with recurrent first-trimester abortions. In the rest of the two cases, the condition was diagnosed during routine infertility workup. In four patients, hysteroscopic septal resection was performed. Follow-up hysterosalpingography and MRI after 3 months of septal resection revealed a normal uterine cavity. Two patients conceived with a normal full-term pregnancy postseptal resection.

The longitudinal vaginal septum (LVS) was diagnosed in three patients. Two patients presented at term, and the diagnosis was made during a vaginal examination. The septum was resected during the second stage of labor, and the patients

| Table 1: Distribution of patients according to age |
|--------------------------------------------------|
| Age group (years) | Number of patients, n (%) |
| 11-18 | 19 (46.34) |
| 19-24 | 13 (31.71) |
| 25-32 | 8 (19.4) |
| 32-39 | 2 (4.8) |

| Table 2: Distribution of patients according to clinical features |
|---------------------------------------------------------------|
| Presenting symptom/complaint | Number of patients (n=41), n (%) |
| Primary amenorrhea | 11 (26.8) |
| Cyclical abdominal pain | 8 (19.44) |
| Irregular menstruation | 1 (2.44) |
| Lower abdominal mass (ovarian tumor) | 1 (2.44) |
| Infertility | 3 (7.31) |
| Recurrent abortions | 3 (7.31) |
| Preterm births | 3 (7.31) |
| Nonvertex fetal presentation | 3 (7.312) |
| Rupture of rudimentary horn in pregnant uterus | 1 (2.41) |
| Normal pregnancy course | 7-2 LVS and 5 rudimentary horn (17.07) |

| Table 3: Distribution of patients according to the American Fertility Society classification of utero-vaginal anomalies |
|------------------------------------------------------------------------------------------------------------------|
| Class | Number of patients, n (%) |
| I | 11 (26.86) |
| II | 6 (14.64) |
| III | 24 (58.55) |
| IV | 0 |

LVS: Longitudinal vaginal septum.

Figure 1: Coronal T2-weighted image showing rudimentary horn of uterus on right side (arrow)
Table 4: The clinical findings and outcomes of the type 1, type 2, and type 3 Mullerian anomalies, respectively

| Type of anomaly                                      | Number of patients | Age group (years) | Presenting symptoms                      | Treatment given                                  | Follow up and final outcome                      |
|------------------------------------------------------|--------------------|-------------------|------------------------------------------|--------------------------------------------------|------------------------------------------------|
| MRKH                                                 | 11                 | 13-18             | Absence of menarche                      | Vaginoplasty                                     | Successful recovery and satisfactory sexual performance |
| Transverse vaginal septum                            | 2                  | 11-13             | Cyclical abdominal pain                  | Septal resection                                 | Normal menstrual cycles                          |
| Cervical and vaginal atresia                         | 4                  | 11-13             | Cyclical abdominal pain                  | Uterocervical canalization and vaginoplasty       | Stenosis of upper vagina with development of hematometra and hematosalpinx. Hysterectomy had to be done in all cases |
| Unicornuate uterus                                   | 3                  | 21-32             | Recurrent preterm                        | Conservative management                          | Full-term vaginal delivery and normal recovery   |
|                                                    | 2                  | 21-32             | Breech presentation at term              | LSCS                                             | Normal recovery                                   |
| Unicornuate uterus with rudimentary horn             | 1                  | 23-27             | Rupture of the horn at 15 weeks of gestation | Emergency laparotomy - excision of the horn       | Normal recovery                                   |
|                                                    | 7                  | 23-27             | incidental finding at the time of LSCS   | LSCS for obstetric indications                   | Normal recovery                                   |
| Unicornuate uterus with functional noncommunicating horn | 1                | 16                | Abdominopelvic mass                      | Excision of horn                                 | Normal recovery                                   |
| Uterus didelphys                                     | 1                  | 24                | Primary infertility for 7 years          | Metroplasty                                       | Did not conceive at 3 years of follow-up          |
| Bicornuate uterus                                    | 1                  | 20                | Primary infertility                      | Cystectomy for left ovarian endometrioma (6 cm × 6 cm) | 1st pregnancy terminated at 18 weeks due to neural tube defects |
| Bicornuate uterus with ovarian malignancy            | 1                  | 38                | Primary infertility ovarian malignancy   | Hysterectomy with bilateral oophorectomy         | 2nd pregnancy reached till term and had LSCS     |
|                                                    |                    |                   |                                          |                                                  | Live with no evidence of disease                  |
| Septate uterus                                       | 2                  | 20-23             | Recurrent first trimester abortions      | Hysteroscopic septal resection                   | 1 patient conceived and reached till term         |
|                                                    | 2                  | 20-23             | Primary infertility                      | Hysteroscopic septal resection                   | 1 patient conceived and reached till term         |
|                                                    | 1                  | 20-23             | Incidental finding during LSCS for breech presentation | LSCS                                             | Normal recovery                                   |
| Longitudinal vaginal septum                          | 2                  | 17-25             | Presented at term in labor               | Septum excised during 2nd stage of labor         | Successful vaginal delivery with normal recovery  |
|                                                    | 1                  | 17-25             | Irregular menstruation, septum, incidental finding on MRI | Excision of the septum                          | Normal recovery                                   |

LSCS: Lower segment caesarean section, MRI: Magnetic resonance imaging, MRKH: Mayer-Rokitansky-Küster-Hauser

had a successful normal vaginal delivery. One of the patients presented at the age of 17 years with irregular menstruation and vaginal septum was diagnosed on MRI examination, which was also treated by septal resection [Table 4].

**DISCUSSION**

Etiology of mullerian agenesis is unclear, and approximately 4% of the cases are familial with affected siblings. Diagnosis can be confirmed with ultrasonography; however, MRI can better diagnose complex malformations, including the rudimentary uterus and associated malformations and should be offered to all patients. Earlier, many of the Mullerian anomalies were treated with radical surgeries such as hysterectomy and hemihysterectomy with vaginectomy, which often lead to permanent loss of reproductive function of such patients. The minimally invasive procedures to repair MDA have altered the treatment approach for several of these conditions. The most noteworthy effect has been seen with the hysteroscopic resection of the uterine septum that has superseded the Jones or Tompkins metroplasty done at laparotomy. The hysteroscopic septum incision is a safe procedure with a considerably quicker recovery and with a significant decrease in the likelihoods of preterm delivery and cesarean section. Sometimes, these minimally invasive procedures have also been employed to postpone the definitive surgery, for example in cases of obstructive
Mullerian anomalies in adolescent patients wherein aspiration of hematocolpos or hematometra is done in conjunction with hormonal suppression of menstruation. The idea is to permit the patient to mature so that they may effectively contribute to the decision-making process later. In patients with a history of obstructive mullerian anomalies, the conception has been realized with the help of assisted reproductive techniques such as in vitro fertilization. In patients with cervical agenesis, pregnancies have also been attained with the employment of transmyometrial transfer of embryos. Uterine transplantation is also a novel and evolving approach to manage infertility due to MDA.

In our study, we encountered eleven patients with MRKH syndrome. The treatment goal in these women is the creation of an artificial vagina, either conservatively or surgically, that allows sexual functioning. MD anomalies can be isolated or associated with urological (15%–40%), skeletal anomalies (12%–50%), auditory, and cardiac anomalies. MRKH syndrome may also be associated with Klippel-Fiel syndrome (congenital fusion of the cervical spine, short neck, and low posterior hairline). Treatment modalities include nonsurgical and surgical methods. The nonsurgical method involves gradual dilatation of vaginal dimple at the introitus. This requires time and strong patient motivation. Since the procedure is painful and also self-administered, usually compliance is very poor. One patient in this study presented with sufficient vaginal length probably with repeated dilatation due to prolonged sexual exposure, as she was married for 7 years.

McIndoe procedure refers to the surgical creation of an artificial vagina using a split skin graft or an amnion graft. In our study, we had also performed McIndoe vaginoplasty using autologous skin graft in eight patients and amnion grafts in two patients. All patients had a successful recovery and satisfactory sexual performance. Chaudhary et al. conducted a study on eight patients with MRKH and performed McIndoe vaginoplasty using amnion grafts with similar results in all patients. Recent ACOG committee guidelines recommend that dilatation should be the first line of management as it is safer and patient-controlled, and surgery should be reserved for patients who are unsuccessful with primary dilator therapy or those who prefer surgery.

The incidence of cervicovaginal agenesis (CVA) is 0.01% in the general population and represents about 3% of the Mullerian anomalies. Functional endometrial tissue is seen in 7% of the cases. We performed McIndoe vaginoplasty on four patients presenting with CVA. Patients subsequently developed vaginal stenosis and hysterectomy had to be performed. Xie et al. conducted a retrospective study on 32 patients with CVA, wherein 84.3% had a successful outcome with utero-cervical canalization and vaginal reconstruction procedure while 15.6% of cases had to undergo a hysterectomy.

Another etiology of primary amenorrhea and cyclical abdominal pain is the complete imperforate transverse vaginal septum. The prevalence is very rare, approximately 1/30,000–84,000 women. Excision of the septum followed by postoperative vaginal dilation is of paramount importance in such cases. We performed excision of the septum with end-to-end anastomosis of the vaginal epithelium and postoperative vaginal dilatation similar to the technique described by Wieriana et al. and had a favorable outcome. Akar et al. reported that reproductive outcomes in patients with a unicorne uterus are poor, with a live birth rate of only 29.2%, 44% with premature births, and incidence of ectopic pregnancy up to 4%. In the present study, we encountered five patients with a unicorne uterus and nine patients of unicorne uterus with a rudimentary horn. About 28% of the patients presented with recurrent preterm births and 40% of patients had an abnormal presentation at term. In the present study, two patients required laparotomy due to spontaneous rupture of the rudimentary horn of the uterus. Vijayalakshmi and Chandana cited a similar case where there was the rupture of a rudimentary communicating horn of unicorne uterus at 24 weeks of gestation.

Didelphys uterus is a very rare uterine anomaly as compared to other abnormalities. The data available on the reproductive outcome in these patients is mixed, owing to its rare occurrence. In our study, there was a single case that presented with primary infertility. After ruling out all other causes of infertility, metroplasty with unification was performed through the patient could not conceive even after 3 years. The association between didelphys uterus and fertility is debatable. Nohara et al. reported a case of a woman...
with didelphys uterus that was pregnant with twins while Mashiach et al.\(^\text{[21]}\) reported triplet pregnancy in a case with didelphys uterus. On the contrary, a retrospective study done by Zhang et al.\(^\text{[16]}\) demonstrated that patients with didelphys uterus required infertility treatments more frequently than with other anomalies.

A bicornuate uterus is formed when the MDs incompletely fuse at the level of the uterine fundus. Reproductive outcome comprises term deliveries in 60%, cases, spontaneous abortion in 28% cases and preterm deliveries in 20% of the cases.\(^\text{[14,19]}\)

In this study, patients with bicornuate uterus presented with primary infertility and endometrioma in one case and ovarian malignancy in the second case. After cystectomy patient had a spontaneous conception. Martinez-Frias et al.\(^\text{[36]}\) found that the risk of congenital defects is four times higher in infants born to mothers with a bicornuate uterus.

Ghi et al.\(^\text{[37]}\) documented a strong association of adverse pregnancy outcomes with the Septate uterus, with 66.7% of the cases with first- and mid-trimester abortions. This comparable to our study where 40% of patients with septate uterus presented with recurrent abortions and 20% with a nonvertex presentation. We performed hysteroscopic septal resection, resulting in a 50% pregnancy rate. A study conducted by Nouri et al.\(^\text{[38]}\) documented a 60% pregnancy rate after hysteroscopic management of septate uterus.

LVS is another entity of Mullerian anomalies where the patient presents with dyspareunia, dysmenorrhea, or may be asymptomatic.\(^\text{[39]}\) In this study, two patients were diagnosed with LVS. Similar to the case reported by de França Neto et al.,\(^\text{[39]}\) the septum was excised during the second stage of labor that was followed by normal delivery.

**Conclusion**

Genital tract malformations are rare. Appropriate preoperative evaluation of reproductive and pelvic anatomy is critical for the treatment of any Mullerian anomaly. Optimal and timely management bear good results.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Robbins JB, Broadwell C, Chow LC, Parry JP, Sadowski EA. Mullerian duct anomalies: Embryological development, classification, and MRI assessment. J Magn Reson Imaging 2015;41:1-2.
2. Rechberger T, Kulik-Rechberger B. Congenital anomalies of the female reproductive tract – Diagnosis and management. Ginekol Pol 2011;82:137-45.
3. Chandler TM, Machan LS, Cooperberg PL, Harris AC, Chang SD. Mullerian duct anomalies: From diagnosis to intervention. Br J Radiol 2009;82:1034-42.
4. Golan A, Langer R, Bukovsky I, Caspi E. Congenital anomalies of the müllerian system. Fertil Steril 1989;51:747-55.
5. Steinmetz GP. Formation of artificial vagina. West J Surg 1940;48:169-3.
6. Grimbizis GF, Camus M, Tarlatzis BC, Bontis JN, Devroey P. Clinical implications of uterine malformations and hysteroscopic treatment results. Hum Reprod Update 2001;7:161-74.
7. Acién P. Incidence of müllerian defects in fertile and infertile women. Hum Reprod 1997;12:1372-6.
8. The American Fertility Society classifications of adnexal adhesions, distal tubal occlusion, tubal occlusion secondary to tubal ligation, tubal pregnancies, müllerian anomalies and intrauterine adhesions. Fertil Steril 1988;49:944-55.
9. Fedele L, Bianchi S, Frontino G. Septums and synechiae: Approaches to surgical correction. Clin Obstet Gynecol 2006;49:767-88.
10. Gündoğdu E, Emekli E, Oğuzman M, Kebapçı M. Evaluation of the abdominopelvic region using MRI in patients with primary amenorrhea. J Pediatr Endocrinol Metab 2019;32:995-1003.
11. Coleman AD, Arbuckle JL. Advanced imaging for the diagnosis and treatment of coexistent renal and müllerian abnormalities. Curr Urol Rep 2018;19:89.
12. Ludwin A, Pityński K, Ludwin I, Banas T, Knafl ε A. Two- and three-dimensional ultrasonography and sonohysterography versus hysteroscopy with laparoscopy in the differential diagnosis of septate, bicornuate, and arcuate uteri. J Minim Invasive Gynecol 2013;20:90-9.
13. Acién P, Acién M. The presentation and management of complex female genital malformations. Hum Reprod Update 2016;22:48-69.
14. Bhagavath B, Ellie G, Griffiths KM, Winter T, Alur-Gupta S, Richardson C, et al. Uterine malformations: an update of diagnosis, management, and outcomes. Obstet Gynecol Surv 2017;72:377-92.
15. Heinonen PK. Distribution of female genital tract anomalies in two classifications. Eur J Obstet Gynecol Reprod Biol 2016;206:141-6.
16. Guerrier D, Mouche ε T, Pasquier L, Pellerin I. The Mayer-Rokitansky-Küster-Hauser syndrome (congenital absence of uterus and vagina)-phenotypic manifestations and genetic approaches. J Negat Results Biomed 2006;5:1.
17. Ludwin A, Pfeifer SM. Reproductive surgery for müllerian anomalies: A review of progress in the last decade. Fertil Steril 2019;112:408-16.
18. Rikken JF, Kowalik CR, Emanuel MH, Mol BW, Van der Veen F, van Wely M, et al. Septum resection for women of reproductive age with a septate uterus. Cochrane Database Syst Rev 2017;1:CD008576.
19. Chan YY, Jayaprakasan K, Zamora J, Thornton JG, Raine-Fenning N, Coomarasamy A. The prevalence of congenital uterine anomalies in unselected and high-risk populations: A systematic review. Hum Reprod Update 2011;17:761-71.
20. Prior M, Richardson A, Asif S, Polanski L, Parris-Larkin M, Chandler J, et al. Outcome of assisted reproduction in women with congenital uterine anomalies: A prospective observational study. Ultrasound Obstet Gynecol 2018;51:110-7.
21. Parikh MN. Congenital absence of vagina: MRKH syndrome. Obstet Gynecol India 2000;501:128-38.
22. Turunen A, Unnérus CE. Spinal changes in patients with congenital aplasia of the vagina. Acta Obstet Gynecol Scand 1967;46:99-106.
23. Willemsen WN. Combination of the Mayer-Rokitansky-Küster and Klippel-Feil syndrome – A case report and literature review. Eur J Obstet Gynecol Reprod Biol 1982;13:229-35.
24. Morcel K, Camboriceux L, Warrior D. Mayer-Rokitansky-Küster-Hauser (MRKH) syndrome. Orphanet J Rare Dis 2007;2:13.
25. Skinner B, Quint EH. Nonobstructive reproductive tract anomalies: A review of surgical management. J Minim Invasive Gynecol 2017;24:909-14.
26. Chaudhary R, Dhamma V, Singh S, Azad R. Vaginoplasty in Mayer-Rokitansky-Kuster-Hauser syndrome using amnion: A case series. Int J Reprod Contracept Obstet Gynecol 2016;5:3832-9.
27. Kannaiyan L, Chacko J, George A, Sen S. Colon replacement of vagina to restore menstrual function in 11 adolescent girls with vaginal or cervicovaginal agenesis. Pediatr Surg Int 2009;25:675-81.
28. Xie Z, Zhang X, Liu J, Zhang N, Xiao H, Liu Y, et al. Clinical characteristics of congenital cervical atresia based on anatomy and ultrasound: A retrospective study of 32 cases. Eur J Med Res 2014;19:10.
29. Caloia DV, Morris H, Rahmani MR. Congenital transverse vaginal septum: Vaginal hydrosonographic diagnosis. J Ultrasound Med 1998;17:261-4.
30. Wierrani F, Bodner K, Spängler B, Grünerberger W. “Z”-plasty of the transverse vaginal septum using Garcia’s procedure and the Grünerberger modification. Fertil Steril 2003;79:608-12.
31. Akar ME, Bayar D, Yildiz S, Ozel M, Yilmaz Z. Reproductive outcome of women with unicornuate uterus. Aust N Z J Obstet Gynaecol 2005;45:148-50.
32. Vijayalakshmi B, Chandana N. Unusual case presentation: Spontaneous rupture of bicornuate uterus with 24 weeks of pregnancy. J Evol Med Dent Sci 2014;3:1709-12.
33. Nohar M, Nakayama M, Masamoto H, Nakazato K, Sakumoto K, Kanazawa K. Twin pregnancy in each half of a uterus didelphys with a delivery interval of 66 days. BJOG 2003;110:331-2.
34. Mashiach S, Ben-Rafael Z, Dor J, Serr DM. Triplet pregnancy in uterus didelphys with delivery interval of 72 days. Obstet Gynecol 1981;58:519-21.
35. Zhang Y, Zhao YY, Qiao J. Obstetric outcome of women with uterine anomalies in China. Chin Med J (Engl) 2010;123:418-22.
36. Martínez-Frias ML, Bermejo E, Rodríguez-Pinilla E, Frías JL. Congenital anomalies in the offspring of mothers with a bicornuate uterus. Pediatrics 1998;101:E10.
37. Ghi T, De Musso F, Maroni E, Youssef A, Savelli L, Farina A, et al. The pregnancy outcome in women with incidental diagnosis of septate uterus at first trimester scan. Hum Reprod 2012;27:2671-5.
38. Nouri K, Ott J, Huber JC, Fischer EM, Stögbauer L, Tempfer CB. Reproductive outcome after hysteroscopic septoplasty in patients with septate uterus – A retrospective cohort study and systematic review of the literature. Reprod Biol Endocrinol 2010;8:52.
39. de França Neto AH, Nóbrega BV, Clementino Filho J, do Ó TC, de Amorim MM. Intrapartum diagnosis and treatment of longitudinal vaginal septum. Case Rep Obstet Gynecol 2014;2014:108973.