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SPECTRUM OF MRI FINDINGS IN MULLERIAN DUCT ANOMALIES: EXPERIENCE AT ATERTIARY CARE TEACHING HOSPITAL IN WESTERN UTTAR PRADESH

Radio-Diagnosis

Dr. Tushar Malik Junior Resident, Dept Of Radio-diagnosis, SRMS Institute Of Medical Sciences, Bareilly.

Dr. Sameer Rajeev Verma* Professor And Head, Dept Of Radio-diagnosis, SRMS Institute Of Medical Sciences, Bareilly. *Corresponding Author

Dr. Namrata Singh Associate Professor, Dept Of Radio-diagnosis. SRMS Institute Of Medical Sciences, Bareilly.

Dr. Pallavi Sinha Assistant Professor, Dept Of Radio-diagnosis. SRMS Institute Of Medical Sciences, Bareilly.

ABSTRACT

Introduction And Background:-Müllerian duct anomalies (MDAs) affect ~7% of the general population and up to 25% of women with infertility or miscarriage. They arise from disrupted duct fusion between gestational weeks 6–11, forming the uterus, cervix, fallopian tubes, and upper vagina. MDAs are linked to renal (30–50%), vertebral, and reproductive issues. Ovaries and external genitalia are unaffected. MR imaging is preferred for detailed evaluation. In symptomatic adolescents or infertile women, imaging aids diagnosis, treatment planning, and surgical decisions. The American Society for Reproductive Medicine revised its MDA classification in 2021, replacing the class system with nine descriptive categories for clarity and clinical utility. **Aim And Objectives:-** To evaluate and characterize the imaging spectrum of various Mullerian Duct Anomalies on MRI and classify them according to American Society of Reproduction Medicine (ASRM) 2021 classification. **Material And Methods:** This retrospective observational study was conducted on Magnetom Skyra 3.0 Tesla MRI 48 channel and Sampra 1.5 Tesla MRI conducted in department of Radiodiagnosis, at a tertiary care teaching hospital in north western Uttar Pradesh and included 20 patients of MRI confirmed cases of mullerian duct anomaly between July,2024 to June 2025. **Observations And Results:** Ninety percent of the cases were less than 30 years of age in this study. Abdominal/pelvic pain (30%) was the most common symptom, followed by primary amenorrhoea (25%), secondary infertility (20%), and irregular menses (10%) and one case reported feaces passage per vagina. Only 5% were asymptomatic. Most participants (75%) had no associated anomalies. Among the affected patients, absent ovaries (2 cases), renal anomalies (2 cases), and polycystic ovaries (1case) were noted. Müllerian agenesis was the most frequent anomaly (6 cases,30%), followed by septate/arcuate uterus (5 cases,25%), unicornuate uterus (3 cases, 15%), and others. **Conclusion:** Müllerian duct anomalies (MDAs) are congenital malformations affecting reproductive health, seen in ~7% of the population and up to 25% with infertility. In this three-year study of 20 patients, MRI revealed müllerian agenesis as the most common anomaly. Accurate imaging and ASRM classification aid diagnosis and management.

KEYWORDS

Adnexa, Didelphys, mullerian, MRKH.

INTRODUCTION

Müllerian duct anomalies (MDAs) are identified in nearly 7% of the general population and in approximately one-third of women presenting with renal anomalies. The prevalence of MDAs varies significantly depending on the population studied, reaching as high as 25% among women with a history of both infertility and miscarriage. In pediatric and adolescent patients who exhibit symptoms of outflow obstruction at menarche attributable to müllerian duct hypoplasia, it is important for the radiologist to delineate the detailed anatomy of the female genitourinary tract, including the assessment of ectopically positioned ovaries, and to evaluate for associated vertebral anomalies. Among women with infertility or recurrent pregnancy loss associated with MDAs, imaging plays a critical role in identifying candidates for therapeutic interventions aimed at enhancing reproductive outcomes and in detecting complications that may necessitate surgical correction.[1]

The fusion of the müllerian ducts between the 6th and 11th weeks of gestation gives rise to the uterus, fallopian tubes, cervix, and the proximal two-thirds of the vagina. Disruptions in this developmental process result in a broad spectrum of congenital abnormalities known as müllerian duct anomalies (MDAs). As the ovaries and distal third of the vagina derive from separate embryologic structures, MDAs do not involve anomalies of the external genitalia or ovaries. MDAs are clinically significant due to their strong association with infertility, endometriosis, miscarriage, and renal anomalies (30%–50%), as well as vertebral, cardiac, and syndromic abnormalities.[2]

The choice of initial imaging modality is largely determined by the clinical presentation; however, magnetic resonance (MR) imaging remains the modality of choice for evaluating MDAs, as it provides superior visualization of both the uterine cavity and external contours, and demonstrates excellent concordance with clinical subtype diagnosis.[3]

Several classification systems exist for Müllerian duct anomalies (MDAs), with the American Fertility Society (AFS) system-later adopted by the American Society for Reproductive Medicine (ASRM)—being the most commonly used due to its straight forward approach. ASRM was subsequently modified in 2021 to standardize terminology, ease identification in scientific databases, educate and facilitate use by providers, and promote patient awareness. The 2021 modification took away the classes which describe anomalies involving the uterus, cervix, and vagina, and divides them into nine descriptive categories. The nine categories include:

1. Mullerian agenesis
2. Cervical agenesis
3. Unicornuate uterus
4. Uterus didelphys
5. Bicornuate uterus
6. Septate uterus
7. Longitudinal vaginal septum
8. Transverse vaginal septum
9. Complex anomalies[5]

Objective

To evaluate and characterize the imaging spectrum of various Mullerian Duct Anomalies on MRI and classify them according to American Society of Reproduction Medicine (ASRM)2021 classification.

MATERIALS AND METHODS

This retrospective observational case study was conducted in department of Radiodiagnosis, in a tertiary care teaching hospital of Rohilkhand region in Western Uttar Pradesh and included all patients referred to the department of Radio diagnosis with clinically suspected mullerian duct anomaly between July, 2024 to June, 2025. The study included patients who were clinically suspected to have Müllerian duct anomalies and were subsequently referred for magnetic resonance imaging (MRI) by their respective clinicians or surgeons. Patients were excluded if they had previously undergone surgical treatment for the condition or if their MRI findings were reported as normal.

MRI examinations were performed using either a Magnetom Skyra 3.0 Tesla MRI system with a 48-channel coil or a Sampra 1.5 Tesla MRI unit. The imaging protocol comprised T2-weighted fast spin echo

(FSE) sequences acquired in axial, sagittal, and coronal planes, with particular emphasis on obtaining a true coronal view of the uterus. Additionally, T1-weighted spin echo sequences were obtained in the axial plane, along with axial T1-weighted and T2-weighted fat-saturated sequences. An optional 3D T2-weighted sequence, such as SPACE or CUBE, was also employed in some cases. Post-contrast T1-weighted fat-saturated sequences in axial and coronal planes were acquired when deemed necessary.

Ethical Considerations: Institutional ethics committee approval was obtained prior to starting the study.

RESULTS:

Table- 1. Demographic Data Of The Included Patients.

Age	No. of Participants(%)
11-20	8(40%)
21-30	10(50%)
31-40	2(10%)

Table- 2. Distribution Of Presenting Symptom In The Included Patients.

Chief Complaints	No. of Participants (%)
Asymptomatic	1 (5%)
Primary Amenorrhoea	5 (25%)
Secondary Infertility	4 (20%)
Irregular menses	2 (10%)
Abdominal/ pelvic Pain	6 (30%)
Passage of stool per vagina	1 (5%)

Table- 3. Other Congenital Anomalies Associated With MDAS In Our Study

Associated Anomalies	No. of Participants (%)
None	15 (75%)
Absent ovaries	2 (10%)
Bilateral polycystic ovaries	1 (5%)
Renal agenesis/ectopic	2 (10%)

Table- 4. Uterine Anomalies Classification According To Asrm Classification

Anomalies	No.ofParticipants(%)
Müllerian agenesis	6 (30%)
Cervical agenesis	0 (0%)
Unicornuate uterus	3 (15%)
Uterus didelphys	1 (5%)
Bicornuate uterus	2 (10%)
Septate/ arcuate uterus	5 (25%)
Longitudinal vaginal septum	2 (10%)
Transverse vaginal septum	1 (5%)
Complex anomalies	0 (0%)

DISCUSSION:

Our study includes 20 participants and categorizes them into three age ranges: 11–20, 21–30, and 31–40 years. The age group of 11–20 includes 8(40%) participants, indicating a moderate level of representation. The highest number of participants, totaling 10(50%), which is half the total number of patients in our cohort falls within the 21–30 age group, suggesting that this is the most represented age range in the dataset. In contrast, the 31–40 age group has the fewest participants, with only 2(10%) individuals, showing significantly lower participation compared to the younger age groups. Overall, the table reflects a declining trend in diagnosis as age increases which related to the study conducted by Yousef et al. who reported that MDAs are commonly diagnosed in the third decade.[8]

The most commonly reported complaint is abdominal or pelvic pain, affecting 6 participants, indicating that this is a prominent concern among the group. Primary amenorrhoea is the next most frequent complaint, reported by 5(25%) participants, followed by secondary infertility, which affects 4(20%) participants. Irregular menses were noted in 2(10%) participants. Interestingly, only 1(5%) participant was asymptomatic, and another reported the rare complaint of passage of stool per vagina, suggesting a possible fistula. These findings suggest that the majority of participants experienced significant gynecological or reproductive health issues, with abdominal pain and menstrual irregularities being the most prevalent.

A majority of the participants, 15(75%) in total, did not present with any associated anomalies, indicating that most individuals in the study had no additional complications. However, 2(10%) participants were found to have absent ovaries, which could have significant implications for hormonal balance and fertility. Another 2(10%) participants showed renal anomalies, specifically renal agenesis or ectopic kidneys, suggesting a link between reproductive and urinary tract malformations. Additionally, 1(5%) participant was diagnosed with bilateral polycystic ovaries, a condition definitely associated with hormonal imbalance and infertility. Overall, while most participants were free of associated anomalies, a small but notable portion exhibited significant reproductive and renal abnormalities. Heinonen et al reported similar results in their study that, Malformations of the renal system has been the most frequent associated malformation with Müllerian duct agenesis resulting in approximately 20% cases.[9] Mooren et al. found that the most common congenital renal abnormality was unilateral renal agenesis, which was reported in almost two-thirds of their cases. However, in our study, only two caseshad renal agenesis (10% of all patients).[10]

Müllerian agenesis was the most frequently identified anomaly, accounting for 6 cases (30%) of the total. This was followed by septate or arcuate uterus, observed in 5 cases (25%) of patients. Unicornuate uterus was found in 3 cases (15%), while both bicornuate uterus and longitudinal vaginal septum were present in 2 cases (10%) each. Uterus didelphys and transverse vaginal septum were less common, each representing 1 case (5%). Notably, there were no cases of cervical agenesis or complex anomalies reported in this cohort. This distribution highlights the predominance of Müllerian agenesis and septate/arcuate variants in the studied population. This supports findings similar to study conducted by Shebreya NH et al in which they concluded that Hypoplastic, Agenesis and Didelphysis found to have the same ratio of (21.6%), while Bicornuate uterus was (13.5%), septate (8.1%), unicornuate and transverse vaginal septum all were of (5.4%) incidence and the least common was arcuate uterus with (2.7%) incidence.[7] Panetal. reported that uterine agenesis was the most common type of MDA, which also supports the findings in our study.[11]

CONCLUSION:

Müllerian duct anomalies (MDAs) represent a diverse group of congenital malformations that arise due to disruptions in the development, fusion, or resorption of the müllerian ducts during embryogenesis. These anomalies, affecting approximately 7% of the general population and up to 25% of women with infertility and miscarriage, carry significant clinical implications, particularly in reproductive health and menstrual function. Magnetic resonance imaging (MRI), with its superior soft tissue resolution and multiplanar capabilities, remains the imaging modality of choice for accurate diagnosis, classification, and treatment planning.

In this study, conducted over three years, 20 patients clinically suspected of having MDAs underwent MRI evaluation. The most prevalent anomaly identified was müllerian agenesis (30%), followed by septate or arcuate uterus (25%). Common presenting symptoms included abdominal/pelvic pain (30%) and primary amenorrhea (25%), indicating a strong association between MDAs and gynecologic symptoms. Most patients (75%) had no associated anomalies, though renal and ovarian abnormalities were observed in a minority.

Classification based on the updated 2021 ASRM system facilitated a comprehensive and standardized categorization of MDAs. The findings underscore the importance of early and accurate imaging diagnosis in guiding clinical management and improving reproductive outcomes in affected individuals. This emphasizes the role of radiologists in multidisciplinary fertility and gynecology care.

Image Gallery

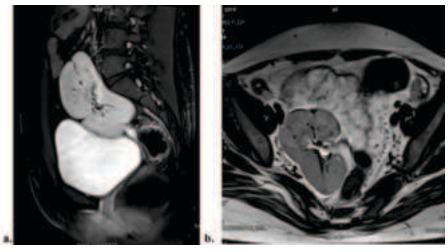

Figure 1: T1w post contrast sagittal (a) and axial (b) MRI sequence demonstrates an ectopic right kidney associated with MRKH

Syndrome

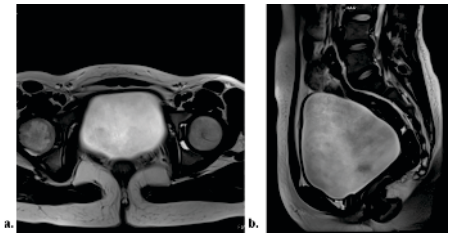

Figure 2: T2W axial (a) and sagittal (b) MRI images demonstrating complete absence of uterus, cervix and upper 2/3rd of vagina.

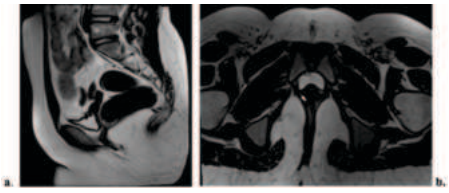

Figure 3: T2W sagittal (a) and axial (b) MRI sequences demonstrating a hypoplastic uterus

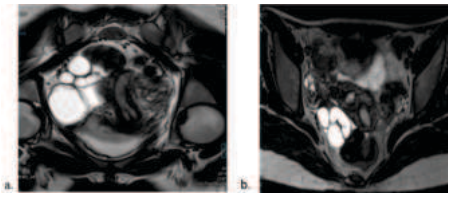

Figure 4: T2 W axial images demonstrating a left unicornuate uterus and rudimentary non- communicating right uterine horn with endometrium.

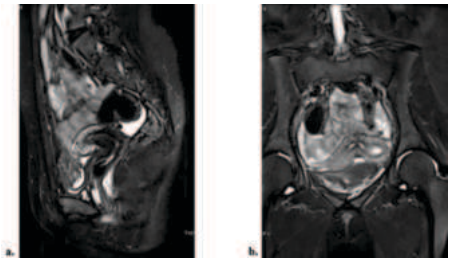

Figure 5: T2 W sagittal and axial images demonstrating complete duplication of uterine horns as well as the cervix as well as hematocolpos s/o Uterine Didelphys.

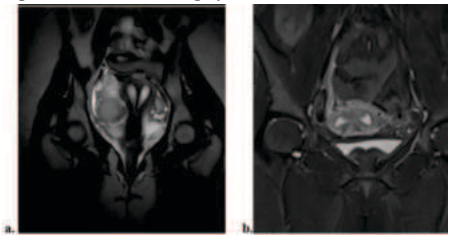

Figure 6: T2w fat sat coronal(a) and axial (b) MRI image demonstrating complete septate uterus.

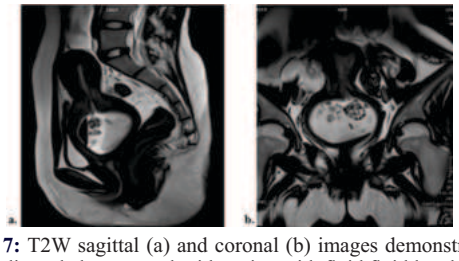

Figure 7: T2W sagittal (a) and coronal (b) images demonstrating a grossly distended upper and mid vagina with fluid fluid levels within and abrupt tapering of distal vagina s/o hematocolpos secondary to transverse vaginal septum.

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