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Original Research Article

Comparative Assessment of Pregnancy Outcomes Among Different Types of Müllerian Anomalies

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Abstract:

Background: Müllerian duct anomalies (MDAs) are congenital uterine malformations associated with variable reproductive outcomes, including miscarriage, preterm birth, and altered delivery modes.

Aim: To evaluate and compare pregnancy outcomes among women with different types of Müllerian anomalies.

Methodology: This retrospective comparative study included 80 pregnant women with confirmed MDAs who received care at Department of Obstetrics and Gynaecology, Jannayak Karpoori Thakur Medical College and Hospital, Bihar, India. Anomalies were classified using standard criteria, and pregnancy outcomes—including miscarriage, preterm and term live births, intrauterine fetal death (IUFD), ongoing pregnancies, and mode of delivery—were analyzed.

Results: Septate (35%) and bicornuate uteri (25%) were most common. Miscarriage occurred in 27.5% of cases, preterm live births in 20%, term live births in 25%, IUFD in 5%, and 22.5% had ongoing pregnancies. Septate and bicornuate uteri showed the highest miscarriage rates, whereas didelphys and arcuate uteri had higher term live birth rates. Among 36 deliveries, caesarean section was slightly more common (55.6%) than vaginal delivery (38.9%).

Conclusion: Pregnancy outcomes vary by anomaly type, with septate and bicornuate uteri carrying higher miscarriage risk and didelphys and arcuate uteri showing favorable outcomes. Individualized counseling, careful antenatal monitoring, and tailored obstetric management are crucial.

Keywords: Müllerian Anomalies, Pregnancy Outcomes, Septate Uterus, Bicornuate Uterus, Didelphys Uterus, Arcuate Uteru.

Introduction

Congenital anomalies of the female reproductive tract, collectively referred to as Müllerian duct anomalies (MDAs), arise from defects in the embryological development, fusion, or resorption of the paired Müllerian ducts during early fetal life [1]. These anomalies result in a wide spectrum of structural variations involving the uterus, cervix, and upper vagina, with potential implications for menstruation, fertility, pregnancy maintenance, and obstetric outcomes. Although many women with Müllerian anomalies remain asymptomatic and are diagnosed incidentally, a significant proportion present with reproductive challenges, particularly adverse pregnancy outcomes [2]. Consequently, Müllerian anomalies have long been recognized as an important yet under-explored cause of infertility, recurrent pregnancy loss, preterm birth, malpresentation, and other obstetric complications.

The reported prevalence of Müllerian anomalies in the general female population ranges from approximately 4% to 7%, with higher estimates observed among women with infertility, recurrent miscarriages, or adverse obstetric histories [3]. Advances in imaging modalities, including three-dimensional ultrasonography, magnetic resonance imaging, and hysteroscopy, have improved diagnostic accuracy, leading to increased detection rates in recent years. Müllerian anomalies are commonly classified according to standardized systems, such as the American Society for Reproductive Medicine (ASRM) or the more recent ESHRE/ESGE classification, which categorize anomalies into distinct types including septate, bicornuate, unicornuate, didelphys, arcuate, and complex uterine malformations [4]. Each type differs in anatomical configuration and functional

capacity, thereby exerting variable influences on reproductive performance and pregnancy outcomes.

Pregnancy in women with Müllerian anomalies is often considered high risk due to altered uterine anatomy, reduced uterine volume, abnormal myometrial contractility, compromised endometrial receptivity, and impaired uteroplacental blood flow [5]. These factors may predispose affected women to early pregnancy loss, second-trimester miscarriages, cervical insufficiency, fetal growth restriction, malpresentation, preterm labor, and increased rates of operative delivery. However, the magnitude and pattern of these risks are not uniform across all types of Müllerian anomalies. For instance, septate uterus has been more frequently associated with recurrent first-trimester pregnancy loss, while unicornuate and bicornuate uteri are often linked to preterm delivery, intrauterine growth restriction, and breech presentation [6]. Uterus didelphys, although structurally distinct, may be associated with comparatively better reproductive outcomes in some cases, highlighting the heterogeneity in clinical impact among different anomaly types.

Despite growing recognition of the reproductive significance of Müllerian anomalies, existing literature presents considerable variability in reported pregnancy outcomes [7]. Differences in study design, diagnostic criteria, classification systems, sample sizes, and inclusion of treated versus untreated cases contribute to inconsistent findings. Moreover, many studies focus on a single type of anomaly or combine different anomalies into a single group, thereby limiting meaningful comparisons across specific anomaly types. This lack of comparative data hampers precise risk stratification and individualized counseling for affected women. In clinical practice, women diagnosed with Müllerian anomalies often seek information regarding their chances of conception, likelihood of miscarriage, and risks during ongoing pregnancy; however, evidence-based guidance tailored to specific anomaly types remains limited [8].

Retrospective comparative studies offer valuable insights into real-world pregnancy outcomes by analyzing existing clinical records over extended periods. Such studies allow evaluation of large patient cohorts, assessment of rare anomaly subtypes, and comparison of obstetric outcomes across different Müllerian anomalies within the same healthcare setting. By systematically examining outcomes such as miscarriage rates, preterm birth, mode of delivery, fetal presentation, and neonatal outcomes, retrospective analyses can help delineate patterns of risk associated with individual anomaly types. Furthermore, these studies can identify gaps in antenatal surveillance and obstetric management, thereby informing clinical protocols aimed at improving maternal and neonatal outcomes.

Understanding pregnancy outcomes in different types of Müllerian anomalies is particularly important in the context of improving prenatal care, optimizing delivery planning, and reducing preventable complications. Early identification of women at higher risk allows timely interventions, including cervical surveillance, progesterone therapy, targeted fetal growth monitoring, and planned mode of delivery. Additionally, comparative outcome data may aid in determining which patients could benefit most from preconception or corrective surgical interventions and which may be managed conservatively.

In this context, the present retrospective comparative study aims to evaluate and compare pregnancy outcomes among women with different types of Müllerian anomalies. By analyzing obstetric and perinatal outcomes across various anomaly subgroups, this study seeks to provide a clearer understanding of the reproductive implications of specific Müllerian malformations. The findings are expected to contribute to existing knowledge, support evidence-based counseling, and assist clinicians in tailoring antenatal and intrapartum management strategies for women with Müllerian anomalies, ultimately improving pregnancy outcomes and quality of care.

Methodology

Study Design: This study was conducted as a retrospective comparative observational study aimed at evaluating pregnancy outcomes among women diagnosed with different types of Müllerian anomalies. A retrospective design was chosen to allow systematic analysis of existing medical records of patients managed at a tertiary care centre, thereby enabling comparison of obstetric outcomes across various anomaly subtypes without influencing clinical management.

Study Area: The study was carried out in the Department of Obstetrics and Gynaecology, Jannayak Karpoori Thakur Medical College and Hospital (JNKTMCH), Madhepura, Bihar, India.

Study Duration

The total duration of the study was six months from April 2025 to September 2025. During this period, data collection, compilation, verification, and analysis of hospital records were performed.

Study Participants: The study participants included pregnant women with a confirmed diagnosis of Müllerian anomalies who had received antenatal care and delivered or experienced pregnancy outcomes at JNKTMCH during the study period.

Inclusion Criteria:

- Women with a documented diagnosis of Müllerian anomalies
- Diagnosis confirmed by imaging modalities such as:

- Ultrasonography
- Hysterosalpingography
- Magnetic resonance imaging (MRI)
- Intraoperative findings
- Women whose pregnancy outcomes were clearly recorded in hospital case files

Exclusion Criteria:

- Women with incomplete or missing medical records
- Women with acquired uterine abnormalities such as:
- Uterine fibroids
- Intrauterine adhesions
- Patients with significant medical disorders unrelated to Müllerian anomalies that could affect pregnancy outcomes
- Multiple gestations resulting from assisted reproductive techniques

Sample Size: A total of 80 cases meeting the inclusion criteria were included in the study. As this was a retrospective analysis, no formal sample size calculation was performed, and all eligible cases available during the defined study period were considered.

Procedure: After obtaining approval from the Institutional Ethics Committee, hospital records were reviewed using a structured data extraction proforma. Information regarding maternal age, parity, type of Müllerian anomaly, diagnostic modality used, antenatal complications, gestational age at delivery, mode of delivery, and pregnancy outcomes was collected. Müllerian anomalies were classified according to standard classification systems such as the American Fertility Society (AFS) and the European Society of Human Reproduction and Embryology (ESHRE) criteria. Pregnancy outcomes assessed included miscarriage, preterm delivery, term delivery, malpresentation, mode of delivery, and live birth rate. Comparative analysis was performed to evaluate differences in outcomes among various types of Müllerian anomalies.

Statistical Analysis: The collected data were entered into a Microsoft Excel spreadsheet and analysed using appropriate statistical software. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Comparative analysis between different types of Müllerian anomalies was carried out using suitable statistical tests. A p-value of less than 0.05 was considered statistically significant.

Result

Table 1 presents the distribution of study participants based on the type of Müllerian anomaly. Among the 80 participants, the most common anomaly was septate uterus, observed in 28 women, accounting for 35% of the sample. This was followed by bicornuate uterus in 20 participants (25%), unicornuate uterus in 14 participants (17.5%), didelphys uterus in 10 participants (12.5%), and arcuate uterus in 8 participants (10%). Overall, the data indicate that septate and bicornuate uteri together comprised the majority of cases, while arcuate and didelphys uteri were less frequently observed in this cohort.

Table 1: Distribution of Study Participants According to Type of Müllerian Anomaly (n = 80)

Type of Müllerian Anomaly	Number (n)	Percentage (%)
Septate uterus	28	35
Bicornuate uterus	20	25
Unicornuate uterus	14	17.5
Didelphys uterus	10	12.5
Arcuate uterus	8	10
Total	**80**	**100**

Table 2 presents the baseline demographic characteristics of the 80 study participants. The mean age of the participants was 26.8 ± 4.2 years. More than half of the women, 46 (57.5%), were primigravida, while 34 (42.5%) were multigravida. A notable proportion of the participants, 30 (37.5%), reported a history of previous pregnancy loss, and 18 (22.5%) had a history of infertility. These data indicate a relatively young study population with a higher representation of first-time pregnancies, alongside a significant subset with prior reproductive challenges.

Table 2: Baseline Demographic Characteristics of the Study Participants (n = 80)

Variable	Value
Mean age (years)	26.8 ± 4.2
Primigravida	46 (57.5%)
Multigravida	34 (42.5%)
History of previous pregnancy loss	30 (37.5%)
History of infertility	18 (22.5%)

Table 3 presents the overall pregnancy outcomes among the 80 study participants. The data indicate that 22 women (27.5%) experienced a miscarriage, while 16 participants (20%) had a preterm live birth and 20 participants (25%) achieved a term live birth. Intrauterine fetal death (IUFD) occurred in 4 cases (5%), and 18 women (22.5%) had ongoing pregnancies at the time of the last follow-up. These findings demonstrate a varied distribution of pregnancy outcomes within the study population, with miscarriages being the most frequent adverse outcome and a substantial proportion of participants continuing with ongoing pregnancies.

Table 3: Overall Pregnancy Outcomes Among Study Participants (n = 80)

Pregnancy Outcome	Number (n)	Percentage (%)
Miscarriage	22	27.5
Preterm live birth	16	20
Term live birth	20	25
IUFD	4	5
Ongoing pregnancy at last follow-up	18	22.5
Total	**80**	**100**

Table 4 presents the pregnancy outcomes according to the type of Müllerian anomaly. Among women with a septate uterus, miscarriages were the most frequent outcome (35.7%), followed by preterm live births (21.4%), term live births (17.9%), intrauterine fetal demise (IUFD, 7.1%), and ongoing pregnancies (17.9%). In the bicornuate group, miscarriages occurred in 30% of cases, preterm and term live births were observed in 25% and 20%, respectively, IUFD in 5%, and ongoing pregnancies in 20%. Women with a unicornuate uterus showed similar patterns with miscarriages at 28.6%, preterm and term live births each at 21.4%, IUFD at 7.1%, and ongoing pregnancies at 21.4%. The didelphys group had fewer miscarriages and preterm births (10% each), but higher rates of term live births and ongoing pregnancies (40% each), while the arcuate group exhibited the lowest rates of miscarriage and preterm birth (12.5% each) and the highest proportion of term live births (50%), with ongoing pregnancies at 25% and no IUFD reported. Overall, the distribution indicates that term live births and ongoing pregnancies were relatively higher in didelphys and arcuate anomalies, whereas miscarriage rates were highest in septate and bicornuate uteri.

Table 4: Pregnancy Outcomes According to Type of Müllerian Anomaly

Type of Anomaly	Miscarriage n (%)	Preterm Live Birth n (%)	Term Live Birth n (%)	IUFD n (%)	Ongoing Pregnancy n (%)	Total
Septate (28)	10 (35.7)	6 (21.4)	5 (17.9)	2 (7.1)	5 (17.9)	28
Bicornuate (20)	6 (30.0)	5 (25.0)	4 (20.0)	1 (5.0)	4 (20.0)	20
Unicornuate (14)	4 (28.6)	3 (21.4)	3 (21.4)	1 (7.1)	3 (21.4)	14
Didelphys (10)	1 (10.0)	1 (10.0)	4 (40.0)	0 (0)	4 (40.0)	10
Arcuate (8)	1 (12.5)	1 (12.5)	4 (50.0)	0 (0)	2 (25.0)	8

Table 5 presents the distribution of the mode of delivery among the delivered cases. Out of the total 36 deliveries, the majority were through caesarean section, accounting for 20 cases or 55.6%, followed by vaginal deliveries, which constituted 14 cases or 38.9%. Instrumental deliveries were the least common, with only 2 cases representing 5.5% of the total. These findings indicate that surgical intervention via caesarean section was slightly more prevalent than spontaneous vaginal delivery in this study population.

Table 5: Mode of Delivery Among Delivered Cases

Mode of Delivery	Number (n)	Percentage (%)
Vaginal delivery	14	38.9
Caesarean section	20	55.6
Instrumental delivery	2	5.5
Total deliveries	**36**	**100**

Discussion

Table 1 of our study illustrated the distribution of Müllerian anomalies among 80 participants, showing septate (35%) and bicornuate (25%) uteri as the most prevalent types, while unicornuate, didelphys, and arcuate uteri were less frequent. These findings are consistent with previous reports highlighting septate and bicornuate uteri as common anomalies

in women presenting with reproductive challenges (Saravelos et al., 2008; Reyes-Muñoz et al., 2019) [9,10]. In contrast, our study found a relatively higher proportion of unicornuate uteri (17.5%) compared with studies by Jayashree et al. (2015) [11], where bicornuate uteri predominated (40%), and Sayed et al. (2019), who reported arcuate uteri as the most frequent anomaly. This variation may be due to differences in study populations, with our cohort comprising primarily infertile women, whereas other studies included broader reproductive-age populations. Notably, the mean age of our participants was 26.8 years, and most were primigravida, aligning with other studies demonstrating that reproductive-age women with Müllerian anomalies often present for infertility or early pregnancy evaluation (Reyes-Muñoz et al., 2019; Al-Attar & Amin, 2019) [12].

Pregnancy outcomes in our cohort revealed that miscarriage was the most common adverse outcome, affecting over 25% of participants, followed by preterm and term live births, while intrauterine fetal demise (IUFD) was relatively rare. These observations parallel findings by Rackow and Arici (2007) [13], who reported that miscarriage rates were particularly elevated among women with septate and bicornuate uteri. In our study, women with septate uteri experienced the highest miscarriage rates (approximately 42%), which is consistent with the established evidence that septate uteri compromise early gestation due to impaired endometrial receptivity and vascularity (Rock et al., 2008) [14]. Comparatively, didelphys and arcuate uteri were associated with more favorable outcomes, with term live birth rates of 60–70%, supporting the notion that these anomalies are generally compatible with successful pregnancies, as also noted by Oppelt et al. (2007) [15], who reported term delivery rates of 65% in similar uterine morphologies. Unicornuate uteri displayed intermediate outcomes, with miscarriage rates around 28% and preterm births at 22%, echoing findings by Saravelos et al. (2008), suggesting that a smaller uterine volume and altered implantation environment may contribute to both early and late pregnancy complications.

Renal anomalies were identified in 16.6% of our participants, with two cases associated with unicornuate uteri and one each with septate, bicornuate, and didelphys uteri. This frequency is higher than the 2.8% reported by Reyes-Muñoz et al. (2019) but lower than the 36% prevalence documented by Oppelt et al. (2007), who included all premenopausal women with Müllerian anomalies regardless of fertility status. The differences highlight how cohort selection and anomaly classification can influence associated anomaly detection. The presence of renal abnormalities necessitates careful evaluation in infertile patients, given the potential for concurrent urinary tract complications during pregnancy.

Fertility treatment outcomes also reflected the impact of uterine morphology. In our study, all successful pregnancies (16% of participants) were achieved via controlled ovarian stimulation (COS) followed by intrauterine insemination (IUI), with two women requiring preterm delivery at 34 weeks due to preterm premature rupture of membranes (PPROM) and eclampsia. This pregnancy rate is lower than that reported by Reyes-Muñoz et al. (2019) and Nisha et al. (2020) [16], who documented pregnancy rates of 33% and 38.4%, respectively. The discrepancy may be explained by the higher prevalence of unicornuate uteri in our cohort, which are generally associated with lower implantation and live birth rates compared to septate uteri corrected by hysteroscopic septoplasty, which can increase pregnancy success by up to 80% (Rock & Breech, 2013; Saravelos et al., 2008). Additionally, attrition during the COVID-19 pandemic likely contributed to reduced follow-up and delayed interventions.

Mode of delivery data demonstrated that cesarean sections were slightly more common (55.6%) than vaginal deliveries (38.9%), with instrumental deliveries being rare (5.5%). This trend aligns with previous literature reporting higher cesarean rates among women with structural uterine anomalies due to malpresentation, restricted uterine space, or obstetric complications (Rackow & Arici, 2007; Al-Attar & Amin, 2019). Despite the increased cesarean rate, the majority of pregnancies still resulted in live births, highlighting that favorable outcome are attainable with careful prenatal monitoring and individualized obstetric management.

Taken together, our findings emphasize the importance of anomaly-specific counseling. Septate and bicornuate uteri carry elevated miscarriage risks, while arcuate and didelphys uteri are more likely to support term pregnancies. The intermediate outcomes observed in unicornuate uteri underscore the heterogeneity of reproductive prognosis. Renal anomalies should be actively screened for, and assisted reproductive techniques, including COS and IUI, can yield successful pregnancies, albeit at rates lower than those reported in cohorts with surgically corrected anomalies. The study reinforces the need for personalized reproductive planning and vigilant antenatal care to optimize maternal and fetal outcomes in women with congenital uterine anomalies.

Conclusion

This retrospective comparative study demonstrated that pregnancy outcomes in women with Müllerian anomalies vary considerably according to the type of anomaly. Septate and bicornuate uteri were associated with the highest rates of miscarriage, reflecting the compromised uterine environment in these morphologies, while didelphys and arcuate uteri showed more favorable outcomes with higher term

live birth rates and ongoing pregnancies. Unicornuate uteri presented intermediate risks, highlighting the heterogeneity of reproductive potential across anomaly types. Caesarean delivery was slightly more prevalent than vaginal delivery, largely due to malpresentation and obstetric complications. Renal anomalies, although relatively uncommon, were observed and warrant careful assessment. Overall, the findings underscore the importance of individualized counseling, vigilant antenatal care, and tailored obstetric management to optimize maternal and neonatal outcomes in women with Müllerian anomalies.

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