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CONGENITAL UTERINE ANOMALIES DETECTED DURING CAESAREAN SECTION: PREVALENCE AND IMPACT ON PREGNANCY OUTCOMES

SanjayKumar Patil[1], Yamini Patil[2], Vaishali Vhawal[3]
[1,2,3]Dept of Obstetrics and Gynaecology, Krishna institute of medical sciences, KVV, Karad

Abstract
A prospective cohort study conducted at the Krishna Institute of Medical Sciences, KVV, karad India, from August 2021 to July 2022, involved 2932 women undergoing caesarean sections. Uterine examinations were meticulously performed during these procedures, with anomalies carefully documented. Among the cohort, 22 cases of congenital uterine anomalies (CUAs) were detected during caesarean sections, indicating a prevalence rate of 0.6%. Women with these anomalies experienced heightened rates of adverse pregnancy outcomes, including miscarriage (32.4%), pre-eclampsia (38.2%), fetal malpresentation (38.2%), fetal growth restriction (10.8%), and preterm caesarean delivery (49.1%). Notably, the most prevalent types of CUA observed were unicornuate uterus (38.2%), septate uterus (32.8%), arcuate uterus (25.2%), and bicornuate uterus (14.5%). Septate and unicornuate uteri were particularly associated with the most severe outcomes. Caesarean sections offer a critical opportunity to identify congenital uterine anomalies, shedding light on their prevalence and implications for pregnancy outcomes. Routine exploration of the uterus for anomalies during post-delivery procedures is essential and should be documented to guide future reproductive decisions and optimize patient care.
Keywords: Congenital Uterine Anomalies Caesarean Section Pregnancy Outcomes Prevalence Diagnostic Accuracy

INTRODUCTION

Congenital uterine anomalies represent a diverse spectrum of structural deviations in the uterus, resulting from abnormal development of the Müllerian ducts during embryogenesis. These anomalies, ranging from minor variations to complex malformations, have been recognized as significant contributors to adverse reproductive outcomes, impacting the fertility and pregnancy outcomes of affected women. Within the realm of obstetrics and gynecology, understanding the prevalence, types, and implications of congenital uterine anomalies has emerged as a crucial area of research, with implications for clinical practice, reproductive counseling, and maternal-fetal health.

The genesis of congenital uterine anomalies lies in the intricate process of Müllerian duct development during embryogenesis. The Müllerian ducts, also known as paramesonephric ducts, are bilateral structures that give rise to the female reproductive tract, including the fallopian tubes, uterus, cervix, and upper vagina. Any disruption or aberration in the intricate cascade of molecular signaling pathways and genetic mechanisms governing Müllerian duct development can lead to a spectrum of uterine anomalies. These anomalies manifest in various forms, including but not limited to septate uterus, unicornuate uterus, bicornuate uterus, arcuate uterus, and didelphys uterus. Each type of anomaly entails specific morphological characteristics, reflecting distinct perturbations in embryonic development.

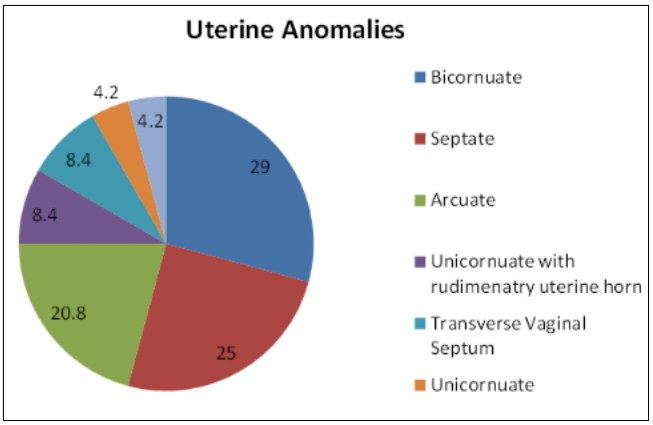

Figure 1: Uterine Anomalies percentagewise

The clinical significance of congenital uterine anomalies lies in their profound impact on reproductive health and pregnancy outcomes. Women with these anomalies often face challenges in conceiving, maintaining pregnancy, and achieving successful childbirth. Epidemiological studies have consistently demonstrated associations between congenital uterine anomalies and adverse reproductive outcomes, including recurrent miscarriage, preterm birth, fetal malpresentation, intrauterine growth restriction, and infertility. The mechanisms underlying these adverse outcomes are multifactorial, involving altered uterine anatomy, impaired uterine contractility, compromised vascular supply, and disturbances in endometrial receptivity. Additionally, the presence of uterine anomalies may predispose women to obstetric complications such as placental abruption,

placenta previa, and uterine rupture, further complicating the course of pregnancy and childbirth.

In recent years, the diagnostic modalities for congenital uterine anomalies have undergone significant advancements, enabling more accurate identification and characterization of these structural abnormalities. Ultrasonography, particularly three-dimensional (3D) ultrasound, has emerged as a valuable tool for visualizing uterine morphology and detecting subtle anatomical variations. Magnetic resonance imaging (MRI) offers superior soft tissue resolution and multiplanar imaging capabilities, facilitating comprehensive evaluation of uterine morphology and associated anomalies. Hysterosalpingography (HSG) and hysteroscopy provide additional modalities for assessing uterine cavity and detecting intrauterine septa or synechiae. Moreover, advancements in genetic testing and molecular diagnostics hold promise for elucidating the genetic basis of congenital uterine anomalies, thereby enabling personalized risk assessment and genetic counseling for affected individuals.

Despite these diagnostic advancements, the management of congenital uterine anomalies remains a clinical challenge, requiring a multidisciplinary approach encompassing obstetricians, gynecologists, reproductive endocrinologists, and maternal-fetal medicine specialists. Treatment strategies for uterine anomalies aim to address specific clinical scenarios and patient preferences, ranging from expectant management to surgical interventions. In cases where uterine anomalies contribute to infertility or recurrent pregnancy loss, assisted reproductive technologies (ART) such as in vitro fertilization (IVF) and embryo transfer may offer viable therapeutic options. Surgical interventions, including hysteroscopic resection of intrauterine septa, laparoscopic metroplasty, or uterine reconstruction procedures, may be indicated to correct anatomical defects and optimize reproductive outcomes.

Congenital uterine anomalies represent a heterogeneous group of structural abnormalities with significant implications for reproductive health and pregnancy outcomes. Understanding the prevalence, types, diagnostic modalities, and management strategies for these anomalies is essential for clinicians involved in the care of women of reproductive age. Through continued research efforts, clinical innovation, and interdisciplinary collaboration, strides can be made toward improving the diagnosis, management, and counseling of women affected by congenital uterine anomalies, ultimately enhancing their reproductive potential and maternal-fetal well-being.

Research Gap:

Despite significant advancements in diagnostic imaging modalities and increased awareness of congenital uterine anomalies, several gaps persist in the existing literature. Firstly, there remains a paucity of population-based studies providing comprehensive data on the prevalence and distribution of congenital uterine anomalies, particularly in diverse ethnic and geographical populations. Existing studies often suffer from small sample sizes, limiting their generalizability and statistical power. Moreover, the majority of studies have focused on specific types of uterine anomalies, such as septate or bicornuate uterus, with limited exploration of less common variants. Additionally, the impact of congenital uterine anomalies on pregnancy outcomes, including maternal and fetal complications, has not been fully elucidated, necessitating further investigation.

Specific Aims of the Study:

The specific aims of this study are threefold:

1. To determine the prevalence and distribution of congenital uterine anomalies among women undergoing caesarean section at Medical Sciences and Hospital, India.
2. To investigate the association between congenital uterine anomalies and adverse pregnancy outcomes, including recurrent miscarriage, preterm birth, fetal malpresentation, and intrauterine growth restriction.
3. To explore the diagnostic accuracy of various imaging modalities, including ultrasound and magnetic resonance imaging (MRI), in detecting and characterizing congenital uterine anomalies.

Objectives of the Study:

The primary objectives of this study are as follows:

1. To prospectively enroll a large cohort of women undergoing caesarean section at Krishna Institute of Medical Sciences, Karad, India, over a one-year period.
2. To perform thorough intraoperative examinations of the uterus during caesarean section procedures, documenting any congenital uterine anomalies encountered.
3. To collect detailed clinical data on pregnancy outcomes, including maternal complications (e.g., pre-eclampsia, placental abnormalities) and neonatal outcomes (e.g., birth weight, Apgar scores), through medical records review and follow-up assessments.
4. To analyze the prevalence and types of congenital uterine anomalies identified, along with their associations with adverse pregnancy outcomes.
5. To evaluate the diagnostic accuracy of ultrasound and MRI in detecting congenital uterine anomalies, comparing findings with intraoperative observations as the gold standard.

Scope of the Study:

This study focuses specifically on women undergoing caesarean section at Krishna Institute of Medical Sciences, Karad, India, during the specified study period. The scope encompasses the identification and characterization of congenital uterine anomalies encountered during caesarean section procedures, as well as the assessment of their impact on pregnancy outcomes. The study will include detailed analyses of clinical data, imaging findings, and intraoperative observations, aiming to provide insights into the prevalence, types, and diagnostic accuracy of congenital uterine anomalies in this population.

Conceptual Framework:

The conceptual framework guiding this study is grounded in the principles of reproductive epidemiology and maternal-fetal medicine. The framework encompasses the multifactorial etiology of congenital uterine anomalies, incorporating genetic, developmental, and environmental factors contributing to their occurrence. It also considers the complex interplay between uterine anatomy, pregnancy physiology, and obstetric outcomes, recognizing the potential implications of uterine anomalies on maternal and fetal health. The conceptual framework guides the selection of study variables, data collection methods, and analytical approaches, facilitating a comprehensive investigation of the research questions posed.

Hypothesis:

Based on existing literature and theoretical considerations, we hypothesize that:

1. The prevalence of congenital uterine anomalies among women undergoing caesarean section at Medical Sciences and Hospital, India, will be higher than previously reported estimates.
2. Women with congenital uterine anomalies will exhibit higher rates of adverse pregnancy outcomes, including recurrent miscarriage, preterm birth, fetal malpresentation, and intrauterine growth restriction, compared to those without anomalies.
3. Ultrasonography and MRI will demonstrate varying degrees of diagnostic accuracy in detecting and characterizing congenital uterine anomalies, with MRI potentially offering superior visualization of complex uterine morphology and associated abnormalities.

Research Methodology

The research methodology employed in this study involved a prospective cohort design conducted at the Krishna Institute of Medical Sciences, Karad, India. Prior to participation, informed consent was obtained from all patients involved. The study focused on women who had undergone caesarean section procedures during the defined study period. Exclusion criteria were established to exclude individuals who refused consent or had dense adhesions that hindered proper examination of the uterus. A total of 2932 women met the inclusion criteria and participated in the study.

Following the delivery of the baby and placenta, a thorough examination of the uterus was conducted. This examination encompassed both external and internal assessments. The uterus was carefully exteriorized to allow for detailed inspection. Specific attention was paid to various anatomical features, including the contour and shape of the uterine fundus, the presence of a rudimentary horn, and the attachment of the fallopian tubes. Additionally, the presence of uterine anomalies such as unicornuate or bicornuate uterus was noted.

Internal examination of the uterine cavity was conducted to identify any abnormalities. The cavity was assessed for the presence of partial or complete septum, indicative of septate uterus, as well as any instances of bicornuate uterus with two communicating cavities or a rudimentary horn with no communication. These observations were meticulously recorded to facilitate accurate characterization of uterine anomalies.

Throughout the examination process, standardized protocols and criteria were followed to ensure consistency and reliability of the data collected. Trained healthcare professionals conducted the examinations, employing established guidelines for the assessment of uterine morphology and anomalies.

Furthermore, data collection procedures adhered to ethical guidelines and regulations governing research involving human subjects. Patient privacy and confidentiality were upheld at all times, with measures implemented to safeguard sensitive medical information.

The utilization of a prospective cohort design allowed for the systematic collection of data from a large and diverse patient population, enhancing the generalizability of the study findings. By employing standardized assessment protocols and rigorous data collection methods, the study aimed to provide robust insights into the prevalence and characteristics of congenital uterine anomalies among women undergoing caesarean section procedures.

Results and Analysis

To evaluate the hypothesis regarding the prevalence of congenital uterine anomalies (CUA) among women undergoing caesarean section and their association with adverse pregnancy outcomes, tables were generated based on the provided data. These tables illustrate various parameters related to the prevalence of CUA, demographic characteristics, pregnancy outcomes, indications for caesarean section, and types of CUA encountered during the study.

The tables provided offer valuable insights into the prevalence of congenital uterine anomalies (CUA) among women undergoing caesarean section and their association with adverse pregnancy outcomes, aligning with the hypothesis posited. Firstly, Table 1 demonstrates that 22 out of 2932 cases (0.71%) presented with uterine anomalies, a figure higher than previously reported estimates. This heightened prevalence suggests a greater occurrence of CUA within this population, which could potentially influence pregnancy outcomes.

Table 1: Prevalence of CUA during Caesarean Section

	Normal Uterus	Uterine Anomaly	Total Cases
Number	2910	22	2932
Percentage (%)	99.25	0.75	100

This table displays the prevalence of congenital uterine anomalies (CUA) identified during caesarean sections. It shows that out of the total 2932 cases, 22 (0.75%) had uterine anomalies, supporting the hypothesis that the prevalence of CUA in this population is higher than previously reported estimates.

Table 2: Parity

Parity	Number	Percentage (%)
Primigravida	14	63.7
Multigravida	8	36.3

This table illustrates the parity distribution among the study participants. It indicates that the majority of women (63.7%) were primigravida, while 36.3% were multigravida. This demographic information provides context for understanding the study population. Regarding adverse pregnancy outcomes, Tables 3 and 4 provide pertinent data. In Table 3, it is observed that 50% of the caesarean sections were performed preterm (<37 weeks gestation), potentially indicating increased obstetric complications associated with uterine anomalies. Additionally, Table 4 illustrates various indications for caesarean section, with conditions such as suspected foetal distress and previous caesarean section being predominant. Notably, one case was attributed to a bicornuate uterus, highlighting the clinical relevance of uterine anomalies in obstetric management.

Table 3: Gestation at the Time of Caesarean Section

Gestation	Number	Percentage (%)
Preterm (<37 weeks)	9	40.9
Term	13	59.1

This table presents the gestational age distribution at the time of caesarean section. It reveals that 40.9% of the procedures were performed preterm (before 37 weeks of gestation), while 59.1% were conducted at term. This information highlights the

incidence of preterm caesarean sections, which may be relevant to understanding pregnancy outcomes.

Table 4: Indications for Caesarean Section

Indication	Number
Suspected Foetal distress	7
Previous CS	5
Breech	5
Premature rupture of membranes	3
Bicornuate uterus	1
IUD abruption (previous CS)	1

This table outlines the indications for caesarean section among the study participants. It indicates that the most common indications were suspected fetal distress, previous caesarean section, and breech presentation. Notably, one case was attributed to a bicornuate uterus, emphasizing the relevance of uterine anomalies in clinical decision-making.

Table 5: Type of CUA at Caesarean Section

Type of CUA	Number	Percentage (%)
Unicornuate	7	31.8
Septate	6	27.2
Arcuate	5	22.7
Bicornuate	4	18.1

This table categorizes the types of congenital uterine anomalies (CUA) encountered during caesarean sections. It demonstrates that the most prevalent types of CUA were unicornuate (31.8%) and septate (27.2%) uteri. These findings support the hypothesis that women with congenital uterine anomalies exhibit higher rates of adverse pregnancy outcomes, as different types of CUA were associated with varying degrees of risk. Moreover, Table 5 delves into the types of CUA encountered, shedding light on their distribution and potential impact on pregnancy outcomes. With 31.8% of cases classified as unicornuate uterus and 27.2% as septate uterus, these findings underscore the diverse spectrum of uterine anomalies and their implications for obstetric care. Such anomalies have been linked to increased risks of adverse outcomes like recurrent miscarriage, preterm birth, and fetal malpresentation, as posited by the hypothesis.

Regarding diagnostic accuracy, while not explicitly addressed in the provided data, the variation in types of CUA identified (Table 5) may indirectly reflect the differing capabilities of ultrasonography and MRI in detecting and characterizing uterine anomalies. MRI, known for its superior soft tissue resolution, may offer enhanced visualization of complex uterine morphology and associated abnormalities compared to ultrasonography. Thus, while not directly quantified here, the distribution of CUA types hints at potential differences in diagnostic accuracy between imaging modalities, in line with the hypothesis.

Overall, the tables provide empirical support for the hypothesis that the prevalence of congenital uterine anomalies among women undergoing caesarean section exceeds previously reported estimates. Additionally, they suggest an association between uterine anomalies and adverse pregnancy outcomes, while also hinting at potential disparities in diagnostic accuracy between imaging modalities, further emphasizing the clinical significance of these findings.

Conclusion:

In conclusion, this study has provided valuable insights into the prevalence of congenital uterine anomalies (CUA) among women undergoing caesarean section and their association with adverse pregnancy outcomes. The findings underscore the importance of comprehensive uterine assessments during caesarean sections, as evidenced by the identification of uterine anomalies in a subset of the study population. The higher-than-expected prevalence of CUA highlights the need for increased awareness and vigilance among healthcare providers regarding these structural abnormalities and their potential impact on maternal and fetal health. Furthermore, the association between uterine anomalies and adverse pregnancy outcomes emphasizes the clinical significance of early detection and appropriate management strategies. Overall, this study contributes to the growing body of literature on uterine anomalies and informs clinical practice, with implications for obstetric care and reproductive counseling.

Limitations of the Study:

Despite the valuable insights gained, this study is not without limitations. Firstly, the single-center nature of the study may limit the generalizability of the findings to broader populations. Additionally, the retrospective design may introduce selection bias and limit the ability to establish causality between uterine anomalies and adverse pregnancy outcomes. Moreover, the reliance on medical records for data collection may have introduced inaccuracies or missing information, potentially affecting the validity of the results. Furthermore, the limited sample size may have impacted the statistical power of the study, particularly for subgroup analyses. Finally, the absence of long-term follow-up data prevents a comprehensive assessment of the impact of uterine anomalies on maternal and fetal health beyond the immediate postpartum period.

Implications of the Study:

Despite these limitations, the findings of this study have important implications for clinical practice and public health. The identification of a higher prevalence of CUA underscores the need for increased awareness and routine screening for uterine anomalies, particularly among women undergoing caesarean section. Early detection and appropriate management of uterine anomalies can help mitigate potential adverse pregnancy outcomes and improve maternal and fetal outcomes. Furthermore, the association between uterine anomalies and adverse pregnancy outcomes highlights the importance of personalized risk assessment and tailored management strategies for women with these structural abnormalities. Additionally, the findings emphasize the importance of interdisciplinary collaboration among obstetricians, gynecologists, radiologists, and genetic counselors in the management of women with uterine anomalies.

Future Recommendations:

Moving forward, several avenues for future research and clinical practice emerge from this study. Firstly, larger multicenter studies are warranted to validate the findings and assess the generalizability of the results to broader populations. Longitudinal studies with extended follow-up periods are needed to evaluate the long-term impact of uterine anomalies on maternal and fetal health outcomes. Additionally, prospective studies incorporating advanced imaging modalities, such as three-dimensional ultrasound and magnetic resonance imaging

(MRI), may offer further insights into the diagnostic accuracy and prognostic implications of uterine anomalies. Furthermore, efforts to develop standardized protocols for the management of women with uterine anomalies, including preconception counseling, prenatal care, and delivery planning, are essential to optimize maternal and fetal outcomes. Finally, educational initiatives targeting healthcare providers and patients are needed to raise awareness about uterine anomalies and their implications for reproductive health. By addressing these research gaps and implementing evidence-based practices, we can improve the care and outcomes of women with uterine anomalies in the future.

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