Journal of Pioneering Medical Sciences
Received: March 26, 2025 | Accepted: April 29, 2025 | Published: August 05, 2025
Volume 14, Issue 07, Pages 105-111

DOI https://doi.org/10.47310/jpms2025140717

Prenatal Diagnosis of Triploidy (69,XXY) with Multisystem Fetal Anomalies and Intrauterine Fetal Death

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Abstract **Objectives:** Triploidy is a lethal chromosomal abnormality characterized by an additional complete haploid set of chromosomes. It often leads to early miscarriage, severe congenital anomalies and Intrauterine Fetal Death (IUFD) in later gestation. We report a case of a 25-year-old primigravida whose fetus was diagnosed with triploidy (69,XXY) after prenatal ultrasound revealed extensive multisystem anomalies, including central nervous system, skeletal, renal and cardiac defects. Despite full counseling and the offer of termination, the couple opted to continue the pregnancy, which ended in IUFD at 25 weeks. This case highlights the critical role of detailed anomaly scanning, genetic testing and multidisciplinary counseling in such complex scenarios.

Key Words Triploidy, IUFD, Chorionic Villus Sampling, Ultrasound

INTRODUCTION

The identification of fetal chromosomal abnormalities, such as triploidy, depends heavily on prenatal diagnosis because this condition develops when cells have three complete sets of chromosomes (69 instead of the typical 46). The two distinct forms of triploidy develop either from disomy after two spermatozoa participate in fertilization or from digynic causes when an ovum exhibits altered meiotic division. Research shows that triploidy constitutes a significant portion of recognized chromosomal abnormalities in the human body, where two to three percent of all conceptions involve this abnormality, along with ten to fifteen percent of early pregnancy spontaneous abortions [1]. The recognition of this condition appears through multiple fetal system anomalies that could eventually result in Intrauterine Fetal Demise (IUFD).

The clinical presentation of triploidy shows itself as either obvious structural malformations like holoprosencephaly combined with cardiac and urogenital anomalies, or less apparent findings that ultrasound can detect. Prenatal diagnosis of triploidy has become more precise because of modern imaging methods, which help families make decisions about their pregnancies. Such medical progress has not eliminated the complications that arise from triploidy since the condition frequently results in premature fetal demise or non-survival beyond pregnancy [2].

Research evidence shows that triploidy represents a condition leading to early infant death because it remains viable only during the first 20 weeks of pregnancy. According to the relevant literature, there is an elevated triploidy incidence with aging mothers, yet multiple studies link this condition to younger maternal populations because triploidy manifests from fertilization mistakes not associated with the aging process [3,4]. Free β-hCG combined with PAPP-A markers and nuchal translucency scans provides early signs for chromosomal abnormalities, including triploidy, during prenatal maternal screening [5].

The definitive identification of cellular genetics through Chorionic Villus Sampling (CVS) and amniocentesis happens with regularity to confirm suspicions found during ultrasound scans of chromosomal irregularities. Medical professionals now endorse Non-Invasive Prenatal Testing (NIPT) that analyzes maternal blood for circulating cell-free fetal DNA because it significantly minimizes physical risks to mothers and their fetuses [6,7]. The medical investigation of triploidy faces diagnostic challenges because of its intricate nature; thus, both parents require thorough genetic counseling about diagnosis implications and pregnancy options and possible outcomes [8].

Nevertheless, the incidence of triploidy presents a broad spectrum of outcomes depending on the genetic composition and resultant phenotypic abnormalities. For instance, diandrictriploidies tend to exhibit more extensive structural anomalies compared to digynic forms. This phenomenon is crucial to understanding the clinical ramifications and guiding the management approaches taken by practitioners [2,9]. The variation in clinical presentation associated with triploidy can often lead to confounding factors in diagnosis, prompting the need for advanced genetic testing modalities such as SNP arrays and microarrays to improve diagnostic accuracy [10,11].

Literature Review

The scientific research about prenatal triploidy diagnosis demonstrates how genetic factors combine with medical aspects and psychological elements of this rare chromosome disorder. The medical difficulties associated with triploidy stand as a primary topic in existing studies because this condition affects many pregnancies, while the literature shows that spontaneous abortions occur most frequently. Chromosomal abnormalities in spontaneous abortions have been researched and triploidy stands out by making up 11.76% of observed chromosome defects according to Farcas *et al.* [2].

The research of Srebniak *et al.* [12] demonstrates that genomic Single-Nucleotide Polymorphism (SNP) arrays function as the standard clinical technique for detecting fetal chromosomal abnormalities that permit early healthcare choices when facing significant ultrasound defects [10]. Geneticists can determine test candidate selection through preliminary counseling and give families essential support as they navigate sophisticated diagnostic procedures [9,13]. Attention has shifted to exact genetic technologies, which reduce prenatal risks and create better counseling experiences for patients.

Research must focus on the maternal age impact on chromosomal abnormalities, such as triploidy, since it affects the risk levels. The literature shows that maternal age acts as a significant risk element, yet younger mothers experience higher likelihoods of polyploid conditions because their possible fertilization complications supersede the typical non-disjunction issues associated with older maternal ages [4]. The need exists for personalized screening procedures to assess maternal age risks because they allow improved early identification of at-risk pregnancies.

Medical studies of diandric and digynic pregnancies show that triploidy survival beyond the second trimester is quite rare since most cases result in fetal death [9]. Scientific evidence shows that triploidy cases resulting from maternal origins need pre-birth counseling and psychological support, which must be organized. Proper genetic evaluation requires absolute attention to identify inherited risks because insufficient genetic analysis may misdiagnose familial risks.

The development of NIPT techniques using cell-free fetal DNA analysis has become notable, according to Kolarski *et al.* [3], the diagnostic tool provides a minimally invasive examination with varying accuracy in identifying triploid fetuses, yet it performs differently from usual aneuploidy detection [2,14]. Practitioners encounter important challenges when dealing with different sensitivities in the detection of chromosomal abnormalities, particularly triploidy, even though the method has practical advantages. Integration of thorough pre- and post-test genetic counseling into NIPT must remain the focus because this provides parents with a wide knowledge of screening technique boundaries and consequences [15].

The utilization of advanced chromosomal analysis techniques has revealed a higher detection capacity for abnormal karyotypes in products of conception associated with spontaneous abortion. For instance, a study involving karyotyping and SNP array analysis reported a detection rate of approximately 31% for chromosomal abnormalities, reaffirming the efficacy of combining approaches to optimize diagnostic outcomes [16]. This reinforces the potential for integrating multi-faceted diagnostic strategies to enhance clinical outcomes and decision-making frameworks for expectant families facing the challenges posed by triploidy [11].

Not only does triploidy invoke serious clinical implications, but it also evokes complex ethical and emotional dimensions for families experiencing such pregnancies. The responsibility of healthcare providers extends beyond mere diagnosis; it encompasses facilitating informed discussions regarding the nature of the condition, potential outcomes and available options based on current clinical evidence. Acknowledging families' psychological needs during these discussions is paramount to providing holistic care [3].

Case Presentation

A 25-year-old woman, gravida 1 para 0, presented during her first pregnancy, which was spontaneously conceived. A routine first-trimester dating scan was performed at 12 weeks' gestation, confirming a viable singleton pregnancy. Nuchal Translucency (NT) was within normal limits and no structural abnormalities were detected.

At 19 weeks and 2 days of gestation, a detailed anomaly scan revealed severe fetal growth restriction and multiple congenital anomalies, including:

- **Central Nervous System:** Mild bilateral lateral ventricular dilatation, agenesis of the Cavum Septum Pellucidum (CSP) and abnormal skull morphology showing the lemon sign
- **Craniofacial:** Hypertelorism
- **Thoracic and Cardiac Findings:** Narrow thoracic cage, cardiomegaly and multiple echogenic foci in the right ventricle
- **Spine and Skeletal:** Abnormal spine shape and sacral agenesis
- **Renal and Urinary Tract:** Bilateral echogenic kidneys with renal pelvis dilatation and an absent urinary bladder

Given the extensive structural anomalies and severe symmetrical fetal growth restriction, the differential diagnosis included chromosomal aneuploidy and complex syndromic disorders. The couple was counseled extensively about the possibility of a lethal chromosomal condition and offered prenatal genetic testing.

Genetic Investigation

Amniocentesis was performed Fluorescent in situ Hybridization (FISH) on uncultured amniotic Fluid was consistent with triploidy. Subsequent karyotype analysis from cultured amniocytes confirmed a triploid karyotype: 69,XXY. Further chromosomal evaluation revealed:

- Trisomy of chromosome 8
- Trisomy of chromosome 13
- Trisomy of chromosome 21

These findings were discussed in detail with the couple, who were informed of the lethal nature of the condition and the lack of potential for postnatal survival. Options including pregnancy termination, expectant management and further testing such as cordocentesis were discussed. The couple made an informed decision to continue the pregnancy regardless of the outcome and declined additional investigations.

Follow-Up and Outcome

A follow-up ultrasound at 22 weeks confirmed progressive severe intrauterine growth restriction, anhydramnios and a persistently narrow chest. These findings indicated further fetal deterioration. Repeated counseling was provided, but the couple reiterated their decision not to pursue termination or further work-up.

At 25 weeks' gestation, the patient presented to the emergency department with reduced fetal movements. An ultrasound scan confirmed Intrauterine Fetal Demise (IUFD).

Labor was medically induced. The fetus was delivered vaginally. Postmortem examination showed a macerated fetus consistent in size with 24 weeks of gestation. Fetal birth weight was 250 grams. The placenta weighed 87 grams, with small chorionic villi and mild increased calcification. The placental weight was below the 10th percentile for gestational age, supporting the diagnosis of placental insufficiency and chronic growth restriction.

Due to maceration, detailed external examination and appreciation of fetal anomalies were limited (Figure 1-6).

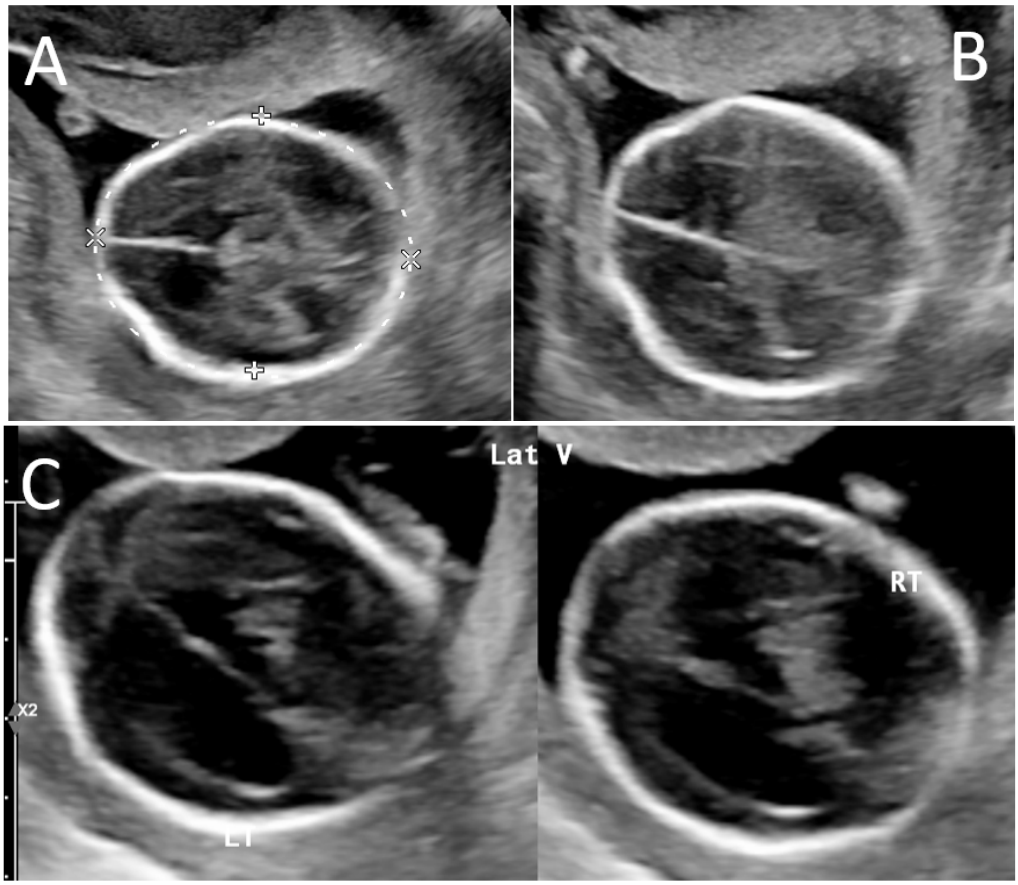

Figure 1: Axial view of a 19-week fetal brain showing (A) The absence of cavum septipellucidi, (B) Frontal scalloping (Lemon sign) and (C) Mild to moderate ventriculomegaly

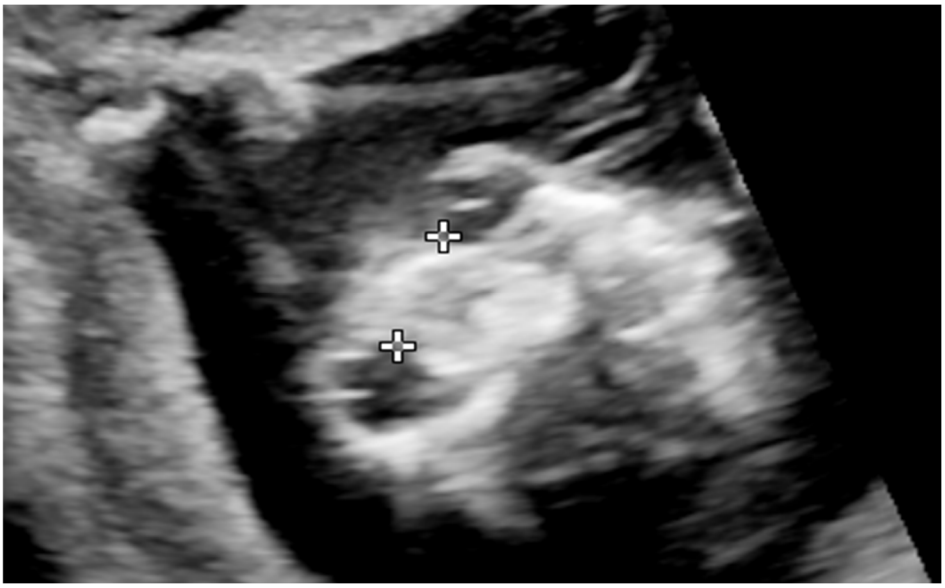

Figure 2: Hypertelorism in a fetus with triploidy at 19 weeks of gestation

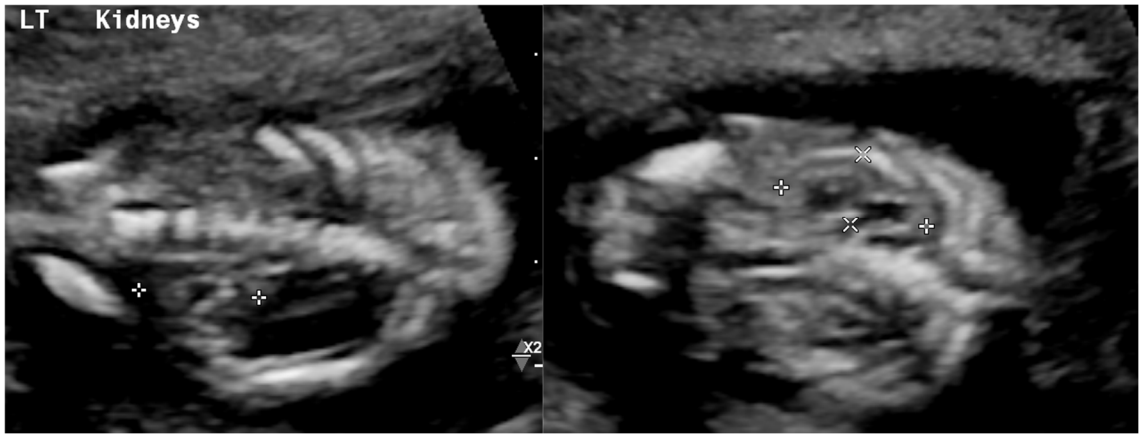

Figure 3: Image showing cystic renal dysplasia with parenchymal hyper-echogenicity

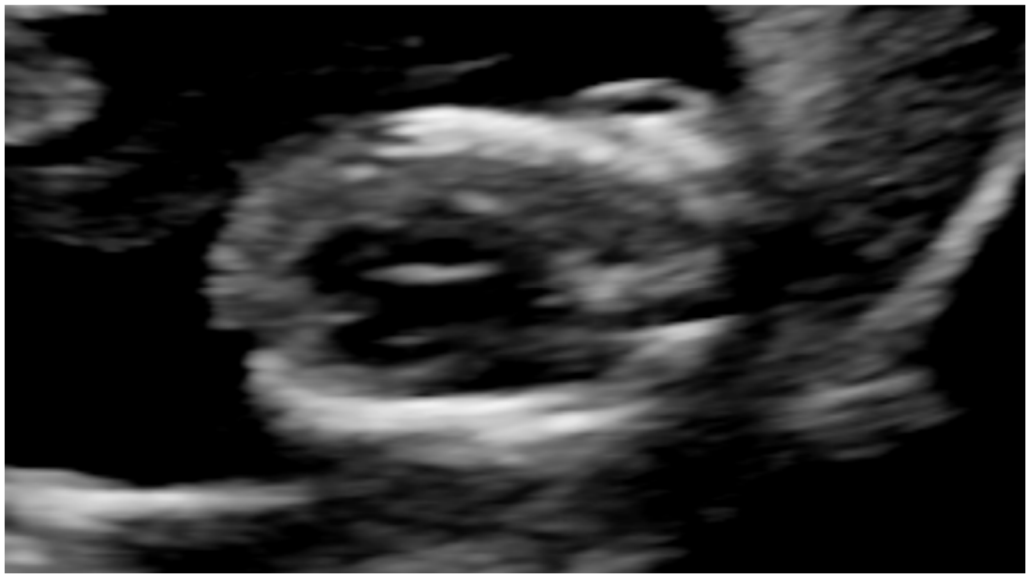

Figure 4: Image showing an Abnormal four-chamber view with cardiomegaly

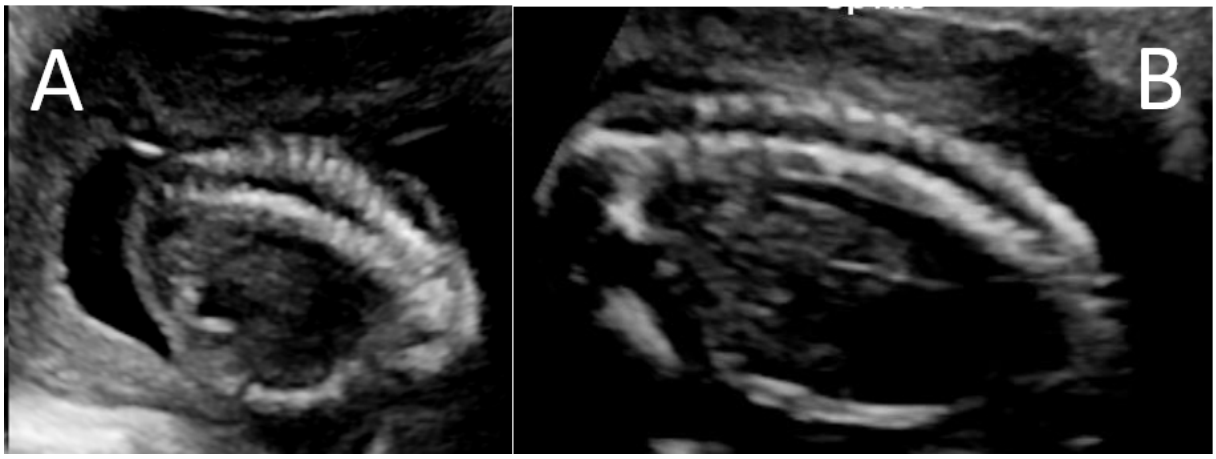

Figure 5: Image showing A: Abnormal spine and B: sacral agenesis

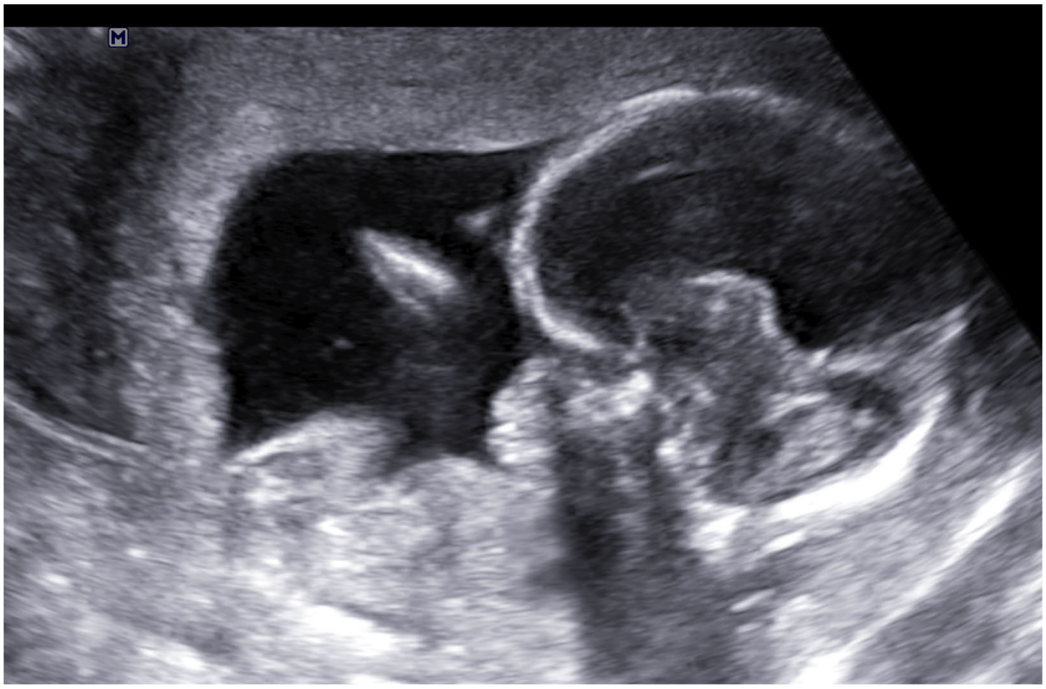

Figure 6: Early severe growth restriction with generalized muscular hypotonia

DISCUSSION

The primary aim of this study is to emphasize the critical importance of early ultrasound screenings, genetic testing and multidisciplinary counseling in managing pregnancies complicated by severe congenital anomalies resulting from chromosomal disorders. This case resonates with previous literature, illustrating the intricate outcomes associated with fetal triploidy and the challenges in prenatal diagnosis and management.

Literature shows that fetal anomalies are severe and rates of Intrauterine Fetal Death (IUFD) are high when triploidy occurs [9]. Massalska *et al.* reported that the genetic anomaly known as triploidy affects less than 2% of all conceptions, while showing paternal or maternal origins, yet our study results through amniocentesis proved 69% XXY triploidy. The literature shows that fetal growth restriction occurs commonly in triploidy cases and affects between 66 to 100 percent of those affected [17]. Multiple studies have confirmed our findings of progressive Fetal Growth Restriction (FGR) in fetal development, as well as consistent ultrasound findings, which demonstrate how difficult it is to predict triploid conditions.

The diverse collection of problems detected in our case study matches studies that demonstrate that triploidy produces different combinations of baby developmental problems. Central nervous system anomalies and severe cardiac defects commonly appear in such cases, per Hayashida *et al.* [18], while our patient exhibited findings of bilateral lateral ventricular dilatation together with cardiomegaly. The medical literature demonstrates numerous abnormal expressions of triploidy, which makes any one fetal defect insufficient to diagnose this

chromosomal condition [19]. This illustrates how complicated triploidy cases remain for both diagnosis and treatment.

The choice of the couple to carry their pregnancy forward despite knowledge of intrauterine fetal death risk warrants attention in prenatal counseling and family relationship management. Parental choices and emotional factors related to their decisions need thorough evaluation, along with counseling for lethal diagnoses. Johnson et al. discovered that most prenatal anomaly diagnoses fail to result in termination, mainly because genetic counseling information interacts with parents' pregnancy-related values and beliefs about continuing their pregnancy [20].

The available literary evidence supports prenatal diagnosis and management for triploidy cases, but this particular study faces multiple challenges. The main drawbacks stem from retrospective data examination and small participant count, since this represents an individual case study rather than large analytical methods. The lack of extended genetic tests following birth prevented full comprehension of newborn outcomes, together with the exact characteristics of detected abnormalities [21]. This case shows how targeted counseling works; however, it requires broader support mechanisms for families dealing with similar medical diagnoses.

Detailed anomaly scanning revealed substantial birth defects, although imaging and diagnostic testing for such late-stage pregnancies proved difficult, especially when dealing with severe growth restriction and IUFD. The value of detailed ultrasound anomaly scans for diagnosis exists, according to Tekesin [22], yet he acknowledges limitations of ultrasound-based diagnosis in identifying chromosomal disorder-related fetal anomalies.

Furthermore, postnatal examination limitations due to maceration of the fetus potentially ground our findings by preventing thorough morphological evaluations that might have provided additional insights into the anomaly spectrum associated with triploidy [23]. This factor highlights a significant hurdle in understanding the complete ramifications of such genetic disorders on fetal morphology and associated clinical features. The case emphasizes the importance of integrating multidisciplinary approaches, where geneticists, obstetricians and pediatricians collaborate closely to provide holistic care.

CONCLUSION

While the current report contributes substantial insights to the understanding of triploidy and its implications for fetal development, it underscores the necessity for robust prenatal diagnostic systems and supportive counseling frameworks. These should entail comprehensive prenatal anomaly screening and genetic testing to ensure accurate diagnoses and appropriate management pathways can be established. The complexities involved with chromosomal disorders like triploidy demand an ongoing dialogue within the medical community, seeking improved methodologies for identifying and managing these rare yet profoundly impactful conditions.

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