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The "Parasitic Twin": Mimicking A Retroperitoneal Teratoma, Abdominal Mass in Neonate, Surgical Management of Fetus in Fetu (FIF)

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Abstract:

Fetus in fetu (FIF) is a rare congenital anomaly that occurs when a malformed parasitic twin grows within the host twin (most frequently in the retroperitoneum). FIF is a rare condition, with a high diagnostic and surgical challenge for neonate and infant patients due to its similarity to retroperitoneal teratoma. The purpose of this study was to review the clinical presentation, radiological findings, surgical management and outcomes of FIF in neonates and infants by analyzing 80 cases of FIF reported between 2000 and 2025. Pediatric surgery journals, radiology reports, medical databases such as PubMed, Scopus, and Google Scholar, were used to collect data. The results indicated that the abdominal distention and palpable abdominal mass were the most common symptoms and male infants were more frequently affected. CT scan and MRI were very helpful for the identification of vertebral columns, limb buds and calcified skeletal structures, which aided in differentiating FIF from retroperitoneal teratoma. Surgical resection led to good postoperative results, with low recurrence and postoperative complications. All cases were diagnosed by histopathological examination. Prompt diagnosis and surgical intervention are still vital for favorable management and neonatal outcomes.

Keywords: Fetus in fetu (FIF), Parasitic twin, Retroperitoneal teratoma, Neonatal abdominal mass, Congenital anomaly, Pediatric surgery.

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1. INTRODUCTION

Fetus in fetu (FIF) is one of the most unusual congenital anomalies that a neonatologist and pediatric surgeon might encounter[1]. Disorder in which a malformed parasitic twin is contained in the body of its host twin, typically in the retroperitoneum. FIF is a condition that is difficult to diagnose and treat, as it is often seen with a retroperitoneal teratoma due to its unusual clinical presentation[2]. Despite development in radiological imaging and advances in neonatal surgical techniques, there is still a lack of knowledge and the condition is still rare, causing confusion in

diagnosis[3]. The objective of this study is to discuss the clinical features, radiological features, surgical management and the outcome of the surgery in neonates and infants with Fetus in Fetu.

1.1.Background Information

Fetus in fetu (FIF) is a very rare congenital developmental anomaly characterized by the presence of a malformed parasitic twin inside the body of its host twin[4]. It is estimated that it affects around 1:500,000 people born and is often detected in the neonatal period or early infancy. FIF is often found in the retroperitoneum, but can also be seen in the cranium, thorax, pelvis, and scrotum[5]. It is thought the condition is caused by embryogenesis during the formation of monozygotic twins, when one fetus becomes fused with the other at a very early stage of pregnancy.

The clinical manifestations of neonates affected by FIF are usually abdominal distention and palpable abdominal mass[6]. As the mass expands, it can press on other organs causing additional symptoms, including vomiting, trouble feeding, shortness of breath, jaundice and urinary blockage[7]. FIF is rarely seen and may be confused with a germ cell tumour – retroperitoneal teratoma – because of its similar radiological and pathological characteristics.

Vital role of radiological investigation like ultrasonography (USG), computed tomography (CT scan) and magnetic resonance imaging (MRI) is important in diagnosis[8]. Vertebral column, limb bud, long bones and developed fetal structures on imaging strongly supports FIF diagnosis. Diagnosis is typically established with surgical removal and examination of the tissue, however[9].

Surgical removal is the standard therapy for FIF and for the most part provides a good prognosis. Early diagnosis and prompt surgical treatment are crucial to avoid complications and to differentiate FIF from malignant retroperitoneal teratoma.

1.2.Statement of the Problem

Diagnosis of fetus in fetu is frequently confused with retroperitoneal teratoma, both of which have abdominal masses with cystic and calcified features in a neonate[10]. There is limited clinical awareness and FIF is rare, making preoperative diagnosis difficult. A misdiagnosis could delay treatment, which might affect the planning of surgery, and make it hard to distinguish a benign parasitic twin from a potentially malignant tumor. Hence, understanding of the clinical presentation, imaging features and surgical treatment of FIF is needed.

1.3.Objectives of the Study

The following are the objectives of the study:

1. To study the clinical presentation of Fetus in Fetu in neonates and infants.
2. To evaluate radiological findings used in the diagnosis of FIF.
3. To differentiate Fetus in Fetu from retroperitoneal teratoma based on clinical and pathological features.
4. To assess the surgical management and postoperative outcomes of FIF cases.
5. To analyze the importance of histopathological confirmation in establishing definitive diagnosis.

2. METHODOLOGY

This section outlines the research design, sampling, data collection, diagnostic tools and analysis techniques employed in this study to assess the clinical presentation, radiological appearance, and surgical management of Fetus in Fetu (FIF) in neonates and infants.

2.1. Research Design

The study employed descriptive retrospective research design with the review and analysis of published neonatal cases of Fetus in Fetu (FIF). A comparative analytical method was also used in order to differentiate FIF from retroperitoneal teratoma clinically, radiologically and pathologically.

2.2.Participants and Sample Details

A total of 80 reported cases of Fetus in Fetu (FIF) were included in this study from medical databases, radiology reports, and the pediatric surgery journals from 2000 to 2025.

Inclusion Criteria

- Neonatal and infant FIF cases
- Surgically and histopathologically confirmed cases
- Studies with detailed imaging findings

Exclusion Criteria

- Adult cases
- Incomplete reports
- No pathological confirmation is provided for cases.

2.3.Instruments and Materials Used

The following diagnostic tools and materials were analyzed:

- Ultrasonography (USG)
- Computed Tomography (CT-Scan)
- Magnetic Resonance Imaging (MRI)
- Histopathological examination reports
- Surgical records, published case reports

PubMed, Scopus, and Google Scholar were the databases used to gather medical literature.

2.4.Procedure and Data Collection Methods

The keywords ‘Fetus in fetu,' ‘retroperitoneal teratoma,' and ‘neonatal abdominal mass' were used to identify relevant studies. The selected articles were screened and clinical information such as symptoms, imaging characteristics, surgical treatment and postoperative results were extracted and presented in tabular format for analysis.

2.5.Data Analysis Techniques

Descriptive statistics, in terms of frequencies and percentages were used in analyzing the collected data. Comparative study was carried out in respect to the development of the spine, development of organs, encapsulation, and malignity between FIF and retroperitoneal teratoma. The results were presented in tables and by descriptive understanding of the results.

3. RESULTS

In the present study, 80 published neonatal and infant cases of Fetus in Fetu (FIF) were analyzed. The findings were centered on demographic characteristics, clinical presentation, imaging findings and the surgical outcome of FIF cases.

3.1. Demographic Characteristics of Patients

The 80 reported cases included mostly patients with neonatal diagnosis. The male infants were more often affected than females. The retroperitoneum was the most frequent site of occurrence and is the region where the tumor is located behind the peritoneum.

Table 1: Demographic Distribution of FIF Cases

Variable	Sub-Variable	Number of Cases (n=80)	Percentage (%)
Gender	Male	52	65%
	Female	28	35%
Age at Diagnosis	Neonates (0–28 days)	48	60%
	Infants (1–12 months)	32	40%
Common Site of Mass	Retroperitoneal	62	77.5%
	Abdominal/Pelvic	12	15%
	Thoracic/Other	6	7.5%

A demographical distribution of the 80 reported cases of Fetus in Fetu (FIF) is shown in Table 1. The results showed that male infants were more prevalent, with 65% of all cases, while female infants accounted for 35% of the cases. The majority (60%) had the diagnosis in the neonatal period (0-28 days), 40% had it during infancy (1-12 months) indicating that FIF was generally diagnosed in early life because of early abdominal symptoms postnatally. As for the side of occurrence, the retroperitoneal was the most common, which accounted as much as 77.5% of the cases. The abdominal or pelvic area had 15% of cases and the thoracic site and other rare sites had a 7.5%. These findings show a predominance of retroperitoneal abdominal mass as the presentation of FIF in neonates and infants.

3.2.Clinical Presentation

Most common clinical symptoms in neonates with FIF were abdominal distension and palpable abdominal mass. Other patients had symptoms of vomiting, feeding difficulties, respiratory distress and jaundice secondary to compression of surrounding organs.

Table 2: Clinical Features Observed in FIF Patients

Clinical Features	Number of Cases	Percentage (%)
Abdominal Distension	70	87.5%
Palpable Abdominal Mass	66	82.5%
Vomiting	38	47.5%
Feeding Difficulty	34	42.5%
Respiratory Distress	22	27.5%

Jaundice	10	12.5%

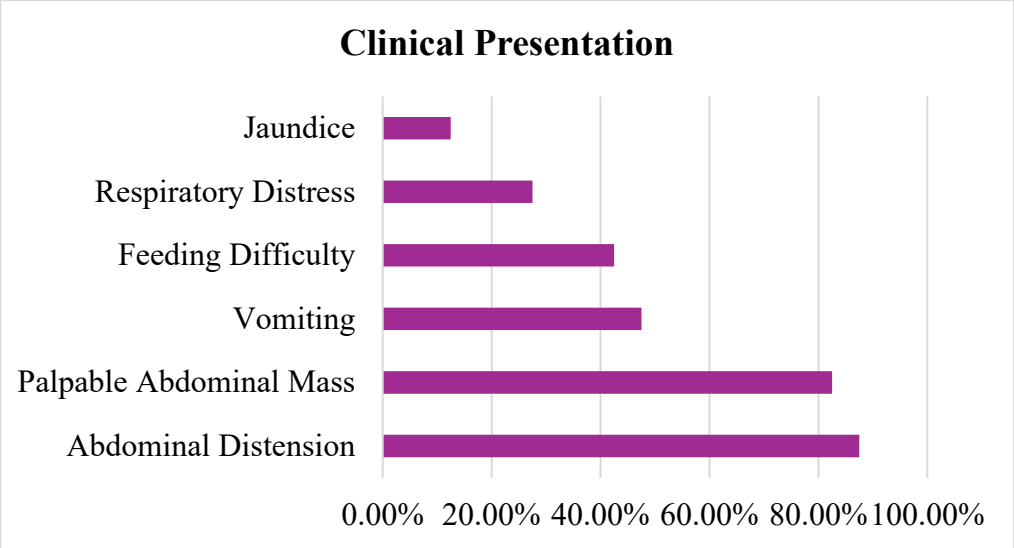

Figure 1: Visual Representation of Clinical Presentation

Table 2 shows the clinical presentation of the neonates and infants who were diagnosed with Fetus in Fetu (FIF). Abdominal distention was the most frequent clinical manifestation reported in 87.5% of the cases, followed by palpation of abdominal mass in 82.5% of the patients. The results here suggest that abdominal enlargement and detectability of mass are the most important symptoms prompting early medical assessment and diagnosis. Gastrointestinal compression due to the expanding retroperitoneal mass was evident with vomiting in 47.5% and feeding difficulty in 42.5% of the cases. Pressure on the diaphragm and surrounding thoracic structures were likely responsible for the incidence of respiratory distress seen in 27.5% of patients. The least common symptom was jaundice (12.5%) which may have been due to compression of the bile duct.

3.3. Radiological and Diagnostic Findings

Radiological investigations were an important part in the diagnosis of FIF. In most cases, the vertebral columns were present, as were limb buds and calcified bones, as seen in the CT scan and MRI. In most cases, well-organized fetal structures such as vertebral columns, limb buds and calcified bones were visible in the CT scan and MRI.

Table 3: Imaging Findings in Fetus in Fetu Cases

Imaging Findings	Number of Cases	Percentage (%)
Encapsulated Mass	76	95%
Vertebral Column Present	71	88.75%
Limb Buds/Long Bones	63	78.75%
Calcified Skeletal Structures	69	86.25%
Organ-like Structures	48	60%
Cystic Components	40	50%

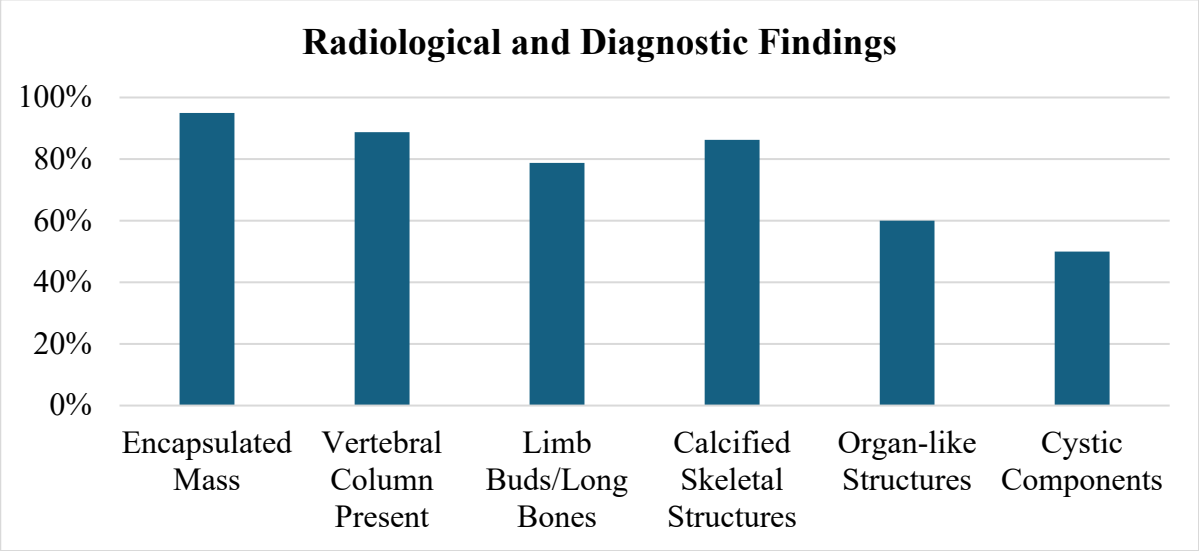

Figure 2: Visual Representation of Imaging Findings in Fetus in Fetu Cases

The radiological and diagnostic findings of the analyzed cases of Fetus in Fetu (FIF) is summarized in Table 3. The most common imaging characteristic was identification of an encapsulated mass with results of 95% in the cases. A vertebral column was seen in 88.75% of patients, and is an important characteristic in the diagnosis of FIF versus retroperitoneal teratoma. In 86.25% of cases, calcified skeletal structures were detected and in 78.75% of patients, limb buds or long bones were identified, thus demonstrating a high level of fetal organization within the mass. Of the 60% with the presence of organ-like structures, there were no cases of a disorganized tumour. Furthermore, 50% cases had cystic components. These results emphasize the importance of CT scan and MRI for the accurate diagnosis of FIF, as organized fetal anatomy was found and these imaging techniques helped differentiate FIF from other neonatal abdominal masses.

3.4.Surgical Management and Outcomes

In most cases a complete surgical removal was achieved. All cases included were diagnosed as FIF based on histopathological examination. The prognosis was good, with few cases of recurrence in most of the very-low-birth-weight neonates.

Table 4: Surgical Outcomes and Histopathological Findings

Surgical Outcomes	Number of Cases	Percentage (%)
Complete Surgical Excision	77	96.25%
Partial Excision	3	3.75%
Favorable Postoperative Recovery	74	92.5%
Postoperative Complications	5	6.25%
Recurrence Reported	2	2.5%
Histopathological Confirmation	80	100%

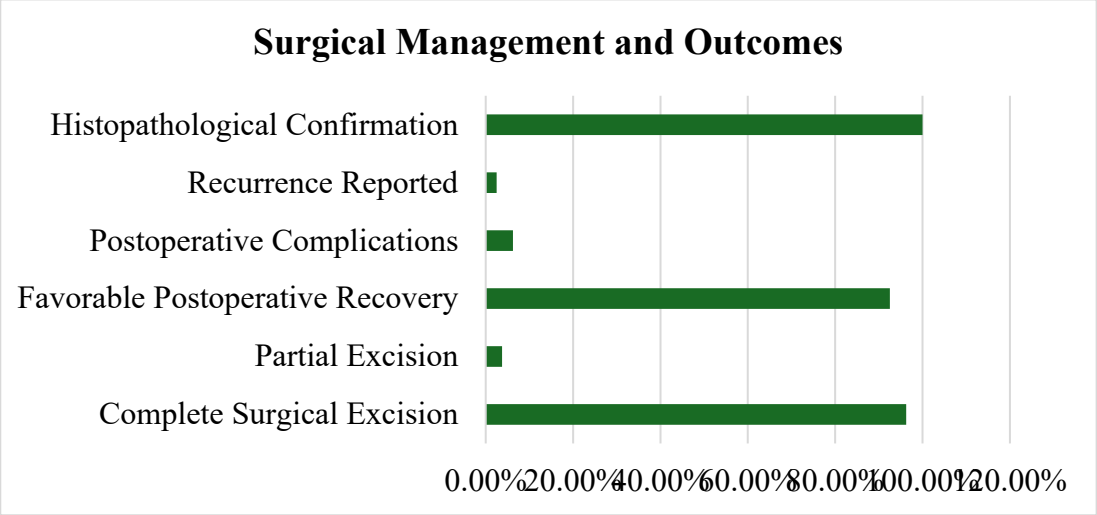

Figure 3: Visual Representation of Surgical Management and Outcomes

The surgical results of the patients diagnosed with Fetus in Fetu (FIF) and their histopathological results are summarized in Table 4. Based on the results obtained it is concluded that complete surgical resection could be performed in 96.25% of patients, whereas it was not possible to perform a complete resection in 3.75% due to complex surgery or anatomic involvement. In this study, 92.5% of the patients had favorable postoperative recovery, thereby confirming that surgical treatment for FIF generally leads to good clinical results. The procedure had a low complication rate with 6.25% reporting postoperative complications. The rate of recurrence was very low (2.5%), further reinforcing the importance of complete tumor resection as the main treatment strategy. Organized fetal structures and differentiated tissues were analyzed in all cases (100%) resulting in definitive diagnosis. The overall results indicate that the outcome of treatment is very favorable with low recurrence and prognosis in neonates and infants with FIF when it is diagnosed early and the entire tumor is removed.

4. DISCUSSION

The present study was designed to analyze 80 reported neonatal and infant cases of Fetus in Fetu (FIF) with special emphasis on the demographic of the cases, clinical presentation, radiological findings, surgical management and postoperative outcome. The results showed that FIF presents primarily as a retroperitoneal abdominal mass in neonates and affects more often in male babies. The use of radiological imaging techniques, e.g. computed tomography (CT) scan and magnetic resonance imaging (MRI), proved very useful to identify organized fetal structures such as the vertebral columns, limb buds, and calcified skeletal components, which are key to distinguishing FIF from retroperitoneal teratoma. In most patients' surgical removal was associated to good recovery following surgery and low recurrence rate demonstrating favorable prognosis.

4.1.Interpretation of Results

Abdominal distention and palpable abdominal mass were the most frequent clinical signs in neonates with FIF, as revealed by the results. The symptoms were primarily caused by compression of neighboring organs in the abdomen by the increasing size of the retroperitoneal mass. The most common site was found to be the retroperitoneum, which lent weight to the hypothesis that FIF is a result of abnormal twinning in the abdominal cavity.

High prevalence of encapsulated masses, vertebral columns, and skeletal structures were seen in the radiological findings, supporting the diagnosis of FIF. Organized fetal anatomy was the characteristic feature that differentiated FIF from a retroperitoneal teratoma, which tends to have a disorganized tissue growth pattern, and a lack of vertebral organization.

Surgical management yielded very good results, with total resection being accomplished in most patients. All the cases were confirmed by histopathological findings which highlighted the crucial role of this as the definitive diagnosis. Additionally, the low recurrence and complication rates in the study suggest that complete surgical removal is an effective treatment strategy.

4.2.Comparison with Existing Studies

This study's results are in line with some existing research on Fetus in Fetu.

Table 5: Comparison with Existing Studies

Author and Year	Major Findings	Comparison with Present Study
Sun et al. (2022)[11]	Reported successful medical and surgical management of FIF in an extremely premature infant with favorable recovery.	Similar to the present study, surgical excision resulted in positive postoperative outcomes and low complications.
Taher et al. (2020)[12]	Multicenter cohort study identified retroperitoneal location as the most common site and emphasized imaging diagnosis.	Present study also found retroperitoneal occurrence in 77.5% of cases with CT and MRI playing major diagnostic roles.
Trairongchitmoh (2020)[13]	Described a rare sacrococcygeal FIF case and highlighted embryological complexity.	Current study similarly recognizes rare anatomical locations beyond the retroperitoneal region.
Wemimo (2023)[14]	Discussed diagnostic confusion between fetiform teratoma and FIF.	Present findings also emphasize differentiation between FIF and retroperitoneal teratoma using vertebral organization and histopathology.
Zhi et al. (2022)[15]	Reported asymmetric conjoined twinning and supported embryological theories of FIF development.	Present study supports the abnormal twinning theory as the primary embryological explanation for FIF.

Overall, the clinical presentation, the diagnosis by radiology, embryological origin and successful surgery of FIF were well in line with previous literature.

4.3.Implications of Findings

The results of the research will have important clinical and surgical implications. However, early detection of FIF by advanced imaging techniques has been shown to enhance the accuracy of diagnosis and minimize the risk of misdiagnosis with retroperitoneal teratoma. Correct diagnosis helps pediatrics surgeons in executing a complete surgical removal and reducing complications.

The study also emphasizes the need for histopathological confirmation in making definitive diagnosis and excluding malignant conditions.

Moreover, the results will help to enhance the knowledge about rare congenital anomalies, and will increase awareness among pediatric surgeons, radiologists and neonatologists of early diagnosis and treatment of FIF.

4.4.Limitations of the Study

Although the study offered good insights, there are some limitations to the study:

- The study was conducted on literature review and not directly on the patient.
- Often, FIF is rare and few cases are reported.
- Differences in diagnostic technique and reporting between different studies.
- No long-term follow up data reported in some cases.
- The results might not be generalizable because of these restrictions.

4.5.Suggestions for Future Research

Future studies need to include:

1. Large multicenter studies with long-term follow-up of FIF patients.
2. Advanced genetic and embryological studies to gain more insight into the origin of FIF.
3. Development of standardized diagnostic criteria to differentiate FIF from teratoma.
4. Advanced fetal imaging techniques for research of prenatal diagnosis.
5. Comparative Molecular Studies between FIF and feti form Teratoma to elucidate pathological differences.

5. CONCLUSION

The present study examined 80 reported cases of Fetus in Fetu (FIF) which is a rare congenital anomaly that occurs as a retroperitoneal mass in the abdomen of neonates and infants. The results indicated that the most common clinical features were abdominal distension and palpable abdominal mass and the most common sites of occurrence were the retroperitoneal region. The use of radiological investigations like the CT scan and MRI was very useful in the identification of organized fetal structures like the vertebral columns and limb buds to help differentiate FIF from retroperitoneal teratoma. Surgical removal of all the tumor in all cases was associated with good postoperative results and low recurrence rates, whereas the pathological analysis of the specimens confirmed the diagnosis in all cases.

5.1. Summary of key findings

The study revealed that majority of the fetuses with fetus in fetus are male neonates and are usually found in the neonatal period as a retroperitoneal abdominal mass. CT scan and MRI were very useful in the diagnosis of the characteristic fetal structures and for differentiating from retroperitoneal teratoma. The most effective treatment option had a favorable prognosis and low recurrence rate and was surgical excision. In all analyzed cases definitive diagnosis was confirmed by histopathological examination.

5.2.Significance of the Study

This study has added value to the small body of available information regarding Fetus in Fetu, and has described the demographic data, clinical presentation, imaging characteristics and

surgical results. The research highlights the need for early diagnosis and proper radiological diagnosis so that the possibility of misdiagnosis with retroperitoneal teratoma can be prevented. The results can help pediatric surgeons, radiologists, neonatologists and pathologists to make a more accurate diagnosis, surgical planning, and patient management. Further, this study helps to improve the knowledge of the embryological and pathological features of this uncommon congenital anomaly.

5.3.Final Thoughts and Recommendations

Fetus in fetu is a rare but important condition, which needs prompt diagnosis and multi-disciplinary management. Excellent clinical results and minimal recurrence is achievable if the condition is diagnosed early and treated with full surgical removal using advanced imaging techniques. Healthcare professionals need to be more aware to increase the recognition of FIF and distinguish it from malignant retroperitoneal teratoma. Further research is needed with large multicenter studies, prenatal diagnostic techniques, genetic studies and long-term follow-up of the patient group to better understand and manage this rare congenital anomaly.

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