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Role of Abdominal Ultrasound in Detecting Surgically Significant Pathologies in Pediatric Umbilical Discharge

Dr. Mahmuda Monowara[1*], Dr. Ipsita Biswas[2], Dr. Shammi Ara Shahida[3], Dr. Md. Mahbub Hossain[4], Dr. Salma Sadiya[5]

[1]*Associate Professor, Department of Radiology and Imaging, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh.*

[2]*Associate Professor, Department of Pediatric Urology, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh*

[3]*Assistant Professor. Department of Radiology and Imaging, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh.*

[4]*Associate Professor, Department of Radiology and Imaging, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh.*

[5]*Associate Professor, Department of Biochemistry and Molecular Biology, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh*

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Corresponding Author:** ***Dr. Mahmuda Monowara, *Associate Professor, Department of Radiology and Imaging, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh.*

Abstract

Background: *Umbilical discharge in children may result from congenital anomalies, infections, or acquired pathologies. Early and accurate diagnosis is essential to guide appropriate management. This study aimed to evaluate the role of abdominal ultrasound in detecting surgically significant causes of pediatric umbilical discharge.*

Methods: *This prospective study was conducted at the Department of Radiology and Imaging, Bangladesh Shishu Hospital and Institute, Dhaka, from January 2023 to March 2025. A total of 300 children presenting with umbilical discharge were enrolled. Abdominal ultrasound was performed in all patients and findings were correlated with surgical, clinical, or follow-up outcomes, considered as the reference standard. Diagnostic performance measures including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and overall accuracy were calculated..*

Results: *Of 300 patients, infants (1–12 months) comprised the largest group (40%) and males were predominant (60%). The most common pathologies detected were urachal remnants (25%), umbilical granulomas/infections (20%) and vitelline duct anomalies (15%). Abscesses (16%), hernias (10%) while 14% had no significant abnormality. Ultrasound demonstrated high concordance with the reference standard, yielding a sensitivity of 92.5%, specificity of 89.5%, PPV of 90.8%, NPV of 91.7% and overall accuracy of 91%. Management included surgery in 60% and conservative treatment in 40%, of whom 36% improved without intervention.*

Conclusion: *Abdominal ultrasound is a highly reliable, non-invasive tool for diagnosing surgically significant causes of pediatric umbilical discharge and effectively guides clinical decision-making.*

Keywords: *Umbilical discharge, abdominal ultrasound, urachal remnant, vitelline duct anomaly, pediatric surgery.*

1. INTRODUCTION

Umbilical discharge in children is a relatively uncommon clinical presentation but carries significant diagnostic and therapeutic implications [1]. The causes range from benign self-limiting conditions, such as umbilical granulomas or superficial infections, to congenital anomalies like patent urachus, urachal cysts, omphalomesenteric duct remnants, or vitelline fistulas, which often require surgical intervention.

Rarely, complicated hernias may also manifest with umbilical discharge [2].

The challenge for clinicians lies in differentiating between pathologies that can be managed conservatively and those that necessitate surgical exploration [3]. Early and accurate diagnosis is therefore crucial in preventing morbidity and ensuring appropriate treatment.

Abdominal ultrasound has become the imaging modality of choice for evaluating pediatric patients with umbilical abnormalities. It is non-invasive, readily available, free of ionizing radiation and provides real-time assessment of both superficial and intra-abdominal structures [4]. High-frequency linear transducers can clearly delineate the umbilical region, while curvilinear probes allow evaluation of deeper structures, making ultrasound highly versatile [5]. Moreover, color Doppler imaging can identify vascularity and detect complications such as abscess formation. In contrast to other imaging modalities, such as fistulography or computed tomography, ultrasound is safe for repeated use and well tolerated in the pediatric population [6].

Several studies have reported the utility of ultrasound in diagnosing urachal anomalies and omphalomesenteric duct remnants, which are among the most common surgically significant lesions presenting with umbilical discharge [7]. Urachal anomalies occur due to incomplete obliteration of the urachus, resulting in patent tracts or cystic lesions that may discharge urine or become infected [8]. Similarly, persistence of the vitelline duct can lead to fistulas or sinus tracts discharging feculent material. These congenital anomalies are usually managed surgically and preoperative identification is vital for planning the appropriate approach [8]. While ultrasound has been shown to provide valuable information, its diagnostic accuracy in detecting the full spectrum of surgically relevant pathologies in pediatric umbilical discharge remains underexplored in many settings, particularly in low- and middle-income countries [9].

Umbilical discharge is a relatively frequent cause of pediatric hospital visits, yet there is limited data regarding the diagnostic performance of ultrasound in this context [10]. Many cases are initially treated conservatively and delayed diagnosis of surgically significant conditions can result in recurrent infections, sepsis, or other complications [11]. Given the increasing availability of ultrasound in tertiary care centers, establishing its diagnostic role is essential for optimizing patient care.

The present study was therefore undertaken to evaluate the role of abdominal ultrasound in detecting surgically significant pathologies among pediatric patients presenting with umbilical discharge. Specifically, it aimed to assess the sensitivity, specificity and overall accuracy of ultrasound in comparison with surgical and clinical outcomes.

2. Methodology & Materials

This prospective study was conducted at the Department of Radiology and Imaging, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh, from January 2023 to March 2025. A total of 300 pediatric patients presenting with umbilical discharge were enrolled after obtaining informed written consent from parents or legal guardians. Children of all age groups up to 16 years who attended the hospital with umbilical discharge were included, while those with a history of prior abdominal surgery or incomplete follow-up were excluded.

Demographic and clinical data including age, sex, type of discharge, duration of symptoms and associated features were recorded. All patients underwent abdominal ultrasound using high-frequency linear and curvilinear probes, with targeted evaluation of the umbilical region and adjacent intra-abdominal structures. Sonographic features such as the presence of urachal remnant, vitelline duct anomaly, umbilical hernia, abscess or collection and other pathologies were documented systematically. Color Doppler was applied when required to assess vascularity and rule out associated complications. The ultrasound findings were compared with the reference standard, which included intraoperative findings and histopathology in surgically managed cases, or clinical follow-up and additional imaging in conservatively treated cases. The primary outcome was the diagnostic accuracy of ultrasound in detecting surgically significant pathologies, defined as lesions requiring operative intervention. Statistical analysis was performed using SPSS version 25. Sensitivity, specificity, positive predictive value, negative predictive value and overall diagnostic accuracy were calculated with 95% confidence intervals. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

3. RESULTS

Table 1. *Baseline Characteristics of the Study Population (n = 300)*

Characteristics	Frequency (n)	Percentage (%)
Age group		
Neonates (0–28 days)	45	15
Infants (1–12 months)	120	40
Children (1–5 years)	90	30
Older children (>5 years)	45	15
Sex		
Male	180	60
Female	120	40
Duration of symptoms		
≤1 month	210	70
>1 month	90	30

Table 1 shows the baseline characteristics of the 300 pediatric patients included in the study. The majority of children were infants aged 1–12 months (40%), followed by children aged 1–5 years (30%), neonates (15%) and those older than 5 years (15%). Males predominated with a male-to-female ratio of 1.5:1 (60% vs. 40%). Most patients (70%) presented with umbilical discharge of less than one month in duration, while 30% had symptoms persisting beyond one month.

Table 2. *Spectrum of Pathologies Detected on Abdominal Ultrasound*

Pathology detected on US	Frequency (n)	Percentage (%)
Urachal remnant (cyst/sinus/patent tract)	75	25
Patent vitelline duct / omphalomesenteric fistula	45	15
Umbilical granuloma / simple infection	60	20
Umbilical hernia (with/without complication)	30	10
Abscess / collection	48	16
No significant finding	42	14

Table 2 summarizes the spectrum of pathologies detected on abdominal ultrasound among the study population. Urachal remnants were the most frequently observed lesions, accounting for 25% of cases, followed by umbilical granulomas or simple infections (20%) and patent vitelline duct anomalies (15%). Abscesses or localized collections were also seen in 16% of patients, while umbilical hernias were identified in 10%. In 14% of children, no surgically significant abnormality was detected on ultrasound.

Table 3. *Correlation between Ultrasound Findings and Reference Standard (Surgical/Clinical)*

Final diagnosis (Reference standard)	Total cases	Correctly identified by US	Missed by US	False positive on US
Urachal remnant	72	68	4	7
Vitelline duct anomaly	42	39	3	6
Infection/granuloma	66	60	6	5
Hernia	33	30	3	4
Abscess/collection	48	45	3	3
No significant finding	39	36	3	6

Table 3 presents the correlation between abdominal ultrasound findings and the reference standard, which included surgical and clinical outcomes. Ultrasound correctly identified 68 of 72 urachal remnants, missing 4 cases and yielding 7 false positives. Similarly, 39 of 42 patent vitelline duct anomalies were correctly detected, with 3 missed and 6 false positives. For infections or granulomas, 60 out of 66 cases were accurately diagnosed, while hernias were correctly identified in 30 of 33 patients. Abscesses or collections were detected in 45 of 48 cases. Among patients with no significant pathology, 36 were correctly recognized by ultrasound, though 3 cases were missed and 6 false positives were reported.

Table 4. *Diagnostic Accuracy of Abdominal Ultrasound for Surgically Significant Pathologies*

Parameter	Value (%)	95% CI
Sensitivity	92.5	88.0 – 95.5
Specificity	89.5	84.0 – 93.5
Positive Predictive Value (PPV)	90.8	86.0 – 94.0
Negative Predictive Value (NPV)	91.7	87.0 – 95.0
Overall Diagnostic Accuracy	91	—

Table 4 summarizes the diagnostic performance of abdominal ultrasound in detecting surgically significant pathologies among pediatric patients with umbilical discharge. The overall sensitivity of ultrasound was 92.5% (95% CI: 88.0–95.5), indicating that most surgically relevant lesions were correctly identified. Specificity was 89.5% (95% CI: 84.0–93.5), reflecting a low rate of false-positive findings. The positive predictive value (PPV) was 90.8% (95% CI: 86.0–94.0) and the negative predictive value (NPV) was 91.7% (95% CI: 87.0–95.0), demonstrating reliable prediction of both presence and absence of surgical pathology. The overall diagnostic accuracy of ultrasound was 91%, highlighting its effectiveness as a non-invasive tool for guiding management decisions and identifying patients who require surgical intervention.

Table 5. *Surgical vs. Conservative Management*

Management outcome	Number of patients (n)	Percentage (%)
Surgery performed	180	60
Conservative management	120	40
Improved without surgery	108	36
Referred for further management	12	4

Table 5 summarizes the management outcomes of the study population. Out of 300 patients, 180 (60%) underwent surgical intervention based on ultrasound and clinical findings, while 120 (40%) were managed conservatively. Among the conservatively treated patients, 108 (36% of the total population) improved without requiring surgery, whereas 12 patients (4%) were referred for further management due to persistent or complicated symptoms.

4. Discussion

This prospective study evaluated the role of abdominal ultrasound in detecting surgically significant pathologies in children presenting with umbilical discharge. Our findings demonstrated that ultrasound had high diagnostic accuracy, with sensitivity and specificity exceeding 90% and played a crucial role in guiding management decisions. The most common underlying causes included urachal remnants, omphalomesenteric duct anomalies and umbilical infections or granulomas, consistent with the spectrum of congenital and acquired conditions reported in previous literature.

Urachal anomalies were the most frequently detected surgically significant pathology in our study, comprising 25% of cases. This aligns with the review by Gleason et al., who emphasized the clinical importance of urachal remnants in pediatric populations and their potential to persist into adulthood with risk of infection or malignant transformation [12]. Similarly, Tazi et al., highlighted that infected urachal remnants can present as abscesses or acute abdomen, underscoring the value of early and accurate imaging for timely surgical intervention [13]. Our high detection rate of urachal pathology supports the reliability of ultrasound as a first-line diagnostic tool in such cases.

Omphalomesenteric duct anomalies, including patent vitelline ducts and fistulae, were identified in 15% of our cohort. Bagade and Khanna noted that imaging plays a pivotal role in diagnosing these remnants, which can otherwise mimic more common causes of umbilical discharge [14]. Recent case reports by Bahrami-Motlagh et al. and Tahmasbi et al., further illustrate the potential for omphalomesenteric duct remnants to cause intestinal obstruction and other complications if left undiagnosed [15, 16]. Our findings of a high correlation between ultrasound and surgical confirmation in such anomalies reinforce the diagnostic value of non-invasive imaging.

Umbilical granulomas and simple infections accounted for 20% of our cases. While these conditions are often managed conservatively,

ultrasound was still useful in excluding deeper-seated or surgically significant pathology. Das described the varied presentations of umbilical lesions, some of which can be deceptively simple but may conceal more complex abnormalities [17]. Therefore, our study supports the role of ultrasound not only in detecting major anomalies but also in differentiating benign conditions suitable for conservative management.

Ultrasound was also effective in diagnosing umbilical hernias and intra-abdominal collections. Hua et al., demonstrated the diagnostic value of high-resolution ultrasound combined with CT for pediatric hernias, but in our setting, ultrasound alone achieved excellent accuracy, making it particularly suitable for resource-limited environments [18]. Similarly, Garcia et al., highlighted the role of point-of-care ultrasound in emergency settings, such as diagnosing volvulus, reinforcing its utility in rapidly assessing abdominal pathology in children [19]. Our study adds to this body of evidence by showing its effectiveness in children with umbilical discharge.

From an embryological standpoint, Hegazy emphasized the clinical correlations of umbilical development, noting that both urachal and vitelline duct anomalies are direct results of incomplete obliteration of embryonic structures [20]. Our findings, in which congenital remnants were the most common surgically significant causes of umbilical discharge, provide clinical validation of these embryological principles.

In terms of diagnostic performance, our results demonstrated an overall accuracy of 91%, comparable to previously reported values. Dilli et al., showed that abdominal ultrasound provides significant diagnostic information in neonatal abdominal conditions such as necrotizing enterocolitis, often exceeding the accuracy of plain radiography [21]. Similarly, Ríos et al., in their systematic review of acute abdomen in pediatrics, reinforced ultrasound as the preferred initial imaging modality due to its safety, availability and accuracy [22]. Our study aligns with these findings and extends them specifically to the context of pediatric umbilical discharge.

Management outcomes in our cohort further validated the clinical impact of ultrasound. Sixty percent of children underwent surgery, while 40% were managed conservatively, with the majority improving without operative intervention. This stratification highlights the pivotal role of ultrasound in preventing unnecessary surgeries while ensuring timely intervention in surgically significant cases. As noted by Arlen and Smith, imaging is indispensable in differentiating anomalies requiring surgical repair from those amenable to observation or conservative management [23].

5. Limitations of the Study

Nevertheless, certain limitations should be acknowledged. Although the diagnostic accuracy was high, a small number of cases were missed or misclassified, reflecting operator dependency and occasional overlapping sonographic features among different pathologies. Additionally, our study was single-centered, which may limit generalizability. Future multicenter studies with larger and more diverse populations could provide broader validation of these findings.

6. Conclusion

In conclusion, our results demonstrate that abdominal ultrasound is a highly effective modality for detecting surgically significant causes of pediatric umbilical discharge. It allows accurate diagnosis of urachal remnants, omphalomesenteric duct anomalies and infections, while guiding appropriate management decisions. Our findings are consistent with prior reports and emphasize the indispensable role of ultrasound in pediatric surgical diagnostics.

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Conflicts of Interest

There are no conflicts of interest

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