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Surgery Section

# Persistent Bowel Loop in the Left Upper Quadrant: An Indication for Relaparotomy in Paediatric Adhesive Intestinal Obstruction: A Retrospective Cohort Study

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## ABSTRACT

**Introduction:** Abdominal surgery in children is known to contribute to Adhesive Small Bowel Obstruction (ASBO). No X-ray findings have been validated for predicting management in ASBO. Various imaging modalities often cannot predict complications or if a conservative line of management would be successful.

**Aim:** To determine if a persistent prominently dilated small bowel loop in the Left Upper Quadrant (LUQ) on plain X-rays (Omega loop) would suggest early operative intervention.

**Materials and Methods:** A retrospective cohort study was conducted in the Department of Paediatric Surgery, IMCH, Government Medical College, Kozhikode, Kerala, India from January 2016 to December 2018. Diagnosis was based on history, clinical features, and radiologic findings. Demographic, clinical, radiologic, and operative data were collected. After exclusions, the study population was divided into two groups: Group A- ASBO patients with the characteristic Omega loop, and Group B- patients without the Omega loop. Appropriate statistical methods were used to compare the groups, with significance defined as p<0.05.

**Results:** Among the 72 cases of ASBO that met the inclusion criteria, 40 (55%) were successfully managed conservatively, and 32 (45%) required non urgent relaparotomy. The median age was 6.9 years (range: 2-12 years), and 55% were male. Group A comprised 16 patients (22.2%), and the remaining patients were in Group B 56 (77.8%). Group A showed higher rates of failure of conservative management (n=14, p=0.0002), with higher rates of single-band obstruction, bowel loss, perforation, matting of bowel loops, and difficult dissection. The Omega loop had a low sensitivity (43.7%) but high specificity (95%) and positive predictive value (87.5%) for the need for relaparotomy.

**Conclusion:** The Omega loop suggests the possibility of more complications, and therefore, earlier operative intervention should be considered.

**Keywords:** Abdominal radiograph, Adhesive small bowel obstruction, Closed loop obstruction, Paucity of gas

## INTRODUCTION

Postoperative small bowel obstruction due to adhesions (ASBO) accounts for 65-75% of all small bowel obstructions and is a recognised complication of open or minimally invasive abdominal surgery [1]. Although most of these patients are managed successfully through conservative means, many of them will eventually require surgical treatment, with laparotomy being the preferred approach. The morbidity and mortality of adhesiolysis remain significant, with rates of about 14-45% and 4%, respectively [2,3].

Similar to adults, paediatric ASBO is also a known complication after abdominal surgery, with a reported incidence of 1.1-8.3% [4,5]. In children, variable success rates for conservative management have been reported, ranging from as low as 0%-16% to as high as 52%-75%. In most cases, operation is often required, indicated by the failure of conservative treatment, high-grade obstruction, closed-loop obstruction, or suspicion of bowel ischaemia.

Several models and scoring systems exist for predicting the need for operation for ASBO in adults, but currently, no such models, based on patient age or other risk factors, are validated in the paediatric age group [6]. The strategy for ASBO is generally implemented based on clinical evaluation (increased abdominal pain or tenderness, signs of peritonitis, progressive or persistent obstruction), biological tests (leukocytosis), and imaging (free air, pneumatosis, and closed-loop obstruction). When conservative management is chosen, regular assessment by the clinician is mandatory for early recognition of signs and symptoms of strangulation that would require early operative intervention.

Furthermore, there are no standardised guidelines for imaging or clinical decision-making regarding the timing of operation, and the ideal timing for operation in paediatric ASBO has been debated, varying among surgeons. There is little evidence in the literature to support decision-making when it comes to objective criteria [6,7].

Although some radiographic signs, such as air-fluid levels, dilated small bowel loops, and absent gas in the large bowel, have suggested clinical suspicion of strangulation, no sign has been objectively studied. The purpose of present study was to determine if a persistently prominently dilated small bowel loop in the left upper quadrant (hereafter referred to as the Omega loop) in the paediatric population would suggest early operative intervention. The authors hypothesise that this loop may characterise an advanced severity of obstruction and, therefore, be less amenable to conservative management.

## MATERIALS AND METHODS

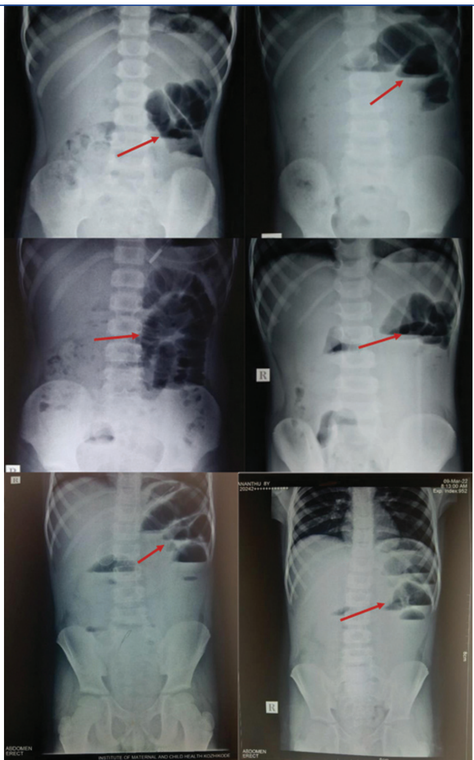
A retrospective cohort study was conducted in the Department of Paediatric Surgery, IMCH, Government Medical College, Kozhikode, Kerala, India, from January 2016 to December 2018. Ethical approval for present study has been obtained from the Institutional Ethics Review Committee with the number GMCKKD/RP019/IEC/157.

The diagnosis of ASBO was made based on patient history, clinical findings, and radiologic findings, and whenever possible, it was confirmed by operative and pathologic findings.

**Inclusion and Exclusion criteria:** Only patients below 12 years of age who underwent their first operation at the institution were included. Patients with a recent operation (within a month) or those suspected to have an alternate primary diagnosis (e.g., paralytic ileus, intussusception, inflammatory bowel disease, intestinal atresia, anorectal malformations, Hirschsprung's disease, prior chemotherapy, incarcerated hernia, malignancies) were excluded as they could potentially affect present study.

### Study Procedure

Clinical symptoms included bilious vomiting, abdominal pain, abdominal distension, and constipation with a prior history of any abdominal surgery. Radiologically, ASBO was defined as distended small bowel loops and multiple air-fluid levels on abdominal radiographs with or without colonic gas. The diagnosis of ASBO was assigned by the attending surgeon only if a combination of these was present. Demographic, clinical, radiological, and operative data were identified and collected from hospital medical records. Biochemical data included a complete blood count and serum electrolytes, and radiographic studies at admission included ultrasound, plain abdominal films, or Computed Tomography (CT) scans when done. The primary diagnosis at the first surgery, approach (open or minimally invasive), anastomosis, use of drains, blood transfusion, operative time, time interval since the previous laparotomy, and the number of Small Bowel Obstruction (SBO) recurrences were also noted. Specific abdominal radiograph findings were noted and charted. The relaparotomy findings were also recorded, which included single-band obstruction, multiple adhesions, and other findings like intestinal gangrene, perforation, volvulus, and internal herniation. Some of the abdominal radiographs demonstrated a persistently prominent bowel loop (Omega loop) in the left upper quadrant apart from the characteristic signs of intestinal obstruction [Table/Fig-1]. This appearance was classically seen when the X-ray was taken atleast 12 to 24 hours into the treatment period but was also seen on initial radiographs depending on the stage at which they presented.



**[Table/Fig-1]:** Typical appearance of Omega loops on plain radiographs.

Urgent operation was defined as patients who were taken to the operating room within six hours of presentation due to signs of peritonitis and clinical concern for bowel ischaemia. Non urgent operation patients were treated conservatively for a period ranging from 6 to 48 hours. Patients whose bowel obstruction resolved without operative intervention were classified into the conservative group.

The study population (that met the inclusion criteria) was then divided into two groups: Group A and Group B. Group A consisted of all patients with ASBO with the characteristic Omega loop on serial radiographs, and Group B comprised all other patients with ASBO with other classical radiologic findings but without the Omega loop. The presence of this loop was determined by two independent surgeon reviewers. This loop had to persist despite nasogastric decompression during treatment.

## STATISTICAL ANALYSIS

Demographics and outcomes were described as medians for continuous variables and as numbers for categorical variables. The Chi-square test was used to compare categorical variables and determine factors predictive of complications. Statistical significance was defined as $p<0.05$. All statistical analyses were performed using the Epi Info statistical software package (version 7.1.2.0, CDC, Atlanta, GA).

## RESULTS

Of the 72 cases of ASBO that met the inclusion criteria, 40 (55%) were successfully managed conservatively, while 32 (45%) required non urgent relaparotomy. None of the patients in present study required urgent exploration (<6h). No pre-existing co-morbidities were noted that could have affected present study. This was the first episode of ASBO for all included patients, and there were no recurrences at the 6-month follow-up. No deaths occurred during admission or follow-up. The median age for all patients was 6.9 years (range: 2-12 years), and 55% were males.

The diagnosis at the first operation included open appendicectomy (n=39), laparoscopic appendicectomy (n=14), Congenital Diaphragmatic Hernia (CDH) (n=8), intussusception (n=5), and Meckel's diverticulum (n=6). Except for the laparoscopic appendicectomy cases (n=14), all other cases were performed using an open approach (n=58). None of the laparoscopic cases were converted to open. All cases in present study were operated on as emergencies (initial operation). No elective cases returned with ASBO.

Abdominal radiographs showed multiple small bowel loops and air-fluid levels (with or without colonic gas) in all 72 patients included in the study at the time of admission the second time, along with typical clinical features of ASBO. However, a persistent Omega loop was seen in 16 patients (22.2%) on subsequent X-rays taken atleast 12 to 24 hours later. These subsets were classified as Group A (with Omega loop) and Group B (without Omega loop) as described above, and their outcomes were compared [Table/Fig-2].

| Parameters | Group-A (Omega loop) | Group-B (No Omega loop) |
|---|---|---|
| **Number of cases** | 16 | 56 |
| **Median age (range) in years** | 7.8 (2.1-11.9) | 6.7 (2-12) |
| **Initial operation:** | | |
| Wound infection | 3 | 6 |
| Burst abdomen | 0 | 1 |
| Blood transfusion | 2 | 10 |
| Hospital stay (days) | 5.5 | 6.5 |
| Drains | 0 | 0 |
| Time interval from first operation (months) | 24.7 | 27.4 |
| **Diagnosis at initial operation:** | | |
| Open appendicectomy | 12 | 27 |
| Laparoscopic appendicectomy | 4 | 10 |
| Meckel's diverticulum (open) | 0 | 8 |
| CDH repair (open) | 0 | 5 |
| Intussusception (open) | 0 | 6 |
| Relaparotomy required (n=32) | 14 | 18 |

| | | |
|---|---|---|
| Conservatively managed (n=40) | 2 | 38 |
| Single band obstruction (n=12) | 11/32 | 1/32 |
| Multiple adhesions and high grade obstruction (n=20) | 3/32 | 17/32 |
| Bowel loss at relaparotomy | 3 | 0 |
| Perforation at relaparotomy | 4 | 0 |
| Matting of bowel at relaparotomy | 6 | 1 |

**[Table/Fig-2]:** Objective parameters in both groups.

**Group A (with the characteristic Omega loop) (n=16):** Among the 32 patients who required relaparotomy (due to failed conservative management), 14 (43.7%) demonstrated the persistent Omega loop (p=0.0002). Among these, 11 had undergone open appendicectomy and three had undergone laparoscopic appendicectomy earlier. In contrast, the remaining 20 patients showed multiple adhesions and high-grade obstruction, but only three (15%) had exhibited the Omega loop earlier (p=0.0002). Bowel loss (including volvulus in 2 cases) necessitating resection and anastomosis was required in 3 (9.3%) cases, and perforation was observed in 4 cases (12.5%), all of which were in Group A. Additionally, this group exhibited the presence of bowel loop matting with difficult adhesiolysis (p=0.02). No deaths or re-admissions for a second ASBO were recorded within six months of follow-up. In the subset managed conservatively (n=40), only 2 (5%) patients displayed the Omega loop (1 out of 25 open appendicectomy patients and 1 out of 3 laparoscopic appendicectomy patients). Thus, the Omega loop has low sensitivity (43.7%) but high specificity (95%) and positive predictive value (87.5%) for the need for relaparotomy. These findings suggest that the Omega loop indicates closed-loop obstructions with a higher likelihood of complications.

**Group B (with no Omega loop) (n=56):** There were no complications such as bowel loss/gangrene or perforation observed in this group. Once again, no deaths or re-admissions were recorded. Interestingly, the Omega loop was not observed in other diagnosis such as Meckel's diverticulum repair (wedge resection or full resection), surgery for intussusception (manual reduction or resection and anastomosis), and CDH repair. The absence of an Omega loop also suggests that the case is more likely to be managed conservatively or may have fewer complications even if a second exploration is performed.

## DISCUSSION

Despite extensive research in this field, the optimal management of paediatric ASBO, including the type and timing of radiologic imaging, remains a subject of debate, and the appropriate timing for surgery is still uncertain [8]. There are no standardised guidelines for imaging or clinical decision-making in paediatric ASBO, and studies have failed to identify clinical or radiological predictors, such as air-fluid levels/dilated loops on Abdominal X-ray (AXR), leukocytosis, tachycardia, and fever, that can reliably predict the need for re-exploration [6,7,9]. It was observed in the study that many children with the aforementioned Omega loop eventually underwent re-exploration for ASBO or experienced higher complication rates.

In present study, patients were evaluated using only a plain AXR upon admission. However, not all findings on AXR are definitive for ASBO. Those presenting with signs of bowel ischaemia would qualify for urgent exploration. The rest were observed for a period of 6 to 48 hours. In this subset, a repeat AXR was performed after 12 to 24 hours if the patient remained clinically stable. If the condition deteriorated during this period, they would proceed to laparotomy without further investigations. Ultrasound, small bowel contrast studies, and CT scans were sparingly used in the institution and only performed in cases of diagnostic uncertainty or to rule out other pathologies. Regardless of the findings, patients who did not resolve their obstruction even after 48 hours were considered for re-exploration, as the morbidity increases significantly beyond that time frame [6].

While ASBO can be suspected based on risk factors, symptoms, and physical examination, several imaging modalities are available to confirm the diagnosis. Abdominal X-ray (AXR) and abdominal CT are considered the most suitable and useful imaging techniques. Another marker, serum procalcitonin level, has been reported to be closely related to the presence of intestinal ischaemia and necrosis in children with ASBO, but it is not widely used [10]. Although AXR may show multiple air-fluid levels with distension of the small bowel and absence of gas in the colon, the specific site of obstruction is often not clearly identified on plain radiography. Similarly, the risk-benefit ratio of CT imaging in paediatric ASBO is not well-established. Jabra AA et al., reported that CT had 87% sensitivity and 86% specificity for diagnosing ASBO in children [9,11]. Wang Q et al., reported that CT is highly sensitive for diagnosing SBO in children (91.5%) and useful for identifying the site of obstruction (78.7%) and the cause of obstruction (68.1%) [12]. Worrisome findings such as bowel wall thickening, free peritoneal fluid, and extent of pneumatosis have been reported to potentially identify patients with high-grade obstruction and bowel ischaemia. However, the benefit of CT scans is hypothetical, as these late findings are often evident through thorough physical examination or reflected in physiological data. Additionally, CT scans involve radiation and may not be widely available in resource-poor settings. Therefore, clear evidence of the benefit of CT in paediatric ASBO is lacking. In summary, AXR and CT imaging are useful for confirming ASBO, but they do not guide management decisions regarding whether to continue conservative management or proceed with relaparotomy.

It is well known that not all AXRs display classic findings of ASBO, and only a few studies have investigated the AXR findings that could help identify patients who would benefit from earlier operative intervention or avoid complications. Johnson BL et al., established that the absence of gas on AXR is more strongly associated with high-grade or closed-loop obstruction than simply dilated gaseous loops. They also recommended that children with such findings should undergo additional imaging with a CT scan or small-bowel contrast study to clarify the diagnosis and avoid delay in definitive treatment for complicated bowel obstruction [13]. Similarly, Hyak J et al., recommended that regardless of the findings on AXR, additional imaging such as CT or operative intervention should be considered if there is no clinical improvement within 48 hours, as the incidence of bowel resection steadily increases after 48 hours of conservative management [6]. In a cohort of adult patients, Tanaka S et al., reported that complete small bowel obstruction, defined as the absence of clear-cut evidence of air within the large bowel on abdominal radiographs, was an independent risk factor for surgical indication, while partial small bowel obstruction was defined as unequivocal evidence of gas in the colon above the level of peritoneal reflection [14]. Similarly, Deng Y et al., demonstrated the same effect in the paediatric population, where the surgical intervention group was significantly more likely to exhibit complete small bowel obstruction and ascites compared to the conservative group [15].

The present study results support the hypothesis that the presence of the Omega loop on AXR is indeed more strongly associated with high-grade or closed-loop obstruction and a higher rate of complications. Furthermore, patients who were successfully managed conservatively had a lower number of Omega loops on AXR. However, it is important to note that clinical judgement should always take precedence over observations in this regard, and further imaging may be ordered to determine if it is safe to continue with non operative management.

### Limitation(s)

The retrospective nature of the study is an inherent limitation, as it may be prone to issues such as incomplete or inconsistent documentation. Another limitation is the lack of uniformity among surgeons in their criteria for diagnosing ASBO. The formation of the

Omega loop may be a dynamic process, and it is uncertain if it could have been detected in those who underwent earlier laparotomy based on surgeon preference. Lastly, the small sample size of the study limits the generalisability of the results.

## CONCLUSION(S)

In paediatric ASBO, the presence of a persistent bowel loop in the LUQ suggests a higher likelihood of complications, and therefore, earlier operative intervention should be considered. The presence of an Omega loop has a low sensitivity but high specificity and positive predictive value for the need for relaparotomy. In such cases, additional imaging should be performed if indicated, and if there are positive clinical signs, definitive treatment should not be delayed.

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