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Conservative treatment of adhesive small bowel obstruction in children: a systematic review

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ABSTRACT

Objective: To assess the effectiveness of conservative treatment for adhesive small bowel obstruction (ASBO) in children.

Design: Systematic review of studies involved children with ASBO who received initial conservative/non-operative treatment.

Setting: The search was performed in April 2013 using PubMed (see online supplementary file 1), current contents, and the Cochrane database.

Participants: Children with ASBO.

Interventions: Conservative treatment included nasogastric decompression, parenteral fluids and correction of electrolyte and fluid imbalance.

Primary outcome: Treatment success.

Secondary outcomes: Length of hospital stay and the time to first feeding after hospital admission.

Results: 7 studies (six retrospective, one prospective), involving 8–109 patients (age: 1 month to 16 years) treated conservatively, were included in the review. The nature of conservative treatment was generally consistent between studies (nasogastric decompression, parenteral fluids and correction of electrolyte and fluid imbalance), although patients in one study also received Gastrografin. The rate of conservative treatment success ranged from 16% to 75% among the five studies, but one trial showed 0% successful rate. The hospital length of stay ranged from 3 to 6.5 days for conservative treatment (vs 10.2–13 days for operative treatment). The time to first feeding ranged from 31 to 84 h for conservative treatment.

Conclusions: In conclusion, in the majority of cases, conservative treatment is an effective means of managing ASBO in children.

Strengths and limitations of this study

- Conservative treatment was successful in more than 50% of children with adhesive small bowel obstruction in the four of the seven included studies.
- All but one of the included studies were retrospective in design.
- There was some variability between studies regarding the conservative treatment regimens.

INTRODUCTION

Adhesions following abdominal surgery are a common cause of small bowel obstruction (SBO) in adults.[1 2] Indeed, adhesions have been reported to account for approximately 70% of cases of SBO in adults,[3] with up to 25% of patients who undergo abdominal surgery subsequently developing adhesive SBO (ASBO).[1] There is less information available on ASBO in children; however, the available data suggest that from 1% to 9% of children will experience ASBO after abdominal surgery.[4–7] As ASBO can lead to morbidity and mortality, and has high associated socioeconomic costs, effective treatment is essential.[1 2]

Treatment for ASBO may be operative or conservative/non-operative. Operative treatment, adhesiolysis through laparoscopic or open approaches, can be effective (and essential in some cases ie, those involving strangulation), but carries a risk of associated morbidity and mortality.[8–10] Various conservative means of managing ASBO have been reported, including nasogastric tube suction and fluid resuscitation, and administration of water-soluble contrast agents, such as gastrografin, which may also serve to determine the need for surgery.[2 11] In adults, conservative treatment of ASBO is frequently used and has been found to be effective in a relatively large, but somewhat variable (approximately 40% to 70%), proportion of cases.[12–15] There is less definitive information available concerning the effectiveness of conservative treatment in children with ASBO, although effectiveness rates ranging from approximately 16–60% have been reported.[16–19] The ASBO guidelines published in 2013 provide no specific guidance for the treatment of children.[20] In general, there is a lack of consensus, or indeed available guidelines, on the management of ASBO in children.

To obtain further information on the effectiveness of conservative treatment for ASBO in children, we performed a systematic review of the literature.

METHODS

Search strategy

The search was performed in August 2014 PubMed (see online supplementary file 1), Current Contents, and the Cochrane database were searched using different combinations of the following key terms: small bowel, obstruction, adhesion, children/paediatric, conservative treatment and the water-soluble contrast agent, Gastrografin. Reference lists of pertinent articles were hand searched, where appropriate, to identify other potentially relevant studies. The search strategy is detailed in online supplementary file for the search in PubMed (see online supplementary file 1).

Selection of studies

Studies were included in the systematic review if they involved paediatric patients (from birth up to 18 years of age) who were diagnosed as ASBO and received conservative treatment. The diagnostic criteria included abdominal pain/distention, nausea/vomiting, failure to pass flatus and stool and showed an air-fluid level on plain erect abdominal radiographs. Conservative treatment included nasogastric decompression, parenteral fluids and correction of electrolyte and fluid imbalance. Clinical report of paediatric patients managed with water-soluble contrast medium (ie, Gastrografin) was also included. Studies were excluded from the systematic review if they included adults, not related to ASBO, surgical management only, non-interventional study, no quantitative outcomes or outcomes did not include rate of treatment success (surgery not required) or non-English language article.

Data extraction

Data were extracted from articles by two independent reviewers. Disagreement between these reviewers was resolved by consulting with a third reviewer. The following information/data were extracted from studies that met the eligibility criteria: author details, year of publication, study design, primary surgical condition leading to the development of adhesions, treatment groups, conservative treatment details, age and sex of patients, treatment success (ie, proportion of patients treated conservatively who did not require subsequent surgical treatment for ASBO), recurrence of ASBO, hospital length of stay, time to first feeding after hospital admission and complications of treatment.

Outcome measures

The primary outcome measure was treatment success. Secondary outcomes were hospital length of stay, the time to first feeding after hospital admission, the proportion of patients who experienced ASBO recurrence and the proportion of patients experiencing complications of after treatment.

Quality assessments

The Newcastle-Ottawa Quality Assessment scale was used to assess the quality of this review. The included studies were assessed on three dimensions: selection, comparability and outcome (for cohort studies) or exposure (for case–control studies). The star system was used to semiquantification of the study quality.

RESULTS

Study selection

A total of 266 articles were identified in the initial literature search, and 22 articles were included in full-text review (figure 1). Of these, 15 were found to be no quantitative outcome or outcome did not include rate of treatment success (surgery not required). Hence, a total of seven articles[16–19 21–23] underwent full-text review. All were found to be eligible for inclusion into our systematic review.

Study characteristics

The characteristics of the studies included in our systematic review are summarised in (table 1). The studies were conducted in several different countries. Of note, all but one of the studies was retrospective in design. The only exception was the study reported by Bonnard *et al*,[21] which was a prospective, case–control study. Appendicitis and intussusception were common primary

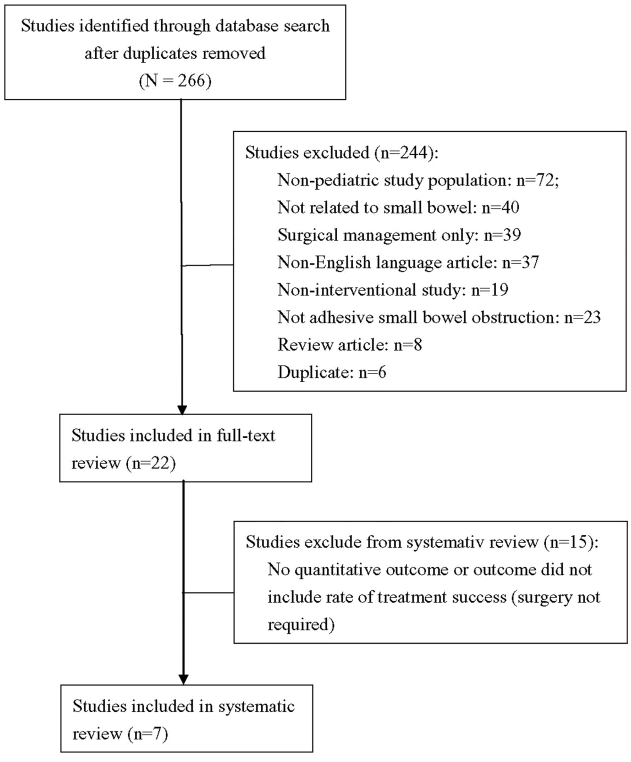

Figure 1 Flow diagram of study selection.

Table 1 Characteristics of studies included in the systematic review

First author (year)	Type of study	Country	Primary condition	Treatment group(s)	Conservative treatment	Age of patients	Sex
Akgür (1991)	Retrospective (cohort)	Turkey	Appendicitis, abdominal trauma, intraperitoneal/retroperitoneal malignancy, intussusception, laparotomy, colonic pull-through surgery	Conservative: n=149 episodes Operative: n=81 episodes	Nasogastric decompression, parenteral fluid, electrolyte resuscitation and maintenance, and restriction of analgesics and antibiotics	1 month to 16 years	60 F/121 M
Bonnard (2011)	Prospective (case control)	France	Appendicitis, neonatal surgical conditions	Conservative: n=8 Control: n=16	Nasogastric decompression, bolus and infused isotonic saline, followed by 50–100 mL Gastrografin. Control patients were treated as above without Gastrografin	Conservative: 1.2 years (range: 0.5–4.1) Control: 3 years (range: 0.3–8.7)	Conservative:4F/4M Control: 9F/7 M
Eeson (2010)	Retrospective (cohort)	Canada	Appendicitis, colostomy, Ladd's procedure, Nissen fundoplication, congenital abdominal wall defect repair, reversal of stoma, congenital diaphragmatic hernia repair, colectomy, ileostomy, gastrostomy, nephrectomy	Conservative: n=26 Delayed operative: n=107 Operative: n=32	Intravenous fluid resuscitation, nasogastric, decompression, and intensive monitoring	Conservative: 9.1 ±6.0 years Delayed operative: 6.4±5.2 years Operative: 5.2 ±4.6 years	Conservative: 7F/19M Delayed operative: 35F/75M Operative: 9F/23M
Vijay (2005)	Retrospective (cohort)	India	Hirschsprung's disease, intussusception, appendicitis, malrotation, Meckel's diverticulum, anorectal malformation, atresia, Wilm's tumour, eventration of diaphragm, ischaemic enteritis	Conservative: n=69	Nasogastric decompression, intravenous fluids, antibiotics, and correction of electrolyte imbalance	0–1 years: n=26 1–5 years: n=19 5–10 years: n=13 10–13 years: n=11	NA
Osifo (2010)	Retrospective (cohort)	Nigeria	Intussusception, perforated appendix, perforated gut, abdominal trauma, typhoid perforation, ovarian cyst rupture, omphalocele closure	Conservative: n=21	Nasogastric decompression, intravenous fluids, antibiotics, and correction of electrolyte imbalance	3.0±6.4 years	8F/13M
Feigin (2010)	Retrospective (cohort)	Israel	Appendicitis, congenital bowel defect, abdominal tumour, enterocolitis, intussusception, meconium ileus, stomach condition, malrotation, genitourinary condition, abdominal trauma	Conservative: n=109 Operative: n=65	Nasogastric decompression, parenteral fluids, and correction of fluid and electrolyte imbalance	Conservative: 8.3 years Operative: 6.3 years	NA
Nasir (2013)	Retrospective (cohort)	Nigeria	Typhoid intestinal perforation, intussusceptions, intestinal malrotation, appendicitis, blunt abdominal injury with rupture viscus, rupture omphalocele, gastroschisis, Wilm's tumour, choledochal cyst, mesentery cyst, obstructed hernia	Conservative: n=16 Operative: n=18	Nasogastric decompression, resuscitation with intravenous fluid and correction of electrolyte imbalance	Conservative: 5 years Operative: 3 years	Conservative: 4F/12M Operative: 8F/10M

F, female; M, male; m, month; NA, not available.

conditions requiring surgery (resulting in the development of adhesions) in all studies, although there were a considerable number of primary conditions necessitating surgery. The number of patients who underwent conservative treatment was variable between studies, ranging from 8 to 109 (note: Akgur *et al*[19] reported the number of treatment episodes, rather than the number of patients). Four of the seven studies reported results for multiple treatment groups, including conservative and operative[16 17 23] or conservative and control.[21] There were two operative groups in the study reported by Eeson *et al*,[17] a group of patients who received operative treatment shortly after admission, and a group of patients who received operative treatment after a period of initial conservative treatment. Both treatment groups in the study reported by Bonnard *et al*[21] in effect involved conservative treatment, plus or minus the addition of Gastrografin. Otherwise, conservative treatment was generally consistent between studies, comprising nasogastric decompression, parenteral fluids, correction of electrolyte and fluid imbalances and monitoring. Parenteral nutrition was not provided to patients in the study reported by Osifo and Ovueni,[22] nor did patients in this study receive intensive monitoring. The age of patients was quite variable, ranging from approximately 1 month up to 16 years of age. Generally, however, patients were less than 10 years of age. In four[17 19 22 23] of the seven studies, there were considerably more male than female patients.

Outcomes

All studies reported data on treatment success, four studies reported data on hospital length of stay,[16 17 21 23] and two studies reported data on the time to first feeding.[16 21] Data for the other outcomes, ASBO recurrence[19] and complications[17 23] were also reported. The rate of treatment success ranged from 0% to 75%, but was >50% in four[16 18 19 21] of the seven studies. The hospital length of stay ranged from 3 to 6.5 days for patients who received conservative treatment. Unsurprisingly, the hospital length of stay was longer for patients who received operative treatment, ranging from 10.2 to 13 days. The time to first feeding ranged from 31 to 84 h for patients who received conservative treatment. All outcomes in the study reported by Bonnard *et al*[21] favoured conservative treatment with Gastrografin over conservative treatment without Gastrografin. In the study reported by Akgur *et al*,[19] the rate of ASBO recurrence was lower with conservative compared with operative treatment, while in the study reported by Eeson *et al*,[17] no patients who received conservative treatment experienced complications compared with more than 10% of patients who received operative treatment (table 2). Nasir *et al*[23] reported there were no significant differences in sex (p=0.24), initial procedure (p=0.12), age (1825 vs 1095 days, p=0.96), duration of symptoms (1 vs 2 days, p=0.32), and time to readmission (275 vs 95 days, p=0.49) between the patients who responded to non-operative management and those who underwent surgery. However, the length of hospital stay was significantly shorter in the non-operative patient group than the group that underwent surgery (5 vs 13 days, p<0.0001).

Quality assessments

All six cohort studies were representative of the average patient with ABSO (table 3). Exposure was ascertained from secure records and outcomes were linked to records for all studies. All six of these studies demonstrated that the outcome of interest was not present at the beginning of the study. The follow-up was adequate for outcomes to have occurred for all six cohort studies.

With regard to the case–control study, the case definition was adequate, there was some potential for selection bias, the controls were derived from the hospital, the assessment of exposure was derived from a secure record, and the same method was used for cases and controls to ascertain exposure (table 4).

DISCUSSION

The purpose of this systematic review was to summarise the available evidence on the use of conservative treatment for the management of ASBO in children. A total of seven studies (only one prospective in design) met the criteria for inclusion in our review. In general, the findings from these studies indicate that conservative treatment can be effective for treating ASBO in large proportion of children.

Of note, four of the seven studies[16 18 19 21] included in our review reported that conservative treatment was successful in more than 50% of cases. This rate of conservative treatment success is similar to that reported in studies involving adults with ASBO.[12–15] Furthermore, Nasir *et al*[23] found that hospital stay were significantly shorter in their group of patients that received conservative treatment compared with those who underwent surgery. Interestingly, conservative treatment was successful in none of the cases in the study reported by Osifo and Ovueni.[22] This is surprising, given the otherwise overwhelming positive effects of conservative treatment. However, as acknowledged by the authors,[22] the children in their study were treated in a resource poor country, which appears to have limited the capacity for comprehensive conservative treatment (including parenteral nutrition) and monitoring. Eeson *et al*[17] also reported a much lower rate of conservative treatment success (16%) than reported in the other studies,[16 18 19 21 23] despite the use of a similar regimen. The reason for this much lower rate of treatment success is not readily apparent, but would suggest that children in the study may have had more severe ASBO than those in the other studies. Further studies are needed to identify the characteristics of children with ASBO who are most likely to respond positively to conservative treatment.

The conservative treatment regimens were, for the most part, consistent between studies, comprising

Table 2 Summary of key outcomes and results for studies included in the systematic review

First author (year)	Key outcomes assessed	Treatment success (primary outcome)	Hospital length of stay	Other outcomes
Akgür (1991)	Treatment success (surgery not required) Recurrence	Conservative: 73.8%		Recurrence Conservative: 36.5% Operative: 18.8%
Bonnard (2011)	Treatment success (surgery not required) Hospital length of stay Time to first feeding	Conservative: 75% Control: 50%	Conservative: 3 days Control: 6.5 days	Time to first feeding Conservative: 48 h Control: 84 h
Eeson (2010)	Treatment success (surgery not required) Hospital length of stay Complications	Conservative: 16%	Conservative: 6.4±7.7 days Delayed operative: 14.0±11.8 days Operative: 10.4±8.9 days	Complications Conservative: 0% Delayed operative: 11.2% Operative: 12.5%
Vijay (2005)	Treatment success (surgery not required)	Overall: 52.2% 0–1 y: 26.9% 1–5 y: 73.7% 5–10 y: 61.5% 10–13 y: 63.6%		
Osifo (2010)	Treatment success (surgery not required)	Conservative: 0%		
Feigin (2010)	Treatment success (surgery not required) Hospital length of stay Time to first feeding	Conservative: 63%	Conservative: 4.5 days Operative: 10.2 days	Time to first feeding Conservative: 31 h Operative: 95 h
Nasir (2013)	Treatment success (surgery not required) Time to re-admission Duration of symptoms Hospital length of stay	Conservative: 37.5%	Conservative: 5 (4–9.3) days Operative: 13 (10–18.5) days	Time to re-admission Conservative: 27.5 (13.3–127.5) days Operative: 95 (15–476) days Duration of symptoms Conservative: 1 (1–3.5) days Operative: 2 (1–4) aysd

NA, not available or not applicable.

nasogastric decompression, parenteral fluids and correction of electrolyte and fluid imbalances. Not all studies specified that children received parenteral nutrition, however, we assume that parenteral nutrition was provided as a matter of course in all but the study reported by Osifo and Ovueni.[22] The findings reported by these investigators suggest that parenteral nutrition and intensive monitoring are an essential component of any conservative treatment regimen for ASBO in children.

Another unique treatment was the administration of Gastrografin after initial conservative management (as described above).[21] Water-soluble contrast material, such as Gastrografin, is safe and non-irritant to the peritoneal cavity of patients (including pediatric patients).[24] Clinical trial conducted by Bonnard *et al*[21] found that addition of Gastrografin to the conservative treatment regimen increased the rate of treatment success from 50% to 75%. The use of water-soluble contrast agents has been much more comprehensively studied in adults with ASBO and have been consistently reported to improve rates of treatment success (ie, the lack of the requirement for surgery) compared with standard conservative treatment.[11 25] Water-soluble contrast agent administration was effective in reducing the need for surgery and shortening hospital stay.[11] However, the value of using water-soluble contrast material in therapeutic purpose is still controversial. A prospective, randomised clinical study was conducted to investigate the efficacy of using meglumine ioxitalamate, a water-soluble hyperosmotic iodine-containing contrast material, as a supplement to the standard conservative treatment of postoperative small-bowel obstruction.[26] The author found that water-soluble contrast material offered no benefit as a supplement to the conservative treatment of small-bowel obstruction. Outcome of a meta-analysis indicated that water-soluble contrast (Gastrografin) did not reduce the need for surgical intervention but it did reduce the length of hospital stays compared with placebo.[27] The value of water-soluble contrast agents in children in the management of ASBO is not known.

Table 3 Newcastle—Ottawa quality assessment scale (Cohort study)

First author (year)	Akgür (1991)	Eeson (2010)	Vijay (2005)	Osifo (2010)	Feigin (2010)	Nasir (2013)
Selection						
1. Representativeness of the exposed cohort						
A. Truly representative of the average patient with ABSO in the community	*	*	*	*	*	*
B. Somewhat representative of the average_____ in the community						
C. Selected group of users ie, nurses, volunteers						
D. No description of the derivation of the cohort						
2. Selection of the non exposed cohort						
A. Drawn from the same community as the exposed cohort	*	*	NA	NA	*	*
B. Drawn from a different source						
C. No description of the derivation of the non exposed cohort						
3. Ascertainment of exposure						
A. Secure record (ie, surgical records)	*	*	*	*	*	*
B. Structured interview						
C. Written self report						
D. No description						
4. Demonstration that outcome of interest was not present at start of study						
A. Yes	*	*	*	*	*	*
B. No						
Comparability						
1. Comparability of cohorts on the basis of the design or analysis						
A. Study controls for treatment	*	*	NA	NA	*	*
B. Study controls for any additional factor (this criteria could be modified to indicate specific control for a second important factor.)						
Outcome						
1. Assessment of outcome						
A. Independent blind assessment						
B. Record linkage	*	*	*	*	*	*
C. Self report						
D. No description						
2. Was follow-up long enough for outcomes to occur						
A. Yes (select an adequate follow-up period for outcome of interest)	*	*	*	*	*	*
B. No						
3. Adequacy of follow-up of cohorts						
A. Complete follow-up—all participants accounted for						
B. Subjects lost to follow-up unlikely to introduce bias—small number lost—>___ % (select an adequate %) follow-up, or description provided of those lost)						
C. Follow-up rate <____% (select an adequate %) and no description of those lost						
D. No statement	*	*	*	*	*	*

ASBO, adhesive small bowel obstruction; NA, not applicable.

Clearly, additional studies are warranted to further examine the use of water-soluble contrast agents, such as Gastrografin, in the conservative management of children with ASBO.

Treatment success was often affected by the age of the children is these studies. For example, the study by Vijay *et al*[18] included patients from 0 to 13 years of age. The treatment success increased for children more than 1 year of age. The study by Akgur *et al*[19] included patients from 1 month to 16 years of age. The investigators reported that the patients, 8 years of age and older, who received gridiron incisions for appendicitis in the

Table 4 Newcastle—Ottawa quality assessment scale (case–control study)

First author (year)	Bonnard (2011)
Selection	
1. Is the case definition adequate?	
A. Yes, with independent validation	
B. Yes, ie, record linkage or based on self reports	*
C. No description	
2. Representativeness of the cases	
A. Consecutive or obviously representative series of cases	
B. Potential for selection biases or not stated	*
3. Selection of controls	
A. Community controls	
B. Hospital controls	*
C. No description	
4. Definition of controls	
A. No history of disease (endpoint)	*
B. No description of source	
Comparability	
1. Comparability of cases and controls on the basis of the design or analysis	
A. Study controls for Gastrografin treatment for ABSO (select the most important factor.)	*
B. Study controls for any additional factor (this criteria could be modified to indicate specific control for a second important factor.)	
Exposure	
1. Assessment of exposure	
A. Secure record (ie, surgical records)	*
B. Structured interview where blind to case/control status	
C. Interview not blinded to case/control status	
D. Written self report or medical record only	
D. No description	
2. Same method of ascertainment for cases and controls	
A. Yes	*
B. No	
3. Non-response rate	NA
A. Same rate for both groups	
B. Non respondents described	
C. Rate different and no designation	

ASBO, adhesive small bowel obstruction; NA, not applicable.

first 3 months of the postoperative period had the greatest chance of overcoming obstruction non-operatively. In contrast, the patients who underwent their first surgery in the neonatal period, for a condition requiring a colonic pull-through, and the last surgery more than 18 months ago has the least chance of overcoming a bowel obstruction.

Our review has a number of limitations that warrant acknowledgment. First and foremost, all but one of the studies included in our systematic review had inherent limitations due to their retrospective design. Second, there was some between study variability in conservative treatment regimens that clearly had an impact on the findings. Aside from treatment success, there was also variability between studies in the types of outcomes assessed, making it difficult for us to comment further on other outcomes (although, unsurprisingly, conservative treatment was clearly associated with a shorter length of hospital stay and time to first feeding than operative treatment). Finally, only a small number of studies met the criteria for inclusion in our review. Ideally, additional, well-designed, prospective studies are needed to more comprehensively evaluate the place of conservative treatment for the management of ASBO in children.

In summary, we have reviewed the current literature reporting outcomes following conservative treatment for the management of ASBO in children. Although some children with ASBO will always require immediate surgery (ie, those with bowel strangulation), the available evidence suggests that comprehensive conservative treatment can be effective in a large proportion of cases. Further studies are needed to optimise conservative treatment strategies for children with ASBO.

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