

Original Research

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Non-operative management of adhesive intestinal obstruction in children, 2000-2012, at Waikato Hospital, New Zealand

Aaron OOI,¹ Udaya SAMARAKKODY,² Askar KUKKADY,² Stuart BROWN,² Jitoko K CAMA²

ABSTRACT

Introduction: Post-operative small bowel adhesions causing bowel obstruction is common in adults but is uncommon in the paediatric age group. The incidence of adhesive intestinal obstruction (AIO) requiring surgical intervention ranges between 2-8% in paediatric patients and majority would occur within the first two years after surgery.

Aim: To review our experience at a tertiary centre in children under 15 years who were admitted with adhesive intestinal obstruction over a 12 year time period, 2000-2012, and to compare outcomes with other international reports

Methodology: This retrospective case series study of all paediatric surgical patients (aged between 1-15 years) admitted with adhesive intestinal obstruction to Waikato Hospital over a 12 year time period were identified by ICD-10-AM codes. Their demographic variables, information of previous surgery and the admissions details including particulars of management were tabulated.

Results: Out of 66 admissions, 10 were excluded and 56 admissions were analysed. 35 patients were successfully managed non-operatively and 21 patients proceeded for operative management (7 early and 14 late). Of the operative group, 3 underwent bowel resections (2 early and 1 late). There was no statistically significant difference between length of stay (LOS) among patients with non-operative and operative management. There was also no statistically significant difference between LOS among patients with early (≤ 24 hours) operative management and late (> 24 hours) operative management. In assessing secondary aims, statistically significant differences in the time of presentation from initial surgery was noted for patients who underwent appendectomy who trended towards earlier presentation compared to other laparotomies.

Conclusion: This study demonstrated that there could still be a role of non-operative management of children with adhesive bowel obstruction but decision on further management should be clearly defined within 24 hours to prevent development of complications.

Key words: intestinal obstruction, children, paediatric surgery, non-operative management

INTRODUCTION

Reports of 1.1% of patients under 16 years of age re-admitted to hospital after lower abdominal surgery are a direct consequence of adhesions, with 8.3% of patients re-admitted possibly related to adhesions over a 4 year follow up period.² Nevertheless, those adhesive intestinal obstruction in paediatric patients requiring surgical intervention has been reported to range between 2.2-8%, most of which occur within the first two years of surgery.^{3,4}

The decision making as to the timing of operative management of any adhesive intestinal obstruction in children can be a daunting task for any paediatric surgeon. All surgeons would agree that one should proceed to the surgical intervention if there are clinical or

Corresponding author: Jitoko K Cama

Email: Jitoko.Cama@waikatodhb.health.nz

1. Paediatric Registrar, Paediatric Surgery Department, Waikato Hospital, Hamilton, New Zealand
2. Paediatric Surgeon, Paediatric Surgery Department, Waikato Hospital, Hamilton, New Zealand

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radiological signs of bowel ischaemia. If there are no signs of bowel ischaemia, some surgeons

would advocate early operative management after the initial resuscitation to prevent bowel ischaemia but at the risk of causing more adhesions later on. Others have advocated the role of non-operative management as a safe option to prevent further adhesions. The success rate with non-operative management in adhesive bowel obstruction in children ranges between 16% to 48.6% without any increase in morbidity and mortality associated with delayed operative management.⁵⁻⁷ This 12 year retrospective review was conducted in a tertiary centre at Waikato Hospital New Zealand to evaluate our experience with children under 15 years of age who are admitted with adhesive intestinal obstruction over a time period and comparing our results with other international reports.

METHODOLOGY

The medical records of all patients between one and fifteen years of age admitted under the Paediatric Surgical Department at Waikato Hospital between the first of January 2000 and 30th of June 2012 inclusive were reviewed retrospectively. Patients were identified based on the following ICD-10-AM codes: K565 – Intestinal adhesions [bands] with obstruction, K566 – Other and unspecified intestinal obstruction and K913 – Post-procedural intestinal obstruction. Of the patients identified, the diagnosis of adhesive intestinal obstruction was made on the basis of compatible clinical and radiologic findings in patients with a history of previous abdominal surgery, and where possible, confirmed on operative findings. Radiologic data were obtained from reports provided by specialist radiologists. Patients with an alternate primary diagnosis such as obstruction due to other causes or paralytic ileus were excluded from the study.

The following information was tabulated from patients' clinical notes: age at presentation with adhesive intestinal obstruction, ethnicity, gender, details of previous surgery (including age at surgery, date of surgery, type of initial surgery and indication, intraoperative and postoperative complications). Admission details were also collated including clinical presentation, type of radiological investigations requested and findings, aspects of conservative management (nil by mouth, intravenous fluid administration, nasogastric tube inserted for decompression and placed on free drainage/aspirates) and details of operative management (date and time of surgery, operative findings and rates of bowel resection).

Patients were divided into three groups based on the type of management received; Non-operative management, early operative management (≤ 24 hours to surgery from time of presentation) and late operative management (> 24 hours to surgery from time of presentation). Length of stay was used as a primary outcome measure to compare the differences in outcome between the aforementioned groups. Our study also set out to examine the difference in time to presentation from initial surgery between patients who underwent a previous appendicectomy compared to other operations.

In assessing the primary outcome of our study, comparison in the length of stay between the non-operative and operative groups, and the early and late operative group were calculated using the two sample Wilcoxon rank-sum (Mann-Whitney) test. Similarly, the time to presentation from time of initial surgery between the appendicectomy groups compared to other operations was also calculated with the same test.

RESULTS

A total of 66 admissions were identified which met our inclusion criteria with the diagnosis of adhesive intestinal obstruction over the 12-year period. Of these, 10 were excluded, nine due to failure in obtaining complete medical notes and one excluded as outcomes were unavailable as the patient was transferred to another tertiary centre. Ultimately, 54 patients were included in the study with 56 admissions, as 2 patients presented on two separate occasions (**Figure 1**). Twenty-eight (28, 50%) of the patients were male, with patients' ages ranging from 1 to 14 years of age (mean 8.2 years, standard deviation 4.0). Fifty two percent (52%) of patients identified as NZ European, with a further 36% being Maori, 8% Other European, 2% African and 2% Asian.

Cardinal symptoms of intestinal obstruction were seen in 93% who had abdominal pain and 91% with vomiting during their presentation. Less than half of the patients (41%) did not have abdominal distension and 36% of patients did not present with constipation. In our series, appendicectomy was the most common operation leading to adhesive intestinal obstruction, followed by exploratory laparotomy for gastric or intestinal perforations, Malone's Antegrade Continence Enema (MACE) procedures, Nissen fundoplication, gastroschisis repair and Ladd's procedure (**Table 1**). The ages at the time of the initial operation ranged from 2 days to 14 years of age (mean 6.0 years, standard

deviation 4.6) and this correlates with the age group of children under the age of 15 years who are under the care of paediatric surgeons at Waikato Hospital. Based on the clinical assessments, 46 admissions (82%) proceeded with an abdominal x-ray as their initial investigation, of which 42 (91%) showed significant dilated bowel loops and air fluid levels suggestive of bowel obstruction. Of the total 56 admissions, 9 (11%) also had an additional USS most commonly done to exclude intussusception of which 7 (77%) proceeded to have a CT scan to exclude other causes such as intra-abdominal sepsis.

Table 1: Incidence of most common operations leading to AIO

Procedure	n	%
Appendicectomy	27	50.0
Laparotomy for gastric/intestinal perforation	6	11.1
MACE procedure	4	7.5
Nissen fundoplication	3	5.5
Gastroschisis repair	3	5.5
Ladd's procedure	3	5.5
Diaphragmatic hernia repair	2	3.8
Other miscellaneous	6	11.1

All 56 admissions were initially managed non-operatively, with 21 admissions proceeding for operative management (**Figure 1**). All patients had a period of non-operative management which consisted of varying aspects of bowel rest; being placed nil by mouth, fluid resuscitation with intravenous fluids and insertion of a nasogastric tube for decompression. Operative

management was required in 37% of our cases, of which 7 were in the early operative management group and 14 in the late operative management group, with a mean time to surgery of 13.4 and 70 hours respectively. Two out of these 7 (28.6%) patients in the early operative management group proceeded to immediate surgery within the first hour with both needing bowel resection. One patient in the late operative group underwent bowel resection which might be suggestive of late operative intervention as he was admitted for a few days prior to surgery, however this study was not designed to ascertain the exact reason.

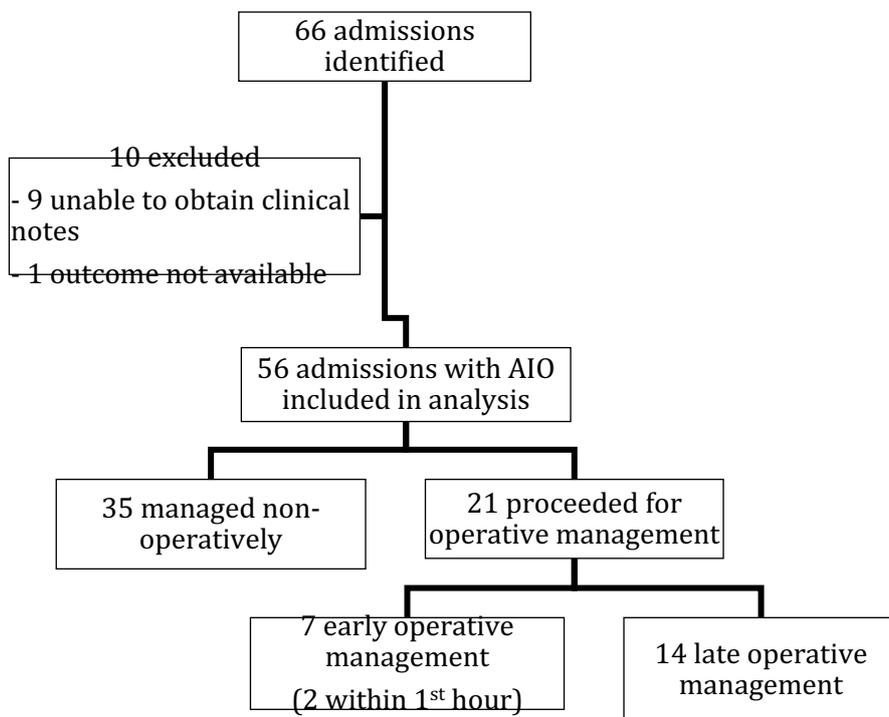
The mean and median LOS in the non-operative compared to the operative groups was 7.1 and 6.9, and 4.5 and 5 days respectively. A larger range of LOS was observed in the non-operative group (1-36 days versus 2-28 days in the operative group). However, there was no statistically significant difference in the LOS between patients undergoing non-operative compared to operative management (P value = 0.27). In comparing patients in the early and late operative group, a mean of 6.6 days and 5.1 days and a median of 5 and 4 days were found for both groups respectively (range 4-8 days and 2-28 days) but this was not statistically significant (P value = 0.87).

The time to presentation with adhesive intestinal obstruction from the time of initial surgery varied widely, from as early as one week to 14 years. A comparison of patients who underwent appendicectomy compared to other operations found a mean of 1.05 years and 3.87 years and median of 1 month and 2 years for both groups respectively. This trend towards earlier presentation with adhesive intestinal obstruction for patients who have had appendicectomy was observed to be statistically significant (P value = 0.001).

Table 2: Comparison of published studies of acute intestinal obstruction in children

Study	Year	n	No. of immediate operative mx	No. of non-operative management	Managed non-operatively, proceeded for operative mx	Total operative rate
Akgur et al	1991	230	81 (45%)	149 (55%)	39 (26% of 55%)	60%
Shieh et al	1995	71	13 (18%)	58 (82%)	23 (39% of 82%)	50.7%
Vijay et al	2005	74	5 (7%)	69 (93%)	33 (48% of 93%)	51%
Eeson et al	2009	165	32 (19%)	133 (81%)	107 (80% of 81%)	84%
Waikato Hospital	2012	56	2 (3%)	35 (63%)	19 (38% of 100%)	37%

Figure 1: Overview of management of patients with AIO



DISCUSSION

Adhesive intestinal obstruction continues to cause significant morbidity in the paediatric population following abdominal surgery, alongside significant health care costs. This is also seen in the era of laparoscopic surgery.⁸ The time of onset of complications associated with adhesions varies widely, occurring as early as one week to several years following surgery and include abdominal pain, restriction of normal activities, time off school and the need for hospital readmissions and further surgery.^{4,9,10}

Several studies have been published to date in examining potential outcome predictors to identify those whose clinical presentation are less likely to respond with non-operative management. Tachycardia and a younger age have been identified as likely factors associated with operative management across a number of studies.^{5,6,11} The absence of leucocytosis and older age appeared to be associated with successful non-operative management. Other factors apart from the age at recent laparotomy, time elapsed since laparotomy, type of previous incision, duration of conservative trial and primary

surgical diagnosis were also predictive criteria identified that correlated with the success of non-operative management.⁷ The latter, in addition to age at presentation less than one year of age, also identified risk factors associated with high risk for operative management in other reports.⁵⁻⁷ Nonetheless, consistent findings other than age at presentation or prospectively validated and sufficiently sensitive clinical predictors remain to be lacking, particularly in the paediatric population.

Despite advancements in surgical techniques, the aetiology of adhesive intestinal obstruction remains incompletely understood. Multiple factors have been implicated in the formation of post-surgical adhesions including infection, operative technique and traumatic factors.¹²

Mechanical effects of pressure, excessive handling of the peritoneum and irritation of the peritoneal lining with blood and foreign materials have been found to be one of many several factors leading to adhesion formation, prompting meticulous attention to operative technique and tissue handling in the attempts to limit the extent of injury during surgery.¹² Although increasing numbers of studies have reported varying efficacy and safety of anti-adhesive technologies as an adjunct to reduce risk of post-operative adhesion formation in adults, limited literature exists to support its use in the paediatric population.^{12,13}

Several studies have reported varying rates of adhesive intestinal obstruction according to type of initial surgery. Consistent with other studies done to date, appendicectomy served as a significant contributor to adhesive intestinal obstruction and appendicectomies are often the most frequently performed operations in the paediatric population, thereby likely posing a significant burden.^{5,15} Although the reason for this is largely unknown, this may be attributable partly due to infections often being considered one of the most common

triggers for adhesion formation, which may explain our finding of patients with appendicectomies tending to present earlier with adhesive intestinal obstruction compared to other operations noted in our cohort of patients. Despite this, a relatively low incidence of 0.31% of adhesion-related readmissions for appendicectomies have been reported, with inflamed and complicated appendicectomies having a higher risk of readmission of 0.36% as expected.² Surgeries noted to have an over representation of post-operative adhesive intestinal obstruction include Ladd's procedures, Nissen fundoplication, stoma formation and reversal, and repair of congenital abdominal wall defects, several of which were also noted in our study.^{5,15} It is worth noting here that our centre currently perform the same type of surgeries as many other paediatric surgical centres with the exception of paediatric oncology.

The management of adhesive intestinal obstruction in the paediatric population continues to remain controversial, with current guidelines lacking and varying rates of successful resolution of symptoms with non-operative management in studies published in other literatures as shown in **Table 2**. Operative management, if indicated, is not without risks, having been associated with incidental bowel injury, blood loss, prolonged ileus and possibility of recurrence of adhesive intestinal obstruction, with multiple surgeries increasing the risk of further adhesion formation.¹⁶ Vijay et al in a study of 74 admissions of adhesive intestinal obstruction in 2005 noted successful resolution of symptoms with conservative management alone in 52.2% of patients.⁶ Similar findings of a total operative rate of 50.7% was found in a study by Shieh et al; 13 children required immediate surgery, with remaining 58 initially managed non-operatively with resolution of symptoms in 35 patients.¹¹ Akgur et al reported an operative rate of 60% in a study of 181 patients who presented with adhesive intestinal obstruction, with 39 (26.2%) episodes proceeding for operative management after a period of non-operative management in 149 cases.⁷ In contrast, other authors have advocated for operative management based on findings showing high rates of surgery required in similar populations. This was demonstrated by Eeson et al, with a total laparotomy rate of 84% (107 out of 133 patients) requiring

operative management after failure of non-operative management.⁵

Our study demonstrated a relatively lower total operative rate of 37% when compared to other similar studies, supporting our impression of a relatively significant role for non-operative management existing in paediatric patients presenting with adhesive intestinal obstruction. This may have been attributable to a number of factors, including surgeon preference and several acknowledged limitations in our study. Patient identification in our study was solely based on coding, raising the possibility of missed cases from patients who were incorrectly diagnosed or coded and the inability to identify patients managed without surgery that never presented to our tertiary centre. Documentation was also not available for a reasonable number of patients, contributing to our relatively small sample size in comparison to other studies published. Finally, we excluded infants less than one year of age due to the high likelihood of associated co-morbidities and often prolonged length of stay in NICU which may have skewed our results disproportionately for outcomes measured, but ultimately may have a lower threshold for operative management.

A limited number of studies have reviewed the various outcomes of non-operative versus operative management, which include the morbidity, mortality and rates of small bowel resection. Although Janik et al concluded that delays in operative management were associated with increased morbidity and mortality, several other recent studies have reported no difference with non-operative management.^{5,6,17} The association between operative delay and the rate of small bowel resection has been previously studied by Lautz et al, who found similar adjusted odds of small bowel resection in the first and second day of admission, but increased in the third day.¹⁸ Subsequently, they recommend consideration of operative management in patients who do not exhibit signs of improvement by the second day after admission, to avoid potentially increasing the risk of bowel loss.¹⁸ The decision for surgery at 48 hours was also recommended in a study conducted by Feigin et al, where it was noted that strangulation did not occur in cases observed for 16 hours or less but rates increased the longer surgery was delayed.¹⁵ Our current study adds a further outcome measure with regards to length of stay with

no difference seen between those managed non-operatively and operatively, supporting consideration for non-operative management in the initial period if no immediate indications for surgery exist, particularly for the first 24 hours following presentation.

In order to assist with risk stratification for these patients on presentation, further prospective studies are required prior to the establishment of clear guidelines in the future. These include additional delineation of consistent clinical determinants that may help determine the need for operative management which is beyond the scope of this study. Evidence for timeframes in which to persist with non-operative management would also be further area of exploration. Ultimately, varied outcome measures on a larger multicentre scale would be required to be collectively studied prior to achieving a consensus in this challenging area of management.

CONCLUSION

We conclude that in children who present with adhesive intestinal obstruction, non-operative management should be considered in an attempt to reduce morbidity associated with surgery. Further studies are required in determining the ideal duration of non-operative management, with the advantages of non-operative management balanced against the risk of bowel resection in this population.

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