

# Postoperative adhesions after abdominal surgery in children: a pilot study in the Philippines

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**To cite:** Deogracias JMC, Almonte JR. Postoperative adhesions after abdominal surgery in children: a pilot study in the Philippines. *World Jnl Ped Surg* 2019;2:e000049. doi:10.1136/wjps-2019-000049

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/wjps-2019-000049>).

Received 12 March 2019  
Revised 29 May 2019  
Accepted 30 May 2019

## ABSTRACT

**Background** Postoperative adhesions (POAs) causing mechanical bowel obstruction is a challenging problem for children who underwent prior abdominal surgeries. Unlike in adults, the role of conservative management remains controversial and children tend to require re-operation. However, despite the longer lifetime risk inherent to the pediatric population, studies are still lacking to come up with guidelines on diagnosis and management. This study aimed to review the profiles and outcomes of patients who underwent surgery for POA and to identify significant risk factors.

**Methods** This was a retrospective review of 172 patients admitted at the Philippine General Hospital from 2010 to 2018 with the diagnosis of POA. Patients who did not undergo surgery and patients who had a different cause of bowel obstruction with the adhesions being only incidental were excluded from the study.

**Results** Ninety-one patients were included in the study. The mean age at surgery was 92.32 months and the male:female ratio was 2.8:1. The most common primary diagnoses were appendicitis, intussusception, and abdominal trauma. POA occurred within the first postoperative year in 63%. The 30-day morbidity and mortality rates were 9.89% and 7.69%, respectively. The most common complications were fascial and anastomotic dehiscences, and sepsis was the most common cause of death. Stoma creation during the index operation, and the presence of bowel gangrene, intestinal resection, and stoma creation during the surgery for POA were statistically significant risk factors for morbidity and mortality.

**Conclusion** The findings in this study support the experience in literature that timely operative intervention can prevent bowel strangulation in cases of mechanical bowel obstruction from POA. However, more data and studies are recommended to arrive at an evidence-based guideline in the management of these children.

## INTRODUCTION

Postoperative adhesions (POAs) occurring within the peritoneal cavity are an unavoidable consequence of the healing process after any surgery with violation of the peritoneum.<sup>1–4</sup> In a literature review, they have been defined as “post-traumatic cicatricial adherences of two normally non-contiguous peritoneal surfaces.” And such adhesions are

considered to be the most common cause of small bowel obstructions in adults with rates as high as 75%.<sup>5,6</sup> However, literature on children remains limited, especially for populations from the developing world. Studies also remain scarce despite the fact that children, especially infants and neonates, have a longer lifetime risk of adhesion-related complications.<sup>7,8</sup> Studies in recent years have tried to quantify the incidence and the burden of disease of intestinal obstruction in children. They have concluded that children have a high incidence of re-operations caused by POA ranging from 6.2% to 12.6%, and that conservative treatment, unlike in adults, have a limited role and remains controversial.<sup>1,3,7,8</sup>

In several studies, it was reported that majority of intestinal obstruction from POA, up to 87%, occurs most often in the first year after the index surgery.<sup>2,3,9</sup> A recent study in 2015 by Fredriksson *et al* also reports that the incidence of small bowel obstruction beyond 2 years of the initial surgery is as high as 30%. The diseases which had the highest risks of postoperative adhesions that required re-laparotomy are Hirschsprung’s disease, malrotation, intestinal atresia, and necrotizing enterocolitis. The length of initial surgery, stoma creation, and postoperative complications were identified as independent risk factors.<sup>8</sup>

However, there is no local or international established protocol or guidelines in the management of postoperative adhesions in children. For adults, there is an international guideline published in 2013 by the World Society of Emergency Surgery and conservative management is recommended as the initial approach to patients presenting with gut obstruction from postoperative adhesions without signs of bowel strangulation.<sup>10</sup>

There is also currently no published literature on POA in the Philippines. This pilot study in children in the Philippines mainly aimed to determine the incidence of POA that causes mechanical bowel obstruction



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(MBO) that required re-operation among children. The first objective of the study was to review the clinical profiles of these patients in terms of age and sex, the primary diagnosis, and the operative findings during their index surgery, which was defined as the surgery immediately preceding the operation for MBO secondary to POA. The second objective was to review the findings during the POA surgery in terms of the presence of bowel gangrene or perforation, the need for intestinal resection, and the creation of a stoma, and document outcomes in terms of morbidity and mortality. The third objective of this study was to look into possible association of the patient's demographic profile as well as factors or variables present during the index surgery to the findings in and the outcomes of the POA surgery. The index variables identified were the time interval from index to POA surgery, the urgency of the index surgery, the presence of peritonitis in the index surgery, and stoma creation during the index surgery.

## METHODS

A retrospective review of medical records of all patients ages 0–18 years with the diagnosis of POA admitted at the Philippine General Hospital from January 1, 2010 to June 30, 2018 was conducted. Those patients who did not undergo surgery for MBO secondary to POA were excluded. Those patients who underwent surgery initially for the possibility of MBO from POA but were found out intraoperatively to be otherwise, and those patients who underwent surgery where the presence of adhesions was only incidental and not the primary cause of the MBO were also excluded in the study. All patients included had at least one prior abdominal surgery.

Descriptive statistics was used to summarize the demographic and clinical characteristics of the patients. Frequency and proportion were used for categorical variables. The age, the number of prior operations, the urgency of the index operations, the time interval from the index to the POA surgery, the presence of peritonitis, and stoma creation during the index operations were considered risk factors. The outcomes recorded were the presence of gangrene or perforation during the surgery for postoperative adhesions, the need for intestinal resection and stoma creation during POA surgery, the length of hospital stay, and 30-day morbidity and mortality. The presence of bowel strangulation, need for resection, and stoma creation during POA surgery were also included as risk factors in analyzing the morbidity and mortality outcomes.

OR and corresponding 95% CIs from binary logistic regression were computed to determine significant risk factors per outcome. Shapiro-Wilk was used to test the normality of the continuous variables. Missing variables were neither replaced nor estimated. Null hypotheses were rejected at 0.05 $\alpha$  level of significance. Stata V.13.1 was used for data analysis.

**Table 1** Demographic profile at index and POA surgery

**n=91**

Males: 67

Females: 24

Age at POA operation	Mean: 92.3 months Range: 1.3–231.2 months Median: 64.0 months IQR: 12.6–175.2 months
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Neonates (<28 days)	0 (0%)
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Infants (28 days to <1 year)	22 (24%)
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Children (1–12 years)	43 (47%)
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Adolescents (13–18 years)	12 (28%)
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Age at index operation	Mean: 75.1 months Range: 0.03–225.7 months
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Neonates (<28 days)	14 (16%)
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Infants (28 days to <1 year)	21 (24%)
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Children (1–12 years)	31 (36%)
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Adolescents (13–18 years)	20 (23%)
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Age not determined	5
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POA, postoperative adhesion.

## RESULTS

Of the 172 pediatric patients admitted with the diagnosis of intestinal obstruction from possible POA at the Philippine General Hospital, 91 or 53% underwent surgery, which confirmed intraoperatively the diagnosis of MBO from POA. The male:female ratio was 2.8:1. The average age at the time of POA surgery was 92.3 months with the range of 1 month and 8 days to 18 years–11 months–27 days. There were no neonates in the series at POA surgery. There were 22 infants, who were less than 1 year old, 43 children with ages 1 to 12, and 26 adolescents, 13 years old and above. With reference to the ages at their index operations, the average was 75.1 months with the youngest only a day-old neonate and the oldest at 18 years old. There were 14 neonates, 21 infants, 31 children ages 1–12, and 20 adolescents. [Table 1](#) summarizes the demographic profiles of the patients in the study.

The most common index diagnosis was appendicitis with 25 cases which is 27% of the cases. Of the 25, 13 were reported to be ruptured. The second most common diagnosis was intussusception with 14 patients. Intussusception was the most common diagnosis for patients under 1 year old who subsequently had MBO from POA. For adolescents, on the other hand, after appendicitis, the second most common diagnosis was a previous operation for abdominal trauma. [Table 2](#) lists all the index diagnoses and their frequencies.

The most common index operation was appendectomy. Eleven were reported to be exploratory laparotomies with a midline incision and 13 were recorded as simple appendectomies with a right lower quadrant abdominal incision. [Table 3](#) lists the most common index operations.

**Table 2** List of index diagnosis and frequency

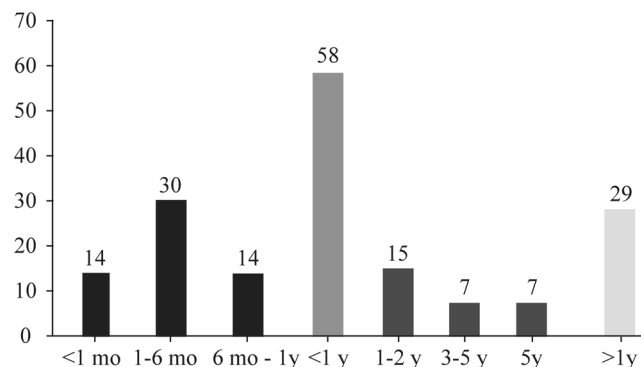
<b>Appendicitis</b>	<b>25</b>
Intussusception	14
Abdominal trauma	6
Imperforate anus	6
Hydrocephalus	5
Malrotation	4
Congenital diaphragmatic hernia	4
Hirschsprung's disease	3
Intestinal atresia	3
Ovarian tumors	3
Meconium peritonitis	2
Cholecystitis	2
Inguinal hernia with intestinal incarceration	2
Septic ileus	1
Peutz-Jeghers syndrome	1
Congenital adhesive band	1
Patent omphalomesenteric duct	1
Biliary atresia	1
Meckel's diverticulum	1
Wilm's tumor	1
Vaginal perforation	1
Omental cyst	1
Cloacal exstrophy	1
Familial adenomatous polyposis	1
Unknown	1

Peritonitis during their index surgery was documented in 36 patients. Stoma creation was done in 21 cases. Seventy-one or 78% of cases had their index operation in an emergency setting and only 30 operations were classified as elective.

The average interval from the index operation to the POA surgery was 18.6 months with a range of 5 days to 11 years and 9 months. Majority of the MBO secondary to POA that required surgical intervention occurred within

**Table 3** Most common index operations

<b>Appendectomy</b>	<b>24</b>
Exploratory laparotomy	11
Simple appendectomy	13
Manual reduction of intussusception	7
Intestinal resection for intussusception	6
Exploratory laparotomy for trauma	6
Closure of ostomy	5
Ventriculoperitoneal shunt insertion	5
Transverse colostomy for imperforate anus	5
Tumor resection (ovarian, Wilm's, and omental)	5

**Figure 1** Histogram showing frequency of postoperative adhesion surgery at time intervals from the index surgery.

the first year after the index operation at 63%. For those who presented with less than 1-year interval, 76% were during the first 6 months after their previous surgery. There were also 14 cases of early POA that had their re-operation done less than 1 month after their index surgery. [Figure 1](#) is a histogram showing the frequency of POA surgery at time intervals from the index surgery.

Eleven of the 91 cases or 12% had more than one previous operations before the POA surgery. One patient with Hirschsprung's disease had a total of four previous operations, with the most recent operation being the closure of his initial ostomy. It was also noted that three patients in this series had POA surgeries twice. [Table 4](#) summarizes the clinical profiles and risk factors present during the index surgery.

With regard to the outcomes of the POA surgeries, 54 or 59% underwent only adhesiolysis or enterolysis. However, among the 91 cases, 21 required segmental intestinal resection and 22 necessitated the creation of a stoma. It was reported that there was intestinal perforation or gangrene in 21 cases at the time of the POA surgery.

**Table 4** Summary of clinical profiles and risk factors at index surgery

<b>n=91</b>	
<b>Urgency of index operation</b>	
Emergency	71 (78%)
Elective	20 (22%)
Peritonitis during index surgery	36 (40%)
Stoma creation during index surgery	21 (23%)
Interval between index and POA	Mean: 18.6 months Range: 0.37–134 months
<b>No of operations prior to POA</b>	
1:	80
2:	9
3:	1
4:	1

POA, postoperative adhesion.



**Table 5** Summary of outcomes

n=91

Presence of gangrene or perforation	21 (23%)
Resection during POA surgery	21 (23%)
Stoma creation during POA surgery	22 (24%)
Morbidity	9 (9.9%)
Mortality	7 (7.7%)
Length of hospital stay	Mean: 18.4 days
Prolonged hospital stay ( $\geq 10$ days)	Range: 5–122 days 61 (67%)

POA, postoperative adhesion.

The 30-day morbidity rate was at 9.9% (nine patients) with four patients having wound and fascial dehiscence and four patients having intestinal anastomotic leaks. One of those patients had both complications. The other two patients' complications were a recurrence of the MBO from POA and a strangulated parastomal hernia. The series has a mortality rate of 7.7% with seven patients dying within 30 days after their POA surgery. The two patients with anastomotic leaks after POA surgery and the one patient with strangulated parastomal hernia eventually died. All seven mortalities reported sepsis as their primary cause of death.

The average overall length of hospital stay of the patients during their admission for POA was 18.4 days which is higher compared with the 9.7 days average length of stay of pediatric surgical patients in the same time period from 2010 to June of 2018. Prolonged hospital stay is defined in this paper as stay for 10 or more days. Table 5 summarizes these figures.

## DISCUSSION

Given the patient's demographic profiles outlined in table 1 and clinical profiles outlined in table 4 and the outcomes outlined in table 5, OR and corresponding 95% CIs from binary logistic regression were computed to determine significant risk factors per outcome. The presence of gangrene and perforation during POA surgery, bowel resection, and stoma creation during POA surgery were also analyzed as risk factors to morbidity, mortality, and length of stay. Analysis showed that only the presence of 30-day morbidity, mortality, and length of hospital stay had significant risk factors. However, due to the limited number of patients in this series, the lack of statistical significance to the association of the other risk factors to the other outcomes can affect the results of this analysis.

Significant association was noted with stoma creation during the index operation and resection and stoma creation during their POA surgery to the presence of morbidity. These patients were five times more likely to have postoperative morbidity than patients without stoma at index operation or those without resection during POA surgery. Also, patients found to have gangrene or perforation at POA surgery were 42 times more likely to

have morbidity than patients without gangrene or perforation at POA surgery. The finding of bowel gangrene or perforation during the surgery for POA is expected to lead to more complications since these patients undergo additional surgical procedures like intestinal resection and stoma creation, compared with a simple adhesiolysis where there is no breach of intestinal integrity. The presence of gangrene or perforation can definitely lead to more infectious complications; however, this subset analysis was not included in this study.

In terms of mortality, patients with stoma creation at index operation, gangrene or perforation at POA surgery, resection, and stoma creation at POA surgery were 5.25 times more likely to expire than patients without these factors within 30 days postoperatively. It was also noted on analysis that patients who underwent their index operation at an older age were less likely to die during their POA surgery. Compared with neonates during index surgery, infants were 91% less likely to expire. Patients with age at index operation of more than 1 year were 96% less likely to expire than patients who were neonates during their index surgery. This particular association between the age at index operation and mortality can be statistically significant; however, factors such as the primary diagnosis as well as comorbidities can also be clinically significant. These factors were not covered in this analysis.

With regard to length of hospital stay during the POA surgery, association was seen in the age at index and the age at POA surgery to the length of hospital stay. Prolonged hospital stay was arbitrarily defined as more than 10 days which is the general average length of day of our patients in our institution. For every month increase in age at index operation, the odds of prolonged hospital stay of a patient decreases by 0.56%. For every month increase in age at postoperative adhesion, the odds of prolonged hospital stay of a patient decreases by 0.24%. This only shows that there is a significant trend that younger patients tend to have prolonged confinement.

Online supplementary appendix 1 shows the table summarizing the association between the risk factors and the different outcomes.

## CONCLUSION

Postoperative adhesions after abdominal surgery are well studied in adults, but data on children are largely based from retrospective studies like this. In this pilot series for Filipino children, more than half of the patients admitted for MBO secondary to POAs eventually underwent surgery and majority happened within the first year of their index surgery. The most common diagnosis that had POA corresponds also to the most common abdominal operation done in children in our institution. Significant risk factors for morbidity during POA surgery were stoma creation at index operation, the presence of gangrene or perforation, intestinal resection, and stoma creation during POA surgery. The same risk factors were also significant in terms of mortality with an additional

risk added when the patient is a neonate during the index surgery. These findings support the experience in literature that in children, a timely operative intervention can significantly improve the chance of avoiding bowel strangulation and, eventually, improve outcomes of patients presenting with MBO secondary to POA.

However, the conclusion that conservative management is not applicable in children cannot be said with our available data and experience. The study did not cover the approaches to diagnosis and management of these patients. Their clinical presentations were also not included in this study. The authors believe that a prospective study including the aforementioned factors that can affect outcome can be done in the future. The authors of this study also recommend the creation of a standardized protocol for the approach in the diagnosis and management and documentation of children presenting with MBO from POA. This protocol can improve the data registry for future research into the true burden of post-operative adhesions in children.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient consent for publication** Not required.

**Ethics approval** The research was approved by the University of the Philippines–Manila Research Ethics Board and was entirely retrospective.

**Provenance and peer review** Not commissioned; externally peer reviewed.

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