EVALUATION OF A SERIES OF PATIENTS OPERATED FOR ADHESIVE INTESTINAL OBSTRUCTIONS

Nazile Erturk*, 1, Kaan Sönmez** and Nuri Kale**

*Department of Pediatric Surgery, Faculty of Medicine, Mugla Sitki Kocman University, Mugla, Turkey., **Department of Pediatric Surgery, Faculty of Medicine, Gazi University, Ankara, Turkey.

ABSTRACT

Background: The risk of bowel obstruction after laparotomy in infants and children, especially in developing countries, has not been well researched. Objectives: The aim of this study was to perform a detailed analysis of adhesions and the risk factors for adhesion-associated intestinal obstruction after laparotomy in children. Methods: This retrospective study involved patients who were operated between January 1990 and January 2001 on for postoperative adhesive intestinal obstruction (AIO). Results: A total of 45 patients (mean 7.75 years) were operated on after 1341 laparotomies. The incidence of AIO was 3.35%. The patients were operated on at 6th postoperative day at the earliest and 10 years at the latest. The mortality and morbidity rates were found to be 2.2% and 22.2%, respectively. AIO was most commonly observed after operations involving the pelvic area (77.7%). Appendectomy, trauma, invagination, and megacolon surgeries were the most common postoperative causes of AIO. Conclusion: This study showed that adhesions in children occurred more commonly after lower abdominal surgery. The risks were closely related to the site and type of the first surgery. Although the risk of having adhesions was very high in the first years, it also persists in the following years.

KEYWORDS: Intestinal obstruction; Adhesions; Abdominal Surgery; Children; adhesion prevention

Introduction

Postoperative adhesions remain a huge, unsolved problem [1]. Intestinal obstruction secondary to adhesions occur at a rate of 10-20% after conservatively managed inflammatory disorders such as acute appendicitis, acute cholecystitis, diverticulitis, pelvic inflammatory disease, and inflammatory bowel disease, and at a rate of as high as 80-90% as a late complication after laparotomy operations [2]. Although the exact incidence of adhesion-induced intestinal obstructions is unknown, several reports have provided figures ranging between 1.1% and 8.3% [3-6]. Unfortunately, this natural healing process may lead to complications including abdominal pain, inability to perform daily activities or to attend school, malaise or pain, and growth retardation, but it may also give rise to serious complications such as hospital admission or re-operation [3]. A substantial workforce loss is caused by adhesion-related complications [4]. The term “overall operative burden” has been recently coined by Grant et al. [6]. Among children aged less than 16 years who were operated with lower abdominal surgery, 1.1% were directly admitted to hospital because of adhesions while 8.3% were re-admitted “possibly” related to adhesions over a 4-year follow-
up. A success rate of 0% to 63% was reported for non-operative management of postoperative adhesive intestinal obstruction (AIO) [7].

To minimise the incidence of this complication considerably increasing morbidity and mortality, it is imperative to investigate its etiopathogenesis in detail and to take appropriate intraoperative measures. Although many large, comprehensive studies have been published on the management of postoperative AIOs in adults, there is a paucity of studies involving children. Therefore, we retrospectively analysed various properties of the patients operated for postoperative intestinal obstruction and diagnosed with AIO at University Hospital Department of Pediatric Surgery.

Materials and method:

This retrospective study involved patients who were operated with laparotomy for postoperative intestinal obstruction and shown to have intestinal adhesions as the aetiology of intestinal obstruction at Gazi University Hospital Department of Pediatric Surgery between January 1990 and January 2001. Detailed demographic, clinical, biochemical, and operative information about the patients was obtained from their medical records. Age, sex, indication for the previous surgery, old incision site and type, upright plain abdominal film findings, abdominal examination findings, white blood cell count, wound properties, and the number of days to the admission for obstruction were recorded for each patient.

Patients who were formerly operated with laparotomy and who were found to have abdominal pain, nausea, vomiting, inability to pass faeces and gas and air-fluid levels on upright plain abdominal film (UPAF) were monitored for AIO. Fever (axillary body temperature greater than 37.5°C), leucocytosis (> 10,000 mm$^3$), abdominal tenderness, signs and symptoms of intestinal obstruction (bilious or fecaloid vomiting, inability to pass faeces or gas, and air-fluid levels over the peritoneal reflection on UPAF) were recorded. Patients with fever, leukocytosis and abdominal tenderness, persistent air-fluid levels of UPAF despite conservative therapy, and signs and symptoms of complete intestinal obstruction or free air were operated early under optimal conditions.

The elements of conservative management included performing nasogastric decompression, administrating parenteral fluid and electrolytes, obtaining white blood cell counts three times a day, taking daily UPAF (more frequent whenever needed), and performing frequent abdominal examinations at intensive care unit setting. Conservative treatment was terminated, and surgery was carried out in patients with elevated white blood cell count and fever, tenderness on abdominal examination, persistent air-fluid levels on UPAF, and signs and symptoms suggesting complete intestinal obstruction. The cases of paralytic ileus were excluded from this study.

Ethics committee approval

This study protocol was approved by the Gazi University Clinical Research Ethics Committee.

Results

During an 11-year period, a total of 45 (3.35%) operations were performed for adhesive intestinal obstruction (AIO) following 1341 laparotomies. Twenty-nine (64.4%) patients were male. The youngest patient was six days old, and the oldest was 14 years old (mean age 7.75 years). Two patients were operated on at the newborn period while a total of 8 (17.7%) patients were operated under the age of 1 year (Table 1). Two patients were found to have abscess formation accompanying adhesion, 1 had an adhesion-induced internal hernia, and 3 had volvulus caused by adhesion. The rate of intestinal obstructions solely by compression by adhesion was 86.6% (Table 2).

Table 1 The number, percentage of the patients with AIO by age groups

| Age                  | Number (n) | %   |
|----------------------|------------|-----|
| Newborn (0-1 month)  | 2          | 4.4 |
| Infant (<1-12 months)| 6          | 13.3|
| Child (<1-16 years)  | 37         | 82.3|
| Total                | 45         | 100 |

Table 2 Operative findings of surgeries performed for intestinal obstruction the operation associated with was an appendectomy

| Findings            | Number | %   |
|---------------------|--------|-----|
| Adhesion            | 39     | 86.7|
| Single adhesion     | 32     | 71.1|
| Multiple adhesions  | 7      | 15.5|
| Abscess             | 2      | 4.4 |
| Internal hernia     | 1      | 2.2 |
| Volvulus            | 3      | 6.7 |
| Total               | 45     | 100 |

Two children with midgut volvulus and jejunal atresia were operated twice. Nine patients presented with acute abdomen. All patients had multiple air-fluid levels on UPAF. White blood cell count was above 10,000 mm$^3$ in 30 patients with AIO and above 11,000 mm$^3$ in 9 patients with abdominal tenderness. All but one patients undergoing intestinal resection and anastomosis had a white blood cell count of above 20,000 mm$^3$. The lowest blood cell count was 3300 mm$^3$ and the highest 36,000 mm$^3$ (mean 15000 mm$^3$).

The most common former operation associated with AIO was appendectomy (35.5%) followed by laparotomies for trauma, invagination, and megacolon. Thirty-five (77.7%) of the previous operations involved the pelvic region (Table 3).

An analysis of the incision sites in a total of 1341 laparotomies showed that AIOs most commonly occurred with a median incision (18.42%) followed by supra- and subumbilical paramedian incision (15.38%). AIOs were least common with the Rockey-Davis incision (1%). Among 45 patients operated for AIOs, the most commonly performed incision was the supraumbilical transverse incision (31.2%) followed by the Rockey-Davis incision (17.7%) (Table 4). Escape special TeX symbols (Among 45 patients operated for AIO, 14 had clean wounds, 13 had clearly contaminated, and 18 had dirty wounds in previous operations. The patients were operated for AIO on the sixth day

Nazile Erturk et al./International Journal of Surgery and Medicine (2017) 3(3):167-172
Table 3 The number of the previous operations and AIOs.

| Disease                   | Operation (n) | Number of adhesive obstruction (n) | The most common form of AIO | Operations involved the pelvic region |
|---------------------------|---------------|-----------------------------------|-----------------------------|-------------------------------------|
| Midgut volvulus           | 4             | 2                                 |                             |                                     |
| Ileal and jejunal atresia | 18            | 5                                 |                             |                                     |
| Megacolon + ARM           | 80            | 7                                 |                             |                                     |
| Invagination              | 50            | 4                                 |                             |                                     |
| Extrophia vesica          | 14            | 1                                 |                             |                                     |
| Acute appendicitis        | 825           | 7                                 |                             |                                     |
| Perforated appendicitis   | 230           | 9                                 |                             | 35.5%                                |
| Choledochal cyst          | 5             | 1                                 |                             | 77.7%                                |
| Gastrochisis              | 8             | 1                                 |                             |                                     |
| Post-traumatic laparotomy | 39            | 4                                 |                             |                                     |
| Wilm’s tm                 | 11            | 2                                 |                             |                                     |
| Bochdalec hernia          | 19            | 1                                 |                             |                                     |
| Hydatid cyst              | 38            |                                   |                             |                                     |
| **Total**                 | **1341**      | **45**                            |                             |                                     |

at the earliest and the tenth day at the latest. The rate of surgeries performed for AIO was 62.2% in the first three months and 84.4% in the first one year (Table 5). Six (13.3%) patients were operated on without administering any conservative therapy, and 29 (64.4%) were operated on in the first three days. The most commonly performed operation was adhesiolysis, while 6 (13.3%) patients required intestinal resection and anastomosis. One (2.2%) patient underwent enterostomy opening (Table 6). Three of six patients who underwent intestinal resection and anastomosis were found to have volvulus, and 1 had intestinal strangulation due to intestinal herniation. Of the remaining two patients, 1 underwent intestinal resection and anastomosis on the second day due to anastomosis leak while the other was also operated with intestinal resection and anastomosis since bowel was opened during adhesiolysis. One (2.2%) patient died, and 3 (6.6%) patients suffered infection. The total morbidity rate in the series was 22.2% (Table 7).

Discussion

Intestinal obstruction requiring surgical intervention occurs at a rate of approximately 2.2% after laparotomy operations [6]. While the mortality rate of postoperative intestinal obstructions was 60% in the 1980s, it has now been reduced to 1.5% [8]. While postoperative intestinal obstruction occurs mostly due to primary causes such as a hernia, invagination, or volvulus in underdeveloped countries, it occurs due to adhesions secondary to previous operations in developed nations [9]. By literature, this study detected an adhesive intestinal obstruction incidence of 3.35%, in 86.6% of which adhesions were the cause of intestinal obstruction.

As some authors have recommended trying conservative treatment methods in an adhesive intestinal obstruction (AIO), some others, on the contrary, have advocated operating on AIOs on an urgent basis. Festen advocated performing urgent surgery for AIOs based on an increased risk of peritonitis, intestinal opening during operation, and intestinal circulatory derangement even with undelayed operations [5]. A study involving 181 AIO cases revealed that cases without fever, leukocytosis, tachycardia, or abdominal tenderness could be conservatively managed and only 26.2% of patients required surgery [10]. In our series conservatively managed patients were excluded. These patients were closely observed unless they showed signs of strangulation. Furthermore, those advocating urgent surgery for AIO also note that approximately 60% of all cases could be improved without surgery [5]. Conservative management of AIOs is also widely applied in adult age groups [11].

The incidence of intestinal injury and recurrent adhesions following operations performed for adhesive intestinal obstruction have been reported from 11-52% (5,10,12,13). In our series one (2.2%) patient developed intestinal injury, and only 2 (4.4%) patients developed recurrent AIO. These figures are the ones reported in the literature.

The indication and the type of incision of previous surgical operations are central to the development of AIOs. In an operative series of 144 patients Cox et al. [14] showed that 23% of the patients had undergone appendectomy, 21% colorectal resection, 12% gynecological surgery, 9% upper gastrointestinal system surgery, and 8% small intestinal surgery, with 80% of all adhesive obstructions being related to previous pelvic operations.

Upper gastrointestinal surgeries are associated with a lower incidence of adhesions compared to the ones involving pelvic region. It has been suggested that this is due to small intestines having a tendency of being located in the pelvis and more mobile.
Table 4 Incision types and numbers and AIO percentages

| Incision                                  | Total number (n) | Number of AIOs (n) | Percentage of AIOs (%) | Percentage among AIOs (%) |
|-------------------------------------------|------------------|--------------------|------------------------|--------------------------|
| R.Davis                                   | 746              | 8                  | 1.07                   | 17.7                     |
| Mc Burney                                 | 94               | 2                  | 2.12                   | 4.4                      |
| Right supra-umbilical paramedian          | 17               | 1                  | 5.88                   | 2.2                      |
| Right sub-umbilical paramedian            | 34               | 1                  | 2.94                   | 2.2                      |
| Right supra-/sub-umbilical paramedian     | 13               | 2                  | 15.38                  | 4.4                      |
| Right supra-umbilical transverse          | 204              | 14                 | 6.86                   | 31.2                     |
| Supra-umbilical                           | 67               | 5                  | 7.46                   | 11.1                     |
| Supra/sub-umbilical median                | 38               | 7                  | 18.42                  | 15.5                     |
| Left supra-/sub-umbilical paramedian      | 40               | 2                  | 5                      | 4.4                      |
| Subcostal                                 | 63               | 1                  | 1.58                   | 2.2                      |
| Left hockey stick                         | 24               | 2                  | 8.33                   | 4.4                      |
| (transverse+paramedian)                   |                  |                    |                        |                          |
| Total                                     | 1341             | 45                 | 3.35                   | 100                      |

Table 5 Time to AIO development after the first surgery

| Time from operation | Number (n) | Percentage (%) |
|---------------------|------------|----------------|
| 1-7 days            | 10         | 22.2           |
| 7 days-1 month      | 7          | 15.5           |
| 1-3 months          | 11         | 24.5           |
| 3-12 months         | 10         | 22.2           |
| One year or longer  | 7          | 15.5           |
| Total               | 45         | 100            |

Table 6 Operative procedures

| Operation                              | Number (n) | Percentage (%) |
|----------------------------------------|------------|----------------|
| Adhesiolysis                           | 38         | 84.5           |
| Adhesiolysis, resection-anastomosis    | 6          | 13.3           |
| Adhesiolysis, enterostomy              | 1          | 2.2            |
| Total                                  | 45         | 100            |

than the other intestinal segments [9,14]. In our series appendectomy were the most common surgery associated with AIOs, with an incidence that was close to the highest incidence reported so far (34.2%) [15]. Furthermore, by the literature, 77.7% of the surgeries associated with AIOs involved pelvis and lower abdomen.

A study investigated the incidence of postoperative intestinal obstructions associated with different incision types in 256 patients. It revealed that median incisions were performed at a rate of 39%, paramedian incisions 8.9%, and transverse incisions 10.5%. Another study reported an incidence of 32.5% for transverse incisions, 25.8% for paramedian incisions, and 11.5% for Rocky-Davis incisions [10,16]. A transverse incision was the most commonly performed incision that was followed by Rocky-Davis and median incisions.

A greater adhesion incidence especially for supra- and sub-umbilical paramedian and median incisions may be attributed to the facts that these incisions involve both upper and lower abdominal quadrants and pelvis, they are mostly preferred for urgent conditions, trauma, and when a specific diagnosis cannot be made, and they involve a greater degree of bowel manipulation. While there are several studies reporting that 21% of postoperative intestinal obstructions following laparotomies develop in the first month, some others reported that 78% of adhesions develop in the first three months. A series involving 2000 laparotomy operations adhesive operations had an incidence of 1%, half occurring in the first month [16]. It was also argued that adhesions occurring after appendectomy and herniorrhaphy operations tend to develop later than those occurring after gynaecological and colorectal operations [5,12,16]. In our study, 62.2% of surgeries for AIOs were performed in the first three months and 84.4% in the first year. The latest operation performed for AIO was performed at 10th year. This observation supports the view that AIOs most commonly develop in the first year but may occur anytime.

The properties of previous operations are also pivotal for the
development of postoperative intestinal adhesions. Bacteria can proliferate in mesenteric lymph nodes at a rate of 59% even in small intestinal obstructions without intraabdominal infection (9%). In a postmortem study, the incidence of adhesions was found to be 67% for previously operated persons and 38% for patients without any operative history. Infections are considered to be the most common cause of this occurrence. The incidence of adhesions reaches 100% when laparotomy and intraabdominal infection coexist [17]. In our series, 31.2% of cases operated for AIOs had clean wounds, with the remaining 68.8% having contaminated and dirty wounds.

Our study showed that 82.3% of AIOs occurred among children older than one year and 17.7% developed in children younger than one year. The incidence was higher with operations performed at the newborn period in children younger than one year. Although it has been proposed that newborns and young children be less prone to adhesions, it is noteworthy that adhesions constitute a significant problem among patients operated on for malrotation or gastrochisis [3,17]. During a 15-year follow-up of 134 newborns operated for omphalocele and gastrochisis the AIOs incidence was 9% and 27%, respectively [17].

While several series have reported a wound infection incidence of 4% for postoperative intestinal obstruction surgeries, that figure went as high as 16-30% in some series. Death as a result of AIOs ranged from 0% to 3.4% in previous reports [10,13,18], and the mortality rate found in our study was 2.2%. The most common cause of morbidity in our series was an infection (6.6%). The combined incidence of lung complications, urinary tract infections, ileus, and sepsis reached 22.2%.

Volvulus, abscess formation, and hernia can also accompany adhesions. In a series of 194 patients operated for AIO, 7 (3.5%) volvulus cases and 6 (3%) internal hernia cases were detected (19). In another study where 31 patients were involved internal hernia co-occurred in 1 case and abscess formation in 2 [5]. In series involving 23 cases, series abscess formation was observed in only one patient [20]. In our series, on the other hand, volvulus had an incidence of 6.6%, internal hernia 2.2%, and abscess formation 4.4%, and all these figures were greater than those reported in the literature.

Table 7 Complications

| Complication       | Number (n) | Percentage % |
|--------------------|------------|--------------|
| Mortality          | 1          | 2.2          |
| Wound infection    | 3          | 6.6          |
| Lung complication  | 2          | 4.4          |
| UTI                | 2          | 4.4          |
| Ileus              | 2          | 4.4          |
| Sepsis             | 1          | 2.2          |

be reduced by treating tissues gently, avoiding excessive dissections, preventing tissue ischemia, avoiding the use of excessively hot and unnecessary electrocautery, avoiding serosal defects, and fighting infections.

Conclusion

In conclusion, our study showed that 82.3% of AIOs occurred among children older than one year and 17.7% developed in children younger than one year. Moreover, the rate of surgeries performed for AIO was 62.2% in the first three months and 84.4% in the first one year. Also, operative techniques that are either noninvasive or less invasive than usual should be used whenever possible. Putting a specific diagnosis and determining the incision type before any operation would aid in creating less intestinal trauma, shortening the operative time, and minimising organ injury, thus reducing the incidence of AIOs.

Authors’ Statements

Competing Interests

The authors declare no conflict of interest.

References

1. Sisodia V, Sahu SK, Kumar S. Clinical Profile of Patients with Postoperative Adhesive Intestinal Obstruction and its Association with Intraoperative Peritoneal Adhesion Index. Chirurgia (Bucur). 2016;111(3):251-8.
2. Zuidema GD: Shackelford’s Surgery of the Alimentary tract. 4th editon, vol. 5, Philadelphia 1996, pp.387-389.
3. Grant HW, Parker MC, Wilson MS, Menzies D, Sunderland G, Thompson JN, et al. Adhesions after abdominal surgery in children. Journal of pediatric surgery. 2008;43(1):152-6; discussion 6-7.
4. Lakshminarayanan B, Hughes-Thomas AO, Grant HW. Epidemiology of adhesions in infants and children following open surgery. Seminars in pediatric surgery. 2014;23(6):344-8.
5. Festen C. Postoperative small bowel obstruction in infants and children. Annals of surgery. 1982;196(5):580-3.
6. Grant HW, Parker MC, Wilson MS, Menzies D, Sunderland G, Thompson JN, et al. Population-based analysis of the risk of adhesion-related readmissions after abdominal surgery in children. Journal of pediatric surgery. 2006;41(8):1453-6.
7. Lautz TB, Barsness KA. Adhesive small bowel obstruction–acute management and treatment in children. Seminars in pediatric surgery. 2014;23(6):349-52.
8. Janik JS, Ein SH, Filler RM, Shandling B, Simpson JS, Stephens CA. An assessment of the surgical treatment of adhesive small bowel obstruction in infants and children. Journal of pediatric surgery. 1981;16(3):225-35.
9. Bass KN, Jones B, Bulkley GB. Current management of small-bowel obstruction. Advances in surgery. 1997;31:1-34.
10. Akgur FM, Tanyel FC, Buyukpamukcu N, Hicsonmez A. Adhesive small bowel obstruction in children: the place and predictors of success for conservative treatment. Journal of pediatric surgery. 1991;26(1):37-41.

11. Ouaïssi M, Gaujoux S, Veyrie N, Denève E, Brigand C, Castel B, Duron JJ, Rault A, Slim K, Nocca D. Post-operative adhesions after digestive surgery: their incidence and prevention: review of the literature. J Visc Surg. 2012;149(2):e104-14

12. Lautz TB, Raval MV, Reynolds M, Barsness KA. Adhesive small bowel obstruction in children and adolescents: operative utilization and factors associated with bowel loss. J Am Coll Surg. 2011;212(5):855-61.

13. Eeson GA, Wales P, Murphy JJ. Adhesive small bowel obstruction in children: should we still operate? J Pediatr Surg. 2010;45(5):969-74

14. Cox MR, Gunn IF, Eastman MC, Hunt RF, Heinz AW. The operative aetiology and types of adhesions causing small bowel obstruction. The Australian and New Zealand journal of surgery. 1993;63(11):848-52.

15. Tanphiphat C, Chittmittrapap S, Prasopsunti K. Adhesive small bowel obstruction. A review of 321 cases in a Thai hospital. American journal of surgery. 1987;154(3):283-7.

16. Miller G, Boman J, Shrier I, Gordon PH. Natural history of patients with adhesive small bowel obstruction. The British journal of surgery. 2000;87(9):1240-7.

17. Dijkstra FR, Nieuwenhuijzen M, Reijnen MM, van Goor H. Recent clinical developments in pathophysiology, epidemiology, diagnosis and treatment of intra-abdominal adhesions. Scandinavian journal of gastroenterology Supplement. 2000 (232):52-9.

18. Nasir AA, Abdur-Rahman LO, Bamigbola KT, Oyinloye AO, Abdulraheem NT, Adeniran JO. Is non-operative management still justified in the treatment of adhesive small bowel obstruction in children? Afr J Paediatr Surg. 2013;10(3):259-64.

19. Deutsch AA, Eviatar E, Gutman H, Reiss R. Small bowel obstruction: a review of 264 cases and suggestions for management. Postgraduate medical journal. 1989;65(765):463-7.

20. Pickleman J, Lee RM. The management of patients with suspected early postoperative small bowel obstruction. Annals of surgery. 1989;210(2):216-9.