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Factors Contributing to the Development of Acute Adhesive Intestinal Obstruction

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Abstract This review discusses data from current literature on the causes and factors of the development of acute adhesive intestinal obstruction, the role of types of surgery, and the effect of laparoscopy on the formation of adhesions and treatment outcomes. It is presented that the formation of intraperitoneal adhesions is a frequent consequence of abdominal pelvic surgery, radiotherapy and inflammatory processes, with more than one third of all cases of intestinal obstruction being secondary to adhesions. The risk of developing sintered intestinal obstruction after abdominal surgery depends on the location of earlier surgery, the manner of access, and the number of earlier surgeries. Most studies show that laparoscopy can reduce the formation of postoperative adhesions compared to laparotomy.

Keywords Acute, Adhesive, Intestinal, Obstruction, Laparoscopy, Surgery, Postoperative

1. Introduction

Peritoneal adhesions, being the cause of 32% of all cases of acute intestinal obstruction and 65–75% of small intestine obstruction, represent a large unresolved problem and burden for public health in all countries of the world [1]. In patients with abdominal pain, acute adhesive ileus (AIO) is a common cause, accounting for 4% of all emergency department admissions and 20% of emergency surgical procedures [2]. The mortality of patients receiving surgical treatment for AIO, especially with the development of intestinal necrosis, remains surprisingly high (5–10%) [1,3–5].

The main cause of adhesion formation in the abdominal cavity is considered to be surgical trauma. At the same time, the formation of adhesions occurs after any surgical procedure in the pelvic and abdominal cavity, including cholecystectomy, gastrectomy, removal of appendicitis, hysterectomy, colectomy, abdominoperineal resection and vascular surgery [6,7,8].

The prevalence of intraperitoneal adhesions ranges from 67 to 93% after general abdominal surgery and reaches up to 97% after open gynecological pelvic procedures [9,10].

Postoperative adhesions, which are the most common cause of intestinal obstruction, tend to recur and require repeated surgical treatment [11].

Vrijland et al [12] reported that after surgical adhesiolysis, adhesions recur in up to 100% of cases confirmed by repeat laparoscopy, and they reappear at the sites of former adhesiolysis, which explains the high risk of recurrence of small bowel obstruction. In addition, relapses become more frequent with each episode, and the intervals between them become shorter [13].

The frequency of postoperative adhesion formation increases with the age of the patient, the number of laparotomies and the complexity of operations [2,14,15]. The number of prior episodes a patient has experienced is the strongest predictor of relapse. Although it is not yet clear how often adhesions recur after conservative or surgical treatment, adhesions are known to pose a lifelong risk of ileus.

It has been reported that 35% of readmissions within a 10-year period after abdominal surgery are directly or possibly indirectly related to adhesions [15]. The risk of developing AKI requiring surgery ranges from 1% after appendectomy [16] to more than 10% after colectomy [17].

According to a number of authors, the incidence of adhesive obstruction of the small intestine was the highest in pediatric surgery (4.2%) and in surgery of the lower gastrointestinal tract (3.2%), while at the same time it was the lowest after abdominal surgery. wall (0.5%), operations on the upper gastrointestinal tract (1.2%) and urological operations (1.5%) [18,19].

2. Materials and Methods

Adhesion formation in the abdominal cavity causes intestinal obstruction, either due to attachment or rotation of the intestine, or as a result of an external compressive effect on the intestine. It has been found that if the prior peritoneal injury is located in the lower abdomen, this may increase the risk of ASIO, mainly due to the proximity of the small

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intestine. Although peritoneal adhesions are the most common organ-related adhesions, adhesions that involve the small intestine and other pelvic structures at the same time are more likely to cause obstruction. It is believed that the interloop adhesions between the small intestine, to a greater extent can cause multiple intestinal obstructions [20]. This adhesion proneness, causing obstruction in the lower abdomen, has been described previously, using the transverse colon as the dividing line in some cases. It has been argued that if peritoneal injury occurs below the level of the transverse colon, there is an increased risk of developing early postoperative ASIO due to adhesion formation; if above this level, the risk of peritoneal adhesions causing obstruction approaches zero. It has also been shown that the largest number of patients underwent hepatobiliary surgery, mainly through correct subcostal incisions, and they had the lowest risk of postoperative ileus requiring relaparotomy [21,22].

About 20% of those who do develop ASIO develop during the first postoperative year [6]. After that, a steady increase in the incidence is observed for at least a 10-year period after the first operation [11].

Extensive soft adhesion formation occurs within 72 hours after laparotomy, but adhesions become firm and vascular in approximately 10 days to 2 weeks. More than 20% of adhesive obstructions develop within 1 month after surgery, and up to 40% within 1 year [23]. At the same time, adhesion formation causes a violation of the local blood circulation of the small intestine in 30% of cases.

Adhesions form in more than 80% of patients between the wound and the peritoneum, and with intestinal involvement in 50% of patients. The most common mechanism of obstruction was a fibrous streak, which was found in 56% of patients, with diffuse adhesions observed in the remainder. At the same time, the latter were more associated with the severity of the operation and the development of ASIO in the future [24].

Thus, patients with diffuse adhesions had a higher incidence of comorbidity, more frequent previous abdominal surgery and a longer period of conservative treatment before surgery compared with patients with fibrous adhesions, longer surgery time, more bleeding and more bowel damage [25].

3. Result and Discussion

Postoperative adhesion formation is usually the result of tissue injury resulting from incision, cauterization, suturing or other types of injuries in its complex development capable of forming scar tissue. It was recently found [13] that all of the patients who had undergone at least one previous abdominal operation developed more than ten adhesions. Factors associated with the formation of postoperative adhesions include mechanical or thermal trauma, infection, ischemia, and foreign bodies. Several other factors, including difficult suturing where tension in the sutured peritoneum produces ischemia, friction, exposure to foreign bodies such as talc and glove powders, lint from abdominal packs or fibers from accessible paper objects, reactive sutures, bowel contents, overheating by lamps or irrigation fluid may contribute to postoperative adhesion formation [26,27]. Such adhesions often contain several foreign body granulomas, suggesting a relationship between foreign material, foreign body granulomas, and adhesion formation. Usually, suture granulomas are often found in patients who have recently undergone surgery [13].

The direct relationship between abdominal surgery and adhesion-related complications is often overlooked due to the long period between the occurrence of complications and primary surgery [2-8]. However, the clinical burden is significant, given that over the next 10 years, up to a third of patients undergoing abdominal surgery will be readmitted to treat adhesion-related complications. Overall, a mean readmission rate of 2.2 per patient was reported [29]. Thus, adhesions should be considered as one of the most important complications after abdominal surgery.

The technique of performing a surgical operation is an important factor in the prevention of the development of adhesions. The surgeon's gentle handling of the abdominal organs and their careful dissection limit peritoneal damage, inflammation, and death of mesotheliocytes. The improvement of surgical technique and the desire of leading schools to reduce the morbidity of operations in the second half of the 20th century stimulated the creation of a completely new direction - laparoscopic surgery, which gave hope for a decrease in the postoperative adhesive process and repeated hospitalizations due to it.

Potential advantages of the laparoscopic approach include less extensive adhesion formation, earlier recovery of defecation, reduced postoperative pain, and shorter hospital stay [30-32].

Although it has been found that laparoscopy may offer some advantages in ASIO, there appears to be a need for careful selection of candidates for laparoscopic treatment. Laparoscopy in the abdomen with very distended bowel loops and multiple complex adhesions may increase the risk of serious complications such as enterotomy and delayed diagnosis of perforations [33,34]. According to some authors, intestinal damage is observed in 6.3–26.9% of patients who received laparoscopic adhesiolysis for AKI [35,36]. According to a number of authors, the frequency of bowel resection turned out to be more frequent in laparoscopic surgery, amounting to 53.5% versus 43.4% in open surgery procedures [37]. Moreover, in patients who had previously received radiation therapy, laparoscopic adhesiolysis was also accompanied by a large number of complications [3-8].

According to Behman et al. from a population analysis of over 8500 patients [37], despite growing enthusiasm for laparoscopy treatment of ADIO, this approach requires considerable caution and raises serious concerns due to the higher risk of bowel injury.

Sharing the same concern, a number of authors noted that careful preoperative selection of those patients who may be

the best candidates for laparoscopic adhesiolysis is necessary [39]. To do this, they developed a specific protocol for the laparoscopic treatment of ASIO, which is as follows.

It is believed that patient selection should be sufficiently precise and that only stable patients (without diffuse peritonitis and/or septic shock with suspected bowel perforation) should be considered for laparoscopic manipulation, in whom the CT scan results correspond to a clear zone of transition and, therefore, suggests the presence of the only adhesive band that completely prevents intestinal movement [40]. Patients with diffuse distension of the small intestine without a well-defined transition zone and suspected of having diffuse entangled adhesions (based on their surgical history and radiographic findings) should initially be treated conservatively, including with gastrografin [4-1]. Moreover, according to Farinella et al., predictors of successful laparoscopic treatment of ASIO are the following: history of 2 or fewer laparotomies, history of appendectomy as an operation, absence of a previous midline incision as a result of laparotomy, and a single adhesive bandage [42].

For carefully selected patients, laparoscopy may be a safe alternative to laparotomy in the surgical treatment of ASIO. These include patients with proximal obstruction, a decompressed bowel with adequate intraperitoneal working space, hemodynamic stability, and the ability to tolerate pneumoperitoneum. In this regard, laparoscopy has some advantages over laparotomy [43,44].

In addition, correct surgical technique has been shown to be of paramount importance in order to avoid bowel injury. Therefore, based on their experience, once the laparoscopic approach is decided, a number of authors have recommended not using Veress needles or blind placement of the first port in close proximity to existing scars. Since safe entry into the abdominal cavity is best achieved by inserting the first Hasson trocar into the left flank with open access or by using a blunt expanding tip, the optical trocar should enter the abdominal wall at the level of Palmer's point for direct vision [45].

Taking into account these recommendations, further results were significantly improved. Thus, in a comparable cohort analysis by Nordin, Freedman [30], laparoscopy led to a reduction in the length of postoperative hospital stay and the duration of surgery by more than 60%. Similar results were reported by Byrne et al. [46].

4. Conclusions

Overall, laparoscopy for ASIO has been shown to be associated with earlier recovery of gastrointestinal function, shorter postoperative hospital stay, and lower overall complication rates. Given these data, both the Bologna guidelines and the Eastern guidelines support the use of laparoscopy as an alternative to laparotomy in eligible patients, citing lower morbidity and length of hospital stay [40,47].

Analysis of the postoperative period showed that almost 90% of abdominal adhesions are formed as a result of previous abdominal surgery, primarily laparotomy (i.e., open surgery) and, to a much lesser extent, laparoscopic surgery [48]. And because the degree of adhesion development seems to correlate with the severity/extent of the underlying initial process, the incidence of adhesions has dropped significantly in the era of laparoscopic surgery, with only about 5% of such cases subsequently developing adhesive disease. Accordingly, the frequency of reoperations directly related to adhesion formation was approximately 30% lower in patients who underwent laparoscopic surgery compared to open surgery [49].

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