Postoperative adhesions in gynecologic surgery: a committee opinion

Practice Committee of the American Society for Reproductive Medicine in collaboration with the Society of Reproductive Surgeons

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Postoperative adhesions are a natural consequence of surgical tissue trauma and healing and may result in infertility, pain, and bowel obstruction. Adherence to microsurgical principles and minimally invasive surgery may help to decrease postoperative adhesions. Some surgical barriers have been demonstrated to be effective for reducing postoperative adhesions, but there is no substantial evidence that their use improves fertility, decreases pain, or reduces the incidence of postoperative bowel obstruction. This document replaces the document, "Pathogenesis, consequences, and control of peritoneal adhesions in gynecologic surgery: a committee opinion," last published in 2013. (Fertil Steril® 2019;112:458–63. ©2019 by American Society for Reproductive Medicine.)

INTRODUCTION

Postoperative adhesions are a natural consequence of surgical tissue trauma and healing. Peritoneal adhesions may result in infertility, pain, or bowel obstruction and may increase the technical difficulty of subsequent abdominal or pelvic surgery. The purpose of this document is to review the epidemiology, pathogenesis, and clinical consequences of adhesion formation and to summarize available evidence regarding the effectiveness of various strategies for reducing postoperative adhesion formation. This document will not cover intrauterine adhesions.

EPIDEMIOLOGY AND IMPACT OF POSTOPERATIVE ADHESIONS

Studies conducted by the Surgical and Clinical Adhesions Research (SCAR) Group have analyzed the records of surgical patients in Scottish National Health Service hospitals and helped to define the epidemiology and impact of postoperative adhesions (1, 2). Overall, approximately one third of patients who underwent open abdominal or pelvic surgery were readmitted an average of 2 times over the subsequent 10 years for conditions directly or possibly related to adhesions or for further surgery that could be complicated by adhesions. More than 20% of all such readmissions occurred during the first year after the initial surgery and 4.5% of readmissions were for small-bowel obstruction (1, 2). Among open gynecologic procedures, ovarian surgery had the highest rate of readmissions directly related to adhesions (7.5/100 initial operations) (2). In the Scottish experience, excepting laparoscopic sterilization procedures, open and laparoscopic gynecologic surgery was associated with comparable risk for adhesion-related hospital readmission (3). Another retrospective study of Canadian women admitted to the hospital with a diagnosis of small-bowel obstruction after gynecologic procedures found that hysterectomy was a significant cause of adhesion-related small-bowel obstruction and that laparoscopic supracervical hysterectomy was associated with a lower risk compared with abdominal hysterectomy (4). In two studies, the incidence of small-bowel obstruction after abdominal hysterectomy ranged between 13.6 and 16.3 per 1,000 procedures (4, 5). Postoperative adhesions increase operating times (6, 7) and the risk of bowel injury during subsequent surgery (8). Adhesions also have major financial implications. In the United States, adhesion-related health care costs exceed $1 billion annually (9).

PATHOGENESIS

Adhesions are the consequence of tissue trauma that may result from sharp, mechanical, or thermal injury; infection; radiation; ischemia; desiccation; abrasion; or foreign-body reaction. Such trauma triggers a cascade of events that begins with the disruption of stromal mast cells, which releases vasoactive substances such as

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histamine and kinins that increase vascular permeability. Oxidative stress is the result of tissue hypoxia. Free oxygen and nitrogen radicals enhance the inflammatory response that results in tissue injury (10). Fibrin deposits then form, containing exudates of cells, leukocytes, and macrophages (11). Healing occurs by a combination of fibrosis and mesothelial regeneration (12). Unlike skin wounds, which heal from the edges, the repair of peritoneal defects occurs from the underlying mesenchyme. As a result, both large and small peritoneal defects heal relatively quickly. Fibrinous exudates form within 3 hours after injury. Most fibrinous exudates are transient and are broken down by fibrinolysis within 72 hours. Trauma-induced local suppression of peritoneal fibrinolysis leads to early fibrinous adhesions (Fig. 1). The invasion of fibroblasts and blood vessels soon follows, resulting in permanent adhesions which can be vascular (Fig. 1).

CONSEQUENCES OF ADHESION FORMATION

The most important potential consequences of adhesion formation are infertility, bowel obstruction, abdominal/pelvic pain, and injury to intra-abdominal structures at subsequent surgeries. The use of imaging such as the visceral slide test has been used to determine the presence of periumbilical adhesions prior to laparoscopy. However, there is no reliable method for identifying adhesions preoperatively and only direct visualization at surgery can accurately identify and quantify postoperative adhesions, though periumbilical adhesions can be detected by ultrasonography (13, 14).

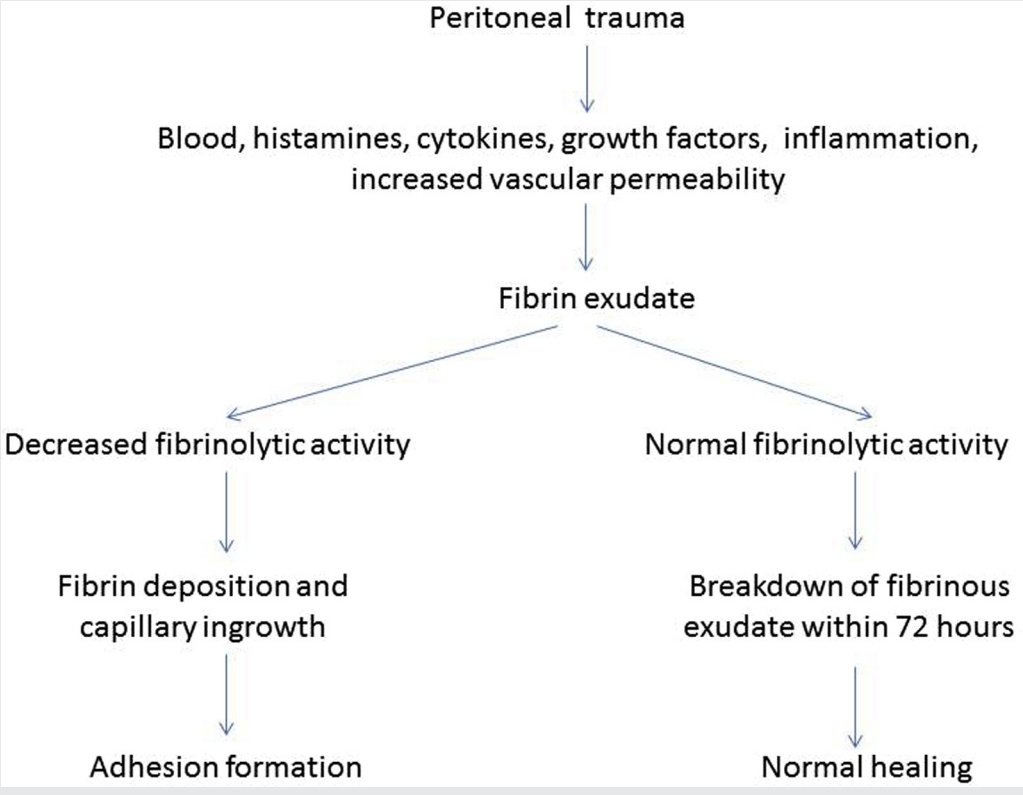
Infertility

Adhesions may affect fertility adversely by distorting adnexal anatomy and interfering with gamete and embryo transport. The only study to assess adhesiolysis and infertility is a small retrospective review. Among infertile women with otherwise unexplained infertility diagnosed with adnexal adhesions at laparoscopy, pregnancy rates after subsequent adhesiolysis by laparotomy were 32% at 12 months and 45% at 24 months compared with 11% at 12 months and 16% at 24 months in women left untreated (15). In women followed for an average of 49 months after tubal surgery, term pregnancy rates were inversely correlated with adhesion scores at the time of the surgical procedure, as assigned using the American Society for Reproductive Medicine classification system for adnexal adhesions (16).

Bowel Obstruction

Adhesions are the most common cause of postoperative small-bowel obstruction (5). In a series of 552 patients with

FIGURE 1



Postoperative adhesion formation.

ASRM. Adhesions in gynecologic surgery. Fertil Steril 2019.

bowel obstruction, intra-abdominal adhesions were judged responsible in 74% of cases (17).

Abdominal/Pelvic Pain

The relationship between adhesions and pelvic pain is unclear. Although nerve fibers have been identified in pelvic adhesions, their prevalence is no greater in patients with pelvic pain than in those without pelvic pain (18). Moreover, there is no relationship between the extent of adhesions and the severity of pain. It generally is accepted that adhesions may cause visceral pain by impairing organ mobility (19, 20). A study of patients with chronic pelvic pain randomized to laparotomy with adhesiolysis or laparotomy alone found that adhesiolysis was effective only in those having dense adhesions involving the bowel (21); however, the extent of adhesion reformation after surgery in these individuals is unknown. It is unclear whether greater reduction in adhesions after surgery would reduce pain further. A randomized, controlled, multicenter trial observed that laparoscopic lysis of mild abdominal adhesions relieved abdominal or pelvic pain, but to no greater extent than sham surgery (22). Clearly, the impact that lysis of bowel or adnexal adhesions may have on abdominal and pelvic pain cannot be confidently predicted but is complicated by the potential for adhesion reformation.

REDUCTION IN ADHESION FORMATION

All surgeons must be familiar with the risks and consequences of postoperative adhesions. Theoretically, formation of adhesions might be reduced by minimizing peritoneal injury during surgery, preventing the introduction of reactive foreign bodies, reducing the local inflammatory response, inhibiting the coagulation cascade and promoting fibrinolysis, or by placing barriers between damaged tissues.

Surgical Technique

Formation of postoperative adhesions often may be minimized by careful surgical technique with adherence to microsurgical principles, including gentle tissue handling, meticulous hemostasis, excision of necrotic tissue, minimization of ischemia and desiccation, use of fine nonreactive suture materials, and prevention of foreign-body reaction and infection (23, 24). The larger the residual amount of blood and serosanguinous fluid, the more frequently adhesions can occur. Postoperative adhesions have been observed in up to 94% of patients after laparotomy (25, 26). Laparoscopy does not necessarily result in fewer adhesions than laparotomy; the extent of tissue injury, not the surgical approach, is the determining factor (27, 28). Risk for the development of de novo anterior abdominal wall adhesions is likely lower after laparoscopy than after laparotomy because the risk relates to the length of the abdominal incision(s) (28). Minimally invasive endoscopic surgery also may result in less tissue and organ handling and trauma, avoid contamination with foreign bodies such as surgical glove powder and lint from laparotomy pads, and facilitate more precise tissue manipulation, all of which may help to reduce risk for postoperative adhesion formation. The incidence of postoperative infection, another risk factor for adhesion formation, is lower after laparoscopy than after laparotomy. Pneumoperitoneum has a tamponade effect that may help to facilitate hemostasis during laparoscopy. However, as most commonly performed using standard insufflators, laparoscopy also can desiccate the peritoneum and, thus, may increase the risk for adhesion formation (29). In animals, adhesion risk increases with both time and insufflation pressure (30, 31). The use of warmed humidified CO_2 has been shown to decrease adhesions in a human model (32).

Regardless of the surgical approach selected, procedures such as myomectomy often result in adhesions. The prevalence of adhesions after open abdominal myomectomy is greater than 90% but is still at least 70% after laparoscopic myomectomy (33–35). Of note, the size and number of fibroids in these reports were not equivalent, thus limiting the ability to compare these results directly.

Whether parietal peritoneal closure is necessary or advisable remains controversial (36–39). Evidence suggests that the incidence of adhesions at the site of closure after laparotomy is approximately 22% with peritoneal closure and 16% without peritoneal closure (36). In women with ovarian cancer, closure of pelvic and periaortic peritoneum appears to result in greater adhesion formation than is observed when the dissected areas are left open (38). However, parietal peritoneal closure at primary cesarean delivery has been observed to yield significantly fewer dense and filmy adhesions (39).

Adjuncts to Surgical Technique

Three types of adjuncts to surgical technique have been used to attempt to reduce postoperative adhesions: anti-inflammatory agents, peritoneal instillation, and surgical adhesion barriers. There are only three anti-adhesion barriers approved by the United States Food and Drug Administration (FDA). They are all designed to be present in the peritoneal cavity to act as barriers during the critical 3 to 5 days that mesothelial repair occurs with or without adhesion formation.

Anti-inflammatory Agents

A number of local and systemic anti-inflammatory drugs and adhesion-reducing substances, including dexamethasone and promethazine, have been evaluated, but none has been found effective for reducing postoperative adhesions (40–42).

Peritoneal Instillation

Antibiotic solutions for peritoneal lavage and prevention of postoperative infection do not reduce adhesions, and some may promote adhesion formation (43).

Thirty-two percent dextran 70 and crystalloid-solution instillations, such as normal saline and Ringer's lactate with or without heparin or corticosteroids, has been used to separate adjacent peritoneal surfaces via hydroflotation (44, 45), but none has demonstrated efficacy in reducing adhesion formation (45).

Icodextrin 4% solution (Adept Adhesion Reduction Solution, Baxter Healthcare Corp.) is a water-soluble, high molecular weight, alpha (1, 4)-linked glucose polymer in an electrolyte solution. When used as a peritoneal instillation (1–1.5 L), 4% icodextrin functions as a colloid osmotic agent to retain fluid within the peritoneal cavity for an interval of 3–4 days. Icodextrin is transferred into the systemic circulation via peritoneal lymphatic drainage and metabolized by alpha-amylase to lower molecular weight oligosaccharides that are eliminated by renal excretion. Although a preliminary randomized, controlled pilot study observed that icodextrin 4% reduced adhesion formation (46), a systematic review concluded that there is insufficient evidence for its use as an adhesion-preventing agent (45, 47). Icodextrin 4% has been approved by the FDA for use in the United States as an adjunct to good surgical technique for the reduction of postoperative adhesions in patients undergoing gynecologic laparoscopic adhesiolysis.

Heparin has been suggested as a means to decrease adhesion formation via inhibition of the coagulation cascade and the promotion of fibrinolysis (48, 49). However, in the only clinical trial, peritoneal irrigation with heparin solution did not appear to reduce peritoneal adhesions after pelvic surgery (49).

Surgical Adhesion Barriers

Surgical barriers may help to decrease postoperative adhesion formation but cannot compensate for poor surgical technique. Modified sodium hyaluronic acid (HA) and carboxymethyl cellulose (CMC) are combined in a bioresorbable membrane (Seprafilm, Genzyme Corp.) that has been modified to prolong its retention time in the body. CMC is nontoxic and is used commonly as filler in food, cosmetics, and pharmaceuticals. The HA/CMC film is a transparent and absorbable membrane that acts to separate opposing tissue surfaces and lasts for 7 days (50, 51). In one study involving 127 patients undergoing open abdominal myomectomy, women randomized to receive HA film were observed to have fewer adhesions than untreated controls (52). Although use of HA/CMC film may reduce midline adhesions (25, 53), a systematic review concluded that there is limited evidence for its effectiveness for preventing adhesion formation after myomectomy (54). A large multicenter trial involving 1,701 patients randomized to treatment with HA/CMC film or no treatment at time of intestinal resection observed no overall difference in the incidence of postoperative small-bowel obstruction between the two groups (55). The HA/CMC film is limited largely to use during laparotomy because it fragments easily if not handled gently. The HA/CMC film has been approved by the FDA for use at laparotomy only in the United States.

Oxidized regenerated cellulose (Interceed, ETHICON Women's Health and Urology) is an absorbable adhesion barrier that requires no suturing. It is degraded into monosaccharides and absorbed within 2 weeks after application. The product has been shown to reduce adhesion formation in randomized controlled clinical trials (56–60), all of which have demonstrated benefit for reducing the incidence and extent of new and recurrent adhesions by 50%–60% after both laparoscopic and open abdominal surgical procedures (54). However, there are few studies which assess whether the reduction in adhesions resulting from use of oxidized regenerated cellulose improves fertility. In one small retrospective study involving 38 infertile women who required pelvic reconstructive surgery, the postoperative pregnancy rate was higher among those treated with oxidized regenerated cellulose than among women not treated with the adhesion barrier (61).

According to the manufacturer, complete hemostasis must be achieved, as the product is rendered ineffective when saturated with blood. A study in humans (in contrast to the results from animal studies) found that adding heparin to oxidized regenerated cellulose provided no additional benefit (62). Oxidized regenerated cellulose (in the form of Interceed®) has been approved by the FDA for use at laparotomy in the United States for reducing adhesions.

SUMMARY

- Postoperative adhesions are a natural consequence of tissue trauma and healing.
- Postoperative pelvic adhesions may result in infertility, pain, and bowel obstruction.
- Adherence to microsurgical principles and minimally invasive techniques may help to reduce postoperative adhesions.

CONCLUSIONS

- There is no evidence that anti-inflammatory agents reduce postoperative adhesions.
- There is insufficient evidence to recommend peritoneal instillation such as icodextrin to reduce adhesions.
- There is no substantial evidence that the use of FDA-approved anti-adhesion barriers improves fertility, decreases pain, or reduces the incidence of postoperative bowel obstruction.
- There are no data to support surgical intervention for lysis of postoperative adhesions in order to improve clinical outcomes such as pain symptoms and infertility or to prevent bowel obstruction.

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and the Society for Reproductive Surgeons have approved this report.

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