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Review

Practical implications of postoperative adhesions for preoperative consent and operative technique

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ABSTRACT

Adhesions complicate most intra-peritoneal operations. Once adhesions have formed, patients are at life-long risk for complications that include small bowel obstruction, increased risks during subsequent operations and female infertility. This has two implications for the daily work of surgeons. On the one hand, surgeons need to include the risks from adhesions during pre-operative consent. On the other hand, surgeons need to use operative techniques that minimize adhesions. Therefore this review focuses on the practical implications of adhesions for preoperative consent and operative technique.

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1. Introduction

Post-operative adhesions result from a linear sequence of events that is initiated by peritoneal trauma.[1] Peritoneal trauma causes an inflammatory reaction resulting in increased vessel permeability, extravasation of immune cells and deposition of fibrin. Usually peritoneal fibrinolytic activity rapidly eliminates deposited fibrin and prevents the formation of mature adhesions. However, in the presence of ischemia or extensive tissue damage, as commonly occurs after surgery, physiological fibrinolysis can be insufficient.[2–4] In this case fibrin bridges form attachments between the traumatized areas and proximal tissues.[5,6] Subsequent organization of the fibrin bridges by fibroblast migration and vascularization under the influence of specific growth factors then results in the formation of fibrous adhesion tissue.[7–9]

When post-operative adhesions occur, they impose a significant burden on patients. The morbidity associated with adhesions includes small bowel obstruction, chronic pain and female infertility.[10–18] Moreover subsequent operations are more risky after adhesions have formed. Adhesiolysis prolongs operating times, increases complication rates and results in higher conversion rates from laparoscopic to open surgery.[14,19,20] From these risks follow practical implications for preoperative consent and operative technique.

2. Practical implications for preoperative consent

Surgeons have an established duty of care to give sufficient information to patients where a significant risk has been established. In spite of this, little data is available on the prominence given to adhesion-related complications during the consent process. A survey sent online to UK surgical trainees showed that only 14% would routinely warn patients undergoing laparotomy of the risks from adhesions.[21,22] These data are consistent with our own experience that adhesions and adhesion-related complications are infrequently discussed during pre-operative consent and rarely documented in consent forms.[23]

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The role of adhesions in the pre-operative informed consent process has to be considered relative to the risk to patients. After lower abdominal surgery the re-admission rate directly related to adhesions is 5% within 5 years.[24] Within 10 years, 34% of patients with open abdominal operations are re-admitted to hospital an average of 2.1 times with a disorder related to adhesions or undergo repeat surgery potentially complicated by adhesions.[25]

Adhesive bowel obstruction is of particular concern. This surgical emergency has a mortality rate of 3% for simple obstruction,[13,26] which escalates orders of magnitude when patients present with perforation.[13] The risk of adhesion related intestinal obstruction after intra-peritoneal surgery is life-long. Follow-up of laparotomy patients showed that 1%–7% develop adhesive obstruction within 1–5 years of surgery.[12,13,27,28] The incidence of adhesive obstruction was 0.3%–10% within 4–6 years after appendectomy,[27–30] around 6% within 5 years after open cholecystectomy[29] and 9%–25% within 2–10 years after bowel surgery excluding appendectomy.[27,28,31,32] This incidence is even higher in particularly high risk surgeries, for example restorative proctocolectomy, where adhesion related obstruction approaches 17%–25% within 5–10 years.[27,33–36]

Guidelines advise doctors to inform their patients in writing if a particular treatment might have serious adverse outcomes “even if the likelihood is very small”.[37] Less serious complications should be mentioned if they are common. Legal precedent in the UK has established failure of notifying a serious adverse event with a risk greater than 1–2% as negligent (Chester v. Afshar, [2004] UKHL 41).[10] Since then courts in the US have adopted an even tougher standard,[38,39] which was established in a landmark Federal case (Canterbury v. Spence, 464 F.2d 772, 1972). Here the decision about whether patients have to be informed of a risk is based on whether a reasonable person in the same position would want to be informed. In the light of these considerations it is clear that the level of risk from adhesion-related complications is one of which patients should be made aware.[10,14,24,27,28,40–42] Therefore surgeons have an obligation to advise patients regarding adhesions and the life-long risk of problems caused by adhesions.[43] Surgeons may also wish to tell their patients what they are going to do to minimize adhesion formation.

3. Practical implications for surgical technique

In order to minimize adhesions, surgical technique is pivotal.[41,44] The aims of successful surgical technique are to minimize peritoneal insult in the form of mechanical, chemical and exposure related trauma. To this end, the duration of surgery and the traumatic insult should be minimized.[1] Desiccation of tissue should be avoided by using moist sponges.[45] Surgeons should avoid leaving devascularized or ischemic tissue behind, since this tissue is highly adhesiogenic.[46] The foreign body reaction from suture material, which is known to trigger adhesion formation, should be minimized by selecting fine and non-reactive sutures, cut as short as is consistent with a stable knot.[47] Bleeding should be minimized and meticulous irrigation should be used to limit fibrin deposition.[6] Finally, powdered gloves should not be used.[48,49]

In addition to general minimally traumatic surgical technique, specific adjuncts for intra-operative adhesion prophylaxis have become commercially available. Pharmacological agents for adhesion prevention have been a focus of intensive research.[50,51] In spite of this, physical barriers remain the only licensed agents for adhesion reduction in the USA and Europe. These agents are designed to decrease adhesiogenesis by preventing the formation of fibrin bridges from traumatized areas to surrounding tissues.[52]

The most commonly used adhesion barriers are Seprafilm, Adept and Interceed. Sprayshield is a barrier agent that was introduced more recently.

3.1. Seprafilm

Seprafilm® (Genzyme, Cambridge, MA) is a solid adhesion barrier consisting of chemically derived sodium hyaluronate and carboxymethylcellulose. Its use is supported by a relatively strong evidence base.[53–56] Seprafilm is the only agent proven to reduce the incidence of small bowel obstruction under certain circumstances. Trials showed a reduction in adhesive small bowel obstruction after intestinal resection[55] and gastrointestinal surgery.[56] In a third study focusing on obstruction following gastrectomy for malignancy the benefit of Seprafilm did not reach statistical significance.[57] Application of Seprafilm requires careful handling because the film is brittle and cracks easily. Furthermore this material fixes upon contact with moist tissue and cannot easily be moved after application. Seprafilm is therefore suitable for open operations but routine laparoscopic use is tedious and not commonly employed. It is also important to note that Seprafilm should not be used to protect bowel anastomoses as this may increase the risk of anastomotic leaks.[54]

3.2. Adept

Adept® (Innovata plc, Nottingham, UK) is a liquid agent which is instilled into the peritoneal cavity prior to closure.[60] It consists of 4% icodextrin in an iso-osmotic electrolyte solution. Icodextrin is a high-molecular weight glucose polymer which results in a prolonged intraperitoneal residence time of the solution.[58] During this time the abdominal organs are separated by flotation. As a result, Adept covers the whole abdominal cavity and need not be applied locally to the traumatized areas. A Cochrane systematic review has concluded that there is currently insufficient evidence for use of Adept® or any other fluid agent in reducing postoperative adhesions.[59] After the publication of this review a randomized, double-blinded, controlled trial by Brown and colleagues offered substantial evidence that Adept improves adhesion scores compared to Ringer's Lactate as assessed at second-look laparoscopy.[60] This study represents the largest trial of a licensed adhesion reduction agent to date. However, these patients were not followed up for the incidence of clinically relevant end points such as small bowel obstruction or chronic pain. Operative handling of Adept is simple as it is introduced via instillation into the peritoneal cavity following laparoscopy where it remains until absorption. It is important to carefully close the abdominal wounds subcutaneously to prevent postoperative leakage of the solution. For this reason, Adept is also not well suited for laparotomy.

3.3. Interceed

Interceed® (Johnson & Johnson Medical, New Brunswick, NJ) was introduced in 1990 as the first resorbable solid barrier for adhesion prophylaxis. It consists of oxidized regenerated cellulose and rapidly changes into a gelatinous consistency upon contact with body fluids, thus providing a protective coating around traumatized areas. Since its introduction a substantial body of evidence was collected that supports the use of Interceed. A recent meta analysis of the current data showed that Interceed significantly reduces adhesion formation.[61] Another advantage of Interceed is relatively easy handling in both open and laparoscopic modalities. In spite of this, prolonged operative times were noted following use in laparoscopy.[62] Another drawback of the use of Interceed is its loss of effectiveness with exposure to blood.[63] Therefore, complete hemostasis must be achieved before Interceed is applied.

3.4. Sprayshield

Sprayshield® (Covidien, Waltham, MA) consists of two modified polyethylene glycol solutions with complementary end functional groups (amines on one end and N-hydroxysuccinamide esters on the other). When mixed at the site of application these solutions react with each other to form an absorbable gel. This makes Sprayshield very easy to use, even in laparoscopic surgery. Sprayshield persists in the abdomen for up to 7 days and is afterwards absorbed by the body and eliminated through the kidneys. Sprayshield is a modification of the adhesion barrier Spraygel®, which had been discontinued after disappointing results were published. Meta analysis of the available human trials with Spraygel[64,65] did not show significant adhesion reduction[59] and a large scale pivotal trial of Spraygel that had commenced in the USA was stopped due to lack of efficacy in the treatment arm.[41] The differences between Sprayshield and Spraygel include a shorter absorption time which presumably decreases the body's foreign body reaction and changing the dye from methylene blue to Brilliant Blue FCF. Further clinical studies are necessary to determine the clinical efficacy of Sprayshield in human patients.

3.5. Advantages and disadvantages of using anti-adhesion agents

In order to make the decision whether an anti-adhesion agent should be used, the surgeon needs to consider the advantages and disadvantages to the patient and to the healthcare system. The advantages for the patient include well documented decrease in the adhesion burden.[66] There is also some evidence that these agents decrease adhesion-related complications in humans,[55] but this evidence is limited. Potential disadvantages include the possibility of allergic reactions to the prosthetic material and cost of the anti-adhesion agent. Allergic reactions have been reported infrequently.[67] Cost effectiveness of anti-adhesion products are a function of the cost of the agent itself minus the cost of adhesion-related complications that are prevented. It has been estimated that an agent reducing adhesion-related readmissions by 25% and costing 110 British Pound Sterling per patient would be cost-effective in the British NHS.[27] However, these calculations are based on estimates that are based on limited evidence. Furthermore, similar calculations are missing for other important healthcare markets.

In the light of these advantages and disadvantages we suggest that surgeons consider using anti-adhesion agents in procedures that are particularly high-risk for adhesions and in young patients who have a higher lifetime risk of adhesion related morbidity.

4. Conclusion

In summary, post-operative adhesions are frequent and cause significant long-term morbidity for patients. Even though adhesion-related complications occur relatively late after the original operation they should not be neglected during the pre-operative consent process. This review has summarized the available evidence that can be used to inform patients about the frequency and severity of adhesion-related complications. Furthermore, physical barriers that decrease adhesion formation have become routinely available. While there is sufficient data to support the hypothesis that these barriers decrease adhesion formation there is limited human evidence that the commercially available adhesion barriers significantly prevent adhesion-related complications. Therefore, we recommend that physical barriers be used in high-risk operations such as proctocolectomy, operations with planned multiple stages such as ileostomy for eventual takedown as well as in young patients who have a high life-time risk of developing complications from adhesions.

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None.

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