

Postoperative abdominal adhesions and their prevention in gynaecological surgery. Expert consensus position

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on behalf of the Expert Adhesions Working Party
of the European Society of Gynaecological Endoscopy
(ESGE)

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Abstract Adhesions are the most frequent complication of abdominopelvic surgery, yet many surgeons are still not aware of the extent of the problem and its serious consequences. While adhesions may cause few or no detrimental effects to patients, in a considerable proportion of cases there are major short- and long-term consequences, including small-bowel obstruction, infertility and chronic pelvic pain. Adhesions complicate future surgery with important associated morbidity and expense—and a considerable risk of mortality. Despite advances in surgical techniques in recent years, the burden of adhesion-related complications has not changed. Adhesions should now be considered the most common complication of abdominopelvic surgery. Adhesiolysis remains the main treatment, despite the fact that adhesions reform in most patients. Developments in adhesion-reduction strategies and new agents now offer a realistic possibility of reducing the risk of adhesions forming and can improve the outcomes for patients and the associated onward burden. This consensus position represents the collective views of 35 gynaecologists with a recognised interest in adhesions. The position is presented in two parts. The first part reviews the published literature on the extent of the problem of adhesions, and the

second part considers the opportunities to reduce their incidence. It also provides collective proposals on the actions that European gynaecologists should take to avoid causing adhesions. Importantly it also advises that it is now time to inform patients of the risks associated with adhesion-related complications during the consent process. With increasing evidence to support the efficacy of adhesion-reduction agents to complement good surgical practice, all surgeons should act now to reduce adhesions and fulfil their duty of care to patients.

Keywords Adhesions · Adhesiolysis · Guidelines · Gynaecology · Surgery

Introduction

Adhesions are the most frequent complication of abdominal surgery and may represent one of the greatest unresolved medical problems in medicine today [1], yet many surgeons are still not aware of the extent of the problem and its serious consequences.

Sixty to 90% of patients who have undergone major gynaecological surgery will develop adhesions [2]. Adhesiolysis remains the main treatment, despite the fact that adhesions reform in most patients (mean 85%) regardless of the method of adhesiolysis used or the type of adhesion being lysed [3].

While adhesions may cause few or no detrimental effects to patients, in a considerable proportion of cases there are serious short- and long-term consequences, with important associated morbidity and expense—and a considerable risk of mortality.

Recent epidemiological data have demonstrated the true extent of adhesion-related complications, and evidence is emerging on the level of associated risk for patients.

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Despite advances in surgical techniques in recent years, the burden of adhesion-related complications has not changed [4, 5]. While laparoscopic procedures are commonly believed to be less adhesiogenic and cause fewer de novo adhesions to form compared to open surgery [6, 7], for many procedures, the comparative risk of adhesion-related complications following open and laparoscopic gynaecological surgery is similar [5].

Developments in adhesion-reduction strategies and new agents do, however, now offer a realistic possibility of reducing the risk of adhesions forming and thus may improve the outcomes for patients and the associated onward burden. The importance of providing clear recommendations on adhesions and their prevention following gynaecological surgery is very apparent.

For this reason, and following recent reviews by colleagues in the United Kingdom [8] and Germany [9], an Expert Working Party under the auspices of the 15th Annual Congress of the European Society of Gynaecological Endoscopy (ESGE) was convened to increase awareness and offer practical proposals to minimise the problem.

The project, while conceived by two of us (RDW, GT), involved a Working Party of 35 gynaecologists with a recognised interest in adhesions (see [Appendix](#)), all of whom contributed actively to the development of this paper through reviews, inputs and consensus proposals, with the majority also attending the consensus workshop held during the 15th Annual Congress of the ESGE. The project progressed in accordance with accepted processes for the development of consensus statements (see “[Consensus process including conflict of interest](#)”).

The project is presented in two parts. The first as published here, provides an overview of the published literature on the extent of the problem of adhesions. The second appears in the next issue of Gynecological Surgery and considers the opportunities to reduce the problems of adhesions. Consensus proposals on the actions that European gynaecologists should now take are also provided in part 2. These proposals are collective opinion and should not be used for performance measure or competency purposes. Together these two papers provide a collective consensus position which it is hoped will raise the level of awareness and understanding of adhesions, and the associated health-care burden and costs, thereby encouraging heightened discussions and actions to address this area of unmet need.

History

Adhesions have been the subject of research for many years with the first case of fatal adhesion-related intestinal obstruction reported as far back as 1872 [10]. Despite

considerable research into adhesions through the years, resulting in improvements in surgical techniques and the use of powder-free surgical gloves, the problem remains as most surgeons are still not fully aware of the magnitude and consequences of adhesions. This lack of awareness has been cited by Ellis as the greatest impediment to reducing adhesion formation, which he aptly described as ‘a sense of fatalism affecting the surgical community, akin to the attitude of surgeons to wound infection in the days before Lister’ [11].

The epidemiology and clinical importance of adhesions

There is strong evidence that the real extent of adhesions and adhesion-related complications is underestimated by most surgeons for the following reasons:

- Adhesive complications occur unpredictably, often many years after a procedure.
- The complications are often treated by physicians or specialists other than the initial operating surgeon.
- The aetiology of adhesion formation is still incompletely understood.
- There has been a long track record of failure or limited use of traditional adhesion-prevention strategies, until the recent introduction of newer agents.
- Although adhesions can be present, they may be asymptomatic so they remain undiagnosed in most cases.

Following initial practice-based research [12–15], the Surgical and Clinical Adhesions Research (SCAR) group has quantified the epidemiology and burden that adhesions pose to patients, surgeons and health services. The initial study followed up adhesion-related hospital readmissions in Scotland for 10 years in a cohort of patients undergoing open abdominal or pelvic surgery [16]. The SCAR Group found that over the study period, up to one in three patients were readmitted at least twice for adhesion-related problems (or other surgery potentially complicated by adhesions) and, moreover, the readmissions continued steadily throughout the 10 years. This research also indicated that patients undergoing open surgical procedures on the colon and rectum [17] and on the fallopian tubes, ovaries and uterus [4] were at most risk of adhesion-related readmissions. The SCAR group subsequently reported that for therapeutic and diagnostic laparoscopic procedures (i.e. all laparoscopic procedures undertaken with the exception of low-risk tubal sterilisations), the risk of adhesion-related readmission was comparable to that of gynaecological laparotomy [5]. The group concluded that despite advances in surgical technique, the burden of adhesion-related readmissions continues.

Other studies report that the incidence of adhesions following gynaecological laparoscopic surgery is 70–100%, diagnosed by second-look analysis [18, 19]. Laparoscopic surgery is generally considered to be accompanied by reduced de novo adhesion formation in comparison to laparotomy [19–21], while reformation is similar. However, a meta-analysis revealed comparable results for open versus laparoscopic surgery for both formation of de novo adhesions and reformation following adhesiolysis [22]. It is postulated that the environment of the pneumoperitoneum [23] and the surgeon’s training may also play an important role in the incidence of adhesions [24].

Pathogenesis of adhesions

In simple terms, adhesions are abnormal attachments between tissues and organs [25] and may be congenital or acquired [26]. The development of acquired adhesions is a generalised phenomenon in response to trauma to the peritoneum. The trauma may be inflammatory or surgical, and may include exposure to infection or intestinal contents, ischaemia, irritation from foreign materials (such as sutures, gauze particles or, historically, glove powder), desiccation, or overheating by lamps or irrigation fluid [27].

The peritoneum is the most extensive serous membrane in the body, serving to minimise friction and facilitate free movement of abdominal viscera, to resist and localise infections and to store fat. It comprises a single-cell layer of mesothelium lying on a submesothelial connective tissue matrix which contains numerous capillaries and lymphatic channels which open into the mesothelial cell monolayer. The surface of the mesothelium is coated in phospholipid (Fig. 1).

This mesothelial monolayer is extremely delicate and hence susceptible to damage, although it also has excellent healing properties provided that there is no ongoing

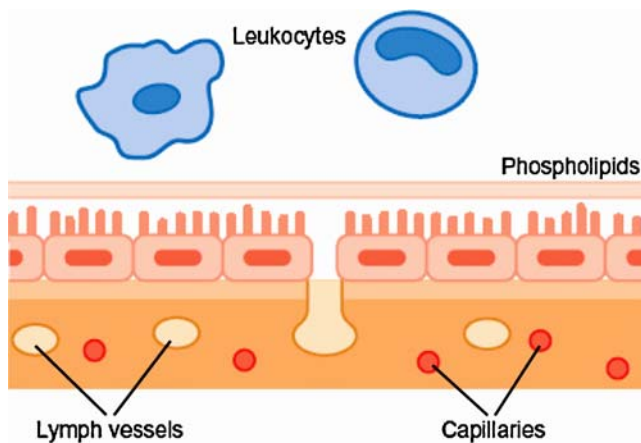


Fig. 1 Anatomy of the peritoneum

inflammation which reduces fibrinolytic activity or deprives tissues of oxygen.

The pathogenesis of adhesion formation is complex, with many factors involved [28, 29] (Fig. 2).

Histopathological studies demonstrate a clear sequence of events from injury to the formation of adhesions. In general, abrasion and other trauma during surgery lead to the disruption of the peritoneal mesothelium and fibrin is then released along with a cascade of other elements, including leukocytes and mesothelial cells. The fibrin is

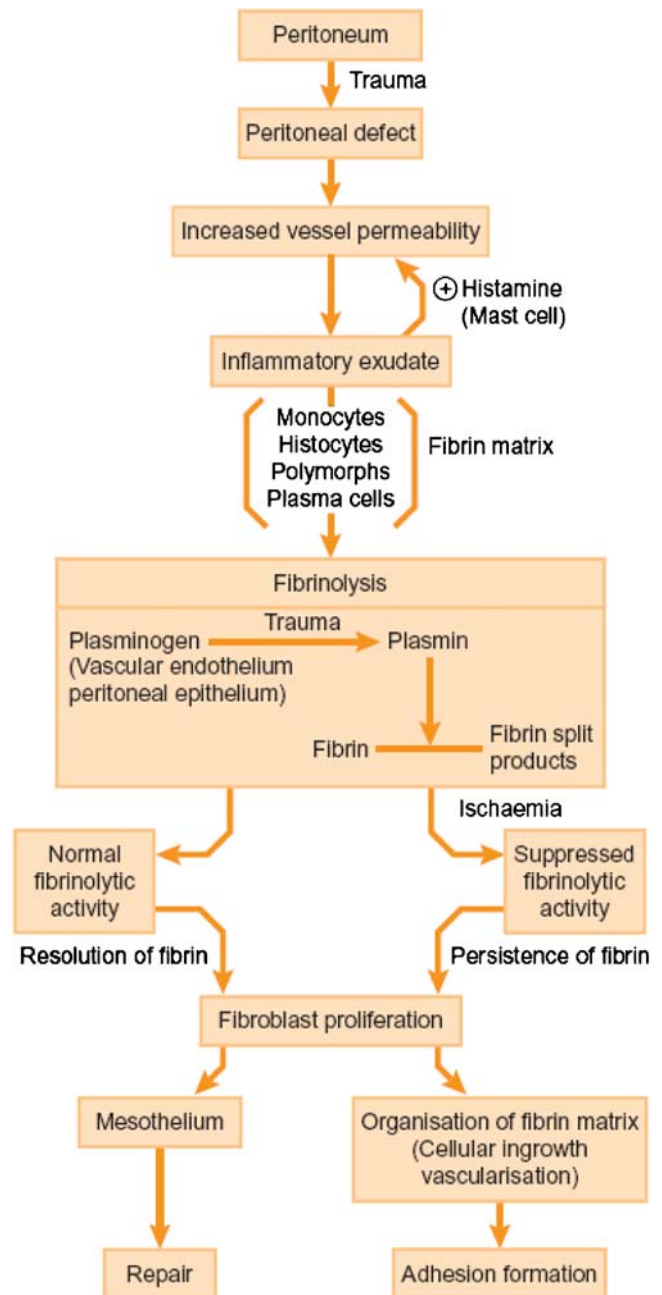


Fig. 2 Summary of normal tissue repair and adhesion formation following surgical trauma [28]

deposited at the damaged surfaces as a result of bleeding and post-traumatic inflammation.

During wound healing, fibrin deposits from damaged mesothelium enlarge to form a bridge between opposing tissue surfaces. Locally generated fibrinolytic factors are released which may degrade all or part of this fibrin bridge. However, surgery, infection and hypoxia dramatically diminish fibrinolytic activity and, under these circumstances, fibroblasts and other cells may migrate across the bridge remnants transforming it into an adhesion [30] (Fig. 3).

The process of adhesion formation commences from the moment of peritoneal injury during surgery, as a result of which the inflammatory cascade is triggered. While the severity and extent of adhesions may change over weeks or months, the question of whether or not an adhesion develops at all is determined in the 3–5 days after peritoneal trauma takes place, i.e. after surgery has been carried out [31]. It is during this post-surgical period that the fibrin layer is reduced through fibrinolysis and the peritoneal membrane either becomes fully re-epithelialised or not. If fibrinolysis does not occur, an irreversible tissue bridge (adhesion) develops, which strengthens within the following weeks and months and in which blood vessels and nerve fibres may form [32].

The interaction of the acute-phase inflammatory protein cascade is, however, not fully understood, nor is its role in changing gene expression patterns and regulating both normal and adhesion fibroblasts [1, 33]. Adhesion formation is a multigenic phenomenon and the role of different activators and factors in this complex process is a matter of considerable research, aimed at not only improving our understanding of the development of adhesions, but also, most importantly, finding optimal strategies for adhesion prevention [28, 29]. The most promising avenues of research are strategies to separate damaged peritoneal surfaces, the fostering of the process of fibrinolysis and

the regulation of hypoxia and prevention of angiogenesis. While the latter approaches are currently still only a research hope, the former is already an available option that surgeons can consider using.

Adhesion-related complications

Although adhesions are now the most frequent complication of abdominopelvic surgery, it is not possible to identify which particular adhesions will cause complications.

The most frequent adhesion-related complications are secondary infertility in women (20–40% of cases are caused by adhesions [34, 35]) and small-bowel obstruction (74% of cases are adhesion-related [36]). Adhesions are also thought to be a significant cause of chronic pelvic pain in many patients [27, 32, 37], but this relationship still requires further investigation. While most patients will develop adhesions following surgery [2], the majority will not experience these problems and may not be aware of their adhesions unless they have further surgery.

For patients undergoing subsequent surgery, adhesions pose an important complicating factor with adhesions from previous surgery significantly increasing operating time [38, 39]. In addition, even in the hands of experienced surgeons, there is a 19% risk of inadvertent enterotomy at reoperative laparotomy [40] and a 10–25% risk of bowel injury in laparoscopic adhesiolysis [41]. In medicolegal terms, tissue damage to underlying structures is the most common factor in successful surgical negligence suits [42]. The associated costs of adhesions to health services, patients and society are significant and continue to increase.

Infertility

Adhesions are the leading cause of secondary infertility in women. They affect fertility adversely by distorting adnexal anatomy and by interfering with gamete and embryo transport. They have been shown to cause peritoneal infertility in 15–20% of women [34, 35, 43]. Furthermore, tubal-related problems account for up to 40% of female infertility cases, with identifiable causes including post-infectious, endometriosis-related and post-surgical adhesion formation [44, 45].

While infertility often has multifactorial causes, there is a clear-cut correlation between adhesions and infertility. In women with infertility as a result of adnexal adhesions, pregnancy rates of 32 and 45% at 12 and 24 months respectively have been reported following adhesiolysis, compared with 11 and 16% at corresponding time intervals in untreated women [46]. A follow-up period of 3 years reported higher pregnancy rates in women who underwent tubal surgery compared with those who did not (29 vs 12%)

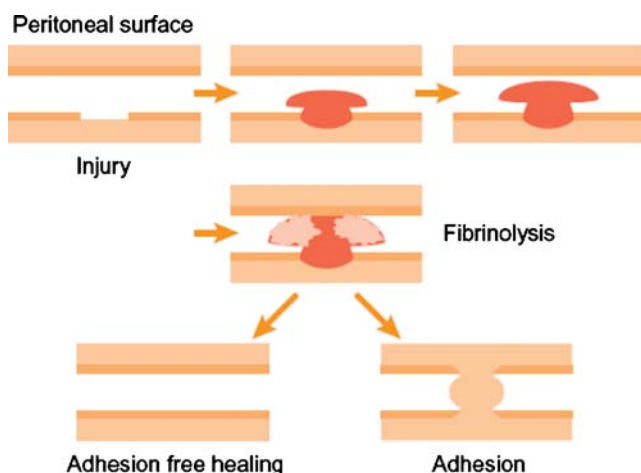


Fig. 3 Development of adhesions [30]

[47]. In women followed for an average 49 months after tubal surgery, term pregnancy rates correlated with adhesion scores as assigned using the American Fertility Society classification for adnexal adhesions [48].

Small-bowel obstruction

In the treatment of adhesion-related small-bowel obstruction, outcomes following medical management have been shown to be worse if the adhesions resulted from previous appendectomy or tubal or ovarian surgery [49].

Small-bowel obstruction (SBO) is the most serious adhesion-related complication with a 10% risk of mortality [50] if not diagnosed and treated immediately. While the risk of SBO is highest after colorectal surgery, it is also a significant problem following gynaecological surgery. In the SCAR study, 4.5% of readmissions following gynaecological laparotomy were for SBO [16].

A recent retrospective analysis of all SBO admissions in two hospitals during the period January 1998 to December 2005 showed that in non-oncological cases, 50.4% of admissions were the result of previous gynaecological surgery with total abdominal hysterectomy cited as the most common cause of SBO [51]. In this study, a total of 13.6 cases per 1,000 resulted in SBO, 75% of these being diagnosed as complete SBO.

This work also suggested that laparoscopic hysterectomy and other procedures did not carry such a high risk of SBO, but the numbers of laparoscopic procedures were more limited. This recent study supports previous findings highlighting the important risk of SBO following gynaecological laparotomy [2, 49, 52–57].

Chronic pelvic pain

A relationship between adhesions and pelvic pain, although controversial, is also apparent. An analysis of 11 studies involving a total of almost 1,000 patients suffering from pelvic pain demonstrated adhesions as being the most common associated pathology in 40% of cases [32].

However, the pathophysiological connection between adhesions and pain remains unclear. It is uncertain which mechanisms trigger adhesion-related pain under physiological conditions, but nerve fibres are often present in adhesions [58, 59] and may be involved in the aetiology. Patients have been shown to experience pain when adhesions are touched [60], and this observation has been further supported in various pain-mapping studies [61, 62].

Whether or not adhesiolysis provides an improvement in chronic pelvic pain is uncertain. While retrospective and prospective studies have shown improvement in 50–90% of cases after laparoscopic adhesiolysis [63–68], only very few studies fulfilled the conditions of a controlled or even

prospective randomised design. In randomised studies, the evidence is more ambiguous, and it is unclear if adhesiolysis is a successful treatment option in the majority of women [41, 69]. As there is a known high rate of reformation of adhesions following surgery (mean reformation rate of 85%) regardless of the method of adhesiolysis [3], and as chronic pain may have multifactorial causes, e.g. psychosomatic, it is not surprising that the role of adhesiolysis as a treatment for chronic pain is uncertain. The risk of intestinal perforation that occurs during laparoscopic procedures for symptomatic adhesions is also high—reported as up to 25% of patients [41, 70]. In a recent review, van der Wal and colleagues noted that considering the risk of complications associated with laparoscopic adhesiolysis, it should no longer be recommended as a therapy for adhesion-related chronic abdominal pain [70]. A critical analysis of the existing literature is therefore needed to further assess the therapeutic effect of adhesiolysis in patients with pelvic pain.

The cost of adhesions

Pre-existing adhesions significantly prolong the duration of surgery [38, 39] and lead to considerable complications in an important percentage of patients. This is particularly the case in accidental intestinal enterotomy which is accompanied by an increased need for intensive care facilities, extended hospitalisation and increased ward costs [40, 41].

A survey in 1993 in Sweden—a country with a population of some 7.1 million—found that total care costs (including costs for sick leave) for adhesive SBO amounted to at least €10 million per year (US\$13 million) [71]. The costs of all hospitalisations for adhesiolysis in the United States in 1994 were estimated to be around €1 billion (US \$1.33 billion), of which approximately €596 million (US \$764 million) was for hospitalisations directly attributable to adhesions [72].

Using the SCAR data [16, 17], the average length of hospital stays for adhesion-related general and gynaecological surgery in 1994 showed that treatment costs for adhesion-related surgical procedures in Scotland represented 2% of expenditure on hospital and community sector services in that year [73], being over £6 million (~€9 million). This was a conservative estimate of the true costs. A subsequent cost model developed by Wilson and co-workers based on the SCAR data predicted that the direct annual cost of adhesion-related readmissions for the United Kingdom as a whole within the first year after initial lower abdominal surgery would be in excess of approximately €36 million (£24.2 million), rising to €141 million (£95.2 million) in the 10th year after surgery [74]. Wilson et al. estimated that the cumulative year-on-year direct costs

of adhesion-related readmissions for a 10-year period would be more than €843 million (£569 million) in the UK population (approximately 58 million in 1999).

Extrapolation of these cost data across Europe or on a global scale indicates the extent of the problem of adhesion-related complications and highlights the concern that adhesion-related events represent a huge burden for health-care resources and funding.

In part 2, the opportunities to reduce the burden of adhesions are reviewed and consensus proposals on action for European gynaecologists to take are presented.

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Appendix

Expert Adhesions Working Party of the ESGE

Members of the Expert Adhesions Working Party of the European Society of Gynaecological Endoscopy (ESGE) are listed below alphabetically. All members actively contributed to the development and review of the consensus paper recognising the importance of publishing on a matter of such importance. The majority participated at the Adhesions Consensus Expert Workshop convened during the 15th Annual Congress of the ESGE and the project progressed in accordance with accepted processes for the development of consensus statements (see “[Consensus process including conflict of interest](#)”).

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Consensus process including conflict of interest

The project processes were in accordance with the ACCP Definition of Consensus Statement [75].

In agreement with the President and the International Scientific Committee of the European Society of Gynaecological Endoscopy (ESGE), an Adhesions Consensus

Expert Working Party was convened during the 15th Annual Congress of the ESGE.

Invitations to join the Expert Working Party were issued to colleagues who were known to have interest and published expertise in the field. No one declined to be involved.

Funding for the expenses of Working Party members to meet at ESGE and to provide input into the research, writing and manuscript review process was sought from companies with a known interest in adhesions in Europe (Genzyme, Confluent, Gynaecare, Baxter BioSurgery). Of these, only Baxter BioSurgery agreed to provide funding and the company provided an unconditional educational grant to support the work. Baxter BioSurgery has had no input to the Working Party consensus process or the proposals made. While it has had the opportunity to review the manuscript, it has at all stages declined to comment on it. The evidence and scope of the manuscript were reviewed and commented on by the Working Party in preparation for and during a workshop at ESGE. Collective consensus opinion was agreed at the workshop and presented during plenary session to seek wider input. In formalising the consensus and this paper, all work has been reviewed and formally agreed upon by all Working Party members.

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