OBSTETRICS

Adhesion prevention after cesarean delivery: evidence, and lack of it

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In spite of the recognized occurrence of cesarean-attributable adhesions, its clinical significance is uncertain. The presence of adhesions during a repeat cesarean section can make fetal extraction lengthy and the procedure challenging and may increase the risk of injury to adjacent organs. Two methods for adhesion prevention are discussed, peritoneal closure and use of adhesion barriers. Peritoneal closure appears to be safe in the short term. In the long term, conflicting evidence arise from reviewing the literature for possible adhesion reduction benefits. A systematic review of the literature on the use of adhesion barriers in the context of cesarean section yielded only a few studies, most of which are lacking in methodology. For now, it appears that the available evidence does not support the routine use of adhesion barriers during cesarean delivery.

Key words: adhesion barriers, pelvic adhesions, peritoneal closure, repeat cesarean section

Cesarean delivery is the most common surgical procedure for women in the United States with more than 1.3 million cesarean surgeries performed every year. When the US national rate of cesarean delivery was first measured in 1965, it was as low as 4.5%.[1] Much has changed since then,[2-5] and among 19 industrialized countries that provided data to the Organization for Economic Cooperation and Development in 2011, cesarean rates ranged from a low of 15% for Iceland to a high of 38% for Italy.[5] Of the 1.3 million cesarean surgeries performed every year in the United States, approximately one third are repeat operations because more than 90% of the women who undergo 1 cesarean delivery (CD) have a repeat procedure in subsequent pregnancies.[6]

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Adhesion formation

Adhesions are abnormal fibrous connections between 2 anatomically different surfaces, as a part of a disordered healing process.[7] Postoperative adhesions are a natural consequence of surgical tissue trauma and healing and develop, transiently or permanently, each time the abdomen is entered. Normal peritoneal healing lasts 5-8 days on average and involves a combination of fibrosis, fibrinolysis, and mesothelial regeneration.[8,9]

It is the suppression of the normal fibrinolysis process that leads to a cascade resulting in adhesion formation (Figure 1). Although the likelihood of adhesion formation in an individual patient is hard to estimate, the peritoneal inflammatory status seems to be a crucial factor in determining the duration and extent of the imbalance between fibrin formation and lysis. Factors that appear to influence the rate of adhesion formation include infection, tissue ischemia, degree of tissue devascularization and manipulation, and surgical technique.

Rates and impact of adhesions after cesarean delivery

As expected, the more often the abdomen is entered, the more extensive and dense adhesions may be encountered. The reported prevalence of adhesions is 12-46% of women at their second cesarean and 26-75% of women during their third cesarean.[10-14] The significant variation in reported rates of postcesarean adhesions is probably related to the different adhesion-grading systems used in different institutions.

Recently Tulandi and Lyell[15] proposed a standardized classification system for adhesion location, extent, and consistency following CD. The authors suggest a point system, with the scores from multiple sites being additive. The use of this classification system may assist mainly in the future research of the possible benefits attributed to the different adhesion prevention methods.

Although significant variation exists in reported adhesion rates following cesarean section, these rates appear to be lower than those reported following gynecological laparotomies.[16] Some authors believe this may be due to anatomical considerations as well as the unique nature of cesarean section.[16,17] In a routine cesarean section, the bowel is usually not directly handled and the operative field focuses on the anterior aspect of the gravid uterus. This is in contrast to gynecological surgery, in which the ovaries, fallopian tubes, pouch of Douglas, and bowel (all often involved in adhesion-related disease) are commonly encountered.

In addition, amniotic fluid is rich in factors that augment fibrinolysis, and spillage of the fluid into the abdominal cavity may assist in fibrin clearance.[16,17] Usually, 2 anatomical areas are of concern in adhesion formation following CD: between the uterine incision and the bladder flap and between the

parietal peritoneum and surrounding structures (uterine incision/bladder flap/abdominal wall). Most authors agree that adhesions involving the bladder, which potentially carry a higher morbidity, are less frequent (7-35% of repeat CS cases) than those involving the abdominal wall (27-77% of repeat CS cases).[10,13,18]

In spite of the recognized association, the clinical significance of cesarean attributable adhesions is uncertain for both mother and child. Focusing on immediate consequences, the presence of dense adhesions can make the surgical procedure and fetal extraction more time consuming and challenging and may increase the risk of bowel or bladder injury and excessive blood loss.[12,13,19-21] In one study, the reported delay in fetal extraction was 5.6 minutes with 1 previous CD and 18.1 minutes with 3 previous CDs.[13] The time to infant delivery and risk of surgical complexity during repeat CD are of critical concern, particularly in emergency cases.

In the long term, postoperative adhesions may be a cause of small bowel obstruction. However, specifically following CD, rates appear to be small. The reported rate of bowel obstruction following 1 CD is 0.5 per 1000 and 9 per 1000 after 3 CDs.[22-24] In a large Swedish nested case-control study, with more than 900,000 women investigated, the odds ratio for bowel obstruction following cesarean delivery (compared with vaginal delivery) was a modest 2.0 and the number of cases of CD needed to cause one case of adhesions or intestinal obstruction (number needed to harm) was as high as 360.[22]

Pelvic adhesions may also distort tubal anatomy and lead to infertility. Nevertheless, there is no strong evidence supporting a causal relationship between a cesarean delivery in the first pregnancy and subsequent subfertility.[25]

Methods for adhesion prevention or reduction

Data related to short- and long-term morbidities with post-CD adhesions are emerging. These are concerning in light of the growing CD rates worldwide. Accordingly, obstetrical practices are increasingly considering adhesion reduction strategies. In part, strategies focus on efforts to reduce the rates of primary CD.[26] In parallel, the availability of different adhesion prevention strategies has also built support for a more proactive strategy to reduce the risk in patients undergoing repeat CDs. Some data exist on different surgical techniques and the potential benefit of future adhesion reduction, including bladder flap formation, single- vs double-layer closure of the uterine scar, and evaluation of the Misgav Ladach technique.[27-30] In this review, we address the 2 most commonly studied interventions in this context: peritoneal closure and adhesion barriers.

Peritoneal closure

Historically, both visceral (uterovesical fold) and parietal peritoneum were surgically closed during CD. This strategy was gradually abandoned because studies have shown that peritoneal nonclosure results in some short-term benefits such as shorter operative time, reduced analgesic requirements, and reduced hospitalization length.[31-36]

Two large and well-designed randomized controlled trials were published in the last 4 years evaluating different aspects of the surgical techniques used in CDs. In the Caesarean section surgical techniques: a randomized factorial trial,[37] 3033 women undergoing CD were randomly assigned to alternative surgical techniques including closure vs nonclosure of the pelvic peritoneum. There were no differences in any of the short-term outcomes evaluated and no significant adverse effects of any of the alternative techniques used in the trial.

In the second and even larger Caesarean section surgical techniques (CORONIS): a fractional, factorial, unmasked, randomised controlled trial,[38] closure vs nonclosure of the peritoneum (pelvic and parietal) was assessed among other surgical aspects of CD. Here almost 16,000 women underwent randomization and, again, there were no statistically significant differences within any of the intervention pairs for the different short-term outcomes.

The inevitable conclusion from these strong data is that short-term morbidity should not serve as a factor in the decision of whether to close the peritoneum. Thus, the focus should shift to the question of potential long-term benefits of this technique and particularly their adhesion reduction potential. On the one hand, peritoneal closure may potentially enhance adhesion formation by causing tissue damage and necrosis as well as foreign body reaction to the suture material. On the other hand, leaving the peritoneal cavity open may result in the adherence of the large uterus to the anterior abdominal wall.

In addition, women after cesarean section are encouraged to early mobilization; thus, the left-open peritoneum can no longer isolate omentum and bowel from the healing uterus, fascia, and rectus abdominis. Two relatively recent, systematic reviews evaluated the association between peritoneal closure and adhesion formation in subsequent pregnancies.[39,40] One reviewed randomized controlled trials (RCTs) and the second, retrospective studies. Both concluded that nonclosure of the peritoneum during cesarean section is associated with more adhesion formation. However, all the authors agreed that more RCTs of higher quality and larger size were needed for more robust conclusions.

Subsequent to these meta-analyses, a large, well-designed trial randomly assigned 533 women during their primary cesarean to peritoneal nonclosure or closure. The authors found no significant difference between the groups in the proportion of patients with adhesions at any site and in time from incision to delivery during a repeat CD ($n = 97$ repeat CDs).[41] This clinical trial had multiple methodological strengths including its primary objective being to examine adhesion formation in a repeat CD, use of an adhesion scoring system, exclusion of patients who had had prior pelvic or abdominal surgery, use of a standard technique for performing the CD, and blinding of the surgeon performing the repeat cesarean to patient allocation. Its main weakness lies in the sample size of repeat CDs. The authors admit the study was powered to identify a large difference (50%) in adhesion rate