Gere S. diZerega, M.D.

Senior Editor
Professor of Obstetrics and Gynecology
University of Southern California School of Medicine
Livingston Research Institute
Los Angeles, California

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Senior Editor:
Gere S. diZerega, M.D.
Professor of Obstetrics and Gynecology
University of Southern California School of
Medicine
Livingston Research Institute
1321 N. Mission Rd.
Los Angeles, CA 90033
USA

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Foreword

by Victor Gomel, M.D.

There has been increasing appreciation of the deleterious effects of postoperative intraperitoneal adhesions and the importance of prevention or at least reduction of their occurrence. Postoperative adhesions may cause abdominal and pelvic pain, bowel obstruction, and infertility. The commonest cause of bowel occlusion in a woman is a prior hysterectomy. Therefore, prevention of adhesions is important in both conventional and extirpative surgery. This book is a summary of both the science of peritoneal repair as well as a manual of surgical techniques directed to the reduction of postsurgical adhesion and consequently improved surgical outcome. The timing of this book's publication is propitious owing to the recent increase in the understanding of peritoneal adhesion formation and the development in improved surgical techniques especially using a minimal access approach to the peritoneal cavity.

The series or cascade of physiologic or pathophysiologic events that lead to either normal peritoneal healing or formation of postoperative adhesions commences with the initial surgical trauma. Surgical trauma is not confined to the operative site alone; frequently there is significant trauma to adjacent and peripheral tissues. Although the former may be integral to the procedure, the latter should largely be avoidable. For example, in an ovarian cystectomy the incision made on the affected ovary to excise the cyst is an essential part of the procedure. However, undue trauma to the ovarian surface from less than gentle manipulation and from sponging with surgical pads is largely avoidable, as is trauma to adjacent peritoneal surfaces from manipulation, insertion of abdominal pads and introduction of foreign material.

As is evident from other chapters of this book, it is easier to prevent de novo adhesions (adhesions that did not exist before) than adhesions reformed subsequent to adhesiolysis. A situation that is very likely to lead to adhesions, frequently of cohesive type, is the apposition of damaged peritoneal surfaces. This is frequently observed between the posterior surface of the ovary and the peritoneal surface of the fossa ovarica.

The ovary is the organ most frequently involved in adhesions. This propensity is the result of its being covered by a single mesothelial layer that is deprived of the underlying support structures present in the peritoneum. Desiccation of the cells of this single cell layer, even by simple exposure to the atmosphere and lights of the operating room, may be sufficient to cause adhesions. The described propensity and the less than gentle technique frequently used are among the major causes of failure of reconstructive surgery. Recognition of these facts, at a time when reconstructive surgery represented the only treatment option for tubal factor infertility, led to the development and introduction of microsurgical techniques in gynecol-

ogy. The gynecologist became more acutely aware of tissue trauma and its deleterious effects and began to employ more delicate techniques.

Microsurgical Technique

Microsurgery has been defined as "surgery under magnification." In fact, magnification is only a single facet of microsurgery, which embraces a broad concept of tissue care designed to minimize tissue damage. The principles include the following:

Delicate Handling of Tissues

This concept demands respect for peritoneal surfaces. Every effort must be made not to damage the peritoneum. This requires avoiding the use of traumatic instruments, such as toothed forceps, and laparotomy pads on the peritoneum. Retraction should be achieved with probes rather than by grasping tissues with traumatic instruments. To avoid desiccation, the peritoneum must be kept moistened, at all times, by frequent irrigation with a physiologic solution such as lactated Ringer's. Sponging with pads should be replaced by irrigation, both to clean the operative site and to expose bleeding vessels. Addition of heparin (1000 to 5000 units per liter, depending upon the anticipated total volume of fluid use) to the irrigation solution largely prevents the clotting of extravasated blood, improves the effectiveness of irrigation in keeping the surgical site well exposed and facilitates the removal of blood, soluble fibrin, and debris from the peritoneal cavity at the end of the procedure.

Hemostasis

Good hemostasis is an integral part of good surgical technique. The presence of blood in the peritoneal cavity increases the likelihood of postoperative adhesions. Blood increases the need for fibrinolysis which is limited to the available amounts of plasminogen and plasminogen activator activity (PAA). Blood clots adhere to the traumatized peritoneum and provide the fibrin matrix necessary for the formation of adhesions.

While pedicles must be well secured, the creation of large areas of necrosis must be avoided by limiting the size of the pedicles and the amount of tissue beyond the tie.

Electrosurgery plays an important role in hemostasis; however, it must be used judiciously. Bleeding vessels should be exposed by irrigation and desiccated using the smallest possible caliber electrode or bipolar forceps and with the appropriate power density in order to avoid damage to adjacent tissues and excessive carbonization.

Avoidance of Introduction of Foreign Material into the Peritoneal Cavity

The introduction of foreign bodies into the peritoneal cavity creates an inflammatory reaction that frequently contains giant cells. Powder used in surgical gloves is a major irritant to the peritoneum. For this reason, it is imperative to wash the gloved hands thoroughly prior to entering the peritoneal cavity, especially with open surgery. In open surgery the gloves should be moistened when handling tissues to reduce peritoneal trauma. The use of nonwoven, moistened pads is preferable to that of ordinary pads, which will shed lint into the peritoneal cavity.

Sutures, necessary as they may be, are a foreign body to the peritoneum and thus engender an inflammatory response and not infrequently cause adhesion. For this

reason less reactive sutures (synthetic absorbable or when required synthetic permanent) must be selected. In addition, in order to decrease the amount of suture material exposed to the peritoneal cavity the finest caliber suture able to do the task should be used and whenever possible the suture and/or the knot buried.

Complete Excision of Abnormal Tissues

Whenever possible all diseased and necrotic tissues must be excised. For example, in the case of endometriosis it is preferable to remove or ablate all of the lesions. In the case of tubal abortion it is necessary to remove all of the blood, clots, and especially the gestational tissues out of the peritoneal cavity and perform a thorough lavage.

Precise Alignment and Approximation of Tissue Planes

Segments of organs requiring anastomosis must be aligned properly to maintain optimal function. In the case of a tubal or bowel anastomosis it is preferable to approximate the muscular and serosal layers separately.

Adhesiolysis

As a general rule, filmy adhesions are usually avascular and are amenable to sharp dissection. Dense adhesions tend to be vascular but will often have avascular areas that can be used to gain access to the tissue layers to identify and occlude their major blood vessels. Lysis of cohesive adhesions will necessitate development of a dissection plane by sharp and blunt dissection and hydrodissection. Very fibrous and extremely cohesive adhesions, usually secondary to previous pelvic surgery or repeated severe infections, may not be amenable to laparoscopic dissection.

The performance of safe adhesiolysis requires the observation of the following measures: Dissection should always commence in well exposed areas. Each adhesive layer must be clearly identified, grasped, and retracted to achieve optimal exposure. It is essential to recognize what lies behind the adhesion before dissection begins. Transection must be carried out parallel to the organ of interest. Adhesions must be divided one layer at a time. Shallow adhesions are simply transected. Broad adhesions are excised by dividing them both along the organ of interest and at their distal attachments and removed from the peritoneal cavity. Transection can be achieved mechanically using sharp scissors, electrosurgically, or with laser energy. Scissor division can be effected close to vital structures but sufficient distance must be maintained if electrosurgery or laser is being used. The instrument used for division must approach the tissue to be divided at a right angle. Vessels encountered along the transection line should be electrodesiccated prior to division. Filmy shallow adhesions are simply divided, occluding the infrequent blood vessel that will be encountered prior to division. Broad adhesions are divided at both ends and removed. When, as is often the case, these adhesions are multilayered, they should be divided one layer at a time. Hydrodissection is a simple way of developing these layers.

With cohesive adhesions it will be necessary to identify the proper dissection plane. This is achieved by placing a small incision between the two adherent structures and by developing a plane either by spreading the jaws of the scissors, by blunt dissection, or by hydrodissection. No thermal energy should be used in such cases.

Adhesions between loops of bowel are tethered at both ends to a particularly vulnerable structure. The cleavage planes should be developed by using hydrodissection and the adhesions divided at their midpoints using scissors to avoid any potential spread of electrical or laser energy to the bowel wall.

Once the adhesiolysis has been completed, copious lavage is performed and, unless the returning fluid is clear, the areas of division are examined to identify and deal with any residual bleeding points.

Pelvic Lavage

Thorough lavage of pelvic, and, when indicated, of the whole abdominal cavity, with a buffered irrigating solution (lactated Ringer's solution), is designed to remove from the peritoneal cavity substances such as blood, fibrin, lint, and other foreign bodies. A buffered irrigating solution is preferred over normal saline in order to remove the hydrogen ions which form during surgery and thereby return the pH of peritoneal fluid to physiologic condition. To suction all of the fluid out of the peritoneal cavity it is essential to place the patient in reverse Trendelenburg position; This applies to both laparotomy and laparoscopy.

When laparoscopic access is used for the procedure, underwater examination of the operative site may be performed. When the irrigation fluid remains clear, the pneumoperitoneum pressure is reduced and the regions inspected with the distal end of the laparoscope under the surface of the fluid. This permits prompt recognition of any small bleeding vessels, which can be desiccated with use of a microbipolar forceps.

Magnification

Magnification may be used when necessary or when performing microsurgical procedures. Magnification enables prompt identification of abnormal morphologic changes, recognition and avoidance of surgical injury and application of the preceding principles with the use of fine microsurgical instruments and suture materials.

Mode of Access

The microsurgical principles outlined above are applicable irrespective of the mode of access, be it abdominal, laparoscopic, or vaginal. Many procedures can be performed through any one of these access routes. The selection of the specific access is dependent upon the lesion, the procedure required, and the skill of the surgeon. The aim would be to select the access that will yield the best outcome for the patient.

Operating within a closed peritoneal cavity largely prevents desiccation of the peritoneal surfaces, especially if the insufflation gas has been moistened and warmed to body temperature. Working within a closed environment eliminates the need to use pads and prevents the introduction of foreign materials such as lint and talcum powder. Laparoscopy permits intraoperative irrigation for lavage and to expose bleeding vessels. Fine electrodes may also be used to achieve precise electrosurgical hemostasis. As in microsurgery, laparoscopic procedures are performed with a limited number of instruments. The laparoscope provides a degree of magnification that can be enhanced further by the monitor and special cameras. The laparoscope provides excellent coaxial illumination. The visibility can be enhanced by bringing the distal end of the scope close to the area of interest.

Abdominal Incision

Most reproductive surgical procedures can be performed through a small (mini-laparotomy) suprapubic transverse or vertical (if a midline or paramedian sear is present) incision. We have successfully used this approach since 1986. The length

of the incision is usually 5 to 6 cm, but is dependent upon the prior pelvic findings and especially the depth of the patient's subcutaneous adipose layer. The site of the proposed incision is infiltrated with a long-acting anesthetic agent such as 0.25% bupivacaine (Marcaine) solution. A transverse suprapubic incision is made and extended down to the fascia. The subcutaneous fat is dissected over the fascia, in the midline upward and downward. The fascia is then incised vertically in the midline. The recti muscles are separated in the midline, and the peritoneum incised vertically, with the incision curbed laterally at the lower end to avoid the bladder. The subcutaneous tissues are reinfiltrated with the same solution before closure of the skin incision. Thereafter, a bilateral inguinal nerve block is established. The small size of the incision, the lack of bowel manipulation along with gentle handling of tissues during the procedure, and the use of local anesthesia reduce postoperative discomfort and analgesia requirements. This approach permits prompt mobilization of the patient and discharge from the hospital within 24 hours. These patients return to normal activity almost as rapidly as those in whom the procedures were performed laparoscopically.

Further Reading

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