

ABDOMINAL INCISIONS IN INFANTS AND CHILDREN

A STUDY OF EVISCERATION*

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WHENEVER THE SUBJECT of abdominal surgery in infants is discussed, questions concerning the incidence and prevention of evisceration are almost invariably asked. We, therefore, feel that a report on the experience derived from a large series of abdominal operations in young subjects would be of value, particularly to the general surgeon, who may only infrequently be called upon to perform abdominal surgery in infants and small children. During the past 20 years, 8,319 major abdominal procedures were performed on children at this hospital; during this period, the incidence of evisceration progressively decreased. The factors which we found to contribute to the reduction in the incidence of wound disruption comprise the basis for this paper.

An ideal abdominal incision gives ready access to the viscus which is being treated, good exposure for performance of the operating procedure, and when closed, a strong and adequate repair of the abdominal wall. In infants and small children, it is often found that to obtain adequate exposure, incisions must be relatively longer than in adults. It is, therefore, particularly important in children to give proper consideration to the choice of the abdominal incision, and to close the defect meticulously if wound weakness and evisceration are to be avoided.

THE CHOICE OF INCISION

The choice of an incision depends upon two factors—the location within the abdominal cavity of the suspected disease process, and the extent of exposure estimated to be required for the treatment of the lesion. In general, the smaller the incision, and the greater the number of layers utilized in wound closure, the better is the healing of the wound and subsequent strength of the abdominal wall. The latter point concerning wound closure is particularly true if the layers of the abdominal wall are split in different directions, or are incised in such a way that when closed, they are not directly superimposed upon one another. Abdominal incisions may be gridiron, vertical, or transverse.

Gridiron Incision. When the diagnosis can be made with certainty for specific lesions, such as acute appendicitis or hypertrophic pyloric stenosis, muscle-splitting gridiron incisions are ideal. They fulfill the requirements as defined above, and their only limitation might be lack of exposure, which is seldom much of a disadvantage.

For the last ten years, it has been our practice in almost all cases of acute appendicitis to employ a right lower quadrant, McBurney, muscle-splitting incision. This approach to the appendix follows the technique of the classical incision,⁷ except that the opening is usually made a little higher than is customary for adults. This is done because the child's cecum often lies a little

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higher, and there is the further advantage that, when necessary, it is easier to make a lateral extension of the wound out above the crest of ileum. A skin incision which is almost transverse, follows the normal skin lines of tension and it heals with little tendency to spreading of the scar. If a more medial exposure is required, Weir's extension may be employed. This is done by dividing the anterior rectus sheath, retracting the rectus abdominis muscle medially, and incising the posterior sheath and peritoneum. If exposure is still inadequate, the incision may be lengthened by cutting across one or both rectus muscles, a step which is necessary only under the most unusual circumstances.

In congenital hypertrophic pyloric stenosis, a right subcostal muscle-splitting incision as described by Robertson⁹ has been found to be extremely satisfactory. The skin incision is made one fingerbreadth below and parallel to the right costal margin, extending from the outer border of the right rectus muscle laterally for a distance of about four centimeters. The muscle and fascial layers each are split in the direction of their fibers and the peritoneum is opened transversely. If the various muscle layers are defined cleanly and undermined before proceeding to the layer beneath, the extent of exposure is increased and the subsequent closure of the wound will be facilitated. Without difficulty the hypertrophied pylorus can be delivered out through this wound for the performance of a Ramstedt pyloromyotomy.

These muscle splitting gridiron incisions practically close by themselves when retractors are removed, and because of their overlapping layers, the fibers which run in different directions give exceedingly strong repair of the abdominal wall.

Vertical Incision. Vertical incisions have the advantage of being easily extended upwards or downwards, and can be made to give very great exposure. Their disadvantage is that they lie across the lines of

maximal abdominal tension, and their sutures are subjected to greater strain than is the case with a gridiron or a transverse incision. The most easily-made abdominal incision is a vertical, midline one, but in infants or children, such an opening should never be used. The factors which make it an easy incision to use—paucity of blood supply and fusion of the layers of the rectus sheath into one at the linea alba—contribute to its tendency to poor healing and to postoperative weakness.

For most intra-abdominal surgery (excluding appendectomy, pyloromyotomy, and some biliary explorations) we have long preferred to use a vertical, rectus incision, retracting the muscle belly laterally. The skin incision is made in such a position that it overlies the mid-portion of the rectus belly. The anterior rectus sheath is incised in the same line as the skin, and then with great care, the rectus muscle is separated from the medial portion of its sheath and is retracted laterally to expose the posterior sheath. The posterior sheath and peritoneum are then opened together, as far laterally as possible. In closing this wound, removing the retractor from the rectus muscle allows it to move over and cover the peritoneal suture line. The muscle belly is anchored medially to the linea alba, so that the muscular tissue is thereby interposed between the lines of closure of the anterior and posterior sheaths. While a vertical rectus-splitting incision provides a quicker, easier and more liberal exposure, its closure gives a much weaker repair of the wall because a solid muscle belly is not interposed between the suture lines in front of and behind it. It has been our experience that the time spent in mobilizing and gently retracting the rectus muscle laterally is quite worth while, and significantly decreases the incidence of wound complications. Only in simple operations such as gastrostomy, or transverse colostomy (which require but a very short wound) do we favor a rectus-splitting incision.

In vertical incisions, the rectus muscle should never be retracted medially (i.e. Battle incision), because in infants the gaps between the nerves supplying the rectus are so short that such mobilization of muscle to gain adequate exposure severs many nerves. When the latter occurs, subsequent weakness and herniation are apt to follow.

Transverse Incision. Transverse incisions, as advocated by Gurd²⁻⁵ and others, are being employed with increasing frequency by us, particularly in the performance of biliary exploration, splenectomy, and trans-abdominal removal of kidney tumors. For such procedures they give an admirable exposure. They can be extended easily across one or both rectus muscles when required. They have the further advantage that, when closed, the repair runs in the direction of, and not across, the line of greatest abdominal wall tension. Such incisions heal beautifully, and the skin scar shows little tendency to spreading. There is a slight disadvantage in that a longer time is required in closing such wounds.

For splenectomy, we have long used with great satisfaction a transverse incision just beneath the costal margin, carrying this medially to the lateral border of the rectus muscle. Only when removing the largest of spleens has it been necessary to divide the rectus.

In the treatment of patients who have intra-abdominal trauma, a transverse incision gives good exposure of both the spleen or liver; it is possible to extend either end of the wound so as to give maximum view of that organ which is damaged. Furthermore, if a kidney is found to be injured, the wound can be lengthened into the flank.

Flank Incision. A flank incision, running downward and forward, is utilized for all ureteral or kidney operations, excepting those for removal of a neoplasm of the kidney. (For embryomas of the kidney we have long advocated the use of a trans-

abdominal approach which provides a much wider opening than can be gained in the narrow space between the crest of ileum and lower edge of the costal cage.) Flank incisions extend from the costovertebral angle obliquely downward and forward to a point medial to the anterior superior iliac spine. The muscle layers are severed in this same line, care being taken not to injure the nerves. If required, the incision may be extended further downward and medially to expose a ureter in its entirety.

Thoraco-abdominal Incision. For lesions of the upper stomach or lower esophagus, extensive tumors of the upper abdomen, for certain diaphragmatic hernias beyond infancy, or in operations requiring wide exposure as establishment of spleno-renal vein anastomosis, a thoraco-abdominal incision is extremely useful. This incision is made obliquely through the lower chest wall in the line of the ninth or tenth intercostal space, running across the costal border into the abdomen as an oblique muscle cutting incision. Following splitting of a portion of the diaphragm and the insertion of a rib spreader into the wound, a very wide exposure is obtained.

Pfannenstiel's Incision. In those children or small babies in whom there is some doubt regarding the sex of the individual or the make-up of the internal reproductive organs, pelvic laparotomy can quickly provide accurate information unobtainable by other methods. For such explorations we have found that a Pfannenstiel incision is adequate for the exposure which is desired, gives a very strong closure, and an almost invisible scar. Skin approximation can be made with subcuticular silk stitches and the child can be discharged from the hospital within a day or two after operation.

CLOSURE OF ABDOMINAL INCISIONS

The closure of an abdominal wound may be an easy matter, or in the presence of distended loops of bowel it may be very

troublesome indeed. Great difficulty of closure is particularly encountered following reduction of a diaphragmatic hernia or repair of an omphalocele, since the abdominal cavity is small and may not be large enough to accommodate comfortably all the viscera which are replaced into it. However, in most cases, with deep anesthesia and with perseverance on the part of the surgeon, proper closure of the abdominal layers can be attained. The use of a thin moist piece of gauze placed over distended loops of bowel like a fish net is of great aid in pushing intestines back into the abdomen and allowing closure of the peritoneum. In all cases in which intestinal obstruction has been present, the use before and during operation of intestinal tube suction will significantly reduce intestinal distention and thereby facilitate repair of the abdominal parietes. In some cases it is necessary to puncture and deflate the intestine to get it back into the abdomen without too much trauma.

For closure of most abdominal wounds, we have generally used a continuous peritoneal suture of 000 chromic catgut, carried on an atraumatic needle; in infants below the age of three or four months, 4-0 chromic catgut may be safely employed. In all difficult closures, the use of interrupted sutures of 0000 silk* is of advantage. These silk stitches are all placed, and then are simultaneously drawn up by the assistant, to distribute the pull to all the strands and to partially bring the wound edges together, following which the surgeon ties each suture in turn. It is very important that the transversalis fascia (or the posterior rectus sheath) be included in the peritoneal suture to give strength to the thin peritoneum. Whenever possible, the peritoneal edges should be everted to minimize the formation of adhesions to the wound. The muscle and rectus fascia, as

well as the superficial abdominal fascia, are each closed in layers with interrupted sutures of 0000 silk.* Sutures of 00000 silk,† placed just under the corium, minimize subsequent spreading of the scar. Skin edges may be approximated by either interrupted or continuous 00000 silk† sutures. Stay (tension) sutures are never employed. The wound is dressed with a simple adhesive-tape bandage without the use of an abdominal binder.

Where drainage of the abdomen is necessary, a soft rubber "cigarette" drain is used. If there has been a gridiron incision for appendectomy, the drain can be brought directly out through this. When there has been any other type of incision, it is better to bring the drain out through a separate stab wound.

Unlike the adult, when bowel is exteriorized in infants or children for establishment of a colostomy or for a Mikulicz resection, it is essential that the peritoneum be sutured to the entire circumference of the bowel with interrupted silk sutures to prevent subsequent herniation of intestinal loops. The exteriorized bowel is also sutured to the skin with interrupted stitches to give quick sealing off of the wound. Both of these lines of suture give sufficient anchorage of the bowel to prevent its retraction. If these various sutures are accurately placed so that they do not pierce the mucosa, and if they are not tied too snugly, they will not give rise to a fecal fistula.

It is of the utmost importance in making and closing abdominal wounds in children that extreme care be taken in the handling of the delicate tissues. Blunt dissection, pulling, tearing, or too-forceful retraction must be avoided. Forceps must be used gently and sparingly. Hemostats must clamp the bleeding point alone, and must not in-

* Deknatel Surgical Silk USP Black Braided Size 0000.

* Deknatel Surgical Silk USP Black Braided Size 0000.

† Deknatel Surgical Silk USP Black Braided Size 00000.

clude a large piece of surrounding tissue. Sutures must be thin, and of the best material available. Stitches must be placed with small bites, and must not be tied too tightly, else pressure necrosis will supervene. Unless such meticulous surgical technic is employed, wound complications are very apt to occur.

FACTORS INFLUENCING WOUND HEALING

To assure proper wound healing, certain abnormal body states must not be allowed to occur postoperatively or, if present, must be corrected as quickly as possible. (1) Anemia must be prevented or rectified by blood transfusion. (2) Hypoproteinemia, as shown by Ravdin,⁸ discourages healing, and it is essential that such a state be alleviated by intravenous infusion of plasma, albumin, or blood, and also by the ingestion of food as soon as possible. (3) Chemical imbalance frequently results in edematous and boggy tissues, and wound healing is thereby deterred. Intravenous fluids administered judiciously will help correct imbalance, but they must not be given in amounts which produce or increase edema. In our experience, edema of a wound contributes more than any other single factor to wound disruption. Parenteral saline solutions are useful in correcting any sodium or chloride depletion, but are dangerous when given in excessive amounts because they will be retained in the tissues and give rise to edema. These precautions are particularly important in the immediate postoperative period when there is a normal retention of body fluid and sodium. The limitation of parenteral fluid and saline is also especially important when caring for infants and premature babies in whom a slight excess of fluid or salt can be disastrous because the kidneys do not have the capacity to rid the body of large amounts of extra fluid or electrolyte. (4) Administration of Vitamin C, as shown by Lanman and Ingalls,⁶ is highly desirable, particularly in cases

where malnourishment exists. (5) The prevention or reduction of intestinal distention by means of suction and intubation, and also by placing the patient in an atmosphere of high oxygen tension,¹ reduces strain on the abdominal wound and its sutures. (6) The proper use of chemotherapy and antibiotic agents helps prevent or minimize the danger of wound infection.

EVISGERATION

If evisceration is going to occur, it generally appears between the fourth and eighth postoperative days; on rare occasions we have seen it as early as the first day or as late as the fifteenth day. Evisceration is a catastrophe which requires immediate operative replacement of the organs back into the abdomen and a reclosure of the abdominal wound. The sudden appearance of serous fluid on an abdominal dressing must always be immediately investigated for the possibility of impending evisceration.

Treatment of Evisceration. When evisceration has occurred, exposed loops of bowel should be covered at once with sterile, warm, saline-soaked gauze pads, and a wide sterile binder wrapped around the trunk. Atropine, alone for infants, or combined with morphine in older children, should be immediately given in suitable dosage, and the patient taken to the operating room. The choice of anesthetic agent depends upon the child's condition. Ether is probably the safest in most cases, and gives good abdominal relaxation. For the very sick individual, cyclopropane might be preferable. Under sterile precautions, the dressing is removed, the viscera are held out of the way, and the skin of the abdominal wall is prepared with a mild antiseptic, such as aqueous Zephiran Chloride 1:1000 solution.* The exposed viscera are cleaned with warm saline and are then

* Winthrop-Stearn's, New York, New York.

returned to the abdominal cavity. Old suture materials should be removed and the wound edges freshened. Closure is best made with through-and-through sutures of heavy braided silk. These go through all layers, including peritoneum, and are later tied over short segments of rubber tubing to minimize their cutting into the skin. Because the individual layers of the abdominal wall are usually frayed and friable, it is generally impossible to close the wound in layers. However, in addition to the through-and-through sutures, it is helpful to place some interrupted stitches in the deeper parts of the wound, even though these do not accurately approximate individual layers. For the reapproximation of the skin edges, interrupted silk sutures are interspersed between the through-and-through sutures. Following operation, these children are usually extremely ill and require every available support to combat peritonitis and intestinal distention. They must have intestinal suction-decompression, oxygen tent, intensive chemotherapy, parenteral alimentation, etc. The skin sutures can be removed on the seventh or eight post-operative day, but the through-and-through sutures should be left untouched until the twelfth or fourteenth day.

STATISTICS ON EVISCERATION

At the Boston Children's Hospital during the period from 1931 through 1950, there were 8319 major abdominal procedures, exclusive of inguinal and umbilical herniorrhaphies. Amongst this large number of operations, wound evisceration occurred in 75 patients—an incidence of less than 1 per cent. Sixty-four of the patients were infants, while 11 were more than two years of age. The material is analyzed by five-year periods in the following table.

COMMENTS

Despite the ever-increasing volume of abdominal surgery being performed each

year in this hospital, there has been a striking decrease in the number of eviscerations in recent years. Furthermore, there has been a reduction in the mortality rates in patients who have had evisceration. These

TABLE I.—*Evisceration Data by Five-Year Periods.*

Five year Periods	Number of Intra-abdominal Operations	Number of Eviscerations	Incidence of Evisceration	Deaths in Evisceration Cases	Mortality in Evisceration Cases
1931 through 1935	1528	20	1.31%	11	55%
1936 through 1940	1877	31	1.65%	14	45%
1941 through 1945	2131	13	0.61%	6	46%
1946 through 1950	2783	11	0.39%	3	27%

favorable trends we ascribe to the following factors which we believe to be of fundamental importance:

1. The use of gridiron incisions for treatment of pyloric stenosis or acute appendicitis. Since the adoption of the subcostal gridiron incision in cases of pyloric stenosis, evisceration has not occurred in any case.
2. Whenever a vertical rectus incision is to be employed, the muscle belly should be retracted laterally, believing that the closure of such a wound gives strength which is greater than that attained in closure of a muscle-splitting wound.
3. Whenever bowel is brought through the abdominal wall for a colostomy, an ileostomy, or a Mikulicz resection, it must be anchored around its entire circumference to the peritoneum with interrupted silk sutures.
4. There must be continual emphasis on the employment of gentle, meticulous surgical technic in the handling of all surgical wounds.
5. The prevention of abdominal distention (in cases where it might be expected to occur) by continuous gastric suction.

6. The treatment of any existing abdominal distention by gastric intubation with suction (or in larger subjects, by passage and use of a Cantor intestinal suction tube) combined with the use of a tent containing a 90 to 95 per cent oxygen.

7. The liberal use (when indicated) of chemotherapy and antibiotic therapy to treat or prevent wound infection.

8. The better preoperative and postoperative care of infants and children, with particular attention being paid to the correction of anemia, hypoproteinemia, electrolyte imbalance and avitaminosis.

9. The prevention of edema by limiting administrations of parenteral fluids and electrolytes to proper amounts.

SUMMARY

During the period from 1931 through 1950, a total of 8,319 abdominal operations, exclusive of herniorrhaphies, were performed at the Children's Hospital of Boston. Experience and opinions gained in the use of certain abdominal incisions is presented. In 75 patients, evisceration occurred. In recent years, the incidence of evisceration has been markedly reduced to 0.39 per cent. The factors which are be-

lieved to contribute to this reduction form the substance of this report.

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