Polyglyconate (Maxon®) Versus Nylon Suture in Midline Abdominal Incision Closure: A Prospective Randomized Trial

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A prospective, randomized comparison of nylon versus polyglyconate (Maxon®) looped suture in running mass closure of midline abdominal incisions was conducted in 225 patients. In the nylon group, 91 patients were evaluable at 2-year follow-up; in the polyglyconate group, 80 patients were evaluable at follow-up. Eleven patients (4 nylon and 7 polyglyconate) developed a ventral hernia. Three of the nylon and none of the polyglyconate sutured patients had a dehiscence. There was no significant difference in the overall rate of ventral hernia and dehiscence between the two suture groups. Running mass closure of midline abdominal wounds yielded satisfactory results with both of the suture materials studied.

The decisions made by a surgeon when opening and closing an abdominal incision include the location and orientation of the wound, the type of suture material to be used, and the closure technique. Wound failure (dehiscence or ventral hernia) may result from an improper choice. For example, fascia commonly had been closed with chromic catgut until it was demonstrated that such closure results in a dehiscence rate of 10–15 per cent.1,2 The optimal choice of incision is not clear; the literature contains data purporting to support the superiority of several variants in wound location and orientation. Closure technique involves a choice of continuous versus interrupted suture, the size of the fascial bites, the length of the suture used, and mass versus layer closure. Continuous mass suture of abdominal wounds has been gaining popularity due to its simplicity and efficacy.3–5

The choices of suture include absorbable or nonabsorbable and monofilament or multifilament configurations. A disadvantage of nonabsorbable suture is its persistence as a potential source of suture sinus, pain, or “buttonhole hernia.”6,9 Theoretically, such events should not occur with an absorbable suture. However, there is concern that absorbable suture may not retain its strength long enough to allow adequate primary fascial healing. A higher rate of wound infection or suture sinus with multifilament, braided suture has been attributed to the persistence of bacteria in the interstices of the braid.10

Our objective in this study was to compare the outcome in vertical midline abdominal wounds having running mass closure with nonabsorbable monofilament nylon versus absorbable monofilament polyglyconate (Maxon®) suture.

Patients and Methods

The study was approved by the Medical College of Wisconsin Human Research Review Committee and conducted in our core teaching hospitals. Informed consent was obtained from all participating patients. Patients were eligible for the study if they were to have a laparotomy through a midline incision. Both elective and emergency cases were entered, encompassing both clean and clean-contaminated wound classes. Exclusion criteria were life expectancy less than 2 years, established peritonitis, and preexisting ventral hernia.

A vertical midline incision through the linea alba was used exclusively. For clean contaminated cases, an intravenous dose of prophylactic antibiotic (usually a cephalosporin) was given within 30 minutes of the skin incision. For an elective colon procedure, bowel lavage with oral polyethylene glycol was followed by oral antibiotic administration.11 When utilized, a drain or enterostomy exited from the abdomen via an incision separate from the vertical midline incision. The use of intraoperative antibiotic irrigation was not controlled. Patients were randomized to be closed with either 0-looped nylon (Ethilon®, Ethicon Inc, Somerville, New Jersey) or 0-looped polyglyconate (Maxon®, Davis & Geck, Inc, Danbury, Conn.) using...
a random number sequence kept in serial sealed envelopes that were opened by the circulating nurse in the operating room. Running mass closure was performed by Senior or Chief Residents (fourth or fifth year) incorporating both layers of the rectus sheath. The peritoneum was not separately closed. The technique of skin closure was chosen by the surgeon.

Early postoperative wound complications were recorded. The patients were then evaluated after 2 and 6 weeks, 6 and 12 months, and 2 years postoperatively. Follow-up evaluation for the presence or absence of a ventral hernia was performed by the surgeon or an investigator through physical examination and communication with the patient's physician. Rates of dehiscence and ventral hernia were compared using the Fisher exact test or the chi-square test; P value ≤ 0.05 was considered to indicate a significant difference.

Results

Of the 225 patients enrolled, 112 were randomized to nylon and 113 to polyglyconate closure. Twenty-one patients (18%) in the nylon group and 33 (28%) in the polyglyconate group were not evaluable at the 2-year anniversary (Table 1). Of these, 13 had been reoperated and 11 had died during this interval; the deaths and reoperations were not related to failure of incision closure, and there were no hernias in these patients (Table 1). Ninety-one patients in the nylon group and 80 patients in the polyglyconate group completed 2-year follow-up and were evaluable. The procedure status (elective versus emergency), wound class, and presence or absence of a colon procedure are recorded in Table 2 and were not different between the two groups.

There was no significant difference between the polyglyconate and nylon groups in the incidence of persistent wound pain (6 and 5 patients, respectively), wound infection (2 and 4), and suture sinus (0 and 1). Wound dehiscence occurred in three patients in the nylon and no patients in the polyglyconate groups (P > 0.05, no significant difference). Among the patients with dehiscence, one underwent an emergency operation for an incarcerated diaphragmatic hernia and had a gastric resection because of gastric necrosis. Fasciitis developed postoperatively, and dehiscence appeared on postoperative Day 10. Reclosure with polyglactin mesh was followed by a second dehiscence after 3 days, treated again by reclosure. An elective incisional herniorrhaphy with insertion of a prosthesis was performed 3 months later; the hernia repair was intact at follow-up examination. A second patient, a drug abuser, underwent an emergency cholecystectomy because of a neglected perforated gallbladder; dehiscence occurred on postoperative Day 7. A third patient, who had severe emphysema, underwent a right hemicolectomy for a perforated colon cancer. He had a dehiscence on postoperative Day 5, was resutured, and suffered dehiscence again on Day 11. Death due to respiratory failure occurred on postoperative Day 25.

Ventral hernia occurred in 4 and 7 patients in the nylon and polyglyconate groups, respectively (no significant difference). All of the patients who developed a ventral hernia had one or more of the characteristics that are recognized as risk factors for ventral hernia.12-14 Seven had obesity, four wound infection, five an emergency operation, eight were male, five were over the age of 65, and all had multiple concurrent medical diagnoses.

Discussion

In this prospective randomized comparison of nylon versus polyglyconate (Maxon®) looped suture used in running mass closure of midline incisions made for both elective and emergency abdominal operations, there was no significant difference in the overall rate of dehiscence and incisional hernia between the two suture groups. The rate of incisional hernia we report is comparable to that noted previously in other studies of vertical midline incisions.1,4,12,13,15 The occurrence of dehiscence in three patients in the nylon group, although not reaching significance in comparison with polyglyconate suture, is relatively high,12,16 but all followed emergency procedures performed in the face of gross wound contamination.

There has been some concern that the use of absorbable suture in a laparotomy incision would result in an excessive rate of ventral hernia.1,17,18 Studies in rabbits19 have shown that a sutured fascial incision has

<table>
<thead>
<tr>
<th>Suture</th>
<th>Excluded After Randomization*</th>
<th>Reoperated During Interval**</th>
<th>Death During Interval to Follow-up***</th>
<th>Lost; Unable to Contact</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nylon</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>Polyglyconate</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>7</td>
<td>33</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>13</td>
<td>11</td>
<td>17</td>
<td>54</td>
</tr>
</tbody>
</table>

* no operation or midline incision not used; ** no hernia at reoperation in any patient; *** no hernia at last contact in any patient.
TABLE 2. Operation Status, Wound Class, and Presence/Absence of a Colon Procedure in Patients who Completed Two-Year Follow-up

<table>
<thead>
<tr>
<th>Operation Status</th>
<th>Wound Class</th>
<th>Colon Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elective</td>
<td>Emergency</td>
</tr>
<tr>
<td>Nylon (n = 91)</td>
<td>69</td>
<td>22</td>
</tr>
<tr>
<td>Polyglyconate (n = 80)</td>
<td>61</td>
<td>19</td>
</tr>
<tr>
<td>Total (N = 171)</td>
<td>130</td>
<td>41</td>
</tr>
</tbody>
</table>

no measurable tensile strength in the first postoperative week. After 2 weeks, 20 per cent of the baseline tensile strength has been restored, increasing to 50 per cent after 1 month, 60–80 per cent after 2 months, and 90 per cent at 1 year. For comparison, the tensile strength half-life for various absorbable sutures is (package insert data): chronic catgut, 1 week; poliglecaprone (Monocryl®), 1 week; polyglactin (Vicryl®) and polyglycolic acid (Dexon®), 2–3 weeks; polyglyconate (Maxon®), 3–4 weeks; polydioxanone (PDS®) 4–5 weeks. Some nonabsorbable suture also loses tensile strength over time when implanted in tissues. A Silk has lost most of its tensile strength at 1 year; nylon (polyamide) loses 15–25 per cent per year; polypropylene (Prolene®) and polyethylene (Ethibond®) retain their strength indefinitely. Some authors have found no difference in wound failure between absorbable and nonabsorbable suture. Others have found that nonabsorbable suture is superior.

The use of polyglyconate suture in 285 patients undergoing a gynecologic procedure through a lower midline incision resulted in one incisional hernia and one dehiscence. A comparison of interrupted versus continuous closure with polyglyconate suture in another group of gynecologic patients could not demonstrate a difference in wound failure. In a randomized comparison of 84 morbidly obese patients undergoing gastroplasty through a midline incision, the use of continuous polyglycolic acid suture (Dexon®) resulted in fewer ventral hernias than did continuous polyglyconate (Maxon®) suture. A randomized study of polyglyconate against nylon in 167 patients (incision type not controlled) reported that the hernia rate after 1 year (6%) was equivalent between the two suture types. In two randomized studies comparing running polyglyconate (Maxon®) to interrupted polyglactin (Vicryl®) suture, dehiscence and ventral hernia rates were equivalent.

The technique of wound closure is of importance in prevention of both dehiscence and incisional hernia. There is no benefit conferred by separately closing the peritoneal layer. Running mass closure seems to offer an advantage over interrupted layered closure in preventing dehiscence. If the ratio of suture length/wound length in running closure is kept above 4:1, there is significantly less wound failure. Maintaining a 4:1 ratio ensures that wide bites of the fascia are taken, which reduces the occurrence of fascial pressure necrosis and fascial tearing by the suture. Wide fascial bites that go well beyond the linea alba and traverse both layers of the rectus sheath result in significantly greater bursting strength compared to a wound in which sutures have been placed only in the linea alba. A suture to wound length ratio of 4:1 also allows for incisional lengthening, which can be as much as 30 per cent in a midline wound during abdominal distension. If an incision is sutured with a suture to wound length ratio of only 2:1, and the incision lengthens 30 per cent, there is a tendency for the suture to cut through tissue.

The results of this present study, and of multiple other studies in the literature, support a conclusion that incisional wound failure is not primarily dependent on the suture material used (catgut excepted). Careful suture closure technique (especially wide fascial bites), prevention of wound sepsis, and attention to patient-related risk factors are more important in preventing dehiscence and incisional hernia. Running mass closure of midline abdominal wounds has yielded satisfactory results and an acceptably low incidence of dehiscence and hernia in our experience.

REFERENCES

5. Montz FJ, Creasman WT, Eddy G, DiSaia PJ. Running mass...


