

Does mass closure of midline laparotomies stand the test of time?

A random control clinical trial

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Summary

We compared the incidence of wound failure (burst abdomen and incisional herniation up to 4 years after operation) in a consecutive series of 282 major laparotomies closed with continuous monofilament nylon, and randomly allocated to mass (all layers except skin) or layered (anterior and posterior aponeuroses separately sutured) techniques. Surgeons were free to choose the site and direction of incision which resulted in a preponderance of midline incisions in the mass, and of paramedian incisions in the layered, group. One patient in the former, and two in the latter, burst their abdomens during early convalescence, and 17 incisional hernias were discovered within four years in the mass group compared with four in the layered group (log rank X^2 7.16, $P < 0.01$). Seven hernias in the former, and one in the latter, group were not detected within eight months of operation.

We conclude that layered closure of a paramedian incision results in a lower incidence of incisional hernias than mass closure of a midline incision and that many hernias are not discovered until years after operation.

Introduction

Since 1971 every major laparotomy in this unit has been prospectively studied in a series of random control clinical trials of methods of incision and closure of the abdominal wall (1-6). We established early on that catgut was an unsatisfactory material (1) even when using a mass technique taking wide bites of tissue with a Moynihan hand-held needle. We were, however, satisfied that both interrupted and continuous suturing with monofilament nylon or steel or polyglycolic acid resulted in a low incidence of burst abdomen. On the other hand, within six months of operation we detected incisional hernias in as many as 10% of survivors.

In an attempt to overcome the problem of incisional herniation—and bearing in mind that these hernias may not be detected within the first few months after operation (7,8)—we decided to test in a long-term follow-up study what had by then become our standard method (mass

closure with continuous nylon) against the layered closure which gave such good results in Jenkins' hands (9).

Patients and methods

SAMPLE DEFINITION

Between January 1980 and May 1981, 282 consecutive patients who were admitted under the care of one consultant surgeon and who accepted elective or emergency major laparotomy were randomized to one or other of the closure regimens detailed below.

Exclusions Grid-iron incisions, Pfannenstiel incisions for exposure of the bladder, incisions for exposure of the kidneys and operations through, or for the repair of, hernias were excluded.

Definition of regimens The control method of closure of the abdominal wall was by a continuous suture of 1 BPC monofilament nylon taking wide bites at one centimetre intervals and embracing all layers of the abdominal wall except skin. The test regimen differed in that the posterior rectus sheath was closed separately by a 0 BPC polyglycolic acid suture and the anterior rectus sheath by continuous 1 BPC monofilament nylon. The surgeon was free to choose the site and direction of incision.

Definition of risk factors The following known or suspected risk factors for poor wound healing were recorded: age, sex, malignancy, preoperative haematological and/or biochemical abnormalities, preoperative bronchopulmonary disease, obesity (defined as a thickness of subcutaneous fat at the site of incision of 2.5 cm or more), uraemia, jaundice, diabetes, perioperative blood transfusion, status of surgeon operating and degree of operative bacterial contamination of the wound.

Investigations During each operation we measured with a sterile ruler the length of the wound and the length of nylon used and counted the number of sutures inserted; the length of nylon divided by the number of sutures gave a figure (which was ideally between four and five centimetres) which reflected the mean depth of bite of the sutures. During all operations swabs were taken from incised viscera or peritoneum and, at the end of each operation, from the subcuta-

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neous tissue before skin closure. Wounds were then classified according to the results of the microbiological cultures into clean, potentially contaminated, lightly contaminated and heavily contaminated (10). Total blood loss was recorded by swab-weighing and by measurement of the contents of suction bottles.

Patients were closely observed whilst in hospital and were examined again 1 month, and about 6 months, after operation. Two to four years later we contacted all surviving patients and arranged a series of clinics to assess the strength of their scars. The assessment was made in all cases by the senior author, except in the case of a few patients who lived too far away to attend. These we contacted by letter or telephone.

Definitions of end points Defective wound healing manifests itself in three ways: early total dehiscence (burst abdomen), wound infection and, at a variable time after operation, the appearance of an incisional hernia. We have accepted the standard definition of burst abdomen (protrusion of abdominal viscera through the wound) and of wound infection (the presence of pus in the wound). We defined incisional herniation as a visible bulge when the patient, standing up, coughed, together with a sharp-margined defect in the abdominal wall at the site of the scar. Most of the incisional hernias which we found were not recognised by patients.

Although most incisional hernias are discovered within 6 months of operation, some only become apparent years later so we did not make a final assessment of the incidence of incisional herniation until 2 to 4 years after we had closed the trial.

Recording of additional treatments Pre-, per- and postoperative antibiotic prescriptions were recorded. All patients received an intravenous bolus injection of 1 g cephaloridine or 1.5 g cefuroxime at induction of anaesthesia. We have previously shown that these two antibiotics do not differ appreciably in their ability to prevent wound infection.

Recording of side effects Late wound pain and stitch sinuses were recorded.

Statistical analysis We used 3 statistical tests, accepting $P < 0.05$ as significant in each case: log rank chi-square test of proportions of events in life tables (11), Fisher's exact test and Student's 't' test, as appropriate.

Results

One hundred and thirty-five patients were randomised to have the abdominal wall closed in layers, and 147 en masse. When the instructions were for layered closure surgeons usually chose to perform either a vertical paramedian (101) or a transverse/oblique (27) incision. On only 7 occasions was a midline incision chosen. On the other hand, when the instructions were for mass closure, the preference was for either a vertical midline (89) or a transverse/oblique (43) incision. On only 15 occasions was a paramedian incision used. We have, therefore, analysed the results of the series not only in terms of the randomised closure, but also in terms of the incision used.

WITHDRAWALS

None of the 7 midline incisions closed in layers, nor of the 15 paramedian incisions closed en masse, suffered either burst abdomen or incisional herniation and these patients are not further considered. In addition to these 22, 54 patients died or had their incisions reopened within six months without having developed a hernia and were also withdrawn from analysis, as our first assessment of incisional herniation was between five and eight months. Thirty-seven patients in the layered, and 39 in the mass, group were consequently withdrawn, leaving 98 layered and 108 mass closures for assessment of early incisional herniation. Thirty-nine patients whose incisions were sound at this time could not be assessed for the full 2 to 4 years, 27 because they had died, 11 because they were lost to follow-up and 1 because the incision had been re-opened.

COMPARABILITY OF THE GROUPS

The randomization produced an acceptable balance of risk factors. A table of comparability is available from the authors. There was an excess of patients in whom parietal bacterial contamination was detected at operation in the mass group (55 out of 147, 37%) compared with the layered group (39 out of 135, 29%). This arose by chance, and is reflected in the higher overall wound infection rate (33 out of 147, 22%, compared with 24 out of 135, 18%).

BURST ABDOMENS

One abdomen burst after being sutured by the mass technique in a 67-year-old man whose gall bladder was removed through an oblique muscle-cutting incision. When the abdominal wall was resutured the nylon was found to have been cut near the finishing knot; this was confirmed by scanning electron microscopy. Two paramedian incisions sutured in layers in men of 63 and 68 respectively burst because the nylon had torn through one edge of the aponeurosis. The length of nylon per stitch in these 2 cases was inadequate (1.6 and 2.1 cm respectively). These 3 patients survived resuture (by the mass technique) and did not subsequently develop incisional hernias.

INCISIONAL HERNIAS

At first follow-up (between 5 and 8 months) 10 incisional hernias were found in the 108 evaluable patients in the mass group and 3 of the 98 in the layered group. Seven further hernias were discovered between 6 months and 4 years after operation in the mass group and one in the layered group. Because of the variable time between operation and the discovery of incisional hernias we present these results in the form of a life table; log rank chi-square equivalent 7.16, $P < 0.01$ (Fig. 1).

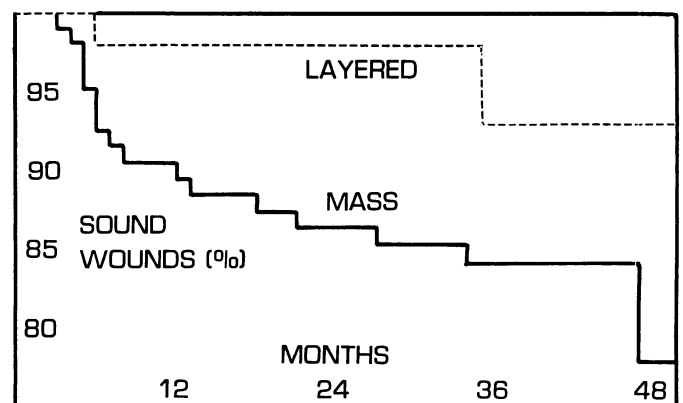


FIG. 1 Life table comparison of the incidence of incisional hernias after mass and layered closure of the abdominal wall.

We then analysed the influence of method of incision on the incidence of hernias. Twelve incisional hernias occurred in the midline, and 3 in the paramedian, group; log rank chi-square equivalent 6.52, $P < 0.02$ (Fig. 2).

In 43 operations in which the surgeon was instructed to close with a mass suture, and in 27 in which the closure instructions were 'layered', the surgeon elected to make transverse/oblique muscle-cutting incisions. In the mass group five incisional hernias were found within 4 years. In the layered group, 1 incisional hernia was found at 37 months (log rank chi-square equivalent 1.85, $0.10 < P < 0.20$).

There were 28 wound infections in the mass, and 15 in the layered, group. Incisional hernias occurred in 9 of the 28 (32.1%) compared with 1 of the 15 (6.7%); Fisher's exact test $P = 0.122$. Of the uninfected wounds, eight of 92 (8.7%) in the mass group developed incisional hernias compared with three of 88 (3.4%) in the layered group; Fisher's exact test $P = 0.213$.

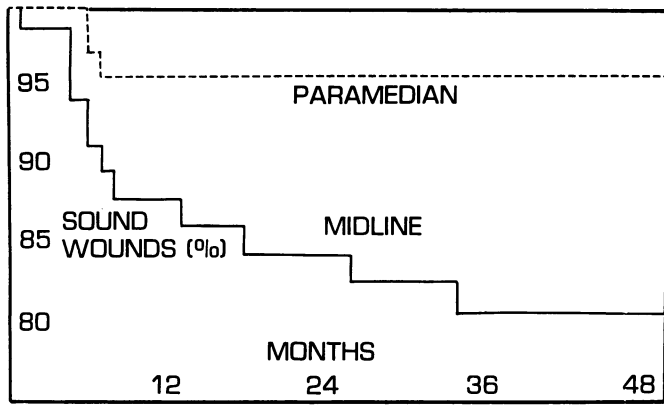


FIG. 2 Life table comparison of the incidence of incisional hernias after midline and paramedian laparotomy incisions.

Less nylon was used in layered closures than in mass, but no significant difference in length of suture material per stitch was found between those patients whose abdominal walls were found to be strong at late follow-up and those who developed incisional hernias. The data were normally distributed, the mean length (\pm s.d.) of nylon per stitch in the mass group being 4.8 ± 1.3 and in the layered group 2.6 ± 1.1 . The difference is highly significant ($t = 8.37$, $P < 0.001$).

WOUND PAIN AND SINUSES

Knots of nylon were removed from 4 patients closed en masse and from 3 of those closed in layers; 2 from each group were for stitch sinuses and the rest for wound pain.

Discussion

Late discovery of incisional hernias is well-known (7, 8) and we have confirmed this in the present trial. We used the expression 'late discovery' rather than late development because our experience of the movement of metal clips placed on the apposed aponeurotic edges at the time of closure (12) suggests that when clips are shown on x-ray to be together 1 month after operation they do not subsequently separate and the wound does not herniate, and that when early postoperative x-rays show clip separation an incisional hernia may not be found until months or years later.

The main causes of incisional herniation are technical inadequacy and wound infection. Our results confirm the influence of the latter, the total incidence in wounds which had been infected being 23.3% compared with 6.1% when no infection had occurred. In both infected and uninfected wounds, mass closure was associated with more incisional hernias than layered.

Because of the preponderance of midline incisions in the mass group and of paramedian incisions in the layered group, we are not in a position to place all the blame for incisional herniation on the method of suture. What we have shown is that midline incisions closed en masse are more likely to herniate than paramedian incisions closed in layers.

In an audit (admittedly not of consecutive patients) Donaldson and his colleagues (13) found a gratifyingly low incidence of both burst abdomen and incisional herniation in patients whose 'lateral' paramedian incisions were closed in layers. This incision differs from the paramedian incision which resulted in 2 burst abdomens in the present series, in that a wider buttress of rectus muscle appears to safeguard the wound from dehiscence, whereas the layered closure secures it against late herniation. We have put the lateral paramedian incision to the test of a random control clinical trial jointly with the Professorial Surgical Unit at the Westminster Hospital. The results of this trial will be published in due course.

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