PAPERS AND SHORT REPORTS

Burst abdomen and incisional hernia: a prospective study of 1129 major laparotomies

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Abstract

Burst abdomen and incisional herniation are continuing problems for the general surgeon. A prospective study was carried out to define the extent of the problem. Over five years from 1975 to 1980 a total of 1129 major laparotomy wounds in adults were assessed at regular intervals for 12 months after operation. There were 19 burst abdomens (1.7%) and 84 incisional hernias (7.4%). The introduction of the mass-closure technique reduced the incidence of burst abdomen from over 3% in 1975 to 0.95% in 1979. It did not, however, improve the rate for incisional hernias, which was 7.6% in 1979. Many factors are associated with incisional herniation: old age, male sex, obesity, bowel surgery, type of suture, chest infection, abdominal distension, and, most important, wound infection.

More work is needed to find the ideal method of wound closure, and efforts should be made to eliminate wound infection.

Introduction

The ideal method of abdominal wound closure has not been discovered. The ideal method should be technically so simple that the results are as good in the hands of the trainee as in those of the surgical master; it should be free from the complications of burst abdomen, incisional hernia, and persistent sinuses; it should be comfortable to the patient; and it should leave a reasonably aesthetic scar.

Since 1975 we have been engaged in a series of trials of different techniques of closure of abdominal incisions,¹⁻³ and we report here the results of a five-year study of 1129 laparotomy wounds. We investigated two different suture materials (monofilament nylon and polyglycolic acid) but have not repeated the

work of Goligher,⁴ who showed that the exclusive use of catgut was associated with an 11% incidence of dehiscence. We attempted to elucidate the factors responsible for wound failure, especially those of incisional herniation, to enable us to improve the outcome.

Methods

During the five years from 1975 to 1980 all adults undergoing major laparotomy in the professorial surgical unit at Westminster Hospital were carefully documented and followed up at intervals for 12 months after operation. Operations through oblique muscle split incisions (chiefly for appendicectomy) were excluded, and a total of 1129 patients were entered into the trial. From 1977 wounds were closed by a mass-suturing technique; before then incisions had been sutured in layers with catgut for peritoneum and nylon for rectus sheath or sutured with single-layer nylon to the rectus sheath alone.

The mass-closure technique consists of picking up all layers of the abdominal wall apart from skin and subcutaneous fat. Care is taken to take wide bites of the rectus sheath, at least 1 cm from the edge of the incision, and a hand-held $\frac{5}{8}$ cutting needle is used. The skin is sutured with fine interrupted nylon; deep tension sutures are not used. Drains, when used, are inserted through a stab wound away from the incision, and a colostomy or ileostomy, when performed, is always fashioned through a separate incision.

Age, weight, body build, site and type of incision, preoperative and postoperative complications, and the bacteriological findings in the wound and of any postoperative wound exudates were recorded, together with the status of the surgeon who performed the wound closure.

The patients were reviewed at one, three, six, and 12 months, when the presence of any infection or wound herniation was carefully recorded. Postmortem examinations were carried out on most patients dying in the early postoperative period; this included a careful study of the abdominal wound both with the naked eye and histologically.

Results

All patients were followed up either until death or for at least 12 months after operation. There were 19 (1.7%) burst abdomens and 84 (7.4%) incisional hernias.

Before 1977 341 layered closures were performed and there were 13 burst abdomens (3.8%). After 1977, however, mass closure was used, and in 788 patients there were only six burst abdomens (0.8%)

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($p < 0.01$, χ^2). Rates of incisional herniation were similar for both groups; 23 (6.7%) in the layered group and 61 (7.7%) in the mass-closure group. These differences were not statistically significant.

The mass-closure group, however, included 104 patients whose wounds were closed with absorbable polyglycolic acid, and among these patients there were 12 hernias (11.5%)—a significantly higher proportion than in those in the mass-closure group in whom nylon was used ($p < 0.05$). Wound herniation was commoner in the elderly ($p < 0.001$), in men ($p < 0.0001$), and in obese patients ($p < 0.0001$) (see table). Patients undergoing bowel surgery were more prone to herniation ($p < 0.01$), as were patients with incisions greater than 18 cm ($p < 0.001$); both factors were significantly related to the rate of wound infection.

Incidence of wound herniation related to some suggested causal factors. Values are numbers of patients

Factor	All patients (n = 1129)	Patients who developed hernias (n = 84)	χ^2 test
Patients:			
Mean age (years)	46.1	58.2	p < 0.001
Men	510	62	p < 0.0001
Obesity	200	30	p < 0.0001
Taking steroids	20	1	NS
Jaundiced	45	3	NS
Incision:			
Midline	544	48	} NS
Paramedian	558	35	
Transverse	27	1	
Length > 18 cm*	155/419	31/36	p < 0.001
Suture:			
Mass (nylon)	684	49	NS
Mass (polyglycolic acid)	104	12	p < 0.05
Two layer (catgut/nylon)	177	9	} NS
One layer (nylon)	164	14	
Surgeon:			
Consultant:	424	18	} p < 0.005
Senior registrar	471	47	
Registrar	207	19	
Operation:			
Local antiseptic	867	63	NS
Drain	548	44	NS
Bowel surgery	378	43	p < 0.01
Malignancy	258	13	NS
Emergency	184	14	NS
Postoperative complications:			
Chest infection	195	32	p < 0.0001
Abdominal distension	148	24	p < 0.0005
Wound infection	179	41	p < 0.00001

* Measuring commenced 1978.
NS = Not significant.

There was no significant difference related to the type of incision used, but when the wound was closed by a consultant there was less chance of eventual herniation. The higher incidence of herniation caused by senior registrars was confined to two senior registrars, both of whom had high incidence of herniation, and a defective closure technique was therefore implicated.

Postoperative complications, particularly chest infection ($p < 0.0001$), abdominal distension ($p < 0.0005$), and wound infection ($p < 0.00001$), were the most significant factors associated with herniation. These factors tended to occur in combination.

Most hernias had appeared by three months after operation; 18 were found at one month and a further 30 at three months. Four patients may have had hernias at three months but were not seen at follow-up until six months after operation. A total of 20 new hernias were noted at six months, 15 at 12 months, and one after 12 months.

Discussion

Our study has shown that the mass-closure technique for abdominal wounds results in a lower incidence of burst abdomens than a layer technique. Though this freedom from wound dehiscence is encouraging, the incidence of incisional herniation has remained high. We have shown that wound failure is associated with several other causal factors, most notably post-operative complications such as chest infection, abdominal distension, and wound infection, most of which occurred in combination.

Recent papers on abdominal dehiscence have given an incidence of 0 to 3%.⁵⁻⁷ Figures on incisional hernias are less easy to find, but Blomstedt and Welin-Berger⁸ reported a 10% incidence after 279 cholecystectomies. Catgut as the only suture material is associated with an unacceptably high rate of wound failure: in 1975⁴ Goligher reported 11 bursts in 100 paramedian incisions closed with catgut. The reason for this high incidence of dehiscence is that catgut does not retain its tensile strength longer than 10 days and this is not long enough for the linea alba or rectus sheath to heal strongly. The logical answer is therefore to support the incision for a longer time. Norris⁹ advocated non-absorbable retention sutures placed through all layers at an optimum distance from the wound margins to ensure their holding power.

Jones *et al* first reported the use of an interrupted mass far-and-near suture technique in 1941¹⁰ and had only one burst abdomen in 81 operations after steel closure. Dudley¹¹ and Jenkins¹² have put forward theoretical arguments supporting this technique, and it has performed well in practical tests. In 1976¹³ Goligher reported one burst abdomen and no hernias after 108 paramedian elective laparotomies using interrupted 28-gauge stainless steel wire sutures; similar satisfactory results have been reported by other workers,^{14 15} and Jenkins¹² recorded only one burst abdomen in 1505 closures with this technique. These methods have resulted in the virtual disappearance of burst abdomens, and this alarming and dangerous complication, associated with a mortality of over 35%,⁵ should now be rare, with an incidence below 1%.

The incidence of late incisional herniation, however, has remained high. Using monofilament nylon we decreased the incidence in our series to 3.8% in 1979. Polyglycolic acid sutures, despite previous satisfactory reports,^{16 17} resulted in our series in a herniation rate of 11.5%, similar to the 11% reported by Pollock,⁶ which is unacceptably high. Most of these wound failures occurred within the first three months and possibly result from the disappearance of the suture material before sufficient collagen has been laid down to restore intrinsic tensile strength. Polyglycolic acid loses over 90% of its strength within three weeks,¹⁸ whereas the abdominal wall fascia requires about 120 days to regain its strength.¹⁹ The use of synthetic absorbable materials for abdominal wall closure therefore requires careful monitoring. In most circumstances this strength is sufficient to hold the fascia together, but with delayed healing due to infection²⁰ or raised intra-abdominal pressure due to postoperative chest infection or abdominal distension the strength of the wound without suture support may be insufficient, leading to the formation of an incisional hernia.

Choice of suture and technique of closure are therefore important predisposing factors to wound failure. Other factors, however, particularly postoperative wound infection, have been implicated. Mechanical stress due to increased intra-abdominal pressure caused by cough and abdominal distension emerged as another outstanding predisposing factor in this series, supporting the findings of previous workers.^{21 22}

The part played by wound sepsis is important as this is the major avoidable cause of wound failure. Forty-eight per cent of patients with incisional hernias had had a wound infection. In 1974 Fischer and Turner²³ found that 88% of patients with incisional hernias requiring repair had had a wound infection, and Pollock,⁶ reporting on a trial of single-layer mass closure in 1979, concluded that the incidence of incisional hernias would be reduced by the elimination of wound sepsis.

Numerous other factors have been held responsible for wound failure, and reports are conflicting. We found a significant association between increasing age and formation of hernias. This was noted by Blomstedt and Welin-Berger in their study in 1972⁷ but did not attain significance. The incidence of wound herniation in men was three times that in women, corroborating the reports of previous workers.^{5 22 24} Obesity, exonerated by Baggish and Lee in 1975,²⁵ was a significant predisposing factor in our study, thus confirming the study by Pitkin in 1976,²⁶ who noted a tenfold increase in deep wound separation in the obese

compared with normal-sized women undergoing hysterectomy. Irvin *et al* in 1976⁵ found a higher incidence of wound failure in the hands of surgeons in training and this appears to be the case in our series.

Lehman *et al*²⁷ and Ellis and Heddle,² as well as other writers, point out that often several factors cause wound failure and we have confirmed this.

Though mass closure with nylon has considerably reduced the incidence of burst abdomen in this unit, there is still an appreciable incidence of incisional hernia. Admittedly, many of these hernias are small and unnoticed by the patient but, nevertheless, they do represent failures of technique. We must emphasise that these results were obtained in a general surgical unit, included a wide variety of cases (including emergencies and reopening of previous laparotomy wounds), and the operations were performed by all grades of surgeons, including juniors in training. More work is obviously needed before the ideal method, or methods, of wound closure can be defined. Wound infection remains the most important factor associated with wound failure, and efforts must continue to eliminate this serious complication.

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Neonatal screening for sickle haemoglobinopathies in Birmingham

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Abstract

During 1978-81 there were about 43 500 births in Birmingham, of which 10.3% were to Negroes and 22.6% to Asians. Cellulose acetate electrophoresis of red cell haemolysates from capillary specimens collected for phenylketonuria screening was performed for these babies to assess the feasibility, cost, and benefits of detecting sickle haemoglobinopathies early.

Eight babies had important haemoglobinopathies; four were homozygotes for haemoglobin S (HbS), three were mixed heterozygotes for HbS and haemoglobin C (HbC), and one had haemoglobin E (HbE) and β -thalassaemia. Also, 534 (1.19%) were heterozygotes for HbS or haemoglobin D (HbD) and 205 (0.46%) for HbC or HbE, 453 (1.01%) were heterozygotes with a fast-moving band, one was a heterozygote for haemoglobin Norfolk, and one

a heterozygote for both HbS and haemoglobin G Philadelphia.

The cost of neonatal screening for haemoglobinopathies was 12.5p per baby (£705 for each serious abnormality).

Introduction

Many studies have shown the incidence and geographical distribution of haemoglobinopathies.¹⁻² In populations where sickle haemoglobinopathies are a major health problem early detection may allow genetic counselling of heterozygotes and prevent complications and sudden death in homozygotes.³⁻⁴ Neonatal screening is not, however, a worthwhile procedure in populations with a low incidence of haemoglobinopathies.⁵ In a survey of immigrant schoolchildren (60% Negroes, 40% Asians) in Birmingham⁶ 8.4% had a haemoglobin abnormality, the most frequent being haemoglobin S (HbS) (4.7%). The gene frequencies of haemoglobin S and C (HbC) in Negro children were approximately 8% and 3% respectively and of haemoglobins D (HbD) and E (HbE) in Asians 1.4% and 0.5% respectively.

During 1978-81 births in the City of Birmingham rose from 13 599 to 15 324 a year of which about 10.3% were of Negro

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