Gut, 1978, **19**, 729-734

Factors which influenced postoperative complications in patients with ulcerative colitis or Crohn's disease of the colon on corticosteroids

J. R. ALLSOP AND EMANOEL C. G. LEE

From the Department of Surgery, Massachusetts General Hospital, Boston, USA, and the Gastroenterology Unit, Radcliffe Infirmary, Oxford

SUMMARY A retrospective analysis was undertaken of the records of 107 patients with Crohn's disease of the colon or with ulcerative colitis who underwent 162 operations under steroid cover. The study revealed no correlation between steroid dosage and postoperative morbidity or mortality. The incidence of wound dehiscence and incisional hernia compared favourably with the reports of other unselected series of similar patients. Contamination did significantly influence results. Septic complications were more frequent when the operative field was contaminated and both delayed wound healing and mortality were related to this sepsis. A 'clean and dirty' technique was effective in controlling contamination during elective bowel division but preoperative bowel perforation and accidental entry into the lumen of the bowel during dissection were potentially avoidable sources of contamination. Primary healing of the perineal wound after proctocolectomy was seldom achieved in contaminated patients where a drain tube was brought out through the main perineal incision. When perineal sinuses or fistulae followed a proctocolectomy, patients with Crohn's disease had a significantly slower rate of healing than did patients with ulcerative colitis. However, there was no difference in the healing of abdominal wounds in relation to the primary pathology. Even abdominal incisions which were used on more than one occasion healed as well as those which were used for the first time. A prophylactic antibiotic regime of either ampicillin or tetracycline offered little protection against postoperative sepsis. The organisms which caused such infections were often insensitive to the two antibiotics.

Corticosteroids are employed widely and often successfully to treat acute attacks of ulcerative colitis. They are also effective in improving the symptoms of patients with Crohn's disease of the colon, but in both diseases their use is often considered to be a major disadvantage if surgery becomes necessary, because they may increase the patients' susceptibility to infection (Fuenfer *et al.*, 1973); they may retard healing (Erlich *et al.*, 1973); and they may be the cause of other serious complications such as peptic ulceration (Glenn and Grafe, 1967). This paper reports the incidence and cause of such post-operative complications in a group of 107 patients who had surgery for ulcerative or Crohn's colitis under corticosteroid cover between January 1969 and December 1974.

Received for publication 2 March 1978

Methods

SUBJECTS

A retrospective study of the case notes of colitic patients who were treated surgically in Oxford during this time was undertaken. If the following criteria were met:

1. The primary diagnosis was ulcerative colitis or Crohn's colitis.

2. Prednisolone in a dose of 20 mg or more per day was administered during the operation and had been continued for at least five days postoperatively.

3. All patients had undergone a single stage proctocolectomy, or split ileostomy.

4. A standard technique had been employed for each operation and the preoperative preparation and postoperative management had been standardised.

Some of the patients had undergone more than one operation, and subsequent abdominal operations in

these patients were also analysed provided that steroids had again been administered. Table 1 sets out the 162 operations in the 107 patients accepted on these criteria. Variations of operative technique were minimal. The following points of surgical technique were employed.

Table 1 *Diagnoses and operations performed*

	Number of patients	*Panprocto-colectomy*	*Split ileos-tomy*	*Closure ileos-tomy*	*Other*	*Total operations*
Ulcerative colitis	56	48	18	3	4	73
Crohn's disease	51	15	46	19	9	89
Total	107	63	64	22	13	162

SURGICAL TECHNIQUE

One-hundred-and-fifty-nine of the 162 abdominal incisions were of the standard paramedian type, and these were closed in the following manner. The peritoneum and posterior rectus sheath was repaired with a continuous suture of chromic catgut with interrupted locking stitches of the same material inserted every 8 to 10 cm. A continuous monofilament nylon stitch was used for the anterior rectus sheath. When there was a deep layer of subcutaneous fat it was approximated with chromic catgut. The skin was closed with interrupted black silk sutures. In addition, in 14% of the patients, monofilament nylon tension sutures were inserted through all layers of the abdominal wall except the posterior sheath and peritoneum.

Closure of the perineal wound after a proctocolectomy always involved approximation of the levators with interrupted chromic catgut sutures and repair of the pelvic peritoneum with continuous chromic catgut. It was always possible to obtain this closure without tension because a technique of perimuscular rectal excision was used (Lee and Dowling, 1972). Below the level of the levators, fascia covering fat of the ischiorectal fossa was approximated with chromic catgut and the skin closed with interrupted silk sutures. In only four patients who had perianal infections or fistulae was the wound superficial to the levators left open and packed. In all cases a tube drain with gentle suction was used in the perineum; before January 1972 this was inserted through the main perineal incision but after this date the drain was introduced through a separate stab incision in the ischiorectal fossa.

Whenever it was necessary to divide or anastomose bowel, a 'clean and dirty' technique was carried out in the following way. A separate instrument tray with drapes was used to isolate the segment of bowel concerned from the wound edges and from other loops of intestine. After dividing the bowel between ligatures, the ends were invaginated with a purse string suture and then painted with a 10% povidone-iodine solution. In addition bowel ends destined to be part of an operative specimen were enclosed in a surgical glove. At the end of the procedure the dirty instruments and drapes were discarded and all members of the operating team changed gloves before proceeding with the operation. To prevent peritoneal or wound contamination when split ileostomies were being fashioned, the closed ends of the ileum were brought through the abdominal wall and the final fashioning of stomas was left until the main incision had been closed and sealed with a waterproof dressing (Lee, 1975).

Similarly, the closure of a split ileostomy was performed in several stages as follows: the bowel was mobilised from surrounding skin and abdominal wall, closed with a catgut suture, invaginated with a purse string suture, and painted with 10% povidone-iodine. After this the abdomen was opened after re-preparing and draping. The bowel ends were then dissected free of the remaining layers of the abdominal wall in preparation for the re-anastomosis, which was perfomed with separate instruments. On completing the anastomosis instruments and gloves were changed before closing the wound.

DEFINITIONS FOR PURPOSES OF THIS STUDY

Delayed healing was defined as a failure to heal by three weeks. Wounds reopened for any reason other than infection during the first three weeks were assessed for healing from the date of the second operation and for the purposes of overall figures, the two operations were regarded as a single unit.

Wound contamination was said to have occurred if there had been accidental entry into the lumen of the bowel or if an abscess cavity or a fistulous tract were entered. Preoperative bowel perforation was also defined as contamination. Elective division of the bowel using the 'clean and dirty' technique was regarded as not having caused contamination.

Wound infection was defined as the spontaneous discharge or release of pus from a wound. Minor cellulitis or small stitch abscesses were not classified as wound infection.

Intra-abdominal sepsis was defined as a collection of pus deep to the parietal peritoneum. A pelvic abscess, one form of intra-abdominal sepsis, only was diagnosed if it needed to be drained by abdominal incision. This was to distinguish it from the more common, though sometimes deeply situated, perineal sepsis which sometimes followed proctocolectomy.

Results

STEROID DOSE

During the first 14 postoperative days patients received between 170mg and 870mg prednisolone. The mean steroid dose given over this period was 413mg (SD 125mg); therefore the average daily dose per patient was 30mg, although most patients had higher doses for the first few postoperative days which were then progressively reduced.

MORTALITY

The overall mortality was 5·5% with the figures for each type of opposition being proctocolectomy 8%, split ileostomy 4·7%, 'other' operations 7·7%, and closure of a split ileostomy nil.

In six patients the principal cause of death was uncontrolled sepsis, with an associated small bowel fistula being a contributing factor in three of these. The remaining three patients died of pulmonary embolism. In view of the causes of death it was worth noting the high incidence of wound contamination amongst the patients who died. (Table 2).

Table 2 *Mortality in relation to contamination*

	Deaths	*Survivors*	*Total*
Contamination	7	32	39
No contamination	2	121	123
Total	9	153	162

$\chi^2 = 12{\cdot}09$; n = 1; P < 0·001.

WOUND DEHISCENCE

There were four cases of wound dehiscence in 162 abdominal incisions. Three of these patients subsequently died while the sole survivor healed primarily after resuture and did not develop a late incisional hernia.

INCISIONAL HERNIA

There was one hernia through the main abdominal incision (0·7%); one para-ileostomy hernia (0·6% of stoma sites) and one hernia through a stoma site which was closed at the time of restoring bowel continuity (1·6% of closed stoma sites).

POST-OPERATIVE ADHESIONS

It was the impression of the surgeons involved that adhesions encountered at subsequent abdominal surgery were less than might be anticipated by the type of primary surgery which had been undertaken. Often adhesions were few in number and filmy in nature. Small bowel obstruction from adhesions occurred in only three of the patients, twice after a proctolectomy and once after a split ileostomy. No patients required reoperation for adhesions within the first four postoperative weeks.

SEPSIS

Thirty-five per cent of the patients had septic complications at one or more sites in the postoperative period. The abdominal wound infection rate was 19% and the rate for perineal wounds was 57%. An intra-abdominal abscess occurred in 15% of the patients.

WOUND HEALING

Eighty-two per cent of patients acheived primary healing of the abdominal wound and 27% of perineal wounds healed primarily.

OTHER COMPLICATIONS

Fistulae of various types were not uncommon. These were: six small bowel to abdominal wall fistulae, five skin level fistulae in association with the ileostomy stoma, two skin-to-skin fistulae, one vaginoperineal fistula, and one urethroperineal fistula which resulted from damage to the bulbous urethra during the perineal dissection of the rectum.

Mechanical small bowel obstruction following technical errors occurred twice, once from failure to close the 'lateral space' and the other from reversed siting of the ileostomy and mucous fistula. A dendritic corneal ulcer and a haematemesis from a peptic ulcer were other complications and are mentioned because of their possible relationship to steroid administration.

FACTORS WHICH INFLUENCED MORBIDITY

Contamination

This was associated with an increased risk of sepsis at all sites as shown in Table 3. The figures were all highly significant.

Table 3 *Incidence of sepsis in relation to contamination*

	*Abdominal wounds**	*Perineal wounds†*	*Intra-abdominal**	*Overall**
Contaminated	46%	81%	41%	77%
Non-contaminated	10%	39%	6·5%	21%
Significance	$\chi^2 = 23{\cdot}6$ P < 0·001	$\chi^2 = 9{\cdot}76$ P < 0·01	$\chi^2 = 25{\cdot}3$ P < 0·001	$\chi^2 = 38$ P<0·001

*39 contaminated patients. 123 non-contaminated patients.
†27 contaminated patients. 36 non-contaminated patients.

Operation performed

The overall sepsis rate varied from 11% for split ileostomy, to 59% for panproctocolectomy. It was apparent that this reflected the incidence of contamination for the various operations.

Presence of preoperative stoma
There was a higher incidence of infection in non-contaminated patients when there was a stoma present at the time of operation, 18% compared with 7% for patients without a stoma at the start of the operation.

Primary diagnosis
Ulcerative colitis and Crohn's disease patients had the same rate of abdominal wound infection when only non-contaminated cases were considered. This suggests that primary diagnosis *per se* does not influence liability to infection. However, ulcerative colitis patients overall did have a higher infection rate because they were the majority of patients having a panproctocolectomy; the operation with the highest incidence of contamination. Primary diagnosis, did, however, seem to influence the rate of perineal wound healing in the 58 panproctocolectomy patients surviving longer than 12 months. As shown in Table 4 patients with Crohn's disease fared less well than those with ulcerative colitis. The difference in healing after 12 months is significant at the 5% level $\chi^2 = 4{\cdot}66$, n = 1, P < 0·05).

Table 4 *Healing of perineal wound in relation to primary diagnosis*

	Percentage of wounds healed at:					
	3 weeks	*2 months*	*3 months*	*4 months*	*6 months*	*12 months*
Ulcerative colitis (45)	33	58	66	73	80	91
Crohn's (13) disease	15	31	31	31	46	62

Perineal drain tube
The siting of the perineal drain tube was changed from midline through the perineal wound to lateral in January 1972. Table 5 indicates the significant improvement in primary healing of the perineal wound which followed the introduction of the laterally placed drain. This finding occurred despite the post-January 1972 group having double the rate of contamination of the earlier group with midline drains. In other respects, though, the two groups were remarkably well matched.

Table 5 *Influence of drain tube site on perineal wound healing*

	Primary healing	*Delayed healing*	*Total*
Midline drain	2	20	22
Lateral drain	15	25	40
Total	17	45	62

$\chi^1 = 4{\cdot}42$, n = 1, P < 0·05.

Repeated use of abdominal incision
The experience with incisions used on more than one occasion is set out in Table 6. There is no significant difference between the results for incisions being used for the first time and those being used for a second, third, or fourth time.

Table 6 *Wound healing in relation to number of times incision was used*

No. of times incision used	*No. of patients*	*Burst abdomens*	*Incisional hernia*	*Delayed healing*
1	106	3	1	17
2	44	1	—	11
3	10	—	—	—
4	2	—	—	—
Total	162	4	1	28

Tension sutures
These were employed at surgeon's discretion and it was therefore difficult to draw valid conclusions about their merits. There was, however, no tendency for them to be used more often in wounds being closed for a second, third, or fourth time.

Prophylactic antibiotics
Eighty-five per cent of patients were given antibiotics at the time of operation and for five to 10 days after. Tetracycline or ampicillin was the antibiotic chosen in all but two of these patients. The rate of sepsis in patients receiving prophylactic antibiotics was 37%, while the rate in patients not receiving antibiotics was 23%. It was also noted that bacteria isolated from infected wounds were almost invariably resistant to the antibiotic previously given.

Steroid dose
The total steroid dosage given to patients over the first 14 postoperative days did not vary significantly between patients with any given complication and those free of that problem. Nor did the administration of steroids over the days immediately preceding surgery correlate with postoperative infection.

Other factors
The patients' sex, age, duration of symptoms before operation, the fact that the patient had to have an emergency as compared with an elective operation, the presence of anaemia, and the presence of a low serum albumin were all computed against results in terms of sepsis and delayed wound healing. None of these factors had any demonstrable effect on the results.

Discussion

CONTAMINATION
This was the most important factor predisposing to infection and, in turn, there was a significant

association with mortality and with failure to achieve primary healing. The pathology was often such that contamination was unavoidable. However, contamination was potentially avoidable in three out of the seven contaminated patients who subsequently died. Similarly, accidental entry into the lumen of the large bowel during dissection accounted for 10 out of the 27 contaminated proctocolectomy patients. Our immediate concern therefore was whether permuscular dissection predisposed to accidental opening of the rectum. Unfortunately, few writers have recorded their incidence of this problem, though Broader stated that the bowel was 'ruptured' during dissection in 15 out of 54 panproctocolectomies when the traditional type of synchronous rectal dissection was being used (Broader, 1974). Thus on present evidence it appears justifiable to persist with the perimuscular technique and thus obtain the benefits of maximal preservation of pelvic parasympathetic nerves.

The other source of potentially avoidable contamination was preoperative large bowel perforation. With diffuse soiling of the peritoneal cavity and localised or sealed perforations, there were five such patients in this series of proctocolectomies. In the Oxford unit physician and surgeon make a joint decision about the timing of surgical intervention in patients with an acute attack of colitis. This depends on the clinical response to a five day course of prednisolone given intravenously (Truelove and Jewell, 1975).

In discussing potentially avoidable contamination, it should be recalled that the significant differences in sepsis between contaminated and non-contaminated groups was demonstrable despite elective bowel division being classed as no contamination. We believe that this implies the success of 'clean and dirty' technique in avoiding significant contamination, especially as all patients in the series had the terminal ileum divided or reanastomosed. The different bacterial counts between small and large bowel contents would also offer an explanation. However, there is no agreement about what constitutes significant contamination at surgery. It seemes appropriate therefore to take all possible precautions at operation including a meticulous 'clean and dirty' technique in all cases.

ANTIBIOTICS

There was no significant difference in sepsis rates between the patients who received antibiotics and those who did not, but it was not unexpected to find the higher sepsis rate in the former group. An important finding was that the majority of organisms recovered from sites of infection were resistant to the antibiotic given prophylactically. Because of these findings, we have altered our antibiotic regimen to meet the need for adequate tissue levels of the appropriate antibiotic at the time contamination is likely to occur (Burke, 1961). The antibiotics we now use are metronidazole (Flagyl), lincomycin, and gentamicin which are bacteriocidal to the majority of gastrointestinal organisms, and the period of their administration has been restricted to minimise the emergence of resistant strains as well as to reduce to a minimum the chance of the patient developing a complication from the drugs. The results of surgery carried out under the new regimen will be reported later.

WOUND DEHISCENCE

The 2·5% incidence in this series compares favourably with the 3% incidence for an unselected series of laparotomies, excluding McBurney's incision for appendicectomy, reported by Efron (1965).

INCISIONAL HERNIA

Blomstedt and Welin-Berger (1972) prospectively studied the incidence of incisional hernia in a variety of incisions used for cholecystectomy. Absorbable sutures were used in 90% of their patients and there was an overall incisional hernia rate of 9·6%, the paramedian rate being 9·5%. We believe the very low incidence of incisional hernias in this series (0·7% of paramedians) indicates that closure with monofilament nylon will keep tissues suitably approximated for a sufficient period for sound healing to occur, even when the healing process is potentially impaired by steroid administration. Monofilament nylon proved once again to be a particularly acceptable non-absorbable suture because wound infections almost invariably settled completely without the foreign material having to be removed.

DELAYED WOUND HEALING

With the abdominal wound, delayed healing was invariably a consequence of infection, and the relationship of this to contamination has been discussed. The primary diagnosis did not influence the rate of abdominal wound healing.

Perineal wound healing however is a more complex matter. In all the proctocolectomy patients, closure of the pelvic and perineal wound was possible using the technique of perimuscular dissection (Lee and Dowling, 1962). In the majority an intersphincteric plane of dissection was used as reported subsequently by Lyttle and Parks (1977); the prerequisite for primary healing was again the prevention of contamination and infection. Another factor which influenced healing was the siting of the perineal drain, a laterally placed drain giving better

results than a midline drain. As a result of this study the use of a perineal drain has been abandoned. Instead the pelvis is drained by one or two Redivac negative pressure drains brought out through the anterior abdominal wall as suggested by Broader *et al.* (1974). Their reported 59% incidence of primary healing of the perineal wound with this technique in their colitis patients was better than the primary healing rate in even the latter part of this series (35·5%). Our recent results support this view and will be reported later.

Finally, the primary diagnosis was a factor which influenced the perineal healing. Patients with ulcerative colitis fared better than those with Crohn's disease in two ways. Firstly, those with Crohn's disease had a higher incidence of contamination from existing perineal pathology and this prejudiced the chances of achieving primary healing. Secondly, for reasons unknown and unrelated to whether or not there was contamination at operation, patients with Crohn's disease had persistent perineal sinuses more commonly and for longer periods that those with ulcerative colitis.

Although there was a trend for our younger patients to have slower perineal healing, we were not able to confirm findings of Broader *et al.* (1974) that patients under the age of 35 years had a significantly greater incidence of delayed perineal healing when compared with those over the age of 35 years. One of the reasons why this occurs may be because the young patients who require a proctocolectomy often have very severe disease.

POSTOPERATIVE ADHESIONS

From the clinical point of view, the 3·2% incidence of small bowel obstruction from adhesions, after proctocolectomy, in this series, with a follow-up period ranging from 10 months to over six years is substantially lower than that reported by Watts of 3 to 4% per year for the first three years after operation. A percentage of their patients also received pre- and postoperative steroids but dosage schedules were not indicated in their paper (Watts *et al.*, 1966). None of our patients developed an intestinal obstruction because the pelvis had given way, a relatively common complication of abdomino-perineal resection of the rectum for carcinoma.

STEROID DOSE

The dose of steroids within the range of 170-870 mg of prednisolone used over the first 14 postoperative days, had no demonstrable effect on morbidity or mortality. Unfortunately, a control group of patients having comparable surgery without any steroid administration was not available for comparison.

Our findings agree with those of Knudsen *et al.* (1976) except that we did not note a higher morbidity and mortality in the patients who underwent emergency operations. The subject is an interesting one and our results of emergency treatment of ulcerative colitis will be reported at a later date.

Conclusion

Our findings suggest that the advantages of prednisolone administration for colitis are not offset by serious postoperative disadvantages if surgery becomes necessary. The study indicated a number of points where changes of operative technique might be advantageous and where the prophylactic use of different antiobiotics might reduce postoperative infection. These changes were introduced in 1975 and the results are currently being analysed.

References

Blomstedt, B., and Welin-Berger, T. (1972). Incisional hernias. *Acta Chirurgica Scandinavica*, **138**, 275-278.

Broader, J. H., Masselink, B. A., Oates, G. D., and Alexander Williams, J. (1974). Management of the pelvic space after proctectomy. *British Journal of Surgery*, **61**, 94-97.

Burke, J. F. (1961). The effective period of preventive antibiotic action in experimental incisions and dermal lesions. *Surgery*, **50**, 161-168.

Efron, G. (1965). Abdominal wound disruption. *Lancet*, **1**, 1287-1291.

Ehrlich, H. P., and Hunt, T. K. (1968). Effects of cortisone and vitamin A on wound healing. *Annals of Surgery*, **167**, 324-328.

Ehrlich, H. P., Tarver H., and Hunt, T. K. (1973). Effects of vitamin A and glucocorticoids upon inflammation and collagen synthesis. *Annals of Surgery*, **177**, 222-227.

Fuenfer, M. M., Olson, G. E., and Polk, H. C. Jr (1975). Effect of various corticosteroids upon the phagocytic bactericidal activity of neutrophils. *Surgery*, **78**, 27-33.

Glenn, F., and Grafe, W. R. Jr (1967). Surgical complications of adrenal steroid therapy. *Annals of Surgery*, **165**, 1023-1034.

Knudsen, L., Christiansen, L., and Jarnum, S. (1976). Early complications in patients previously treated with corticosteroids. *Scandinavian Journal of Gastroenterology*, **11**, suppl. 37, 123-128.

Lee, E. (1975). Split ileostomy in the treatment of Crohn's disease of the colon. *Annals of the Royal College of Surgeons of England*, **56**, 94-102.

Lee, E. C. G., and Dowling, B. L. (1962). Perimuscular excision of the rectum for Crohn's disease and ulcerative colitis. *British Journal of Surgery*, **59**, 29-32.

Lyttle, J. A., and Parks, A. G. (1977). Intersphincteric excision of the rectum. *British Journal of Surgery*, **64**, 413-416.

Truelove, S. C., and Jewell, D. P. (1974). Intensive intravenous regimen for severe attacks of ulcerative colitis. *Lancet* **1**, 1067-1070.

Watts, J. M., De Dombal, F. T., and Goligher, J. C. (1966). Long-term complications and prognosis following major surgery for ulcerative colitis. *British Journal of Surgery*, **53**, 1014-1023.