Br. J. Surg. Vol. 62 (1975) 792–799

Prophylactic interparietal povidone-iodine in abdominal surgery

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SUMMARY

This study sought to determine in a district general hospital (a) the frequency and nature of bacterial contamination at operation, (b) the incidence of consequent infection and (c) the prophylactic effect, if any, of interparietal povidone-iodine against postoperative wound infection.

Bacterial contamination was shown in 49 per cent of all the abdominal surgical wounds at the end of operation. From 61 per cent of the subsequently infected wounds, organisms identified as contaminants at operation were again found. Interparietal instillation of povidone-iodine resulted in a statistically significant reduction in wound infection ($P<0{\cdot}01$) in treated patients compared with untreated, randomized, matched controls. It was of significant value in cases of intestinal resection and peritonitis, in obese patients and in those with paramedian incisions.

Laboratory studies indicate that povidone-iodine does not induce bacterial resistance. This chemical antibacterial agent may thus provide a preferable alternative to antibiotics in preventing such infections.

'EVERY operation in surgery is an experiment in bacteriology' is just as true today as when Moynihan opened his address to the first meeting of the Association of Surgeons in May 1920 with these words, and this despite the advances in surgery, anaesthesia and medical therapy in the intervening years.

Almost half a century after that meeting the Public Health Laboratory Service in 1960 concluded from a national survey that 10 per cent of all surgical wounds became infected. A consequence of such infections was that infected patients each spent an average 1 extra week in hospital. The annual cost of this extra bed occupancy in England and Wales alone was estimated at £3·3 millions. According to the Department of Health and Social Security (1975) data the comparable cost in 1973 was £22·3 millions.

The many variables, including the type of surgery and the differing criteria used for defining sepsis, preclude meaningful comparisons between series of patients from different locations (Gilmore, 1973). One fact that does, however, emerge from published experience is the pre-eminence of abdominal surgery in all large series of postoperative wound infection (Public Health Laboratory Service, 1960; National Research Council, 1964; Davidson, Clark and Smith, 1971; Shaw et al., 1973).

Moynihan continued his address in 1920 with this proposition: 'Our bacteriological experiment may be conducted with one of two intentions. 1. The exclusion of all organisms from the wound; 2. The destruction of all organisms reaching the wound, by a bactericide applied to the wound surfaces.' Considering the hazards of the then known bactericides it was not surprising that Moynihan preferred aseptic surgery. Whilst asepsis is an ideal towards which surgeons strive, one must accept the fact that the exclusion of all organisms from the wound is probably impossible, especially in operations on the bowel or in the presence of peritonitis. It is therefore suggested that the best attainable standards of asepsis should be complemented by the use of an applied antibacterial agent. Such bactericides must fulfil demanding criteria, including spectrum of activity, tissue tolerance and absence of acquired bacterial resistance. In addition, the bactericide ought to be presented in a formulation appropriate to surgical use.

A desire to conserve the more valuable antibiotics is closely linked with the recognized danger of resistant bacterial strains which emerge following any form of antibiotic administration (Alder and Gillespie, 1967; Whitehead, 1973). Since most, if not all, the independently active antibiotics have probably been discovered (Lowbury and Ayliffe, 1974), serious reappraisal of the value of antiseptics is essential.

Previous experience demonstrated the efficacy of a dry powder aerosol formulation of povidone-iodine (Disadine DP) following appendicectomy (Gilmore et al., 1973; Gilmore and Martin, 1974); this was the first controlled trial in which an antiseptic was shown to prevent wound infection. We now report an extension of our 'experiments in bacteriology' to include a wider variety of abdominal surgery. We have also conducted studies on the frequency and nature of the bacterial contamination of surgical wounds. In addition, laboratory studies have sought to establish whether organisms can be induced to develop resistance to povidone-iodine.

Materials and methods

Surgery

The study was undertaken at the North Middlesex Hospital, London. One hundred and fifty-six consecutive patients under the care of one consultant and undergoing abdominal surgery were included in a controlled trial of wound spraying. Twelve patients were withdrawn: 9 because they died within 2 weeks of operation, one because of uncontrollable diabetes

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mellitus, another because the drain was brought out through the main wound and not through a separate incision and the last because he required a second operation within 2 weeks of the first.

Random allocation of patients to one of two groups was achieved by using a table of random numbers; the code in the form of an 'Advent calendar' was kept outside the theatre. The method of skin disinfection in both groups was identical. The surgeon was only informed of the spraying procedure to be used after he had closed the peritoneum with continuous chromic catgut and taken a bacteriological swab from the open wound.

The parietal layers of the wound of the patients in group I were sprayed with dry powder povidone-iodine (Disadine DP), while the wounds of patients in group II were sprayed with the propellant alone. Spraying was carried out by the runner nurse who, having shaken the aerosol, held it at an angle of 45° and sprayed the open wound for 10 seconds from a distance of 25 cm. All the wounds were closed with monofilament nylon except for gridiron incisions, which were closed with interrupted chromic catgut. Black silk skin sutures were used throughout. All the closed wounds were sprayed with Nobecutane, thus allowing easy and regular inspection; no other dressing was applied. Drains, when required, were brought out through a separate stab incision, well away from the operative wound, and covered with sterile gauze.

A standard form was completed at the end of each operation recording the patient's age, sex, ward, diagnosis and build. Patients with less than 1 cm of subcutaneous fat were classified as thin, those with 1–2·5 cm as average and those with more than 2·5 cm as obese. The operative procedure, the type and length of incision, the duration of operation, the surgeon and whether the patient was given systemic antibiotics and the reason for this therapy were also documented.

All the wounds were inspected by the clinical microbiologist who was unaware of the operation performed and the spraying procedure used. In deciding the state of the wound postoperatively the criteria of Ljungquist (1964) were adopted. The wound was assessed as 'clean' or 'infected'. It was infected if at any time a purulent discharge occurred. If a serous discharge appeared it was swabbed and cultured and the wound classified according to the culture result.

All the patients were seen 6 weeks after operation, and any wound discharging pus after the patient returned home was included in the infected group. A few patients failed to attend the outpatients' department and were followed up by post.

Throughout the patient's stay in hospital careful watch was kept for any evidence of reaction to either spray.

Bacteriology

At every operation following closure of the peritoneum but prior to spraying, a swab tip was rolled along the length of both wound edges. It was then sent in Stewart's transport medium for bacteriological examination. A swab was also taken from all subsequently infected wounds. Each swab was inoculated on to two blood agar plates, a MacConkey's plate and into Robertson's meat broth, and a Gram film was made. One blood agar and the MacConkey's plate were incubated aerobically at 37 °C, while the second blood agar plate was incubated anaerobically. All the plates were incubated overnight, and if no growth occurred, for a further 24 hours. The Robertson's cooked meat broth was subcultured if the original plates did not yield organisms at 48 hours.

A record was kept of the colonial appearance of each strain of bacteria isolated and appropriate biochemical tests carried out to diagnose Enterobacteriaceae to species level. All β-haemolytic streptococci were grouped, while *Streptococcus faecalis* was identified by colonial appearance on blood agar and MacConkey's medium. *Staphylococcus aureus* and *Staphylococcus albus* were distinguished by the coagulase test. *Streptococcus viridans*, non-haemolytic streptococci, *Micrococcus* spp., diphtheroids and *Lactobacillus* spp. were identified by colonial morphology and Gram film. Anaerobic organisms were diagnosed by the absence of growth in the presence of oxygen and by Gram film. *Pseudomonas* spp. were recognized by pigment production and oxidase reaction.

Each organism isolated was tested for sensitivity to an extended range of antibiotics by disc diffusion. This was controlled by the comparative method using *Staph. aureus* (NCTC 6571), *Escherichia coli* (NCTC 10418) and *Pseudomonas pyocyanea* (NCTC 10662).

When similar bacterial strains were isolated both from the operative and the postoperative swab, they were regarded as belonging to the same strain if the results of the reactions tested were identical and the response to antibiotics did not differ by more than one drug.

An attempt to induce resistance to povidone-iodine was carried out using five strains of bacteria; these were *Pseudomonas* sp. NCTC 5525 and an environmental strain of an unidentified *Pseudomonas* sp. isolated from a medicament; *E. coli* 0111 and 0141 and *Serratia marcescens*. All strains were grown in nutrient broth for 24 hours at 37 °C. Samples (0·02 ml) of these cultures were inoculated into a set of tubes containing a double dilution series of povidone-iodine in 1 ml of minimal salts solution with 0·2 per cent glucose. Each set of tubes also included two controls, one containing minimal salts solution and glucose, the other minimal salts, glucose and a similar inoculum of bacteria. All the tubes were incubated at 37 °C and examined daily. When visible growth was present, samples (0·04 ml) were taken from the tube containing the highest concentration of povidone-iodine allowing bacterial growth and inoculated into a fresh set of tubes containing a similar range of povidone-iodine concentrations. The contents of all tubes remaining clear at 48 hours were plated out to determine the minimal bactericidal concentration. Each organism under test was passaged sixteen times.

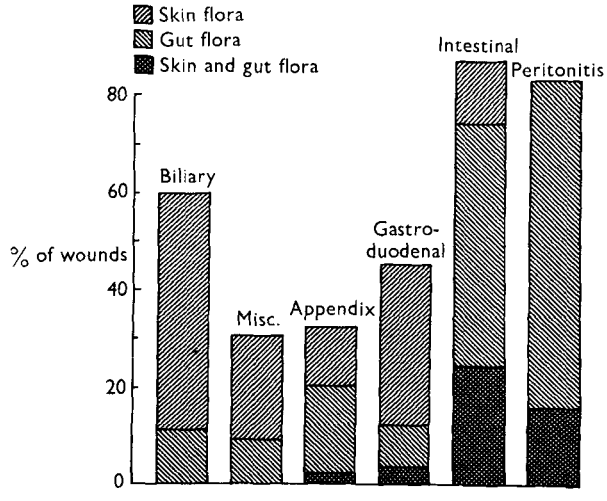

Fig. 1. Nature of organisms isolated from the operative wound related to the surgical procedure.

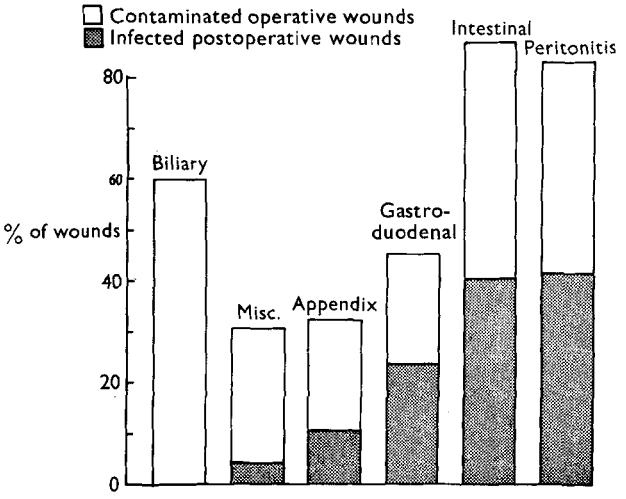

Fig. 2. Incidence of operative bacterial wound contamination and postoperative infection related to the surgical procedure.

Statistical methods

For comparison of continuous variables, i.e. age, postoperative stay, length of incision and duration of operation, the *t*-test has been used. The χ^2 test has been used to analyse both 2×3 tables, i.e. patient's build and surgeon. Fisher's exact test has been used on all 2×2 tables, which includes the rest of the results obtained.

Double-sided tests have been used throughout, with the exception of comparisons of infection rates between the two treatment groups, where the single-sided test was considered appropriate.

Results

Twenty-four of the 144 patients studied developed postoperative wound infection. Three-quarters of the infected patients came from the control group, in which the infection rate was 24 per cent compared with 8·6 per cent in those receiving interparietal povidone-iodine. Comparison of spraying with povidone-iodine against spraying with propellant alone was statistically in favour of povidone-iodine ($P < 0{\cdot}01$) (*Table I*).

Table I: FREQUENCY OF WOUND INFECTION

Group	Total	Infected	Significance
Control	74	18	—
Povidone-iodine	70	6	$P<0{\cdot}01$

Table II: BACTERIAL SPECIES ISOLATED FROM OPERATIVE AND POSTOPERATIVE SWABS

	Operative swab		
Organism	Direct plate	Enrich-ment media	Post-operative swab
*E. coli**	20	5	8
Staph. albus	17	30	3
*Str. faecalis**	7	4	3
Str. viridans	9	1	1
Staph. aureus	3	4	4
Micrococcus sp.	1	4	0
Haemolytic streptococci	3	1	0
Bacteroides sp.*	1	2	3
Acinetobacter sp.	2	1	0
Diptheroids	1	2	1
Pseudomonas sp.*	1	1	0
Anaerobic streptococci*	1	1	1
Enterobacter sp.*	1	1	0
Non-haemolytic streptococci	1	1	1
Proteus sp.*	1	0	1
Klebsiella sp.*	0	1	1
Neisseria sp.†	1	0	0
Lactobacilli*	0	1	0
Bacillus sp.	0	1	0
Str. pneumoniae	0	0	1
*Cl. welchii**	0	0	1
Total	70	61	29

* Species regarded as gut flora in this study.
† Not *N. meningitidis* or *N. gonorrhoeae*.

Swabs of the operative wound were obtained in 133 patients. Bacteria were isolated from 65, indicating an operative wound contamination rate of 49 per cent. Of the total 131 strains of bacteria isolated at operation (*Table II*), 83 belong to species usually associated with the skin flora. *Staph. albus* was the organism most frequently found, but 30 of the total 47 strains isolated were only recovered from the cooked meat enrichment medium. Of the organisms associated with the gut flora, *E. coli* was the predominant species, followed by *Str. faecalis*.

The nature of the organisms isolated varied according to the operative procedure (*Fig.* 1). Forty of the 76 isolates obtained from cases of appendicectomy, intestinal resection and peritonitis belonged to the gut flora, compared with 7 out of 57 in the biliary, gastroduodenal and miscellaneous groups. The miscellaneous group comprised patients undergoing laparotomy in whom a hollow viscus was neither incised nor resected (5 cases of splenectomy and/or lymph node mapping, 4 of proximal gastric vagotomy, 3 fundoplications, 2 ovarian cystectomies, 2 divisions of adhesions, 1 bilateral adrenalectomy and oophorectomy and 10 explorations for carcinoma or PUO).

The incidence of bacterial wound contamination related to the operative procedure is given in *Fig.* 2.

Significantly more patients with peritonitis ($P<0.01$) or undergoing intestinal resection ($P<0.002$) had contaminated wounds compared with those in the other categories. Twenty-seven per cent of patients in the contaminated group had malignant disease compared with 14 per cent in the non-contaminated group. Patients with contaminated operative wounds were significantly older ($P<0.01$) and had longer operations ($P<0.01$).

Fig. 2 also shows that the incidence of postoperative infection mirrored the incidence of operative contamination except in biliary surgery. Twenty-six per cent of patients with contaminated wounds developed infection compared with 10 per cent with non-contaminated operative wounds ($P<0.04$).

The average duration of operation in the infected cases was 64 minutes compared with 42 minutes in the non-infected ($P<0.05$). There was, however, only 12 seconds' difference in the mean duration of operation between the two treatment groups. Patients whose wounds healed by first intention had a mean post-operative stay of 10 days, compared with 2 weeks in those who developed wound infection ($P<0.05$).

Swabs were obtained from all infected cases except 6 patients whose infection only became manifest after they had left hospital. In 11 of the 18 patients whose wounds discharged in hospital, organisms present at the time of closure were isolated from the subsequently infected wounds, a correlation rate of 61 per cent. In 6 patients the correlating organism(s) belonged to the gut flora, in 3 to the skin flora and in 2 there was a mixture. Twenty-nine strains of bacteria were isolated from the infected wounds (*Table II*), and 18 (60 per cent) of these belonged to gut flora, compared with 48 out of 131 (37 per cent) of the operative contaminants. These findings suggest that 17 per cent of gut flora contaminants resulted in infection compared with 6 per cent of skin flora contaminants.

E. coli was the organism most frequently isolated from the infected wounds, and 6 of the 8 strains recovered corresponded with those found at operation. Four strains of *Staph. aureus* were recovered but only one correlated with that found at operation, suggesting that postoperative infection with this organism may include sources other than those occurring at operation. The *E. coli* were all obtained from cases of intestinal resection or peritonitis, while the strains of *Staph. aureus* were all isolated from patients in the miscellaneous or gastroduodenal groups.

Interparietal povidone-iodine resulted in a reduced infection rate after all forms of abdominal surgery (*Fig.* 3). The reduction in infection in patients undergoing intestinal resection, of whom 90 per cent had contaminated wounds, was significant at the 4 per cent level, while that obtained in patients with peritonitis, of whom 80 per cent were contaminated, was significant at the 5 per cent level. Half of the infections in the study occurred in these patients. Fourteen patients in the control group were in this high risk category (5 small bowel resections, 4 large bowel resections and 5 cases of peritonitis), and 10 (71 per cent) became infected. Whereas of the 15 in the povidone-iodine group (1 small bowel resection, 7 large bowel resections and 7 cases of peritonitis), only 2 (13 per cent) became infected. This difference is significant ($P<0.01$).

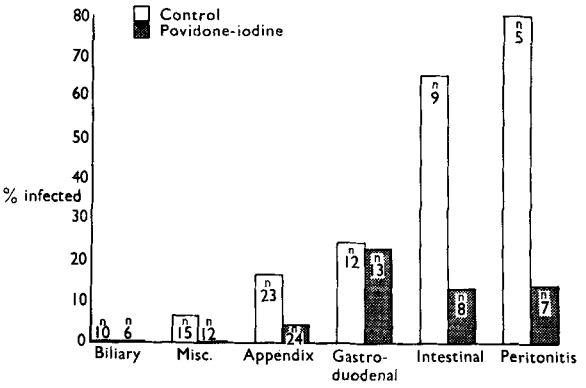

Fig. 3. Effect of interparietal povidone-iodine on the frequency of wound infection.

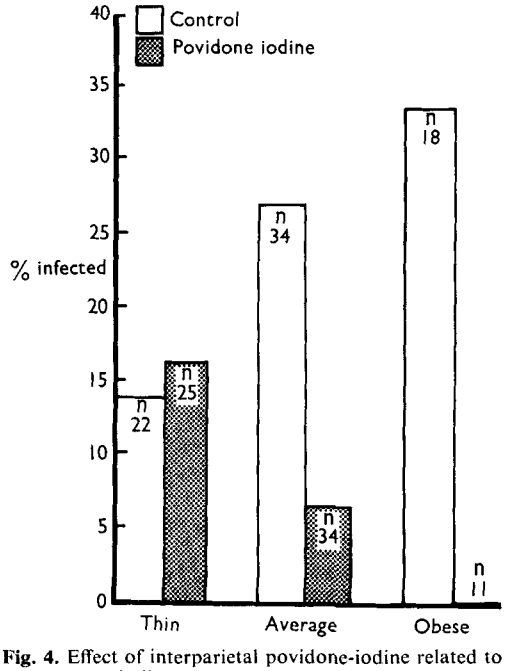

Fig. 4. Effect of interparietal povidone-iodine related to the patient's build.

It is evident (*Table III*) that povidone-iodine is effective, no matter what the demonstrated bacterial state of the wound, for the infection rate in the contaminated cases sprayed with povidone-iodine was below that of the non-contaminated controls; while of the 68 patients with sterile operative swabs, only 3 per cent in the povidone-iodine group became infected compared with 17 per cent in the control group.

Although the overall infection rate increased according to the patients' obesity, povidone-iodine prophylaxis resulted in a significant reduction in

Table III: FREQUENCY OF WOUND INFECTION RELATED TO BACTERIAL CONTAMINATION OF OPERATIVE WOUND

Group	Not contaminated		Contaminated	
	Total	Infected	Total	Infected
Control	35	6 (17%)	35	12 (34%)
Povidone-iodine	33	1 (3%)	30	5 (16·6%)
All cases	68	7 (10%)	65	17 (26%)

Table IV: FREQUENCY OF WOUND INFECTION RELATED TO AGE, SEX AND PATHOLOGY

	Control group		Povidone-iodine group	
	Total	Infected	Total	Infected
Age				
0–20	16	3	16	2
21–50	25	5	27	1
Over 50	33	10	27	3
Sex				
Male	34	8	44	5
Female	40	10	26	1
Pathology				
Benign	64	14	55	4
Malignant	10	4	15	2

infection in both the average ($P < 0{\cdot}025$) and the obese patient ($P < 0{\cdot}04$) (*Fig.* 4). The incision most frequently contaminated by bacteria was the paramedian (67 per cent). Of the 22 paramedian wounds in the control group, 10 became infected compared with 1 out of 19 in the povidone-iodine group. This difference is significant ($P < 0{\cdot}005$).

All but 16 of the 144 operations in the series were performed by one of two surgeons, their individual infection rates being 15 and 22 per cent. No matter which surgeon operated the infection rate was always lower in the patients receiving povidone-iodine.

Twenty-four per cent of patients with malignant disease developed wound infections compared with 15 per cent with non-malignant conditions. Povidone-iodine reduced infection in both by at least two-thirds (*Table IV*). Although the incidence of infection varied with age, being greatest in the younger and older patients, it was identical in the sexes. Spraying with povidone-iodine reduced infection in all age groups and in both sexes, but this reduction only reached significance in female patients (*Table IV*).

Ten patients in the control group and 13 in the povidone-iodine group were given antibiotics in hospital. Half in the former and 4 in the latter group commenced antibiotic therapy during operation, but no patient received antibiotics preoperatively.

Although some patients gave a history of antibiotic sensitivity, no reaction, local or general, was seen to either aerosol throughout the entire trial.

The laboratory studies showed that the minimal inhibitory and bactericidal concentrations of povidone-iodine for all the 5 organisms tested was less than 0·00089 per cent of available iodine. This contrasts with the 5 per cent available iodine delivered by the aerosol. After 16 passages the minimal inhibitory and bactericidal concentrations of povidone-iodine had not altered.

Discussion

The results show that dry powder povidone-iodine sprayed into the wound at operation prevents infection in all forms of abdominal surgery. Its significant value in cases associated with the heaviest bacterial contamination is of particular interest.

Davidson, Clark and Smith (1971) applied a computer analysis of 14 factors responsible for wound infection to 1000 patients. They identified a positive operative wound culture to be more than three times as significant as any other single factor in the occurrence of wound infection. The greatest risk of infection was borne by patients undergoing potentially contaminated abdominal surgery. This study also demonstrated a markedly greater hazard from contamination with organisms of the gut flora compared with those of the skin flora, as did Jepsen (1973). An earlier large scale study on 14 854 cases (National Research Council, 1964) established a five times higher incidence of infection in patients with contaminated operative wounds compared with those with sterile cultures.

In the present study organisms were recovered from 49 per cent of the operative wounds. Of the 131 strains recovered, 64 per cent belonged to the skin flora. The high incidence of *Staph. albus* and other Gram-positive organisms was similar to that found by Jepsen (1973), yet Jepsen found contaminants to be present in only 17 per cent of wounds. The high rate of recovery of organisms may be partly accounted for by the method of swabbing, which thoroughly sampled both sides of the wound. If skin preparation had been inadequate, skin flora may have been recovered; indeed, contamination of the wound may have occurred for the same reason.

A disappointingly low rate of isolation of anaerobes was obtained. There were 5 isolates from the operative swabs and the same number (17 per cent) from the infected wounds. This contrasts with 23 and 90 per cent obtained by Gilmore and Martin (1974) and Leigh et al. (1974) respectively from infected appendicectomy wounds. In both the present study and that of Gilmore and Martin (1974) swabs were transported to the laboratory in Stewart's medium, whereas Leigh et al. (1974) used Robertson's medium.

The incidence of infection after gastric surgery (24 per cent) was higher than one would expect. Skin organisms were isolated from all 4 wounds which discharged in hospital, and in 2 cases they correlated with those found at operation. One patient in the povidone-iodine group underwent gastrectomy and hemi-hepatectomy for carcinoma, while one in the control group had an emergency procedure for haematemesis; both patients were debilitated and thus more susceptible to sepsis. The 2 late infections, one from each group, were probably of ward origin.

No patient developed wound infection after cholecystectomy, despite 9 of the 16 patients having contaminated operative wounds. The reason for this is probably threefold. Only 2 of the contaminants were gut organisms, the rest belonging to the skin flora. The Kocher muscle-cutting incision results in a healthy vascular wound, especially if cutting diathermy

is avoided. Lastly, all drains were brought out well away from the operative wound.

The fact that in 6 patients (4 control and 2 povidone-iodine) sepsis only became manifest after discharge emphasizes, as shown previously (Gilmore and Martin, 1974), the necessity of a thorough outpatient follow-up in any study of wound infection. Four of these late infections occurred in contaminated appendicectomy wounds and may have been endogenous in origin. The other 2, one from each treatment group, occurred in non-contaminated wounds following vagotomy and pyloroplasty. This suggests, as stated above, subsequent exogenous contamination.

Meticulous surgical technique will reduce the frequency of contamination, but the exclusion of all bacteria from the wound is not possible. Adhesive plastic drapes apparently do not prevent contamination by skin organisms (Lilly et al., 1970), while plastic wound protectors failed to reduce infection in abdominal surgery even when introduced over the wound edges (Williams et al., 1972). It is clear, both from the present and previous studies, that for any agent to make significant reductions in postoperative wound infection it must prevent the growth of organisms, especially gut organisms deposited in the wound at the time of the operation.

Although Altemeier et al. (1968) concluded that wound infection was increased by prophylactic antibiotics, there is evidence that if used correctly, antibiotics may be of value against such infections (Gilmore and Sanderson, 1975). Ampicillin (Nash and Hugh, 1967; Stoker and Ellis, 1972), kanamycin (Moylan and Brockenbrough, 1968) and cephaloridine (Evans et al., 1974) have been shown to reduce infection when instilled into the wound after abdominal surgery. Short term systematic prophylaxis with cephaloridine (Polk and Lopez-Mayor, 1969; Evans and Pollock, 1973) and gentamicin and lincomycin in combination (Stokes et al., 1974) are also effective. The incidence of resistant strains, however, is reaching such a level that the trend will only be reversed by holding some antibiotics in reserve and limiting the use of these invaluable drugs to essential therapy (Finland, 1972). Since Finland believed that the widespread prophylactic use of broad spectrum antibiotics is primarily responsible for many of these resistant strains, a return to the principles of Lister (1867) would seem indicated.

Edlich et al. (1969) assessed the effectiveness of various antiseptics in contaminated wounds in the experimental animal, but there have been few clinical trials of these agents in wound infection. Chlorhexidine (Crosfil et al., 1969) and noxytiolin (Bird et al., 1971; Stoker and Ellis, 1971; Frazer-Moodie, 1974) both failed to reduce infection when instilled into the abdominal wound prior to closure. Neither antiseptic, however, was applied with an aerosol.

The wide antimicrobial activity of elemental iodine has long been known (Davaine, 1873), but it has not been used as much by surgeons as one would expect. This is because it is insoluble in water, chemically unstable and irritant to the tissues. On the other hand, povidone-iodine, a complex of the polymer polyvinylpyrrolidone and iodine (Siggia, 1957), enhances the bactericidal activity of elemental iodine (Bogash, 1956), while rendering it water-soluble, chemically stable and non-irritant to the tissues. Even patients allergic to iodine do not react to povidone-iodine when patch-tested (Shelanski and Shelanski, 1956).

Table V: DISTRIBUTION OF VARIABLE FACTORS IN BOTH GROUPS

	Control	Povidone-iodine	Significance
Sex			
Male	34	44	NS
Female	40	26	$P<0{\cdot}06$
Mean age (yr)	43±21	39±21	NS
Build			
Thin	22	25	NS
Average	34	34	NS
Obese	18	11	NS
Pathology			
Benign	64	55	NS
Malignant	10	15	NS
Operation			
Appendicectomy	23	24	NS
Biliary	15	12	NS
Miscellaneous	10	6	NS
Gastric	12	13	NS
Intestinal resection	9	8	NS
Peritonitis	5	7	NS
Mean duration (min)	46±29	46±31	NS
Incision			
Midline	20	17	NS
Paramedian	22	19	NS
Kocher/transverse	10	6	NS
Lanz	22	28	NS
Mean length (cm)	17±7	15±6	NS
Operative wound			
Contaminated	35	30	NS
Non-contaminated	35	33	NS
Surgeon			
A	18	18	NS
B	49	44	NS
C	7	9	NS
Antibiotics			
Peroperative	5	4	NS
Postoperative	5	9	NS

NS, Not significant.

The results obtained by Pollock and Evans (1975) in an open study in which they compared povidone-iodine with cephaloridine require careful appraisal. There were no untreated controls. Randomization was attempted by the 'toss of a coin', but merely resulted in a wide difference in the number of patients allocated to the treatment groups, both in total and in the one criterion (type of operation) considered. The difference in secondary sepsis rates in the two groups is difficult to explain, since no single application of any topical agent can be expected to prevent secondary infection.

In the present study a concerted effort was made to eliminate bias. None of the patients included was involved in any other trial. The accepted method of randomization used in this study resulted in a similar distribution of patients between both groups (*Table V*). Although there were more women in the control group, this probably did not affect the result since the infection rate in both sexes was identical. In addition, skin preparation and method of wound closure were

standard, and postoperative wound inspection was undertaken 'blind' by the clinical microbiologist.

It has been shown (Burke, 1961; Alexander and Altemeier, 1965) that for systemic antibiotics to prevent wound infection, therapy must commence at the time of operation. Since no patient was given preoperative antibiotics and only 5 patients in the control group and 4 in the povidone-iodine group received peroperative antibiotics, bias due to this cause is unlikely.

The findings of this controlled trial therefore reflect a valid assessment of prophylactic povidone-iodine opposite a control group under comparable conditions.

Any surgeon wishing to reduce his wound infection rate, and thus improve both patient care and turnover, would now appear to have several choices. These include prophylactic topical antibiotics, prophylactic systemic antibiotics and interparietal povidone-iodine.

Lowbury and Ayliffe (1974) believe that unless restraint is exercised in the use of antibiotics, within four decades doctors may well be recording antibiotic therapy as a short episode in the long history of medicine. In order that the antibiotic era may be prolonged, it would seem rational to use chemical antiseptics where they are effective, well tolerated and display a wide bactericidal activity. Antibiotics may thus be reserved for the treatment of systemic infections.

Acknowledgements

We are most grateful to Mr Richard A. Payne for his advice and for allowing his patients to be included in this trial. We thank the staff of the North Middlesex Hospital who were involved and without whose cooperation this trial would have been impossible, especially the theatre staff and the bacteriology technicians. We thank Miss Elaine Laws for statistical advice. We are indebted to the Department of Medical Illustration of St Bartholomew's Hospital for the illustrations. Disadine DP is a product of Avlex Ltd, a subsidiary company of ICI, who provided the materials used in this trial.

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