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The effect of topical povidone iodine on wound infection following abdominal surgery

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SUMMARY

The effect of povidone iodine on wound sepsis following gastrointestinal surgery was studied in a trial involving 153 patients of whom 72 had their wounds sprayed with povidone iodine dry powder (Disadine DP) and 81 acted as a control group. The infection rate of 9·9 per cent in the patients treated with povidone iodine was significantly lower than that of 24·4 per cent in the control group ($P < 0·05$). Bacterial contamination of the wound at the time of operation was shown to be of importance, being associated with a 52 per cent infection rate in the control group. However, spraying of contaminated wounds with povidone iodine reduced the infection rate to the significantly lower level of 11 per cent ($P < 0·05$). We conclude that povidone iodine is a safe and effective means of reducing wound sepsis following gastrointestinal surgery.

POVIDONE iodine is a water soluble, non-irritant complex of the polymer polyvinylpyrrolidone and iodine, and is active against bacteria, spores, fungi and viruses. It has been advocated for local application to prevent wound sepsis following gastrointestinal surgery, but conflicting results have been obtained from clinical trials. Although a significant reduction in wound infection has been shown by some workers (1–3), others have failed to demonstrate this (4, 5). The results have also been variable when povidone iodine was compared with antibiotic prophylaxis (3, 5–8). These inconsistencies may be explained, at least in part, by variations in the groups of patients studied and in surgical technique, as the overall levels of wound sepsis in these studies vary widely. A factor of particular importance may be the control of bleeding in the wound, as povidone iodine is absorbed by red blood cells (9), and inadequate haemostasis is likely to result in inactivation of the antiseptic applied to the wound. In view of the uncertainty about the value of povidone iodine, a further clinical trial on its efficacy in preventing wound infection following gastrointestinal surgery was felt to be justified.

Patients and methods

All patients undergoing elective abdominal surgery under the care of one consultant surgeon during a 15-month period were admitted to the trial, excluding those with a known allergy to iodine. Emergency cases were not entered in the trial as it was felt that it would be difficult to maintain strict adherence to the protocol. Patients undergoing large bowel surgery, who had a routine preoperative preparation which included oral neomycin and metronidazole, were allowed to enter the trial. There was no restriction on the administration of antibiotics postoperatively if this was indicated.

Skin preparation before operation was carried out with chlorhexidine gluconate in 70 per cent alcohol. Following closure of the peritoneum with catgut, the patients were allocated using a numbered randomization card in advent calendar form to one of two treatment groups: those who would receive povidone iodine and those who would not. Mistakes in randomization accounted for deletion of more treated than control patients. A bacteriology swab was taken from the wound, rubbing both sides thoroughly, and sent in Stuart's transport medium for culture. The patients in the treatment group were then sprayed with Disadine DP, a dry powder povidone iodine spray delivering 0·5 per cent available iodine. Spraying was performed from a distance of about 25 cm until the whole of the wound had received a light dusting of powder; those in the no treatment group were not sprayed. The wound closure was completed using Dexon for the muscle layers and silk for the skin, and when drains were used they were brought out through a separate stab incision.

A standard numbered form was completed for each patient, noting the patient's age, sex and build, the operation, its duration and the surgeon. The treatment group was not recorded on this form or in the patients' notes. All wounds were assessed after 5–7 days and again at 2 weeks by the house surgeon. Arrangements were made for patients who left hospital within this period to return to the ward for assessment. If discharge appeared at any time it was swabbed and cultured. The wounds were classified as *a*, major infection with copious purulent discharge, *b*, minor infection with scanty discharge of pus and *c*, non-infected. Bacteriological culture was performed routinely for aerobic and anaerobic organisms. Statistical analysis of the results was carried out using Fisher's exact probability test, the χ^2 test and the Wilcoxon rank sum test, where appropriate.

Results

One hundred and fifty-six patients were entered into the trial, of whom 3 were excluded from the analysis as they died within 2 weeks of operation. Of the remaining 153 patients who completed the trial, 71 were treated with povidone iodine and 82 were in the control group.

Table I shows the distribution of recorded variables in the two treatment groups. There was no significant difference between the groups in any of these factors. Of the 21 patients in the povidone iodine group who received postoperative antibiotics, 19 were given co-trimoxazole, ampicillin or amoxycillin for urinary or chest infections and 2 were given a cephalosporin for biliary tract infection. In the control group 12 patients received co-trimoxazole, ampicillin or amoxycillin for urinary or chest infections and 3 a cephalosporin for infected bile. The incidence of wound sepsis is shown in *Table II*. Overall, there were 7 infected wounds in the povidone iodine group and 20 in the control group, giving infection rates of 9·9 per cent and 24·4 per cent respectively. The lower sepsis rate in those patients who received povidone iodine was significant ($P < 0·05$, Fisher's exact test). There was no significant difference in the proportions of major and minor infections between the groups.

The operations performed were classified into four groups: biliary, gastroduodenal, intestinal and miscellaneous, and the effect of povidone iodine was examined separately in each (*Fig.* 1). There was a noticeably lower infection rate in the patients treated with povidone iodine in all except the biliary group. The

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Table I: DISTRIBUTION OF VARIABLES IN THE TWO GROUPS

	Povidone iodine	Control	
Total patients	71	82	*
Male	33	36	*
Mean age (yr)	56	55	†
Range (yr)	27–76	16–76	
Female	38	46	*
Mean age (yr)	61	59	†
Range (yr)	25–82	22–83	
Surgeon			
Consultant	65	74	*
Registrars	6	8	
Mean operative time (min)	59	55	†
Range (min)	20–105	20–105	
Patient's build			
Small	25	23	‡
Medium	37	43	
Large	9	16	
Type of operation			
Biliary	19	27	‡
Gastroduodenal	11	8	
Intestinal	32	41	
Miscellaneous	9	6	
Preoperative antibiotics	20	24	*
Postoperative antibiotics	21	15	*
Contaminated wound	27	23	*

* No significant difference Fisher's exact test.
† No significant difference Wilcoxon test.
‡ No significant difference χ^2 test.

Table II: INCIDENCE OF WOUND INFECTION

Treatment group	Infected Major	Minor	Total		Not infected
Povidone iodine	3	4	7	(9·9%)	64
Control	7	13	20	(24·4%)	62

reduction in infection rate in the intestinal group, from 34 to 12 per cent, appeared impressive but in view of the small numbers was not significant using Fisher's exact test.

The organisms responsible for initial wound contamination in the main types of operation are shown in *Table III*. In 28 patients a single organism was isolated, and in 22 there were two or three species. The greatest yield of organisms, as would be expected, was from the intestinal operations, where faecal streptococci and *E. coli* predominated. There was a notably low incidence of anaerobes grown from both initial wound swabs and from the subsequently infected wounds. Overall, 50 of the 153 patients in the study had positive cultures from the operative wound swab indicating contamination of the wound, and 15 of these later developed wound sepsis (*Table IV*). The contaminated wounds treated with povidone iodine had an infection rate of 11 per cent, which was significantly lower than the 52 per cent infection rate in those contaminated wounds in the control group ($P < 0{\cdot}05$, Fisher's exact test). Of the remaining 103 patients who had no growth from the operative swab, subsequent sepsis arose in 12 per cent. The application of povidone iodine to these wounds which were clean at the time of closure (i.e. negative operative culture) had no significant effect on the subsequent infection rate.

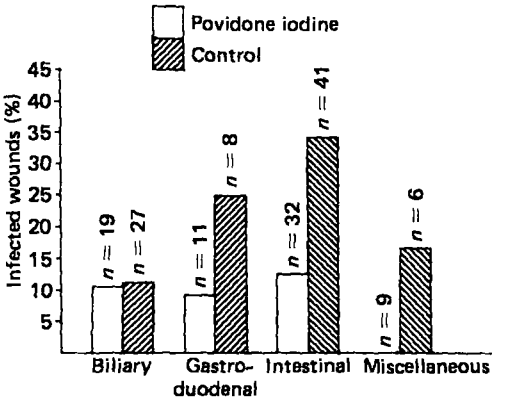

Fig. 1. Wound infection rates in patients treated with povidone iodine and control patients in the different groups of abdominal operations. (None of the patients treated with povidone iodine in the miscellaneous group developed wound infection.)

The organisms isolated from the infected wounds are listed in *Table V*. Of the 27 patients who developed wound sepsis, the organisms responsible were cultured in 21; a single organism was found in 7 patients, and 2 or more in 14 patients. In 5 patients no culture swab was obtained as the discharge occurred after they had left hospital and ceased before the second wound assessment at 2 weeks. In one patient pus was sent for culture and organisms were seen on microscopy but failed to grow. Fifteen of the 27 patients who developed wound infections had proved wound contamination prior to closure of the incision, and in 11 of them the same organisms were cultured later from the pus discharged by the septic wound. Thus, in those patients with a wound contaminated at operation, the same bacteria were responsible more often than not for any subsequent infection.

Although infected wounds grew multiple organisms twice as often as single organisms, the isolation of more than one contaminating species from the incision was not associated with an increased infection risk in this study. Five of the 22 patients with multiple organisms contaminating the wound subsequently developed wound sepsis, compared with 10 out of 28 patients with a single contaminant.

Discussion

This study shows a significant reduction in the incidence of wound infection in those patients whose incisions were sprayed with povidone iodine dry powder. Although a wide variety of operations was included, there was good matching between the treatment and control groups and no factors other than the use of povidone iodine could be found to explain the difference.

The use of antibiotics, in particular those given preoperatively, is likely to have influenced the overall incidence of sepsis, but as the administration of antibiotics was similar in the two treatment groups, it should not have afforded either group greater protection. The bacteria responsible for wound contamination during surgery were mostly normal gut flora such as *Streptococcus faecalis, E. coli*, klebsiella, proteus and *Clostridium perfringens*. There were also contaminants which may have come from the skin,

Table III: ORGANISMS GROWN FROM OPERATIVE WOUND SWABS

	Intestinal	Gastro-duodenal	Biliary	Miscellaneous
Faecal streptococci	14	5	4	4
Escherichia coli	12	1	5	3
Haemolytic streptococci	5	2	—	—
Staphylococcus albus	3	2	2	2
Staphylococcus aureus	1	—	—	1
Klebsiella	3	2	1	2
Proteus	1	—	—	1
Candida	1	—	—	—
Clostridium perfringens	1	—	—	—
Diphtheroids	1	—	—	—

Table IV: THE RELATION OF WOUND INFECTIONS TO OPERATIVE CONTAMINATION

Treatment group	Positive operative culture	Wound sepsis No.	%	Negative operative culture	Wound sepsis No.	%
Povidone iodine	27	3	11	44	4	9
Control	23	12	52	59	8	14
Total	50	15	30	103	12	12

Table V: ORGANISMS CULTURED FROM INFECTED WOUNDS

	Povidone iodine	Control
Escherichia coli	4	7
Faecal streptococci	1	4
Staphylococcus aureus	1	6
Staphylococcus albus	1	2
Haemolytic streptococci	—	2
Proteus	—	4
Bacteroides fragilis	—	1
Klebsiella	—	1
Clostridium perfringens	1	—
Diphtheroids	—	1

namely *Staphylococcus albus, Staphyloccus aureus* and haemolytic streptococci. The low incidence of anaerobic organisms both on initial swabbing and in septic wounds was surprising, as nearly half the operations were intestinal. Swabs were sent to the laboratory in Stuart's transport medium, and routine culture for anaerobes was performed. The explanation may lie, at least partly, in the use of preoperative oral metronidazole and neomycin in all the patients undergoing large bowel operations, as this regimen has been shown to abolish anaerobic but not aerobic sepsis (10). In addition, the colonic counts of *Bacteroides fragilis* have been demonstrated to be reduced significantly by oral metronidazole and neomycin, as has the count of *E. coli* but not of other faecal organisms (11).

Bacterial contamination at the time of operation is a major factor predisposing to the subsequent formation of pus in wounds (12) and the results of this study illustrate this with infection occurring in over half of the contaminated wounds that were untreated; however, the 12 per cent infection rate in those incisions which were bacteriologically clean before closure, was not inconsiderable. It is possible that these arose from secondary infection in the postoperative period, although significant contamination by bacteria at the time of operation may have been missed by the swabbing procedure. The marginally lower rate of infection in the clean wounds treated with povidone iodine (*Table IV*) was not significant but does clearly refute the suggestion that povidone iodine may cause wound infection by an irritative effect (6).

Although some antibiotics may be more effective than povidone iodine in reducing wound sepsis, there are dangers in the widespread use of antibiotics for prophylaxis because of side effects and the development of resistant strains. On the other hand, povidone iodine has the advantage of being harmless to the patient (13) and, furthermore, it has not been possible to demonstrate the development of any bacterial resistance to it (14). We suggest that it has a safe and useful role to play in the reduction of wound sepsis following abdominal surgery.

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International Vascular Symposium: final announcement

Vascular disease is now the commonest cause of death and illness in the Western world, and its surgical and medical treatment, together with the associated technology, are advancing rapidly.

The aim of the International Vascular Symposium is to stimulate discussion on controversial aspects of vascular disease. It will consist of invited papers from the International Advisory Committee, plenary lectures and free communications, including poster sessions. In addition, there will be an optional postgraduate course for surgeons-in-training and technicians' workshops. There will be a supporting social programme and a trade exhibition, forming an integral part of the meeting.

The Symposium will be held from 14 to 17 September 1981. It has been planned to follow the International Cardiovascular Society meeting in Athens, and will bring together surgeons, physicians and scientists treating vascular disease from major centres throughout the world: it will give them a unique chance to reach firm decisions concerning the management of their patients. Already more than 1200 enquiries have been received from people interested in attending from over 40 countries.

Registration papers and exhibition details are available from the Secretariat, Conference Associates IVS, 34 Stanford Road, London W8 5PZ (Tel. 01-937-7529).