

abdomen cavity and is free of surrounding connective tissue.

At post-mortem there is very little lateral movement of the oesophagus but 1–2 cm. of vertical movement. The most important structure preventing the stomach sliding into the chest is the phreno-oesophageal membrane (Fig. 2A). If this fibro-elastic membrane is intact, it is not possible to pull the stomach into the thorax by traction on the oesophagus in the majority of cadavers, but if it is cut one can always pull the stomach into the thorax. However, it is difficult to identify the phreno-oesophageal membrane in unfixed specimens and at surgery so that it may be only of limited value in the repair of sliding hiatus hernia.

### TREATMENT OF SLIDING HIATUS HERNIA

There is no correlation between the size of the hiatus and the formation of the hiatus by the crura and the presence or absence of hiatus hernia (Listerud and Harkins, 1958). There is therefore little logic in narrowing the oesophageal hiatus while repairing the hernia. It has been shown, in the vast majority of cases (Hill, 1967a, b), that provided the stomach is returned to the abdomen and anchored there, the sphincter mechanism is sufficient to prevent further reflux, and it would thus appear that provided the stomach remains in the abdomen, the simpler the operation for repair of hiatus hernia, the better.

### SUMMARY

Three easily recognized anatomical structures, the sling-muscle fibres, the transverse mucosal fold, and the internal and external cardiac notch or incisura, are the most constant landmarks in the lower oesophagus. It is suggested that this complex of structures may be taken as the level of the junction of the oesophagus and stomach. One or more of these structures can be recognized by the various

methods used in the diagnosis of sliding hiatus hernia. The phreno-oesophageal membrane is the most important structure preventing the stomach sliding into the thorax.

The oesophagus lies in a 'bed' of connective tissue within a pleural and pericardial covered tunnel and this connective tissue can be used as an anchor in the repair of sliding hiatus hernia.

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## THE USE OF CHLORHEXIDINE ANTISEPSIS IN CONTAMINATED SURGICAL WOUNDS

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PERFECT aseptic technique should result in primary healing of all clean surgical wounds. In cases where wounds are contaminated something more is required to ensure first-time healing. The use of local antiseptics has been reviewed by Garrod (1955) and although there is excellent evidence from animal experiments of the value of some agents, notably the acridines and chlorhexidine, the results from clinical trials are inconclusive. Most trials in which control figures are quoted are of the sequential type, and when concurrent controlled trials are carried out (Meleney, 1945; Williams and Miles, 1949; Fielding, Rao, Davis, and Wernigk, 1965; and Caro, Reynolds, and De Smith, 1967) neither simple antiseptics nor

topical antibiotic combinations show significant advantage.

Chlorhexidine (Hibitane, I.C.I.) has a wide antibacterial spectrum (Lawrence, 1960) and is effective in the presence of blood (Calman and Murray, 1956); some *in vivo* activity has been claimed (Shepherd and Kinmonth, 1962). It therefore seemed worth assessing its value in preventing the development of infection in a contaminated surgical wound. Appendicectomy offered the clinical conditions most suited to the experiment, being a common operation performed under aseptic conditions in a standard fashion but with the possibility of contamination from inside the abdomen.

**MATERIAL AND METHODS**

To standardize the cases only appendicectomies through gridiron (muscle-splitting) incisions were included in the trial. Data have been collected from 288 operations performed in the Bradford Hospitals and in St. James's Hospital, Leeds. The series was not quite consecutive because some of the cases were discarded when information was incomplete, or were missed, for example, during staff changeovers. It

- a. Primary healing.
- b. Presence or history of purulent discharge.
- c. A third category of 'induration' when, taking into account the local signs and clinical state and course of the patient, the observer thought that the wound was probably infected. This last observation was necessarily subjective, but as a number of such patients discharged pus at home it was thought to be valid.

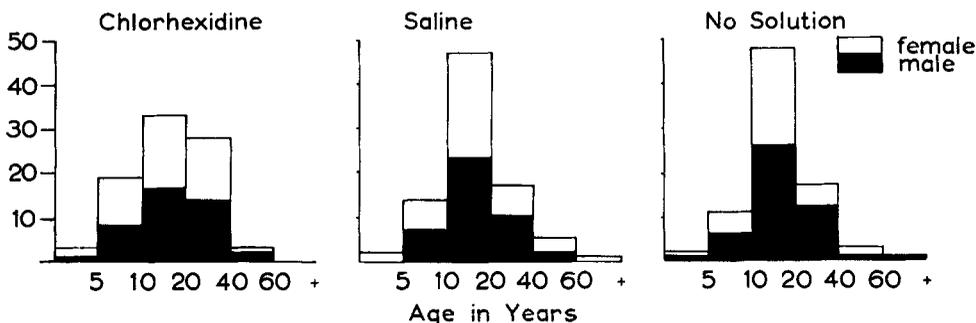


FIG. 1.—Numbers in each age-group.

Table I.—FINDINGS AT OPERATION

STATE OF APPENDIX	CHLORHEXIDINE	SALINE	NO SOLUTION
Normal	26 (29 per cent)	30 (33 per cent)	44 (52 per cent)
Mildly inflamed	41 (45 per cent)	31 (34 per cent)	28 (33 per cent)
Mildly inflamed with peritonitis	6 (7 per cent)	7 (8 per cent)	2 (2 per cent)
Gangrenous	7 (8 per cent)	14 (16 per cent)	7 (8 per cent)
Gangrenous and perforated	11 (12 per cent)	8 (9 per cent)	4 (5 per cent)

Bottles were prepared which contained 100 ml. of either 0.9 per cent saline or 0.5 per cent aqueous chlorhexidine. These solutions were sterile and their identity was known only to the hospital pharmacist who had numbered the bottles in a random manner. One of these solutions caused slightly more bleaching of the tissues than the other and subsequent tests have revealed that this was the chlorhexidine. As the fact was neither recorded nor memorable it is not thought to have altered the 'blindness' of the trial. The experiment consisted in instilling into the wounds of 2 out of every 3 patients the contents of a bottle of solution. A full 100 ml. was gradually

Table II.—INCIDENCE OF WOUND SEPSIS

STATE OF APPENDIX	CHLORHEXIDINE			SALINE			NO SOLUTION		
	Indurated	Purulent	Combined Total (per cent)	Indurated	Purulent	Combined Total (per cent)	Indurated	Purulent	Combined Total (per cent)
Normal	0/26	0/26	0	0/30	0/30	0	2/44	2/44	9
Mildly inflamed	0/41	0/41	0	0/31	0/31	0	0/28	3/28	11
Mildly inflamed but with peritonitis	0/6	1/6	17	1/7	2/7	43	0/2	1/2	50
Gangrenous	1/7	0/7	14	0/14	2/14	14	0/7	2/7	29
Gangrenous and perforated	1/11	9/11	91	1/8	5/8	75	0/4	2/4	50
Overall sepsis rate	12/91 (13.2 per cent)			11/90 (12.2 per cent)			12/85 (14.1 per cent)		

was decided that the normal treatment policy of the consultant in charge of the case (as regards drainage, use of antibiotics, etc.) should not be altered. As a consequence, 22 patients were given superficial drains or intraperitoneal drains which were brought out through the wound. It did not seem possible to lay down criteria for what constituted infection in these wounds and they have therefore been excluded from the analysis.

At the time of operation details of each patient were entered on a pro forma; the state of the appendix was recorded, together with the presence or absence of peritonitis. On the day of discharge the wound was inspected and placed in one of three categories:—

used, being allowed to spill over the edges as necessary and to stay in contact with the tissues for at least 2 minutes before being mopped out. The wound was then closed in the usual way. In every third patient admitted to the trial no solution at all was used. This was in order to test a suggestion that the physical act of washing might itself alter the sepsis rate. It was left to the surgeon to remember which was every third patient, hence the slight difference in numbers between this and the other groups.

**RESULTS**

The total numbers in the three groups were saline 97, chlorhexidine 99, no solution 92. From these

were excluded 7, 8, and 7 patients respectively whose drains were brought out through the wound. The age and sex distribution is shown in *Fig. 1*, whilst *Table I* gives the operative findings in the three groups. *Table II* shows the wound sepsis rates; the actual numbers of indurated and purulent wounds are given and then the sum of these totals expressed as a percentage of the cases in each group. The average length of stay in days (*Table III*) is inclusive of the days of operation and of discharge.

*Table III.*—AVERAGE LENGTH OF HOSPITAL STAY IN DAYS

STATE OF APPENDIX	CHLORHEXIDINE	SALINE	NO SOLUTION
Normal	8.2	8.3	8.8
Inflamed (all groups)	9.8	9.6	10.2

### DISCUSSION

The strength of chlorhexidine was ten times that recommended by the manufacturers for *in vivo* use, although well below any likely toxic level. No deleterious effects have been noticed from the use of the compound in this concentration. Reference to *Fig. 1* and *Table I* shows that the chlorhexidine group and the saline group are comparable; there are, however, throughout the series, minor differences in the 'no-solution' group. It is probable that the design of the experiment has allowed an unconscious bias to creep in during the selection of these patients despite the original intention of treating every third case in this way. Although the figures (and work by Taylor, 1961) suggest, therefore, that the mechanical act of washing may, in lightly contaminated wounds (i.e., when a normal appendix was removed), have reduced the sepsis rate, the point is not claimed.

It does not require further statistical analysis to show that chlorhexidine was no more effective than saline in preventing wound sepsis. Reference to *Tables II* and *III* shows that both crude sepsis rate and length of hospital stay are virtually identical. It seems reasonable to assume that the wound infection arises by contamination from the infected matter within the abdomen; if this is the case, then the two reasons for the inefficacy of chlorhexidine in reducing the infection rate are, first, that when used as described it fails to sterilize the wound, or, second, that the wound becomes reinfected from within once the disinfectant has been eliminated. A carefully controlled trial by Noon, Beall, Jordan, Riggs, and DeBailey (1967) showed that combined wound and intraperitoneal irrigation with an antibiotic mixture halved the sepsis rate in peritonitis due to bowel perforation. This reduction was entirely confined to

the incidence of wound sepsis. Intraperitoneal abscess was equally common in both trial and control groups. The figures suggest that wound infection is not dependent on continuing contamination from inside the peritoneal cavity and further that the search for an effective wound antiseptic may prove fruitful.

Systemic antibiotics are used sparingly in these hospitals and would only have been given to the most seriously ill. The overall sepsis rate for those given antibiotics was 18 of 25 (72 per cent) compared with 10 of 41 (24 per cent) in an apparently similar but almost certainly milder group who were not. It seems unlikely that the drugs had any beneficial effect on wound sepsis. Finally, it is worth noting that of the 201 patients from whom a normal or mildly inflamed appendix was removed (i.e., excluding cases of peritonitis, perforation, or gangrene) there were only 8 with minor wound troubles, all of whom might readily have been treated at home. One other required evacuation of a large haematoma, but the need for this was evident early. There were no other serious complications and a case could be made out for the much earlier discharge of these patients when home circumstances permit.

### SUMMARY

In a controlled blind trial the instillation of 0.5 per cent chlorhexidine into the wound at gridiron appendicectomy has been found to be ineffective in preventing subsequent wound sepsis or in reducing hospital stay.

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