colleagues at the South-western Regional Neurosurgical Unit, Mr. Douglas Phillips and Mr. Allan Hulme, who encouraged me to make use of the method in their cases and for allowing me access to their notes, and to specially thank Mr. G. F. Rowbotham, of the Regional Centre of Neurological Surgery, Newcastle upon Tyne, who also referred three cases to me. I am especially grateful to Dr. R. M. Norman and Dr. R. Sandry, of the Neuro-pathological Laboratory, Frenchay Hospital, Bristol, for the histological studies. I also wish to acknowledge the grant made by the University of Bristol Department of Surgery and to Professor Masservy and staff of the Veterinary College, Langford, for facilities for the preliminary experimental work.

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SERUM AMYLASE ESTIMATIONS IN DIFFERENTIAL DIAGNOSIS

BY

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"The diastase content of each individual is very constant, so that deviations from this normal value are significant" (Somogyi, 1938, 1941). The simplest laboratory investigation used in differentiating acute pancreatitis from other "acute abdomens" is the serum amylase estimation. Occasional rises encountered in other abdominal emergencies (Burnet and Ness, 1955), after the administration of opiates (Wapshaw, 1953), in mumps (Wolman *et al.*, 1947), after alcohol (Carter, 1945), in renal failure and other miscellaneous conditions (Polowe, 1946), have thrown doubt on its value. This study is a critical evaluation of a rapid "side-room" serum amylase estimation in conditions which often present as a differential diagnosis of acute pancreatitis. In addition, the case histories of those conditions other than acute pancreatitis where a rise was encountered have been analysed to try to demonstrate any common factors.

For the purposes of this study serum amylase estimations were carried out on 454 patients, divided as follows: (a) 45 cases of pancreatitis (41 acute and 4 chronic) in which the diagnosis was made in 32 cases on clinical grounds in conjunction with a raised serum amylase, in 11 cases by laparotomy, and 2 cases at necropsy (Table II); (b) 337 cases of conditions recorded as the differential diagnosis of acute pancreatitis; and (c) 72 miscellaneous causes of acute abdominal pain.

Method.—The method used was a modification of Somogyi's iodometric technique as described by King

TABLE I.—Serum Amylase Estimations in 454 Cases

Diagnosis	Serum Amylase (Units/100 ml.)				Total No. Cases
	< 200	200–355	400–640	800+	
Acute appendicitis ..	85	5	Nil	Nil	90
Exacerbation of peptic ulcer ..	81	6	"	"	87
Perforated viscus ..	20	12	2	1	35
Intestinal obstruction ..	29	5	Nil	Nil	34
Coronary thrombosis ..	30	Nil	"	"	30
Acute cholecystitis ..	55	5	"	1	61
Miscellaneous ..	67	4	"	1	72
Acute pancreatitis ..	Nil	2	12	27	41
Chronic pancreatitis ..	2	1	1	Nil	4

(1946). This measures the rate of hydrolysis of a standard starch solution (75 mg./100 ml.) by the amylase at 37° C. to erythrodextrin, achrodextrin, maltose, and glucose. Sampling was carried out at 30 seconds and one minute, then at two-minute intervals, reverting to intervals of 30 seconds when the end-point (a final disappearance of any blue colour) was neared. A normal range of 60 to 200 units/100 ml. was established.

Precautions

(a) Blood for serum amylase estimation was taken in all cases prior to operation or administration of morphine derivatives.

(b) McGeachin (1953) stated that no deterioration in serum amylase activity occurred in serum stored at 4° C. for periods up to 72 hours. Six out of 30 consecutive serum amylases of the early cases, redetermined after refrigeration at 4° C. for periods varying from 12 to 24 hours, showed some diminution in activity. In consequence, all estimations were carried out immediately the blood samples had been taken.

(c) Salivary contamination of the starch substrate was prevented by incorporating cotton-wool filters in all pipettes.

(d) Amylase-producing organisms may be introduced into the substrate and cause deterioration. The commonest significant natural contaminants, shown by daily cultures of the substrate, were starch-splitting organisms of the *Bacillus subtilis* group. Estimations using starch solution grossly contaminated with these cultures were compared with the results using uncontaminated starch and after seven days with a freshly prepared substrate. No deterioration occurred over this period provided the solution was refrigerated when not in use. In consequence starch substrate was prepared freshly every week, stoppered, and refrigerated between estimations.

(e) The difficulty of recognition of the end-point in artificial light or with bile-stained serum was obviated by the use of a white tile, on to which equal volumes of the sample and iodine were placed.

Acute Pancreatitis

The ranges of serum amylase encountered in the 41 cases of acute pancreatitis can be seen in Table I. Twenty-four were 1,100 units or above, and all determined within 24 hours of the onset of symptoms were 533 units or greater. A pre-operative diagnosis of acute pancreatitis was made only once without the aid of enzyme studies, and here laparotomy had to be resorted to for confirmation (Case 35, Table II). Four of the 15 other cases proved by laparotomy (Cases 3, 5, 19, and 57) died post-operatively, whereas only 2 of the 25 with a raised serum amylase treated conservatively were fatal.

TABLE II.—*Serum Amylase Values in Acute and Chronic Pancreatitis*

Case No.	Sex	Age	Differential Diagnosis	Mode of Confirmation	Serum Amylase (Units/100 ml.)	Eventual Outcome	Comments
1	F	45	Acute cholecystitis	Clinical	3,200	Recovery	
2	M	68	Ac. cholecystitis and perforation	"	1,600	"	
3	F	40	Perforation ..	Laparotomy	650	Death	
4	M	65	Ac. cholecystitis and int. obstruction	Clinical	533	Recovery	
5	F	65	Perforation ..	Laparotomy	None	Death	
6	F	65	Int. obstruction	"	100	Recovery	Chronic
7	F	59	Perforation and ac. cholecystitis	Clinical	3,200	"	
8	F	46	Perforation and biliary colic	"	3,200	"	
9	F	66	Cor. thrombosis, perforation, and exacerbation of duodenal ulcer	"	1,600	"	Confirmed at laparotomy 6 months later
10	F	73	Perforation or exacerbation of duodenal ulcer	"	533	"	
11	F	72	Cor. thrombosis and exacerbation of duodenal ulcer	"	1,600	"	
12	M	60	Ac. cholecystitis and exacerbation of duodenal ulcer	"	800	"	Laparotomy refused
13	M	66	Perforation ..	"	1,100	Death	P.M. refused
14	F	47	Pancreatitis ..	"	1,600	Recovery	
15	M	44	Perforation ..	"	3,200	"	
16	M	67	Perforation of duodenal ulcer	Laparotomy	400	"	
17	M	55	Pancreatitis ..	Clinical	1,600	"	
18	M	50	Exacerbation of duodenal ulcer	"	533	"	Amylase 2 days after onset
19	F	78	Ac. cholecystitis	Necropsy	None	Death	
20	F	66	" "	Clinical	1,600	Recovery	
21	F	69	" "	Laparotomy	533	"	Laparotomy 2/12 later confirmed
22	F	68	Ac. appendicitis	"	None	"	
23	F	65	Perforation	"	"	"	
24	F	63	Perforation or cor. thrombosis	"	"	"	
25	M	72	Carcinoma of stomach	Clinical	320	"	Chronic
26	F	68	Perforation ..	Laparotomy	400	"	Post-op. amylase
27	F	55	Biliary colic ..	Clinical	800	"	
28	F	67	Stone in common bile duct	"	800	"	X-ray confirmation
29	M	61	Cholecystitis ..	Laparotomy	620	"	
30	M	47	Exacerbation of duodenal ulcer	"	640	"	
31	M	73	Cholecystitis ..	Clinical	1,600	"	
32	F	41	Biliary colic ..	"	1,600	"	
33	M	43	Cholecystitis ..	"	1,066	Death	P.M. confirmed
34	F	65	Cor. thrombosis or cholecystitis	"	1,600	Recovery	
35	F	46	Pancreatitis ..	"	400	"	Amylase 2 days after onset
36	F	47	Ac. cholecystitis	"	3,200	"	
37	M	25	Perforation or cor. thrombosis	Laparotomy	1,600	"	Post-op. amylase
38	F	47	Pancreatic cyst	"	400	"	Chronic
39	F	46	Perforation ..	Clinical	230	"	3 days post-op.
40	F	45	" ..	Laparotomy	None	"	
41	M	44	" ..	Clinical	1,600	"	
42	F	65	" ..	Laparotomy	320	"	2 days after onset
43	F	68	Carcinoma of stomach	"	None	"	
44	F	82	Ac. cholecystitis	Necropsy	80	Death	5 days after onset. Chronic
45	F	71	Ac. cholecystitis or ac. appendicitis	Clinical	None	Recovery	Urinary diastase 250 units
46	F	57	Hydronephrosis	Laparotomy	"	"	
47	M	72	Coronary thrombosis or perforation	"	"	"	Urinary diastase 500 units
48	F	63	Perforation ..	"	"	"	
49	F	72	Ac. cholecystitis	"	"	"	

TABLE II (continued)

Case No.	Sex	Age	Differential Diagnosis	Mode of Confirmation	Serum Amylase (Units/100 ml.)	Eventual Outcome	Comments
50	F	73	Biliary colic ..	Clinical	1,600	"	
51	F	65	Ac. cholecystitis	"	533	"	1 day after onset
52	F	66	" "	"	1,600	"	
53	F	68	" "	Laparotomy	None	"	Chronic
54	M	55	Pancreatitis ..	Clinical	2,400	"	
55	F	45	Ac. exacerbation or perforation or ac. cholecystitis	"	1,600	"	
56	F	35	Ac. cholecystitis	"	1,600	"	Post- <i>puerperal</i> pancreatitis
57	F	70	Perforation ..	Laparotomy	1,100	Death	1 day after onset
58	F	43	Ac. cholecystitis	Clinical	400	Recovery	3 days after onset

The age range was 25 to 78 years, with an arithmetic mean of 59 years (see Chart). The ages recorded showed two well-marked frequency peaks between 40 and 45 years and again between 60 and 70 years. Forty-one cases were female and only 17 male.

Age incidence of patients with acute pancreatitis.

The serum amylase generally fell rapidly in 48 to 72 hours in those cases with an initially high level, but was still above the upper limit of normal in a moderate number of cases after seven days.

Three cases in this group are of particular interest in that they reflect on the varied aetiology of acute pancreatitis and on possible explanations of a raised serum amylase in other conditions.

Case 28.—An obese woman of 67 was admitted for routine cholecystectomy and was found at operation to have, in addition to chronic cholecystitis and cholelithiasis, numerous small pigment stones in the common bile duct. A choledochogram on the 16th day after the operation showed a filling defect suggestive of a calculus at the lower end of the common bile duct. On the 18th day she complained of severe colicky pain in the right hypochondrium, and this was accompanied by generalized guarding and tenderness. The serum amylase at this stage was 800 units/100 ml. No morphine derivatives had been given within the previous 14 days. The "T" tube drainage was replaced by a small catheter, continuous suction was applied and after a stormy convalescence she fully recovered. It is a reasonable assumption that this patient had a stone at the lower end of the common bile duct which obstructed the ampulla of Vater, causing reflux of bile along the pancreatic duct and a mild pancreatitis.

Case 30.—A man aged 47 was admitted as a case of acute exacerbation of a duodenal ulcer and treated

conservatively with apparent success; three days later, however, he had a severe recurrence of epigastric pain. This was accompanied by profuse vomiting. On examination there was rebound tenderness over the whole upper abdomen. The serum amylase was 640 units/100 ml., and laparotomy one hour later revealed an abscess on the lesser curvature of the stomach which had ruptured into the pancreas. This case well illustrates how inflammation of adjacent viscera may involve the pancreas and cause a rise in serum amylase.

Case 56.—An obese woman of 35 experienced a sudden attack of severe colicky upper abdominal pain two weeks after the birth of her child. The pain was unremitting, lasting 36 hours—that is, until analgesics gave relief. The only physical sign was epigastric tenderness. The serum amylase on admission was 1,600 units/100 ml., and all subsequent investigations, such as barium-meal and Graham's x-ray etc., were negative. I regard this case as an example of post-partum pancreatitis as described by Joske (1955).

Perforated Peptic Ulcer

It is significant that 10 out of the 14 cases (Table II) of acute pancreatitis subjected to laparotomy had a differential diagnosis of perforated peptic ulcer, and *pari passu* with this the highest percentage of cases with a raised serum amylase (15 out of 35 cases) occurred in this disorder. However, in only three cases were the figures above 533 units/100 ml., and in one of these, already described (Case 30), the ulcer had given rise to a perigastric abscess which subsequently ruptured into the pancreas. The highest value recorded was 1,600 units/100 ml. in a middle-aged man who had an anterior perforation of the first part of the duodenum. The second, of 640 units/100 ml., occurred in a similar case of perforation of the duodenum, but was accompanied by pre-gangrenous changes in the ileum, and this patient subsequently died. In neither case was the pancreas adequately examined, and there was no obvious explanation for the rise. The 12 remaining cases had values ranging between 200 and 400 units/100 ml., generally well below those encountered in acute pancreatitis of similar duration. Probst et al. (1949) believe that serum amylase could be of value in differentiating an anterior from a posterior duodenal perforation. Table III, an analysis of cases with amylase values of 200 units/100 ml. and over, fails to confirm this.

TABLE III.—Serum Amylase Values in Cases of Perforated Peptic Ulcer in Relation to Site and Duration of Perforation

Serum amylase Site .. Duration in hours ..	200 Ant	200 Post	260 Ant	266 Post	320 Ant	320 Ant	375 Ant	640 Post	640 Ant	1,600 Ant
	3	4	72	5	2½	8	5	2	48	3½

Intestinal Obstruction

In this group only 5 out of 34 estimations were above 200 units/100 ml., and the highest recorded was 355 units/100 ml. Two of these are of interest in that their histories and findings suggest a possible explanation of this rise.

Case A.—A man aged 72 was admitted with abdominal distension and vomiting. He was hypertensive, and on examination had minimal tenderness and guarding in the epigastrium. His symptoms subsided on conservative treatment, but a subsequent barium enema showed marked distension of the small bowel and fluid levels suggesting a partial obstruction. A barium meal at a later date showed a fullness in the region of the pancreas with displacement of the duodenal loop. The serum amylase on two

successive days was 320 units/100 ml. As the radiologist suggested, this patient probably had a pancreatic cyst, a condition sometimes associated with a high serum amylase.

Case B.—A woman aged 54 complained of severe generalized colicky abdominal pain of sudden onset, associated with vomiting and diarrhoea of 24 hours' duration. On examination she was shocked and hypotensive, and had generalized abdominal guarding, rigidity, and absent bowel sounds. The serum amylase was 320 units/100 ml., and a diagnosis of a perforated viscus was made. Laparotomy revealed gangrene of the whole of the small intestine, suggesting a mesenteric thrombosis. A subsequent necropsy confirmed this. The thrombus was occluding the whole of the lumen of the superior mesenteric artery for a distance of 3 cm. from its origin.

It is reasonable to assume the rise in serum amylase in Case B resulted from pancreatic ischaemia secondary to obstruction of the inferior pancreatico-duodenal artery. By contrast, a fatal case of a mesenteric embolus obstructing the first major branch of the superior mesenteric artery had a normal serum amylase. This differed only in that the patient was not hypotensive when the serum amylase was determined, the clinical presentation of these two cases being identical.

Coronary Thrombosis

One of the 12 cases of acute pancreatitis (Case 9) in which E.C.G. recordings were made showed changes suggestive of a posterior infarction. Burn (1951) remarked on the close association of focal pancreatitis and coronary thrombosis at necropsy—later confirmed by other workers. In two of his cases the serum amylase had been markedly raised before death. He failed, however, to indicate whether morphine derivatives had been administered, and by contrast none of the 34 cases of myocardial infarction studied in this series had a serum amylase greater than 200 units/100 ml.

One case deliberately investigated at intervals after ½ gr. (10 mg.) of morphine had been given intramuscularly gave the following results (the serum amylase figure immediately prior to injection being 160 units/100 ml.

Time after Injection ..	1½ hours ..	3 hours ..	12 hours ..	18 hours ..
Serum amylase ..	353 units ..	800 units ..	640 units ..	320 units ..

These values correspond to those observed in normal individuals after opiates by Wapshaw (1953), the rise still being maintained after 18 hours.

Acute Cholecystitis

Table II shows that 21 out of 53 cases of acute pancreatitis had a provisional diagnosis of acute cholecystitis. Only 6 of the 61 cases with this disease showed a rise of serum amylase, but none were within the range commonly seen in acute pancreatitis. The greatest activity was 800 units/100 ml., recorded in only one case. All five cases were obese and hypertensive, but as both these were common findings in this group they must be accepted as of no significance.

Acute Appendicitis

Five cases of 90 investigated in this group had a raised serum amylase. The elevations were slight, the maximum being 266 units/100 ml. This was recorded in two fatal cases, one of which was found at necropsy to have polycystic kidneys. It is conceivable that inadequate urinary amylase excretion, concomitant with the hypotension existing in both these cases when the determinations were made, could account for the slight

risers. There was no constant relation between the severity of the inflammation and the serum amylase level.

Exacerbation of a Peptic Ulcer

Only 6 out of the 87 cases of exacerbation of peptic ulcer investigated had figures greater than 200 units/100 ml., and the highest recorded (one case) was 355 units/100 ml. No explanation for these slight elevations could be drawn from detailed analysis of these case histories.

Miscellaneous Group

Barratt-Boyes (1957) describes six cases of ruptured aortic aneurysm, all with a normal serum amylase, in which the first differential diagnosis was acute pancreatitis.

This group included two cases of sacular arteriosclerotic abdominal aneurysms of identical size and distribution—that is, extending from the renal arteries to the bifurcation of the aorta. In the first the serum amylase, recorded two days after retroperitoneal rupture when the patient was shocked and hypotensive, was 800 units/100 ml. The second, determined when the preliminary leak was occurring (shown at laparotomy) and the patient hypertensive, was 230 units/100 ml. Here, compression or obliteration of the inferior pancreaticoduodenal artery, plus diminished urinary amylase excretion in the first case (secondary to the hypotension), were probably responsible for the rise in serum amylase.

One of the two cases of malignant hypertension in this group, with a grade IV retinopathy in a terminal phase, had a serum amylase of 320 units/100 ml., whereas the second, less severely affected, had a normal value. The rise in the first case may have resulted from pancreatic arteriolar damage or have been secondary to poor urinary amylase excretion.

Levels of 355 units/100 ml. in a proved case of sarcoidosis and 320 units/100 ml. in a case of pyrexia of unknown origin with associated meningism were encountered in this group. The former, sustained on two successive days, might conceivably have been due to pancreatic involvement in the sarcoid process.

The second patient had some injection of the fauces, cervical lymphadenopathy, and raised E.S.R., but all other laboratory investigations were negative. Unfortunately, serological investigations to exclude a mumps encephalitis were neglected.

Ten cases of renal colic and 10 with ruptured ovarian cysts included in this section had normal amylase values.

Discussion

This simple estimation, shown by Burnett and Ness (1955) to be suitable for ward side-room use, is as reliable as more detailed methods provided the precautions outlined in its description are observed and the investigator is solely concerned with a rise in amylase activity. Table I demonstrates the consistently high values which occur in acute pancreatitis, as compared with those encountered in conditions which are often its differential diagnosis. Its value in differentiating coronary thrombosis, acute cholecystitis, exacerbation of a peptic ulcer, and acute appendicitis from acute pancreatitis is well substantiated by these findings. The serum amylase in all cases of acute pancreatitis, determined within 24 hours of the onset of symptoms, was 533 units/100 ml., or greater, but in

five cases investigated after long periods values in the range 200 to 400 units/100 ml. were encountered.

Interpretation of results must therefore not only take into consideration the previous administration of morphine derivatives and any co-existent parotitis, but also whether the symptoms are subsiding and their duration prior to the estimation.

Critical levels quoted by previous authors are to be deplored, as occasionally very high values are encountered in other conditions, particularly in cases of perforated peptic ulcers where there is no demonstrable macroscopic pancreatic disease. It cannot be too strongly stressed that the serum amylase estimation is never pathognomonic and should never be allowed to outweigh the clinical assessment. The possible sources of serum amylase are pancreas, salivary glands, serozymogenic glands of the small intestine, and amylase-producing intestine organisms.

The rise encountered in conditions other than acute pancreatitis is relatively easy to explain in some cases; for example, Case 28—obstruction of the ampulla of Vater with a small stone and reflux of bile up the pancreatic duct; while in Case 30 actual local destruction and inflammation of pancreatic tissue by a perigastric abscess was demonstrated at laparotomy. Similarly, partial or complete obstruction of pancreatic arteries in vascular catastrophes such as ruptured aortic aneurysms seems a logical explanation of the raised serum amylase.

The slight rise encountered in other intra-abdominal conditions, however, is more difficult to account for, but presents an interesting problem. Burnett and Ness (1955) postulate that the raised values encountered in perforations are related to duration and degree of peritoneal contamination, with consequent absorption of the normal pancreatic enzymes. It was not possible to confirm this (Table III). An estimation of these factors is fraught with difficulty, as the duration is affected by the presence or absence of an omental seal and it is impossible to measure the degree of peritoneal contamination with any accuracy. Dilatation, inflammation, or decreased viability of the intestinal wall, such as occurs in intestinal obstruction or an acute appendicitis, might result in increased absorption of intestinal amylase from glands or occasionally from the amylase-producing organisms resident there (Burnett and Ness, 1955).

Normal urinary amylase concentration is two to six times the normal serum amylase (Polowe, 1946), hence any impairment of this normal excretion as the result of frank renal disease or secondary to hypotension might lead to a rise in the serum amylase level. This effect of renal disease is well illustrated by a case which at necropsy had post-operative strictures of both ureters, bilateral pyonephrosis, and a perinephric abscess. The N.P.N. was 160 mg./100 ml., serum amylase 400 units/100 ml., and a random urine amylase less than 5 units, before death. Hypotension (a systolic pressure below 80 and a diastolic less than 40) occurred over varying periods in 12 cases of this series, and 10 of these had values ranging from 200 to 400 units/100 ml.

Antiperistalsis with reflux of intestinal secretions into the pancreatic duct, or associated neuromuscular imbalance leading to a spasm of the sphincter of Oddi, can result in activation of trypsinogen and thus account for the occasional raised amylase in intestinal

obstruction. Both these conditions may occur as a result of excessive vomiting. In the present series no significant association could be demonstrated between excessive vomiting and a raised serum amylase. For example, out of 11 cases having severe protracted vomiting, seven normal values and the remaining four, with raised levels, were also hypotensive. Dehydration, enhanced by vomiting and consequent vagal stimulation, could give rise to inspissation of the pancreatic secretion and occlusion of the smaller pancreatic ducts. This, in the presence of an actively secreting pancreas (after a meal), could lead to rupture of acini and enzyme absorption into the blood stream. Twelve cases in this series were grossly dehydrated, but only four had a raised serum amylase, and of these two were in addition hypotensive.

Adrenalectomy and hypophysectomy in dogs are both followed by a transient rise in serum amylase (Cope *et al.*, 1938), suggesting that these glands are intimately connected to the exocrine pancreas. Does the exocrine pancreas respond to stress or could adrenal cortical depression in some cases account for a rise in the serum amylase? There was no constant relation in this series between cases clinically described as "shocked" and the serum amylase level. Six cases of hormone-dependent breast carcinomatosis subjected to hypophysectomy or combined with adrenalectomy had serum amylase estimations determined pre- and post-operatively. None of these cases showed any significant post-operative rise, the highest recorded figure being 230 units/100 ml.

From these analyses of the case histories it is probable that many factors may be operative, either singly or together, in causing a rise in the serum amylase in an individual case. These variables must obviously be taken into consideration in the evaluation of any raised serum amylase.

Summary

A simple method of serum amylase estimation is critically reviewed and precautions essential in its use are described.

Serum amylase values in 41 cases of acute pancreatitis, 320 cases of conditions clinically confused with acute pancreatitis, and 89 miscellaneous conditions clearly substantiate the value of the serum amylase estimation in the differential diagnosis of acute abdominal pain.

Theories of the mode of production of a raised amylase in conditions other than acute pancreatitis are reviewed and, where possible, correlated with the clinical findings.

I appreciate the co-operation shown to me by the surgical staff at Walton Hospital, Liverpool. I thank Dr. H. E. Vickers and Miss P. Kennedy for their encouragement and helpful criticism during the preparation of this paper.

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"PHISOHEX" AND SAFER SURGERY

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Widespread concern about cross-infection in surgical wards has led to a more precise revaluation of many aseptic techniques, but some long-established and comforting rituals tend to escape this scrutiny.

The need for an improved surgical scrub technique became apparent during an investigation into sepsis rates in two surgical units of this hospital group. Using a standard classification of sepsis (Howe, 1957), it was shown that of 600 clean operations performed over a period of several months 10% developed major sepsis. Each unit had 33 beds for male and 33 for female patients, and the total of 132 beds was increased if surgical emergencies demanded. A wide variety of surgery was performed, including many emergency cases, but only those where it was believed that primary healing should occur were included in the study.

As part of the study an investigation of contact cross-infection in operating theatres was made. The incidence of glove puncture was found to be 30% in over 1,000 gloves, and experiments confirmed that organisms rapidly passed from the operator's skin to the glove exterior provided the glove was punctured and wet (Webster, 1958). Contamination therefore seemed to be possible in virtually every operation where the minimum team was three and where six gloves were either on or near the operating site. There was great variation in the time taken for a surgical scrub, the maximum being eight minutes using brush, soap, and running water. Surgeons apparently chose cleaning agents haphazardly or by individual preference from three different cake soaps, all available in the basins. These were common yellow or green soap and a hexachlorophane soap.

As the most troublesome of hospital pathogens, *Staphylococcus aureus*, is resistant to ordinary cake soap (Bayliss, 1936), it seemed possible that the adoption of a standard surgical scrub technique capable of achieving and maintaining the superficial bacterial cleanliness of the hands throughout the operation would minimize one possible source of the contamination of clean wounds. Several chemical products said to be capable of a sustained superficial sterilizing effect upon the skin are now available; of these the most desirable would appear to be a true soap substitute which simultaneously solves the problem of soap alkali allergy. An experiment was accordingly made with a soapless detergent cream incorporating 3% hexachlorophane, with a pH of 5.5, the same as skin. The soapless detergent, "phisoderm" is a water-miscible anionic detergent cream. It contains a sulphonated ether, wool fat, cholesterol, and petrolatum, and is a surface tension reducent 40% more powerful than soap. The remarkable effectiveness of