SELECTIVE SURGERY FOR GASTRODUODENAL HAEMORRHAGE*

BY

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In the treatment of gastroduodenal haemorrhage the current methods of selecting patients for emergency surgery cause many of the most dangerously ill patients to be transferred to the care of the surgeon, with whom, therefore, rests considerable responsibility for bringing the overall mortality of this condition to an irreducible minimum. The success of the surgeon will depend upon such factors as the judicious selection of patients, the proper preparation of the patient for surgery, and the successful location and elimination of the bleeding-point. In 1956 we reported a study of circulating blood volumes in gastroduodenal haemorrhage and made suggestions regarding the preparation of patients for emergency surgery (Tibbs and Leslie, 1956). As a next step, it was decided to carry out a planned investigation of the surgical treatment of gastroduodenal haemorrhage to test not only the suggestions made in our previous paper but also to study other factors affecting the outcome in this form of treatment. The paper now presented reports the findings and conclusions in a group of patients treated surgically according to the principles we wished to examine.

Ideally, proper preparation and maintenance of the circulatory state during operation should permit the operation of choice to be carried out in nearly every case without undue anxiety, and this, in fact, has been our experience. Making the operation safe in this way is of fundamental importance, but attaining the object of the operation—complete control of the haemorrhage—is scarcely less important. With this in mind, the accurate location of the site of haemorrhage was attempted in all our patients. This was undertaken in order to determine how often the bleeding-point could be accurately located, and whether this was a desirable step in precise control haemorrhage.

The secondary objects of our study were to consider whether our selection of patients for operation was reasonable, to determine by long-term follow-up our success in eradicating this basic condition causing haemorrhage (as distinct from mere control of haemorrhage), and to learn the causes of failure, mortality, and morbidity.

Material and Methods

A detailed policy of surgical management was laid down at the outset, and a consecutive series of 67 patients operated upon for acute gastroduodenal haemorrhage were treated in accordance with this policy. All such patients in whom surgery was undertaken by me between the years 1953 and 1957 have been included without exception; they were all operated upon as emergencies. These cases were selected for operation on the following criteria: (a) They had already required 6 bottles (3,240 ml.) or more of transfused blood to maintain a reasonable circulatory state. (b) They were showing evidence of continuing or renewed haemorrhage (as judged by haematemesis, pulse rate, or blood-pressure) within a few days of admission to hospital; that is to say, they were

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not responding to the regime (basically that described by Ogilvie *et al.*, 1952) administered within the hospital.

Patients of all ages and both sexes were included; no case, however adverse, was refused operation if this course appeared to offer any prospect of saving the patient otherwise despaired for. All cases were operated on because it was believed that the bleeding came from a curable lesion of the oesophagus, stomach, or duodenum, but on occasion lesions not falling in this category were disclosed.

The patients were prepared for operation in the following way.

(1) Operation was arranged for one and a half hours after the decision to operate had been made.

(2) During the interval, blood was given at the rate of 1 bottle (540 ml.), every 20–30 minutes until the following requirements were met: (a) the pulse rate was brought below 100 a minute; (b) the blood-pressure was restored to a systolic pressure of at least 110 mm. Hg and a diastolic pressure of at least 75 mm. Hg; and (c) the hands were restored to good colour.

When these requirements were met the transfusion was slowed down until the actual operation. If a patient failed to improve, it was usually considered that the haemorrhage was outpacing transfusion, and operation was undertaken without delay under the cover of rapid blood transfusion; a careful reappraisal was, of course, made to consider whether the diagnosis was correct or if some complicating factor was present.

The estimation of plasma protein, as suggested in our previous paper, was not used, because so often the difficulties in the emergency procedure made it necessary to omit all excepting bare necessities; experience without its guidance was so satisfactory that we did not persist with this method.

Operation was undertaken with the intention: (1) to locate accurately the site of haemorrhage and to identify the cause; (2) to control haemorrhage by the most efficient method, preferably by excision, but as an alternative by exclusion or suture of the bleeding-point; and (3) to treat surgically the condition causing haemorrhage.

In order to reduce variable factors, only one surgeon (myself), by arrangement with my colleagues, undertook management of, and operation upon, these cases; in fact, they represent nearly all the cases coming to surgery from a medical clinic of approximately 60 beds and occasional cases from other medical wards in the hospital. Anaesthesia was administered by a restricted group of anaesthetists.

The first concern was the welfare of the patient, and, if this conflicted with the programme given above, naturally it was modified; it was, however, rarely necessary to depart to any significant degree from the routine given.

A postal follow-up was conducted recently. This was six years after the first case and six months after the most recent one.

Emergency surgery upon cases with portal hypertension was avoided as a matter of policy, and this class of case is therefore virtually excluded from this paper.

Results

Decision to Employ Surgery

The criteria of selection for surgery were designed to avoid those cases which were likely to stop bleeding

spontaneously and to select only those which, by the severity and persistence of haemorrhage, were likely to provide the fatalities of this illness.

In retrospect, the following facts were observed:

The average time between the initial haemorrhage (at home) and operation was seven days; the average time between admission and operation was four days. This suggests that reasonable opportunity to stop bleeding spontaneously had been given.

Out of 49 patients with adequate records, 33 had actually fainted from loss of blood at some stage prior to operation and another 13 had experienced dizziness or giddiness.

Out of 61 patients with adequate records, 30 had at least once before operation shown a blood-pressure below 100 mm. Hg systolic; many of these were already being protected by blood transfusion, and for a number a figure below 100 mm. Hg systolic would represent a severe drop in blood volume because the patient was normally hypertensive (Tibbs and Leslie, 1956).

Eight patients were at one stage *in extremis*, with blood-pressure unrecordable or below 50 mm. Hg systolic: only one of these died.

All patients had shown recurrent haemorrhage after admission, the unfavourable significance of which is well recognized (Avery Jones, 1947); all patients had required about 6 bottles (3,240 ml.) or more of blood and had therefore presumably bled at least to this extent.

At operation, 39 cases had a visible and often palpable artery protruding from the ulcer base. Sixteen of these were actually bleeding or bled at a touch; 11 of these bled torrentially at operation.

These points may indicate that most of these patients were liable to severe haemorrhage and either would have required a large number of blood transfusions (and on recovery still retain a potentially dangerous or symptom-causing lesion) or would have died. It is concluded that the criteria for operation provide a reasonable compromise between unnecessary surgical intervention and undue delay in coming to surgery.

Timing of Operation

Early in the series it was found that postponing the operation until a convenient time could be dangerous to the patient. It was concluded that, if the patient had demonstrated a dangerous tendency to bleed heavily and repeatedly, then operation should be undertaken as promptly as possible after a decision to operate had been made. The time of one and a half hours was chosen because it gave good time for resuscitation, cross-matching of sufficient blood to cover the operation, and preparation of a theatre and/or terminating of a preceding operation.

Time was never given for further resuscitation because if the patient failed to respond within one and a half hours, having been given adequate blood, it indicated either an urgent need for operation in order to stop the continuing haemorrhage or that the diagnosis was at fault.

Practical experience with the 67 cases made it clear that this was a sound policy: no patients were lost before or during operation, and in neither of the two patients dying within 24 hours of operation was death in any way related to mistiming the operation or to inadequate preparation for operation (Cases 1 and 2). The majority of patients gave no real anxiety at any stage, even those in whom anaesthesia and operation were begun under cover of heavy continuous transfusion because uncontrolled haemorrhage was negating efforts at resuscitation (5 cases).

It is concluded that the policy of fixing the operation for one and a half hours after the decision to operate has been made is both practical and sound.

Pre-operative Blood-transfusion Requirements

The policy of pre-operative blood transfusion has already been described. This was designed to bring the patient to operation in the safest possible condition. The average amount of blood given pre-operatively was 2.8 bottles (1,510 ml. of citrated blood—each bottle containing 420 ml. of whole donated blood and 120 ml. of citrate solution).

Only two cases gave serious difficulties during operation.

Case 1.—A man aged 50 with a "gastrostaxis" (possibly a diffuse haemorrhagic gastritis) bled so heavily from the gastric remnant after closing the abdomen that his circulatory state was considered too critical for re-entry of the abdomen (a decision later regretted). His condition was never mastered, and after several hours and 17 pints (10.6 litres) of blood transfusion he succumbed.

This may have been an inadequate operation, but was not an inadequacy of pre-operative preparation.

Case 2.—A man aged 54 (also referred to as Case O by Tibbs and Leslie, 1956) was admitted to hospital in a moribund state, but with massive transfusion and noradrenaline a recordable blood-pressure was obtained; however, marked peripheral cyanosis was present. He was considered to be in a virtually irrecoverable circulatory state, but because repeated haematemesis of bright-red blood made it clear that heavy haemorrhage continued, operation was undertaken. This was concluded successfully with resection of the causative gastric ulcer, but his circulatory state did not improve, and he died 12 hours later.

It seems likely that a period of extreme hypotension had initiated irreversible changes and the patient had entered a state unresponsive to blood transfusion.

In all other cases operation was performed in an unhurried manner permitting the procedure of choice to be carried out.

The amount of blood transfused at operation was at the discretion of the anaesthetist, who gave sufficient blood to balance any obvious losses at operation or to achieve and maintain, so far as he could assess, a relatively normal blood volume.

Of the 67 patients, 21 showed a moderate or severe fall of blood-pressure at operation (16 of these were over 60 years of age; this may be significant, because less than half of the patients were over 60 years of age). Seven recovered their normal blood-pressure without any special measures, seven recovered their normal blood-pressure only when ouabain was given by the anaesthetist (all of these were over 60 years). Five improved only when haemorrhage was controlled and two with a more rapid transfusion. It would appear that the elderly myocardium may benefit from support with ouabain.

It is concluded that the policy adopted brought the patients to operation in a state that was either satisfactory or allowed safe conduct provided no complicating factor beyond immediate control was present, the cause for bleeding was adequately dealt with, and, it is scarcely necessary to say, a skilled anaesthetist manipulated blood transfusion and ouabain administration.

The average amount of blood given during and immediately after operation was 2.75 bottles (1,480 ml.). The majority of patients required no further transfusion, and it was clear that their blood-volume requirement had been adequately balanced. Thus the average

amount of blood transfusion to prepare for and conduct operation for haematemesis was from 5 to 6 bottles (2,700–3,240 ml.). It must be borne in mind that many of these patients had been maintained, so far as was possible, in a state of near normal blood volume until a further haemorrhage prompted the surgeon to take over; cases less well cared for might require a larger quantity of transfused blood to see them safely through their operation. The maintenance of a reasonable blood volume is undoubtedly the most important single safely factor in the operation.

The blood requirements were in good accord with those that might be expected from our previous blood-volume studies.

Location of the Source of Haemorrhage

The policy of seeking the source of haemorrhage as an initial step in the operation often involved a gastrotomy, and naturally the question arises whether this was really necessary or whether a "blind" gastrectomy would have sufficed when the source of bleeding was not obvious. Determination of the site of haemorrhage, or at least a guess based upon high probability, is essential for successful control of the bleeding by surgical operation. There are various possible means of determining this, and these are now considered.

Circumstantial Factors: Age and Sex

Table I relates these two factors to the lesion which was actually identified at operation; it can be seen that they provide no real help except possibly to indicate that men of over 60 with gastroduodenal haemorrhage are likely to have a duodenal ulcer. It must be concluded that age and sex alone do not enable the surgeon to predict the site of the lesion.

Clinical History

In 54 cases out of 67 the clinical history gave reliable indication of a peptic ulcer or of the actual lesion found. In patients with peptic ulcer many histories were of no use in predicting whether a gastric or duodenal ulcer would be found. Stomal ulcer was in all six cases accurately diagnosed from the known presence of a gastroenterostomy. In 10 cases the history gave no help, and in one it was actually misleading. (In two cases the history was missing from the notes.) From this experience it would appear that the history may give a positive indication of the lesion but often fail to give other than the grossest indication, and in about one in seven no indication at all. However, seven out of eight cases with histories of under two months' duration were acute gastric lesions, so that a short history should prepare the surgeon for an acute gastric lesion—often not evident from external examination of the stomach. Four out of five cases with a short history superimposed on a long history of dyspepsia were also acute gastric lesions. A prolonged history was of little value, and, as might be expected, of 42 cases with recorded long histories 12 were chronic gastric ulcers and most of the remainder were chronic duodenal ulcers. Neither of the patients with hiatus hernia gave any useful history to suggest the diagnosis. A history of consumption of aspirin preceding onset of haemorrhage strongly suggests an acute gastric ulcer (Alvarez and Summerskill, 1958); two cases with this history were bleeding from acute gastric ulcers.

One may wonder if the actual vomiting of blood at some stage excludes a lesion below the duodenum (unless, of course, a gastroenterostomy is present). It was our

policy to assume that if the patient had vomited blood it was unnecessary to search for the lesion below the duodenum. Within this series of patients this held true, but as there was only one lesion—a jejunal diverticulum—below the duodenum, our experience does not permit us to draw any conclusion on the reliability of this. There are certainly exceptions; for instance, we recently encountered a patient with an aortic aneurysm bleeding into the duodeno-jejunal flexure who vomited large quantities of bright-red blood, and we have heard of other cases in which a jejunal lesion (other than a stomal ulcer) produced haematemesis. It would appear, however, that when haematemesis is included in the history a lesion below the duodenum is so unlikely that the surgeon should search carefully for a lesion in the oesophagus, stomach, or duodenum before considering the infra-duodenal portion of the alimentary tract. Out of 63 cases with clear records on this point, 59 had had haematemesis and 4 showed melaena only—the latter included the jejunal lesion. A patient with melaena only and no haematemesis should be distinguished by the surgeon, because if, on laparotomy, the source of bleeding is obscure, a search of jejunum and below should perhaps have priority, and certainly a "blind" gastrectomy should *not* be undertaken: here positive identification of the bleeding-point is imperative.

Location of the Lesion at Laparotomy

The following observations are based on the fact that, in all cases but one, positive evidence of the site of bleeding was obtained during operation; in those cases in which the bleeding-point was not actually seen at operation the presumptive evidence of external examination or palpation through a gastrotomy was confirmed by examination of the specimen.

Out of the 67 patients, 41 (Table I) showed obvious evidence of the likely source of their haemorrhage from simple inspection and palpation of organs in the upper abdomen at laparotomy. In only one of these was this evidence misleading; in this patient the duodenum showed external evidence of an ulcer, and gastrectomy was performed; the specimen showed an acute gastric ulcer, until then unsuspected, in the centre of which was an obvious bleeding-point. It is concluded that external evidence of peptic ulceration may be accepted as indicating the site and cause of bleeding; this evidence may be gross or, at the other extreme, no more than a small but highly significant area of recent adhesion formation, stippling, or a covering of fibrin.

In 26 cases there was no external evidence of the probable site of bleeding. In all these cases we were able to determine the bleeding-point by means of a gastrotomy, duodenotomy, or oesophagotomy, with the exception of the case of hiatus hernia referred to later. In four of these cases an acute gastric ulcer required a gastrectomy at a higher level than would usually be performed; it is believed that a "blind" gastrectomy might well have failed to control haemorrhage in these cases. A gastrotomy may occupy 10 minutes' time and is perhaps an inelegant procedure, but, in fact, in our experience it did not unduly complicate the operation or cause any appreciable wound-sepsis rate.

It is concluded that gastrotomy enables exact location of the bleeding-point to be made in nearly every case; it is not essential, but it is highly desirable if the first object of the operation, control of haemorrhage, is to be achieved with certainty.

Gastrotomy

In 25 cases gastrotomy was performed (Table I). The technique used was as follows.

The stomach was partially delivered and appropriately packed off with moist gauze. A 3-in. (7.5-cm.) longitudinal incision was then made in the body of the stomach; through this incision two fingers were introduced for palpation of the lesser curvature of the stomach and duodenum from within. If necessary, inspection of the interior of the stomach was then carried out. This was performed by introduction of a malleable light through the gastrotomy opening and the use of "mops on sticks" inserted deeply into the stomach, gently spreading areas of the mucosa to conduct a systematic search. With this technique, the usual ulcer-bearing area of the stomach was seen satisfactorily.

If initial palpation and inspection of the stomach interior were not successful, the gastrotomy was enlarged and a more generous view obtained or the whole hand inserted into the stomach. This permitted easy palpation of the lower oesophagus from within. In several cases

the larger incision allowed the stomach to be everted to give an extraordinarily comprehensive view of the mucosa. Incidentally, a wide gastrotomy allowed massive blood clot, when present, to be scooped out or the demonstration of additional ulcers above the bleeding-point if these were present.

Palpation.—Out of the 25 cases, the bleeding-point was palpable in 15. It was recognized as a minute projection which often felt no bigger than a grain of sand; its feeling is quite distinctive, however (Bohn, 1949). The projection was, of course, a small vessel standing up in the base of a soft acute ulcer which otherwise could not have been detected by palpation. In many of these cases the bleeding-point was seen as well as palpated. Table I gives further details. In three cases of duodenal ulcer, the presence of the ulcer was appreciated only by palpation from within the duodenum via the pylorus.

Inspection.—In the remaining 10 cases the bleeding-point was demonstrated visually in all excepting one (Case 3). When the bleeding-point had been located, care was taken to include it in the gastrectomy performed.

TABLE I

No. of Cases	Lesion	Age			Sex		Lesion at Laparotomy		Gastrotomy			Operations Performed	Deaths and Cause
		No. of Cases Under 40 Years	No. of Cases 40-60 Years	No. of Cases Over 60 Years			Externally Evident	Not Externally Evident	No. of Gastro-tomies Performed	Lesion Palpated as Minute Projection	Lesion Visualized but Not Palpated		
					M	F							
14	Acute gastric ulcer	3	9	2	6	8	2	12	13	10	3	13 Billroth I 1 wedge excision	{ 1 pulmonary embolus (aged 80) 1 "irreversible shock" due to hypotension (aged 54) 1 recurrent haemorrhage (aged 80) 1 leaking duodenal stump (aged 64) 1 plastic peritonitis of uncertain origin (aged 76)
7	Chronic	1	3	3	4	3						6 Billroth I	
2	Acute duodenal ..	1		1	1	1	1	1	1		1	1 Polya 2 ..	
26	Chronic	2	9	15 all male	22	4	23	3	3	3		24 ..	2 duodenotomies, suture of bleeder and gastro-enterostomy Total gastrectomy 4 suture and vagotomy 1 Polya 1 Billroth I
1	Massive duodenal ulcer and oesophageal ulcer	1			1		1						
6	Stomal ulcer ..	1	2	3	5	1	1	5	5	2	3		
2	Hiatus hernia ..				1	1		2	{ 1 gastrotomy and 1 high gastrotomy in same patient on separate occasions	Lesion located at second operation	{ 1 (a) Billroth I, (b) repair and vagotomy 1 repair and vagotomy	1 necrosis of gastric remnant with leak (aged 69)	
1	Hiatus hernia and portal vein thrombosis			1		1		1					1 oesophagotomy
2	"Gastrostaxis"		2		1	1		2	2		2	Oesophagotomy, local suture, and hiatal repair 2 Polya	1 hepato-renal failure (aged 68) 1 uncontrolled haemorrhage (aged 50)
1	Neurolemmoma ..	1				1	1					Billroth I	1 pancreatitis (aged 47) 1 pulmonary embolus (aged 55)
1	Torsion of gastrectomy stump	1			1		1					Revision gastrectomy	
1	Jejunal diverticulum	1			1		1					Excision	
1	Retrograde intussusception of gastro-enterostomy	1			1		1					Polya	1 mediastinitis (aged 48)
1	Duodenal ulcer and rupture of oesophagus	1			1		Duodenal ulcer evident	Ruptured oesophagus not evident					
1	Gastric carcinoma	1				1						Nil	
67	Total ..	9	31	27	45	22	41	26	25	15	9	66	11 (7 with peptic ulcer)

Complications.—3 burst abdomens, 1 subcutaneous separation of incision, 4 post-operative bleeding (not from original lesion). 1 left subphrenic collection of bile, 1 pulmonary embolus, 3 lung collapse, 1 lung infection, 3 post-operative anaemia, 2 wound infections, 1 bed sore, 2 heart failure.

Significance of Hiatus Hernia

In one case gastrotomy failed to reveal the cause of bleeding; this was early in our experience, the presence of a palpable hiatus hernia receiving insufficient attention.

Case 3.—A man aged 69 gave no helpful history, and at laparotomy no lesion was evident externally but a hiatus hernia was palpated. Gastrotomy revealed no abnormality—in spite of this a gastrectomy was performed (unwisely). Two days later the patient's life was again endangered by copious haemorrhage, and after the usual preparation he was taken to the theatre for further operation. On this occasion proceedings were started with oesophagoscopy, and blood was seen coming from the region of the cardia. At laparotomy a high gastrotomy was performed and two small erosions close to the cardia were identified and sutured; a vagotomy was performed, the hiatus hernia repaired, and the left gastric artery divided at its origin. The patient made an excellent recovery.

Two other cases of hiatus hernia were encountered; in one, the lack of any helpful history caused oesophagoscopy to be undertaken as a first step and the lesion was correctly identified by seeing a bleeding area. This was treated successfully by vagotomy and repair of the hiatus hernia; the ulcer was not sutured. The other case deserves more consideration.

Case 4.—The patient was a woman aged 65. No helpful history—abrupt onset of heavy haemorrhage with haematemesis three days previously. Laparotomy revealed a large hiatus hernia, and oesophagotomy revealed two shallow oesophageal ulcers, one of which was bleeding; both were sutured. Ten days later the patient again had heavy haemorrhages; she went into gradual liver coma and renal failure, and died two weeks later. At necropsy the operation site was in good order, but a recent thrombosis of the portal vein was found; in spite of this, the abdominal viscera looked remarkably normal.

It is probable that in this patient oesophageal haemorrhage was the product of the two conditions, hiatus hernia and an acute portal hypertension. Even if diagnosis had been complete at operation, the eventual outcome would probably have been unaffected, although another procedure might have been chosen. This case comes as a reminder of the frequency with which hiatus hernia coexists with another lesion and the care with which its presence must be interpreted.

It is interesting that Case 3 is the only one in which a gastrectomy was performed in the absence of a clear indication of the site of haemorrhage and the only one in which the bleeding-point was missed completely at the first operation. The error made was due to unfamiliarity with the best course under these circumstances, and this experience led to a greater inclination to start the operation with an oesophagoscopy. Disclosure of an obvious hiatus hernia at a laparotomy for haemorrhage in the absence of any other obvious lesion should make the surgeon regard this as the cause of haemorrhage until proved otherwise; he may interrupt proceedings to perform an oesophagoscopy, but our own course of action, having come this far, would be to perform a high gastrotomy or even an oesophagotomy to identify and suture the bleeding-point. If another lesion is evident in addition to hiatus hernia, then it seems clear that the logical course is to inspect first whichever is the easier to visualize.

Upon consideration of this particular dilemma, it is concluded that a "blind" gastrectomy is quite unjustifiable in the presence of a hiatus hernia. Hiatus hernia is the likely cause for haemorrhage if no other lesion is

demonstrated, but the harmless existence of hiatus hernia in the presence of another lesion is well recognized, so that hiatus hernia must not be accepted too readily as a cause for haemorrhage. This problem need not arise if oesophagoscopy is employed in any patient in whom the symptoms are suggestive of hiatus hernia or in whom there is no satisfactory history of premonitory symptoms.

Elimination of Further Haemorrhage

In most cases the causative lesion was readily excised in its entirety by an appropriate gastrectomy, but in several elderly patients with massive duodenal ulcers excision or exclusion of the ulcer would have involved a real danger of damaging the pancreatic duct (Bentley, 1952).

Early in the series this situation was dealt with unwisely in one case by leaving the ulcer undisturbed within the duodenal stump of a Polya gastrectomy; there was no bleeding from the ulcer at the time. Three days later the patient died of a torrential recurrent haemorrhage. This experience is not rare, and where an ulcer is left in the duodenal stump a determined effort must be made to reduce the likelihood of renewed haemorrhage. (The hesitation in reoperating on the patient just referred to was greatly regretted: a short period of indecision lost any opportunity of saving the patient. It would have been better to initiate immediately a second operation when it was clear that the first operation had failed to control haemorrhage.)

In 13 cases the duodenal ulcer was so massive that it was considered dangerous to attempt its excision, let alone its exclusion. In all these cases the offending vessel was readily seen through a longitudinal duodenotomy or through the transected duodenum. In eight cases it was actually bleeding or started to bleed at a touch. In all cases except one the vessel was deliberately underrun with sutures whether it was bleeding or not; the exception provided the fatal recurrent haemorrhage already referred to; none of the others showed recurrent haemorrhage. The sutures were of strong linen placed deeply with a stout Mayo needle. The duodenum was closed by sewing a flap of anterior duodenum across the lowest accessible point of the ulcer and then turning in the two "dog ears"; finally, the medial edge of the ulcer was sutured to the intumed anterior duodenal wall. We found this a practical and safe procedure, and in our hands was more adaptable than Yudin's snail closure; it is, of course, a variant of the method suggested by Tanner (1950a).

Bleeding stomal ulcer in patients with gastroenterostomy was treated in two cases by an appropriate excision of the stoma and a gastrectomy; in a further four cases the stomal ulcer was exposed by an anterior gastrotomy and locally excised or sutured, and a vagotomy was performed. Gastrectomy produced an unexpected fatality in one case from separation of the gastroduodenal anastomosis (post-mortem examination showed necrosis of stomach due to excessive mobilization). Local suture and vagotomy produced a case of haemorrhage from a recurrent ulcer 18 months later. However, the bleeding stomal ulcer is probably best treated by local suture or excision and vagotomy because of the safety and simplicity of this procedure.

One patient with "gastrostaxis" died from uncontrolled haemorrhage a few hours after operation (Case 1).

To sum up, haemorrhage was not controlled adequately or permanently in four cases. (1) A massive

duodenal ulcer left within the duodenal stump. Fatal recurrent bleeding from the causative vessel (the gastroduodenal artery) because this was not sutured. (2) A hiatus hernia to which bleeding was not attributed at the first operation; this was successfully treated by a second operation. (3) A case of hiatus hernia, oesophageal ulceration, and portal-vein thrombosis with renewed bleeding after 10 days and fatal outcome from hepatorenal failure. (4) A "gastrostaxis" (the diagnosis was accurately made but the surgical procedure was inadequate for the situation); outcome fatal.

Table I gives an account of the various lesions encountered and the operations performed.

Our general conclusion based on this experience is that accurate identification of the bleeding-point and its excision, or its ligation by stitching, with control or exclusion of gastric-acid secretion, will give a high rate of success in controlling haemorrhage. Procedures designed to control ulceration but leaving the bleeding-point to chance are certain to allow continued or recurrent haemorrhage in some cases, and must be regarded as failing to achieve the objective—namely, secure control of haemorrhage.

Should there be continued haemorrhage, a second laparotomy, if possible, probably offers less risk than conservative treatment. The first operation has been inadequate and must be completed.

Removal of Clot from Stomach

The gastric bleeders provided the largest clots within the stomach, and often it was useless to attempt aspiration of this via a stomach-tube. It was felt to be unwise to leave a large clot, for fear that it might be vomited and inhaled in the post-operative period. These clots were removed by sponge forceps through the gastrotomy, if performed, or extruded through the transected pylorus by means of appropriate pressure after mobilization of the stomach; the latter course enabled ejection of the clot to be carried out cleanly into a dish. These procedures proved satisfactory, and we believe them to have been worth while.

Mortality

Immediate Outcome of Operation.—Table I shows the findings at operation, the definitive operation performed to treat the lesion causing haemorrhage, and the consequent mortality and complication rate.

All deaths within hospital came to necropsy. In this group of patients with gastroduodenal haemorrhage treated surgically there were at least two deaths, and possibly a third, attributable to the operation itself. This contrasts sharply with the absence of any fatality amongst the last 100 consecutive gastrectomies for uncomplicated gastric or duodenal ulceration performed by me. Three factors, apart from chance, may account for this.

1. *Age of Patient.*—The three deaths referred to above were due to breakdown of a gastroduodenal anastomosis, to a leaking duodenal stump, and to a peritonitis of uncertain origin in patients aged 69, 64, and 76 respectively. Old age would certainly provide less capacity to survive a complication of this magnitude and might possibly make such complications more likely by reason of diminished vitality and rate of wound-healing. The state of these patients prior to operation, particularly with regard to nutrition, was, of course, unknown. Swynnerton and Tanner (1953) give clear evidence of the adverse influence of age in patients operated on for

gastric ulcer; in their experience each successive decade after 40 years showed an increasing mortality rate. Their figures of 15.9% for patients aged 60–70 years and 42.9% for those aged 70–79 were derived from a series which included the war years, but do give an indication of the inherent influence of old age. Fraenkel and Truelove (1955), Stewart *et al.* (1956), Avery Jones (1957), and Cates (1959) all produce evidence of the adverse effects of age on either the medical or the surgical treatment of haematemesis. Death among those treated medically is most commonly due to associated conditions such as chest disease rather than haemorrhage (Avery Jones, 1956).

2. *Effect of Blood Loss.*—As will be seen when post-operative complications are considered, there was a strong suggestion of delayed wound-healing in patients who had lost a large quantity of blood, replaced by transfusion. Incidentally, the haemoglobin of the patient who died from burst duodenal stump was 22% on admission to hospital.

3. *Fatigue of Surgeon.*—This is a factor that should not be underrated. Many of these operations were done in addition to a full day's work. The surgeon's precision and judgment may be impaired under these conditions; it is as well to recognize this, particularly as these operations are often more exacting than a routine gastrectomy: the surgeon must actively remind himself to take especial care to leave all parts with good blood supply and to obtain high-quality closure of the duodenum; there is likely to be little latitude here.

Complications

The complication rate (Table I) was higher than with the usual run of gastrectomies for uncomplicated peptic ulcer, and the same factors producing increased mortality may have been responsible.

Burst abdomen or subcutaneous separation of the incision did not occur in any of the last 100 consecutive "cold" gastrectomies performed by me; we believe that delayed healing followed haemorrhage, and the very thin fascial layers in the abdominal wall of many elderly patients, unable to hold sutures well, combined to produce the four cases observed. The ages of the patients concerned were 72, 75, 76, and 76 (all survived). These cases occurred early in the series, and, after they had occurred, multiple deep tension sutures passing through all layers of the abdominal wall were employed in all patients aged over 65, or if the fascial layers of the abdominal wall were considered to be poor material; after the adoption of this routine, no more cases of burst abdomen or subcutaneous wound dehiscence occurred. The secure closure of the abdominal wound was thought to be of especial importance because our policy was that, the older and more feeble the patient, the sooner ambulation should begin. Most patients were taking a few steps within 48 hours of operation (Asher, 1947).

The mortality and morbidity recorded in Table I may at first sight be thought to be unduly high, but it must be remembered that no patient, however unpromising, whose life was endangered from haemorrhage was refused operation if this appeared to offer the best chance of survival. The fact that two cases went into heart failure, sufficient to cause anxiety, within a few days of operation is some indication of the class of patients included in this series. By reason of the method of selection of patients and my declared interest, this series was strongly biased with poor-risk patients.

Blood Transfusion

The number of blood transfusions given to patients to sustain them through their illness from the time of admission to the medical wards to their discharge from their surgical wards was 11.2 bottles per patient (6,040 ml.) (based on 28 records). This figure perhaps indicates that surgical management of gastroduodenal haemorrhage for patients selected on the basis described—that is, heavy persistent bleeders—is economical of blood transfusion. This in itself may constitute a factor-deciding operation in patients with rare and valued blood groups such as A rhesus negative. This applies to one of our patients in whom the decision for operative treatment was made after she had required 4 bottles (2,160 ml.) of blood in the medical wards. There was a regional shortage of her blood group at that time, and operation was undertaken to limit her loss, not only because rhesus-positive blood might have had to be resorted to in the event of continuing blood loss, but also because group A rhesus-negative blood might have been needed urgently for a maternity case.

Follow-up

The 56 patients leaving hospital were followed up by out-patient clinic and by postal inquiry; two patients could not be traced. Table II summarizes the findings, and the following facts were revealed.

(a) There were three cases of a further gastroduodenal haemorrhage.

TABLE II.—Long-term Follow-up

Survivors Leaving Hospital	Original Lesion	Gastric Symptoms	Deaths after Discharge from Hospital
14*	Acute gastric ulcer	{ 3 "small stomach" } all mild 1 "dumping"	
5	Chronic gastric ulcer	{ fairly marked—sense of epigastric heaviness; has multiple other unrelated symptoms	1—unrelated cause, 2 years later (aged 78)
2	Acute duodenal ulcer	{ 1 has required further operation for stomal ulcer 1 mild epigastric discomfort	
23	Chronic duodenal ulcer	4 mild	{ 2—unrelated causes: 9 months later (aged 79); 2 years later (aged 71) 1—recurrent haemorrhage a year later in a case treated by duodenotomy, suture of ulcer and gastroenterostomy (aged 70)
5	Stomal ulcer	1 has required a further operation for recurrent haemorrhage	1—unrelated cause, 1 month later (aged 76)
2	Hiatus hernia		
1	Retrograde intussusception of gastroenterostomy	1 "afferent-loop" syndrome; has required further operation	
1	"Gastrostaxis"	Required further operation for haemorrhage from a neurofibroma at stoma	
1	Gastric carcinoma	Died 2 months later	
1	Neurolemmoma	Living abroad; reported to be well	
1	Duodenal ulcer and oesophageal ulcer	Did not reply to questionnaire; known to be comparatively well and without gastric symptoms	

* Two of these patients could not be traced.

Summary: 56 left hospital: 2 untraced, 6 died since leaving hospital, and 48 cases traced (44 satisfactory and 4 unsatisfactory and required further surgery).

Case A.—A man aged 70 died from internal haemorrhage a year after leaving hospital. At his original operation a duodenotomy, suture of the bleeding point, and a gastrojejunostomy were carried out. It is probable that his death was due to bleeding from a stomal ulcer and that it indicates the undesirability of the procedure adopted in this patient.

Case B.—A man aged 40 was readmitted to hospital with haematemesis a year after operation; this had been for haemorrhage from a stomal ulcer which was locally excised and a vagotomy performed. A second operation revealed a persisting strand of vagus nerve, and this was divided. The patient remained well one year later.

Case C.—A woman aged 51 was readmitted to hospital because of anaemia, episodes of haematemesis, and persistent occult blood in stools. At the original operation a Billroth I gastrectomy had been performed for multiple gastric erosions. A further operation was undertaken, and haemorrhage was found to be arising from a small polyp-like projection removed from the anastomosis. Histological examination showed it to be a neurofibroma. The patient remained well one year later.

(b) In addition to the death already mentioned, five other patients had died. One, aged 76, had died from heart failure one month after leaving hospital. Three patients had died nine months, two years, and two years respectively after leaving hospital, from causes other than gastroduodenal haemorrhage; the ages of these patients were 79, 78, and 71 years respectively. A patient with gastric carcinoma died soon after leaving hospital.

(c) The remaining 46 patients were questioned at periods varying from six months to six years after their operation. Eleven patients complained of mild or moderate symptoms typical of any gastrectomy series; two had severe symptoms and required further operation—one for stomal ulceration and the other for afferent-loop syndrome.

We conclude that the cure rate of the original condition causing haemorrhage may be slightly less favourable than with elective operations for uncomplicated peptic ulceration, but in most patients a good long-term result can be expected in spite of the circumstances of the operation.

Pathology Note

Twenty-one cases out of 67 were due to bleeding from gastric ulcers. Seven of these were more than 1 cm. across and had a firm fibrous base; these were thought to be chronic. The remaining 14 ulcers had every appearance of being of very recent origin, because they were shallow, lacked induration, and varied from a few millimetres to 1 cm. across; they were either single or multiple, were situated close to the lesser curve, and those that had bled had a small artery protruding from the base.

There was evidence that these 14 acute lesions were associated with a well-established atrophic gastritis. Some of the earlier specimens were not examined histologically for this particular point, but Dr. R. O. K. Schade reports that, histologically, 10 cases showed clear evidence of atrophic gastritis, and three of these had widespread intestinal metaplasia. Avery Jones (1947) found gastroscopic evidence of mucosal atrophy in 16 out of 38 cases of acute gastric ulcer.

Many of the patients with atrophic gastritis complicated by a shallow bleeding ulcer gave a history of vague dyspepsia for some years, but more than half of these patients gave as well a recent history of only a few days of epigastric pain of moderate severity. Of 12 patients giving this history, 10 had one shallow gastric

ulcer or more. Avery Jones (1947) drew attention to the association between a brief history and haemorrhage from acute gastric ulcer demonstrated by the gastroscope. The clinical picture of a brief history culminating in haemorrhage seems typical of atrophic gastritis complicated by a shallow ulcer.

Discussion

It is unprofitable nowadays to compare the results of medical and surgical treatment of gastroduodenal haemorrhage—one is complementary to the other, and surgery will (and should) inevitably collect many of those cases likely to provide the fatalities; few patients should die from haemorrhage without an attempt at saving them by surgery. Our own experience in this respect is interesting.

A survey was made of all the deaths associated with admission for haemorrhage from peptic ulcer in two medical wards consistently referring cases to us over the period 1953–7. During this time 392 patients were admitted for gastroduodenal bleeding, and 47 of these were transferred for surgery and are included in the present series. Among the 345 patients remaining in the medical wards, three deaths occurred from associated disease (coronary thrombosis, basilar artery thrombosis, and bronchopneumonia) and two from haemorrhage so violent that there was no opportunity of saving the patient by surgery; no deaths preventable by surgery occurred among these five patients dying on the medical wards. This perhaps indicates a high degree of success in selecting patients for surgery, and we have already indicated the reasons why we consider that surgery was not overused in this series. The overall mortality rate for the 392 patients just referred to, including those that came to surgery, was 3%. Our findings and results are in general accord with those of Bohn (1949), Tanner (1950b, 1951, 1954), Ogilvie *et al.* (1952), Fraenkel and Truelove (1955), Avery Jones (1957), and Cates (1959), and we do not propose to analyse further the features of the entire group medically and surgically treated.

Perhaps the question, "Is surgery employed too seldom?" should be asked. Our observation that no patients died on the medical wards for lack of surgery makes it hard to see how more frequent employment of surgery could lower the mortality rate any further.

It is just possible that a few "medical" deaths might be prevented by the advantages of early ambulation and the shortened illness offered by surgery. These problematical advantages would scarcely justify the increased administrative difficulties arising from reorganization of the average hospital to accommodate more emergency major operations of this type; it would probably be an unwise deployment of our hospital resources. Moreover, the surgery of gastroduodenal haemorrhage is often exacting, and certainly requires an experienced operator if it is to retain its advantage over medical treatment in selected cases; widespread adoption of indiscriminate gastrectomies for haemorrhage might well lead to a dilution of the skill employed. There is a risk in surgical treatment which is accepted only because, by present selection, it is considered far less than the risk of continuing with medical treatment. It seems that increasing the number of emergency gastrectomies for haemorrhage cannot be justified.

One problem that continues to arouse controversy is the matter of a "blind" gastrectomy. Bruce and Dudley (1959) produce good evidence that in cases in

which laparotomy reveals no obvious source for the haemorrhage a "blind" gastrectomy will usually prove successful. Our study, however, confirms their own observation that in an occasional case haemorrhage will not be controlled by this means, and we have suggested at least two circumstances as direct contraindications to a "blind" gastrectomy. Moreover, our experience shows that in most cases the bleeding-point can be located with certainty. It is not our intention to condemn outright the "blind" gastrectomy but rather to emphasize its shortcomings and to indicate that by gastrotomy, with simple palpation within the stomach, we can obtain a quick and sure location of the point of bleeding in over half the patients in whom, otherwise, gastrectomy would be "blind." A "blind" gastrectomy may be justifiable as a carefully considered decision, but one cannot feel enthusiastic towards it as a routine policy, particularly as the alternative procedure of a preliminary gastrotomy can so easily resolve all doubts or, in the occasional case in which it fails to reveal the source of haemorrhage, warn the surgeon that he should think again before proceeding with gastrectomy.

Summary

A group of 67 patients with gastroduodenal haemorrhage were selected for operation on the basis of the amount of blood transfusion already needed to maintain good condition and the presence of persistent or renewed haemorrhage after admission to hospital. This resulted in a reasonable compromise between unnecessary eagerness to operate and undue tardiness.

A defined policy of pre-operative transfusion to restore certain minimal clinical requirements and of arranging a set time for the operation was found to be both practical and satisfactory.

At operation the site of bleeding was demonstrated in all cases either by exterior evidence of peptic ulceration or by palpation and visualization through a gastrotomy; in one case a second operation was necessary to accomplish this.

By gastrotomy it was found possible to detect the bleeding-point in virtually every case in which the bleeding was gastric or duodenal in origin. In several cases a bleeding gastric ulcer situated above the upper limits of the usual gastrectomy was found; a routine "blind" gastrectomy might well have missed these lesions. It has been concluded that a blind gastrectomy is seldom necessary and is to be avoided, particularly in the presence of hiatus hernia or in patients with a history of melaena only.

The most effective methods of controlling the bleeding-point have been discussed and the necessity stressed for securing the bleeder in some fashion.

Long-term follow-up showed that it was possible, in most cases, to cure the condition causing haemorrhage.

The clinical picture of haemorrhage with a short dyspeptic history was found to be very suggestive of atrophic gastritis.

An overall mortality rate of 3% was found for a group of 392 patients admitted for gastroduodenal haemorrhage and treated either medically or by surgery in cases selected by the criteria given.

I thank the physicians of the Royal Victoria Infirmary for their most friendly collaboration. My anaesthetist colleagues have been partners in a rewarding enterprise, and I should like to record my appreciation of their unfailing co-operation and to acknowledge my dependence upon

their skill; in particular I am indebted to Professor E. A. Pask, Drs. M. H. Armstrong Davison, A. Mackenzie, J. A. G. Horton, and J. S. Inkster for their help in this respect and for many valuable suggestions and much information incorporated in this paper. I am grateful to Professor A. G. R. Lowdon for his encouragement, advice, and helpful criticism.

The treatment of the patients referred to in this paper required at least 700 bottles of blood, and I should like to express, on behalf of these patients, their debt of gratitude to the blood donors and to those who collected and cross-matched all this blood without error.

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INFECTIVE HEPATITIS IN A MIXED SCHOOL, WITH HIGH ATTACK RATE IN FEMALES

BY

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A small epidemic of infective hepatitis in an urban district of the County of Lancashire consisted almost entirely of girls at one mixed school, although there was no great excess of girls in any one class at the school.

Pickles (1939), in his classical description of infective hepatitis in rural Yorkshire, does not give any figures showing that females are specially susceptible to this disease.

MacCallum *et al.* (1951) reprint tables for Denmark (1928-45) and Sweden (1931-7)—countries in which the disease was nationally notifiable—and also for their special area of study, the wartime Eastern Region of England, where all types of jaundice were made notifiable in November, 1943. Again there is no mention of differences between the attack rates for the two sexes; for example, an excess of female cases in the Eastern Region "was due almost entirely . . . to the absence of adult males on active service."

The factors in the Lancashire school epidemic were analysed, and finally compared with figures quoted by MacCallum *et al.* (1951), which refer to large numbers of pupils and schools.

The Epidemic

A semi-urban community of about 10,000 in the south-west of Lancashire was served by three primary

schools, of which one, X, traditionally took its pupils from a well-localized area in the township.

After a period of freedom of six months or more the first three cases of infective hepatitis occurred in January, 1959. They were all pupils at school X. The epidemic came to an end in June; no new cases were reported up to the beginning of 1960.

In all, 30 cases were notified by the school welfare officer, health visitors, and general practitioners—jaundice was voluntarily notifiable from May 22—or were discovered by me on the home visit made to each case. Of these, 29 were school-children, of whom 27 attended school X. Conversely, among the 87 household contacts of these 29 children jaundice or suspicious symptoms occurred only once. Among the 86 contacts who escaped clinical infection were 23 of school age; 8 attended secondary schools and 6 primary schools other than X. Evidently this was a true school epidemic.

However, some of the 27 pupils of school X may have been infected by a sibling attending the same school—that is, when the second child fell ill 15 to 40 days after its sibling. In 13 households only one child per household was affected; in another six households hepatitis attacked two children in each, the interval between the two illnesses being 0, 4, 15, 18, 29, and 95 days respectively. In the last household two children and the father fell sick, with an identical interval of 27 days between each of the siblings, and between the second sibling and father.

We have therefore the alternative of 27 "school" cases, or 23 "school" cases and 4 "home" cases.

Age and Sex Incidence.—No personal or household history suggesting hepatitis was obtained from any teacher, school-meal-service helper, or workman on the premises. There was a high female attack rate (Table I).

For comparison, an outbreak of mumps in October/November, 1959, involved 15 girls and 8 boys, a distribution which I find could have arisen by chance once in 3 to 5 situations.

Evolution of Epidemic.—There is a three to four weeks' periodicity of number of cases against time (see Graph).

Relation to Vaccination against Poliomyelitis.—Groups of children were given their first or second injection on December 15, 1958, April 13, 1959, or May 4, 1959. The last two sessions were held when the weekly report of the school welfare officer had shown no absences due to jaundice for at least six weeks. This was an inadequate precaution (see Graph);

Infective hepatitis at school X.