3. A full-width anastomosis—the old-fashioned Polya. This operation may have two unhappy sequelae; filling of the proximal loop giving a sense of postprandial distension, and stretching

FIG. 8.—Two-stage gastrectomy for adherent duodenal ulcer. (Figs. 4 to 8 suggest a resection much more conservative than is actually performed, because the stomach elongates greatly when its vessels are ligated, and as the branches of the left gastro-epiploic artery are tied the fundus comes right away from the spleen. Estimates of the level of gastric resection by reference to the spleen are meaningless, because the size of the spleen and its attachments to the stomach are quite inconstant. The most disastrous mistake in peptic ulcer surgery, because it is irremediable, is to remove too much stomach, and unless the surgeon lifts up the left costal margin from time to time to see how much is left before he divides the stomach, he is apt to make this mistake. The size of a pint mug is right.)

of the vascular pedicles. The reduced stomach and the new stoma occupy quite different positions from the normal stomach and pylorus which they replace, but they should be just as free to distend and to empty, and to move about as they do so.

Conclusion

I believe that to-day, and till something better appears, the treatment of peptic ulceration that has proved resistant to medical treatment is by gastrectomy—Billroth I gastrectomy for gastric ulcer, Billroth II gastrectomy for duodenal ulcer. I know my own results till 1935. Since that time I have suffered the interruption of five years in the Army, the greater part overseas, and the destruction of my house with all my records. Secretaries, since my return, have been characterized by their impermanence, and those patients whom I should like to follow are scattered over four continents. I cannot therefore give accurate figures of my own, and, when asked to write on peptic ulceration for Butterworth's *Encyclopaedia*, I gave the aggregate figures of four surgeons whose work is well known to me.

Total number of operations	..	..	..	1,456
Death rate	..	..	..	2.7%
State of survivors:				
Satisfactory	..	..	93%	
Better but not symptom-free	..	..	5.6%	
Worse (including re-ulceration)	..	..	1.4%	

The causes of death after gastrectomy are shock, infection, chest complications, and leakage from the duodenal stump. Shock has been eliminated by transfusion, infection by chemotherapy, chest complications by preparation before operation and early movement afterwards. Duodenal leakage does not happen to the surgeon who realizes that discretion is the better part of valour where it is the patient rather than himself that needs the valour. There should be no mortality, and there would be none if gastric surgeons were afforded the same privileges as are demanded as a right by their prima-donna colleagues—special theatres, new apparatus as soon as it is invented, theatre sisters who are left in the job long enough to become really expert, and anaesthetists and first assistants who work for years on the same team.

of the mesentery of the jejunum where it forms part of the stomach wall, with the inevitable symptoms of fainting, sweating, and nausea that are part of the vaso-vagal mesenteric reflex.

4. Anastomosis anterior to the colon, an operation that is successful when the colon behaves but is entirely at the mercy of its vagaries.

5. Fixity of the stomach and the stoma owing to adhesions or to insufficient division

In 1935 my total mortality in operation for uncomplicated ulcer was 4.5%. In 1935 transfusion was used seldom and with caution, physiotherapy was reserved for elderly arthritics, and chemotherapy had not yet been invented. I do not know my mortality to-day, but I have certain pointers. No patient with a primary peptic ulcer has died in my wards at Guy's Hospital since 1938. Of my Service patients, only one has died, from sloughing of the stump of a Bancroft's operation, since which disaster I have discarded this device. Of 115 private patients operated on since my return to civil life, in Nuffield House and the Royal Masonic Hospital, one, a gentleman of 66, died on the second day from extensive mesenteric thrombosis. Compared with the dangers and disablements the lesion brings, these risks are small.

TREATMENT OF MASSIVE BLEEDING FROM PEPTIC ULCER

BY

A. G. OGILVIE, M.D., F.R.C.P.

N. CARDOE, M.B., B.S.

AND

F. H. BENTLEY, M.D., F.R.C.S.

(From the Departments of Medicine and of Surgery, the Royal Victoria Infirmary, Newcastle-upon-Tyne; and the University of Durham)

In a previous report from the Royal Victoria Infirmary, Newcastle-upon-Tyne, Ogilvie and Spencer (1950) described the results of treatment, in a general medical clinic, of massive bleeding from gastric and duodenal ulceration. Among 170 consecutive patients admitted as emergencies because of severe bleeding the mortality was 2.4%. The series was in no way a selected one, and contained all such patients admitted to one medical clinic during the years 1941–8 in an industrial area, where the majority of severe medical and surgical emergencies find their way to the teaching hospital; 27 of the patients (16%) were aged 60 or over. It was recognized that there were many variables to consider, such as the age of the patient, the duration of severe bleeding before admission to hospital, the presence of a chronic ulcer, the situation of the ulcer, the cardiovascular condition of the patient, and the presence of intercurrent disease. Although the series was not a very large one, it did not appear from the analysis of the cases that any of these factors, except that of age, had seriously affected the results.

Since that report was published observation has been continued and developed in the hospital in order to define a policy in the treatment of massive ulcer bleeding, particularly in regard to the relationship of medical and surgical treatment, and to assess its precise results. Tanner (1951) explained clearly the need for such a policy in the management of this difficult problem if the results are to be properly evaluated, and described his own large experience following different methods of treatment (Table I). In his hands the procedure with the lowest mortality in a series of 854 patients was the Finsterer method, by which is meant: "To operate on all patients giving a history of chronic ulcer as soon as a diagnosis of massive bleeding is made. If it is uncertain whether the bleeding is due to chronic ulcer an

expectant policy is followed, but if bleeding is repeated an exploratory laparotomy should be carried out." This plan resulted in a mortality of 7.5%, but it should be noted that very many (43%) of the patients were over 60.

TABLE I.—*Tanner (1951): Peptic Ulcer and Gastritis Groups (Incidents of Bleeding)*

	No. of Cases	Over 60 (%)	Operated on (%)	Overall Mortality (%)	Average Age of Patients Who Died
Period No. 1, 1941 to 1943. Operation avoided on "reception" duty	193	33	5	10	62
Period No. 2, December, 1943, to June, 1944. Operation earlier—always gastrectomy	60	33	15	20	62
Period No. 3, June, 1944, to December, 1947. Operation early—simplest to stop bleeding	312	35	11	11	65
Period No. 4, January, 1948, to September, 1949. "Finsterer"	215	43	59	7.5	65
Period No. 5, January to July, 1950. Selective surgery with bias towards conservative treatment	74	55 (34 over 70)	18	13.5	72
Totals	854	40		11	65 yrs.

Present Investigation

In our own hospital all patients with haematemesis and melaena are admitted as emergencies to the medical clinic on "reception" duty. There are four medical clinics, and each in rotation is on emergency duty three to four days at a time every two weeks. We have studied the cases of massive bleeding admitted to two out of the four medical clinics, and so obtained an adequate number of patients without the clinical problems of management becoming too unwieldy, and without creating any bias in selection of cases. The survey was continued from March 1, 1949, to November 30, 1951, a period of two years nine months; during this time 358 patients were admitted urgently to the two clinics because of severe ulcer-bleeding, representing rather more than half of the total admissions to the medical department for this condition during the period. The series does not include the 170 cases previously reported.

The policy of treatment agreed between the two medical clinics—those of Professor F. J. Nattrass and Dr. A. G. Ogilvie—and the surgical department, was first to treat by medical measures all patients admitted because of severe bleeding from peptic ulcer, and then to consider surgery (and generally to treat by operation) as soon as it was plain that medical treatment was not succeeding. The recognition of the lack of success of purely medical measures was usually made within 24 hours of admission if bleeding still continued; or at any time while the patient was in hospital if the bleeding, having once stopped, started again. Pursuit of this policy brought about 10% of our patients to operation: several surgeons were concerned in the series, but most of the operations were carried out by one surgical firm.

Our report is concerned with bleeding from peptic ulcer, a term which includes acute ulcers and multiple erosions. Those few cases of massive bleeding known to be due to other causes—notably gastric carcinoma and oesophageal varices—have been excluded from our figures. The evidence on which the diagnosis of ulcer depended for inclusion in this series of 358 patients is:

Ulcer demonstrated radiologically	169
Good clinical evidence of ulcer: barium meal negative	113
Ulcer found at operation or necropsy	57
Presumed acute ulcers (no pain; no evidence of liver or blood disease; barium meal negative or refused)	19
	358

We admire the persistence and skill of Avery Jones and his colleagues in securing so high a percentage of accurate diagnoses in the early days of the illness, but do not believe the ordinary medical clinic can emulate the special facilities and experience of these workers. With us the diagnosis has depended on clinical criteria, and on subsequent radiological examination (in most patients) when the acute emergency was over. Early in our series a patient who died of bleeding had had a previous radiological examination which suggested oesophageal varices; at necropsy the bleeding was found to be due to chronic peptic ulceration. Since that time, in any case of clinical doubt we have acted on the assumption that the haemorrhage was from a peptic ulcer, and in only two patients in two and a half years has the practice led to a known error in diagnosis: these two patients, with no previous dyspeptic history, were operated upon for uncontrolled bleeding, and were found to be suffering from hepatic cirrhosis. No harm came to them, and we have continued in the belief that when the diagnosis is in doubt the slight risk inherent in an exploratory operation in a patient with hepatic cirrhosis does not justify withholding operation from a patient who continues bleeding, although the source is uncertain.

Medical Treatment

To say that the first step in treatment is a careful and accurate history might seem like a repetition of the obvious, but it is emphasized here because the details of the history are important. The previous health, digestive history, source of haemorrhage, amount of blood lost, time of bleeding, and interval before admission are essential pieces of information, and are made clear only by careful inquiry. The first examination of the patient, on the other hand, though it must be adequate, need not be too detailed. Any but the very lightest palpation of the abdomen is to be avoided. Pallor, restlessness, sweating, disorientation, and dehydration are to be looked for, and can be readily ascertained by a general survey. The search for hypothetical masses in the abdomen can, and indeed should, be left for a later opportunity in most cases, though the possibility of an associated perforation must be excluded. The administration of morphine is a routine measure, and the patient lies flat in bed and is kept warm but is not artificially heated. The blood group is ascertained on admission, and the appropriate blood ordered if required. If bleeding has ceased the condition of the patient will be improving, and he may not require blood: in the presence, however, of any of the clinical signs of haemorrhage an immediate transfusion is given.

Indications for Transfusion

In making the first assessment of the patient on admission the pulse rate and blood pressure are not reliable guides, though at a later stage, when the patient is settled in bed and rested, the pulse rate is of the first importance in assessing progress. More certain immediate evidence of severe or continuing blood loss is to be obtained from noting the clinical signs of pallor, restlessness, or sweating. Crude information, too, can be secured from the level of haemoglobin. The presence of sweating or restlessness; anaemic pallor, as shown in the palms of the hands and in the conjunctivae; or a haemoglobin level of 60% or under are our indications for immediate transfusion, which is continued at an appropriate rate and may total three, four, or more litres of blood, until the condition of the patient, a haemoglobin level of at least 75%, and (at this later stage) the pulse rate indicate satisfactory progress. This is a particularly urgent matter in the elderly patient, in whom anoxia is a most serious complication; not only are there the dangers attendant on a reduced oxygen-carrying power of the blood, in particular coronary insufficiency, but there is also the potential danger of further haemorrhage in a person with a low blood level.

Whether the patient is transfused or not, careful and constant observation are needed, so that recurrence of

haemorrhage may be recognized promptly. We have found the half-hourly pulse chart to be the most helpful routine observation for this purpose, though daily haemoglobin estimation is useful also. Not only should the pulse rate remain steady, but it should gradually come down to less than 90 a minute if progress is to be accepted as adequate. A tendency to sweat about the head is often an early sign of renewed bleeding, and may be observed before signs of restlessness or dehydration are evident. Increased pallor is often obvious, but may be difficult to detect, especially in artificial light. If bleeding is slight but persistent there may be no other evidence than a fall in the haemoglobin level or a failure of the level to rise despite the giving of blood. These evidences of further bleeding are countered by further transfusion until the general condition of the patient, the haemoglobin level, and the pulse rate are reassuring, or failure to respond to transfusion indicates the need for surgical treatment. We deprecate the use of aspiration by stomach or duodenal tube as a means of observation, for it seems to us that the information which the method affords can be obtained by simple clinical observation.

Although the pulse rate will call attention to any sudden change, it has to be remembered that the pulse may be quickened from causes other than bleeding. We have not found that haemorrhage increases the respiration rate as a rule, so that if a rise in pulse rate is accompanied by an increase in respiration some cardiac or pulmonary cause should be considered, particularly if the clinical appearances do not suggest bleeding; otherwise blood may be given to a patient with early heart failure or bronchopneumonia who does not require blood and cannot tolerate it. A further caution in regard to transfusion exists in the relation between the anaemia of haemorrhage and heart failure. In elderly patients in whom moderate but repeated bleeding has been ignored or inadequately treated large transfusions are dangerous, and repeated small amounts are required.

Diet and Fluid

There has been much argument about the best dietary regime for patients after a haematemesis, but the more important question of the total fluid intake has been relatively neglected until recent years (Avery Jones, 1947). Except when blood is voided, vomiting is unusual, and if it should occur it may indicate a complication such as perforation or pyloric stenosis. The patients are usually thirsty, but do not always ask for fluid; some are too weak or too ill to drink adequately without help and encouragement. It is our practice to encourage patients to drink the contents of three 1-litre jugs of water each 24 hours, in addition to their two-hourly milk feeds, and most patients accept this volume of fluid readily. It is, however, essential that the nursing staff should become "fluid conscious." When fluid intake is adequate there is no difficulty about "water balance"; and when, in addition, enough blood has been given we have had no urgent biochemical disorders requiring treatment.

Within a few hours of admission feeding by mouth is begun. The diet consists of two-hourly or hourly feeds of milk, cereal with milk, egg and milk, "ovaltine," then porridge or "farola," and so on. This dietetic practice is a routine one, and is followed in all our cases until recovery allows a normal diet. Sometimes a patient who is experiencing active haemorrhage feels nauseated and may refuse a feed, but feeding by mouth is interrupted for no other reason. The fact or suspicion of active bleeding is not regarded as a reason for starving the patient.

Ascorbic acid, 500 mg., is given daily, but no other routine medicinal remedy, except that magnesium trisilicate with phenobarbitone and belladonna in the form of a powder is prescribed if the patient complains of pain, but not otherwise. Morphine may be required from time to time, but if pain is persistent the question arises whether some complication other than haemorrhage is present.

It is a rule that these patients should not be allowed to become unduly constipated. The prejudice against the use

of enemata is hard to understand: straining at stool is not good for an ill person, especially one suffering from haemorrhage, and there may be much discomfort if the bowels are not emptied regularly. If a bowel action does not occur naturally on any day an enema is given the following morning. This practice also provides useful information about progress.

Decision for Surgery

The surgeon is asked to see any patient in whom bleeding does not appear to be satisfactorily controlled. He thus becomes acquainted with the particular problem, and takes part in the decision and in the pre-operative observation. If after 24 hours' adequate medical treatment in hospital there is evidence of continuing bleeding—as shown by renewed fainting and collapse, the vomiting of further recent blood, or a recurrence of severe melaena—a pulse rate remaining between 90 and 120, or failure of the haemoglobin level to rise, operative treatment is decided upon. Similarly, if the bleeding stops but starts again while the patient is still in hospital no further attempt is made to cure him medically, but surgical treatment is decided upon. Past experiences have shown us that most of the patients who died after gastro-duodenal bleeding were those who had recurrent bleeding in hospital. Over the years it has not been uncommon for us to watch patients in whom there were apparent contraindications to surgery bleed two, three, or more times, with several days in between haemorrhages, only to be obliged to operate in the end, and wishing that so much of the patient's resistance and reserves had not been wasted.

Delay in starting surgical treatment is bad for another reason—the loss which the community suffers from extravagant use of blood in the continued medical treatment of a patient who has, in fact, become a surgical responsibility. We believe there may be patients in this series, and in others, who have recovered without operation, but only at the cost of large amounts of blood which might have been saved by more prompt surgery. The usual amount of blood given in this series *after* a decision was made to operate was between 1 and 1.5 litres, and this includes that given at operation and in the recovery phase. The economics of blood transfusion is too little considered nowadays. Our insistence on early and sufficient transfusion is not due to any spendthrift attitude in the use of blood. It will often save those recurrent haemorrhages which use up more blood and may still end fatally, leaving many sad reflections—among them, that all the blood has been wasted in that it has failed of its purpose.

Pre-operative Treatment.—As soon as the decision is made to operate the rate of blood inflow is increased (if necessary) until there is reasonable evidence of a satisfactory blood volume and haemoglobin level. Although no figure may be regarded as a fixed one, it is desirable to have the pulse rate not more than 100–110, and the haemoglobin not below 70% at the start of the operation. During this period it is important to empty the stomach with a tube of adequate calibre; we use an oesophageal tube, size 12. No attempt is made to investigate or correct biochemical disturbances: the problem is the urgent one of bleeding.

Anaesthesia.—We have been fortunate in having the skillful collaboration of Professor E. A. Pask and his colleagues in the treatment of our patients. Professor Pask tells us that, beyond the usual anaesthetic measures necessary in the gentle management of an ill patient, the only special danger lies in the risk of reflux of blood into the trachea. Therefore not only is the stomach kept as empty as possible by means of the indwelling tube, but induction of the anaesthetic is carried out in such a way as to minimize the risk of regurgitation, and an intratracheal cuff-tube is introduced as early in anaesthesia as possible: this is much facilitated by limiting the morphine given in the pre-operative period. To avoid regurgitation at the end of operation, the surgeon introduces the suction end into the stomach shortly before

the gastric suture line is completed. We have found this a useful manoeuvre in preventing reflux when the cuff-tube is withdrawn. A blood drip transfusion is maintained throughout the period of anaesthesia. It has been our experience that the condition of the patient at the end of the operation—as judged by pulse rate, blood pressure, and pulse volume—has not been worse than at the start.

Operation

The surgical problem is to stop the bleeding, and it is therefore necessary to work quickly, though gently, until the bleeding vessel is secured; thereafter only gentleness is important. The surgical approach can be discussed under three headings.

1. *Partial Gastrectomy.*—In the presence of a chronic peptic ulcer partial gastrectomy is the best treatment when it is possible, for it not only solves the immediate problem of bleeding but leaves the patient in a satisfactory condition for his future life. If the ulcer is in the stomach, partial gastrectomy is almost always possible, even in the presence of a large perforating ulcer involving liver or pancreas, using a Billroth I (Schoemaker) type of resection. For chronic duodenal ulcer a Polya gastrectomy is often feasible, even when the ulcer has perforated posteriorly to form a chronic cavity in the pancreas. Transverse division of the duodenum at the level of the ulcer quickly exposes the ulcer cavity: the bleeding vessel (often the gastro-duodenal artery) can then be under-run and the bleeding stopped. If the ulcer is within 2 to 3 cm. of the pylorus, freeing of a cuff of posterior duodenal wall and routine closure in two layers is effective. If, however, the ulcer cavity extends to the right of the line of the gastro-duodenal artery it is hazardous to dissect the posterior duodenal wall, and it is wiser to leave the ulcer *in situ* and to close the duodenal orifice by an inturning method (Bentley, 1952), which securely closes the duodenum without disturbing the dangerous region behind it.

2. *Opening the Viscus and Ligation of the Bleeding Vessel.*—Although partial gastrectomy is usually possible, conditions exist at operation for bleeding from chronic ulceration when the surgeon should do the least possible, contenting himself with stopping the bleeding and so saving life. Such conditions may arise from the violent nature of the haemorrhage or from the presence of a severely inflamed duodenum with extensive periduodenitis and formation of an inflammatory mass involving duodenum and surrounding viscera. Extragastric ligation of vessels is of little value because of the great number of branches reaching the stomach and duodenum, and the freely anastomosing plexus of large vessels in the submucosa (Bentley and Barlow, 1952). Incision of the anterior stomach or duodenal wall and direct exposure of the bleeding artery in the ulcer bed is the only swift and reliable attack in the circumstances. Subsequent repair of the anterior duodenal wall may, however, so narrow the duodenum as to necessitate a posterior gastro-enterostomy; but this is quickly done, and leaves for the future the problem of more adequate surgery when the patient has recovered from his acute emergency.

3. *When No Ulcer is Discovered.*—On rare occasions careful palpation of the stomach and duodenum, and search behind the first part of the duodenum, do not reveal any scarring or ulcer thickening, and a difficult decision has to be made. Incision of the stomach and duodenal wall and search inside the viscus is an unsatisfactory procedure, for it is impossible to search adequately all the large potential area of bleeding; and the slender prospect of a positive result does not justify the soiling and further loss of blood that the method entails. More routine use of pre-operative gastroscopy may be the best answer to this problem, but we have not so far used this technique. In the absence of evidence of portal hypertension at operation, and if the surgeon is sure on clinical grounds that the bleeding was gastro-duodenal, and if blood can be seen through the wall of the upper jejunum, we believe that a partial gastrectomy

should be carried out. We have done this seven times in the present series, and in only one case has the bleeding continued after operation. Search of the specimens revealed one or more shallow ulcers, or multiple erosions.

It is an anxious decision for the surgeon and his attendant medical colleague to make, but in our judgment the danger from leaving things as they are and merely closing the abdomen is greater than is the danger of an unsuccessful partial gastrectomy.

Post-operative Management

The routine treatment after partial gastrectomy needs only slight variation in the patient with haemorrhage. Transfusion is stopped as soon as the blood level is restored, but the usual free drinking we permit after gastrectomy cannot be indulged because of the tendency to post-operative ileus in the presence of much blood in the small bowel. Glucose-saline by intravenous or subcutaneous hyalase drip is therefore needed for about two days, together with restricted fluids by mouth. Early ambulation and breathing exercises are especially important in these ill patients: our most recent elderly patient—aged 80—who had bled from a hole in the gastro-duodenal artery for which 10 litres of blood had been given pre-operatively and 1 litre post-operatively, perambulated with assistance round the ward on the third post-operative day and went home on the twelfth day. Such old ill patients require continuous stimulation away from recumbency and from lethargy—both mental and physical. Appropriate measures are taken to deal with any disturbance in serum chlorides, alkali reserve, or serum potassium during the first days of recovery, before feeding by mouth becomes free.

Results

The series consisted of 358 consecutive patients admitted because of severe bleeding from peptic ulcer; 106 of them (30%) were 60 or over. The result of the agreed policy of treatment—namely, to treat all cases medically in the first instance, and by surgery if bleeding continued after 24 hours in hospital or bleeding having once stopped started again—was that bleeding was satisfactorily halted in 339 of the 358 patients. Of the 358 patients, 35 came to surgical operation—that is, about 10% of the total. Nineteen patients died, a mortality of 5.3%. The figures are analysed in Tables II and III.

TABLE II.—*Results of the Policy—2 Years 9 Months (1949–51)*

Treatment	No.	No. Over 60 Years	Death	Average Age Deaths
Medical treatment alone ..	323	95		
Medical treatment followed by surgery ..	35	11		
Total	358	106 (30%)	19 (5%)	62 years

TABLE III.—*Analysis of the Series by Decades*

Age	No.	Deaths
Under 30	43	0
30–39	52	1
40–49	78	2
50–59	79	6
60–69	71	3
70 and over	35	7
Total	358	19

It will be appreciated that it was never in our minds to compare medical and surgical treatment. It is of greater value to consider the precise place of surgery in the treatment of those patients (about 10% in this series) who are not responding well to a medical regime, and to determine the stage at which operation should be performed. In our

view there is no subject in which the artificial barrier between physician and surgeon is more out of place than in the management of massive haemorrhage from peptic ulcer. The problem is a combined one, and it was because of this view that we sought to assess the results of the combined policy here reported.

A mortality of just over 5% is a reasonable justification of the policy and the methods of treatment employed, and we feel satisfied to continue this form of medical-surgical treatment of the bleeding ulcer patient. Consideration of the details of the patients who died (Table IV) shows, however, that the mortality rate could have been lower. In 8 of the 19 fatalities (Nos. 1-6, 15, and 16) death seems to have been truly inevitable, having regard to the condition of the patient at the time of admission to hospital or the nature of the lesion (No. 16). In two or three of the cases it may be that earlier recognition of the grave nature of the illness and transference to hospital might have had a favourable result, but these eight patients, of average age 72 years, are to us the inherent inevitable mortality of the series.

More profitable, if more humbling, is contemplation of the other 11 fatal cases. In four (Nos. 7, 8, 9, and 10) death occurred from continued bleeding, and the surgeon was not called. The four deaths did not result from the application of our policy, but rather from a failure to apply it correctly, owing to errors in judgment. They emphasize the importance of the practice of employing surgery as soon as it is plain that medical treatment is not succeed-

ing. In one of these cases (No. 8) it is true there was reason to believe from previous x-ray examination that the patient was bleeding from oesophageal varices. Some patients with severe bleeding due to peptic ulcer do not give an "ulcer" history, and we feel sure that operation is indicated in every case of persistent upper alimentary haemorrhage unless very clear evidence of hepatic cirrhosis or grave blood disorder is present.

In Cases 11, 12, 13, and 14 transfusion seems to have been inadequate. Blood was given too little or too late, or too little and too late. No patient suffering from haemorrhage can be regarded as doing well whose pulse rate is still raised or whose haemoglobin level is below 70%. This is the more important the greater the age, but it is true of all. A low haemoglobin level hinders healing and so inclines to further haemorrhage; and, in patients with defective coronary circulation, anoxia of apparently moderate degree may precipitate acute cardiac insufficiency (as in Cases 12, 13, and 14) or predispose to coronary thrombosis. Blood must therefore be given promptly and in an amount sufficient to restore the haemoglobin level to normal or reasonably near to normal, though for obvious reasons its administration may have to be spread over several days.

Three patients who died after operation might have been saved. In two (Nos. 17 and 18) excessive use of intravenous fluids after operation probably aggravated the pulmonary oedema and pneumonia from which these patients died. Once operation is completed and bleeding has stopped,

TABLE IV.—*Statement of Deaths*

No.	Age	Sex	Ulcer	Details
<i>Medical Treatment Alone</i>				
A. Death considered inevitable:				
1	89	F	Chronic duodenal ulcer	Advanced senility changes and mental confusion precluded surgery. Death from effects of bleeding
2	77	F	" gastric "	Bleeding stopped. Patient became drowsy and then unconscious. Necropsy showed senility changes but no certain cause of death
3	76	M	" " "	Bleeding and vomiting for three weeks before admission. Death a few hours after admission. Large perforation in stomach; peritonitis
4	71	M	" duodenal "	Known to have vomited blood day before; moribund on admission. Death in half an hour
5	61	M	" gastric "	Several bleeds during last year. Recent bleed 12 hours before admission. Death 6 hours after admission. Necropsy: extensive caseating tuberculosis both lungs; enormous posterior wall ulcer
6	55	M	Subacute gastric ulcers	No chronic indigestion. Recent bronchitis and one melaena. Necropsy: rheumatic endocarditis; pneumoconiosis, acute bronchiolitis. Two subacute gastric ulcers. Death thought to be related to pulmonary rather than alimentary disease
B. Failure to advise surgery:				
7	67	M	Two chronic pyloric ulcers	Two haemorrhages during week before admission. Two further bleedings over 5 days in hospital. Transfusion inadequate
8	57	F	Chronic gastric ulcer	Several bleedings in hospital over 9 days. Liver palpable. Treated in error as a case of portal hypertension
9	55	F	No necropsy performed	Continued small bleedings in hospital over 16 days
10	54	M	Chronic gastric ulcer	Continued small bleedings in hospital over 8 days. Acute bronchiolitis and emphysema
C. Inadequate transfusion:				
11	73	M	None found at necropsy	Several severe bleedings over 3 weeks in and out of hospital. Transfusion inadequate and surgery not considered; but necropsy showed no source of bleeding
12	56	F	Chronic gastric ulcer scar. Four acute gastric ulcers	Bleeding three hours before admission; haemoglobin 60%; transfusion started after 7 hours. Death suddenly as last of the first half-litre was being given, due to acute cardiac ischaemia
13	48	M	Chronic gastric ulcer	Bleeding 1 day before admission; haemoglobin 50%; 1 litre of blood given. Two days later haemoglobin 53%. Death suddenly after further 7 days, due to acute cardiac ischaemia
14	42	M	" stomal "	Bleeding for 6 days before admission; haemoglobin 39%; 1 litre of blood given; further bleed two days later. Death from cardiac ischaemia
<i>Medical Treatment Followed by Surgery</i>				
A. Death considered inevitable:				
15	70	M	Chronic duodenal ulcer	Bleeding 1 day before admission. Very ill for some days before admission, but no signs of a perforation. Continued deterioration in hospital. Operation, sealed-off perforation; subphrenic abscess; bleeding duodenal ulcer. Gastrectomy and drainage abscess. Death after 3 days
16	54	F	Acute gastric erosions	Bleeding 2 days before admission; continued bleeding after 24 hours in hospital. Operation, no ulcer mass: partial gastrectomy. Continued profuse bleeding. Death 2 days later. Necropsy: multiple acute erosions with haemorrhages throughout the mucosa of the gastric remnant
B. Excessive post-operative intravenous therapy:				
17	70	M	Chronic gastric ulcer	Bleeding 1 day before admission: continued bleeding after 24 hours in hospital. Gastrectomy. Death after 4 days, with pulmonary oedema and bronchopneumonia, probably associated with excessive intravenous fluid
18	67	M	" duodenal "	Bleeding 1 day before admission: continued bleeding after 24 hours in hospital. Operation: profuse duodenal bleeding, only partially stopped. Death after 5 days, with pulmonary oedema, probably associated with excessive intravenous therapy
C. Surgical death:				
19	35	M	Chronic duodenal ulcer	Perforated ulcer 2 months before: extensive pulmonary tuberculosis. Several bleedings in hospital over 10 days; operation evaded because of pulmonary condition. Finally, operation—gastrectomy. Death from injury to aberrant pancreatic duct entering first part of duodenum

further intravenous fluid therapy, especially saline, has to be employed with caution. The last patient (No. 19) died from a technical hazard not solved by the surgeon—the presence of an aberrant pancreatic duct opening into the back of the first part of the duodenum. This duct was not seen in the oedematous scar, and a pancreatic fistula resulted from which the patient ultimately died. The problem would have been avoided by not disturbing the ulcer base in the pancreas, and closing the duodenal orifice by an inturning method, as mentioned above.

It is no doubt impossible to achieve the ideal level of skill, but there are reasonable grounds for thinking that several of our fatalities need not have occurred if treatment had been more skilful. If that is so, the inherent mortality of our series would be a figure between 3 and 4%. If we could obtain this result in a comparable series of patients we would be satisfied that we had reached as near to the truly inevitable death rate as could be achieved in our present state of medical knowledge and methods.

One further observation is pertinent—whether patients with known chronic ulcers of the stomach or duodenum should be advised to continue on expectant medical treatment or be operated upon because of the risk of bleeding or of perforation. Of our 19 fatalities, 14 had deep chronic ulcers, some of enormous size. An ulcer which has extended through the muscle coats of the stomach or duodenum is no longer peptic in nature, but has become a callous ischaemic ulcer—ischaemic until it ulcerates into a neighbouring large blood vessel—and is not capable of natural sound healing. Against the continued ill-health which these ulcers represent, with the risk of perforation or bleeding, has to be set the risk and result of operation. The mortality of partial gastrectomy in a skilled organization is about 2%, and the prospect of a healthy digestion and social life following this operation is about 90%. Equivalent facts about medical treatment of chronic peptic ulcer to set against these figures are less certain, and are the subject of separate investigations now proceeding.

Summary

A policy in the treatment of massive bleeding from peptic ulcer has been defined and applied, particularly in regard to the relationship of medical and surgical treatment, and its results are assessed.

The policy was to treat such bleeding by medical measures in the first place, and by surgery as soon as it was plain that medical treatment was not succeeding.

The importance of early and adequate transfusion in medical treatment is stressed.

The decision for surgery was usually made within 24 hours of admission to hospital, if bleeding still continued; or at any time while the patient was in hospital if the bleeding, having stopped, started again.

In this way 358 consecutive patients were treated, of whom 30% were aged 60 or over: 10% of the patients came to operation. The overall mortality was 5.3%.

The fatalities are considered and improvements in methods discussed.

The results are held to justify the policy of treatment, readily applicable to the medical and surgical departments, in collaboration, of a general hospital.

REFERENCES

- Bentley, F. H. (1952). *Brit. J. Surg.* In press.
— and Barlow, T. E. (1952). *Modern Trends in Gastro-Enterology*, p. 309. Butterworth, London.
Jones, F. Avery (1947). *British Medical Journal*, 2, 441.
Ogilvie, A. G., and Spencer, I. O. B. (1950). *Ibid.*, 2, 138.
Tanner, N. C. (1951). *Edinb. med. J.*, 58, 293.

THE MALARIA ERADICATION SCHEME IN MAURITIUS

BY

M. A. C. DOWLING, M.R.C.S., L.R.C.P., D.P.H.
D.T.M.&H.

Officer in Charge, Malaria Eradication Scheme, Mauritius

Until recent years the chief method of malaria control consisted in the destruction of the larval stage of the anopheles mosquito by means of surface oiling, usually combined with the clearing, canalizing, or draining of its breeding-places. This method has been employed in Cyprus, and the success of the campaign there is well known. Shortly after the end of the 1939–45 war a malaria-control scheme, based on anti-adult measures and employing the residual insecticide D.D.T., was undertaken in British Guiana under the direction of Dr. Giglioli. The universal spraying of indoor resting-places proved to be very successful against the chief local vector, *Anopheles darlingi*, which, being predominantly a domestic species, was reduced almost to the point of elimination in the course of the next few years. Unfortunately, however, the ever-present risk of anopheline extension from the neighbouring territories made necessary the continued application of the antimalarial measures. In 1948, following upon the success of the British Guiana experiment, the Government of Mauritius, in conjunction with the Colonial Insecticides Committee, decided to sponsor a similar scheme in an attempt at the total eradication of malaria from the island. It was considered that, eradication once obtained, it would be possible to prevent the reintroduction of anopheles at the port or airfield. The high recurrent annual expenditure on malaria would then no longer be necessary.

Mauritius is a small island of some 720 square miles (1,864 km.²) with a population of almost half a million. Malaria was introduced in the middle of the last century, and the year 1867 saw a severe epidemic of the disease affecting chiefly the capital town of Port Louis, which was probably the point of introduction. In this town, with a population of 47,000, there were more than 6,000 deaths in a single month. The disease rapidly encircled the island, transmitted by the African vectors, *Anopheles funestus* and *A. gambiae*. The former appears to have been the chief carrier, and, by breeding vigorously all the year round, maintained the infection at a high level on the coast during the winter months of June–December. It was possible to find as many as 1,200 adults of this species in a single room on the coast—an unusually high density. *A. gambiae* probably played an important part in the transmission of the disease during the epidemic summer months.

Residual Spraying

In the first instance an attempt was made to eradicate the two vectors by residual spraying. This primary method was to be supplemented or superseded by other measures if these were considered necessary in the light of experience. A small team, selected in the United Kingdom, arrived in Mauritius in November, 1948, to direct the experiment and, by setting up scientific controls, to interpret the results. For purposes of administration the island was divided into six districts, each with a locally chosen team of 50 to 70 men under the direct supervision of a field officer. A thorough house survey had been ably carried out before the arrival