If these can be adequately dealt with by interstitial radium also, this may be done. If, however, the glandular areas are not accessible to interstitial radium they should be irradiated by surface methods, either by x rays or by surface radium. Short-distance surface radium may be used if the region to be treated is comparatively superficial, as in the neck. For deeper regions x rays, or possibly telecurietherapy, should be employed.

Where growths in this group are too extensive to permit of adequate treatment by interstitial radium, treatment by x rays in the first instance will often succeed in reducing the growth sufficiently to permit of the insertion of radium subsequently. This is an important point, inasmuch as it is far better to employ the combined method of treatment than a doubtfully complete interstitial radium treatment.

For the cases in which, for anatomical and other reasons, interstitial radium cannot be applied x rays should be used. In a proportion of these cases very good primary results are obtained, although, unfortunately, recurrence is only too common after a period of freedom lasting for months or years. Among the growths in which good results are frequently obtained by x rays are certain pharyngeal and especially all palatal growths, carcinoma of the prostate, carcinoma of the cervix and corpus uteri, and carcinoma of the thyroid gland. In view of the tendency to recurrence sooner or later I would urge, however, that even when complete disappearance of the growth is effected by x rays, either radium or surgery should be subsequently employed in the attempt to make the result more permanent.

The exceptions to these methods of treatment in the moderately radio-sensitive group are the carcinomas of the skin, which are best treated by x rays. Surface radium may also be used, especially for the very small growths. The results obtained are entirely satisfactory when there is no involvement of bone or cartilage, even when the disease is extensive. When, however, bone or cartilage is involved the percentage of successes is very greatly reduced; this is also the case when previous incorrect radiation treatment has been applied. Skin growths that have been treated by repeated doses of soft or low-voltage x rays for long periods may become quite radio-resistant.

Radio-Resistant Growths

The methods of treatment in this group are similar to those adopted in the moderately sensitive group, with the exception that the cases have to be more rigorously selected. Interstitial radium is the treatment of choice, but it is essential that the whole extent of the growth be thoroughly barraged and with full dosage. In cases in which this thorough irradiation cannot be effected x rays may afford some degree of palliation, but they rarely achieve more. Perhaps the most difficult problem in this group is the treatment of the resistant cervical gland metastases, the proximity of the skin negating the application of the very high doses which are necessary to secure regression of the growth. There is a tendency to return to block dissection whenever possible in these cases, with pre- and post-operative irradiation, either by x rays or by surface radium.

Finally, a word about the combination of x rays and surgery. In comparing the results of surgery and radiotherapy it is often found that in certain groups the three- or five-year results do not differ greatly. I do not think, however, that it is sufficiently realized that the factors which determine the success of radiotherapy and those which determine the success of surgery differ very greatly. It is likely, therefore, that even though the percentage of three-year or five-year successes may be the same, the individual cases that survive are probably quite different. Thus, in a particular group of cases treated by surgery,

Mrs. X might be the only survivor after five years, but if the same series of cases had been treated by radiotherapy the sole survivor might be quite a different person, Mrs. Y. In each case the percentage survival would be the same. The point I would urge is, can we by combining our radiotherapy with surgery save Mrs. X and Mrs. Y too? It seems to me that in dealing with this deadly disease we should not be content with using only one means of treatment. Every proved means that is applicable should be applied. For example, even though we can make a breast growth disappear by means of radium, the breast still remains a potential source of danger to the patient and should be removed. It is difficult, I know, to advise a patient, who to all outward evidence is rid of her disease, to submit herself to a major operation, or, if she has already had a major operation, to an intensive irradiation. But there is, as yet, no method of treatment of malignant disease so satisfactory that we can afford to be lulled into a sense of false security by the contemplation of a satisfactory primary result.

THE TREATMENT AND POST-OPERATIVE RESULTS OF PERFORATED PEPTIC ULCERS

BY

F. HECTOR SCOTSON, M.B., B.S., F.R.C.S.

HONORARY SURGEON, MANCHESTER VICTORIA MEMORIAL JEWISH HOSPITAL

An investigation was made into the late results following operations performed for perforated peptic ulcers, and I wish to record, in some detail, all relevant facts of a series of cases operated on by me during the years I acted as assistant resident surgical officer (May, 1925, to December, 1929) and resident surgical officer (June, 1927, to May, 1929) to the Manchester Royal Infirmary.

In my series there are 131 duodenal ulcers, forty-five gastric ulcers, and five gastro-jejunal ulcers. One of the gastro-jejunal ulcers followed a posterior gastro-jejunostomy, performed eleven years previously for a perforated duodenal ulcer, which was treated by suture and gastro-jejunostomy; three followed anterior gastro-jejunostomy for duodenal ulcer; and one an anterior Polya gastrectomy for a gastric ulcer.

SURVEY OF CASES

SEX INCIDENCE AND HISTORY

There were 170 males and eleven females—a proportion of over 15 to 1.

The usual large number of males as compared with the small number of females is evident in my survey.

TABLE I.—Sex Incidence according to Type of Ulcer

Sex	Duodenal	Gastric	Gastro-jejunal
Males	125	40	5
Females... ..	6	5	0
Total	131	45	5

This male sex preponderance, which is especially noticeable in the case of the duodenal ulcers, has been noted by Dineen,⁵ Hinton,⁶ Gilmour and Saint,⁶ and many others, and presents no new features.

LENGTH OF HISTORY

This varied greatly; in the case of the duodenal ulcers the length of history previous to the perforation of the ulcer ranged from one week to forty years—the average being:

Males	32.38 months
Females	85.17 ..

while in the case of the gastric ulcers the length of symptoms was between two weeks and forty years—the average being:

Males	...	...	...	32.47 months
Females	...	...	...	68.40 "

It will thus be noted that the average length of ulcer history prior to perforation was well over twice as long in the female sex as in the male, and hence it may be assumed that perforation of a peptic ulcer is more likely to occur in a male than in a female subject.

AGE INCIDENCE AND LOCALIZATION

It will be seen from the table that the maximum number of perforated duodenal ulcers in males occurred in the fifth decade, whilst that of the gastric ulcers occurred in the sixth.

TABLE II.—Age Incidence—Duodenal and Gastric Ulcer

Age	Duodenal Ulcers		Gastric Ulcers	
	Males	Females	Males	Females
10-19	3	0	0	0
20-29	26	0	6	1
30-39	24	2	5	2
40-49	42	0	9	2
50-59	22	3	17	0
60-69	8	1	3	0
Total ...	125	6	40	5

In some cases it was difficult to state with certainty whether one was dealing with a perforated duodenal or pyloric ulcer. The doubtful cases I classified as duodenal ulcers; the other cases, when the ulcer seemed definitely on the gastric side of the pyloric vein, were of course classified as gastric ulcers. Table III shows the distribution.

TABLE III.—Site of Ulcers

Sex	Duodenal	Pyloric	Lesser Curvature	Greater Curvature	Anterior Surface	Posterior Surface	Position not Stated
Males ...	125	14	13	2	3	2	6
Females	6	2	0	0	0	1	2
Total ...	131	16	13	2	3	3	8

The three ulcers on the posterior surface of the stomach had perforated into the lesser sac of peritoneum, and to expose them an opening was made through the transverse mesocolon.

SYMPTOMATOLOGY AND TREATMENT

In nearly all cases there was the usual sudden onset, which could be fixed at a definite moment, of agonizing pain, with board-like rigidity of the abdominal muscles. In all cases the question of shoulder-tip pain was inquired into, and in doubtful cases reliance was placed on this in differentiating the case from acute perforative appendicitis. In a few instances the physical signs of abdominal tenderness and rigidity were not definite, and in these cases some reliance was placed on pelvic tenderness, elicited in rectal examination—the tenderness being due to escape of fluid from the perforation and tracking into the pelvis. It was surprising, in one or two cases, to find quite a large perforation in the duodenum with a fair collection of pelvic fluid, but little or no fluid in the general abdominal cavity, and a corresponding lack of abdominal signs. A few cases, unfortunately, were admitted with a distended abdomen, and suffering markedly from collapse, showing that peritonitis was present. All patients who were obviously not *in extremis* were operated on but the few

hopeless cases, whose condition did not permit of operation, and who died shortly after admission, are not included in this survey.

In all except a few extremely ill cases, where local anaesthesia was employed, operation was performed under general anaesthesia. A right rectus slide incision was made and the perforation sought and closed. In the earlier cases linen thread of size 90 was used for this purpose, but later catgut was invariably employed, as I considered that an unabsorbable suture might prevent healing of the ulcer. The ulcers were invaginated by Lembert sutures introduced parallel with the long axis of the bowel, and an omental graft was placed over this line, if a piece easily presented. Personally, I did not consider this graft of much importance. The abdomen was then gently cleansed with moist gauze swabs until it was fairly free from all the extravasated fluid. Gastro-jejunostomy was performed in twenty-nine cases. This procedure I considered requisite in those cases in which the ulcer seemed unusually chronic or producing stenosis, or if stenosis appeared to be present after the closure of the perforation. In only a few cases, in which there was frank peritonitis or gross soiling of the peritoneum with particles of food, was a large suprapubic tube inserted through a stab incision into the pelvis. The abdomen was then closed with a small tube drain to the abdominal wall in those cases where there appeared to be a probability of infection here.

MORTALITY

Of the 181 patients thirty-one died, making a mortality of approximately 17 per cent. Details according to localization are:

Percentage mortality of duodenal ulcers	...	12.22
" " gastric ulcers	...	28.90
" " gastro-jejunal ulcers	...	40.00

Rayner¹³ states that during the years 1925-8 the average number per year of all the perforated peptic ulcers admitted to the Manchester Royal Infirmary was 135, of which 75 per cent. were duodenal. The mortality rate for perforated duodenal ulcer cases was 12 per cent., while that of gastric ulcer was 33 per cent. These figures agree fairly closely with my series—some of which are included in those reported. The mortality of the perforated gastric ulcers is seen to be much higher than that of the duodenal group, and this fact is in accordance with the observations of most surgeons. This increased mortality in the case of the gastric ulcers is probably accounted for by a number of factors—namely, the likelihood of serious haemorrhage preceding perforation, the generally larger size of the perforation and greater amount and infectivity of the extravasated contents, and also the difficulty, in many cases, of making a satisfactory closure of the perforation in a large gastric ulcer. Harries⁷ considers that the reduction of alkaline salts of the body, due to neutralization of the escaping acid gastric content, is an important factor in this regard.

The following tables indicate the mortality according to type of ulcer, time from perforation to operation, and type of operation performed.

TABLE IV.—Duodenal Ulcer

Hours Perforated	Treated by Suture			Treated by Suture and Gastro-jejunostomy		
	No. of Cases	Died	Mortality per cent.	No. of Cases	Died	Mortality per cent.
Twelve hours or less ...	48	4	8.33	12	0	nil
More than twelve hours ...	34	3	8.82	6	2	33.33
Time not stated ...	25	7	28.00	6	0	nil
Total ...	107	14	13.08	24	2	8.33

TABLE V.—*Gastric Ulcer*

Hours Perforated	Treated by Suture			Treated by Suture and Gastro-jejunostomy		
	No. of Cases	Died	Mortality per cent.	No. of Cases	Died	Mortality per cent.
Twelve hours or less ...	15	2	13.33	1	0	nil
More than twelve hours ...	12	3	25.00	—	—	—
Time not stated ...	13	8	61.54	4	0	nil
Total ...	40	13	32.50	5	0	nil

The total number of perforations (excluding five cases of gastro-jejunal ulcer) were thus:

Treated by suture... 147—mortality 18.36 per cent.
Treated by suture and gastro-jejunostomy ... 29—mortality 6.9 per cent.

AFTER-HISTORY

As the last of the above cases were operated on over three and a half years ago, we may assume that most of those who have had no symptoms of any sort since the operation may be regarded, with some justification, as clinically cured.

With Bryce's² series of forty-eight cases in which recurrent symptoms of ulceration took place, in only four was it more than one year and nine months after the time of operation. It would therefore seem unlikely that there would be any return of symptoms after three and a half years of absolute freedom. Gilmour and Saint,⁶ however, found that recurrence of symptoms took place in two cases, out of their series of twenty-seven, in whom the after-history was known, three and a half and five years after perforation.

Below is given a classification of results in ninety-two cases in which information was obtained from the questionnaire sent to each patient, or personally seen by me, for the purpose of providing information for this paper. By "slight symptoms" is understood occasional dyspepsia, not severe enough at any time to cause the patient to be absent from work or household duties; and by "severe symptoms" is meant ulcer symptoms, sufficient to cause loss of work and medical or surgical treatment to be sought.

TABLE VI.—*After-Results Compared with Two Other Series*

	Bryce (100 Cases)	Gilmour and Saint (44 Cases)	Present Series (52 Cases)
	Per cent.	Per cent.	Per cent.
No symptoms ...	32.00	38.60	42.39
Slight symptoms ...	27.00	25.00	38.04
Severe symptoms, or had a further operation	41.00	36.40	19.57

In investigating the results of the after-history of the cases I made a special point of asking the patients

TABLE VII.—*Replies to Questionary*

	Duodenal Ulcers				Gastric Ulcers	
	Prescribed Diet Followed		Prescribed Diet not Followed		Prescribed Diet Followed	Prescribed Diet not Followed
	Suture	Suture and Gastro-jejunostomy	Suture	Suture and Gastro-jejunostomy		
No symptoms	14	3	11	5	3	3
Slight ..	7	4	16	2	3	3
Severe ..	5	0	10	0	2	1
Total ...	26	7	37	7	8	7

whether or not they had followed out the dietary restrictions imposed on them when they left hospital—each patient being given the usual diet sheet when discharged. The preceding table classifies the replies received, according to whether the ulcers were duodenal or gastric, the type of operation performed in the former cases, and whether or not they had adhered strictly to the diet imposed on them.

TYPE OF OPERATION TO BE ADOPTED

The operation planned for any acute abdominal catastrophe should obviously be the one which will give the immediate lowest mortality, and if two procedures conform closely in this respect then that one should be chosen which will give the best ultimate results. In the hands of most surgeons this means: should the suture of the ulcer be combined with gastro-jejunostomy? It is plain that it would be unwise to subject patients who are in a very poor condition to a gastro-jejunostomy, however desirable it might otherwise be, as the added time for its performance might easily prove too much for the immediate resources of the patient.

Reviewing the mortality of the above cases of perforated duodenal ulcer, it will be seen that the cases where the period since perforation is known to be less than twelve hours, which were treated by suture and gastro-jejunostomy, had a lower mortality figure than those in which suture alone was used—namely, *nil* to 8.33 per cent.; in addition, there were no deaths in the group of perforated pyloric ulcers treated by the combined operation. The general mortality of all cases of perforated peptic ulcer (excluding gastro-jejunal) treated by the combined operation is much lower than those treated by suture alone—namely, 6.9 per cent. to 18.36 per cent. The only group in which the combined operation appeared to increase the mortality was in those cases of duodenal ulcer perforated for over twelve hours; in this, out of six cases so treated two died, giving a mortality of 33.33 per cent. Unfortunately, in the two tables (IV and V) the information as regards the interval elapsing between time of perforation and operation is in many cases incomplete, and so it has been impossible to give a correct percentage mortality, according to time elapsing since perforation, in those cases treated by simple suture; the mortality figures in the first two items in Tables IV and V are obviously too low. Gastro-jejunostomy was performed only on those patients whose general condition warranted the extra time required for its performance. Simple suture was reserved for all cases which did not appear to necessitate a gastro-jejunostomy for their immediate or ultimate cure, or whose condition warranted only the minimum amount of manipulation. Hence we cannot state definitely that gastro-jejunostomy reduces the mortality, but from the above figures we are justified in stating that gastro-jejunostomy can be safely undertaken in those cases which require the performance of a short circuit, have perforated less than twelve hours previously, and in which the general condition is good. In my series there were no deaths in patients so treated.

Many surgeons confine themselves entirely to simple suture; a few perform gastro-jejunostomy in nearly all cases, arguing that thereby the immediate mortality is lowered by this means; whilst a number adopt a course similar to the one followed here.

Grey Turner¹⁵ records a series of 147 cases on which he operated with a mortality of 15.64 per cent. He is of opinion that it is best to rely on simple suture, and, if a gastro-jejunostomy is necessary for the cure of the ulcer, to do this before the patient leaves hospital. Cope,³ in a survey

of all the cases of perforated peptic ulcer taken to St. Mary's Hospital during the years 1920-4, found a mortality rate of 25.3 per cent. in the sixty-seven patients so admitted, and he included in this percentage three moribund and unoperated cases. He states that in those cases where the time elapsing between perforation and operation was known, eight out of twenty-four died when simple suture was employed, while only three out of sixteen died when gastro-jejunostomy was combined with suture. In the former case the average lapse of time was thirteen hours, while in the second it was only five and a half hours. Thus, he considers that the time factor alone would be sufficient to account for the more favourable results. Cope finds that he is relying on simple suture alone more frequently than he did formerly. Mills¹² advocates the performance of gastro-jejunostomy with suture of the ulcer, and in this he is supported by Deaver,⁴ who published a series of fifty-six perforated peptic ulcers with only two deaths. Luff¹¹ reports a series of 112 cases of perforated duodenal ulcer and twenty cases of perforated pyloric ulcer, all of which were treated by suture and gastro-jejunostomy, with a mortality of 13.6 per cent. In this series one case of gastro-jejunal ulcer occurred following the operation, and this perforated. This one recovered after closure of the perforation. Rayner¹³ combined gastro-jejunostomy with suture of the perforation six times in thirty cases, for the same reasons as above, and in a further two cases had to do this operation within three weeks after simple suture on account of cumulative vomiting.

Apart from two cases of perforated gastric ulcer occurring in the anterior surface of the stomach—when I made a rapid excision of the ulcers with scissors before suturing—I have had no experience of excision of any perforated ulcer, either alone or combined with such procedures as pyloroplasty. The rapid excision of the friable edges of the perforation, in the case of a large gastric ulcer, would certainly assist in its closure by enabling the sutures to obtain a better hold, and bring healthier tissues into apposition. Such major procedures as duodenectomy and partial gastrectomy for perforated peptic ulcer would appear to be quite unjustifiable in the hands of the average surgeon, although in several clinics in Central and Eastern Europe this mode of treatment is advocated. Hoche and Marangos⁹ describe eighteen cases treated by gastrectomy, using the Billroth II technique, with a mortality of 22.4 per cent., and they collected from the published records 405 cases of resection within twelve hours of perforation, with a mortality of only 9 per cent. Judine¹⁰ has done ninety-eight resections with a death rate of 11 per cent. Boehm¹ has reduced his mortality from 29 to 21 per cent. by adopting partial gastrectomy as his routine treatment. The advantages claimed are that the death rate is low, other ulcers are removed, secondary operations are not needed, and recurrent ulcer is not likely to occur.

AFTER-RESULTS

From Table VI it is seen that in less than 20 per cent. of the patients from whom replies were received were there symptoms which can be described as severe, and that over 40 per cent. had no symptoms of any sort. Reference to Table VII shows that in the case of the duodenal ulcers treated by simple suture, 54 per cent. of patients who had adhered to the dietary restrictions had no symptoms, while of those who had not done so only about 30 per cent. were symptomless. In the former cases only 19 per cent. had severe symptoms, against 27 per cent. in the latter. It is to be noted that none of the duodenal ulcers treated by suture and short circuit had any severe post-operative symptoms. In the cases of the gastric ulcers the effect of dietary restrictions did not seem to reduce the onset of recurrent symptoms. In this connexion Shelley¹⁴ quotes eighty-two cases treated at one hospital. Of those treated by simple inversion 43 per cent. were

described as "cured"—in this group the mortality was 15 per cent., while of those treated by inversion and gastro-jejunostomy 61 per cent. remained cured, but the mortality in this group was 23 per cent. White and Patterson¹⁶ found that two-thirds of the patients treated by simple suture remained well, while 10.15 per cent. required a subsequent gastro-jejunostomy.

CONCLUSIONS AND SUMMARY

1. In this series of 181 cases of perforated peptic ulcer there were five anastomotic ulcers. It is generally recognized that gastro-jejunal ulcer is more likely to occur in an anterior anastomosis than in a posterior one, and so it is not surprising that three of the cases followed anterior gastro-jejunostomy. It is interesting to note the occurrence of anastomotic ulcer following an anterior Polya gastrectomy: the ulcer in this case, which perforated and caused death, was on the anterior part of the anastomosis near the lesser curvature of the stomach.

2. Perforation of a duodenal or gastric ulcer is more likely to occur in a male than in a female, as judged by the average length of ulcer history prior to the perforation.

3. In most cases the symptoms and signs of a perforated peptic ulcer are obvious, but in a few the occurrence of shoulder-tip pain may help in a differentiation between that type of acute abdomen and one due to perforative appendicitis. Again, a rectal examination may help to decide that perforation of an ulcer has taken place with escape of fluid into the pelvis, when the abdominal signs are not definite.

4. The treatment of this condition has been discussed at some length. In this series the mortality of cases treated by the combined operation of suture and gastro-jejunostomy has been low, and if the case requires a short circuit, as judged by the foregoing criteria, this can be safely performed.

5. In the investigation of the after-results following simple suture, it will be seen that a large proportion have no further symptoms, and this number is definitely increased in those who adhere to the list of instructions regarding diet, hygiene, and alkaline powder, given to each patient for future guidance on discharge from hospital. Although there were several patients complaining of slight symptoms following the combined operation of suture and gastro-jejunostomy, none of these had any severe symptoms, or anything to make one suspect the onset of an anastomotic ulcer. Some surgeons maintain that this complication is especially liable to follow a gastro-jejunostomy performed for perforated duodenal ulcer.

Finally, I wish to thank the honorary surgeons of the Manchester Royal Infirmary, under whose care all the above cases were admitted, for their kind permission to make this investigation.

REFERENCES

- Boehm, C.: *Der Chirurg.*, 1931, iii, 257.
- Bryce, A. G.: *British Medical Journal*, 1930, i, 774.
- Cope, Z.: *Ibid.*, 1925, i, 139.
- Deaver, J. B.: *Ann. of Surg.*, 1929, lxxxix, 529.
- Dineen, P.: *Ibid.*, 1929, xc, 1027.
- Gilmour, J., and Saint, J. H.: *Brit. Journ. Surg.*, 1932, xx, 78.
- Harries, D. J.: *Practitioner*, 1932, cxxviii, 554.
- Hinton, J. W.: *Surg., Gynecol. and Obstet.*, 1931, lii, 778.
- Hoche and Marangos: *Arch. f. klin. Chir.*, 1932, 626.
- Judine, S. S.: *Journ. de Chir.*, 1931, xxxviii, 159.
- Luff, A. P.: *British Medical Journal*, 1929, ii, 1125.
- Mills, G. P.: *Ibid.*, 1925, i, 12.
- Rayner, H. H.: *Ibid.*, 1929, ii, 1048.
- Shelley, H. J.: *Amer. Journ. Surg.*, 1932, 277.
- Turner, G. Grey: *British Medical Journal*, 1925, i, 213.
- White, W. C., and Patterson, H. G.: *Ann. of Surg.*, 1931, 242.