

Surgical treatment of hiatal hernia: a 10-year survey

JOHN BORRIE

From the Departments of Thoracic Surgery, Dunedin and Wakari Hospitals, and the Department of Surgery, University of Otago Medical School, Dunedin, New Zealand

The results of surgical treatment of 150 patients with hiatal hernia in the decade 1952–62 are presented. They were followed from three to 13 years after herniorrhaphy. All 131 patients alive were interviewed or communicated with. Fifty-one per cent had had a previous abdominal operation. It is concluded that oesophagoscopy is essential to confirm the diagnosis and exclude the presence of oesophagitis, stricture, or neoplasm before beginning any treatment, be it medical or surgical. Anti-obesity measures are advisable before operative treatment. A left transthoracic, Allison type of repair gives excellent results in over 80% of patients, with relief of all symptoms. An anchoring suture between the under surface of the diaphragm and the fundus of the stomach does not improve the results of this type of repair. There is an occasional place for an abdominal or right-sided approach if other right-sided lesions require surgical correction. After a successful operation patients must continue to limit the quantity of food they eat to keep their weight down to a normal level. Two patients are briefly described whose symptoms, due to severe oesophagitis, developed following prolonged nasogastric intubation. A third report describes an unusual post-operative complication of perforation of a Richter-type of hernia of the stomach into the left pleural cavity eight months after hiatal herniorrhaphy.

In the decade 1952–62 270 patients with hiatal hernia were referred to the Southern Metropolitan Thoracic Surgical Unit, Dunedin. Of this total, 120 received medical treatment only and 150 had surgical treatment. This paper analyses those treated surgically.

They have been carefully followed, and seen either six-monthly or annually after operation; all who survived operation and the passing years were interviewed again in 1965.

The survivors were therefore followed for periods ranging from three to 13 years from the time of their hiatal herniorrhaphy. In 55% (83 patients) the follow-up period was five years or more, in 33% (50 patients) four to five years, and

in 12% (17 patients) over three years. Those with the slightest post-operative symptoms were checked by post-operative oesophagograms during their follow-up period. Thirty per cent (45 patients) had this follow-up investigation a year or more after operation.

The pathological data of the 150 surgical cases are shown in Table I.

ASSOCIATED OESOPHAGEAL LESIONS

As has been stressed by Robb (1954), Adler and Rodriguez (1959), McConchie (1961), and others, a hiatal hernia is not infrequently associated with other oesophageal lesions, sometimes related, sometimes quite unrelated.

Robb (1954) reported malignant disease of the gullet or stomach in six of 130 patients (almost 5%). McConchie (1961) reported an associated oesophageal carcinoma in 8% of his cases.

Adler and Rodriguez (1959) viewed the problem differently; they found that, of 194 patients with malignancy involving the gastric cardia and distal oesophagus, 9.2% had an associated hiatal hernia.

In this series there was an 8% incidence of associated lesions. These were: carcinoma of the oesophagus or cardia, seven patients; leiomyoma

TABLE I

Type of Hernia	No. of Cases	Per cent
Sliding hiatal hernia	136	90
Mucosal stricture	10	
Full thickness stricture	9	
Neoplasm	11	
Associated cardiospasm	2	
Paraoesophageal hiatal hernia	10	7
Mixed hiatal hernia	4	3
Total	150	100

of the oesophagus, two patients; and lipoma of the oesophagus, two patients.

All of these lesions were associated with sliding hiatal herniae.

This 8% incidence is noteworthy and in itself underlines the importance of performing an oesophagoscopy before any patient referred with symptoms and radiological evidence of hiatal hernia is started on a purely medical regime. Only by oesophagoscopy can one be reasonably certain that there is no associated carcinoma that could grow beyond all hope of cure if one blindly accepts radiological evidence alone. This safeguard of oesophagoscopy is not infallible and may have to be repeated at one- or two-monthly intervals; but it gives the patient the benefit of the best oesophageal check yet devised for excluding an early or latent carcinoma.

CLINICAL FEATURES

SEX INCIDENCE In this series 60% were women and 40% men.

AGE RANGE This is shown in Table II.

TABLE II

Age Group	Cases (%)
0-10	2
11-20	3
21-30	5
31-40	9
41-50	18
51-60	32
61-70	26
71-80	5
	100

The lesion in our series occurred most commonly in middle and later life, the majority of patients seeking relief in the fifth to seventh decades. Others confirm this point (Edmunds, 1957).

Those presenting in the first decade at the time of operation were aged 6 weeks, 17 months, and 2 years respectively. They required operation because of failure to respond to standard medical treatment.

SYMPTOMS These followed the same pattern as those described by Allison (1951). They were: retrosternal pain, 82%; acid reflux, 67%; flatulence, 50%; dysphagia, 24%; vomiting, 17%; haematemesis and/or melaena, 11%; choking, 2%; and palpitation, 2%.

The symptom of haematemesis and/or melaena is important and emphasizes that chronic anaemia can be due to an unsuspected hiatal hernia which can be revealed by an oesophagogram and oesophagoscopy. It need not be the only cause, but in the presence of intractable anaemia it is worthy of surgical repair. I have recently encountered a patient whose anaemia did not resolve after hiatal herniorrhaphy, and who was found at subsequent laparotomy for intractable melaena and anaemia to have a small, bleeding haemangioma of the second loop of jejunum.

Two patients had para-oesophageal hiatal herniae discovered in a mass x-ray survey revealing the typical shadow of a fluid level in the posterior mediastinum.

DURATION OF SYMPTOMS It is surprising how long the patients had put up with their symptoms before seeking medical advice. The times ranged from two to 20 years and were: up to two years, 37%; three to five years, 26%; six to 10 years, 22%; 11 to 20 years, 12%; and over 20 years, 3%.

AETIOLOGICAL FACTORS

Obesity was a common predisposing cause and was seen in 26% of the patients. It was more frequent in the women. Questioning revealed that many of these women had weighed 8-10 st. (50-63 kg.) before marriage; but in the succeeding 10 to 20 years their weight had risen to an average of 12-14 st. (76-89 kg.). Dedication to three 'square' meals per day, plus potatoes, bread, cream cakes, or sweets, had been their undoing.

Two patients gave a history of lower chest trauma.

Two others developed symptoms associated with severe reflux oesophagitis and oesophageal stenosis following three weeks of continuous nasogastric suction for abdominal emergencies. Their case summaries are as follows:

Mr. L. aged 46 years developed acute pancreatitis on 4 August 1959 and was treated by immediate laparotomy and three weeks of intravenous therapy and nasogastric suction. He had a complicated convalescence with a burst abdomen and drainage of a pancreatic abscess on 22 August. He was discharged on 18 November 1959.

In the middle of September 1959, for the first time in his life, he had difficulty in swallowing. This persisted. He was referred to the Thoracic Surgical Unit. Investigation in April 1960 confirmed hiatal hernia with reflux oesophagitis and stricture. This was treated by hiatal herniorrhaphy on 10 May 1960. Thereafter,

aided by regular oesophageal dilatation, his swallowing has improved; his oesophageal lumen was substantially normal at the last oesophagoscopy on 2 February 1966.

Mrs. W. aged 50 years was admitted on 9 July 1960. In May 1960 she had perforated a duodenal ulcer and required three weeks' post-operative gastric suction. Following removal of the nasogastric tube she began to vomit. A gastroenterostomy was performed.

She was referred to the Thoracic Surgical Unit on 9 July 1960. Further investigation revealed a tight stricture in the lower oesophagus. It was at 40 cm. from the upper jaw, was 8 French in diameter, and could be dilated with difficulty up to 24 French. This was done three times, and on the last occasion a Souttar tube was inserted. As the stricture could not be adequately and permanently dilated she required oesophago-jejunostomy with a Roux-Y loop, which was performed on 26 July 1960.

Histological examination of the stricture confirmed that the lamina propria was grossly thickened by fibrous tissue up to 4 mm. thick. There was no neoplasia.

Following this procedure Mrs. W. has remained fit and able to swallow well and to lead a normal life.

This experience exactly parallels that of Bingham (1958), who reported four such cases associated with hiatal herniae.

PAST MEDICAL HISTORY

In this series, 24% of patients had had a previous cholecystectomy without relief of symptoms, and 18% had had an appendicectomy, making a combined total of 42% who had had a previous laparotomy for abdominal pain. An additional 9% had had a pelvic operation.

In two patients a previous trans-abdominal hiatal herniorrhaphy had been performed elsewhere.

There were also two patients known to have symptoms and signs of ischaemic heart disease.

INVESTIGATIONS

OESOPHAGOGRAMS All patients had a barium study of the oesophagus, stomach, and duodenum, followed by oesophagoscopy using Negus oesophagoscopes.

Relation between Radiographic and Oesophagoscopy Findings Oesophagograms are excellent when they reveal the shadows of disease or dysfunction; but it must again be stressed that there are times when the most careful radio-

graphic examination of the oesophagus fails to reveal a lesion. Complete investigation, therefore, of oesophageal symptoms has concluded only after oesophagoscopy. This can reveal a cardia sufficiently lax to produce symptoms of reflux without this being seen at radiographic screening.

In this series the relationship between the two investigations was: positive oesophagogram and positive oesophagoscopy, 84%; negative oesophagogram and positive oesophagoscopy, 9%; and positive oesophagogram and negative oesophagoscopy, 7%.

The 7% 'negative oesophagoscopies' occurred in patients with paraoesophageal herniae, in whom the oesophagus is normal but the greater curvature of the stomach rolls up as a gastric volvulus through a paraoesophageal opening into the posterior mediastinum.

OESOPHAGOSCOPY This has a telling place in the complete assessment of hiatal hernia. It must never be omitted and is essential before the start of any treatment, be it medical or surgical. It should not be performed by a novice but in a unit with an interest in disorders of the oesophagus.

Oesophagoscopy can help materially in the following ways. It can:

1. Exclude the presence of other lesions of the oesophageal mucosa, especially neoplasm.
2. Check the presence of reflux of gastric juice into the lower oesophagus.
3. Confirm the loss of the normal angle of entry of the oesophagus into the stomach.
4. Note the degree of competence, if any, of the cardia.
5. Show the level of change from oesophageal to gastric mucosa (this is normally from 38 to 40 cm. from the upper jaw).
6. Confirm the presence of mucosal oesophagitis.
7. Determine the degree of mucosal stricture, if present.
8. Allow of the taking of a mucosal biopsy for histological study.

TABLE III

Findings	Cases (%)
Reflux and lax cardia	30
Reflux and mucosal oesophagitis	40
Mucosal stricture	6.5
Full thickness stricture of the oesophageal wall	6.5
Associated tumour	8
No oesophagitis but positive oesophagogram (paraoesophageal hernia)	9
	100

The greatest value of oesophagoscopy in hiatal hernia has been in determining the presence of severe oesophagitis, mucosal stricture, or neoplasm.

The results of oesophagoscopy in this series are given in Table III.

TREATMENT

MEDICAL TREATMENT Many patients faced with a diagnosis of proved 'hiatal hernia' elect to have a period of medical treatment. It has much to offer and can be curative, especially when the hernia is associated with obesity, duodenal ulcer, or cardiac ischaemia.

The sheet anchors to medical treatment are weight reduction, posture, and antacids.

Weight Reduction Fundamentally, the only way to reduce weight is to eat and drink less. Smoking and anti-appetite pills have nothing to offer and can do harm. Many patients are dishonest dieters; but he who wants to lose weight can and will if he once decides that a 'taper waist' is preferable to his shapeless form.

The essentials are daily weighing, at the same time, on bathroom scales in front of a full-length mirror, realizing that over-weight is dangerous and that one cannot eat 'inbetweens' or second helpings. A pin-up photograph of a well-built Adonis or a trim Venus above the scales and beside the mirror acts as a daily challenge and can work wonders.

As a last resort a period in hospital on a strict 800 calorie diet can diminish obesity, as can the practical advice to halve grocery, meat, and drink bills.

Posture Some patients can tolerate the head of the bed on blocks, others prefer to sit propped up with pillows and with the foot of the bed raised on blocks. If the one fails to bring relief, the other should be tried.

Antacids Many have been used, without any being found specific.

SURGICAL TREATMENT This was advised for the following reasons: failure of medical treatment to relieve symptoms; mucosal oesophagitis, which can lead to oesophageal stenosis; severe anaemia; para-oesophageal hiatal hernia; or an associated lesion, such as neoplasm.

The 'hell in hiatal hernia' is mucosal oesophagitis, which when not checked by timely herniorrhaphy can lead to permanent oesophageal

stricture. When the oesophagitis is confined to the mucous membrane, simple herniorrhaphy is effective in relieving the deformity and the symptoms and in arresting the tendency to permanent stricture formation.

If left untreated, the patient will enter the late seventies or early eighties with a lesion that of itself will not kill but will make swallowing a misery and require dilatation until such time as increasing kyphosis of advancing years will make further oesophagoscopies hazardous. Herniorrhaphy can prevent this and obviate the need for severe bypass operations. It is to prevent this that hiatal herniorrhaphy is required in the presence of oesophagitis.

The surgical methods used are summarized in Table IV.

TABLE IV
SURGICAL TREATMENT OF HIATAL HERNIA

Surgical Method	No. of Cases	%
For hernia uncomplicated by reflux stricture		
Allison repair (left trans-thoracic) ..	132	88
Right trans-thoracic repair	3	2
Trans-abdominal repair	1	0.5
For associated carcinoma		
Oesophago-gastrectomy	4	3
Dilatation only	3	2
For full-thickness reflux stricture		
Oesophago-jejunostomy	6	4
Oesophago-gastrectomy	1	0.5
Total	150	100

Surgical Technique The surgical technique most frequently used in this series was that described by Allison; this has been described elsewhere (Borrie, 1961).

In the first 75 patients, after the crural fibres of the diaphragm had been approximated and the oesophagus sewn to the diaphragm by a ring of anchoring sutures, no additional anchoring sutures were placed between the cardia and the fundus of the stomach on the one hand and the under surface of the diaphragm on the other. In the second 75, since 1959 this was done routinely. As the follow-up results of the two groups were identical, it is concluded that this step has little effect on the final result. I believe that the fundamental requirements at operation are to expose the hernia, reduce the herniated stomach, keep it reduced, and preserve sufficient lumen at the cardia to permit normal deglutition.

Findings at Operation The size of the hernial orifice varied considerably. It was 2 fingers' diameter in 3%, 3 fingers' diameter in 30%, 4

fingers' diameter in 20%, and 5 fingers' diameter in 47%.

The height of the hiatal hernial sac above the diaphragm was 2 in. in 68%, 2 to 4 in. in 28%, and over 4 in. in 4%.

Right-sided Transthoracic Approach In three patients the hiatal hernia was approached and repaired through the right pleural cavity. The case summaries are as follows:

Mrs. B. aged 58, misdiagnosed as having a hydatid cyst of the right lung and explored by right thoracotomy on 30 January 1957, was found to have a para-oesophageal hiatal hernia. This was successfully reduced and repaired from the right side (Borrie, 1958). She remains well and symptomless eight years after the operation.

Mrs. H. aged 63 had a 'coin lesion' in the lower lobe of the right lung. She also had a large para-oesophageal hiatal hernia. Because of the lung tumour a right-sided approach was chosen and performed on 14 March 1963. The lung tumour proved to be a subpleural fibroma which was removed by wedge resection. The hernia was also reduced and repaired. Since the operation she has remained well and three years later had minimal symptoms.

Mr. W. aged 67 had a sliding hiatal hernia together with a right anterior diaphragmatic hernia on 23 May 1963. Both these lesions were repaired through a right thoracotomy.

A year later he had some persistence of symptoms with fluoroscopic evidence of continuing reflux without recurrence of the hernia.

A second operation was performed on 20 April 1964 through the left pleural cavity and a single suture was placed to approximate the crural fibres of the diaphragm around the cardia. This relieved his symptoms. The patient has remained well.

From this small experience of a right-sided approach I submit that for preference one should choose a left-sided approach: but if there is an associated right-sided lesion, as for example, a pulmonary neoplasm requiring surgical treatment, then this can be combined with a right-sided hiatal herniorrhaphy. It is easier to correct a para-oesophageal hernia successfully from the right side (Mrs. B. and Mrs. H.) than a sliding hernia (Mr. W.).

ASSOCIATED NEOPLASMS OF THE OESOPHAGUS

Of those with associated oesophageal neoplasms, two leiomyomata were dissected out of their extramucosal, intramural sites, the oesophageal

wall was repaired, and the standard hiatal herniorrhaphy performed. The clinical details have already been published (Borrie, 1960). Two lipomata were similarly treated.

Of those with associated oesophageal carcinoma, three patients had dilatation alone and four had partial oesophago-gastrectomy.

OPERATIVE MORTALITY

In this series of 150 operations, four post-operative deaths occurred in women in the fifth and sixth decades. They were:

(1) A woman aged 65 died 15 days after operation of pulmonary artery thrombosis and mesenteric artery thrombosis.

(2) A woman aged 63 died seven days after operation of massive pulmonary embolism.

(3) A woman aged 55 died 29 days after operation of multiple pulmonary emboli.

(4) A woman aged 65 died four days after operation of post-operative heart failure with atrial fibrillation and subsequent ventricular fibrillation.

One had a sliding, one a para-oesophageal, and two had mixed hiatal herniae.

This death rate is higher than the 1% in 394 operations of Sweet (1962) or 0.5% in 200 operations of Groves, Martinez, and Effler (1959).

There have been no post-operative deaths in a further 100 hiatal herniorrhaphies.

POST-OPERATIVE COMPLICATIONS

The commonest post-operative complication was a transient left pleural effusion in 7%. Wound sepsis was next, occurring in 4% of patients. The complete list was: transient left pleural effusion, 7%; minor wound sepsis, 4%; venous thrombosis in legs, 2%; post-operative atony of bladder, one patient; haemothorax, one patient; perforated strangulated Richter-type hernia of stomach through diaphragmatic counter-incision, one patient.

This last complication occurred as follows:

Mrs. E. D. T. aged 64 had a left transthoracic hiatal herniorrhaphy on 14 September 1959. In the course of this a one-inch radial incision was made in the left dome of the diaphragm. This small incision was later closed in two layers (according to the operation record) using No. 4 silk sutures. Her convalescence was uneventful.

After the operation she experienced intermittent bouts of unusual abdominal pain. A check barium meal failed to reveal any abnormality. Eight months

after operation at lunch on 18 May 1960 she found that no food would go into her stomach; she regurgitated all she had eaten. She had severe pain and tightness in the left chest.

She was re-admitted to this unit on 20 May 1960. Radiography showed a left hydropneumothorax. Screening showed radio-opaque dye entering the stomach and escaping through the dome of the left diaphragm into the left pleural cavity.

At emergency thoracotomy, 3 pints (1.7 l.) of brown, odourless fluid were aspirated from the left pleural cavity. The lower lobe of the left lung was found to be adherent to omentum which had penetrated through the inch opening in the diaphragm. In the centre was a knuckle of strangulated stomach in which there was an inch-long perforation.

The constricting neck of the hernia was incised; the perforation and the opening in the diaphragm were closed.

Convalescence was uneventful and she remains well six years later.

Windsor (1963) described a similar case. Effler (1965), in advising a technical modification of the original Allison operation to eliminate the diaphragmatic counter-incision, has referred to 16 case histories, reported by seven surgeons, wherein re-operation for this specific complication was required.

LATE FOLLOW-UP

When followed up after this 14-year period not all the patients were alive.

Of the seven patients who had a carcinoma as well as a hernia three had not been treated surgically because of the extent of spread of the lesion. They had lived less than a year. The remaining four had died within two years of operation from their carcinoma.

Twelve further patients had died (Table V). Their survival times ranged from eight and a half years to one month. All but one of this group had been relieved by hiatal herniorrhaphy.

TABLE V
CAUSE OF DEATH

Patient	Age at Operation	Date of Operation	Survival	Cause
O.B.	66	6.6.56	8½ years	Myocardial infarct
A.H.	70	1.12.58	7 years	Old age
J.L.	61	12.12.57	5 years	Pulmonary embolism
McG.	58	10.12.57	3 years	Asthma and respiratory failure
V.O.C.	70	9.3.55	3 years	Tractor accident
S.	71	7.1.60	2½ years	Acute leukaemia
I.C.	57	7.8.59	3 years	Coronary thrombosis
W.D.	56	14.1.58	2½ years	Acute alcoholism
P.	49	13.10.61	2 years	Coronary thrombosis
F.J.E.	78	8.6.61	17 months	Coronary thrombosis
J.A.McM.	62	26.6.58	5 months	Coronary thrombosis
L.	59	17.11.57	1 month	Coronary thrombosis

Of the original 150 patients, 131 were therefore interviewed again and re-assessed.

RESULTS

The results were grouped as excellent, if the patient was symptomless; good, if there were occasional symptoms; fair, if there were some symptoms but *no* radiological signs of recurrence; poor, if there were symptoms *and* radiological evidence of recurrence.

To this group are added two subdivisions, namely, those requiring revision operation, and those with residual post-oesophagitis stricture requiring occasional dilatation.

As stated earlier, the reason for the original operation was 'unrelieved, persisting symptoms'. In the follow-up, therefore, when the patient declared that there was total relief from all symptoms, one felt there was no justification for submitting them to a further oesophagogram.

From reviews in 1963 and in 1965 the results were assessed as follows: excellent, 81%; good, 7%; fair, 3%; poor, 9% (symptoms and radiological recurrence 2%, requiring revision operation 2%, and requiring occasional dilatation of residual stricture 5%).

REVISION OPERATIONS The reasons for the three revision operations were: repair too tight, two patients; repair too loose, one patient. Following correction of these defects the patients entered the category of 'good' results.

These findings parallel the smaller series reported by Humphreys, Ferrer, and Wiedel (1957) and followed from two to nine years; in this series after surgical repair by a similar technique the results were good in 83% of cases.

OTHER PROBLEMS

POST-OPERATIVE DEVELOPMENT OF OTHER GASTRO-INTESTINAL LESIONS Three patients after hiatal herniorrhaphy developed other gastro-intestinal lesions. These were duodenal ulcer in two and gastric ulcer in one, all confirmed by fluoroscopy. These three patients responded to medical treatment.

POST-OPERATIVE OBESITY Some 13% of these patients in their early post-operative days were so relieved of their symptoms that they over-ate and put on more than 2 st. (12 kg.) in weight. This weight increase was accompanied by a return of some symptoms. These were again relieved once

the weight was returned to the operative weight level by dieting. The importance of keeping the weight at its correct level for age and sex cannot be over-emphasized.

REFLUX OESOPHAGEAL STRICTURES

Full-thickness Strictures In the total of 270 cases of hiatal hernia there were, as mentioned, 27, or 10%, with tight oesophageal strictures. These included some who had a lower oesophagus lined by gastric-type epithelium. These patients were treated as follows: dilatation alone, 18; oesophago-Roux-en-Y-jejunostomy, eight; oesophago-gastrostomy, one.

Mucosal Stricture Only Those who had mucosal strictures only were treated by a standard Allison-type hiatal herniorrhaphy accompanied by dilatation of the stricture to size 40 French. On three occasions this dilatation had to be repeated at intervals up to three months, but over the period of two years the mucosal stricture gradually resolved and allowed reasonable swallowing. No patient required subsequent resection of the stricture nor any other surgical treatment for it.

I am grateful for secretarial assistance from Miss Noeleen Richardson.

REFERENCES

- Adler, R. H., and Rodriguez, J. (1959). The association of hiatal hernia and gastro-oesophageal malignancy. *J. thorac. Surg.*, **37**, 553.
- Allison, P. R. (1951). Reflux esophagitis, sliding hiatal hernia, and the anatomy of repair. *Surg. Gynec. Obstet.*, **92**, 419.
- Bingham, J. A. W. (1958). Oesophageal strictures after gastric surgery and naso-gastric intubation. *Brit. med. J.*, **2**, 817.
- Borrie, J. (1958). The right-sided approach for hiatal herniorrhaphy. *Ibid.*, **2**, 728.
- (1960). Unsuspected oesophageal leiomyoma found at hiatal herniorrhaphy. *Ibid.*, **1**, 1018.
- (1961). Diaphragmatic hernia. Ch. 70 in *Abdominal Operations*, 4th edition, Maingot, R. Appleton-Century-Crofts, New York.
- Edmunds, V. (1957). Hiatus hernia. A clinical study of 200 cases. *Quart. J. Med.*, **26**, 445.
- Effler, D. B. (1965). Allison's repair of hiatal hernia: late complication of diaphragmatic counterincision and technique to avoid it. *J. thorac. cardiovasc. Surg.*, **49**, 669.
- Groves, L. K., Martinez, W. V., and Effler, D. B. (1959). Thoracic repair of esophageal hiatus hernia: evaluation of 200 consecutive cases. *Ibid.*, **38**, 537.
- Humphreys, G. H., Ferrer, J. M., and Wiedel, P. D. (1957). Esophageal hiatus hernia of the diaphragm. An analysis of surgical results. *J. thorac. Surg.*, **34**, 749.
- McConchie, I. (1961). Gastro-oesophageal carcinoma in hiatal hernia. *Aust. N.Z. J. Surg.*, **31**, 6.
- Robb, D. (1954). Oesophageal hiatus hernia. A clinical study based on 138 cases, of which 96 were treated surgically. *Ibid.*, **24**, 18.
- Sweet, R. H. (1962). Experiences with 500 cases of hiatus hernia. A statistical survey. *J. thorac. cardiovasc. Surg.*, **44**, 145.
- Windsor, R. (1963). Strangulated diaphragmatic hernia with perforation of the stomach. A case report. *N.Z. med. J.*, **62**, 425.