acute leukaemia, but some intrapulmonary bleeding was identified in half. They reported also that one-third of all fatal haemorrhages in leukaemia occurred in the lungs.¹³ Leach¹⁴ found that pulmonary haemorrhage was the direct cause of death in three out of 157 cases of acute leukaemia. Pulmonary infiltrates and associated symptoms were observed in over 30% of a large series of children with acute lymphocytic leukaemia. Despite aggressive attempts at diagnosis the cause of the pulmonary process was determined in less than a quarter of the cases.¹⁵

We suggest that intrapulmonary bleeding may often cause radiographic abnormalities in patients with leukaemia. Bronchopulmonary lavage offers a safe approach to diagnosis in these cases, and alveolar macrophage staining for haemosiderin and haemoglobin may be useful in determining whether a recent bleed has occurred. When infection and haemorrhage are both present the lavage procedure may also allow identification of an infectious agent. The technique may provide evidence for pulmonic haemorrhage but may not delineate the cause. For example, pulmonary embolism occurring in leukaemic patients¹⁶ might lead to similar findings at bronchopulmonary lavage.

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References

- 1 Bodey, G. P., *et al.*, *Cancer*, 1966, 19, 781.
- 2 Sickles, E. A., *et al.*, *Annals of Internal Medicine*, 1973, 79, 528.
- 3 Levine, A. S., *et al.*, *Seminars in Hematology*, 1974, 11, 141.
- 4 Drew, W. L., *et al.*, *Journal of the American Medical Association*, 1974, 230, 713.
- 5 Fennessy, J. J., and Kittle, C. F., *Journal of Thoracic and Cardiovascular Surgery*, 1973, 66, 541.
- 6 Whitecar, J. P., *jun.*, *et al.*, *Cancer Chemotherapy Reports*, pt. I, 1972, 56, 543.
- 7 Finley, T. N., and Ladman, A. J., *New England Journal of Medicine*, 1972, 286, 223.
- 8 Golde, D. W., Finley, T. N., and Cline, M. J., *Lancet*, 1972, 2, 1397.
- 9 Bowling, M. C., *Histopathology Laboratory Procedures of the Pathologic Anatomy Branch of the National Cancer Institute*. Public Health Service Publication No. 1595, Washington, U.S. Government Printing Office, 1967.
- 10 Golde, D. W., Byers, L. A., and Finley, T. N., *Nature*, 1974, 247, 373.
- 11 Golde, D. W., Finley, T. N., and Cline, M. J., *New England Journal of Medicine*, 1974, 290, 875.
- 12 Blank, N., Castellino, R. A., and Shah, V., *Radiologic Clinics of North America*, 1973, 11, 175.
- 13 Hersh, E. M., *et al.*, *Journal of the American Medical Association*, 1965, 193, 105.
- 14 Leach, W. B., *Canadian Medical Association Journal*, 1961, 85, 345.
- 15 Siegel, S. E., Baehner, R., and Nesbit, M., *American Society of Hematology Seventeenth Annual Meeting*, 1974, Abstract no. 378, p. 171.
- 16 Wiernik, P. H., and Serpick, A. A., *Cancer*, 1969, 24, 581.

Gastro-oesophageal Reflux Complicating Highly Selective Vagotomy

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Summary

An unacceptably high incidence of gastro-oesophageal reflux was observed in a small series of patients with duodenal ulcer who had been treated by highly selective vagotomy. Possibly this is due to an altered angle of entry of the oesophagus into the stomach, and we now routinely narrow this angle at operation.

Introduction

Highly selective vagotomy (H.S.V.) without drainage is rapidly gaining acceptance in the treatment of uncomplicated chronic duodenal ulceration. It is claimed that a more normal pattern of gastric emptying is preserved and that the incidence of post-vagotomy sequelae, such as dumping, diarrhoea, and bilious vomiting, is greatly reduced.^{1,2} Furthermore, an exhaustive review³ has shown that in the Leeds and Copenhagen series side effects, such as dysphagia, flatulence, and heartburn, were no more common after H.S.V. than after vagotomy with a drainage procedure.

We encountered severe and persistent oesophageal reflux in five of a small series of patients with chronic duodenal ulceration who were treated by H.S.V. without drainage in our unit.

Patients and Methods

Twenty patients with chronic duodenal ulceration and no clinical or radiological evidence of pyloric stenosis, gastro-oesophageal reflux, or hiatus hernia underwent H.S.V. At operation the diagnosis was confirmed and pyloric stenosis and hiatus hernia excluded. All the operations were performed by one of us (J.M.). The surgical technique was standard,⁴ the denervation being started at a point just to the left of the terminal branches of the nerves of Latarjet (6-7 cm from the pyloroduodenal junction). All the patients were followed up regularly for at least two years. Acid-output studies were performed before and three months after the operation. Interpretation of the insulin response was based on Hollander's⁵ original criteria with the addition of a second one-hour collection period. The results were classified as negative, early positive (0-60 min), and late positive (60-120 min).

Results

Though only 20 patients were treated in this pilot series we were disturbed to find that five developed persistent symptoms of gastro-oesophageal reflux. The typical features of gastro-oesophageal reflux—heartburn, retrosternal discomfort, and regurgitation, accompanied by increased flatulence—developed shortly after surgery in three of the patients and between six to 12 months after in the other two (see table). A postoperative barium meal examination showed gastro-oesophageal reflux in four of the patients, with evidence of a hiatus hernia in three. Though reflux could not be shown radiologically in the other patient a

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slight hold-up of the barium at the lower end of the oesophagus was seen, which could have indicated spasm due to some oesophagitis as his symptoms were particularly severe at the time of the examination. As in the preoperative examination all the patients had normal gastric emptying after the barium meal. Their symptoms were sufficient to require constant medication and all five patients were classified as grade III on the Visick scale.⁶

The insulin test was positive in four of these patients, which corresponds well with our finding that 12 of the 17 patients who had been insulin tested at the time of writing were insulin positive.

Symptoms and Radiological Findings in Five Patients with Gastro-oesophageal Reflux

Case No.	Age and Sex	History of Ulcer (Years)	Time of Appearance of Symptoms after Operation	Symptoms	Barium Meal X-Ray Findings
1	49 M.	6	12 months	Heartburn, flatulence	Hiatus hernia, reflux
2	44 M.	10	Very soon	Heartburn, flatulence	Slight delay in lower end of oesophagus
3	56 M.	14	6 months	Heartburn, acid regurgitation	Hiatus hernia, oesophageal reflux
4	50 F.	30	Immediately	Nausea, epigastric discomfort, heartburn, flatulence	Hiatus hernia, oesophageal reflux
5	41 F.	6	3 months	Heartburn, acid regurgitation	Oesophageal reflux

Discussion

There is a definite incidence of gastro-oesophageal reflux after truncal vagotomy, but it is persistent in only 7% of cases and severe in only 1.5%.⁷ We are unaware of any reports of this problem after H.S.V. without drainage yet we found that in five out of 20 patients this operation resulted in persistent troublesome reflux. How can this be explained?

Reflux after truncal vagotomy is thought to result from weakening of the lower intrinsic oesophageal sphincter rather than disturbance of the normal anatomical relationship at the gastro-oesophageal junction.⁸ The fact that the incidence of reflux is no less after transthoracic vagotomy supports this theory.⁹ Thomas and Earlam¹⁰ have shown that the length of the zone of increased pressure at the gastro-oesophageal junction is decreased after truncal vagotomy with drainage, though there is no lessening of the pressure itself in this region, as there is after gastrectomy. Griffith and Harkins¹¹ suggested that the technique of selective vagotomy may actually prevent oesophageal damage and denervation, and they considered that malfunction of the lower oesophageal sphincter was caused by division of terminal filaments of the vagus as they enter the oesophageal muscle. Certainly H.S.V. does not involve any greater mobilization of the paraoesophageal vagal trunks than does truncal vagotomy. Indeed, there should be less interference in this area. Possibly, as a result of the greater mobilization of the stomach which is necessary in this operation a degree of gravitational dependence develops which may alter slightly the angle of entry of the oesophagus into the stomach. Such a mechanism has been

suggested by Windsor¹² to account for the greater degree of reflux seen after Billroth I gastrectomy compared with the Polya operation. Alternatively, even the most limited and careful dissection in the region of the intra-abdominal oesophagus may be sufficient to damage the small vagal fibres which supply the lower oesophageal area. Certainly, the possibility that the trouble arises at this point cannot be discounted.

Might some inadequacy in the gastric emptying mechanism play a part? This mechanism seemed to be normal in our patient when tested by barium meal radiography, but this is not a very sensitive test. Total vagotomy without drainage certainly causes inadequate emptying, which leads to gastric distension and oesophageal regurgitation in many but not all cases.¹³ Similarly, selective vagotomy alone, with only the innervation of the pyloric sphincter intact, causes an unacceptably high incidence of gastric stasis¹⁴ in spite of earlier reports to the contrary.¹⁵ The current trend is to leave some 10-11 cm from the pyloric sphincter innervated, rather than 7 cm as done formerly,⁴ but it seems possible that the object of the operation could be vitiated by excessive preservation of gastric innervation. The point to which innervation is taken may be quite critical.

We are forced to conclude that though minor differences in technique affecting either the oesophagogastric junction or the distal point of denervation may not cause problems individually, together they may lead to just the sort of trouble that has been observed in these cases. Moreover, it may prove difficult to define and work to technical tolerance limits, which may be more critical than has been appreciated. Can anything be done to minimize the adverse effect we have described?

Since making these observations it has been our practice to narrow the angle of His by opposing the stomach to the oesophagus with a continuous chromic catgut stitch run up for about 5 cm from the oesophagogastric junction. This simple procedure, which has been used by Hollender¹⁶ in 76 patients undergoing H.S.V., may readily be added when small vagal fibres are being cleared from the area.

References

- Humphrey, C. S., and Wilkinson, A. R., *British Journal of Surgery*, 1972, 59, 779.
- Johnston, D., *et al.*, *Gut*, 1972, 13, 842.
- Johnston, D., *Gut*, 1974, 15, 748.
- Goligher, J. C., *British Journal of Surgery*, 1974, 61, 337.
- Hollander, F., *Gastroenterology*, 1948, 11, 419.
- Goligher, J. C., Pulvertaft, C. N., and Watkinson, G., *British Medical Journal*, 1964, 1, 455.
- Williams, J. A., and Woodward, D. A. K., *Surgical Clinics of North America*, 1967, 47, 1341.
- Williams, J. A., and Cox, A. G., *After Vagotomy*, p. 42. Butterworth, London, 1969.
- Grimson, K. S., *et al.*, *Journal of the American Medical Association*, 1947, 134, 925.
- Thomas, P. A., and Earlam, R. J., *British Journal of Surgery*, 1973, 60, 717.
- Griffiths, C. A., and Harkins, N. H., *Surgical Clinics of North America*, 1962, 42, 1431.
- Windsor, C. W. O., *British Medical Journal*, 1964, 2, 1233.
- Dragstedt, L. R., *et al.*, *Annals of Surgery*, 1947, 126, 687.
- Clarke, R. J., McFarland, J. B., and Williams, J. A., *British Medical Journal*, 1972, 1, 538.
- Burge, H., *et al.*, *British Medical Journal*, 1969, 3, 690.
- Hollender, L. F., *Journal de Chirurgie*, 1973, 106, 379.