

The selective nerve stain leucomethylene blue as an intraoperative aid to achieving complete vagotomy

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SUMMARY The recently reported vagal nerve stain leucomethylene blue was assessed in 20 patients as an intraoperative aid to attaining complete vagotomy. Of 101 stained specimens removed at surgery, only 30 (30%) contained nerve tissue. Four of 17 postoperative insulin tests were positive by Hollander's criteria. The dye technique was found to be an unreliable method of ensuring complete vagotomy at the time of surgery.

Due to the high incidence of incomplete vagotomy (Davies, 1956; Ross and Kay, 1964; Johnston, Thomas, Checketts, and Duthie, 1967) there is a need for a simple and reliable intraoperative method for achieving complete vagal section. Lee (1969) recently described a selective nerve stain, leucomethylene blue¹, which he claimed reliably stained small vagal fibres. The present report describes our experience with the dye in 20 patients.

Material and Methods

For this study 20 patients undergoing vagotomy for peptic ulcer disease were selected at random over a three-month period. The operations were performed by 14 different surgeons but the stain was applied and the specimens removed in each instance by one of the authors (M.L.F.).

The technique employed was similar to that described by Lee with the exception that the left gastric artery was not divided. After dissection of the peritoneum and division of both main vagal trunks, leucomethylene blue was applied to the bared anterior and posterior surfaces of the oesophagus using a cotton swab. Considerable

difficulty in exposing the posterior wall of the oesophagus was encountered in 11 of the 20 patients. Upon application of the dye, all tissues turned blue. The excess stain was wiped off with saline swabs. Any residual strands of blue tissue were removed and each specimen was separately labelled and sent for pathological examination.

Postoperative insulin tests were done in 17 patients in the first three months following surgery.

Results

Of 101 stained specimens removed at surgery, 67 were from the anterior and 34 from the posterior oesophagus. When examined microscopically, 30 (30%) contained nerve tissue, described by the pathologist in the majority of cases as 'minute fragments of myelinated nerve'. The remaining 71 consisted of muscle, blood vessel, or fibrofatty tissue. In one instance (case 11) a fibre which failed to be stained by the dye was removed at surgery and found to contain nerve.

Of the 17 postoperative insulin tests, 13 were negative and four positive by Hollander's criteria. In three of the four cases having incomplete vagotomies on insulin testing, exposure of the posterior oesophagus was judged by the author to be inadequate, whereas difficulties in exposure were experienced in only six of the 13 cases in which the insulin test proved negative (Table I).

¹Leucomethylene blue was obtained from Paines & Byrne Limited, Pabynr Laboratories, Greenford, England.

Patient	Age (yr)	Operation	Exposure of Oesophagus	Stained Specimens		Specimens Containing Nerve		Nerve per Specimens	Insulin Test
				Anterior	Posterior	Anterior	Posterior		
1	46	V & P	Good	4	1	3	1	4/5	Negative
2	61	V & P	Good	2	1	2	1	3/3	Negative
3	34	V & P	Good	7	4	2	2	4/11	Positive
4	61	V & P	Fair	6	5	1	1	2/11	Negative
5	55	V & P	Fair	6	1	0	0	0/7	Negative
6	64	V & P	Poor	5	3	0	0	0/8	—
7	41	V & Ant.	Good	3	5	2	1	3/8	Negative
8	52	V & P	Fair	1	2	1	1	2/3	—
9	48	V & P	Fair	3	3	0	1	1/6	Positive
10	33	V & P	Poor	2	3	0	0	0/5	Positive
11	55	V & G/E	Poor	1	0	1	0	1/1	Negative
12	46	V (S) & P	Good	5	2	3	1	4/7	Negative
13	64	V & P	Good	7	0	2	0	2/7	Negative
14	61	V & P	Fair	1	0	0	0	0/1	Negative
15	62	V & Ant.	Good	2	1	1	1	2/3	—
16	54	V (S) & P	Good	4	0	1	0	1/4	Negative
17	39	V & P	Fair	0	0	0	0	0/0	Negative
18	63	V ¹	Good	3	0	0	0	0/3	Negative
19	51	V & P	Poor	1	1	0	0	0/2	Positive
20	51	V & P	Poor	4	2	1	1	2/6	Negative

Table I Results using leucomethylene blue in 20 patients

V = vagotomy, S = selective, P = pyloroplasty, Ant. = antrectomy, G/E = gastroenterostomy.

¹Vagotomy for recurrent ulceration.

Discussion

As yet there is no satisfactory intraoperative method of ensuring complete vagotomy. Burge's electrical stimulation test (Burge and Vane, 1958; Burge, Roberts, Stedeford, and Lancaster, 1969) has not met with general acceptance because it is inconvenient and of questionable reliability (Lythgoe, 1961; Clark and Murray, 1963). Lee's new method appeared to offer an attractive alternative. The dye, leucomethylene blue, is a clear yellow solution which when oxidized turns to its blue form (methylene blue). According to Lee, small nerve fibres oxidize the dye more readily than muscle or connective tissue and are, therefore, selectively stained blue. Large nerve fibres or trunks are not stainable. The reason for this is unknown. From 27 patients, 69 specimens were removed and 51 (74%) were found to contain nerve tissue. The dye was therefore said to stain selectively small vagal fibres. The results of insulin tests were not reported.

In the only published data in the literature since Lee's original paper Cox and Cooke (1970) in a preliminary communication found that only nine of 30 specimens removed from 10 patients contained nerve tissue. The present series also fails to confirm the selectivity of the dye. In less than one-third of stained specimens could nerve tissue be identified, and in one instance the dye failed to stain a fibre which, on subsequent pathological examination proved to contain nerve. Incomplete vagotomies as judged by the insulin test were not

prevented by use of the dye. For these reasons we have found the staining method unreliable and do not recommend its use as an intraoperative aid to achieving complete vagotomy.

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References

- Burge, H. W., Roberts, T. B. L., Stedeford, R. D., and Lancaster, M. J. (1969). Present position of the electrical stimulation test. *Gut*, 10, 155-159.
- Burge, H. W., and Vane, J. R. (1958). Method of testing for complete nerve section during vagotomy. *Brit. med. J.*, 1, 615-618.
- Clark, C. G., and Murray, J. G. (1963). The Burge test for complete vagotomy. *J. roy. Coll. of Surg.*, 8, 212-218.
- Cox, A. G., and Cooke, W. M. (1970). Vagotomy for peptic ulcer. *Brit. med. J.*, 1, 432-433.
- Davies, J. A. L. (1956). Late results of vagotomy combined with gastro-jejunostomy or pyloroplasty in the treatment of duodenal ulceration. *Brit. med. J.*, 2, 1086-1091.
- Johnston, D., Thomas, D. G., Checketts, R. G., and Duthie, H. L. (1967). An assessment of postoperative testing for completeness of vagotomy. *Brit. J. Surg.*, 54, 831-833.
- Lee, M. (1969). A selective stain to detect the vagus nerve in the operation of vagotomy. *Brit. J. Surg.*, 56, 10-13.
- Lythgoe, J. P. (1961). Comparison of the insulin and electrical stimulation tests for completeness of vagotomy. *Brit. med. J.*, 1, 1196-1200.
- Mason, M. C., Giles, G. R., Graham, N. G., Clark, C. G., and Goligher, J. C. (1968). An early assessment of selective and total vagotomy. *Brit. J. Surg.*, 55, 677-680.
- Ross, B., and Kay, A. W. (1964). The insulin test after vagotomy. *Gastroenterology*, 46, 379-386.