Further reduction in the tempeature to 65-70°C (about 200 mm Hg) has been investigated. The destruction of all vegetative bacteria has been achieved, and though this further reduction in tempeature is not essential for cystoscopes it may prove to be of value for other heat-sensitive surgical instruments.

We gratefully acknowledge the help and advice received from Professor W. A. Gillespie, professor of clinical bacteriology, Bristol University, Dr. J. C. Kelsey, director of Sterilization and Disinfection Reference Laboratory, Central Public Health Laboratories, London, and Mr. A. Bishop, of the Department of Health and Social Security, London.

The transportable low-pressure steam sterilizing unit was built by Drayton Cartle Co. Ltd. with a development grant awarded by the Department of Health and Social Security, London.

References

Association of Clinical Pathologists (1967). Notes on Sterilization No. 1, "Sterilization and Disinfection of Cystoscopes." London.
Alder, V. G., and Gillespie, W. A. (1961). *Journal of Clinical Pathology*, 14, 515.
Alder, V. G., and Leitch, C. W. (1963). *Hospital (London)*, 59, 662.
Francis, A. E. (1959). *Proceedings of the Royal Society of Medicine*, 52, 998.
Gibson, G. L., Johnston, H. P., and Turkington, V. E. (1968). *Journal of Clinical Pathology*, 21, 771.
Kelsey, J. C. (1961). *Journal of Clinical Pathology*, 14, 59.
Kelsey, J. C. (1963). *Journal of Clinical Pathology*, 16, 542.
Miller, A., Gillespie, W. A., Linton, K. B., Slade, N., and Mitchell, J. P. (1960). *Lancet*, 2, 86.
Mitchell, J. P. (1970). *British Medical Journal*, 3, 241.
Mitchell, J. P., and Alder, V. G. (1970). *British Hospital Journal*, 80, 1944.
Opfell, J. B., and Miller, C. B. (1965). *Advances in Applied Microbiology*, vol. 7. New York, Academic Press.
Williams, R. E. O., Blowers, R., Garrod, L. P., and Shooter, L. P. (1966). *Hospital Infection*, 2nd edn. London, Lloyd-Luke.

PRELIMINARY COMMUNICATIONS

Methylene Blue for Rapid Identification of the Parathyroids

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Summary

Rapid identification of parathyroid tissue has been rendered possible by preoperative intravenous infusion of methylene blue before exploration of the neck. The technique has been used on 17 patients with thyroid and parathyroid disorders. In all cases one or more of the parathyroids have been demonstrated with histological confirmation, but with greater experience almost all have been shown readily. This has resulted in an appreciable reduction in operating time, and the method should help to reduce the high incidence of clinical hypoparathyroidism after total thyroidectomy.

Introduction

Selective in-vivo staining of the parathyroid glands by intravenous and intra-arterial administration of toluidine blue was first described in dogs (Klopper and Moe, 1966; Hurvitz *et al.*, 1967) and later in rats and man (Hurvitz *et al.*, 1968; Keaveny and FitzGerald, 1968; Keaveny *et al.*, 1969; Yeager and Krementz, 1969). The enthusiasm of these workers and others (Professor Volker Bay, personal communication, 1970) encouraged me to attempt this method to avoid the frustration of prolonged searching for parathyroid adenomata. The withdrawal of toluidine blue from general use led to a search for an alternative dyestuff.

Experience in patients treated in this centre for methaemoglobinaemia with methylene blue suggested that this dye might be a reasonable and safe substitute, and this expectation has been fulfilled.

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Patients and Method

Methylthionine chloride: tetramethylthionine chloride (methylene blue injection 1%, Harvey Laboratories, Philadelphia) was administered at a calculated dose of 5 mg/kg body weight in 500 ml of 5% glucose and 1/5 normal saline. This volume of solution was found to give maximal staining of the parathyroids when infused intravenously for one hour before exposure of the neck. Seven patients with a variety of thyroid disorders, nine with suspected parathyroid tumours, and one with parathyroid hyperplasia were investigated. Where parathyroid adenomata were suspected exploration of the neck was carried out systematically in a manner similar to that proposed by Cope (1941). In the control group with thyroid disease, where surgery was sometimes difficult, it was not always considered justifiable to prolong the search for the parathyroids if they were not immediately obvious. Identification of all stained glands was verified by biopsy and immediate frozen section and later by paraffin block histological examination. Blood pressure, pulse, respiration, temperature, and E.C.G. were recorded before, during, and after operation. Serum calcium levels were measured before surgery and one week postoperatively to confirm that no adenomata had been missed or that any patient had been rendered hypoparathyroid.

Results

Intravenous administration of methylene blue resulted in staining of both normal and abnormal parathyroid glands. The total experience would seem at first to indicate that the method might not be helpful in that 68 parathyroid glands were looked for and 41 found and confirmed. However, the Table shows that experience of the technique and better timing of the infusion led to a progressive improvement in identification. All patients who were considered on clinical and biochemical grounds to have an adenoma had one readily displayed by this technique. The nine instances of adenomata were identified and confirmed histologically within 30 minutes of exposure compared with a previous mean of two hours before the adoption of this technique. In the last six cases as set out in the Table it will be seen that the identification of the glands became much simpler. In Case 13 a very large adenoma was found which had probably caused a pronounced hypoplasia of the remaining glands.

I have found that the colour of the parathyroids progressively increases in intensity after infusion of the dye up to one hour and seems to last for 20 minutes before diminishing in intensity over the next two and a half hours. The normal parathyroids

stain a dusky slate blue, the parathyroid adenomata all stain dark blue to purple. In most patients the thyroid gland and the strap muscles are tinged a light blue. Thyroid cysts when present seem to take up the dye and stain dark blue, but this does not prove confusing. No troublesome side effects were encountered and, in particular, no evidence of myocardial toxicity as reported occasionally with toluidine blue (Yeager and Krementz, 1969). Undoubtedly the pseudocyanotic pallor imparted to the patient during surgery and for a few hours after deprives the anaesthetist of one of his vital signs and calls for extra caution in assessing oxygen requirements. We found it wise to warn the ward staff that a "blue" patient was being returned from the theatre and to tell patients that their urine would be blue for a week or so.

Identification of Glands

Case No.	Preoperative Infusion Time	Parathyroids			
		R. IV	R. III	L. IV	L. III
1 ..	2½ hours	0	—	—	—
2 ..	2 „	—	—	—	0
3 ..	1½ „	—	—	—	0
4 ..	1 hour +	0	—	0	—
5 ..	1 hour	0	0	0	000
6 ..	1 „	—	0	0	000
7 ..	1 „	0	—	0	—
8 ..	1 „	—	0	—	0
9 ..	1 „	0	0	—	0
10 ..	1 „	—	000	—	—
11 ..	1 „	0	—	—	000
12 ..	1 „	0	000	—	0
13 ..	1 „	—	—	—	000
14 ..	1 „	00	00	00	00
15 ..	1 „	0	—	0	000
16 ..	1 „	0	000	0	0
17 ..	1 „	0	000	0	0

0 = Normal parathyroid. 00 = Parathyroid hyperplasia. 000 = Parathyroid adenoma.

Discussion

On the basis of these observations this technique is recommended when faced with the problem of identifying parathyroid tumours. I suggest that it is likely to be useful also where preservation of normal parathyroids is difficult as in total thyroidectomy for carcinoma. So far it has not been possible to determine by histological techniques where methylene blue is taken up in the parathyroids, for the routine methods of fixation decolorize the dye and unstained sections are so pale at the required thickness that no detail can be made out. Precipitation of the dye is being attempted to elucidate this point, while tagging methylene blue with a radioactive isotope marker is an exciting prospect and could if practicable enable preoperative scanning of the neck and mediastinum to locate an adenoma. This possibility is being explored.

I am grateful to Mr. A. S. Till, Mr. M. H. Gough, and Mr. G. E. Moloney for their encouragement and permission to initiate this technique on cases under their care and to the patients themslves for allowing me to stain them in this way.

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References

Cope, O. (1941). *Annals of Surgery*, **114**, 706.
Hurvitz, R. J., Hurvitz, J. S., and Morgenstenstern, L. (1967). *Archives of Surgery*, **95**, 274.
Hurvitz, R. J., Perzik, S. L., and Morgenstenstern, L. (1968). *Archives of Surgery*, **97**, 722.
Keaveny, T. V., and FitzGerald, P. A. (1968). *Lancet*, **2**, 284.
Keaveny, T. V., FitzGerald, P. A., and McMullins, J. P. (1969). *British Journal of Surgery*, **56**, 595.
Klopper, P. J., and Moe, R. E. (1966). *Surgery*, **59**, 1101.
Yeager, R. M., and Krementz, E. T. (1969). *Annals of Surgery*, **169**, 829.

MEDICAL MEMORANDA

Renal Artery Dysplasia with Hypertension in Neurofibromatosis

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Fifteen cases of renal artery stenosis associated with neurofibromatosis have been reported, mostly in the European literature (Allan and Davies, 1970; Smith *et al.*, 1970). We report a further case. In addition to stenosis of the main renal artery an unusual endothelial cell proliferation of the intima with atrophy of the media and elastic layers of the arterioles was shown.

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Case Report

An 11-year-old boy (weight 22 kg) was admitted to hospital with headaches and vomiting. Apart from one sibling who had nerve deafness the family history was negative. He had a pronounced kyphoscoliosis, multiple café au lait spots, a plexiform neuroma in his thenar eminence, and two pea-size nodules in the intercostal spaces. His blood pressure was 220/150-270/220, he had papilloedema and retinal haemorrhages, but there were no signs of congestive failure. E.C.G. showed severe left ventricular strain. Proteinuria was not found. Blood urea was 24-34 mg/100 ml. Urinary catecholamines were repeatedly normal. Aortography showed a left renal artery stenosis (Fig. 1).

On the daily regimen of methyldopa 3 g, bethanidine 80 mg, chlorothiazide 500 mg, with potassium supplements and propranolol 120 mg the blood pressure remained in the same range. Prompt control was achieved with the addition of intravenous diazoxide (300 mg). This drug had to be repeated initially after six days and subsequently at intervals of two to four days. The requirements increased over succeeding weeks until after one month he needed diazoxide 300 mg eight-hourly. It was decided to attempt a surgical repair. At operation, because of difficulties imposed by the skeletal abnormalities a nephrectomy was carried out. The stenosed segment of the main renal artery was not obtained. An intercostal nodule was excised.

Histologically the nodule was a neurofibroma. The kidney (75 g) was macroscopically normal. Microscopically the cortex showed occasional hyalinized glomeruli. Most of the glomeruli were normal. The most striking features were randomly distributed lesions in the arterioles; many looked relatively normal. In others (Figs. 2 and 3) a pronounced intimal proliferation of endothelial cells was seen, at times almost obliterating the lumen. In places there was