Conclusion

The presence of a familial tendency to ulceration, except in the arteriosclerotic group, is usually associated with the inheritance of varicose veins; this applies to post-thrombotic as well as to varicose ulceration. It must not be assumed, however, that varicose veins are present in an individual before thrombosis occurs, as this is not usually so. It means merely that thrombosis, unless caused by fracture or infection of the leg, seems more likely to occur in individuals with a family history of varicose veins.

Where thrombosis may occur, as in parturient women, patients recumbent for medical or surgical reasons, and those with fractures of or undergoing operations on the leg, special efforts should be made to prevent it if there is a family history of varicose veins, thrombosis, or ulcus cruris.

Summary

The influence of heredity in gravitational ulceration of the leg has been investigated in a series of 525 patients.

The significance of the family history has been considered in various groups of patients with ulcers from different causes.

The implications of the family history in regard to prevention of thrombosis are mentioned.

I am grateful to Dr. John T. Ingram and Dr. F. F. Hellier for allowing me to carry out this investigation on their patients, and to Dr. Percy Stocks and Miss Eileen M. Brooke for providing me with information from the General Register Office.

REFERENCES

- Anning, S. T. (1949). *British Medical Journal*, **2**, 458.
 Annotation (1950). *Ibid.*, **2**, 338.
 Bauer, G. (1948). *J. int. Chir.*, **8**, 937.
 Carleton, Alice (1948). *Arch. Derm. Syph.*, **Chicago**, **57**, 636.
 Čičováčki, D., and Stöger, R. (1939). *Wien. klin. Wschr.*, **52**, 708.
 Cummer, C. L., and LaRocco, C. G. (1940). *Arch. Derm. Syph.*, **Chicago**, **42**, 1015.
 Curtis, A. C., and Helms, R. W. (1947). *Ibid.*, **55**, 639.
 Curtius, F. (1928). *Dtsch. Arch. klin. Med.*, **162**, 194.
 Eger, S. A., and Casper, S. L. (1943). *J. Amer. med. Ass.*, **123**, 148.
 Estes, J. E., Farber, E. M., and Stickney, J. M. (1948). *Blood*, **3**, 302.
 Gay, J. (1868). *On Varicose Diseases of the Lower Extremities*. Lettsomian Lectures of 1867. Churchill, London.
 Jensen, D. R. (1932). *Ann. Surg.*, **95**, 738.
 Larson, R. A., and Smith, F. L. (1943). *Proc. Mayo Clin.*, **18**, 400.
 Luke, J. C. (1941). *Surg. Gynec. Obstet.*, **73**, 472.
 McPheeters, H. O., and Anderson, J. K. (1946). *Injection Treatment of Varicose Veins and Hemorrhoids*, 3rd ed. Davis, Philadelphia.
 Magnus, G. (1921). *Dtsch. Z. Chir.*, **162**, 71.
 Nicholson, B. B. (1927). *Arch. Surg.*, **Chicago**, **15**, 351.
 Ottley, Constance (1934). *British Medical Journal*, **1**, 528.
 Payne, R. T. (1936). *Ibid.*, **1**, 877.
 Pratt, G. H. (1950). *Med. Clin. N. Amer.*, **34**, 897.
 Roberts, C. (1949). Cited by R. R. Foote, *Varicose Veins*, p. 38. Butterworth, London.
 de Takats, G., and Quint, H. (1930). *Surg. Gynec. Obstet.*, **50**, 545.
 Taylor, E. S. (1939). *J. Amer. med. Ass.*, **112**, 1574.
 Virchow (1855-61). Cited by Warwick (1931).
 Warwick, W. T. (1931). *The Rational Treatment of Varicose Veins and Varicocoele*. Faber and Faber, London.
 Weber, F. Parkes (1930). *Practitioner*, **124**, 392.
 — (1948). In *Modern Trends in Dermatology*, edited by R. M. B. MacKenna. Butterworth, London.
 — and Dorner, G. (1910). *Lancet*, **1**, 227.
 — Rest, H., and Lutterotti, O. (1930). *British Medical Journal*, **2**, 279.
 Witts, L. J. (1942). *Ibid.*, **2**, 309.
 Woofler, A. C., Dick, W. S., and Biering, W. L. (1945). *Arch. intern. Med.*, **76**, 230.

The London Area Mobile Physiotherapy Service (L.A.M.P.S.) is a voluntary society founded in May, 1948, to provide physiotherapy at home to those who cannot afford to pay, since it became clear that the National Health Service would, for some years at least, be unable to provide such a service. About 30,000 members of the Home Nursing Scheme have automatically come into the society, and some 250 private physiotherapists are providing the treatments, which in the year 1949-50 amounted to nearly 4,000.

TREATMENT OF POST-PHLEBITIC LEG AND APPLICATION OF VENOUS-PRESSURE MEASUREMENT*

BY

A. J. WALKER, M.B., F.R.C.S.

Formerly Chief Assistant, Surgical Professorial Unit,
 St. Bartholomew's Hospital; Surgical Tutor,
 General Infirmary at Leeds

Homans (1941) was the first to champion ligation of the superficial femoral vein in the treatment of the post-phlebitic leg. He argued that the condition was due to valvular incompetence in the main leg veins as a result of the thrombus recanalizing, and that ligation of the superficial femoral vein, harmless when performed for other conditions, was likely to do good. His lead was followed by Buxton *et al.* (1944), who recorded 21 cases, later increased to 26 (Buxton and Collier, 1945). Linton and Hardy (1947) published 34 cases (58 legs), later raised to 49 (84 legs) (Linton and Hardy, 1948), in which they stripped the long saphenous vein as well. Glasser (1949) and Sandegård (1949) published 91 (40 cases followed up) and 32 cases respectively, the latter selecting his patients for operation by the retrograde phlebogram method of Bauer (1948).

Bauer in his paper advocated the ligation of the popliteal rather than of the femoral vein and published the result of 24 cases, later increased to 196 (Bauer, 1950). I have set out the results claimed by these authors in Table I. Ulcers are claimed to remain healed in 70-100% of cases, bursting pain is usually cured, but oedema persists in a disappointingly high proportion of those treated, except in Bauer's hands.

Impressed by Bauer's arguments and results, we have employed his methods at St. Bartholomew's Hospital on a series of 30 legs. This paper presents the results of this treatment, and the application of venous-pressure measurements in the selection of cases. The division and ligation of the vein is done through a 3-in. (7.6-cm.) vertical incision in the upper half of the popliteal fossa. Afterwards the knee is kept extended for five days to aid healing, but early walking with a crêpe bandage is allowed. Rapid healing is ensured if the joint crease is not transgressed.

Material

Twenty-six patients were treated, 4 of the 30 ligations having been done bilaterally. Four patients, accounting for six of the ligations, showed no evidence of previous thrombosis, and these must be included in Bauer's (1948) and Luke's (1941) group with primary valvular incompetence of the deep veins. The histories varied from 2 to 50 years in duration, and the ages from 24 to 72. Four patients were older than Buxton's upper limit of 55 years, and I agree with Glasser (1949) that this upper limit is meaningless.

The chief symptoms were ulceration or eczema—usually painful—bursting pain, and oedema. Less common were coldness and cyanosis, nocturnal cramps, and varicose veins. Ulceration occurred in 15 instances (50% of total). In 12 cases the ulcers were notably painful, a feature which helped to distinguish them from varicose ulcers. The medial malleolus was the common site, and a varying

*A slight amplification of a paper read to the Section of Surgery at the Annual Meeting of the British Medical Association, Liverpool, 1950.

TABLE I.—*Comparison of Results Claimed by Various Authors after Venous Ligation for Valvular Incompetence*

	Ligation of Superficial Femoral Vein						Ligation of Popliteal Vein		
	Buxton and Collier		Linton and Hardy		Glasser	Sandegård	Bauer		Present Series
	1	2	1	2			1	2	
No. of ligations followed up	21	26	58	84	40	32	24	196	27
Follow-up period (months)	3-6	3-15	3-14	1-16	6-48	9	3-14	6-36	3-15
Ulcer cases:									
No.	14	15	21	36	40	25	22	Not stated	15
% staying healed after operation	29	87	95	81	72.5	76	91	84	64
Bursting pain:									
No.	Not stated			54	Not stated		{ —	Not stated	20
% improved			All improved	37			{ —	—	15
% cured	Majority		—	63			{ 100	100	80
Oedema:									
No.	7	Not stated	24	84	Not stated		{ 24	Not stated	25
% improved	0	0	58	55			{ 17	—	38
% cured	0	0	42	45			{ 83	Usually cured	17

extent of pigmentation and subcutaneous sclerosis usually surrounded the ulcer. In two instances the skin changes were present without ulceration.

I cannot agree with Boyd (1950) that the presence of pigmentation and sclerosis necessarily means that secondary varicose veins are present, nor that these ulcers usually penetrate the deep fascia: the excision of these ulcers will readily show their superficial character. The extra pain associated with them cannot be attributed to greater infection as Boyd suggests: small clean ulcers can be excruciatingly painful. It is probably due to the greater pressure in the venules of the ulcer base.

Eczema occurred in only five legs. In four of these the eruption was painful. In two, the rash was confined to the feet, which is unusual, and in the others the leg was involved, as is more common.

Bursting pain is often described as one of the distinctive symptoms of deep venous incompetence. It was present in 20 legs (66% of total). Bursting as a descriptive term is perhaps not wholly appropriate. Although many patients do describe the pains as bursting in character, it has been referred to as an ache, a burning pain, a deep pain, and a tight feeling or a shooting pain. It is always located in the calf or lower leg, though in one case it was localized to an area of pigmentation and sclerosis above the medial malleolus. The commonest factor is that it comes on when the leg is dependent. It is always worst at the end of the day or after prolonged standing, but it may start directly the foot is put to the ground. In such cases it may wear off in a short while, only to restart as the day wears on. In others it is present all day. In some it is worse during exercise. It varies in severity from the annoying to the incapacitating. It is true to say that it is always relieved by elevation, but some patients state that they may feel it again when they get warm in bed. Of all the symptoms it is the one most easily treated. "Dependent pain" might be a more accurate term, but "bursting pain" graphically describes what is the probable cause—venous distension by blood at an abnormal pressure. In this it resembles the ache felt in varicose veins, but "bursting" pain is usually the more severe of the two.

Oedema occurred in 25 legs (83% of the total), but varied much in degree. It never extended above the knee, and was always worse after prolonged standing. Whereas in some a night's rest would cause disappearance of oedema, in the majority it was always present to some degree, but never to elephantoid proportions. The milder cases were controllable by elastic support, but in the worse legs elastic support of all types was badly tolerated and many patients with oedema would not wear their stockings and bandages towards the end of the day.

Authorities vary very much in their account of the frequency of superficial varicosities in the post-phlebotic leg. I agree with Luke (1941) that they are not usually a feature. They were present in nine cases (30% of the total), but in all except three cases the varices were scattered loops which did not fill from above. In two cases there were quite long varicose trunks in the leg, but in only one leg was the internal saphenous vein incompetent throughout its extent. In no case, however, did the veins empty when exercising with a light tourniquet below the knee, and in some they became tense.

Diagnosis

Apart from the history of a previous deep thrombosis, the diagnosis of deep venous disease was usually suggested by the finding of signs and symptoms such as those mentioned previously without there being any varicosities to account for them. It is not usually difficult to distinguish clinically between true varicose ulcers—associated with marked superficial varicosities and a "feeding" vein, no oedema, and but little pain—and the ulcers due to deep venous disease. The diagnosis of deep venous disease was confirmed in 25 cases by finding a venous pressure above 50 mm. Hg in the foot on exercise, with or without a light tourniquet below the knee to control the superficial veins as in Perthes's test, and a patent though often irregular main venous channel on ascending phlebography. The details of this technique are described below.

In 12 cases descending phlebography was used as well. Bauer's (1948) open technique was preferred to Luke's (1941) blind one, and reflux to the popliteal vein was demonstrated. If these indications were present the popliteal vein was tied. If, however, it was impossible to demonstrate patency of the femoral vein venous ligation was, of course, not possible. During the period that this work covers, four such patients were encountered. They are not included in this series. In three other cases, however, an additional phlebogram was taken by exposing the popliteal vein and injecting 20 ml. of diodone into it. In each of these three cases it was possible to demonstrate not only that the femoral vein was thrombosed but also that the blood was returning through a large collateral vein that ran up behind the femur and was probably derived from the profunda femoris veins. The foot venous exercise pressure was, of course, high; the valves in the collateral vessel must have been incompetent, and this new vessel was thus having the same effect on the venous return as would an incompetent femoral vein. These cases were treated as though it was the femoral vein which was incompetent, and they are included in the result of popliteal vein ligation. (The phlebograms from the popliteal vein are shown in Figs. 1-3.)

Boyd (1950) has argued that the information gained by pressure readings can be obtained more simply by exercising with a rubber band applied tightly enough below the knee to obliterate the superficial veins, as in Perthes's test. With this in position, if the deep veins are obliterated or incompetent the superficial veins should stand out after exercise and may ache. This is true so far as it goes, but most of these patients have no prominent superficial veins, and in them the test fails. Further, as is shown later, it is possible by means of the venous-pressure readings to exclude those patients whom experience in the method has shown will not benefit from operation. Of all methods of investigation of the venous function of the leg, this alone is quantitative.

FIGS. 1-3.—Phlebograms from the popliteal veins showing thrombosed femoral veins and incompetent collateral veins.

Results

Popliteal Vein Ligation.—Of the 30 legs treated 27 have been followed for from 3 to 15 months. This period is too short for any conclusions to be drawn from the ulcer cases. The effect on the other symptoms is definite enough, however, to encourage hope that the results in the healing of the ulcers will eventually prove similar. The results are summarized in the last column of Table I.

Ulceration.—Of 15 ulcerated-leg cases, only 13 have been followed. Two of these were unhealed on discharge from hospital, and both of these patients have refused to return for further treatment, and so have been excluded, leaving only 11 legs in which the treatment was concluded and the patients followed up. Four of these recurred. These four were among those with the worst pressure changes on exercise, and under such circumstances we have come to expect a bad result. They recurred at 3, 4, 8, and 12 months after operation. With one exception the recurrent ulcers were smaller than before and painless. In considering these patients with ulceration, too much significance must not be attached to the role of popliteal vein ligation in maintaining the ulcers in the healed state. Most of these patients continued to wear elastic support of one kind or another after the operation, and support by itself might produce similar results in the period under consideration.

Bursting Pain.—This was present in two-thirds of all legs. In the cases followed up, it was said to be unchanged in one case and considerably improved in three others. In all the rest (80%) it was abolished.

Oedema.—This is traditionally the most difficult symptom to treat. It was present in 23 legs followed up. It was improved to the extent that it was controllable by an elastic stocking in 11 legs, and was abolished completely, so that a stocking was unnecessary, in a further 3 legs.

Other Symptoms.—Nocturnal cramp is a feature of venous disease of the leg that has never been satisfactorily

explained. It was present in only three legs and was abolished by popliteal vein ligation in each instance. Coldness and cyanosis were present in five legs. Three of these had previously had sympathectomy without permanent benefit; only one was improved by popliteal vein ligation. Eczema is a disappointing symptom despite local treatment. Of the five legs affected, three improved.

Subjective Improvement.—The 26 patients were asked whether they thought they had benefited from the operation. Eleven said they had, eight said they had not, and five were uncertain. Two cases were too recent for the result to be assessed. Of all the symptoms, pain, whether bursting pain, cramp, or pain in the ulcer itself, is the one most constantly relieved.

Treatment of the Post-phlebotic Ulcer

The chronicity of these ulcers is due to two factors—the disturbance of venous return and the local changes in the skin and subcutaneous tissues. A large number of deep thromboses must recanalize without any valvular incompetence developing. During the period of complete thrombosis, pigmentation, induration, and ulceration and scattered varices may develop, and persist when the venous function has returned to normal. I have studied five such cases. It would seem that the venous changes cause the pigmentation and sclerosis, which affects the powers of resistance and healing of the skin. These skin changes may be permanent.

To prevent recurrence of ulceration it is logical to treat both cause and effect not only by ligation of the superficial or deep veins, as indicated, but also, whenever this is possible, by exercise and grafting of the indurated area (Homans, 1917). I have performed this double treatment in only four of the present series, selecting those cases in which the ulcers were of long standing but the indurated area was not too extensive. The results so far are encouraging, but it is early yet to assess the result.

If not excised, it is important that the ulcer should be healed before the patient leaves hospital. Healing is achieved either by compression bandages or by elevation, and may be speeded at times by the use of local streptomycin to sterilize the area, and by grafting the ulcer. On discharge from hospital the patient should wear an elastic support to control

the veins in the neighbourhood of the ulcer site. In the presence of such persistent oedema, however, the support may not be well tolerated.

Venous-pressure Measurements in Selection of Cases

The method used to measure venous pressure has been described elsewhere (Walker and Longland, 1950). The apparatus used is shown in Fig. 4. A mercury manometer

FIG. 4.—Apparatus for measuring venous pressure.

is connected by a three-way tap to a sphygmomanometer hand bulb and to a glass tube piercing the airtight cork of the reservoir bottle, which is sterile and is half filled with sterile heparinized saline. Also piercing the cork and extending below the fluid level is one end of a sterile polythene cannula several feet long. With the polythene cannula filled with saline from the bottle, its far end is tied into a vein which is exposed under local analgesia on the dorsum of the foot. Blood can then flow into the cannula, but by adjusting the pressure the flow can be checked. To measure the venous pressure, the pressure in the apparatus is raised above the expected venous pressure, and then, when the cannula is clear of blood, lowered very slowly. The pressure is read on the manometer at the instant blood appears in the cannula. Thanks to the flexibility of the tube, it is quite easy to take these readings with the patient exercising. The method of investigation is well within the capacity of the average house-surgeon.

Using this method, we have measured the venous-pressure changes on exercise in normal legs and legs with varicose veins on the post-phlebotic syndrome. Our results (Walker and Longland, 1950) agree with those published elsewhere (Smirk, 1936; Beecher, 1937; Seiro, 1938; Pollack *et al.*, 1949; Warren *et al.*, 1949; White and Warren, 1949; Hojensgard and Stürup, 1949). At rest, the venous pressure in the limbs is the pressure exerted by a column of blood extending vertically from heart level to the level of the point of measurement. In the standing position it varies in the foot between 70 and 100 mm. Hg, irrespective of the state of the leg veins, depending solely on the height of the patient. But directly the patient exercises, the pressure falls in a normal individual to less than 30 mm. Hg.

Pollack and Wood (1949) have shown that the degree of exercise has little influence on this result. If there are superficial varices present, then the pressure on exercise is reduced less, depending on the severity of the varicosities, to figures varying from 80 to 30 mm. Hg. If the reflux down the varices is prevented by placing a tourniquet below

the knee the pressure on exercise is reduced further till it reaches the normal range. In contrast, if there is valvular incompetence or thrombosis of the deep veins, then the fall of pressure on exercise is even less than in varicose vein cases, and is unaffected by the below-knee tourniquet. In some cases the pressure may even rise. The pressures to be expected in the various groups are summarized in Table II.

TABLE II.—Foot Venous Pressures in Erect Position

Standing still—all cases	70–100 mm. Hg
Exercising—normals	0–30 „ „
„ —varicose veins	30–80 „ „
„ with light tourniquet below knee	0–30 „ „
„ —deep venous disease	50–110 „ „
„ with light tourniquet below knee	50–110 „ „

It is reasonable to assume that the fall on exercise is proportional to the efficiency of the venous return of the whole limb, and that in legs with the least fall of pressure on exercise ligation of the main vein will merely divert the blood to other incompetent channels with no resulting benefit. In those with the greatest fall of pressure in exercise the collateral veins are presumably competent, and benefit is likely to be considerable. To test this assumption those cases in which the venous pressures were measured are so arranged (Table III) that those with the greatest fall of venous pressure on exercise are at the bottom and those with the least at the top. Opposite each case are recorded the results of the operation. These changes are recorded numerically as 3, 2, and 1, meaning that symptoms were unchanged, improved, or cured respectively. In the case of ulcer, 1 means that it has remained healed, 2 that it has recurred to a small degree, 3 that it has recurred to a size as large as before. As regards oedema, 2 indicates that the oedema is controllable by elastic support. Table III shows a steady improvement in

TABLE III.—Changes in Symptoms After Popliteal Vein Ligation Compared With the Changes in Venous Pressure on Exercise, Before Ligation

Case	Rise (+) or Fall (–) in Venous Pressure on Exercise	Bursting Pain	Pains of Ulcer or Eczema	Cramp	Ulcer*	Eczema	Cyanosis and Coldness	Oedema†	Overall Improvement	Remarks
G. B. ..	+10	1		1				2	+	
R. M. ..	+6	1	3		3			2	+	
A. H. (Rt.) ..	+6		3			3	3	3	+	Leg amputated
A. H. (Lt.) ..	+2		3			2	3	3	+	
A. A. ..	+6		3			3	3	3	+	Worse
A. B. ..	+4	3	2		1			3	+	Oedema worse
Mrs. D. L. ..	0	2						3	+	
Mrs. E. B. ..	–6	1	2		2			3	+	
Mrs. N. R. ..	–12	1					3	3	+	
Mrs. W. D. T. ..	–12	1	1	1	2			3	+	
Mrs. M. H. ..	–15						2	1	+	
Mrs. E. P. ..	–16		1		1			2	+	
Mrs. S. J. ..	–17	1			1			1	+	
W. A. ..	–18	2	1		1			2	+	
Mrs. E. O. ..	–18		2		3			2	+	Ulcer never healed
Mrs. F. H. ..	–18	2						2	?	
Mrs. E. R. ..	–20	1	1		1				+	
Mrs. M. A. ..	–31	1	2		3			3	–	Ulcer never healed
Mrs. E. B. ..	–32	1				2			+	
Mrs. R. K. ..	–36	1	2			2		2	+	
Mrs. R. D. ..	–36	1	1	1	1	2		1	+	

3 = Not improved; 2 = improved; 1 = symptom cured.

* In cases of ulcers: 1 = remained healed; 2 = recurred to small degree; 3 = recurred as large as before.

† 2 = Oedema controllable by elastic support.

results as the drop in pressure on exercise recorded pre-operatively increases. If there is no pressure fall on exercise before operation the operation will probably be valueless, especially when ulceration, eczema, and oedema are the principal symptoms. As the drop in pressure on exercise becomes greater the outlook improves.

Discussion

Among patients who exhibit the post-phlebitic syndrome in varying degrees, not all are suitable for popliteal vein ligation, and this should not be practised indiscriminately if the best results are to be obtained.

Unsuitable cases are: (a) Those in which the main vein has not recanalized. These will be excluded by the ascending phlebogram. In doubtful cases a phlebogram from the popliteal vein may help. (b) Those in which venous function has returned to normal. These will show normal venous pressures. Their sole symptom is ulceration. (c) Those with maximal valvular incompetence. In these, exercise will produce little or no drop of venous pressure from the resting level and may even show it to rise.

When these cases have been excluded, note should be taken of the presenting symptoms in the remainder before operation is advised. The most consistently good results are obtained where pain is a prominent symptom, be it bursting pain, cramp, or painful ulcer or eczema. The results in treating oedema are less satisfactory, and experience suggests that where oedema is a predominant cause of complaint ligation may not abolish it. It is too early to say to what extent ligation will help to prevent recurrent ulceration, especially as most patients continue to wear elastic support and so complicate the problem. In suitable cases excision and grafting of the ulcers of patients whose veins have been tied may well prove helpful in producing a lasting cure. Venous-pressure measuring is a simple investigation and not purely a research weapon. Its routine use is a most valuable help in the selection of patients in whom popliteal vein ligation is contemplated.

Summary

A series of 30 legs, the seat of valvular incompetence of the deep veins, is presented; on these popliteal vein ligation was performed.

A simple method of measuring venous pressures at rest and during exercise is described. It is shown how these readings coupled with ascending phlebography can establish the diagnosis of valvular incompetency of the deep vein.

Treatment has been by ligation and division of the popliteal vein. Figures for the 3-15 months follow-up are presented, and are contrasted with the results of other authors.

It is shown how those results could be improved by the selection of cases by means of their venous-pressure changes.

The operation is most useful in those patients in whom pain is a prominent feature.

I am greatly indebted to Professor Sir James Paterson Ross, director of the Surgical Professorial Unit at St. Bartholomew's Hospital, for facilities to undertake the work, and for much helpful criticism in the preparation of this paper. Also to Mr. R. S. Corbett, Mr. J. P. Hosford, and Mr. E. G. Tuckwell for access to such of their patients as are included in this paper; and to Mr. R. S. Murley and my colleagues on the surgical professorial unit for advice and assistance; to the theatre staff for their patience; and to the photographic department for the radiographs.

REFERENCES

- Bauer, G. (1948). *J. int. Chir.*, **8**, 937.
 — (1950). *British Medical Journal*, **2**, 318.
 Beecher, H. K. (1937). *J. clin. Invest.*, **16**, 733.
 Boyd, A. M. (1950). *British Medical Journal*, **2**, 269.
 Buxton, R. W., and Collier, F. A. (1945). *Surgery*, **18**, 663.
 — Farris, J. M., Moyer, C. A., and Collier, F. A. (1944). *Ibid.*, **15**, 749.
 Glasser, S. T. (1949). *Surg. Gynec. Obstet.*, **89**, 541.
 Hojensgaard, I. C., and Stürup, H. (1949). *Acta chir. scand.*, **99**, 133.
 Homans, J. (1917). *Surg. Gynec. Obstet.*, **24**, 300.
 — (1941). *New Engl. J. Med.*, **224**, 179.
 Linton, R. R., and Hardy, I. B. (1947). *Surg. Clin. N. Amer.*, **27**, 1171.
 — (1948). *Surgery*, **24**, 452.
 Luke, J. C. (1941). *Surg. Gynec. Obstet.*, **73**, 472.

- Pollack, A. A., Bowen, E. T., Myers, T. T., and Wood, E. H. (1949). *J. clin. Invest.*, **28**, 559.
 — and Wood, E. H. (1949). *J. appl. Physiol.*, **1**, 649.
 Sandegård, E. (1949). *Nord. Med.*, **41**, 560.
 Seiro, V. (1938). *Acta chir. scand.*, **80**, 44.
 Smirk, F. H. (1936). *Clin. Sci.*, **2**, 317.
 Walker, A. J., and Longland, C. J. (1950). *Ibid.*, **9**, 101.
 Warren, R., White, E. A., and Belcher, C. D. (1949). *Surgery*, **26**, 435.
 White, E. A., and Warren, R. (1949). *Ibid.*, **26**, 987.

USE OF DECAMETHONIUM IODIDE IN ANAESTHESIA FOR PERORAL ENDOSCOPY

BY

C. F. SCURR, M.B., D.A.

Anaesthetist, Westminster Hospital

In the early papers on the use of D-tubocurarine in anaesthesia, note was made that a combination of curarization with thiopentone-nitrous-oxide anaesthesia provided satisfactory conditions for peroral endoscopy. It is usually preferable to perform these examinations under local analgesia, but, as Dinsdale (1949) has pointed out, there may be indications for using general anaesthesia—for example, in children, in very nervous patients, or where there is difficulty in obtaining relaxation of the jaw.

Bourne (1947) contributed a paper on the use of D-tubocurarine for intubation. However, one authority has described its use for this purpose as a steam-hammer blow; thus a pointer is given to the main disadvantage of using D-tubocurarine in these cases—if an adequate curarizing dose is given, then depression of the patient persists for about three-quarters of an hour. Attempts to avoid this by reducing the dose of D-tubocurarine lead only to unsatisfactory results. However, as Bourne points out, the toxic effects are less than when deeper anaesthesia with ether is employed.

Suitable anaesthesia for peroral endoscopy and intubation is, however, provided by the use of decamethonium iodide in conjunction with thiopentone—a combination which seems to avoid almost entirely the disadvantages of the D-tubocurarine-thiopentone technique.

The important desiderata for peroral endoscopy are relaxation of the jaw, an open glottis, and lack of reflex response. Relaxation of the jaw is usually stated to accompany anaesthesia with thiopentone; but this cannot be guaranteed, and very often the stimulus of introducing a laryngoscope will cause the jaw muscles to tighten. In the edentulous this factor is less important, but where there is a full set of long teeth, especially in association with some degree of inferior retrusion, profound relaxation is essential.

As Gray and Halton (1946a, 1946b) noted, D-tubocurarine is a potent preventive of laryngeal spasm. In an adequately curarized patient the cords are almost invariably seen to be well abducted, and this is essential for atraumatic intubation or bronchoscopy. This lack of spasm makes it possible to perform oesophagoscopy without intubation (Organe, 1947), as there is no anxiety about loss of control of the airway. It is preferable, however, to intubate such cases. A special advantage of curarization applied to oesophagoscopy is that the relaxation of the post-cricoid sphincter makes passage of the oesophagoscope a very easy procedure.

Decamethonium iodide prevents reflex motor response by producing a block at the myoneural junction of skeletal muscle. The use of topical anaesthesia to depress reflexes