As these ulcers respond so well to medical treatment, and as they would never require surgery if they did not bleed, operation should be undertaken only in order to save life or because a chronic ulcer is suspected. If they are operated upon, local excision would be the best procedure if one could be sure that there was only one ulcer and if it is likely to be technically easy. All the 48 patients in this group recovered. There were five surgical cases, four of them being treated by gastrectomy.

Gastro-jejunal Ulcers

The diagnosis of gastro-jejunal ulcer was made clinically in patients who had had a previous operation—either a short-circuit or a gastrectomy. This diagnosis was sometimes wrong, but it is used as a convenient one for this group, which presents a special problem for the surgeon, who has to weigh the fact that a chronic ulcer is almost certainly present and demanding surgery against the added difficulties and dangers of a complicated resection. Of the seven patients in this group three bled from the original gastric or duodenal ulcer for which the short-circuit had been performed and one from an acute jejunal ulcer. The recovery of the four surgical cases was largely due to early operation. They were all operated on very soon after admission.

Case 14.—This patient, a man aged 42, was known to have a large gastro-jejunal ulcer which had followed an inadequate gastrectomy for duodenal ulcer. He was extremely collapsed and actively bleeding when he was admitted. To make him fit for operation 2½ litres of blood were required. Exploration revealed an enormous gastro-jejunal ulcer which penetrated deeply into the pancreas. In the base of the ulcer was a large artery with a fresh thrombus in it. A further 2 in. (5 cm.) of stomach was resected, and a fresh anastomosis was formed. A year later he underwent his third gastrectomy (and vagotomy) for another ulcer, which this time eroded deeply into the liver.

Other Cases.—Two patients not included in the series were treated surgically. One had a large carcinoma and recovered well after a total gastrectomy. The other patient bled profusely a week after the suture of a perforated gastric ulcer. He died after a long, tedious resection.

Summary and Comment

For several years all patients suffering from haematemesis or melaena admitted to the Royal Berkshire Hospital have been treated in the surgical wards. In the last three years 135 patients with peptic ulcer haemorrhage have been so treated, with a mortality of 7.4%. Under the age of 40 there were no deaths, no women died, and no patient died from an acute ulcer. Thirty-three patients were treated by operation, with two deaths. Although some patients were treated medically and some by surgery the principle of treatment was the same in all cases, and no comparisons can or should be made between the medical and the surgical results. This principle was that each patient was considered as a potential surgical case and was operated upon as soon as his life appeared to be endangered by his complaint. If surgery is to be used in this way it is justifiable only if a low surgical mortality can be achieved. A low mortality is dependent on careful judgment in the selection of cases, adequate and efficient transfusion, and early operation.

It was in consultation with Dr. John Mills, director of the pathological department, that most of these patients were treated, and I would like to express my gratitude to him both for this help and for the efficient transfusion service that he maintains. I am also grateful to my colleagues, who allowed me to treat these patients in my wards.

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IONTOPHORESIS IN THE TREATMENT OF PERIPHERAL VASCULAR DISEASE

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Among the methods of treatment designed to overcome vasospasm or to produce vasodilatation in peripheral vascular disease the use of choline derivatives is suggested by the work of Dale and Gaddum (1930) and Dale, Feldberg, and Vogt (1936). Acetylcholine is unstable and rapidly hydrolysed in the tissues (Renshaw *et al.*, 1938). Its action on the autonomic nervous system is a double one, producing both muscarine- and nicotine-like effects. Some of its esters do not share these defects, and in this study we have been able, using the method of ion transfer, to compare the actions of the anions of two substances: acetyl- β -methylcholine ("mecholy" and "amechol") and carbaminoylcholine ("carbachol," "doryl," and "moryl").

Pharmacology

The action of carbaminoylcholine, the official name of which is carbachol, resembles that of acetylcholine, but is more prolonged. The Simonarts (1934) showed that its nicotine-like action was stronger than in the case of acetylcholine. Fraser (1938) pointed out that its action on the cardiovascular system ~~was~~ ^{came} off in 30–40 minutes, though its effect on the gastro-intestinal tract and urinary bladder may persist for several hours.

Acetyl- β -methylcholine also has a relatively prolonged action, and Simonart (1932) showed that the methyl-group substitution deprived acetylcholine of its nicotine-like action. Its effects, in contrast to those of carbachol, are most pronounced on the cardiovascular system.

The method of ion transfer has been shown by Kovacs (1934), Saylor, Kovacs, *et al.* (1936), and Kramer (1937) to be superior in peripheral vascular disease to oral, subcutaneous, and intramuscular administration of compounds of this type. Montgomery, Holling, and Friedland (1938) determined by direct (plethysmographic) measurement the increased blood flow produced in the limbs of normal subjects by mecholy iontophoresis, and their results fully confirmed the belief that this treatment effected dilatation of blood vessels specifically in the treated part. It is a further advantage that such unwanted general effects as micturition, defaecation, salivation, and bronchial spasm are much diminished when parasympathetic stimulants are given iontophoretically.

Method

The technique of Kovacs, Saylor, and Wright (1936) has been employed throughout. Reinforced asbestos paper is saturated with a 0.5% solution of the substance to be used and wrapped round the leg or thigh. A malleable metal plate, connected to a positive galvanic pole, is placed over this and held in position with a rubber bandage. A large flat electrode moistened with normal saline is placed under the back and connected to the negative pole. The electrodes should not be applied over any raw or inflamed areas or over recent scar tissue. The skin should always be protected by the asbestos paper from direct contact with the metal electrodes, so that burns may be avoided.

The current is turned on gradually at the beginning of each treatment and reduced slowly to zero at the end. A current of 5 mA passing for five minutes is used at the first session, these figures being gradually increased on subsequent occasions, but 30 minutes' treatment at 30 mA is not usually exceeded at any one time. The most useful warning of overdosage is the patient's reaction. Any more than a slight redness or sweating of the part treated is an indication for stopping treatment.

No rigid rules can be made for frequency of treatments, though thrice weekly was most usual in our cases. Duration of therapy is determined by the patient's response; but where treatment has been given over a period of three to four weeks without benefit the method is unlikely to be of value.

Severe general parasympathetic effects may conveniently be dealt with by an injection of 1/100 gr. (0.65 mg.) of atropine sulphate. Bronchial asthma, hyperthyroidism, and recent cardiac infarction are all contraindications to iontophoresis with these substances.

intervention was necessary. Satisfactory or partial improvement was seen in 56 cases (67%). A general survey of the table shows clearly that better results were obtained by the use of acetyl- β -methylcholine (Groups I and III) than with carbachol (Group II). The eight cases of senile gangrene were relatively resistant to iontophoresis with either compound, and similarly disappointing results were found in Raynaud's and Buerger's diseases and in acrocyanosis, but the number of cases was too small to allow any conclusions to be drawn. It is likely that some of these cases were more suitable for sympathectomy. We were unable to confirm the good results of Murphy (1937) in the treatment of thrombophlebitis by this means, and have latterly abandoned it.

The most satisfactory results were seen in 24 cases of intermittent claudication and 21 cases of diabetic gangrene. Improvement was observed in 19 cases of the former (79%) and in 16 cases of the latter (76%).

From our results we cannot infer, as did Kramer (1937), that iontophoresis with parasympathetic stimulants pro-

Condition	Group I (1938-41)				Group II (1941-6)				Group III (1946-8)				Totals
	No. of Cases	Improvement			No. of Cases	Improvement			No. of Cases	Improvement			
		Satisfactory	Partial	Nil		Satisfactory	Partial	Nil		Satisfactory	Partial	Nil	
Arteriosclerosis:													
Intermittent claudication	5	3	1	1	8	2	4	2	11	5	4	2	24
Senile gangrene	4	0	2	2	3	0	1	2	1	0	0	1	8
Gangrene in diabetes meli-													
tus	10	6	4	0	3	1	1	1	8	2	2	4	21
Painful vasospasm	0	—	—	—	3	0	3	0	5	3	2	0	8
Raynaud's disease	1	0	1	0	2	0	0	2	1	0	1	0	4
Buerger's disease	1	0	0	1	1	0	0	1	0	—	—	—	2
Thrombophlebitis	6	2	1	3	7	1	2	4	0	—	—	—	13
Acrocyanosis	3	0	2	1	0	—	—	—	0	—	—	—	3
Totals	30	11	11	8	27	4	11	12	26	10	9	7	83

Results

Numerous workers, particularly in America, have obtained good results in peripheral vascular lesions. Kramer (1937), using mecholyl iontophoresis in 30 cases of various types, observed beneficial results in 22. Murphy (1937) treated 33 cases of thrombophlebitis by the same means, and found substantial improvement in 31. Ready healing of associated varicose ulcers was seen. Saylor, Kovacs, *et al.* (1936) obtained satisfactory results in 23 out of 26 patients with varicose ulcers.

The present series, comprising 83 unselected cases, covers the period from 1938 to 1948. The cases are divided into three almost equal groups by the exigencies of the recent war. Having used mecholyl from 1938, we were deprived of it in 1941 and used doryl, moryl, and carbachol as substitutes. It was not until 1946 that acetyl- β -methylcholine again became available as amechol.

The standard adjuvant treatment given to these patients consisted of rest, warmth, and antiseptic measures where necessary; in cases of diabetes mellitus the blood-sugar level was kept within reasonable limits. The patients were usually in bed, though the majority of cases of intermittent claudication were treated as out-patients. The results obtained are detailed in the accompanying table.

Discussion

The method of treatment described cannot be regarded as an isolated piece of therapy, nor is a cure claimed in any case. The pathological basis of most of these conditions is patently irreversible.

Improvement was judged to be satisfactory when either all symptoms disappeared or only minimal local surgical

duces its best results in vasospastic cases. The great majority of our cases of intermittent claudication and diabetic gangrene showed mural calcification of the vessels radiologically, and we feel that this finding should not be regarded, as it often is, as a contraindication to the iontophoretic use of such compounds. It is our firm belief that this method is applicable, in the first instance, to all cases of peripheral vascular disease. Our aim has been, by perseverance with the treatment, to avoid the need for surgery or to reduce to a minimum such operative measures as may eventually prove necessary.

Summary

The treatment of 83 cases of peripheral vascular disease by iontophoresis is described. The greater value of acetyl- β -methylcholine for this purpose is shown.

This work could not have been undertaken without the unfailing help of Miss A. M. Clark and Miss A. Fazakerley, successively heads of the department of physiotherapy at the David Lewis Northern Hospital.

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