Virological evidence that there were still several poliovirus carriers in the school posed a serious administrative problem. Six of the children, having reached the age of 5, were due to be transferred on January 29 to three different primary schools. One of these six was a known carrier, and it was possible that some of the others were undetected carriers. We thought that the continuing presence of carriers in the nursery school would be unimportant but that spread of infection by transfer of these children to other schools was undesirable. It was decided that no children from that nursery school (whether known carriers or not) were to be transferred to primary schools, and no children (whether immunized or not) were to be admitted to that nursery school, until poliovirus infection had died out. The Education Department co-operated fully, the parents raised no objection, and the restrictions remained in force until March 29, when we were able to say, from the results of the subsequent virological examinations, that the school was free from poliovirus infection.

Discussion

It is clear that a child recovering from poliomyelitis may continue to excrete poliovirus for a period much in excess of 21 days, the traditional period of isolation in hospital. However, it is also clear that the infection may be established in the patient's environment before his removal to hospital and is likely to be widespread (at least among the children) in this environment before the patient's return. (It is notable that none of the nine adults on the staff of the nursery school was found to be infected, but contact between staff and pupils in a nursery school is not strictly comparable to contact between adults and children at home.) Thus no harm is likely to result from the patient's return, even while still infectious, to his original environment, which is probably already infected. The danger arises when the patient, or any person (especially a child) in his circle of contacts, changes his environment, as by transferring to a new school. If restrictions are placed on the movements of contacts during a period of "quarantine" this period must last several months.

In the later stages of poliovirus infection the quantity of virus excreted in the faeces diminishes and may be intermittent. As in the case of other enteric infections, this may lead to difficulties of interpretation of the significance of negative routine tests of single specimens, and, moreover, it may be impracticable to examine multiple specimens or use concentration methods, particularly if the outbreak is large. It is well known that communities of children regularly experience successive waves of infection by different enteroviruses, one displacing the other as the prevalent agent (Bell *et al.*, 1961). The eventual emergence of enteroviruses other than poliovirus in our group of nursery children, as in the incident described by Selwyn and Howitt (1962), may thus provide stronger evidence of the termination of the poliovirus episode than the mere finding of negative specimens (Hale *et al.*, 1961).

Summary

An outbreak of poliomyelitis in a nursery school in Glasgow is described. After the occurrence of one paralytic case and one non-paralytic case, seven carriers were found by virological examination of the remaining 35 children. No carriers were found among the staff. The carrier state was less common in children who had had three doses of inactivated vaccine. There was no

correlation between the carrier state and symptoms suggestive of abortive poliomyelitis. The carrier state lasted several weeks. The problems of the administrative control of infection are described.

Our thanks are due to the staff of the Health and Welfare Department, Glasgow, and of the nursery school for their assistance in the collection of specimens; and to Dr. W. A. Horne, Medical Officer of Health, and Dr. N. R. Grist, Reader in Viral Epidemiology, for their advice and encouragement.

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SELECTIVE NERVE CRUSH OPERATION FOR RELIEF OF INTERMITTENT CLAUDICATION

BY

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Arterial occlusion in the lower leg is most commonly due to atherosclerosis, and may lead to the development of intermittent claudication or gangrene. When claudication is present the degree of economic and social handicap produced is proportional to the limitation of walking-distance imposed. If this is severe the patient may be able to work but unable to reach his work because of claudication.

The aim of treatment is to increase the walking-distance, but attempts to do so are often disappointing. Arterial grafting or thrombo-endarterectomy is effective in selected cases, but, as Boyd (1960) points out, this is possible in approximately 10% of patients. We have found (Reid *et al.*, 1961) that phenol injection of the lumbar sympathetic chain has a wider application in treatment and improves substantially about 35% of patients with femoro-popliteal occlusions.

There remain a group of patients unsuitable for arterial surgery in whom sympathectomy has given a good temperature response but has not increased the claudication distance. The operation of selective nerve crush was devised in 1950 in association with Mr. J. Sloan Robertson as a means of improving the walking ability of this type of patient.

Crushing of the nerves to gastrocnemius and soleus produces wasting of these muscles and reduces their oxygen requirements on exercise, yet sufficient regeneration occurs to restore muscle tone. This allows the patient to walk further without limping and also ensures adequate venous return.

As the operation is concerned with function and does not improve ischaemia it has a limited application. It should be considered in patients who are unable to work because of claudication limited to the calf muscles,

where cardiac reserve is adequate and where there is no threat to viability.

The Operation

The anaesthetized patient is laid in the prone position with the foot projecting beyond the end of the operating-table. This permits easy identification of the type of movement produced by each muscle group on stimulation of the nerve of supply by faradism.

A midline longitudinal incision is made over the popliteal fossa and upper calf, and the deep fascia is incised on the lateral side of the short saphenous vein and sural nerve. This avoids bleeding from branches of the short saphenous vein, which enters the popliteal vein medial to the medial popliteal nerve. This nerve is readily located in the fatty tissue of the popliteal fossa, and the two bellies of the gastrocnemius muscle are split by sharp dissection to expose it distally.

The various branches of the nerve are dissected free and individually identified by faradic stimulation. The sensory nerve from the knee-joint and the sural communicating nerve are recognized from their positions and the absence of muscle contraction on stimulation. Stimulation of the nerves to the gastrocnemius and soleus produces strong plantar flexion of the foot. The branches to the gastrocnemius arise nearly always at the same level from the superficial surface of the medial popliteal nerve, and the upper nerve to the soleus arises on its own or frequently with the nerve to the lateral belly of the gastrocnemius. The distal nerve to the

soleus may arise before that to the tibialis posterior, but the sequence may be reversed, and it may even arise below the nerve to the flexor digitorum longus (Hovelacque, 1927). The nerve to the tibialis posterior is recognized by strong inversion of the foot on stimulation and the nerve to the flexor digitorum longus by flexion of the toes.

The branches to the gastrocnemius and soleus are firmly crushed with artery forceps (see Fig.) until translucent and proximal stimulation fails to produce muscle contraction. As a strong stimulus or a moist nerve will conduct the electrical impulse across the crushed area, the nerve is elevated on a glass rod and carefully dried

with a swab, and the faradic impulse is limited to the minimum producing contraction in the intact nerve. Adequate denervation is confirmed by the absence of plantar flexion on stimulation of the medial popliteal trunk.

The deep fascia and skin are closed and a light lateral splint is applied for three or four days to obviate broadening of the scar. The operation is neither severe nor time-consuming, bleeding is minimal, and the patient is ambulant in a few days and ready for dismissal by the twelfth post-operative day.

Results

The first operation was performed in November, 1950, and 65 patients were operated on between 1950 and 1960. The only female patient has since died and is excluded from the results.

Twenty-seven are known to have died; 34 survivors were interviewed in November–December, 1961, two were contacted by postal questionnaire, and one was untraced. The average time between operation and interview was 5.3 years.

In 23 of the 27 patients who died, the survival time after operation averaged 4.6 years, and this was not related to the age at operation (Table I). The mean age at operation of these patients was 59.9 years, with a range of 49 to 67 years. The cause of death has been ascertained from records and the Registrar-General in 24. Coronary artery thrombosis was the cause in 10 cases, cardiac failure in 2, and a cerebrovascular incident in 1 case—that is, 54% were cardiovascular in origin. Of the other 11 deaths, five were due to carcinoma.

TABLE I.—*Survival Time After Operation Related to Age at Operation*

Age-group:	< 55	55–59	60+
Survival time (years) ..	4.7	5.4	3.99
No. of patients ..	7	5	11

Because the follow-up notes on many of these patients are not complete up to the time of death, only an approximate estimate of the success of operation can be made. Sixteen of the 27 patients are known to have gained substantial improvement in claudication distance from a mean initial distance of 120 yards (110 metres) to a mean final distance of more than a mile (1.6 km.), which was maintained in the majority until death supervened; 15 of these returned to useful work for periods ranging from one to nine years.

Of the 36 patients traced, 28 had unilateral operations, seven had bilateral operations, and one, in whom both legs were operated on at an interval of two months, is grouped as a bilateral operation for the purpose of analysis. The mean age of the 64 patients was 54.7 years, with a range of 37–65, although over 80% were between 45 and 60 (Table II). The average follow-up was 5.3 years, the longest being 11 years 1 month, and in only three patients was it less than two years. No patient operated on within one year of the survey has been included.

The results fall into three categories: group 1, those in whom the improvement gained was substantial and was maintained up to the date of interview—17 patients

TABLE II.—*Age-groups at Operation (64 Patients)*

Age at operation ..	< 50	50–54	55–59	60–64	65+
No. of patients ..	10	15	19	15	5

(47%); group 2, those in whom improvement was substantial but for varying reasons was not maintained—10 patients (28%); and group 3, those in whom no improvement occurred—9 patients (25%).

Group 1.—The 17 patients in this group had a mean follow-up time of 4.9 years, which shows that these are not necessarily the patients most recently operated on. The gain in claudication distance was substantial, from a mean initial distance of 125 yards (114 metres) to a mean final distance of 1 mile. The best result was in a patient, aged 47 at the time of his operation in 1951, whose improved claudication distance of 1 mile has been maintained to date. In this group, 11 were working at the time of interview, five had retired on grounds of age, and one was unemployed. Three patients in this group developed further occlusive vascular incidents. One developed an ischaemic ulcer of the opposite leg in 1956, four years after operation. This healed after sympathectomy and he was still able to walk a mile without claudication, his pre-operative distance being 100 yards (91.5 metres). A second patient developed ischaemic rest pain in the same leg in 1959, a year after operation. This was relieved by repeat phenol injection to the lumbar sympathetic chain and he was still able to walk over a mile without claudication. The third had a bilateral nerve crush operation in 1959, and a year later one leg deteriorated and his claudication distance diminished from 1½ miles to 100 yards. After repeat phenol injection his claudication distance improved to 1 mile.

Group 2.—This group comprised 10 patients whose average duration of relief (mean final claudication distance, 500 yards—457 metres) was 2.5 years, with a range of 6 months to 7 years. The mean improvement in this group was from 125 to 525 yards (114 to 480 metres).

The deterioration was caused by return of calf-muscle function or further occlusion of the same leg in five, by occlusion of the opposite leg in four, and by hemiplegia in one. Seven of these 10 patients returned to work but only four have been able to continue at work since the second incident.

Group 3.—This group comprised nine patients in whom no benefit from operation was obtained, and in some there was actual diminution of the claudication distance. In spite of this, four of these patients have been able to continue working; two worked for six and eight years respectively; and three have been unemployed since operation.

Considering the results as a whole, 47% of the surviving patients interviewed had excellent maintained results and 28% had satisfactory relief for 2.5 years on average—that is, 75% of the results were initially good. If the 28 patients who had a unilateral operation are considered separately, 85% had excellent initial results.

If the age at operation is related to the result obtained (Table III) it is seen that the results did not differ significantly between patients under 55 and those 55 and over. Although we believe that the operation should

be performed mainly in the younger age-groups, it is possible to obtain good results in the older patient.

A comparison of the results obtained in unilateral and bilateral operations (Table IV) shows that 4 of 28 patients with unilateral operations had no improvement, whereas five of eight patients undergoing bilateral operations are regarded as immediate failures. This accords with Boyd and Bloor's (1960) results in bilateral tenotomy.

TABLE IV.—*Comparison of Results in Unilateral and Bilateral Operations*

Result	Operation	
	Unilateral	Bilateral
Good	14	3
Late failure	10	0
Immediate failure	4	5
Total	28	8

The operation itself was relatively free from incident, the average post-operative stay in hospital for the 64 patients being 17 days. This exceeds the normal 12 days because of complications in five patients. One was detained 33 days owing to a pulmonary infarct, two were slow to regain walking control and required 28 and 26 days, and two developed foot-drop and were detained for 63 and 41 days. This foot-drop occurred in two of the early cases in which a periarterial sympathectomy of the popliteal artery was also performed in an attempt to produce a local vasodilatation in the calf muscles. The retraction required to perform this produced a closed lesion of the lateral popliteal nerve, which eventually recovered.

Regeneration of the crushed nerves permits a moderate recovery of calf function, and in only 7 of the 36 patients traced was there any evidence of a limp. Even so, three of these came into group 1 with claudication distances of 1, 2, and 1½ miles (1.6, 3.2, and 2.4 km.).

In others, who failed to improve or who deteriorated subsequently, the cause of failure appeared to be an early return of calf-muscle function confirmed by the Ritchie-Sneath test. This occurred in three of the early cases where the need for severe crushing of the nerve was not appreciated. In some patients claudication was not improved in spite of apparently adequate denervation, and this may be due to claudication pain affecting the tibialis posterior and flexor digitorum longus.

Discussion

When improvement in claudication by any method of treatment is claimed, it is necessary to assess the importance of relief due to spontaneous improvement of the collateral circulation. In all cases the interval between onset of claudication and operation exceeded one year and phenol injection of the sympathetic chain preceded operation by 7.1 months on average, the patient's claudication distance remaining static during this period. In eight cases, when operation followed phenol injection at less than three months, the results were basically uninfluenced, as four of these eight were in group 3—no improvement.

Accordingly, we consider that the improvement gained in the successful cases was real and the results show that the operation is of value in the treatment of claudication in selected cases.

Previous attempts have been made to improve claudication by limiting the demands on oxygen supply of

TABLE III.—*Effect of Age at Operation on Result*

Result	Unilateral Cases Operation Age of Patients	
	< 55 Years	55+ Years
Good	7	7
Late failure	4	0
No improvement	2	2

the calf muscles. Tenotomy of the tendo Achillis was described by Boyd *et al.* (1949), and Boyd and Bloor (1960) assessed the long-term results. They regarded it as being of value in selected cases, and in a series of 62 cases of unilateral tenotomies, found that 14 patients obtained complete relief of symptoms, 14 had initial relief but deteriorated subsequently, and 34 obtained no relief from the operation. The higher success rate of selective nerve crush, which, unlike tenotomy, usually does not produce a limp, suggests that it is to be preferred in treatment. At the start of the present series, one of us (W. R.) performed eight tenotomies and eight nerve-crush operations. These were reviewed after a year. Of the selective nerve-crush patients, seven were working and none had a limp; and of the tenotomies, one was working and all had a limp.

Learmonth and Slessor (1952) described the operation to divide the nerves to the gastrocnemius and the upper nerve to the soleus, but thought that it was advisable to give anticoagulants to forestall the possibility of venous thrombosis due to inactivation of the muscle pump. They first used denervation towards the end of the second world war as the result of an observation (also made by Boyd in the Middle East) that claudication might not follow wounds of the popliteal artery requiring ligation if (1) the nerve branches to the gastrocnemius were involved, or (2) if the medial popliteal nerve trunk was involved, and power was not regained in the gastrocnemius and soleus. About 1947 they had an arterio-sclerotic patient in whom claudication did not occur after resection of a popliteal aneurysm which included the nerves and blood-vessels to the gastrocnemius. They also had a patient with a fixed ankle-joint due to calcification of the anterior calf muscles who did not have claudication. Learmonth (personal communication, 1962) considers it is possible to determine which patient may be helped by nerve section by trying the effect on walking of a check-iron to keep the ankle fixed.

Marston and Cockett (1962) published a short-term follow-up of 15 cases in which they performed total denervation of the gastrocnemius and soleus, with sympathectomy in nine of these. Good results for this procedure are claimed but, in contrast to our experience with selective nerve crush, they had a high incidence of complications (two developed deep-vein thrombosis, and three had skin necrosis at the site of operation).

One very striking feature of the present series is that none of the 65 treated patients subsequently developed gangrene. We believe that this was due to the selection of patients whose feet were warm and viable, and is an indication of the efficacy of phenol block in ensuring an adequate development of the collateral circulation.

The results in some patients of the present series have been disappointing. Late failure due to further occlusion in either leg and a reduced expectation of life are a natural consequence of the underlying disease. The other principal cause of failure was early regeneration of the nerve supply to the gastrocnemius and soleus.

Summary

An account is presented of an operation for treatment of intermittent claudication which produced good results in 85% of unilateral cases, although 35% later deteriorated owing to further occlusion.

Operation is indicated where severe claudication is confined to the calf muscles of one leg and interferes with the patient's working capacity.

Operation is contraindicated in patients with serious cardiac insufficiency or where the viability of the leg is in doubt.

Bilateral operation should seldom be undertaken.

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AGROSAN POISONING IN MAN

BY

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Poisoning through the medium of food has been known for centuries. Acute food poisoning has always been a hazard, sometimes in the form of botulism and lathyrism as well as poisoning with heavy metals, especially arsenic. We are also familiar with chronic and insidious poisoning by means of arsenic in food. But, of recent years, outbreaks of chronic food poisoning with organic chemicals have taken a considerable toll of human life in different parts of the world. Of particular concern have been the loss of human life and the suffering caused by adulteration of oil or ghee used for cooking purposes, as happened in Morocco (Smith and Spalding, 1959; Moroccan Situation, 1959) and in Karachi in 1961, or by the mercurial poisoning of wheat in Iraq in 1956 and 1960 (Jalili and Abbasi, 1961).

In this paper cases of agrosan poisoning due to eating seed wheat treated with "agrosan GN" (a mixture of phenyl mercury acetate and ethyl mercury chloride) are reported. The series includes several fatal cases.

Epidemiology

The outbreak began in the middle of February, 1961, and food poisoning was first suspected during early March, in three patients admitted to the Government Lady Reading Hospital at Peshawar. It continued till about the middle of March and affected about 100 people. Several families were afflicted by similar symptoms in Nizampur Area, Tehsil Nowshera, and District Peshawar, and still more cases followed in the nearby villages. Some of these cases died at home, others were admitted to local hospitals or treated as out-patients. At the end of March, 1961, and beginning of April, 1961, some of these families from Nizampur, Badabher, Ziarat Kaka Sahib, Landi Arbab, Village Kahi, and Akora Khattak were admitted to the Government Lady Reading Hospital, Peshawar, and the following account is based on the data collected from them, their relatives, and well-wishers. In all, 34 patients were admitted: 2 men, 7 women, 14 boys of 15 years old and under, and 11 girls in the same age group.