sulphapyridine. The pelves and ureters were dilated and their mucosae thickened, congested, and haemorrhagic; the bladder contained a small amount of grey sandy particles, and both ureters were blocked by concretions at their entrance into the bladder. Unfortunately the sand-like material was lost in the fluids and could not therefore be examined for sulphapyridine. Stryker (1940) had the opportunity of examining at necropsy the renal lesion in a child of 5 months who had died of pneumococcal meningitis and had developed gross haematuria after 44.2 grammes of sulphapyridine, administered over a period of four weeks. In this case the mucosa of the urinary tract appeared normal. In the calices and pelves of both kidneys a small amount of yellowish-white gravel was found, and four calculi were isolated from the pelvis of the right kidney. Here, as in Tsao's case, there was an accumulation of gravel in both ureters, mostly at the entrance of the ureters into the bladder. Microscopically the kidneys showed dilatation of the cortical tubules and glomerular spaces due to precipitation within the tubules of concretions of varying structure—namely, sharp-edged basophilic crystals, amorphous basophilic debris, and discoid bodies of homogeneous material.

Diagnosis

When haematuria is observed in a patient to whom sulphapyridine is being administered it must always be borne in mind that the drug may be responsible, and the urine should be examined for crystals. The crystals are elongated and sharp, and occur in clusters grouped at one end and radiating at the other. They are well shown in a photograph reproduced in Plummer and McLellan's paper. It is worth noting that in Captain Scott's case the crystals could not be identified in the centrifuged deposit of the urine, but they could be seen clinging in abundance to the sides of the glass vessel and showed the typical structure under the microscope. The crystals were washed off the sides of the vessel, tested chemically, and identified as sulphapyridine by Miss Gilchrist of the biochemical department of the Royal Infirmary, Edinburgh. Unless concretions of acetyl-sulphapyridine are present in large quantities they are readily redissolved and cannot be identified in the urine. Southworth and Cooke (1939), for example, found them in the urine of only 1 of 3 patients who developed haematuria after sulphapyridine. Occasionally renal calculi of acetyl-sulphapyridine may be demonstrated as negative shadows in excretory or instrumental pyelograms (Plummer and McLellan, 1940). In spite of the sulphur-containing radical the stones themselves are not opaque to x rays. In the absence of crystals it may be difficult, and at times even impossible, to determine at the onset whether the haematuria should be attributed to the sulphapyridine or whether it is a symptom of an acute nephritis, since many of the patients under treatment with the drug are victims of acute infections in which nephritis is known to occur as a complication. If the bleeding is due to acute nephritis numerous casts in the urine or oedema or shivering attacks will eventually point the diagnosis. These symptoms are no more characteristic of renal damage due to sulphapyridine than they are of aseptic calculous pyelitis and ureteritis in general. Furthermore, the haematuria due to sulphapyridine is often accompanied by renal pain or colic which is far more severe than the lumbar pain that is an occasional feature of acute nephritis.

Occasionally pain precedes the appearance of haematuria, and Southworth and Cooke (1939) describe a case in which the possibility of an acute appendicitis was seriously debated. The patient was a girl of 17 who developed a transient attack of pain in the right lower quadrant of the abdomen two days after she had been

started on a course of sulphapyridine for a respiratory condition. On the following day the pain recurred and was accompanied by burning pain on micturition. Tenderness was most marked over McBurney's point. Owing to the onset of gross haematuria and the fact that her abdominal tenderness extended up to the right costo-vertebral angle, conservative treatment was decided on, and the sulphapyridine, of which she had received 10.5 grammes, was stopped. Her symptoms subsided rapidly.

Treatment

As a rule the symptoms of haematuria and renal colic disappear within twenty-four hours when sulphapyridine is withheld and fluids are forced. In the event of signs of nitrogen retention 5% glucose or 4.28% sodium sulphate solution should be administered by the intravenous "drip" method. If anuria develops and persists in spite of these measures, cystoscopy and ureteric catheterization or, if need be, renal pyelotomy, as suggested by Tsao, deserve consideration owing to the tendency for plugs of concretion to block the orifices of the bladder. This was not carried out in the case I have described, as it was not until the patient had recovered that I had the opportunity of perusing the relevant literature and of learning something of the nature of the condition.

I wish to acknowledge my thanks to Colonel J. M. Mackinnon for permission to publish this record, and to Major C. E. van Rooyen for his friendly co-operation. My grateful thanks are also due to Major Ian Murray for much helpful discussion during its preparation.

REFERENCES

- Antopol, W., and Robinson, H. (1939). *Proc. Soc. exp. Biol.*, N.Y., **40**, 428.
 Backhouse, T. C. (1939). *Lancet*, **2**, 736.
 Graham, D., Warner, W. P., Dauphinee, J. A., and Dickson, R. C. (1939). *Canad. med. Ass. J.*, **40**, 325.
 Gross, P., Cooper, F. B., and Lewis, M. (1939). *Proc. Soc. exp. Biol.*, N.Y., **40**, 448.
 Heathcote, R. St. A. (1940). *Med. Ann.*, p. 103.
 Plummer, N., and Ensworth, H. K. (1939). *J. Amer. med. Ass.*, **113**, 1847.
 — and McLellan, F. (1940). *Ibid.*, **114**, 943.
 Smith, F. J., and Needles, R. J. (1939). *Amer. J. med. Sci.*, **198**, 19.
 Southworth, H., and Cooke, C. (1939). *J. Amer. med. Ass.*, **112**, 1820.
 Stryker, W. A. (1940). *Ibid.*, **114**, 953.
 Tsao, Y. F., McCracken, M. E., Chen, Ji, Kuo, P. T., and Dale, C. L. (1939). *Ibid.*, **113**, 1316.

EXPERIENCES IN TREATMENT OF PERIPHERAL NERVE INJURIES WITH AMNIOPLASTIN

BY

LAMBERT ROGERS, F.R.C.S., F.R.A.C.S., F.A.C.S.

Surgeon Captain, R.N.V.R.; Consultant in Neurosurgery
to the Royal Navy; Professor of Surgery, University
of Wales

For some time efforts have been directed towards finding a substance which would isolate a damaged structure by preventing it adhering to its surroundings and which by ultimately becoming absorbed would leave the structure concerned quite free. Wilder Penfield and his associates (Chao *et al.*, 1940) experimented on cats by placing various membranous materials between the scarified cerebral cortex and a flap of overlying soft parts. They found that of the materials used the best was a prepared form of human amniotic membrane which they called amnioplastin. This was absorbed in about three weeks, leaving the cortex free from adhesion.

Following Penfield's report it appeared that this substance would be useful in the surgery of peripheral nerves as well as in that of the central nervous system. Having had some experience of it in eight intracranial cases in which it was used to prevent meningo-cerebral adhesions, and having noted the frequency with which peripheral

nerve lesions so far met with in the present war are due to the involvement of nerve trunks in scar tissue, I thought it desirable, after freeing such trunks, to attempt to isolate them by wrappings of amnioplastin. It is not proposed here to discuss the intracranial uses, but, in order to afford comparison with peripheral lesions similarly treated, an example is given of the type of cerebral case in which the membrane has been used.

Type of Cerebral Case

Old Gun-shot Wound of Head. Meningo-cerebral Adhesions: Traumatic Epilepsy

A fitter aged 51 had three years previously been shot through both frontal lobes with a large-calibre revolver bullet. Dense meningo-cortical adhesions anchored both frontal lobes and were regarded as responsible for his epileptic fits, which had developed subsequently to the shooting accident. On May 7, 1940, a large bone flap was turned down; the adhesions were separated by endothermy, and the frontal lobes were wrapped in amnioplastin. He has remained well and free from fits since.

Peripheral Nerve Cases

The membrane has been used in 12 cases of injury involving the following peripheral nerves: ulnar 2, median 4, musculo-spiral 1, great sciatic 2, external popliteal 3. Brief details of these cases are shown in the accompanying table. It is realized that these are

Just before use—i.e., on the morning of operation—enough amnioplastin for what is intended is removed from its storage in spirit and boiled for half an hour in distilled water in a large beaker. After boiling, the amnioplastin, which is slightly cloudy when it comes out of spirit, is more transparent and is of a light green colour. It is not unduly fragile, is easily handled, and resembles rather thin oil-silk. It is taken from the beaker and floated on saline in a large bowl, when pieces may be cut to the requisite size and shape.

Technique of Use in Peripheral Nerve Cases.—The nerve trunk having been isolated and freed from scar tissue both above and below the level of the lesion, and bleeding having been attended to meticulously, so as to obtain a dry field, the site of the lesion (which may be a suture line, an area that has been strangled by dense fibrotic tissue, or a length of nerve anchored by numerous adhesions) is wrapped around by a suitably shaped piece of amnioplastin. This piece must be large enough to extend beyond the limits of the lesion in order to include some normal nerve trunk both above and below it and thus completely isolate it.

Results

Except in one intracranial case, that of a large recurrent meningioma, all wounds have healed by first intention. Results have been both gratifying and encouraging. Early functional restoration has been noted in most and a freedom from pain in all. The relief of pain, cessation

Table giving Details of Peripheral Nerve Lesions treated by Amnioplastin Isolation

Case	Age	Lesion	Operation	Date of Operation	Result
1	22	Ulnar. Bomb wound, forearm, Aug., 1940. Motor paralysis absolute; sensation lost over ulnar distribution	Freeing of nerve from dense adhesions. Wrapped in amnioplastin	20/11/40	Almost complete recovery within six weeks
2	20	External popliteal. Bomb wound, May, 1940. Drop-foot	Freeing of nerve from scar tissue. Wrapped in amnioplastin	26/11/40	Progressive recovery—not yet complete
3	27	Median at wrist. Causalgia. Cut tendons and nerve. June, 1940	Freeing of nerve from scar tissue; incision made into nerve. Wrapped in amnioplastin	26/11/40	Pain relieved, sweating ceased. Rapid recovery—incomplete
4	19	Median in arm. Musculo-spiral at elbow. Bomb wound at Dunkirk, May, 1940	Freeing of median nerve, which has been partially divided, from dense scar tissue	29/11/40	Slight improvement
5	26	Median just below elbow, following crush of arm in watertight door and fracture of ulnar, Sept., 1940	Nerve found to be embedded in extremely dense scar tissue. Nerve freed and wrapped in amnioplastin	20/12/40	Much recovery in short time
6	20	Median at wrist. Bomb wound of forearm, May, 1940. Causalgia	Neuroma involving median and tendon of flexor carpi radialis. Neuroma dissected off nerve. Incisions into trunk of nerve	2/1/41	Pain relieved. Recovering
7	23	Great sciatic in buttock and comminuted fracture of great trochanter by machine-gun bullet, Aug., 1940	Nerve exposed and found to be partly destroyed at its exit from pelvis; much scar tissue around it. Freed; isolated in amnioplastin	31/1/41	No change
8	28	External popliteal and fracture of fibular neck, Nov., 1940	Exposure of nerve and isolation in amnioplastin	17/2/41	Recovering rapidly
9	21	Musculo-spiral. Wrist-drop following inoculation with T.A.B., Oct., 1940	Exposure of nerve; separation of adhesions; isolation in amnioplastin	25/2/41	Recovering
10	20	Great sciatic in buttock. Injury by injection into nerve, June, 1940	Perineuritis. Isolation in amnioplastin	7/3/41	Recovering
11	19	External popliteal lesion and fracture of fibula by bomb explosion, Jan., 1941	Nerve found divided; proximal neuroma. Neuroma excised; end-to-end suture with knee flexed; amnioplastin isolation	27/3/41	No change as yet
12	35	Fractured surgical neck of humerus; damaged median and ulnar trunks. Accident at sea, Dec., 1940	Perineuritis and myositis ossificans. Isolation of nerve trunks with amnioplastin	29/3/41	No change as yet

early days in which to draw conclusions as to ultimate results, and I have not yet had an opportunity to reopen a wound and re-examine a nerve trunk that has been isolated by the membrane some time previously; but the results up to date are so encouraging in the incomplete lesions and cases of causalgia so far dealt with that it appears advisable to report our experiences.

Preparation, Preservation, and Method of Using Amnioplastin.—The amnioplastin has been prepared in the surgical unit at Cardiff by Mr. Charles Langmaid and members of the unit laboratory staff from placentas obtained from the obstetric department, in charge of Prof. Gilbert Strachan. The method of preparation has been that described by Penfield and his associates (Chao *et al.*, 1940; Penfield, 1940), and the membranes have been preserved in alcohol (70%), in stoppered bottles.

of sweating, and early restoration of normal skin appearances in the two examples of causalgia have been particularly striking. It remains for the future to determine whether the late results of these peripheral cases are equally good, and for an opportunity to occur by which we may ascertain from the condition of the operation field whether neural isolation persists and whether the membrane is absorbed as completely in man as in experimental animals.

Conclusion and Summary

Amnioplastin appears to be a valuable material for the isolation of nervous elements. Its use so far in the surgery of peripheral nerves has been encouraging, relief of pain and restoration of early function being noted in cases in which it has been used after freeing nerves strangled in scar tissue.

Experience in the use of amnioplastin has been obtained in 8 intracranial cases, 12 peripheral nerve cases, and in one or two additional instances, such as a scar in the popliteal space. The type of peripheral nerve case in which the membrane has been used, the method of its employment, and the results so far obtained are here reported. These results are so encouraging as to suggest its continued and further use.

REFERENCES

- Chao, Y.-C., Humphreys, S., and Penfield, W. (1940). *British Medical Journal*, 1, 517.
Penfield, Wilder (1940). *Ibid.*, 2, 668.

A HISTORY OF THE RESCUE AND AFTER-CARE OF TWO CASES AFTER FOUR DAYS' BURIAL

BY

G. S. SWAN, M.B., Ch.B.

On a Thursday, at 1 a.m., a bomb struck a block of three-storied cellared houses. Some of these houses were completely destroyed. As it was known that a number of people were in them at the time of the disaster rescue work started almost at once, but with little hope of saving anyone alive. At 6 p.m. on Friday an elderly woman was rescued alive, but in such a serious condition that she died a few days later.

The First Rescue

At 7 p.m. on Sunday I was sent for, as the rescue squad had heard a voice under the debris. On arrival I made contact with the trapped girl, one of my own patients, Miss F. B., aged 21, whose voice could faintly be heard, obviously at some distance below the debris. She told me her name, that she knew her father and mother were dead, and that she was quite immobile except for a little movement of the left hand. It was astonishing to find her so completely intelligent, and throughout the six hours before she was finally removed at 1 a.m. on Monday—exactly ninety-six hours from the time she was first trapped—she retained her intelligence and was of great help in guiding the rescue squad in their difficult task.

At 9.30 p.m., debris having been removed entirely by hand and several wooden beams sawn through, a narrow hole four feet in depth allowed of contact with the girl's left hand. It was just possible to feel her pulse, which was well perceptible at about 90 beats per minute. A short time afterwards her head was uncovered, when it became obvious she was face downwards in position. By means of a length of rubber tubing and a feeding-cup we succeeded in getting her to rinse out her mouth, after which she was allowed to swallow a little hot well-sugared tea. Shortly afterwards, as more of her body became exposed, I gave her one-third of a grain of morphine, and about quarter-hourly sips of tea, by now out of the feeding-cup direct. By midnight she was completely exposed at the bottom of a deepish hole. The rescue squad also succeeded in burrowing sideways at her body level, a burrow sufficient to admit head and shoulders with debris supported by some flooring cross-beams. It was through this burrow that we succeeded in delivering her.

She was lying crouched, face down, her knees on her chest and heels under her buttocks, her right arm under her chest and left arm by the side of her face—a normal breech position. Across her back was the dead body of her father. It was evident we dared not remove him

before the girl, so we arranged the rescue squad with one man from above easing up the dead body as much as possible, another down the main hole supporting the chin, and a third grasping her hips and gently pulling her through the small narrow side burrow. As she was being removed she told us there was a woman alive next door. Once on the warm stretcher I immediately straightened her legs and sent her to hospital, where all was in readiness for her reception.

The Second Rescue

On investigating her report that a woman was alive next door, we found, to our surprise, that this was true. After shouting we heard a voice say, "I am A. D. [aged 34]; I am all right, and walking about in the cellar. I have a baby with me, who is not very well, and we have some bottles of milk." This turned out to be delirium, and it was some hours before contact was made. It was then discovered that she was lying on the cellar stairs, her head higher than her feet, and completely immobile.

The only way to deliver her was through a narrow aperture formed by the absence of the upper panel of a door, the rest of the door supporting a mass of debris. It was impossible to risk cutting away the side of the door, but it was possible to remove a triangular piece of the lower panel. Her pulse was weaker than the girl's, but countable at about 100. She also received morphine, and was fed in a similar way to the first patient. The dead body of a 3½-year-old boy was lying under her right arm. To deliver her through this narrow aperture one man was able to step inside the hole and just scramble down to place both hands under her shoulders; another man, lying on the debris held by his heels, was just able to reach her legs. I lay over the aperture and, as she was eased upwards, succeeded in grasping her shoulders and bringing her out of the hole over my own right shoulder to stretcher-bearers behind. This was at 6 a.m. on the Monday, 101 hours after being buried. She also was immediately sent to hospital.

Treatment of the Patients

When admitted both patients were placed in warm beds with suspended cradle lamps and received a transfusion of two pints of plasma. Blood pressure on admission was: Miss F. B., systolic 85, diastolic ?; Miss A. D., systolic 90, diastolic ? 70. After transfusion both blood pressures were 140/80.

General Examination of Case I.—Severely shocked, but perfectly conscious and mentally very alert. Very thirsty. Eyes bright and free from grit; lips and tongue abraded and some dirt ingrained; air passages clear—no evidence of gritty lungs. A few small pressure sores on back and large area over sacrum. Full range of movement in upper limbs; small superficial patches of skin gangrene over patellae; both lower limbs stiff, and foot-drop present on left. One gramme of sulphanilamide four-hourly for forty-eight hours, followed by one tablet (0.5 gramme) four-hourly for four days. Frequent hot drinks taken very well. All pressure sores dressed with gentian violet; nursed on an air-bed; right foot splinted; rest of skin perfectly clear. Extremities were warm.

General Examination of Case II.—Severe shock; cold; mental condition incoherent with periods of delirium; very thirsty. Eyes clear; tongue dry; air passages clear—no evidence of gritty lungs. Bruising of both legs, with large gangrenous patch on right thigh posteriorly, lateral aspect of right leg, and above left outer malleolus; a smaller patch of superficial skin gangrene on right side of chest, also on both wrists posteriorly. Patient was not able to move either of lower limbs; the right leg and foot were oedematous, also right hand and arm. Warm fluids were