surfaces, and cause a decrease in the amount of discharge. The procedure usually adopted is to give a dose of 5 c.cm. intramuscularly every fourth day until six such injections have been given. A further series of six at seven-day intervals is then administered, and a period of one week permitted to elapse, during which the patient receives the radium treatment. The majority of patients tolerate these injections very well, but in a small percentage of cases a definite systemic reaction is observed, patients complaining of pain at the site of injection, with sickness, headache, and a slight rise of temperature; if these symptoms are at all pronounced they must be regarded as a contraindication to the continuance of the treatment.

THE TREATMENT OF ACUTE PYOGENIC INFECTION OF THE KNEE-JOINT.

BY

A. H. SOUTHAM, M.A., M.Ch.Oxon., F.R.C.S.Eng.,
RESIDENT SURGICAL OFFICER, MANCHESTER ROYAL INFIRMARY.

ACUTE pyogenic infection of the knee-joint may arise as the result of a wound of the joint, by extension of inflammation from a neighbouring focus, or in conditions such as septicaemia and pyaemia where the organisms gain access to the joint from the blood stream.

The treatment recommended in the older textbooks was by making vertical incisions on either side of the patella and inserting drainage tubes into the joint. This was often followed by disastrous results, the infection tracked along the fascial planes up into the thigh and down the calf, where, later, secondary abscesses had to be incised, whilst the patient's general condition steadily deteriorated and amputation had finally to be performed as a life-saving measure.

It is not going too far to say that the presence of a drainage tube in the knee-joint almost inevitably ends in disaster. It acts as an open drain for the entrance of secondary organisms from without, and as a foreign body in the joint which serves to keep the inflammatory process active. Further, from a study of the anatomy of the knee-joint, it will be apparent that attempts to drain the joint must be inefficient.

The synovial membrane lining the knee-joint has, like the peritoneum, considerable power for overcoming septic infection when placed under suitable conditions. But it must be remembered that the virulence of organisms is much greater when they are contained, under pressure, in a closed cavity such as the acutely inflamed and swollen knee-joint. For the successful treatment of acute arthritis, therefore, it is necessary to place the synovial membrane under the most favourable conditions, and to lower the intra-articular tension and keep it so reduced without the use of drainage tubes. In mild types of infection this can sometimes be accomplished by aspiration or by incision and lavage, followed by suture of the joint, but in acute pyogenic infection this often fails, the joint fills up again and again, and it becomes obvious from the patient's general condition that something radical must be done.

During the war the treatment of acute suppurative arthritis of the knee furnished one of the most difficult problems of surgery. In the early days it was said¹ that surgeons were impotent to prevent the loss of life or limb in these cases. Later, with improved methods and greater knowledge, better results were obtained, though, in many cases, it was impossible to overcome the infection, and amputation had to be resorted to.

Willems, the Belgian surgeon, suggested treatment² of these cases by active movements on the part of the patient to provide free drainage after incision of the joint. But it is difficult to persuade patients to move an acutely inflamed joint, and I have had little success with this procedure. It is, I think, open to question whether it is advisable to start immediate movement of a joint infected by streptococci in a patient who is already in an acutely toxic condition. As a result of experience gained in the war I have adopted the treatment here described in cases of acute pyogenic infection of the knee-joint, arising from general causes, with satisfactory results. The patients have been left with a useful limb and a movable joint. The number of cases is so limited that I would not presume to draw definite conclusions, yet the method seems worthy of

further trial; it is simple, and the after-treatment and dressings are reduced to a minimum; it has, in my hands, given more satisfactory results than can be obtained by other methods of treatment.

In 7 cases it was successful, the patients having left hospital with movement in the joint which was steadily improving. The last case, one of acute osteomyelitis of the tibia and pyaemic infection of the knee-joint, proved fatal from generalized pyaemic abscesses and pericarditis. *Post-mortem* examination of the knee-joint, two weeks after the operation, showed the joint structures to be healthy, and no pus was present in the joint, the acute condition having completely subsided.

Method of Procedure.

Operation should be immediately carried out when pathological examination of the fluid withdrawn from the joint shows that pus cells and pyogenic organisms are present.

Under general anaesthesia the knee-joint is opened by two lateral incisions, on either side of the patella. These extend from the head of the tibia to the upper limit of the subcrural pouch. A tourniquet may be used, or the bleeding points, which are numerous, may be caught in artery forceps; these forceps can be removed later, no ligatures being necessary.

The joint is then thoroughly irrigated with hot saline solution, by means of a Higginson's syringe. Every corner of the joint is explored with the nozzle of the syringe and the knee is flexed and extended to ensure thorough lavage. The irrigation should be continued for ten minutes. The synovial cavity is then dried with lint swabs soaked in ether and held in artery forceps. When this has been completed a small quantity of bipp is applied systematically to the articular surfaces and synovial membrane lining the joint. No sutures are used, the lateral incisions being left open for drainage.

About a dozen turns of broad gauze are then wrapped round the joint, plenty of wool and a firm bandage being applied over this. A strapping extension is fixed to the leg and the limb placed in a Thomas splint, with the knee slightly flexed. The patient is then returned to bed and a light weight applied to the extension.

The temperature usually falls about the third day and the patient's general condition rapidly improves. The dressing is not changed till the fourteenth day, when a fresh one is applied, a little bipp being at the same time rubbed over the lateral incisions. The acute symptoms have usually completely subsided by this time; the splint is now removed and the patient encouraged to move the joint. Massage accompanied by active and passive movements is carried out, and the patient should start walking, when the conditions permit, as early as possible. The dressing is changed about every seven days or as required.

The lateral incisions remain healthy and clean throughout, though it is usually several weeks before they are healed. Probably if secondary suture was adopted this stage might be considerably shortened.

CASE I.

C. D., a miner aged 21 years, was admitted to the Manchester Royal Infirmary on November 3rd, 1920. He stated that whilst working in the mine on October 27th he knocked his right knee against a sharp stone; the knee swelled up and he had been treating it at home. He was found to have a dirty ragged wound on the inner side of the knee, which opened into the joint, from which pus could be expressed. Bacteriological examination showed that streptococci were present. The temperature was 103° F. and the pulse 130.

The knee was treated on the lines described. The temperature fell to normal on the fourth day. When the wounds were dressed on the fourteenth day a small abscess was found in the calf; this was incised. The temperature remained normal throughout, and he was discharged from hospital on January 15th, 1921. The knee could then be flexed to a right angle, the joint was normal in size, and the wounds nearly healed. I have seen the man constantly since; he walks well and has a good range of movement in the knee-joint.

CASE II.

P. A., a butcher, aged 32 years, was admitted to the Royal Infirmary on September 27th, 1920, with a compound comminuted fracture of the right tibia and fibula, the result of a street accident. The wounds became badly infected, and several operations were performed on the leg. His progress was satisfactory till January 8th, when he suddenly had a rigor and the temperature reached 104° F. The rigors continued,

and his knee was then found to be swollen and acutely tender. Pathological examination of the joint fluid showed that pus cells and streptococci were present. The patient was continually asking for the leg to be amputated.

On January 12th it was decided to give the treatment above described a trial. This was carried out, and his condition rapidly improved, the temperature becoming normal on January 16th, and remaining so till his discharge. Several sequestra were subsequently removed from the site of the fracture. The Thomas splint was retained longer than usual owing to the condition of the fracture. He was discharged from hospital on February 24th. The patient now walks with a stick, and can flex his knee to a right angle.

CASE III.

A. R., a boy aged 11 years, was admitted to the Royal Infirmary on January 29th, 1920, with a dirty wound over the left knee-joint, the result of a fall some days earlier. The wound did not appear to communicate with the joint, and he was sent home on February 2nd.

He was readmitted to hospital on February 16th. The knee was painful and swollen, and his temperature was 103.6° F. X-ray examination showed no bony injury. The joint was aspirated on several occasions, and pus cells and staphylococci were found present. As the joint repeatedly filled up and his temperature reached 104° F. the procedure described was adopted. The temperature dropped slowly and his condition rapidly improved. He was discharged on March 24th, the wounds being healed. The knee-joint could be flexed about 45 degrees at that time. I have not seen the boy since that date.

CASE IV.

E. J., a boy aged 16 years, was admitted to the Royal Infirmary on February 3rd, 1921, suffering from acute osteomyelitis of the right tibia. Operation was carried out for this condition the same day, when the medullary cavity of the tibia was freely opened.

His progress continued satisfactory till March 1st, when the right knee-joint was found to be painful and swollen. Aspiration of the joint showed pus cells and streptococci to be present. The joint was therefore opened, washed out, and bipp applied, the limb being placed in a Thomas splint. The right elbow-joint also became involved and was treated on similar lines, lateral incisions being made either side of the olecranon.

A streptococcal vaccine was prepared from the pus by Dr. G. E. Loveday, and injections given at regular intervals. This additional treatment contributed in no small degree to the successful result of the case. His subsequent progress was satisfactory, both joints quickly cleared up, but the wound of the tibia continued discharging pus. He is still receiving hospital treatment for this condition, and massage to the affected joints, which are slowly improving.

CONCLUSIONS.

1. The insertion of drainage tubes into the knee-joint is not only unnecessary, but harmful in acute arthritis. If thorough irrigation with saline is carried out at an early stage, the synovial membrane lining the joint can safely overcome the septic infection aided by the application of bipp.

2. The joint cavity must be left open after the irrigation, otherwise the pus will reaccumulate under pressure, and, burrowing through the capsule, spread in the fascial planes.

3. Extension must be applied to the limb during the early stages to separate the articular surfaces and prevent erosion of the cartilages at the site of pressure.

4. Mobilization and massage must be instituted as soon as the stage of active inflammation has subsided, usually within fourteen days.

REFERENCES.

¹ Gray, *The Early Treatment of War Wounds*. ² *Lancet*, July 10th, 1920, p. 81.

THE RESULTS OF NINETY-EIGHT CASES OF NERVE SUTURE.

BY

PAUL G. DANE, M.D. MELB.

IN the *Medical Journal of Australia*, July 26th, 1919, I reported the results of my observations, extending over two years, on 63 cases of nerve suture, comprising 23 cases of suture of ulnar nerve, 14 of median, 12 of musculo-spiral, 13 of sciatic, and one case of musculo-cutaneous nerve of arm.

This number has been amplified since by the addition of other cases, and the original cases have been revised, so

that 98 cases of nerve suture are now presented, arranged in six series as follows:

1. Ulnar series ...	35 cases
2. Median series ...	20 "
3. Musculo-spiral series ...	15 "
4. Sciatic series ...	22 "
5. Musculo-cutaneous ...	1 "
6. Brachial plexus ...	5 "
	98 "

These cases are entirely unselected—they are taken seriatim from the card records of the Massage Department, No. 5 Australian General Hospital, Melbourne, and all are the result of gunshot wounds, and have been under observation for from twelve to thirty-six months.

The results of operative treatment on these various groups will now be given, and following that a more detailed study of them will be touched upon. On deciding as to recovery I have taken the amount of motor recovery as the standard, it being much more important from a practical standpoint, and much more easy to determine accurately and quickly than sensory return; but as a rule sensory recovery was more complete and earlier than return of motor power.

The groups of cases are divided into four classes: Perfect results; Good; Fair; and Bad results. Under the column "Perfect" are grouped cases that have gone on to full motor and sensory recovery, even though the muscular power be feeble, as it is in a great many cases; under "Good" are found cases where there has been a recovery of muscles subserving gross movements, such as the long flexors in the forearm or the gastrocnemius or tibialis anticus in the leg, but where the muscles subserving finer movements, such as the intrinsic muscles of the hand, have not recovered. In my former paper I also included under this group cases that had a probability of further recovery, but it is hardly necessary to do this now, as the cases have been under observation so much longer. In the group labelled "Fair" are cases that have recovered to a more limited extent, and under "Bad" are cases that have not recovered any function.

Table showing Results in 98 Cases of Nerve Suture.

Nerve.	Perfect.	Good.	Fair.	Bad.	Total.
Ulnar ...	8	12	3	12	35
Median ...	5	4	5	6	20
Musculo-spiral ...	5	3	3	4	15
Sciatic ...	6	4	2	10	22
Musculo-cutaneous ...	0	1	0	0	1
Brachial plexus ...	1	1	2	1	5
Total ...	25	25	15	33	98
Per cent. ...	25.5	25.5	15.3	33.6	

By this table it is seen that 25.5 per cent. of the cases have gone on to perfect recovery, whereas 49 per cent. (the last two groups) are practically failures, but if we add together the first two columns as constituting good results we get 51 per cent. of good results as against 49 per cent. of bad results. However, I do not think that we can regard the results purely in this manner, as each individual case must be considered by itself; for instance, in the "Perfect" group of 25 cases only 11 cases regained full motor power—by that I mean regained a perfectly useful limb of the same functional capacity as before the wound; in the majority of cases many of the muscles that regain movement remain weak and atrophic.

The explanation of this fact involves many factors, such as concomitant injury to blood vessels, other nerve trunks, sepsis, and improper pre-operative and post-operative treatment—probably more to this last factor than anything else.

A few of these points are now indicated:

Ulnar Nerve Series.—Sixteen cases had also an injury to the median nerve, and one of these had in addition the musculo-spiral severed. Three of these had also the main artery ligatured.

Median Nerve Series.—Nine of these had the ulnar nerve injured, and one had in addition the musculo-spiral nerve severed; one case had both main arterial trunks ligatured.