THE MANAGEMENT OF THE ACUTE SPINAL CORD INJURY

G. M. BEDBROOK, M.S., F.R.C.S., F.R.A.C.S.,
Perth

The planned management of acute injuries to the spinal column with neurological involvement, as seen in Royal Perth Hospital during the years 1954 to 1958, has led to the first civilian paraplegic unit in Australia. Although paraplegia from causes other than injury will not be discussed in this paper most of what follows applies to all types of paraplegia.

The last fourteen years have seen a great advance in the care of these patients, whose injury is one of the most severe to affect the human body without causing the immediate death of the person so affected. It has shown the tremendous advance which is possible with the help of ancillary medical services. It is now well established that only in a specialized unit can the best results be obtained; the patient will be better served by adequate transport over a thousand miles to a properly controlled and properly run centre than by being moved hastily to the nearest local hospital where only inadequate and certainly not specialized care can be given to the injured.

In Western Australia we are fortunate that there is complete support from the medical profession, so that all spinal cord injuries are transported to Royal Perth Hospital within a very short time of their accident.

Table 1 shows the number of cases in Western Australia between December, 1952 and May, 1958 with their causation.

FIRST AID

First aid given to these patients may be fundamental in saving their life. The principles on which first aid depends are:

1. The maintenance of a good respiratory airway. Many are unconscious and, if allowed to remain on their backs without proper care of the nasopharynx, they will suffocate. Many will be found in ditches. Adequate clearing of the airway by elevation of the mandible or by removing the obstruction is usually all that is necessary.

2. Proper management of the damaged spine. This is a problem which has been argued for many years. A patient when found in the supine position is better transported in the supine position, provided the airway is satisfactory. If he is found in the prone position, a decision will have to be made as to whether to leave him prone or to turn him into the supine position. If there is an obstructed airway then the prone position may be better but it should be borne in mind that there may also be a damaged costal cage. In this situation the prone position is contraindicated.

CLINICAL ASSESSMENT

The early clinical management of the patient inevitably implies a thorough, detailed clinical examination. It may seem unnecessary to emphasise this but unfortunately clinical examination is not always easy, particularly in the presence of extreme pain. However, the surgeon must gently but persuasively elicit all the symptoms and all the signs. This may take a long time but is of fundamental importance. A careful examination of each neurological segment in turn may indicate that there has been an initial sparing of neurological function. This fact alters the prognosis. Disappearance of the initial sparing with the onset of oedema is a worrying feature, but in most cases there is no indication to institute operative treatment either on such initial findings or on their worsening, unless sustained. The importance of accurate physical examination may be illustrated by the sparing of one sacral segment while the lumbar segments remain paralysed. Sacral sparing in these circumstances encourages the surgeon and the patient as it so greatly improves the

Footnote:
1 Read at the Seventh Biennial Congress of the Australian Physiotherapy Association, May, 1958.
MANAGEMENT OF ACUTE SPINAL CORD INJURY

TABLE 1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Traumatic: Acute</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>18</td>
<td>17</td>
<td>7</td>
<td>65</td>
</tr>
<tr>
<td>Traumatic: Late admission</td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Poliomyelitis</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>—</td>
<td>18</td>
</tr>
<tr>
<td>Secondary carcinoma</td>
<td>—</td>
<td>—</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Spinal cord tumours</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Miscellaneous (haemorrhage,</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>5</td>
<td>12</td>
<td>9</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>myelitis, spina bifida, spastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number: 1  6  14  30  44  40  15  150

Table 2

<table>
<thead>
<tr>
<th>Type</th>
<th>1952</th>
<th>1953</th>
<th>1954</th>
<th>1955</th>
<th>1956</th>
<th>1957</th>
<th>1958</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paraplegia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>Incomplete or below level of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LI with root escape</td>
<td>—</td>
<td>—</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>10</td>
<td>15</td>
<td>4</td>
<td>46</td>
</tr>
<tr>
<td>Quadruplegia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete</td>
<td>—</td>
<td>—</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>—</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>19</td>
<td>9</td>
<td>5</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Total number of cases</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>15</td>
<td>19</td>
<td>24</td>
<td>9</td>
<td>80</td>
</tr>
</tbody>
</table>

Number of patients complete with quadriplegia on admission who showed useful recovery 12 = 35%
Number of patients with complete paraplegia (above LI segment) on admission who showed useful recovery 2 = 4%
management; (d) dietary management; (e) occupational therapy management; (f) social management; (g) treatment of complications (bedsores and urinary problems). Throughout it is fundamental to remember that the patient's progress depends on proper daily management. It also depends on developing a proper psychological approach, both in the patient and his family.

**Surgical Management**

The surgical management of the acute paraplegic includes firstly, the proper assessment of the damage which has occurred; secondly, active measures which may be designed to relieve spinal cord damage and compression or to fix the spinal column.

The principal surgical management of these patients is conservative. In fact, when in doubt, operation is best not advised. The two problems, bony and muscular damage on one hand and neurological damage on the other, must always receive due consideration; of the two the latter is by far the more important. In the lumbar column the spinal canal is large and the proportion occupied by nerve tissue is small; in the thoracic column the spinal cord has not a great deal of room, while in the cervical column the cervical cord occupies the majority of the bony canal. There are three types of lesions possible: cord damage alone, root damage alone and various combinations of these.

**Indications for Surgical Interference**

1. To achieve proper reduction a fracture or fracture dislocation.
   (i) In the cervical column the accepted method is by Crutchfield forceps and traction; operation is rarely indicated and then only if this fails and if the patient's general condition will allow it.
   (ii) In the lumbar column, postural reduction of the dislocation or fracture is the accepted method, with operation reserved for those in which there is a failure of this method.
   (iii) In the thoracic column there is rarely any indication for surgery.

2. Major dislocations are an indication for open surgical reduction.

3. Incomplete paraplegia, which in spite of careful management progresses to complete paraplegia.

4. Paraplegia with no bony injury and with a spinal block.

5. Severe root pain.

The indications for internal fixation are more difficult to determine. Unstable fractures become stable very quickly. The writer feels that internal fixation of lumbar fractures is indicated only in the following circumstances: an unstable fracture, irreducible and likely to cause further cord damage, with no fractures of the spinous processes, but with considerable root pain. The diagnosis of compression of the spinal cord and/or spinal roots is a difficult one. It is commonly said that operation will allow spinal root recovery by removing compression, or that internal fixation guards already damaged tissues from further damage in turning and other necessary movements. These conditions are rare and the *erector spinae* muscles act as extremely good natural splints. Unfortunately records do exist of patients whose neurological lesions have been worsened by the injudicious use of operation. I have seen two, both of whom recovered. The original trauma of injury is much greater than that usually produced by any injudicious aftercare. The cord injury is maximal at the time of impact.

**Urological Management**

Patients admitted with spinal cord injuries have a bladder with a defective nerve supply. There are two major types, but intermediate forms are seen: (i) the "controlled reflex bladder", found only in patients with a severed, but intact spinal cord; (ii) an "automatic bladder", found in patients with cauda equina lesions with no spinal cord function. The latter depend entirely on intrinsic mechanisms for the proper emptying of the bladder. A normal human bladder has two important functions, that of storage and that of emptying. In the patient with injury to the spinal cord both these functions must receive attention. Immediately after injury retention of urine
MANAGEMENT OF ACUTE SPINAL CORD INJURY

...occurs, except perhaps in the very early stage of spinal shock, lasting for a few hours at most. The force of the detrusor is seriously diminished and the contracture and contraction of the bladder neck increases, particularly in cases with an isolated spinal cord. There are two important principles in treatment. Firstly, the bladder should be allowed to distend normally each day either by clipping off the catheter (Foley’s, number sixteen) or by removing the catheter if necessary. Secondly the resistance of the bladder neck should be diminished as time goes on, if necessary by transurethral resection, alcohol block or pudendal neurectomy. A poor detrusor may then be able to empty the bladder completely. I aim at the removal of the catheter as soon as possible for it is a potent cause of infection and reinfection of the bladder. Infection, however, occurs inevitably.

NURSING MANAGEMENT

The nursing of acute paraplegic patients is of great importance, for in their early management they need the most gentle handling. The fundamental principles are regular two-hourly turning, proper attention to position and a constant awareness of pressure sores and their prevention. Nursing has to be combined with the work of the physiotherapist; it is difficult to say where one responsibility ends and the other begins. Regular washing every two hours is unnecessary and twice daily sponging is all that is required, together with inspection at each turn. The proper turning technique requires at least three people, two orderlies and one nurse. The orderlies stand on one side of the bed, lift the patient across to their own side, rigidly in one piece, while the nurse makes the bed on the opposite side; the patient is then lifted up and turned on to his side or to his back. The important principle is that no rotation is allowed at the site of injury. Individual patients need individual posturing, but it is important that the extended position should be used and that no patient should be allowed to have any joint in a flexed position, particularly the feet (Figs. 1, 2 and 3).

Pressure Sores

Pressure sores are always preventible. In 65 acute cases treated in the unit only one serious pressure area developed and this after six weeks. There are two chief types of pressure sores, the superficial type, due to external pressure, and that due to underlying bursitis and infection with gangrene of overlying tissues. Pressure sores are major catastrophes in treatment. Their eradication depends on prevention by the above turning techniques, by removal of pressure and by treatment of anemia and malnutrition; in established cases surgical closure may be required.
Physiotherapy

The management of the paraplegic patient is a challenge to the physiotherapist; proper physiotherapy is of the greatest value to these very disabled people. The aims of physiotherapy are to strengthen and re-educate spared muscles and limbs, to mobilise them, to develop mechanisms of compensation and to assist in rehabilitation. Specific objectives include bed exercises and training in balance, in moving from bed to chair or toilet and vice versa, standing, walking (two-point swing-through, three-point and four-point) and in sports and the daily routine of living.

![Figure IV A paraplegic shown on a Stoke-Mandeville cycle](image)

The development of the upper extremities is of tremendous importance to the ultimate recovery of the patient, for on them depends the ability to walk and work. Therefore, one of the first positive approaches that physiotherapists can employ is the strengthening of the upper extremities.

There are many methods used in the treatment of paraplegia, some more valuable than others. The role of some of these methods may be summarized as follows.

1. Massage is important in mobilising scars, making scar tissue supple and improving the blood supply around ulcers.
2. Postural exercises improve the general mobility of the patient.
3. The use of ultraviolet light on pressure sores is controversial, but I do not believe that it has been proved helpful.
4. Infrared therapy too is condemned, unless used very carefully, for these patients burn easily. Electrotherapy may be of use in some circumstances.
5. Passive movements maintain joint mobility. The prevention of joint fixation is vital in the early management of paraplegia; the use of slings and class work have been developed at Shenton Park Annex for this purpose.
6. Respiratory exercises and the use of the cough machine are of some assistance in preventing bronchopneumonia and bronchial obstruction. We have developed a tilting table to assist patients with quadriplegia or high thoracic lesions in regaining the upright position, and thus learning to overcome some of the more difficult sympathetic reflexes.

Spasm

Spasm is usually found in the flexor groups and is only found where there has been a section of the cord, caused either by trauma or by infection.

Prevention. Spasm usually occurs only in shortened muscles and thus in the early stages the physiotherapist must aim to prevent muscle shortening, particularly of the flexor groups. Spasm occurs particularly in those patients who have been allowed to remain with joints in the flexed position. Adequate posturing in the early stages is an important step towards prevention.

Control. Control is achieved by gradually extending joints and by “wearing out” spasm by resisted activity. This is obtained by helping patients to stand in the extended
position for long periods and by encouraging proper posture at all times. In fact, if the physiotherapist can produce extensor spasm the patient will be much assisted. In 150 patients we have seen only two examples of extensor spasm and four of severe flexor spasms.

Surgical Management. Assistance in the management of spasm can be given by a number of procedures including tenotomy, neurectomy, myotomy, rhizotomy and alcohol block. Alcohol block is the ideal method of control for serious flexor spasm interfering with the life and treatment of individual patients.

Walking

Walking is therapeutically important because it gives psychological aid, prevents urinary complications, such as stone and severe infections, and assists in the development of adequate bladder function.

Walking may be of a number of types. Patients with low lumbar lesions will walk easily with four-point walking, whilst high thoracic lesions rarely progress past good two-point walking. The erect position alone is of great importance in the maintenance of good health.

Dietetic Treatment

The significance of dietetic treatment is indicated by the fact that in the early stages of spinal paralysis the body is in negative calcium, phosphate and nitrogen balance. Until mobilisation is obtained metabolic balance is not regained, and hence the importance of early mobilisation. In the past, paraplegic patients have been allowed to waste severely because of lack of attention to this physiological process. Estimation of the daily caloric requirement is made and this is given in some way. I prefer to see all patients with a minimum of 3,000 calories, the basic need for most patients being about 2,500. Mobilisation not only reverses the negative metabolic balance but it prevents infection and other complications. After mobilisation the caloric requirements increase because activities such as walking may mean that patient uses four times the amount of energy used by a normal person. We try to maintain a high protein, high calorie diet, with a moderate amount of calcium, in the early stages and later a high protein, high carbohydrate and high caloric diet.

Occupational Therapy

The aims of occupational therapy are to prevent despondency, to assist in recovery of muscles and limbs and at least to start occupational rehabilitation after vocational assessment. Specific objectives are to assist in normal living activities, particularly in quadriplegic patients, to find and give occupational interest, to start a specific project of work, preferably remunerative, in a workshop, or to begin training in a rehabilitation kitchen.

In the early stages the occupational therapist assists in daily living activities, and, in the quadriplegic patient, reading, writing and feeding with the patient in the recumbent position. Once the patient is out of bed, occupational therapy includes therapeutic activities; physiotherapist and occupational therapist must work together in achieving the physical recovery of muscle groups.

I was particularly impressed abroad with the development of occupational therapy departments in America and Canada, where looms, treadle saws, carpentry and metal work are well used. Ultimately occupational therapy helps in obtaining a position out of hospital.

Paraplegic patients must be taught something of how to prevent complications. Physiotherapists and occupational therapists can help in this regard.

Social Management

The social management of a person with paraplegia is an essential part of thorough medical treatment and rehabilitation. On admission, an almoner sees every patient and advises on any financial or domestic difficulties. In this way a common sense psychological approach is immediately started and major psychological difficulties may be prevented. The housewife injured in a motor accident knows that her children will be taken care of; the wage earner is
provided with some finance through ordinary social channels. Sometimes physiotherapists have discovered social problems for the almoner. The occupational therapist may be able to help in the eventual re-employment problem.

Rehabilitation is thus seen as a team matter and needs the co-operation of the doctor, nurse, almoner, physiotherapist and occupational therapist.

Employment problems are difficult. Gradually an awareness of the economic saving to the community by employing these people is being developed through employer and employee organizations. Already in Western Australia there are many employers of paraplegic personnel and much has been done by and through the Commonwealth Rehabilitation Service.

A final addition to the organization set up for the care of the paraplegic patients in Western Australia has been an outpatient and follow-up clinic, where the long term problems of paraplegia can be studied, where the urological problems can be dealt with efficiently and quickly, and where physiotherapy can be given if necessary.

What Has Been Achieved?

In the four years since the Paraplegic Unit has been established, over 150 patients have been treated. Of these, 80 suffered traumatic paraplegia, 11 of whom are dead. In two death was caused by renal complications, eight and fifteen years after onset; the remaining nine deaths were related to the initial severity of the lesion. Of those who survived (69 patients) 25 are still in hospital under active treatment; 26 of the remaining 44 are working and several others are undergoing vocational training.

The results indicate the possibilities. Although reasonable, they are not yet up to world standards. They give an indication that the future for patients with paraplegia and spinal injuries will be much brighter than in the past.