George M. Bedbrook

The Care and Management of Spinal Cord Injuries

Foreword by Robert W. Jackson

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Foreword

Spinal paralysis is probably the most devastating of all the illnesses that can befall man. Only a few years ago, 80% of spinal victims were dead within three years due to the complications that frequently accompany the condition. Today, the situation is quite different and 80% of spinal victims have a relatively normal life expectancy. The author of this book was one of the first to realize that if a paraplegic patient is carefully looked after in the early stages of his illness and if all of the potential complications are prevented, that individual can eventually recover sufficient function to live a productive and independent life. This basic concept underlies the modern approach to the treatment of spinal injuries.

My first contact with Sir George Bedbrook was in the field of sports for the disabled. Again, he was one of the first to realize that sport can be invaluable in the rehabilitation of a severely handicapped person. The physical benefits of participation in sport are quite obvious. Not so obvious, however, are the psychological benefits which are so important in the total rehabilitation of an injured person.

Sir George Bedbrook was knighted for his work in the field of paraplegia and is currently the President of the International Medical Society of Paraplegia. He has made many significant contributions, both in the initial treatment and in the later rehabilitation of spinal cord victims. He is a man who truly cares about people. He is superbly organized, meticulous in his planning, and energetic in his execution of goals. He demands and receives perfection from his staff. As a result, his Spinal Unit in Perth, Australia is one of the best treatment and rehabilitation centers in the world. His knowledge, from both the scientific and practical viewpoints, is truly staggering—a fact that is quite obvious from the details contained in this book.

It is an honour and a privilege to be asked to write the Foreword to such a definitive and comprehensive treatise on the subject of spinal paralysis. I believe this book will become a classic in its own time.

R.W. Jackson, M.D.
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President
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Preface

My purpose in writing this book is to describe the practical, day-to-day care and medical management of individuals with spinal paralysis. Emphasis is placed on the *team approach.* I have endeavored to strike a balance that will satisfy the needs of all medical and allied health professionals involved in the diagnosis, treatment, and rehabilitation of spinal paralytic patients, without devoting too much space to information that will not be useful to all the groups.

The epidemic of spinal paralysis is increasing internationally. Although the percentage of spinal paralytics in the total population remains small, this condition accounts for considerable human suffering and an unusually high expenditure of hospital time and resources. In the past decade, practical methods of management have considerably reduced both the duration of hospitalization and related costs. A chapter on the paraplegic in developing countries demonstrates that even with limited financial resources, improvement of care can be achieved.

I have included no theoretical discussions of the causes of spinal paralysis. However, some chapters, such as those on physiology and pathology, provide background that the reader can use both for solving practical problems and as a base of knowledge upon which he or she can build by further reading. Important references to the world literature are provided at the end of each chapter.

This book also does not describe sophisticated procedures for treating spinal injuries. All medical procedures may be applied to the paraplegic and the tetraplegic*; in fact, without all of them, rehabilitation is impossible. As medicine develops in general, rehabilitation of spinal paralytics becomes more practical. Each medical specialty can make its own contribution to the care of the disabled, and these contributions must be made if rehabilitation is to be adequate.

Therapy, particularly nursing and physical therapy, inevitably assumes the largest role in the book. All members of the medical team need to recognize that their involvement in this area must be steady and constant, requiring a major proportion of their time and effort.

Restoration is not new: It is as old as medicine and has been the aim and object of medicine from its earliest days. There is nothing magical about the care and management of paraplegics and tetraplegics—just hard work, which is time consuming and sometimes frustrating, but nevertheless successful and rewarding. It is hoped that the team approach presented here will promote maximum care from the onset of spinal paralysis for the rest of the patient's life.

*Even though *quadriplegic* is often used, the accepted international terminology is *tetraplegic,* which I have used in this book.

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This list shows the multidisciplinary specialty that the care of spinal paralysis has become, whereby experts in so many areas have given much to care programs. The overseas contributors have given freely of their time and expertise.

I would like to thank Dr. M. Kerr for her help in collating this manuscript and to my secretarial staff, Mrs. S. Masel, Miss S. Lamb, Mrs. L. Carroll and particularly Mrs. D. van Leen, my acknowledgement is thankfully given, whilst to Miss L. Cox, herself a contributor on nursing, goes my commendation. Without her efforts to get all the material collated, this book would not have reached the publisher.

Contents

1 Prevention of Spinal Paralysis: Emergency Management

Preventive Measures

If the present average of 24 patients with spinal paralysis per million population could be reduced to only 10 per million, the savings in suffering, manpower, time, and expense to the community would be tremendous. All who are involved in the acute and long-term treatment programs of the spinal paralytic patient need to be aware of the importance of preventive medicine. The following is a brief summary of the preventive measures aimed at reducing the number of paralytic patients.

Traumatic Paralysis

Because the majority of patients admitted to hospital with spinal paralysis have a history associated with a traumatic incident, the author feels that prevention must be emphasized at the beginning of the book, for it is evident that many cases of traumatic spinal paralysis are the results of avoidable circumstances. In the same way, nontraumatic paraplegia may be prevented by careful prophylactic medicine and conservative regular review of "normal." In 1977, the total weighted average expenses for a patient with spinal cord injury were $42,341 for the first year, $8,246 for the second year, and $6,358 for the third year (these figures represent all neurological categories, including tetraplegia).* Inflation and increased costs occur yearly. Apart from the devastating effects of trauma to the patient, the prevention of trauma is of great immediate financial benefit to the community whereas the long-term gain is inestimable. The expenditure on preventive programs of even 5%–10% of the amount necessary to run a 40-bed spinal paralysis service per annum would go far toward alleviating many cases of spinal paralysis. What then are the best methods available to halt this debilitating morbidity?

Seat-Belt Legislation. The introduction and enforcement of seat-belt legislation has resulted in a reduction in the death rate from motor vehicle accidents. Although there has been a significant drop in the number of deaths of vehicle occupants, there has also been an increase in cases of tetraplegia due to cervical injuries sustained when victims are trapped, usually in a "roll-over," whereby the neck is forced into extreme flexion. However, there is no doubt that seat belts remain an effective means of preventing severe motor vehicle trauma.

Mechanical Advances. Advances in motor vehicle engineering and design have proved that if the involved person can remain inside the vehicle, he stands a greater chance of not sustaining fractures of the spine with subsequent spinal paralysis. Safety doors and the construction of an appropriate frame for the body have been part of the program aimed at reducing accidents. Statistically, this reduction has not been great, but credit must be given to the engineers who designed what is certainly a satisfactory method of prevention. The failure of these methods must remain the responsibility of the users, in the same way as smallpox or diphtheria cannot be prevented without inoculation. Motorcyclists are a group at partic-

*Data supplied by the National Spinal Cord Injury Data Research Center in Phoenix, Arizona, U.S.A.

ular risk, because even with the use of well-designed crash helmets that prevent head injuries, cervical injuries can occur.

Publicity. Aggressive public-relation schemes that communicate clearly the adverse effects of motor vehicle accidents should help reduce the road toll. These can take the form of advertisements, films, lectures, and slide evenings, each of which is aimed at presenting the stark reality of injury.

Education. Education in the schools can help considerably in reducing spinal injury. Long-term effects of vehicular accidents resulting in spinal cord damage can be explained very effectively to older school children. Time spent by young people in spinal paralysis units as orderlies and as untrained personnel has far-reaching results. Children must be instructed in the correct method of crossing roads and using their bicycles. As they are taught to swim, they must be taught the hazards of surfing, swimming, and diving. Educational programs instigated by life-saving associations, road-safety councils, and similar organizations would be ideal.

School education can undoubtedly go a long way in the prevention of every sort of accident. Spinal injuries can also be caused by falls from horses, by people who do not take the proper precautions. An active program of adult education such as that implemented by safety councils should also reach a wide audience.

There is also a need for more active educational programs among the medical and paramedical professions. Trauma due to motor vehicle accidents has reached epidemic proportions, and the widest possible application of preventive principles is needed. Medicoancillary factions must be in the forefront. Many professional groups are involved, including, among others, engineers, road-safety control officers, administrators, and architects. All play an important part in the prevention of these severe conditions. The treatment of a patient after an accident that results in spinal paralysis may be termed successful, but total prevention of the accident should be the aim of society.

Stricter Vehicular Inspection. There is no question that vehicular inspection could result in fewer accidents. A regular inspection at the time of relicensing (at least every 2 or 3 years) results in fewer admissions to hospitals of patients with spinal paralysis.

Driver Fitness. A person's fitness to drive and his ability to use a motor vehicle safely are related to his psychologic, and often psychopathic, state as well as to his physical state at the moment of driving. A poor social history is often associated with motor vehicle accidents, and it is significant that only a small percentage of patients admitted to spinal paralysis units have had post-high-school education.

A driver's fitness may be related to (1) his physical fitness: whether he has cardiac, respiratory, spinal, or skeletal disease; (2) his psychologic fitness. This is an important aspect that in the future may be given a great deal more emphasis.

Driver selection with regard to age, capacity, and replacement of natural aggression with other activities (e.g., sporting and recreational activities) might help. It has been shown that in times of war, vehicular accidents are reduced to a minimum because the aggressive spirit of man finds an alternative outlet.

Weather Conditions. Weather conditions are important, particularly in winter in some countries. There are times when motor vehicles should not be on the roads unless it is absolutely necessary. However, this principle is difficult to enforce. All vehicular accidents can be minimized when fog, rain, snow, and ice, are bound to make driving extremely dangerous by reducing speeds and advising drivers not to drive. Ideally, the private motor vehicle driven by those with little experience should be warned not to travel.

Nontraumatic Paralysis

Prophylaxis. Nontraumatic spinal paralysis can be prevented to a great extent by good prophylactic programs and the early diagnosis of all conditions where paraplegia may occur, e.g., acute infections of the spine, spinal deformities associated with kyphos and congenital malformations of the cord. The correct estimation of deformities in children and child-care pro-

grams will prevent some patients from becoming paraplegic whereas better medical care of acute infections, e.g., tuberculosis, osteomyelitis, and brucellosis, will prevent others from becoming paraplegic. Careful and repeated medical examinations result in the early diagnosis of benign or malignant spinal cord tumors and make surgery worthwhile before there is neurologic damage.

Better Management. Accurate diagnosis and more thoughtful management of patients with acute spinal injury and other conditions of the spine, e.g., scoliosis, kyphoscoliosis, and careful, conservative management will certainly reduce the number of total and permanent tetraplegics. The procedure of laminectomy has a poor record (see Chap. 5), and many patients incompletely tetraplegic, operated on after acute trauma, have become completely tetraplegic or paraplegic.

Emergency Management and First Aid

First Aid

First aid to patients with fractures of the vertebral column, associated with neural disabilities, must be similar to first aid administered in any other illness or accident, i.e., with the aim of *preservation of life* and the *reduction of risk* to both patient and first aider. It is not unknown for the first-aid worker to be killed or injured while caring for patients in vehicular or industrial accidents. Movement of the patient from danger is important and should be done as gently and carefully as circumstances permit. It is important with motor vehicle accidents to place red discs, triangles, or warning lights at all danger points. The carrying of such warning signs is mandatory in some countries.

Once the patient's environmental safety has been ensured, there are only two reasons for sudden death: massive hemorrhage or asphyxia. Therefore, hemorrhage must be stopped and an airway established. Only then should the first aider attempt to assess the clinical situation, attend to transport, and prevent any further deterioration of the patient's condition. Clinically, the vital factor on which the totality of management depends is the level of consciousness of the patient. The diagnosis of a fractured spine with paraplegia or tetraplegia should not create any difficulty in the conscious patient because he is able to complain of pain, report the inability to move limbs or feel areas, and respond intelligently to questions. The first aider must learn to make a diagnosis in a systematic manner by (1) assessing the cardiovascular system and recognizing the presence of shock; (2) examining the motor-skeletal system by observation, palpation, and testing for movement and sensation; (3) examining the abdomen for presence of direct injury with or without pain; (4) noting any visceral incontinence that may indicate spinal cord damage.

Diagnosis of spinal column injury in the unconscious patient may be difficult, even beyond the capacity of a highly trained medical officer. It is only by observing one limb or body area moving with more ease than another, the restlessness of the patient with stillness of the lower and/or upper limbs, or the lack of response in the lightly unconscious patient to painful stimuli, that the first aider has some indication of spinal cord paralysis. However, if palpation is carried out along the length of the spinal column from the cervico-occipital junction to the lumbosacral junction, severe dislocation should be apparent. Most fractures and fracture dislocations causing spinal cord damage have some major physical signs that are obvious, for example, separation of the spinous processes. If trauma to the spine is suspected, every patient with possible neck injury should have cervical traction applied, if only temporarily, while he is *carefully turned with the trunk in one piece,* i.e., as a unit, for further clinical examination. Even then the diagnosis is difficult for an untrained person. *All unconscious patients should be suspected of having both a head and a cervical column injury until both have been excluded.*

Transportation

Once a spinal injury has been assessed, the next responsibility of the first aider is to arrange transport for the patient to a medical

center with all the necessary facilities, ideally a *Spinal Unit*. Treatment during transport should be directed toward (1) making the patient as comfortable as possible; (2) ensuring there are no sharp objects that will cause further trauma; (3) maintaining the lumbar and cervicodorsal spinal curve; (4) maintaining traction on the cervicodorsal injuries; (5) ensuring maintenance of an airway at all times, including turning the patient into a semiprone position if necessary; (6) the use of oxygen via a mask or nasal catheter in all spinal injuries.

Sometimes treatment depends on whether the first aider is working alone or with assistance. The single worker, on finding the unconscious patient, may have to decide whether he should leave the patient to obtain the necessary transportation or remain with him in the hope that transportation will become available. In this circumstance, a decision is not always easy. A clear head and calm thinking are needed to decide what is best for the patient. Conscious and semiconscious patients with no airway obstruction are undoubtedly most comfortably transported in the supine position, cushioned and protected from any further danger.

The unconscious patient and the patient with chest or abdominal injuries present a problem, particularly for those first aiders with insufficient assistance. Various schools of thought exist with regard to their management, but the decision must be qualified by the conscious state of the patient, as discussed previously; the presence of associated injuries, e.g., to the chest or other motor skeletal injuries; the number of assistants available to aid with transportation. If the patient is unconscious, in the absence of any medical equipment, the semiprone position should be adopted with the head supported in a fixed position and the airway unobstructed. On the other hand, if airways are available with mechanical suckers, oxygen therapy, and reliable assistants to use this equipment, the supine position should always be considered best. In all cases, if the patient needs to be turned, the first aider must not attempt to do this alone but should work with assistance to turn the patient in one motion, not allowing any rotatory movement to occur at the cervicodorsal or lumbodorsal junction that would cause further harm to an already damaged cord.

The best method of transporting the spinal patient has been a matter of considerable discussion so the problem should be approached with an attitude of common sense. Obviously a spinal patient trapped at the bottom of a mine shaft or in a narrow underground passage needs to be securely strapped to available rigid structures, such as poles or boards, if he is to make the hazardous journey to the surface safely. On the other hand, if the patient is found by the roadside, transportation can be effectively achieved on the Jordon Multilift Stretcher (Fig. 1.1), or if cervical injuries are suspected the Jordon Splint (Fig. 1.2) can be used.

The Jordon Multilift Stretcher enables the patient to be lifted as he lies without rolling or undue movement. The stretcher consists of a frame that is placed over the body, irrespective of where or how the person is lying. Specially designed flexible plastic gliders are slid under the body in whatever locations they are needed. They are dropped over special connections located on the frame. The gliders adjust themselves to the body contours and provide a safe, secure cradle. The frame and patient can then be lifted onto a portable stretcher for transfer into the ambulance.

The Jordon Splint consists of a shaped splint that follows the contour of the occipital area, the cervical spine, and the thoracic spine. It terminates at the lumbar region. The head

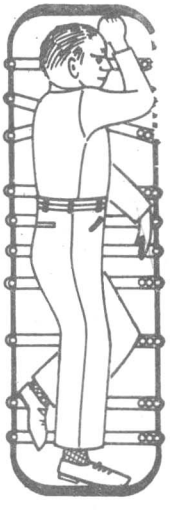

Fig. 1.1 The Jordon Multilift Stretcher.

Fig. 1.2 Jordon cervical Splint in position.

straps are placed across the forehead and under the chin. The third strap secures the splint at waist level.

There are so many variables in the acute situation that any rigid rule of management could prove incorrect in the final analysis. Most medical authorities now agree that patients with spinal injuries should not be transported in the fully prone position, except under extreme circumstances, i.e., when lack of space to move the patient safely away from the danger area prohibits any other method.

It is always advisable to commit a verbal request for transportation into writing if possible. The information should include the name and age of the patient, a tentative diagnosis, and a request for the type of transport preferably required, as well as more assistance if this is required.

Observation of Signs. During transportation, the first aider must observe the patient for various signs: (1) general color, particularly any increase in pallor and pulse rate; (2) onset of vomiting: If this does occur in patients in the supine position, the first aider must make certain that the airway is maintained and no vomitus is inhaled. If the patient is semiprone, vomitus is not likely to be inhaled, but in either case the first aider should not hesitate to remove dentures, hold the mouth open, and clean it with his finger to remove any solid pieces of vomitus that may cause untold harm in the obstruction of the bronchial tree; and (3) onset of restlessness. This is usually due to the gradual onset of physiologic shock with anoxia, but the cause may be pressure and pain from hard objects in clothing that have been overlooked, or increased pain due to a protruded disc.

Methods of Transport. An *ambulance* is the usual method of transportation from the site of the accident to the first medical center. In most Western countries, ambulance centers exist in all metropolitan areas and are organized in every country district. All ambulance officers are well trained in first aid.

Utility or station wagons and other vehicles can be rapidly converted to ambulance-type transportation by reducing the air in the tires to ensure even movement over heavy terrain and by making certain that the stretcher, improvised or not, is firmly attached to the floor of the vehicle. Under these circumstances, it may be difficult to give attention to the patient. The driver must not speed; in fact, there is an optimum speed of 50–65 km/h (30–40 mi/h) depending on the type of road.

Other types of transportation include aircraft, helicopters, trains, and motorboats, all of which can be used under specific conditions. Helicopters and other aircraft should always be considered in the transport of patients from areas inaccessible by road. In the Vietnamese and Korean Wars the helicopter proved to be a major vehicle of first-aid management, particularly for patients with spinal cord injuries. Unpressurized aircraft must fly at low altitudes (i.e., less than 10,000 feet), where little harm can come to patients even with spinal injuries combined with head injuries. Anoxia and asphyxia must always be guarded against in these special circumstances.

Treatment in an Emergency Center

When the patient first reaches a medical center, an initial, well-recorded, medical examination by a doctor is essential. In the presence of any vomiting or severe nausea, a