Spinal Cord Injuries

comprehensive management and research

Sir Ludwig Guttmann

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COMPREHENSIVE MANAGEMENT AND RESEARCH

BY

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THIS BOOK IS DEDICATED TO
THE MEMORY OF

Dr George Riddoch (1888-1947)

Neurologist, The London Hospital and the
National Hospital for Nervous Diseases.
Pioneer Advocate of Specialized Units
for the Treatment of Sufferers from
Spinal Cord Lesions

'. . . and the breath came into them, and they lived, and stood upon their feet, an exceeding great army.'

Ezekiel 37, 10

'You are the living demonstration of the marvels of the virtue of energy. . . . You have given a great example, which We would like to emphasize, because it can give a lead to all: You have shown what an energetic soul can achieve, in spite of apparently insurmountable obstacles imposed by the body.'

H.H. Pope John XXIII on the occasion of the 1960 International Stoke Mandeville Games in Rome

PREFACE

In 1950, I wrote a monograph on my experience on 570 spinal paraplegics and tetraplegics, of whom 458 were traumatic lesions, mainly war casualties, treated at the National Spinal Injuries Centre, Stoke Mandeville Hospital in Aylesbury, since its inception on 1 February 1944. This monograph, published in 1953 in Volume Surgery of the British Medical History of the Second World War, laid down the principles of a synthesis between all clinical procedures and measures of social and professional rehabilitation in a subject which, throughout all ages, had been considered as one of the most depressing and neglected in medicine: Spinal Paraplegia.

The idea of giving spinal cord sufferers a comprehensive treatment and care from the start and throughout all stages is now more and more universally recognized, as against the customary approach of fragmentation of the initial and early treatment of these patients from their social rehabilitation, erroneously called 'Third Phase' of management. In this respect, the congregation of paraplegics and tetraplegics in Spinal Centres under the care of a specialized staff has proved beyond all doubt to be the best basis for such comprehensive management of these most severely disabled victims of accidents and disease, and consequently the idea of setting up of Spinal Injuries Centres, originated during World War II in Great Britain, is now spreading all over the world.

New and significant disclosures have been made in our research throughout the many years since that monograph was published, which were applied in the practical management of the spinal man, and the consequence was a steady stream of publications by myself and my co-workers on numerous aspects of that complex multidisciplinary speciality of medicine, surgery and social science.

One can point to progress in many directions, but some of the more outstanding may be mentioned here: the participation of the isolated cord through co-ordinated reflexes in the restoration and maintenance of the upright position of the paralysed, reorientation of postural and vasomotor control by special methods, prevention and treatment of pressure sores and infection of the urinary tract in the immediate and later stages, restoration of the respiratory function in tetraplegics and a new approach to the sexual problems. Our findings of the highly significant role played by autonomic mechanisms, especially the cardio-vascular system, in the function of the organism below and above the transection of the spinal cord have opened new vistas into future research. Ways have been revealed in which the dysfunction of internal organs in the paralysed part of the body excite abnormal discharge of the various components of the autonomic system and also how the autonomic hyperreflexia can be controlled and avoided. In the psycho-

logical readjustment of the paralysed the introduction of sport and vocational training of the paralysed have proved invaluable for their social re-integration into community life.

This book is the product of about 30 years' personal experience of more than 4,000 paraplegics and tetraplegics treated at Stoke Mandeville. In this work, my previous research on neurophysiological and clinical problems since 1923 in Breslau and from 1939–43 in Oxford has helped me immensely towards the understanding of the many aspects of the physiology and pathology in spinal man.

It was not the purpose of this book to describe in detail all the various surgical and other procedures employed as these can easily be obtained from existing specialized text books, but rather to evaluate the most debatable procedures carried out on traumatic paraplegics and tetraplegics. Therefore, only certain specific procedures introduced at Stoke Mandeville have been described in detail.

In planning this book, special attention had to be paid to the details of the multifarious and diverse physical and psychological effects which spinal injuries exert on the organism. Therefore, all these aspects had to be organized and moulded into an homogeneous and meaningful pattern.

While this book gives an account of my own concept of comprehensive management of paraplegics and tetraplegics, the experiences and publications of other workers in this field are widely mentioned and discussed in relation to our own experiences.

I recognize that no book on paraplegia can be complete or perfect, but I trust that this book will be of interest and guidance to everyone concerned with the treatment and social readjustment of spinal paraplegics and tetraplegics.

I have been most fortunate in having a team of enthusiastic, loyal and hard working medical and para-medical co-workers and many volunteers with me throughout the years. Various research projects have been carried out co-operatively with some of my medical colleagues, mentioned individually in the text of this book, and my gratitude to them is deeply felt. I am equally grateful to those colleagues of this and other hospitals as well as to members of the Department of Physiology in Oxford, who co-operated in carrying out special techniques in which they were experts.

The development of the Stoke Mandeville Spinal Centre to its national status would not have been possible without the co-operation of the various administrative authorities concerned and I would like to place my sincere appreciation to them on record.

To Else, my wife, I am deeply grateful for her enduring patience, encouragement and active help in my work.

I had the good fortune to have Joan Scruton as lay administrator of the National Spinal Injuries Centre at my side from the beginning of my work, who, with her calm efficiency and loyalty, shared a great deal of the administrative burden with me. She and Kate Lambrechts have been of indispensable help in preparing the manuscript in its various stages, and I owe much to their devotion and accurate work.

I am also very appreciative of the excellent work of our photographers, Arthur Riddle and, in particular, Derek Standen, who have been responsible for most of the illustrations in this book.

Last, but by no means least, my warmest thanks are due to the publishers of this book, Blackwell Scientific Publications, for their understanding and great trouble they have taken to comply with my wishes.

Ludwig Guttmann

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CHAPTER 1

HISTORICAL BACKGROUND

Of the many forms of disability which can beset mankind, a severe injury or disease of the spinal cord undoubtedly constitutes one of the most devastating calamities in human life. This is readily understood if one realizes the paramount physiological importance of the spinal cord not only as the main transmitter of all impulses and messages from the brain to all parts of the body and vice versa but also as a nerve centre in its own right, controlling vital functions such as voluntary movements, posture, bladder, bowel, and sexual functions, as well as respiration, heat regulation, and blood circulation. Therefore, a severance or severe injury of the spinal cord, whether caused by trauma or disease, always results in a disablement of great magnitude from the site of the lesion downwards.

It is obvious that such an affliction has always aroused medical interest, and references to spinal cord injuries have already been found in records from very early periods of civilization. The Edwin Smith Surgical Papyrus, written about 5,000 years ago by an Egyptian physician (translated by the famous Egyptologist, Dr Breasted), contains a clear description of the cardinal symptoms of a complete lesion of the cervical cord, following dislocation or fracture of the spine: paralysis of all four extremities, complete sensory loss, loss of bladder control, priapism, and involuntary seminal ejaculations. Reference is even made to conjunctival congestion—today recognized as the result of vasodilatation due to paralysis of the vasomotor control in these high lesions. In discussing the prognosis and therapy of such patients (cases 31 and 33 of the Papyrus), the comment of the unknown author is as brief as it is significant: 'an ailment not to be treated'. It is not known whether this ancient author has generalized his defeatist attitude to spinal cord lesions at any level, but it cannot be denied that the sentiments thus expressed have prevailed throughout thousands of years amongst most members of the medical profession in all countries, towards sufferers from severe lesions of the spinal cord.

Medical history is very sketchy between the Egyptian and Greek periods. Homer made reference in the tenth chapter of the *Odyssey* to Elpenor, the youngest of Odysseus's companions, who, having got drunk and longing for fresh air, slept on the roof of Circe's house. Roused in the morning by the bustle of his companions' departure, he leapt up suddenly and, forgetting the right way down, toppled headlong from the roof, breaking his neck, 'and his soul went down to Hades'.

Hippocrates, about 400 BC, in the chapter *περὶ τῶν ἐντοσ παθῶν* describing chronic paraplegia, mentions constipation and dysuria, as well as oedema of the lower limbs and

bedsores, as complications of paraplegia. It is interesting to note that he already advocates a large intake of fluid and a special diet for these patients, consisting of four to nine pints of milk, preferably from an ass, combined with honey, and he also recommends a special mild white wine from Mendes in Egypt. Hippocrates also introduced various methods of reduction of deformities of the spine by traction, and his famous extension bench—better known, through the work of Aulus Cornelius Celsus, as scamnum—was employed in various modifications by physicians throughout the centuries to reduce fractures as well as other deformities of the spine by forceful and brisk procedures. They

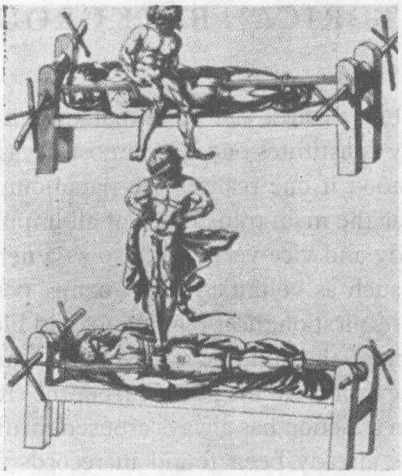

FIG. 1. Vidus Vidius manuscript, Bibliotheque Nationale, Paris.

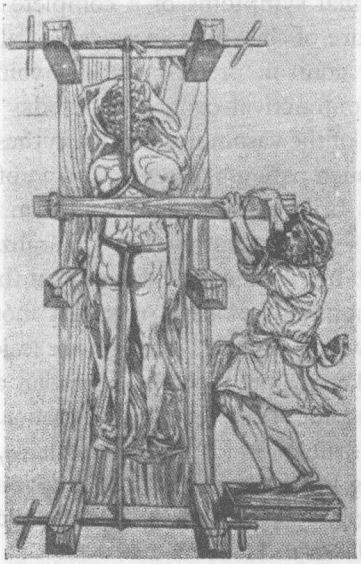

FIG. 2. De Machinamentis (Oribasius). In: Vidus Vidius: Chirurgia, è Graeco in Latinum connersa, Paris 1544.

were described by Oribasius (324–400) and Paulus of Aegina (625–690), and Figs. 1 and 2 are illustrations of the technique employed, as published in *Chirurgia, è Graeco in Latinum connersa* (Paris 1544), by Vidus Vidius. The victim, lying on a bench in prone position, was pulled extended from the shoulder upwards and distally from the hips, while the medical attendant either stood or sat on the gibbus, or a cross-bar was pressed onto the gibbus until it disappeared. Avicenna (980–1037), while following Paulus of Aegina's treatment for dislocation of the thoraco-lumbar spine, reduced the cervical spine by extension in supine position followed by fixation of the neck through splints. It was Roland of Parma, professor at Salerno, who, in his *Chirurgia* (1210), discarded the use of Hippocrates' bench and used manual extension only. For dislocation of the thoraco-

FIG. 3. Calot's method of manual reduction

lumbar spine, the patient was placed in supine position and the medical attendant pulled on his legs, while an assistant held the upper part of the body. For the reduction of the cervical spine, the patient was placed in sitting position, the physician braced his feet on the patient's shoulders and pulled his head briskly with a folded cloth passed underneath his chin. However, the famous French surgeon, Ambroise Paré, in his *Dix-Livres de Chirurgie* (1564), reverted to Hippocrates' extension method in prone position but used it with greater caution by reducing the fracture of dislocation by manual pressure and immobilizing the vertebral column after reduction by splints or specially designed lead plates. The patient was then turned on his back and kept in that position for a long time. This extension technique in prone position with manual reduction of the vertebral fracture or dislocation was still used in the nineteenth century by Jean Francis Calot, manipulating the spinal deformity with his fists (Fig. 3). I myself witnessed this method

even in 1917, when, before taking up medicine, I worked as an orderly in the Accident Hospital for Coalminers (Knappschaftslazarett) in my home town of Königshütte in Upper Silesia, Germany, now Chorzow, Poland. It was executed by the surgeon in charge, Dr Hartmann, in a case of fracture-dislocation of the thoraco-lumbar junction of the spine. The only difference between his and Paré-Calot's technique was that the patient was held in the air in supine position by two assistants extending the patient under the armpits and two extending the pelvis and legs, while the surgeon reduced the dislocation by forceful manipulation with his fists from below. After this procedure, the patient was put in a plaster cast. He died four weeks later from sepsis and cachexy as a result of urinary infection and multiple pressure sores.

Surgical intervention in spinal injuries and operations on the spinal cord have been discussed and described long before the modern principles of asepsis were discovered. Amongst authors of ancient times, Galen, 131, may be mentioned, who reported about experiments on the effect of longitudinal and transverse incisions of the spinal cord. He found that, whilst a longitudinal incision in the cord had no demonstrable effect on function, transverse incision resulted in paralysis of the body below the level of the lesion. Paulus of Aegina, who modified Hippocrates' method of traction for vertebral dislocations by external fixation of the reduced spine by a thin sheet of wood fixed along the spine extending above and below the site of injury, can also be considered as the originator of decompressive laminectomy and he also advocated removal of a fractured spinous process causing pain. Antrine Louis (1762) successfully removed a bullet lodged in the spine.

An important contribution at the end of the eighteenth century to the subject of traumatic paraplegia, as a result of a fracture-dislocation of the 12th thoracic vertebra, is the treatise of the German surgeon, J.Sömmering (1793): *Bemerkungen über Verrenkung und Bruch des Rückgraths*. In 1814, Henry Cline, a London surgeon, carried out a laminectomy, but the patient died nine days later. It was in this first quarter of the nineteenth century that arguments on indication and value of this operation were widely discussed amongst leading members of the medical profession, and the management of spinal injuries became a topic of real interest in England and other countries.

Throughout the nineteenth century, the general tendency in the treatment of spinal cord injuries was to be conservative, and leading neurologists and surgeons threw the weight of their authority against surgical treatment. There were a few prominent supporters of operative treatment, such as Astley Cooper (1827), but, on the whole, Charles Bell's view (1824)—'laying a patient upon his belly and by incisions laying bare the bones of the spine, breaking up these bones and exposing the spinal marrow itself, exceeds all belief'—was widely accepted. One of the famous personalities in British history of that time, Lord Nelson, was one of the victims of a spinal cord injury, as a result of a gunshot wound during the battle of Trafalgar, when the bullet, after penetrating the chest, lodged in the thoracic spine, producing a paraplegia below the breast. The final scene in Nelson's life was recorded by Beatty, the ship's surgeon, and has been described in detail in Oliver Warner's book *Trafalgar*, from which the following is quoted: 'Mr Beatty was called by Dr Scott to Nelson, who said—"Ah, Mr Beatty! I have sent for you to say what I forgot to tell you before, that all power of motion and feeling below my

chest are gone: and you very well know I can live but a short time . . . . You know I am gone". The surgeon's reply was: "My Lord, unhappily for our Country, nothing can be done for you." ' Nelson died within a few hours. It is also of historical interest that, on 2 July 1881, the 20th President of the United States of America, James A.Garfield, became a victim of a spinal injury as a result of a gunshot injury resulting in an incomplete conus-cauda lesion, and died 79 days later. The Museum of the Armed Forces Institute of Pathology in Washington has preserved the specimen of President Garfield's shattered vertebrae. There is another vertebral specimen on show in the same Museum —namely, the upper cervical vertebrae of John Wilkes Booth, who made history as the murderer of President Abraham Lincoln and who received a bullet wound through the cervical cord. Recently (1972) Governor George Wallace of Alabama became a victim of a spinal cord injury, following a gunshot wound during his election campaign. He survived but is still chairbound.

The great developments in surgery in the Listerian period, Pasteur's work on bacteriology, the introduction of ether anaesthesia, and later the discovery of X-ray by Röentgen have, no doubt, modified the extreme conservative view, and the field of spinal cord surgery has steadily been extended. However, the prognostic outlook of sufferers from severe lesion of the spinal cord has remained extremely poor, and the mortality rate in both peace and war has been very high. The hopeless frame of mind, held even by experts, has been appropriately summarized by Wagner & Stolper (1898) on page 576 of their book: *Die Verletzungen der Wirbelsäule und des Rückenmarks* (the injuries of the spine and spinal cord), a book which up to the First World War was considered as a standard work on the subject of spinal injuries. Their views are expressed as follows: In complete lesions it is the physician's forlorn task, even while knowing that the patient is approaching an early death, to keep him alive for weeks and months on end, only to see him wretchedly fade away, despite all skill and efforts.

In the Balkan wars, the mortality rate after spinal cord injury was over 95 per cent, and recollections of casualties with spinal cord injuries from the First World War and the after-war period have also left depressing memories of hopelessness and helplessness. The literature of that time in every country, though containing many excellent publications on problems of pathology and physiology, reveals a profound defeatist attitude of the medical profession towards these unfortunate sufferers, when dealing with the problem of prognosis and rehabilitation.

Harvey Cushing, the world famous neuro-surgeon and Consultant in Neurosurgery to the American Army during the First World War, gave in 1927 a vivid description of the pitiful fate of battle casualties with spinal cord injuries, 80 per cent of whom died in the first two weeks. 'The conditions were such', he wrote 'owing to pressure of work, as to make it almost impossible to give these unfortunate men the care their conditions required. No water beds were available, and each case demands undivided attention of a nurse trained in the care of paraplegics. Only those cases survived in which the spinal lesion was a partial one.'

The mortality rate of traumatic paraplegics in the British Army was similar. The early mortality (death within the first few weeks or months) varied from 47 to 65 per cent (Vellacott & Webb-Joynson, 1919), and the overall mortality after three years was

estimated at 80 per cent (Thompson-Walker, 1937). Most of those men who managed to survive dragged out their lives as useless and hopeless cripples, unemployable and unwanted. They were doomed to spend the rest of their lives as pensioners at home or in institutions, dependent on other people's assistance and, as a rule, with no incentive or encouragement to return to a useful life. On the contrary, the existing legislation and regulations regarding war pensions or workmen's compensation made it quite impossible for these 100 per cent disabled men to return to remunerative employment, for fear of losing their pensions and compensation. Indeed, until the Disabled Persons' Act (1944) was passed in this country, society still adhered to the ancient Greek conception, as recorded in Lysias' oration *περὶ τοῦ ἀδυνάτου* (about 400 BC), that 100 per cent disablement excluded a cripple from remunerative work.

In the inter-war period and even during the Second World War, the defeatist attitude of most members of the medical profession in this and other countries was still prevalent, and the general attitude of despondency is revealed in the report of the Medical Research Council of 1924: 'the paraplegic patient may live for a few years in a state of more or less ill-health'. Martin (1947) aptly summed up the unsatisfactory situation as follows: 'The record attained in World War I is not a very enviable one and it is quite apparent that the methods of treatment of traumatic paraplegia were not improved by the rich experience of that War.' Gowland (1934, 1941) gave the following account of the conditions of traumatic paraplegics from the First World War treated at the Star and Garter Home, founded after the First World War in Richmond, Surrey, for disabled ex-servicemen—'Two or three times a week, the patient is bathed: this means he must be lifted from his bed to his ward chair and wheeled into the bathroom, where his pyjamas and nightclothes are removed, and he is placed in a very warm bath and washed by an orderly.' In discussing the problem of painful, reflex spasms and contractures, he points out: 'The position is often terrible. I suppose there is more morphia, atropine and hyoscine used in this Home, which I look after, than in any other place of the same size in the country'. To quote further statements of this author: 'When the vertebral lesion had consolidated—say some eight to twelve months after injury—it is well to encourage the paraplegic to sit up and get about in a wheelchair or hand-propelled or motor tricycle.' Such views which reflect very well the conception held generally, in these years, that nothing or very little could be done for these unfortunate people, was hardly designed to encourage the paramedical professions—nurses, physiotherapists, occupational therapists and society at large, in particular the Ministry of Labour and employers—to help these men to return to a useful life and employment. These victims of war, road and industrial accidents did not establish a social problem as, in the vast majority of cases, their life expectancy was very short, as a rule 2–3 years to the utmost, as a result of sepsis from infection of bladder and kidneys on the one hand and pressure sores on the other —complications which were considered inevitable. Therefore, any attempt to restore such a person to his former social activities seemed to be out of the question and the view generally held was the sooner he died the better for all concerned. It is, therefore, not surprising that, in all discussions on rehabilitation during the years 1939–42, the subject of rehabilitation of victims of spinal paraplegia was hardly mentioned in spite of the fact that the modern principles of rehabilitation had been successfully applied for a