The history of spinal cord injury is a long one, dating back to ancient Egypt. Five thousand years of recorded history reveal the chronicles of those who labored to care for victims of this catastrophic injury. In this chapter, advances in the care of spinal cord injury are related in chronological order, from ancient times to the present. In addition, special attention is paid to subjects such as surgery, rehabilitation, education, and spinal cord regeneration. Although medical advances have benefited patients who suffer from spinal cord disorders, as well as those who have sustained spinal cord injury, the history of spinal cord disorders is outside of the scope of this chapter.

ANCIENT EGYPT

The Edwin Smith papyrus, which dates to 3,000 to 2,500 years B.C. is the most authentic document in ancient Egypt. It was written by an Egyptian physician, most likely Imhotep (Figure 1.1), and later translated by the famous Egyptologist, Dr. James Breasted of Chicago University (1,2,3). It contains accurate descriptions of complete injuries of the cervical spinal cord, as well as the observation that the best treatment for the injured vertebrae is rest and support (Figures 1.2, 1.3). Descriptions of spinal cord injury are found in cases 29–33 and 48 of this ancient record. Case 31 states:

If thou examinest a man having a dislocation in a vertebra of his neck, shouldst thou find him unconscious of his two arms and his two legs on account of it (and) urine drips from his member without his knowing it, his flesh has received wind, his two eyes are bloodshot: it is a dislocation of a vertebra of his neck extending to his backbone, which cause him to be unconscious of his two arms and his two legs. If, however, the middle vertebra of the neck is dislocated, has an emissio seminis which befalls his phallus, thou shouldst say concerning him, ‘one having dislocation of vertebra of his neck while he is unconscious of his two legs and his two arms and his urine dribbles, “an ailment not to be treated [cured].”

Case 33 is very similar. These cases describe the cardinal symptoms of complete cervical cord injury secondary to fracture of the cervical spine: tetraplegia, complete sensory loss, urinary incontinence, priapism, involuntary ejaculation, and conjunctival congestion caused by the loss of vasomotor control.

The Egyptians did not attempt surgical intervention for spinal cord injury, although they did reduce fractures and perform surgical decompression following skull fractures. They used bronze catheters for urinary drainage, and described pressure ulcers.
ANCIENT INDIA

The *Sushruta Samhita* (4), written in India during the third or fourth century A.D., describes the treatment of spinal injury. The care of cervical dislocations involved manipulative reduction, bandages, splints, and bed rest. Fractures of the lower spine were treated by immobilization; the patient was placed on a board and tied down by ropes to five pegs. The authors of the *Sushruta* did not believe that spinal fractures were curable.

Vaidya (400 B.C.) distinguished different types of ulcers using clinical examination and auscultation (5).

ANCIENT GREECE

Fragmentary records describe the contribution of the ancient Greeks to spinal cord medicine. Aesculapius, god of medicine, was believed to be the son of Apollo, god of the sun. The religious cult of Aesculapius took the place of scientific medicine. Hippocrates (460–370 B.C.) (Figure 1.4) disassociated medicine from religion, and brought Greek medicine to its highest achievement (6).

His travels in Greece and Egypt greatly affected his medical advancements. He created a method called *succession on a ladder*, as well as other methods of traction, for the treatment of spinal cord injuries. He also described paraplegia with bowel and bladder dysfunction, pressure ulcers, gibbosity at different levels, and paralysis accompanied by cold abscess (Pott’s disease). Indicating that traumatic gibbosity is not correctable, he stated “wherefore succession on a ladder has never straightened anybody, as far as I know, it is principally practiced by those physicians who seek to astonish the mob... But the physicians who follow such practice, as far as I have known them, are all stupid.” In *Anatomy of the Spine*, Hippocrates mentioned details of articulation, nerves and vessels, sheaths of the spinal marrow (cord), ligaments and muscles. In regard to spinal injuries, he states:

In cases of displacement backward along the vertebrae, it does not often happen, in fact, it is rare that one or more vertebrae are torn from one another and displaced. For such injuries do not readily occur; as a spine could not easily be displaced backward but by a severe injury on the fore part through the belly (which would prove fatal) or if a person falls from height and...
should pitch on the nates or the shoulders (and even in this case he would die, but not immediately). The spinal marrow would suffer, if from displacement of a vertebra it were to be bent, even to a small extent, for the displaced vertebra would compress the spinal marrow, producing insensitivity of many great and important organs and many other ill consequences of a serious nature.

He condemned the open reduction of such cases, and favored spontaneous callus formation. He mentioned that displacement of vertebrae forward is mostly fatal. If it is not fatal, the patient loses the power of his legs and arms (tetraplegia), and has torpor of the body and retention of urine. He introduced the extension bench and other methods for the reduction of deformities, particularly gibbous. Hippocrates did not distinguish between paralysis caused by trauma or disease and considered treatment to be the same for either of them.

Hippocrates recommended keeping ulcers dry and exposed to the air, except when wine or a cataplasm is applied. He used juices, honey, vinegar, oil, lead, alum, lotus, and many other topical applications on decubiti. He recommended wound irrigation with clean water or boiled river water. Celsus advised cleaning with vinegar and suturing small ulcers with women's hair. Greek medicine, especially from the school of Alexandria, influenced and was succeeded by Roman medicine.

ANCIENT ROME

In the first century A.D., Aulus Cornelius Celsus, in his treatise *De Medicina*, included a brief discussion on spinal cord injuries, especially fractures of the spinous processes. For incomplete spinal cord lesions, he recommended Hippocrates' method of traction for vertebral dislocations. In complete spinal cord lesions, death usually ensued.

Galen (131–201 A.D.) (9), who practiced in second-century Rome, was a physician to Marcus Aurelius. He followed Hippocratic methods, adding very few new techniques to medical treatments, but as a founder of experimental physiology, he wrote over 400 separate treatises. Not only did he describe the anatomy of the brain, but also that of the spinal cord and the brachial and lumbar sacral plexuses. In addition, he anticipated Brown–Sequard's hemisection. He described injuries of the first
INTRODUCTION

and second cervical vertebrae, stating that they are fatal, and that respiration stops with injuries at the third or fourth vertebrae. He also described other lower-level injuries. Galen believed that evacuation of the bladder was accomplished by contraction of the abdominal muscles, and eminent scholars such as Vesalius and Albrecht von Haller promulgated this doctrine for centuries.

Oribasius (10) was born in Greece in the fourth century (324–400). He later went to Rome at the invitation of the Emperor Julian, who requested that Oribasius compile his knowledge of Greek medicine. While in Rome, he modified the Hippocratic table to correct spinal deformity using forceful and brisk procedures.

Paul of Aegina (625–690) (11), also a Greco-Roman, compiled several books. Book VI described Hippocrates’ technique for treating spinal injuries and in addition advised postreduction spinal splinting for the treatment of dislocations. He is considered the originator of laminectomy for spinal cord decompression and the removal of the offending bony fragments.

These discoveries and advancements influenced later civilizations, just as Greek civilization had influenced that of Rome.

THE MIDDLE AGES (700–1400 A.D.)

With the gradual infiltration of the Roman Empire by barbarian tribes, science was replaced by superstition and intellectual stagnation. During this time, Jewish medicine may have been the only type of medicine practiced (12). In the seventh century, with the rise of Arabic and Islamic civilizations, many works were translated from the Greek, Latin, Persian, and Hindu languages into Arabic. Avicenna (980–1037) (Figure 1.5), a Persian physician, translated and made contributions of his own (13,14). During his life, he compiled about one hundred books, the most comprehensive of which is the Canon of Medicine, in five volumes. This book was translated into Latin and was the main reference used in European schools for almost six centuries.

In relation to spinal injuries, Avicenna followed the method of Paul of Aegina. To reduce dislocations of the thoracolumbar spine, the physician placed the patient in the prone position and stood with his heels on the gibbosity. To reduce dislocations of the cervical spine, the patient was placed in the supine position and neck extension was followed by splint fixation. The Arab physician Moses Maimonides (Figure 1.6) wrote on diet, hygiene, and toxicology (15). He practiced in Cairo and followed Avicenna’s system. His book, published in 1199, mentioned paraplegia as well as some neurologic signs. Another Arab physician, Albucasis, recommended removal of bone fragments from the spinal canal.

Western medicine at this time was very primitive. Medicine was practiced not by physicians, but by monks who used religious rites, herbs, salts, and brews to cure disease. Although there are many references to the medical remedies of the time, there is nothing recorded about spinal cord medicine.

THE EARLY RENAISSANCE

By the thirteenth century, the school of Salerno brought European medicine out of the Dark Ages. Constantinus Africanus (16) learned the Arabic language and practiced Greco-Arabic medicine. Roland of Parma wrote his book, Chirurgia, (17) in Salerno in 1210. He discarded the use of Hippocrates’ bench and used new methods for spinal cord injuries. For cervical dislocations, the patient was placed in the sitting position and reduction was effected by traction applied to the hair or by a cloth sling under the jaw. For thoracic and lumbar dislocations, the patient was placed in the supine position and the physician exerted traction...
traction on the legs, with countertraction applied to the upper half of the body by an assistant. During this time, several famous authors in France and Italy published whole books on spinal cord medicine. A gradual transition from the Latin and Greek languages to the French and English languages paralleled the development of science, mathematics, and philosophy in Western Europe.

THE LATER RENAISSANCE

Paul of Aegina’s book (18), written in 1465, recommended a process for the reduction of a spinal fracture. While the physician exerts direct pressure at the fracture site, traction is applied to the upper extremities by one assistant, and to the lower extremities by another.

Ambroise Paré was a progressive surgeon who wrote the Ten Books of Surgery (Dix Livres de Chirurgie) 1564 (19). As a barber-surgeon, he joined the army, and advanced to be the chief army surgeon to four successive kings. He adopted and modified the Hippocratic technique of fracture reduction by placing the patient in the prone position. However, he cautioned against causing more damage through manipulation. The spine was immobilized by lead splints, and the patient remained in bed in the supine position for a lengthy period of time. Paré also went back to the work of Paul of Aegina, reviving laminectomy for fractures causing cord compression. For fractures of the spinous process, he only recommended the removal of bony fragments if the patient was in pain. If the fragments were still attached by periosteum and the patient was not in pain, he reduced the fracture and splinted the back until full healing occurred. For cervical dislocation, he had an attendant press hard on the shoulders while he pulled up the head by two hands close to the ears. With some turning of the head, the dislocation was reduced and a stabilizing bandage was applied around the shoulders. France followed Paré’s technique for a long time; in fact, Jean-François Calot used the same techniques in the nineteenth century (20). Falciius Hildans (1560–1634) used a clamp to reduce cervical dislocations, and in some cases, removed bone fragments and repaired ligaments.

SEVENTEENTH AND EIGHTEENTH CENTURIES

By the seventeenth and eighteenth centuries, anatomic dissection was permitted in Europe. Despite this advancement, the management of spinal injuries was still primitive. Paré’s technique, with some modification, was used widely in Germany, Holland, Italy, and England. In France, during the year 1753, Geraud removed a musket ball from the lumbar spine and the patient experienced partial recovery. Almost a decade later in France, Louis removed a metal fragment from a paraplegic officer who eventually recovered. Trephining the lamina was suggested by Chopart (20) (1743–1795) and Desault (20) (1744–1795). The latter recommended trephining the laminae for decompression even in the absence of visible fracture. In 1762 Antrine Louis (21) removed a bullet lodged in the spine. In 1793, J. Soemmering wrote about dislocations and fractures of the spine in his book, Bemerkungen ueber Verrenkung ins Bruch des Ruckgraths (20). In the second half of the eighteenth century, Jean Louis Petit (21) wrote his treatise, Les Maladies des Os (Diseases of the Bones), and his method was used almost exclusively during that century. He reduced fractures by hyperflexion of the spine in an attempt to disengage the spinous processes. Lorenz Heister (22) was a leading German surgeon who used Petri’s method for thoracic and lumbar injuries, but used extension for cervical injuries. Hunzovsky in Germany hyperextended the neck for cervical injuries by suspending the patient from the ceiling (23).

NINETEENTH CENTURY

The nineteenth century saw advances in anatomy, pathology, physiology, and surgery. Medicine became a more scientific discipline. The history of spinal cord medicine in the nineteenth century was reviewed by Ohry and Ohry-Kossoy (24), and in Garrison’s History of Neurology (25). Sir Astley Cooper (26) described cauda equina lesions and their management, as well as fractures and dislocations of the spine resulting in paralysis. In 1860, Brown–Sequard described different kinds of spinal paralysis based on vascular changes (27,28,29). Injuries were divided into thoracolumbar and cervical paraplegia until 1881, when Sir William Gull coined the term quadriplegia.

With the adoption of Joseph Lister’s (1827–1912) techniques of antisepsis, surgical morbidity and mortality decreased. Hence, surgeons were encouraged to intervene more frequently, and progress was made in the field. In 1815, H. Cline recommended a controversial new procedure: The removal of the fractured spines and laminae (laminctomy) in fracture dislocations. Because laminctomy weakens the spine, Burrell, in 1887, applied a plaster jacket for postsurgical stabilization. This jacket was also used after manipulative reduction without surgery. In 1895, Sir Victor Horsley presented his results for treatment of tuberculosis of the spine to the British Medical Association (30).

Two famous world leaders were the victims of spinal cord injuries caused by a gunshot wound, and both died. Lord Nelson was injured at the battle of Trafalgar, and he died a few hours after the injury in 1805 (31,32). In 1881, James A. Garfield, the twentieth President of the United States, was shot, and died in less than three months (33).
TWENTIETH CENTURY

At the onset of the twentieth century, the prognosis for victims of spinal cord injury remained poor, although it had improved to some extent because of advances in bacteriology and disinfection by Pasteur and Lister, and Roentgen’s discovery of X-rays and ether anesthesia. In the Balkan wars, the mortality rate of spinal cord injury was still 95 percent. Harvey Cushing (34) reported that 80 percent of the battlefield casualties with cervical spine injuries died within the first two weeks. Those who survived had incomplete lower injuries. The British army reported the same results. During the interwar period, the prognosis was still poor, and those who survived led miserable lives as cripples.

The scientific advances of the latter half of the twentieth century were very great. Advances in the fields of surgery, rehabilitation, education, urology, pharmacology, and special topics, and research in spinal cord regeneration are described separately.

SURGERY

In 1902 Italy, Lorenzo Bonomo developed the technique of hemilaminectomy, which was adopted and modified by many surgeons. In 1905, Harvey Cushing described the categories of spinal injuries, and the indications and contraindications for surgery in each case. Later advances in surgery of the spinal cord included myelotomy, myelography with or without interposition of nerves, and nerve cell transplantation (autologous or embryonic).

Numerous advances in orthopedic surgery can be reviewed in the orthopedic and neurosurgical literature (35,36,37). Surgical orthopedic instrumentation such as rods, fixators, wires, screws, meshes, plates, clamps, hooks, and cements was developed. Different surgical approaches to the spine came into use, including thoracoabdominal, transoral, transthoracic, transabdominal, thorascopic, and laparoscopic. Laminotomy, laminectomy, foraminectomy, arthrodesis, and bone grafting were introduced.

After World War I, German experiences in spinal medicine were recorded by Foerster (38), Lhermitte and Roussy (34) did the same in France. In the United States, dramatic changes began to occur in the early 1930s. Dr. Donald Munro (Figure 1.7), a neurosurgeon with a background in general and urological surgery, developed an interest in the care of spinal cord injury (SCI) patients. He made great efforts to improve the rehabilitation of SCI patients, as well as to meet their socioeconomic needs (39–44). Many view Dr. Munro as the true founder of modern SCI care. In England, on February 1, 1944, Sir Ludwig Guttmann (Figure 1.8) established a unit at Stoke Mandeville (44) in Aylesbury, and introduced multidisciplinary staffing for the comprehensive treatment and rehabilitation of SCI. Under his leadership, this unit became a world-renowned center for teaching, research, and clinical care. After the inception of these two units on either side of the Atlantic, many others followed. Drs. Ernest Bors and A. Estin Comarr in Long Beach, California pioneered rehabilitation and urology protocols that were followed in all the other centers. In Boston H. Talbot began an SCI clinic, as did B. Moeller in Memphis, Tennessee. In the United Kingdom, a number of centers developed: Lodgemoor in Sheffield; the Robert Jones and Agnes Hunt Orthopedic Hospital at Oswestry, Shropshire; the Pinderfield Hospital, Wakefield, Yorkshire; the Liverpool Spinal Unit at Promenade Hospital; the Edenhall Unit in Musselburgh, Scotland; Phillipshall Hospital near Glasgow; and Rookwood Hospital, Cardiff, Wales. Centers of excellence in Europe included: Tobelbad, Austria; Fontainebleau (Paris), Invalides (Paris), and Mulhouse, France; Brugman, Belgium; Koblenz, Bachum, Amsburg, Frankfurt, Murnau, Tubingen, Ludwigshafen, Heidelberg, Cologne, and Berlin in Germany; Aardenburg, Amsterdarn, Holland; and Dublin, Ireland. A list of other centers in Europe, Canada, Australia, the Middle and Far East, and South America can be obtained from The International Society of Paraplegia. At the present writing, the Department of Veterans Affairs in the United States has twenty-three centers devoted to spinal cord injuries and disorders. The Department of Health and Human Resources has established regional centers in different states. In 1945, Lyndhurst Lodge was established in Toronto, Canada, and the Canadian Paraplegic Association was founded. The Canadian Veterans Administration has also established wards for SCI care.

Many new diagnostic techniques were developed, such as positive contrast myelography, radionuclide myelography, peridurography, discography, angiography, computerized axial tomography (CAT), magnetic resonance imaging (MRI), digital subtraction angiography, ultrasonography, electrophysiological studies, evoked potentials (sensory and motor), and myelonscopy.

REHABILITATION

In 1929, Alfred Taylor of New York used a traction halter fitted to the occiput and the mandible for cervical spinal injuries. In 1933, William A. Crutchfield devised cranial skeletal traction (45). Other traction devices were made by Barton (1938), Vinke (1948), and Gardner (1970s). In 1959, Perry and Nickel introduced halotraction, which is still in use.

The history of rehabilitation medicine is reviewed in detail by DeLisa (46). In the three-volume work Principles and Practice of Physical Therapy (48), published in 1939, there was no mention of SCI made under “Phys-
ical Therapy of the Nervous Diseases,” probably because the condition carried a mortality rate of 80 percent during World War I. In the 1930s, Donald Munro, a neurosurgeon at Boston City Hospital, developed an interest in and sympathy for the victims of SCI. He developed a small center for the comprehensive care of SCI patients, and functioned not only as a neurosurgeon, but also as a rehabilitation specialist, urologist, psychologist, socioeconomist, researcher, and teacher. He introduced tidal drainage of the bladder (intermittent bladder irrigation), which reduced the risk of urinary tract infections. The U.S. Army initiated a SCI center in Oxford-Wingate, Massachusetts, where Munro’s methods were adopted. Munro was a consultant to those Army hospitals having SCI sections in the Bronx, Long Beach, Chicago, and elsewhere. Ernest Bors and A. Estin Comarr carried the torch of care and research and opened the way for better care of SCI patients. Advances in rehabilitation were carried out by neurosurgeons acting as chiefs of paraplegia sections (Krueger in the Bronx, Cramer in Memphis, and Scarffond Pool in Atlantic City). Howard Rusk, Arthur Abramson, and Harry Kessler were important figures in rehabilitation. Subspeciality areas began to develop, such as genitouriological rehabilitation, sex therapy, infertility therapy, driver’s training, educational counseling, functional independence, and development of assistive devices (47).

EDUCATION

The care of SCI was very briefly taught in medical schools until Donald Munro introduced the concept of comprehensive care for SCI victims. His career heralded a turning point in the history of SCI treatment. His ideas on neurotraumatology and rehabilitation were first accepted in the military hospitals. For the next 40 years, the Veterans Administration led SCI rehabilitation, and remarkable achievements were produced. Annual conferences were held, and the papers presented were recorded in the annual proceedings. In the 1970s, Erich Krueger, the national director, initiated traineeships to prepare physicians qualified in the care of SCI. In the 1980s, Emanuele Manerino initiated a two-year fellowship program, which graduated many physicians specialized in the comprehensive care of spinal cord injured patients. The Department of Health and Human Services established eighteen SCI centers across the United States, leading to the development of SCI rehabilitation programs in many major universities. Joseph Binard initiated annual courses in different regions and established educational courses for non-SCI centers.

The American Paraplegia Society, founded in 1954 by A. Estin Comarr, incorporated in 1977 and sponsored annual educational meetings. The American Paraplegia Society also established the Journal of Spinal Cord Medicine, which has become a leading journal in the field. In 1978, the Society attempted to register as the American
Board of Spinal Cord Injury, but was not approved by the American Board of Medical Specialties. Through the efforts of Joel A. De Lisa and other leaders in the field, in 1995 Spinal Cord Injury Medicine was approved as a subspecialty under the American Board of Physical Medicine and Rehabilitation. Dr. Margaret Hammond, Chief Consultant to the VA, headed the task of specifying the subject matter of the field.

The American Spinal Injury Association (ASIA), founded in 1971, has made great contributions to the diagnosis and comprehensive management of SCI through annual meetings, teaching sessions, workshops, and research grants. ASIA has sponsored several programs overseas and thereby furthered the spread of knowledge in many countries.

In 1961, Sir Ludwig Guttman founded The International Medical Society of Paraplegia (IMSOP). This was a major milestone in the care of SCI worldwide. The Society holds annual meetings in Stoke Mandeville, U.K., and is affiliated with national societies all over the world, including the Association Francophone Internationale de Groupes d’Animation de la Paraplegie, the American Paraplegia Society (APS), the American Spinal Injury Association (ASIA), the Australian Branch of IMSOP, the Deutschprachige Medizinische Gesellschaft für Paraplegie (DMPG), the Japan Medical Society of Paraplegia (JMSOP), the Dutch-Flemish Society of Paraplegia (DMPG), the National Institute for Care of Paraplegia in Sri Lanka (NIP), the Nordic Medical Society of Paraplegia (NMSOP), the Southern African Spinal Cord Association (ASPSCA), and the Latin American Society of Paraplegia (SLAP). IMSOP (now ISCOIS) established Spinal Cord as their official journal, previously known as Paraplegia.

SPINAL CORD REGENERATION

The work of Ramon y Cajal (1900–1920) showed that “although severed central nerve fibers in young and adult mammals commenced to regenerate, the attempts proved abortive and the process did not functionally benefit the animal” (49). During the next two decades, experiments on amphibia and reptiles showed that regeneration can follow cord injury.

From 1950 to 1970, Windle worked with DOCA, ACTH, Promin (bacterial polysaccharide), and millipore tubes. He concluded that “there is little evidence, as yet, that true physiological recovery, either motor or sensory, has been attained in mammals” (50). From 1970 to 1980, Kao used microsurgery to transplant autogenous brain tissue, sciatic nerve, and nodose ganglion into the spinal cord, and succeeded in demonstrating axonal growth within the grafted tissue (51). Fetal neurons, as solid tissue and as suspension, were transplanted into the transected cord (52). At this time, research into genetic engineering and stem cell studies also began (53,54).

SPINAL SHOCK

In 1874 Goltz and Freusberg in Strasbourg clearly described spinal shock in the dog (55). Sherrington produced spinal shock in the monkey, which he referred to as a neurogenic condition, by transection of the cervical cord. Although he did not use the term autonomic dysreflexia, he described a rise in blood pressure elicited by skin stimulation, which appears after the resolution of spinal shock (56).

AUTONOMIC DYSREFLEXIA

Head and Riddoch first described autonomic dysreflexia in 1917 (57). Its significance and dangers were described by Whitteridge (58); Guttmann and Whitteridge (59), Thompson and Witham (60), Pollock et al., Bors and French (61,62), Schreibert (63), and Arieff et al. (64). Many other reports followed from Europe, America, and Australia.

HETEROTOPIC OSSIFICATION

Para-articular osteoarthropathy was first described by Riedel (1883) (65) and Eichart (1895). A detailed description of the condition in paraplegics was elaborated by Madame Klumpke-Dejerine and Cellier (66) and Dejerine et al. (67). They were followed by many others, among them Soule (68), Abramson (69), Abramson and Kamber (70), Liberson (71), Damanski (72), Hardy and Dickson (73), Paeslack (74) Freehafer and Yurick (75), and Rossier et al. (76).

URODYNAMICS

The first measurement of intravesical pressure was made by Rudolph Haidenhain (1837–897) in Breslau. He and Colberg focused on sphincter tone; De Wittich and Rosenplanter (1867) recorded intravesical pressure, and Julius Budge (1811–1888) discovered that the third and fourth sacral anterior roots were the motor nerves of the bladder. Goltz experimentally transected the spinal cord at the thoracolumbar level in dogs and noted reflex bladder evacuation, which disappeared by ablation of the lower cord below this level. Schatz (1841–920) initiated the use of human subjects for spinal cord medicine research. Dubois (1848–1918) continued his work, measuring bladder pressure and rectal pressure in normal con-
trols and paraplegics. Other names in this field are Quincke and Adler in Germany, Angelo Mosso and Paul Pellacani in Italy, Fritz Born in Switzerland, and Guyon and Duchastelet in France (77).

In Germany, Adler studied manometry in the neurogenic bladder and differentiated conal from supraconal lesions. In Vienna, Schwartz studied cystometry in gunshot wounds of the spinal cord. In the United States, Walker, Dalton, Roussy, and Rossi also made advances. In Baltimore, Walker proposed simple devices for cystometry. In St. Louis, Dalton coined the term cystometry, and described the different types of neurogenic bladder. Roussy and Rossi studied cystometry in SCI at different levels. In England, Henry Head and George Ridgeway studied neurogenic bladders and described automatic micturition as a part of the mass reflex in supraconal lesions. Sir Gordon Holmes studied neurogenic bladders in soldiers in France (1915–1916). In 1933 in London, Denny-Brown and Robertson measured bladder pressure, urethral pressure at the bladder neck, external sphincter pressure, and rectal pressure. In 1935, Kenneth Watkins described reflexic and areflexic bladders in cord injuries. Donald Munro, who in 1947 introduced tidal drainage, described the atonic cord bladder early in injury, the autonomous cord bladder, the hypertonic cord bladder, and the inhibited cord bladder. Many others contributed to the field in the early years, including Nesbit, Lapides, Tang, Ruch, Bors, Comarr, and Bradley.

PHARMACOTHERAPY

Numerous pharmacotherapeutic agents have been tried in the treatment of SCI, including methylprednisolone, alone (78) or in combination with the antioxidants alphatocopherol and selenium (79); lidocaine (80); alpha-methyltyrosine (81); aspirin; dipyriramole (82); naloxone (83); DMSO (84,85,86); immunosuppressive drugs (87); nerve growth factor (88); enzyme therapy such as endothacin (93); and nitric acid inhibitors (94). Other approaches have included genetic strategies (53); cooling (hypothermia) (95); X-rays (96); electromagnetic stimulation (97,98,99); hyperbaric oxygen therapy (100,101); revascularization (102); and acupuncture (103).

PRESSURE ULCERS

Pressure ulcers have been recognized since antiquity, and physicians of different civilizations have proposed various treatments. Chinese ulcer physicians (Young) (97) for-
after World War II did the labor of distinguished clinicians and scientists improve the look of SCI victims. In universities all over the world, researchers are working to erase Imhotep’s dictum that spinal cord injury is “an ailment not to be cured.” As Professor Max Thoreck has said, “La science n’a pas de patrie” (science has no homeland). It is hoped that the efforts of researchers around the world will soon fulfill man’s wishes for a cure.

References

8. Ibid., 289–306.