

NEUROCRITICAL CARE THROUGH HISTORY

Homage to the Pioneers and Their Treatment of Spinal Cord Injury



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The history of the management of traumatic spinal cord injury (TSCI) goes a long way back and is closely connected to wartime [1–3]. Initially, garrison military hospitals tended to the wounded, but medical centers quickly became involved. In the USA, the Civil War introduced spine trauma to the neurologist. Although not directly involved with patient care, the neurologist and scientist Brown–Séguard, for example, pointed out that spinal cord compression by bony fragments could cause more damage than direct injury of the spine. He also noted wounds could lead to tetanus, for which neurologists were often consulted [4]. Although the syndrome that bears his eponym may occur in traumatic spine injury, he linked his constellation of findings to a lateral cord lesion in both patients and animal experiments. In Europe, care of the spinal cord advanced after both World Wars. A number of European centers were suddenly forced to take care of large numbers of injured soldiers. In the USA, spinal cord injuries were directed to Turner’s Lane General Hospital in Philadelphia under the care of the neurologist Silas Weir Mitchell and surgeons George Morehouse and William Keen.

In this paper, I will point out the remarkable details of care provided by Wilhelm Wagner (1848–1900) and Emil Kocher (1841–1917). Their crumbling textbooks have been filed in old libraries but contain a wealth of observations and treatment suggestions we still use today. They forged a path for the other luminaries recognized in this historical text.

Wagner and Kocher

Designated units already did exist before the wars increased the need for care of spinal cord injury. Although working in near obscurity, Wilhelm Wagner in Königshütte Hospital in Silesia (later Germany) and far more recognized Emil Theodor Kocher in Berne, Switzerland, wrote the classic textbooks for treatment of TSCI [2, 5] (Fig. 1). It is also not well known that care of the injured patient was quite sophisticated at the time and often guided by a “review of systems,” something we still do today. Wagner delineated the anatomy and mechanisms of injury and focused initially on who might need early surgery, and his experience was based on management of injured coal miners. Wagner’s textbook systematically characterized types of injury. Wagner was prescient in recognizing early reduction of fractures. He summarized six issues: (1) sepsis, (2) pressure sores, (3) urinary tract infections, (4) chest infections, (5) kidney stones, and (6) post-traumatic syringomyelia. Wagner recognized pressure points (i.e., heels, calves, buttocks, and sacral area) and used water beds. He was well aware of the development of systemic instability of blood pressure and heart rate. He mentioned periods of asystole and felt as anxiety by the patient (*beängstigende empfindung in augenblick der unterbrechung*) (Fig. 2).

Kocher was awarded the Nobel Prize in Physiology or Medicine in 1909 for his achievements in the surgical treatment of thyroid disorders, but he had many other achievements including understanding of the effects of increased intracranial pressure. Kocher’s detailed work on traumatic spinal cord injury published in 1896 showed a number of classic motor postures in high cervical injury and carefully traced the sensory deficits (Fig. 3). Such an attention to detail was new at the time.

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This article is part of the collection “Neurocritical Care Through History.”

DIE VERLETZUNGEN
DER
WIRBELSÄULE
UND DES
RÜCKENMARKS.

VON
Prof. Dr. W. WAGNER UND Dr. P. STOLPER
in Königshütte O.-S. in Breslau.

MIT 232 ABBILDUNGEN IM TEXT.

STUTT GART.
VERLAG VON FERDINAND ENKE.
1898.

Fig. 1 Wagner and Stolper's text on traumatic injury (*verletzungen*) of both spine (*Wirbelsäule*) and spinal cord (*Rückenmarks*). Stuttgart: Verlag von Ferdinand Enke. 1898)

Déjerine, Munro, and Guttman

The French experience in the world wars was equally important in establishing military spinal injury units and involved many renowned neurologists, including Marburg, whose names later became eponyms for various neurologic disorders. For example, Guillain and Barré recognized that bed sores were caused by pressure and not incontinence [6]. They also acknowledged the importance of bladder management and infection control in a dramatic departure from the neurologists who preceded them. Jules Déjerine (1849–1917) was a neuroanatomist and pathologist who pioneered treatment and rehabilitation of the large number of soldiers afflicted by spinal cord injury during the First World War and the following years. Following Déjerine's death in 1917, his wife, Auguste (1857–1927), carried on his pioneering rehabilitation work [7].

In the UK, the establishment of the spinal unit at the Stoke Mandeville Hospital in Aylesbury, England, (now part of the NHS), was a seminal moment. Neurosurgeon George Riddoch was one of the first devoted to the care of spinal cord injury, but the negativity surrounding care of these patients resulted in lapses of care until Riddoch "found" Guttman [1]. Dr. Ludwig Guttman (1899–1980) led rehabilitation efforts after fleeing Nazi Germany in 1939. (His Jewishness more or less obliged him to leave his native Germany, and he surely would have recognized that the Nazi leadership was unsympathetic to the rehabilitation of the physically disabled [8–10].) Guttman made dramatic improvements in the basic care of patients (better air beds to avoid decubitus, better nutrition, and better bladder care); however, it is no exaggeration to say Guttman owed much to the pioneering work of the American Donald Munro (1889–1973).

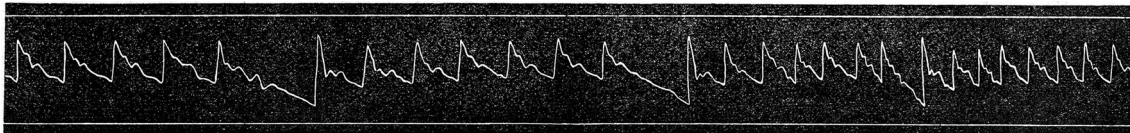


Fig. 6. Pulsanomalie bei Fractur des 12. Brustwirbels. Fall 1.

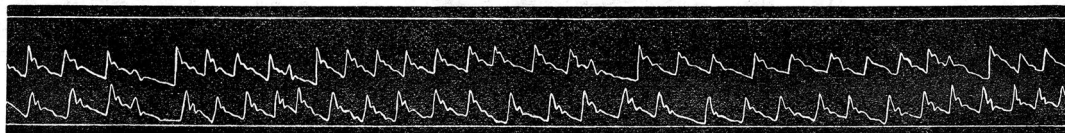


Fig. 7. Pulsanomalie nach Contusion der Brustwirbelsäule. Fall 2.

Fig. 2 Recording of irregular heart rate (*pulsanomalie*) (from Wagner, W. Stolper, P., *Die Verletzungen der Wirbelsäule und des Rückenmarks* 1898, Stuttgart: Verlag von Ferdinand Enke.)

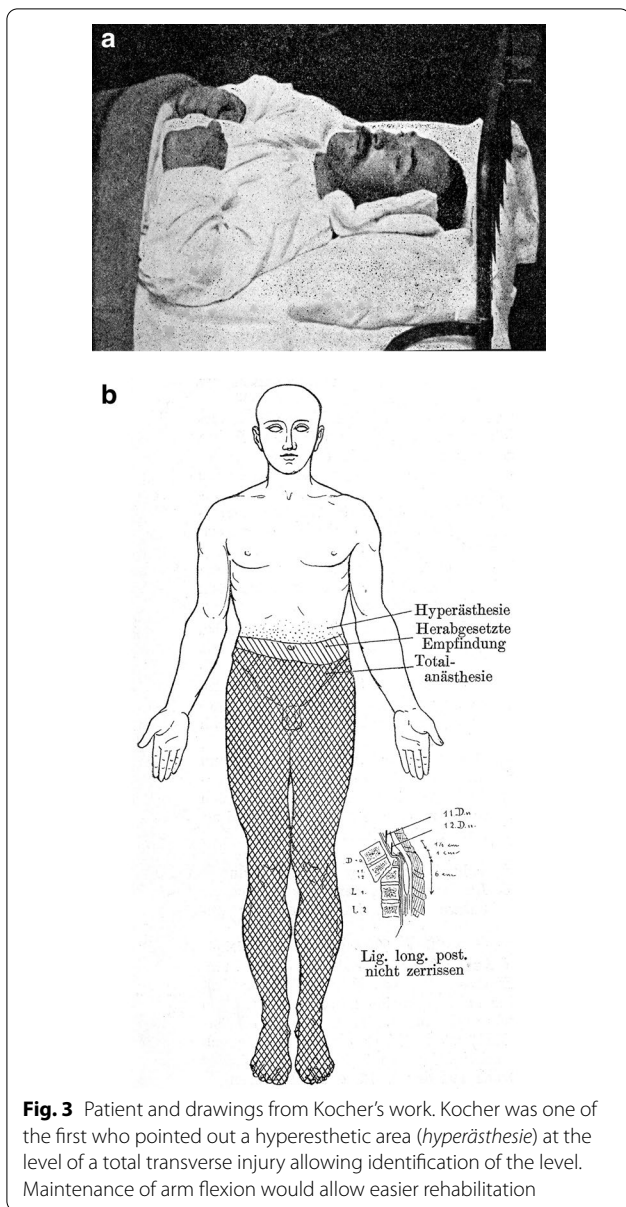


Fig. 3 Patient and drawings from Kocher's work. Kocher was one of the first who pointed out a hyperesthetic area (*hyperästhesie*) at the level of a total transverse injury allowing identification of the level. Maintenance of arm flexion would allow easier rehabilitation

Munro adopted a holistic approach to management of the spinal cord patient. He accepted the physicians' responsibility to train nursing staff in the care of these patients. He claimed that many of his colleagues were not interested in rehabilitation and simply arranged transfer to nursing homes to rid themselves of these patients. It is highly doubtful that Munro ever read the German texts about spinal cord injury. Munro started from the same premise but worked out a management protocol that is still standard today in many US hospitals including the Veterans Administration. Munro, a neurosurgeon, decided in 1938 that patients with an irreparable spinal cord injury but good use of their arms should be kept

alive and rehabilitated to an independent functional state. Not only did this require a multifaceted approach but also a (not easily accomplished) buy-in from US insurance companies.

Ignoring pushback from his colleagues, Munro established a spinal unit for TSCI in Boston City Hospital. The cornerstone of the practice was prevention of bladder infections and urosepsis. The bladder shows no volitional reflex function due to flaccidity of the detrusor muscle. Overdistention of the bladder during the spinal shock phase results in long-standing atonicity. The estimated duration was 8 weeks followed by delayed development of reflex automatism. Peristalsis was paralyzed, and the disappearance of bowel sounds signaled complete fecal retention. The paralysis could also interfere with function of the diaphragm and cause respiratory distress [11–13].

Munro's approach involved "tidal drainage," which consisted of continuous bladder washouts with antiseptic solutions, admittedly a nonstandard approach but necessary before the advent of antibiotics. Munro understood the need to turn patients every 2 h and to minimize the time (ideally less than 15 min) the skin was in contact with urine or feces. Munro insisted on non-operative reductions to avoid surgical wound complications.

By 1953, Munro had treated 445 patients on this protocol, albeit with 28% mortality; however, the majority went on to become independent and self-caring. Munro noted no psychologic problems in this cohort. Munro summarized the acute effects of spinal cord injury in what he called "a state of areflexia." This included *respirator areflexia*, increasing anoxia and providing a highly oxygenated environment; *stomach and bowel areflexia* or acute paralytic ileus, which required withholding food and fluids and urging physicians to be patient rather than recommending ineffective drugs or even abdominal operations; *bladder areflexia*, resulting in marked retention and possibly kidney injury and requiring immediate catheter placement; *skin and vascular areflexia*, which required correction of hypoproteinemia as well as frequent turning and meticulous care; and *areflexic sweating* and body temperature instability, which demanded the creation of a constant temperature environment.

Conclusion

Many dedicated physicians over the span of the 20th century participated in the work that led to the current standard of care for traumatic spinal cord injury. The care of acute spinal cord injury evolved with trial and error and wholly empirically. It is encouraging that many physicians saw an opportunity rather than

adopting a defeatist approach. The damage is permanent; a life-changing disability is the norm, but with good nursing and medical care, rehabilitation to a functional state is successful. Wagner, Kocher, Munro and Guttman's pioneering efforts deserve the respect of all of us.

Author Contributions

EFMW performed all research relating to this article and is the sole author.

Source of Support

No extramural funding supported this effort.

Conflict of interest

None.

Ethical Approval/Informed Consent

Not applicable.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Published online: 24 January 2020

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