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General Principles

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History of Interventional Pain Medicine

Formative years

The contemporary era in pain management really began with the discovery of nitrous oxide and its analgesic properties in the late 18th century. This was soon followed by scientific investigation of the anesthetic properties of nitrous oxide and ether on animals, and the use of these substances in human patients. Surgical anesthesia was first publicly demonstrated at Massachusetts General Hospital in 1845 and 1846. The discovery and use of anesthetics changed the perception of pain (Fig. 1.1). In the 1850s Charles Gabriel Pravaz, a French surgeon, and Alexander Wood of Edinburgh independently invented the syringe (Fig. 1.2a,b), which allowed injections of morphine. By the 1860s the efficacy of locally applied opiates, especially morphine, directly to the skin or nerves for pain relief was widely accepted. The effects of pre- and intraoperative administration of morphine to the area of incision or amputation were investigated. When cocaine became available as a local anesthetic, owing to the work of Sigmund Freud and, especially, Karl Koller, this soon resulted in its use as a local anesthetic in diverse procedures (Fig. 1.3a,b).

Surgical techniques for pain relief represented another great medical advance during the 19th century. With the advent of antiseptic surgery, procedures became less life threatening, allowing investigation of pain relief techniques involving permanent interruption of afferent pathways. Innovative techniques were developed for treating trigeminal neuralgia, in addition to procedures such as retrogasserian neurectomy and cordotomy, ablation of the sympathetic nervous system, sympathectomy for visceral pain and angina pectoris, and surgical management of neuralgia.

Pain mechanisms

Little was understood about pain mechanisms at the beginning of the 19th century. Many questions such as how

sensibility related to movement, whether separate sensory and motor nerves existed, and whether single nerves could perform different functions were still unanswered. Early researchers tried to explain pain by concentrating on the specialization of functions in different parts of the brain. Animal experiments investigating the function of spinal nerve roots were more successful, significantly contributing to medical knowledge during this period. Investigators such as Claude Bernard, Charles Bell, and Francois Magendie developed innovative experimental procedures that allowed differentiation of sensation from movement and between functions of anterior and posterior spinal nerve roots. A significant impetus to the perception of the nervous system as a system involving the transmission of sensations from the periphery to the center through a system of complex relays was provided by the work of German physiologist and comparative anatomist Johannes Muller (Fig. 1.4).

Muller proposed a connection between the anatomic pathway of a fiber and perception of sensation, stimulating further research on specific fibers for pain and nociception. As a result of such work, an entirely new school of physiologic research was founded. Soon nerve structures were identified in the dermis, leading to investigation of dissociation of sensations in that region, such as sensation of touch, pressure, and pain; and the spinal cord was more realistically appraised as a central processor with the ability itself to affect the transmission of sensations. Other noteworthy contributions were made by Waller, who developed a sectioning technique allowing observation of fatty degeneration of a fiber, leading to an awareness of ascending and descending pathways and the origin of nerve fibers.

There were many other pioneers who, through work with patients in pain or self-experimentation, contributed to the general body of medical knowledge: Weir Mitchell's work with neuritis, neuralgia, and causalgia, Henry Head's discovery of two different types of nerve fiber, and Sherrington's notion of an integrated nervous system were major advances establishing a firm foundation for an understanding of pain



Figure 1.1 The first surgical anesthesia in Massachusetts General Hospital in 1845.

mechanisms and more effective approaches to treatment (Fig. 1.5).

We are indebted to Melzack and Wall for perhaps the most significant leap in understanding, the gate control theory. This explanation located both facilitators and inhibitory influences on the cells of the substantia gelatinosa of the spinal cord; with large-diameter, fast-conducting touch fibers suppressing, and smaller-diameter, slower-conducting pain fibers increasing, central output. Because nerve lesions usually involve smaller fibers, they result in over-activity of the substantia gelatinosa. Scar formation at the site of nerve injury causes complications, increasing nerve excitability at the site of the lesion (Fig. 1.6).



Figure 1.2 (a) Gabriel Pravaz, courtesy of Wellcome Library, London. (b) Alexander Wood, reproduced with permission from Peter Stubbs (www.edinphoto.org.uk).

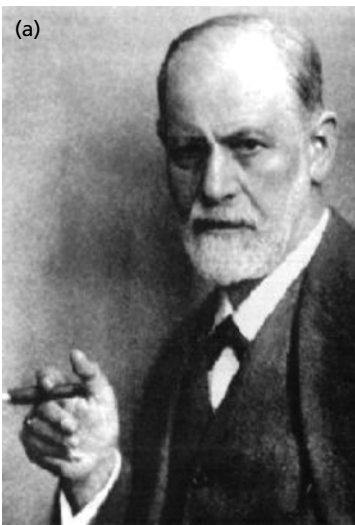


Figure 1.3 (a) Sigmund Freud, (b) Karl Koller (courtesy of the Wood Library Museum of Anesthesiology, Park Ridge, IL, USA).



Figure 1.4 Johannes Müller.

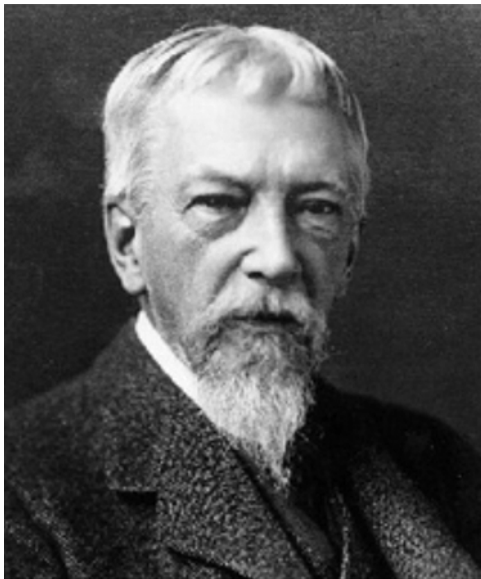


Figure 1.5 Weir Mitchell. (Courtesy of the Clendening History of Medicine Library, University of Kansas Medical Center.)

Establishment of interventional pain medicine

Greater understanding of pain mechanisms has resulted in the development of devices offering innovative therapeutic approaches. For instance, dorsal column stimulators were a direct result of the gate control theory. The efficacy of treatment relies on stimulation of low-threshold primary afferent



Figure 1.6 R. Melzack and P. Wall. (Courtesy of Dr. Ronald Melzack.)

fibers, which causes central inhibition of pain signals. Dorsal column stimulators are now an effective means of treating patients with chronic neuropathic and vascular pain. In addition, peripheral nerve stimulators have been used to manage chronic pain after peripheral nerve injury. Deep brain stimulation is a newer technique, still somewhat uncertain in terms of efficacy of pain relief.

New treatment techniques represent another beneficial byproduct of pain-related research. For instance, the discovery of opioid receptors in the central nervous system provided a rationale for the development of intrathecal and epidural administration of opioids. These now active techniques have resulted in the formation of a new sub-specialty under the umbrella of primary specialists of pain medicine. This sub-specialty has been called interventional pain medicine.

Biotechnology allows drugs targeted towards specific physiological processes to be developed, sometimes designed for compatibility with the body to reduce side effects. Genomics and knowledge of human genetics is having some influence on medicine, as the causative genes of most monogenic disorders have now been identified. In addition, the development of techniques in molecular biology and genetics is influencing medical technology, practice, and decision-making.

Evidence-based medicine is a contemporary movement to establish the most effective algorithms of practice through the use of systematic reviews and meta-analysis. The movement is facilitated by modern global information science, which allows all evidence to be collected and analyzed according to standard protocols, which are then disseminated to healthcare providers. One problem with this “best

practice” approach is that it could be seen to stifle novel approaches to treatment. The Cochrane Collaboration leads this movement.

Defining a pain specialist

John Bonica was the first anesthesiologist who experienced the difficulties of pain management during his years in the army as he was treating the wounded soldiers from the Pacific. He felt strongly that no one particular physician is capable of looking after a patient with pain. He proposed the first concept of multidisciplinary approach to pain management.

What defines a “pain specialist?” Rollin Gallagher stated, “specialties define themselves [in] many ways: by age group (pediatrics), organ system (cardiology), specific constellation of illnesses or diseases (infectious diseases), type of procedure (surgery), or practice setting (emergency medicine).” Held to this definition, pain management becomes a unique specialty indeed. Although pain management is concerned with the diagnosis, treatment, and rehabilitation of a singular sensory symptom, it is essential that practitioners undertake a multidisciplinary approach to achieve these ends. They must also be well versed in the study of pain and its prevention. Although more than 60% of pain specialists originate from the field of anesthesiology, they can also come from a variety of other disciplines such as interventional radiology, physical therapy, psychiatry, primary care medicine, and neurology. In addition, pain specialists must possess a keen understanding of the variety of conditions and causes associated with pain. This broad range of training and knowledge allows the practitioner to achieve their ultimate goal: the management of a patient’s pain. Despite these extensive requirements, pain management remains classified as only a subspecialty of anesthesiology under the certification of the American Board of Anesthesiology (ABA) in the United States. The American Academy of Algology in 1983, now the American Academy of Pain Medicine (AAPM), has strived to create a separate specialty of pain medicine, but without success so far.

Education and training of interventional pain physicians

With increasing recognition of pain management as a specialty, there is early development and formalization of curricula and training programs. Noteworthy among accomplishments in this area are development by the American Board of Anesthesiology of a course of training in pain for anesthesiology residents, formulation of guidelines by the Accreditation Council for Graduate Medical Education for

the approval of pain fellowship programs, and the establishment of a core curriculum for the study of pain by the International Association for the Study of Pain (IASP). Post-graduate fellowship training programs are now widely available. The American Board of Anesthesiology certifies anesthesiologists, physiatrists, and neurologists for added qualification in pain management after they have taken their pain management certification examination. The American Board of Pain Medicine certifies physicians of all specialties when they take a written examination. Similar action has also been taken in the United Kingdom and is spreading to other countries such as the Netherlands, Australia, and Turkey. In addition, the study of pain has altered the way many physicians manage their patients, increasing awareness of opportunities for alleviating pain and the necessity of early intervention.

Competency and certification of pain physicians

Effective pain management requires that physicians take a multidisciplinary approach to their evaluation, diagnosis, treatment, and rehabilitation of pain problems. They must not only draw from several medical disciplines, but must also understand the complex nature of pain. This distinction makes pain medicine a unique specialty compared with more specific medical fields such as cardiology and pediatrics. Even so, pain medicine continues to develop gradually as a specialty in North America and Western Europe, with other countries being left behind.

However, because pain practitioners are required to possess such a broad skill set, medical schools have found it difficult to develop effective curricula and credentialing methods for this subspecialty. The inadequacy of education in pain management can, and has, led to the poor treatment of pain disorders, especially those of a chronic nature. Although the link between inadequate education and improper treatment is well understood, studies suggest that disparities in pain education continue to exist.

The current problem in educating a pain specialist is, therefore, a two-fold issue. First, the existing pain medicine education disparity must be addressed. The development of effective and relevant curricula will provide future pain specialists with adequate training. Second, in addition to curriculum development, the program must have a thorough and integral assessment method to determine competency properly. Credentialing is vital for upholding precise standards within pain medicine.

Several organizations, such as the American Board of Anesthesiology, the American Academy of Pain Medicine, and the World Institute of Pain, have begun to address the disparity and credentialing issues.

Present status of interventional pain medicine

Can we, today, looking back over history, state that we have finally conquered pain? The answer has to be the following: in some ways, yes; in some ways, no. We have certainly conquered surgical pain, the pain of childbirth, and perhaps pain due to trauma. Unfortunately, we have not progressed a great deal in the areas of chronic and cancer pain.

Chronic pain remains a taxing and frustrating situation for both the patient and the clinician. Despite our concern and advanced knowledge, we are still unable to help the patient who comes to us with increasing pain, decreased function, and debilitating psychological difficulties, such as feelings of low self-worth, depression, and inability to cope.

One should emphasize the importance of pain management, its advances as a discipline, and the options we now have available to treat a patient with moderate-to-severe pain. The discovery of opioid receptors, a taxonomy of classification of pain, a multidisciplinary and multimodal treatment approach, and the establishment of curricula and training are spectacular advances in pain medicine. It is not surprising, therefore, that these advances have contributed significantly to the practice of medicine.

Pain societies and education

Over the past few decades, several organizations have been created, with the primary purpose of expanding pain management education in the United States and the world. These organizations include the following.

- The American Society of Regional Anesthesiology and Pain Medicine (ASRA). Organized in 1976, the ASRA is an affiliation of anesthesiologists and other physicians who have strived to advance scientific knowledge through education about and research of regional anesthesia. Pain control has become a major area of interest of the society.
- The International Association for the Study of Pain (IASP). Founded in 1973, the IASP has become the largest multidisciplinary international association in the field of pain. Its purpose is to encourage pain research, promote education, facilitate the exchange of information, encourage education of the public regarding pain issues, encourage the development of a data bank, and to advise political agencies on standards of pain treatment.
- The World Institute of Pain (WIP). With the development of pain medicine into a subspecialty, it was recognized that links between the international pain centers also needed to be developed. The WIP was created to accomplish this goal. In addition to this mission, the WIP strives to educate and train personnel of member pain centers, develop common protocols for efficacy and outcome studies, categorize and

credential pain centers, and develop examination processes for pain centers in testing trainees.

Credentialing

Even if medical schools adopt and maintain effective pain management curricula, the establishment of clinical reliability for pain specialists is only half-complete. There remains the essential task of credentialing. An effective and objective system for determining competency must also be developed.

The World Institute of Pain

The Fellow of Interventional Pain Practice (FIPP) Examination Board provides an examination in interventional techniques and attempts to establish clinical competency further in interventional pain practice. Eligibility for the certification examination requires the following:

- licensure;
- completion of a 4-year Accreditation Council for Graduate Medical Education (ACGME)-approved residency (or equivalent), that included pain management;
- American Board of Medical Specialties board certification or equivalent;
- a minimum of 24 months of clinical practice experience in pain medicine; and
- upon certification, strict adherence to ethical and professional standards set by the WIP and its Section of Pain Practice.

The Examination in Interventional Techniques consists of three sections: theoretical examination, practical examination, and oral examination.

Although certification programs do recognize accepted levels of knowledge and expertise in pain management, it is generally agreed that they cannot guarantee competence or successful treatment of the patient to the public. Nor can they guarantee that certification examinations will properly reflect state-of-the-art knowledge and procedures, owing to the rapid changes in the field of pain medicine. However, these certification programs strive to establish clinical reliability for a specialty that requires advanced training, experience, and knowledge.

Conclusion

A review of the history of pain demonstrates that until the time of Bonica, pain management was considered to be unimodal, unidisciplinary, and managed without any clear structural organization. Today, new drugs and creative techniques and procedures have expanded the scope of pain medicine into a multidisciplinary field of clinical practice.

Pain management practitioners must possess a broad skill-set, advanced training and knowledge, and, perhaps above all else, clinical experience. Even so, there remain undeniable disparities in pain management education. Now that we recognize that the problems exist, further efforts must be made by our community to establish and assure clinical reliability and competency in the practice of pain medicine. As pain medicine expands as a subspecialty, so too must educational efforts.

Further reading

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