

Corning and cocaine: the advent of spinal anaesthesia

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Abstract

The inception of spinal anaesthesia can be traced to James Leonard Corning, a New York neurologist who inadvertently administered cocaine spinal anaesthesia in 1885. In 1898 August Karl Gustav Bier, a German surgeon, pioneered the successful use of operative spinal anaesthesia in lower limb surgery. Early spinal anaesthesia was fraught with complications but through advances in aseptic technique, anaesthetic agents and equipment, the seminal work of Corning and Bier has evolved into a widely established anaesthetic modality.

Keywords

Spinal anaesthetic; Leonard Corning; August Bier; history; development.

Early history

The very first spinal anaesthetic was delivered by accident. Its inception can be traced to the late 19th century and the work of a New York neurologist James Leonard Corning (1855-1923)^[1]. Corning was born in Connecticut but received his medical education in Germany, graduating from the University of Würzburg in 1878. His earlier research was conducted using hydrochlorate of cocaine - the only available local anaesthetic agent at the time - first on the peripheral nervous system and later the central nervous system. He observed that subcutaneous injection of cocaine was associated with both vasoconstriction and local anaesthesia. Corning reasoned that injecting cocaine solution into the subcutaneous tissues between two contiguous spinal processes would result in its uptake by the 'minute ramifications of the veins' and (the anaesthetic) 'being transported in the blood to the substance of the cord' resulting in 'anaesthesia of the sensory and perhaps also the motor tracts'^[1]. He wrote: 'I hoped to produce artificially a temporary condition of things analogous in its physiological consequences to the effects observed in transverse myelitis or after total section of the cord'^[1].

His first experimentation involved injecting 20 minims (~1.3 ml) of a 2% cocaine solution into the space between two inferior dorsal vertebrae of a young dog. Within 5 min he noted first incoordination and later weakness and anaesthesia of the animal's hind quarters which resolved completely in approximately 4 h. In his next subject, a man who suffered with 'spinal weakness' and 'seminal incontinence', Corning injected 30 minims (~2 ml) of 3% cocaine into the T11/12 interspinous space. No effect was noted within 6-8 min and he repeated the injection.

Ten minutes later the subject remarked that his legs felt 'sleepy' and Corning could demonstrate 'greatly impaired' sensitivity to pinprick and electrical current in the legs, genitalia and lumbar region which advanced over 15–20 min. No motor weakness or gait disturbance was noted. The man made a full recovery but interestingly, Corning recorded that he complained of headache and vertigo the next morning. Thus it seems plausible that Corning's early experimentation resulted in inadvertent dural puncture, intrathecal injection and furthermore, the first report of a common complication even today – post-dural puncture headache (PDPH). His work was published in 1885 in a historic article entitled 'Spinal anaesthesia and local medication of the cord (1885)'^[1].

The stimulus for Corning's early work was more than likely derived from the contemporary investigations of William Halstead and Richard Hall, who as the directors of the Roosevelt Hospital (New York) Out-Door Department had been publicising demonstrations of local and regional anaesthesia with cocaine which Corning would certainly have followed^[2,3]. Corning himself continued to experiment with interspinous injection, later proceeding to intentional intrathecal injections in the treatment of various neurological conditions^[4,5]. Corning, whilst he appreciated the clinical value of spinal anaesthesia, never himself applied it in a surgical procedure.

It was 14 years after Corning's first publication that August Karl Gustav Bier (1861–1949), a German surgeon, published the first reports of successful spinal anaesthesia in surgery: 'Experiments with cocainization of the spinal cord'^[6]. In the intervening years notable advances had been made in the field of lumbar puncture^[7,8]. Bier actually administered the first spinal anaesthetic in 1898, publishing his results the following year. On August 16th 1898, in the first of six orthopaedic cases in his subsequent paper, Bier injected 15 mg of intrathecal cocaine in a 34-year-old worker undergoing resection of a tuberculous ankle joint. His description is remarkable for its similarity to the modern process; he described positioning the patient in the lateral position, infiltrating the skin and subcutaneous tissues with the cocaine solution, observing the flow of cerebrospinal fluid from a long hollow needle before injection of the anaesthetic solution into the 'dural sac'. He went on to perform five more spinal anaesthetics in the same month. Only in one patient was total anaesthesia achieved; five patients could still sense touch or pressure, but not pain. Furthermore in four of these patients, Bier reported complications including back and leg pain, vomiting and headache. Even at this early stage, he had associated the loss of cerebrospinal fluid with headache and discussed the risks of local anaesthetic toxicity. Within the same publication Bier describes the attempts of himself and his assistant, Dr Hildebrandt, to deliver cocaine spinal anaesthetics to one another. Sensation in the unfortunate Dr Hildebrandt was tested in various ways including a needle pushed down to the femur, burning cigars, avulsion of pubic hairs and strong blows to the tibia with an iron hammer, none of which resulted in pain. In spite of promising results, complications were recorded including parasthesia in a lower limb and the loss of 'much' cerebrospinal fluid. Bier reported that subsequently he experienced a severe headache, associated with dizziness which was relieved completely by lying flat for a total of 9 days^[6].

Discussion

Although his understanding of spinal anatomy was not entirely accurate, James Leonard Corning's early experiments were critical and paved the way for further advances in spinal anaesthesia as later made by Bier and his contemporaries. Corning's hypothesis that the interspinous blood vessels ('minute ramifications of the veins') communicated directly with the blood supply to the spinal cord would be corrected soon afterwards by Tate and Cagliari^[9]. What Corning produced in his first injection of the dog were the effects of a spinal anaesthetic; his subsequent injection of a man resulted in effects more akin to an epidural anaesthetic, albeit one with hallmarks of dural puncture. Bier's pivotal contribution of 1898 proved that cocaine spinal anaesthesia was a viable and effective modality of surgical anaesthesia. However, far from espousing the results of his work, he took a reserved stance on its role in surgery. 'The method will become useful only if the hazards and inconveniences associated with it are fewer than those involved in general anaesthesia'^[6]. His publication of 1899 precipitated a deluge of further research and publication on the subject. With this new wealth of clinical experience, the opinion of the medical establishment towards spinal anaesthesia became firmly circumspect; there was widespread concern over the frequency with which headache, nausea, infection, circulatory collapse and even death occurred^[10]. Whilst the early concept of spinal anaesthesia was

promising, its acceptance – as Bier had commented – first required advances in local anaesthetic agents, technique and equipment:

1. Advances in aseptic technique dramatically reduced the risk of meningitis and local infection. In 1907, Barker^[11] employed repeated scrubbing of the skin with a brush and hot, soapy water followed by application of antimicrobial compresses washed away with saline^[11].
2. Key developments in the spinal needle were also seen in the early 20th century with the development of atraumatic needles, designed to part dural fibres rather than cut them. The Greene needle (1923) had a smooth, rounded tip and was associated with a PDPH of only 4%^[12]. The concept was further improved to produce a needle with a solid conical point with the opening just proximal to the tip; this, the original Whitacre needle (1951), was a great success and its design is in use today with only small modifications^[13].
3. The toxic and addictive properties of cocaine drove the development of the first synthetic local anaesthetic agents. Procaine (Novocaine) was first employed in operative spinal anaesthesia in 1905 by the surgeon Heinrich Braun^[14]. It was later modified by combination with glucose to produce a hyperbaric solution with which Barker (1907) could manipulate the level of anaesthesia^[11]. Combination with adrenaline was found to increase the efficacy of these early agents^[15], although only with the subsequent development of lidocaine (1943), bupivacaine (1957) and prilocaine (1960) were the anaesthetic agents available to produce a rapid, potent and safe block lasting several hours^[16].

Through key developments such as these, the ‘hazards and inconveniences’ of which Augustus Bier and the medical establishment was so cautious were progressively addressed. Spinal anaesthesia grew in popularity but was never safe from setback. One notorious setback in the United Kingdom was the Woolley and Roe case, which recorded the fate of two healthy middle-aged men who, in 1947, were left paraplegic after receiving spinal anaesthetics on the same day, from the same doctor, at the Chesterfield Royal Hospital. The reason, it was concluded, was due to contamination of the equipment during the sterilization process^[17].

Although modern equipment and techniques have facilitated the universal acceptance of spinal anaesthesia, it is still subject to rigorous cycles of audit that monitor safety and efficacy. The 3rd National Audit Project of The Royal College of Anaesthetists (January 2009) reaffirmed that central neuraxial blocks (including spinal anaesthetics, epidurals and combined spinal epidurals) are beneficial and carry an acceptably low incidence of major complications^[18].

Summary

Spinal anaesthesia was first identified inadvertently by Leonard Corning in New York in 1885. Subsequently, August Bier employed the technique successfully for surgical anaesthesia in Germany in 1898. The opinion of the medical establishment towards early spinal anaesthesia was guarded but through progress in aseptic technique, anaesthetic compounds and equipment, spinal anaesthesia has grown in popularity and today has a firmly cemented role in modern anaesthesia carrying an acceptably low incidence of major complications.

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