

# The surgeons Halsted and Hall, cocaine and the discovery of dental anaesthesia by nerve blocking

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VERIFIABLE CPD PAPER

## IN BRIEF

- Describes the discovery and use of cocaine as an anaesthetic and the dangers of self-experimentation.
- Dr Halsted and his aide Dr Hall discovered the technique for blocking the inferior alveolar nerve and the antero-superior dental nerve using cocaine as an anaesthetic.
- Since its introduction, the anaesthetic technique described has been revolutionary in the practice of odontology.

GENERAL

William Stewart Halsted is considered to be one of the most influential and innovative surgeons the USA has ever produced. His contributions to surgery are abundant, ranging from sophisticated surgical techniques in the field of breast surgery, surgery of the digestive apparatus and traumatological interventions, to the introduction of gloves in the operating theatre. Here we present Dr Halsted, together with his aide Dr Hall, as the discoverers of the technique for blocking the inferior alveolar nerve and the antero-superior dental nerve using cocaine as an anaesthetic. The anaesthetic technique, described perfectly by both surgeons in 1885, has been revolutionary in the practice of odontology since its introduction, offering dentists the possibility of performing invasive interventions to the maxillary without pain.

## DISCOVERY

### Biographical data, travels, and training in Europe

William Stewart Halsted (Fig. 1) was born in New York in 1852. In 1875 he entered the College of Physicians and Surgeons at the University of Columbia (NY), earning a doctorate in Medicine in 1877.

He periodically travelled to Europe and, in Vienna, he worked as an assistant to Billroth, famed for his surgery of the digestive system. In Germany, he benefited from the teaching of prestigious surgeons such as Volkmann, Kaposi, Chiari and Zuckerland. In Switzerland he met Hermann Kocher, renowned for his surgical skills and knowledge of diseases of the thyroid gland, with whom, over the years, he developed a profound friendship.

In 1883, at the age of 36, he was awarded a professorship and became the Head of the Department of Surgery of the Johns Hopkins Hospital in Baltimore (Maryland),

and then went on to occupy the position of Chief of Surgery until 1922, when he died.<sup>1</sup>

Richard John Hall (Fig. 2), who was born in Ireland, emigrated as a child to New York. He followed medical studies at the College of Physicians and Surgeons at the University of New York, earning himself a Doctorate in Medicine in 1878. Like his colleague Halsted, he also travelled to Europe, visiting the best universities and clinics of those times.

In New York he worked as a surgeon at the Roosevelt Hospital and was the first, in 1886, to perform an appendectomy. In a cruel twist of fate, the man who had been pioneer in this type of intervention died of acute appendicitis on 24 January 1897.<sup>2</sup>

### THE DISCOVERY OF COCAINE AS AN ANAESTHETIC

We owe the first reference to the anaesthetic effects of coca to Spanish Jesuit Bernabé Cobo (1582-1657), who in his 1653 manuscript work on the New World, mentions that toothaches can be alleviated by chewing coca leaves.<sup>3,4</sup>

In 1884, Carl Koller reported the use of cocaine as a topical anaesthetic for the mucosa of the eye at a Congress of Ophthalmology in Heidelberg, held on 15 September of that year.<sup>5</sup>

News of Koller's discovery spread across the world faster than did the discovery of general anaesthesia, because



Fig. 1 William Stewart Halsted



Fig. 2 Richard John Hall

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communications had improved as transatlantic cables had been laid, thereby affording almost instantaneous telegraphic contact.

A doctor present at that Congress of Ophthalmology in Heidelberg, Dr Henry D. Noyes, from New York, sent a letter that was published on 11 October 1884 in the *New York Medical Records*, even before Koller made the presentation of his discovery in Vienna on 16 October the same year.<sup>6</sup>

Halsted and his colleague Hall learned about the discovery through the 'Noyes Report' addressing the Congress of Ophthalmology in Heidelberg, although some investigators consider that Halsted and Koller had already been meeting at the University of Vienna between 1878 and 1880 at the Department of Pathology of the Allgemeines Krankenhaus, where Koller worked next to Sigmund Freud.<sup>7</sup>

After that time, Halsted and Hall began their first clinical trials, initially infiltrating the nerve trunks with 4% solutions of cocaine injected into the branchial plexus and the posterior tibial nerve, using the hypodermic syringe described by Charles Gabriel Pravaz to do so. In this way they managed to perform painless operations on the upper and lower limbs. They also began to use cocaine subcutaneously as a local anaesthetic, following the technique developed by the Frenchman Reclus and the German Schleich.

In 1892, Dr Schleich was the first to publish a clinical report addressing more than 1,000 operations in which the cocaine infiltration technique was used, and he later presented his findings and the Annual Congress of the German Society for Surgery in Berlin.<sup>8</sup>

### THE DISCOVERY OF NERVE BLOCK ANAESTHESIA

In 1884, William Stewart Halsted was already a successful surgeon in New York. He had worked for two years in Berlin with Ernst von Bergmann and Karl Thiersch in Leipzig, and with Richard von Volkmann in Halle, where he became interested in asepsis and antisepsis and the study of the basic sciences and anatomy.<sup>9</sup>

When he returned to the USA, he started to work at the Roosevelt Hospital and in another four hospitals in New York, there meeting Richard Hall, with whom he began to develop nerve block anaesthesia, teaching their colleagues and students

in practical exercises. Halsted, Hall and their colleagues performed more than 1,000 painless minor surgical interventions at the Outpatient Department of the Roosevelt Hospital.

Halsted was a meticulous and very patient anatomist. He acquired a 4% solution of Cocaine from Parke Davies & Company (the extracting and distributing company of cocaine in the USA) and started to test it on his students at the College of Physicians and Surgeons in New York. The results were spectacular. When the cocaine was injected along the course of a nerve it anaesthetised the innervated region. However, it did have some undesirable side effects, such that it became necessary to dilute the solution in order to use lower doses, which also proved to be effective. One of the most striking applications was tooth extraction, which until then had always been extremely painful.

On the same day that the first article in English of Koller's work appeared in *The Lancet*, at the beginning of December 1884, Hall reported its results in the *New York Medical Journal*.

The Editor's comment accompanying the initial publication of Hall's findings recommended that the drug should not be considered innocuous, pointing out that Dr Hall himself had observed marked constitutional symptoms with the injection of 32 'minima' (1 'minima' = 0.059 ml) of a 4% solution of cocaine hydrochloride.

The self-experimentation was to have tragic consequences for the protagonists, who ended up completely addicted to the substance.<sup>10</sup>

### COCAINE ADDICTION

The frequent use of the alkaloid itself, for experimental ends, led to the doctors becoming addicted to the substance and they began to exhibit erratic social and professional behaviour; this in turn led to several admissions to hospital and cures to combat their addiction.<sup>11</sup>

For Halsted this meant the end of his career as a surgeon in New York. William H. Welch, a great friend and colleague of Halsted, was the person who – with great efforts and acting as a true friend – managed to rehabilitate the renowned surgeon and restore his reputation, offering him a place at his laboratory at the Johns Hopkins Hospital in Baltimore as

occupational therapy. Shortly afterwards, Welch hired a boat to sail to the Leeward Islands in February and March 1886 and, in turn, kept Halsted safely out of contact with cocaine.<sup>12</sup>

The trip did not prove to be the solution and not very long afterwards Welch and McBride, two of Halsted's friends, and even his brother Richard convinced him to check into the Butler Hospital (Providence, Rhode Island), which was a facility for alcoholics since in those times addiction to drugs was relatively rare. There, he remained under strict surveillance for six months. In those days he was consuming at least three 'grains' of cocaine a day (1 grain = 64.79891 mg), which is a dangerous amount.<sup>9</sup>

The key to the treatment received by Halsted was the replacement of cocaine by morphine.

In 1887, he entered rehabilitation again, this time for nine months, after which he returned to the laboratory and progressively resumed his clinical activities. Thanks to Welch's support, almost two years later in 1889 he was named, provisionally and for only one year, assistant professor and surgeon at the Johns Hopkins Hospital.<sup>1</sup>

His dedication to his work and his prowess as a surgeon led him to be awarded a professorship in 1892, despite his precarious state of health. There is considerable controversy as to whether Halsted finally managed to cure himself of the cocaine habit since despite his great achievements as a surgeon and professor there were sudden 'trips away' and he sometimes abandoned his post claiming different illnesses. In 1969, on the occasion of the eighth decade of the Johns Hopkins Hospital, a sealed black box was opened with a silver key; this box contained a secret report written by William Osler, who revealed that Halsted had tried to cure his addiction to cocaine by using morphine, and that it was his addiction to this substance that led to his death.<sup>9</sup>

In turn, Hall moved to Santa Barbara in California working as a surgeon in a rural hospital, although he was never to free himself of his own addiction.<sup>2</sup>

### DISCUSSION

Several researchers pre-empted Halsted and Hall in the description of nerve block

**Table 1 Contributions of the different authors to the discovery of the nerve blocking method**

Authors	Year	Contribution to the discovery
T. Moreno y Maiz A. Bennett	1868 1873	Sciatic nerve block in frogs
J. M. Da Costa	1875	Use of cocaine in dental interventions
W. B. Burke	1884	Ulnar nerve block by cocaine injection
W. S. Halsted R. J. Hall	1884	Cubital, anterosuperior, inferior alveolar and lingual nerve's block with cocaine and the use of the substance in topical application or infiltration
V. von Anrep	1890	Intercostal nerve block

anaesthesia with cocaine (Table 1).

Moreno and Maiz (1868) and Bennett (1873) had investigated the effects of cocaine in experimental animals, describing block of the sciatic nerve in frogs and suggesting the use of cocaine as a local anaesthetic.<sup>13,14</sup>

In 1875, Jacob Mendes da Costa also reported the successful use of cocaine administered hypodermically and described its usefulness in tooth extractions.<sup>15</sup>

W. B. Burke, from South Norwalk, Connecticut, reported in the *New York Medical Journal* the block of the ulnar nerve by cocaine injection in an intervention with the goal of removing a lead pellet from the little finger of a patient.<sup>16,17</sup>

In November 1884, the Russian Vassily von Anrep described the block of an intercostal nerve in a case of a broken rib, mentioning the possible use of cocaine in surgery and he was the first physician, in 1890, to use cocaine subcutaneously.<sup>18,19</sup>

Halsted claimed the authorship of anaesthesia by nerve blocking in two letters, one of them sent to Rudolph Matas, one of the greatest proponents of local and regional anaesthesia in the USA, and the other to Sir William Osler, referring to the book by James Leonard Corning, dealing with local anaesthesia and published in 1886, in which he complained that Corning's book was based almost exclusively on Halsted's own work.<sup>20</sup>

In November and December 1884, Halsted and Hall also sent reports to the *New York Medical Journal* in which they told of their experiences in the production of nerve block with cocaine in the cubital nerve, the anterosuperior alveolar nerve, the inferior alveolar nerve and the lingual nerve, as well as the use of cocaine in the form of topical administration or in infiltrations.<sup>21,22</sup>

Both were pioneers in the development of the block of different nerves, in describing the superiority of intradermal injection over the hypodermic route, and the possibility of obtaining adequate anaesthesia, using the lowest amounts of dilute solutions of cocaine. They pre-empted Schleich and Reclus by several years, although unfortunately they never published two papers written in 1886 and 1902 concerning the use of cocaine as an anaesthetic in different types of surgical intervention.<sup>9</sup>

Although Halsted and Hall were not the first physicians to perform nerve blocks, they should both be considered pioneers in describing many nerve block techniques of great use in dentistry and oral surgery.

In April 1922, just six months before Dr Halsted's death, the American National Dental Association recognised the significance of Halsted's discovery in local and regional anaesthesia, presenting him with a gold medal and giving him full credit for the discovery of neuroregional anaesthesia.<sup>20</sup>

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