Review

Update in Anaesthesia

The Discovery of Anaesthesia

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Abstract

This article traces the discovery of modern anaesthesia in North America.

Key words: anaesthesia, anaesthesiology, pain, surgery

INTRODUCTION

The modern era of anaesthesia began abruptly in Boston, Massachusetts, on the morning of Saturday, 7 November, 1846.[1] A young woman, Alice Mohan, underwent an above-knee amputation after inhaling ether.[2] To the stunned amazement of the large audience in the hospital operating theatre, she later reported she had felt no pain as her limb was sawed off. The profound anaesthetic effects of ether had been discovered, and the world had changed forever.

EARLY BACKGROUND

The chain of events leading to this decisive clinical experiment were long, complex, and controversial. Ether was first synthesized as early as the 16th century. The volatile oily liquid was used as a solvent and cleaning agent but also had apparent medicinal uses. It was occasionally drunk as a gastrointestinal antispasmodic and inhaled as a bronchodilator. It was also well known as a recreational drug, inhaled to give the user an intoxicating high.

Another gas, nitrous oxide, was first synthesized in 1772 by the English chemist Joseph Priestley. Humphry Davy noted its exhilarating effects when he inhaled it experimentally in 1799. These euphoric qualities resulted in nitrous oxide soon becoming an entertaining novelty at parties and traveling exhibitions. Although Davy suggested in passing that nitrous oxide might be useful for surgical analgesia, this idea was overlooked.

Before the discovery of anaesthesia, the lack of effective analgesia profoundly limited the scope and effectiveness of surgery. Surgical operations were performed rapidly on patients who endured in silent agony or screamed and thrashed in pain. For centuries, surgeons had searched for an effectual way to alleviate operative pain. However, by the early 19th century, no universally effective analgesic had been found.[3]

HORACE WELL AND NITROUS OXIDE

Dental disease, one of the commonest surgical conditions, became the catalyst for the discovery of surgical anaesthesia and the controversy that followed. In 1842, Horace Wells, an innovative American dentist from Hartford, Connecticut, developed a new dental solder.[4,5] Seeking expert validation of his invention, he consulted with the region's leading chemist, a Harvard University Professor, Charles T. Jackson.[5] An expert in multiple fields and widely read, Jackson was a medical doctor, a chemist, and an expert geologist.[6] Accompanied by his dental trainee, William T. Morton, Wells travelled to Boston, Massachusetts, to meet with Jackson.

Jackson certified the safety and purity of Well's new gold solder, a key recommendation from a highly regarded authority.[5] In partnership with Morton, Wells set up a dental office in Boston. However, Wells soon lost confidence in Morton, whom he discovered to be dishonest and a heavy drinker.[5] The partnership was dissolved amicably in 1844, with Wells focusing on his practice back in Connecticut.

In December 1844, Wells attended a public exhibition of effects of nitrous oxide.[4,5] One of the volunteer subjects fell against a chair after inhaling the gas, injuring his leg, but felt no pain. It was this observation, according to later accounts, that prompted Wells to think of nitrous oxide as an analgesic. He had a molar tooth painlessly extracted after inhaling nitrous oxide the next day. Encouraged by the analgesic effects, he began offering painless tooth extractions in his Hartford practice. By the end of the year, he has successfully given nitrous oxide to

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over a dozen patients.[7-9] He also successfully tried inhaled ether for a minor surgical procedure but concluded that nitrous oxide was easier to use.[10]

Seeking broader recognition by the medical profession, Wells arranged a demonstration in Boston, a centre of medical expertise, in January 1845.[7,8,11] Unfortunately, the nitrous oxide was administered poorly, and the patient cried out in pain. The sceptical audience of medical students dismissed the effectiveness of the gas, and Wells left Boston humiliated. Struggling with profound depression, he temporarily abandoned his dental practice and, with it, his use of nitrous oxide.[7,8] The effectiveness of nitrous oxide for dental analgesia was mentioned by a Hartford colleague in the *Boston Medical and Surgical Journal* later in 1845[12] but seemingly without attracting wider attention.[13]

WIILLIAM MORTON AND ETHER

Wells' former apprentice Morton continued his dental practice in Boston. Curious about Well's success with nitrous oxide, he decided to trial the gas in his own practice. In October 1846, he approached Jackson to ask advice on nitrous oxide. Jackson instead suggested ether,[3,14,15] which he had inhaled as a bronchodilator some years previously and considered safe to use.[16]

On 30 September, 1846, Morton administered ether to a dental patient and extracted a tooth without pain. At Jackson's suggestion,[16] in early October, Morton approached John Collins Warren, Professor of Surgery at Harvard University, a founder of the Massachusetts General Hospital (MGH) in Boston, and one of the leading surgeons in America. Warren agreed to let Morton try his unspecified analgesic on his next surgical patient.[3,17]

The next operation Warren scheduled was on an inpatient at the MGH, Gilbert Abbott. Abbott had a congenital lymphovascular malformation in his tongue and submental area.[18] He had been admitted to the MGH some weeks earlier, probably for observation of his neck mass prior to surgery. Warren planned to make a small neck incision and insert a stitch to attempt to cut off the blood flow to the cyst.

On Friday, 16 October, 1846, Morton gave ether to Abbott in the operating theatre at the MGH, using a makeshift vaporizer. Warren made a small incision and tied off an artery leading to the cyst. As Warren dissected around the blood vessel, Abbott moved and moaned. He later said he was unaware of the initial incision but felt as if someone was scraping his neck as the procedure ended.[1,3] Warren was initially unconvinced of the effectiveness of the gas but agreed to repeat the experiment the next day.[14,17]

On Saturday, his surgical colleague George Hayward excised a large lipoma from the arm of a woman after Morton administered ether.[1-3] On recovering consciousness, she reported no pain. Ether had promise; more research was needed.

HENRY J. BIGELOW AND FURTHER INSIGHTS

Further progress with surgical procedures halted while Morton filed a patent application,[3] with Jackson as a co-applicant. Morton continued to experiment with ether in his private practice, successfully providing analgesia for many patients for dental extractions. Unsurprisingly, the results of the inexperienced anaesthetist were not without complications—one patient had life-threatening apnoea;[1] in others, analgesia was ineffective;[9] and still others suffered severe coughing. Fortunately, no one died, and Morton persisted in initiating drug-induced comas.

Present at the initial MGH experiments was a junior surgeon, Henry J. Bigelow.[1,19] He visited Morton's office and witnessed the successful use of ether for dental extractions.[1] Impressed by what he had seen, he arranged for further clinical experiments at the MGH. He also presented an abstract at the American Academy of Arts and Sciences on 3 November, outlining the potential effectiveness of ether to his professional colleagues.

THE DISCOVERY OF ANAESTHESIA

Later that week, on the morning of November 10th, the MGH operating theatre was packed with over 200 spectators: medical students, doctors, clergymen, lawyers, and others.[20] Alice Mohan, a young woman with an infected knee, was carried into the room and laid onto the operating table, her diseased leg extending over the edge. Morton gave her ether to inhale, and after three minutes, she lost consciousness. The surgeon George Hayward sliced open her thigh and sawed through the femur with a hacksaw in less than two minutes. As Hayward tied the final stitches onto bleeding arteries, Mohan regained consciousness. Ether had worked: she said she had felt no pain until the last moments of the operation.[1,2,20]

The next patient that morning was Betsey Magoun, a 53-year-old woman with a large tumour in her lower jaw, probably an ameloblastoma, a tumour arising from dental enamel.[21] She too inhaled ether, and then John Collins Warren sliced open her cheek, laid back the flap, and began to saw the mass from her mandible. Blood flowed freely from severed arteries and ran down her throat. Under light inhalational anaesthesia, she abruptly turned blue and stopped breathing. The operation had to be halted as attempts were made to revive her.[17] Fortunately for the patient—and for the future of anaesthesia—she recovered. The operation was completed without anaesthesia, the patient suffering greatly.

The profound potential as well as the possible fatal dangers of ether had been conclusively demonstrated to a large and influential audience. Previous experiments with dental extractions and minor procedures under ether were suggestive prologue; the two major operations under ether anaesthesia removed any doubt as to the effectiveness of the inhaled vapor.

SPREAD OF THE NEWS

Bigelow published an account in the *Boston Medical and Surgical Jornal* on 18 November.[1] He opened his article, 'It has long been an important problem in medical science to devise some method of mitigating the pain of surgical operations. An efficient agent for this purpose has at length been discovered. A patient has been rendered completely insensible during an amputation of the thigh, regaining consciousness after a short interval. Other severe operations have been performed without the knowledge of the patients.'

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Surgeons began cautiously trialling ether soon afterwards. An increasing number of operations and procedures were performed under ether inhalation at the MGH,[3,21,22] while surgeons and dentists in Boston began using ether in private practice.[2,14,23] Outside of Boston, ether was used successfully in Salem, New York City, and beyond within weeks.[24,25]

By December, news had crossed the Atlantic. In an echo of the events in Boston, on 19 December, a tooth was painlessly extracted after ether was inhaled. Two days later, surgeon Robert Liston used ether for a leg amputation at University College Hospital. Ether anaesthesia spread rapidly across Britain, Europe, and eventually worldwide, revolutionizing the practice of surgery.

Ether was also successfully trialled for labour analgesia.[26,27] The ability to produce effective labour and surgical analgesia radically transformed management of complicated births.

CONTROVERSY, LIES, AND FAILURE

In Boston, controversy erupted as to who had discovered inhalational anaesthesia. While Jackson and Morton had been initially credited with the novel insight,[1] Well's prior experience with nitrous oxide was cited as the sentinel work.[8,10,13] Jackson asserted he had conceived of the idea independently, based on his prior use of ether. Morton, a man of limited education, claimed to have thought of the idea alone and denied any help from Jackson or Wells.

Working through a lawyer, Morton slandered the reputation of Jackson, attacking his academic record. He also denigrated the prior work of Wells. Wells responded with well-documented testimonials confirming his earlier success with nitrous oxide and ether.[7] Jackson went further, researching Morton's prior background. Morton, it emerged, was a serial conman and prolific fraudster.[28] Well's earlier insights into Morton's personality,[5] it turned out, were accurate.

Ultimately, none of the three men benefited from the discoveries. Beset by mental illness, Wells committed suicide in January 1848.[5] Jackson maintained his claims but died without widespread recognition of his role in the discovery, his reputation stained by Morton's smears.[6] Morton continued his fabrications[29] and attempted to monetize his role in the discovery, but his patent was never successfully enforced.[28]

The United States Congress considered offering a large financial award to the discoverer of anaesthesia. However, a physician in Georgia, Crawford Long, had successfully used ether for a number of operations since 1842 but had neglected to publish his results or communicated his findings to the wider medical profession.[30] Confronted with multiple claimants to the first discovery of anaesthesia, Congress never awarded any money.[28]

CONCLUSION

From a modern perspective, it is clear the dramatic morning of 7 November was the confluence of multiple events. Wells had the creativity as an inventor to try nitrous oxide but not the mental health or good fortune to consolidate his initial work; Jackson had the insight as an academic to consider ether but not the pressing need as a clinician to test his theory; and Morton, unencumbered by education or concern for others, had the personality to persist in the dangerous human experimentation with a potent and potentially fatal drug to the point of inducing surgical anaesthesia.[15]

Others may have considered ether previously, but all had held off out of abundance of appropriate caution. Fortunately for humanity, the combined efforts of these three men converged in the revolutionary experiment that initiated the modern era of surgery, obstetrics, and Anaesthesia.

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