● History Article

The Contribution of John Lundy in the Development of Peripheral and Neuraxial Nerve Blocks at the Mayo Clinic: 1925-1940

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Under the leadership of Dr. John S. Lundy the Mayo Clinic saw a dramatic shift in the practice of anesthesiology during the 1920s, largely in response to the increasing complexity of the surgical procedures. The Mayo Clinic had already established a reputation for excellence in the surgical treatment of abdominal and rectal cancer. Prior to the introduction of curare in 1941, complete abdominal muscle relaxation was difficult to safely obtain under deep ether anesthesia. As the number of intra-abdominal operations grew, the limitations of general anesthesia became obvious, and attention was focused on regional anesthesia as an alternative. Previously, the objection to regional anesthesia had been the rather frequent occurrence of untoward drug reactions.[1] Thus, the challenge for the anesthesiologist became one of balancing safety with the need for new anesthetic techniques. With the development and refinement of these new techniques, the need for specialized training in the field of anesthesiology was recognized. It was the responsibility of the Section on Regional Anesthesia at the Mayo Clinic to safely administer a combination of both general and regional anesthesia.

The Beginning of Regional Anesthesia at the Mayo Clinic

In 1900, Dr. William Mayo traveled to Paris, France for the International Medical Congress meeting. It was there that Dr. Mayo met Dr. Theodore Tuffier and was first familiarized with the method of spinal anesthesia. Although, Dr. Mayo was quite impressed with Dr. Tuffier's work, he feared that spinal anesthesia would lead to irreparable damage of the central nervous system.[2] From 1900 until 1919, the methods of anesthesia at the Mayo Clinic had remained largely unchanged. The satisfaction of the surgeons with the delivery of anesthesia alleviated any desire to search for new anesthetic techniques. However, this did not deter Dr. William Mayo's brother, Dr. Charles Mayo, from striving to discover new advancements in the field of anesthesia. This mission led Dr. Charles Mayo to Europe in 1920.

While in Europe, Dr. Charles Mayo visited Dr. Victor Pauchet and subsequently met Dr. Gaston Labat. Dr. Labat had trained in Paris under Pauchet, with whom he helped write the third edition of Pauchet's renowned book, *L'Anesthesie Regionale*. Dr. Mayo was so impressed by Dr. Labat's work in regional anesthesia, he persuaded him not only to return to Rochester as a special lecturer in regional anesthesia, but also to write a book on regional anesthesia for the American medical audience. (Letter from Gaston Labat to Charles Mayo, undated, but around August 1921, Mayo Foundation Archives, Rochester, Minnesota.) During his short stay at the Mayo Clinic, Dr. Labat spent the majority of his time lecturing to surgeons and demonstrating regional anesthetic techniques. Concurrently, he began to work on his textbook, *Regional Anesthesia: Its Technic and Clinical Application.* After less than a year at the Mayo Clinic, Dr. Labat moved to New York City where he continued to practice regional anesthesia.[3]

As the Mayo Clinic's reputation as a center of surgical excellence grew, it became imperative to appoint a dedicated physician not only to develop, but also to integrate the specialty of anesthesiology. It was around this time that Dr. William Mayo met

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a young, ambitious physician at a medical meeting in Seattle. Dr. John Silas Lundy impressed Dr. Mayo with his enthusiasm for anesthesiology and research, and was immediately invited to join the Mayo Clinic Staff.[4] Thus, in 1924, at the age of 30, Dr. Lundy joined Drs. William and Charles Mayo in Rochester, as the head of the Section on Regional Anesthesia (Fig 1).

Dr. Lundy's interest in anesthesia began as a schoolboy, when he helped the town doctor administer general anesthesia to the people in the local community.[5] At that time, there were no official training programs for physicians interested in practicing anesthesiology. Shortly after arriving at the Mayo Clinic, Dr. Lundy invited Dr. Charles F. McCuskey to join the section as a trainee in anesthesia on July 1, 1925. The following year, Dr. McCuskey became the second member of the Section on Regional Anesthesia and remained on staff until 1933. With these 2 members, the Section on Regional Anesthesia became formally recognized. This allowed residents from medicine and surgery to train for 3 or more months in the special techniques performed by Drs. Lundy and McCuskey (Fig 2).

Fig 1. John Silas Lundy, M.D. (Courtesy of the Wood Library-Museum of Anesthesiology.)

Fig 2. Dr. Lundy demonstrating the technique used for sacral blocks. (By permission of Mayo Foundation for medical education and research.)

The high quality of the training, as well as the demand for physicians trained in regional techniques, attracted many fine, young physicians to Dr. Lundy's program. Among these physicians was Dr. Ralph Waters who reported for a volunteer assistantship in regional anesthesia in July of 1926.

In 1929, a 3-year fellowship that led to a degree of M.S. in anesthesia was established. The fellowship included clinical experience in: anesthesia, transfusion of blood, use of oxygen and helium, and 6 months of research. The techniques mastered by Dr. Lundy's trainees were numerous. Most notable were sacral blocks, field blocks, cervical blocks, and spinal anesthesia. Many of these techniques were used consistently over the 15-year period studied (Fig 3). At the time of Dr. Lundy's retirement in 1959, the Section on Regional Anesthesia had successfully trained more than 90 residents in regional anesthesia. (Rehder K, Southorn P, Sessler A. *Art to Science*. Rochester, MN, Mayo Clinic, 2000, pp 23-42.)

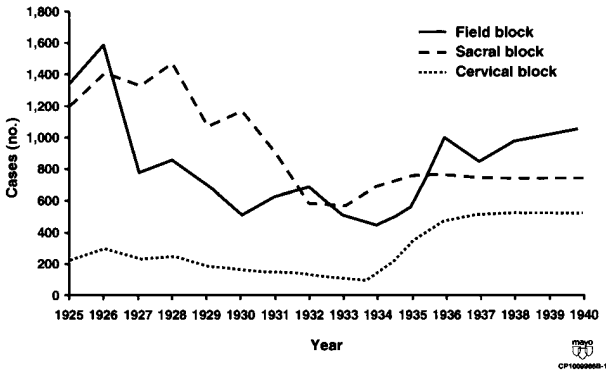

Fig 3. Number of cases performed at the Mayo Clinic using cervical blocks, sacral blocks, and field blocks (includes abdominal wall blocks) between 1925 and 1940.

Methods of Regional Anesthesia

Dr. Lundy wrote in 1925, "an objection to regional anesthesia in the past was the rather frequent occurrence of marked untoward drug reactions. Experience has shown that this result may be avoided by a deliberate unhurried technique."[1] With the increase in permanent personnel to the Section on Regional Anesthesia, it became possible to perform this deliberate, unhurried technique described by Lundy. The percentage of regional anesthesia compared with the total number of anesthetics at the Mayo Clinic grew steadily from 1925 to 1931, after which time it remained relatively stable at approximately 25% to 30% (Fig 4). The development of new local anesthetics also made regional anesthesia safer. For many years, Procaine was essentially the only local anesthetic available for spinal, regional, and local methods. In 1931, butylaminobenzoid acid-β-dimenthylamino-ethylestermonohydrochloride (Pantocain, Hoechst, Germany) was introduced. Its longer duration of action soon made it the local anesthetic of choice for prolonged procedures.[6] Lundy believed that the individual patient's tolerance to local anesthetics was directly related to age, heart rate, blood pressure, weight, rate of injection, and the skill of the anesthetist.[7] Intravascular injection was frequently the cause of sudden major untoward reactions. Prior to the introduction of vasoactive medications, hypotension was a common problem. With intramuscular or intravenous injection of either epinephrine or ephedrine, the morbidity associated with severe hypotension was lessened. Oxygen therapy also advanced the level of safety in the field of anesthesiology. Lundy wrote in 1933 that patients suffering from vascular depression during spinal anesthesia could greatly benefit by inhalation of oxygen either alone, or mixed with carbon dioxide.[8] In addition, oxygen was also noted to relieve the nausea associated with spinal anesthesia.

Fig 4. The percentage of surgical procedures performed under regional anesthesia at the Mayo Clinic from 1925 to 1940.

Regional Techniques Used at the Mayo Clinic

At the Mayo Clinic, abdominal blocks were one of the most frequently used forms of regional anesthesia. If the abdominal wall was anesthetized well, the skin, fat, muscle, and parietal peritoneum could be painlessly incised.[9] Abdominal blocks were performed when general anesthesia was contraindicated in patients having a laparotomy, hernia procedures, or cystoscopy. Abdominal blocks were also often intentionally combined with general anesthesia. Puncturing the viscera appeared to be the main complication of this technique. With the Mayo Clinic surgeons having a reputation for excellence in operations of the bowel, the administration of a successful abdominal block, either alone or combined with general anesthesia, was imperative.

Equally important to Lundy and his surgical colleagues was the successful administration of a sacral block. The Mayo Clinic attracted many patients with lesions of the colon and rectum. Sacral blocks were used frequently for these procedures, with great success, as well as minimal untoward effects. Lundy wrote in 1935, "For anal operations, sacral block is without a doubt the best method of anesthesia. It provides relaxation without much prostration, and it avoids the distortion of the anus that results from infiltration."[10] In the 1920s, sacral blocks were preferred over spinal anesthesia for procedures on the anus due to the lack of a lumbar puncture headache. Sacral blocks could be accomplished through a single injection of the caudal canal through the sacral hiatus, although the block appeared to be more successful if the first 4 sacral foramina on each side were injected posteriorly as well. After 1928, as spinal anesthesia became safer, sacral blocks were used less often.

Dr. Lundy reintroduced spinal anesthesia at the Mayo Clinic in July of 1927, for a select group of patients for whom muscle relaxation was essential. This group consisted of those with malignant lesions of the large bowel or an intestinal obstruction.[11] The use of subcutaneous ephedrine as a supportive and prophylactic measure in patients receiving spinal anesthesia was largely responsible for the successful reintroduction of this technique (Fig 5). It was found that with the subcutaneous injection of ephedrine 15 to 20 minutes before the subdural injection, the incidence of severe hypotension decreased. Nausea and vomiting were often associated with intra-abdominal procedures. This side effect was usually treated with morphine premedication and a combination of oxygen and carbon dioxide. It is clear from his report in 1927 that Lundy not only understood the drawbacks of spinal

Fig 5. Spinal anesthetics as a percentage of total regional techniques at the Mayo Clinic between 1926 and 1940.

anesthesia, but that he also realized its potential as a great regional technique. Lundy wrote, "Spinal anesthesia will have been used in a larger number of cases in 1928 than in 1927, however, I believe that its extended use will depend on the employment of a technique which will safely permit the production of more enduring anesthesia."[11] It also became apparent that if hypoxia could be avoided, death under spinal anesthesia might be prevented. As 1928 ended, both the frequency and severity of untoward reactions associated with spinal anesthesia had significantly decreased. Lundy then turned his attention to increasing the duration of spinal anesthesia, without sacrificing safety.

Regional anesthesia for operations on the head and neck were popular prior to the 1930s due to the limited options available for general anesthesia. Prior to the introduction of intratracheal anesthesia, it was very difficult to safely anesthetize a patient for an operation on the head and neck. The specific technique used would depend on the location and duration of the surgical procedure. The most popular regional techniques were deep and superficial cervical blocks. A combination of these blocks were often used for operations on the thyroid gland. For procedures on the larynx, a superior laryngeal block was frequently used. The surgeon or anesthesiologist would preoperatively perform a field block near the area of incision. The field block served 2 goals: the obvious reduction in surgical stimulation, as well as realization of a bloodless surgical field. However, after the introduction of Magill's intratracheal method of administering a general anesthetic, cervical blocks were only used on those patients who were unsuitable for general anesthesia. Similarly, the scalp could be infiltrated using a circumscribed infiltration of the area with local anesthetic for intracranial operations. This technique was described as the separate infiltration of 3 distinct layers. The intradermal injection blocked the superficial layer, the subcutaneous injection blocked the layer between the skin and the cranium, and the injection against the bone blocked the periosteum.[10]

Conclusions

Regional anesthesia became an integral part of the practice of anesthesiology at the Mayo Clinic during the 1920s and 1930s. As the Mayo Clinic became known as a center of surgical excellence for intra-abdominal surgery, it was crucial that the Section on Regional Anesthesia refine their anesthetic techniques. For this reason, abdominal blocks and sacral blocks were frequently used during the time period studied. Prior to 1929, sacral blocks were regarded as the most satisfactory method of producing anesthesia and relaxation for operations of the rectum, perineum, cervix, and anus. This technique was essentially abandoned with the increasing use of spinal anesthesia. The dramatic increase in the number of spinal blocks can be directly linked to the introduction of premedication, vasoactive drugs, and oxygen. After spinal anesthesia was found to be a safe anesthetic alternative, it gained popularity for several reasons: the technique was easily performed, the patient experienced relatively little discomfort, the complete muscle relaxation facilitated the work of the surgeon, and the lack of postoperative complications was appealing.

The training program initiated by Dr. Lundy allowed both new and experienced physicians to learn and perfect the regional anesthetic techniques used routinely at the Mayo Clinic. Many of Dr. Lundy's trainees would subsequently leave the Mayo Clinic and assert their newly found regional skills across the country. Lundy's training program allowed anesthesiologists to administer state of the art anesthesia to patients at the Mayo Clinic and ultimately impact the practice of anesthesiology worldwide.

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