Documenting the discovery of anesthesia: The Crawford W. Long Museum

Key words: Anesthesia history; biography; Crawford W. Long Museum; Crawford Williamson Long; ether, first use as an anesthetic.

Life of Crawford W. Long, MD (1815-1878)
Crawford W. Long, MD, a physician and pharmacist, was the first to use ether anesthesia for painless surgery. The event took place in Jefferson, Georgia, on March 30, 1842. Anesthesia's discovery has long been recognized as one of the most important advances in modern medicine. Crawford Williamson Long was born on November 1, 1815, the son of James Long, a successful planter and merchant in Danielsville, Georgia (Figure 1). He entered Franklin College (now the University of Georgia) at the early age of 14 and received a master of arts degree in 1835.

Crawford Long began his study of medicine in Jefferson (which is 20 miles from Athens and 60 miles northeast of Atlanta) with George Grant, MD. Traveling to Lexington, Kentucky, in 1837, he took his first course of lectures at the Medical Department of Transylvania University. He completed his medical studies at the University of Pennsylvania, receiving a degree in 1839. For the next 18 months, the new Dr. Long practiced in New York hospitals until returning to Jefferson in the fall of 1841 where he bought the office of his preceptor, Dr. Grant.

In the 1830s, the social fad of inhaling "laughing gas" became popular. As a medical student, Dr. Long participated in these "frolics" using ether nitrous oxide or sulfuric ether. Dr. Long's Jefferson office became a popular gathering place for the young men of the area. He gave them sulfuric ether since he had no nitrous oxide. Long noticed that
participants under the influence of ether felt no pain even though they suffered cuts and bruises from falling down. This observation manifested itself in a theory that ether could be used in surgical procedures to block the normal response to pain.

On March 30, 1842, the opportunity to test his theory came when James Venable requested Dr. Long to remove a cyst from his neck. Mr. Venable was given ether on a towel to inhale during the procedure. Afterward, Mr. Venable reported feeling no pain during the operation. The surgery was a success—Crawford W. Long had discovered anesthesia. By the time he read about the public administration of anesthesia for a surgery by William Thomas Green Morton in Boston, Massachusetts, in October 1846, Dr. Long had performed at least six other operations using ether. He had made no secret of his work; all of his surgeries were witnessed and known of by the physicians in the area. Throughout his medical career, Dr. Long continued to use ether anesthesia in his practice for minor and major surgeries, amputations, and childbirth.

Crawford Long took no immediate steps to publicize his discovery, however, preferring to experiment until he was convinced of ether’s anesthetic properties, safety, and universal application. Encouraged by family and colleagues, Long wrote a scholarly article for the *Southern Medical and Surgical Journal*. "An Account of the First Use of Sulfuric Ether by Inhalation as an Anesthetic in Surgical Operations" was published in December 1849. Acknowledgment of his achievement has been overshadowed by the controversy brought about by the claims of Horace Wells, William Thomas Green Morton, and Charles Jackson, each of whom sought credit for anesthesia’s discovery. Ultimately, the weight of evidence, especially the affidavits secured from former patients and witnesses, has swayed the verdict of history in Dr. Long’s favor.

Dr. Long married Mary Caroline Swain a few months after the landmark operation. They resided in a home next to his office in Jefferson where the first four of their 12 children were born. In 1850, in hopes of acquiring a larger practice, Dr. Long moved his family to Atlanta. Dissatisfied with Atlanta, a year later the Long’s moved to Athens to be closer to family and friends. Dr. Long entered into a partnership with his brother, also a physician, and they operated a drugstore on Broad Street across from the college campus. Dr. Long returned often to Jefferson to treat friends and relatives or to tend to matters relating to his farms in Jackson County. His death occurred while he was attending a patient on June 16, 1878, and he is buried along with his wife and several children in Oconee Cemetery in Athens.

**Crawford W. Long Museum, Jefferson, Georgia**

In 1951, a local committee interested in founding the Crawford W. Long Memorial Museum was formed. The committee raised half the purchase price of the two-story brick building believed to be on the site of Dr. Long’s medical office in Jefferson. The Georgia Historical Commission (a state agency) matched the amount, and the structure was secured in 1952. Restoration work was begun in that year with funding from then Governor Herman Talmadge and later from Governor Marvin Griffin. The work was completed in 1957 and the Crawford W. Long Memorial Museum opened to the public on September 15.

After seven years, when the Georgia Historical Commission decided to close the facility, the city of Jefferson and the Crawford W. Long Museum Association assumed ownership. Much needed financial support was obtained through the efforts of Atlanta anesthesiologists, who effected a system for regular contributions to be made from the Georgia Society of Anesthesiologists and the Medical Association of Georgia. Financial support from these groups was instrumental in funding a complete refurbishing in 1979 and for the extensive expansion project and design of exhibits in 1987 which resulted in the present-day three-building complex (Figure 2).

The Crawford W. Long Medical Museum building, the original museum structure, was built c.1879 by J.B. Pendergrass, MD, as his doctor’s office and drugstore (Figure 3). On display are personal items belonging to Crawford Long and his family and displays which illustrate the advancements in modern anesthesia (Figure 4). The focal point is a highly detailed diorama depicting the first painless operation on March 30, 1842. The museum has an expanding collection of anesthesia machines and equipment on display, and numerous videos are available for viewing on Dr. Long, the discovery of ether, the “ether controversy,” and the practice of anesthesia.

The entrance building formerly served as Jefferson physician J.T. Stovall’s medical office. It was incorporated into the museum during the 1987 expansion (Figure 3). Exhibits cover the history of Jackson County with texts and photographs along with changing displays in three floor cases. Also housed in the Stovall Building is the museum’s archives and collections on Dr. Long and area history, some of which is stored in a humidity- and temperature-controlled “vault.”

The third building is the Pendergrass Store, a
Greek Revival structure, now an outstanding example of adaptive use (Figure 3). The front section facing Sycamore Street was built in 1858 as a dry goods store, with the rear section added in the 1880s. There are two exhibit areas in the building: a 19th century general store and a typical 1840s doctor's office and apothecary shop which is being furnished with supporting displays describing the
The mission of the Crawford W. Long Museum is: to preserve, interpret, and promote the achievements, life and times of Crawford W. Long, Georgia physician and the discoverer of anesthesia. Medical and pharmaceutical equipment is still being sought for the period doctor’s office; store stock items and anything relating to Dr. Long and anesthesia’s development are needed as well. Monetary donations are always welcomed. The museum’s funding currently comes from the city of Jefferson, the Medical Association of Georgia, the Georgia Society of Anesthesiologists, Friends of the Museum, donations, and sales at the museum “store.” Sketches of the museum, commemorative Coca Cola® bottles (created to mark the sesquicentennial anniversary of anesthesia’s discovery), Crawford Long T-shirts, and biographical pamphlets are among the many items available for purchase. Plans are underway for an endowment fund campaign to begin in late 1996.

After serving as the researcher for the expansion project, Susan B. Deaver was hired in 1988 as the museum’s first director. The current president of the Museum Association is Kelly G. Hillis, a bank president in Jefferson. In 1994, Eugene J. Murdock, CRNA, became the first nurse anesthetist to serve on the museum’s board of directors.

Conclusion

Commemorating Dr. Long’s contribution to medical science has taken many forms. Georgia citizens chose him as one of their two representatives for Statuary Hall in the U.S. Capitol building in Washington, DC; his statue was dedicated in 1926. When a two-cent postage stamp was released on April 8, 1940, the first day-of-issue celebration was attended by thousands in Jefferson (Figure 5). March 30 was selected as the date for Doctors’ Day in honor of Crawford W. Long for his first documented use of ether anesthetic. The citizens of Jefferson have always been at the forefront of the bat-
tle to secure recognition for their former resident. Nowhere can their commitment be recognized better than in the Crawford W. Long Museum.

The museum is open Tuesday through Saturday from 1:00 to 5:00 pm, other times by appointment, at no cost to the public. Guided tours can be arranged by reservation, and a visit can include a viewing of documentaries and programs on Dr. Long and anesthesia. The museum is located in downtown Jefferson, which is about 60 miles northeast of Atlanta, just 5 miles south of Interstate 85 on U.S. 129. For more information, contact the Crawford W. Long Museum at 28 College Street, Jefferson, Georgia 30549; phone (706) 367-5307.

SUGGESTED READING


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Susan B. Deaver, Med. HSP, has served as the first director of the Crawford W. Long Museum since 1988. She has a background in education and holds a master's degree in heritage preservation.
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**References**

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INDICATIONS AND USAGE
Sevoflurane is indicated for maintenance of general anesthesia in adult and pediatric patients for inpatient and outpatient surgery.

CONTRAINDICATIONS
Sevoflurane can cause malignant hyperthermia; it should not be used in patients with known history of sensitivity to sevoflurane or to other halogenated agents.

PRECAUTIONS
Sevoflurane should be administered only by persons trained in the administration of general anesthesia. Facilities for maintenance of a patent airway, artificial ventilation, oxygen enrichment, and circulatory support must be immediately available. Since levels of anesthetic gases can vary rapidly, only vaporizers producing predictable concentrations of sevoflurane should be used.

Compound A is produced when sevoflurane interacts with soda lime. Its concentration in a circle absorber system increases with increasing absorber temperature and increasing sevoflurane concentrations and with decreasing fresh gas flow rates. In compliance with the definition of Compound A, a dose of Compound A does not contain enough of the compound to cause malignant hyperthermia.

2. During maintenance of anesthesia, the required dose of nondepolarizing muscle relaxants is likely to be reduced compared to that used during nonhalogenated anesthesia. Administration of supplemental doses of muscle relaxants should be guided by the response to nerve stimulation.

The effect of sevoflurane on the duration of depolarizing neuromuscular block induced by succinylcholine has not been studied.

Bradyarrhythmia 5%, Hypotension 4%, Tachycardia 2%

Indications for dantrolene sodium intravenous for additional information on these patients has not been established.

Nerworth: The concentrations of sevoflurane in milk are probably of no clinical importance 24 hours after anesthesia. Because of rapid washout, sevoflurane concentrations in milk are predicted to be below those found with many other volatile anesthetics.

Sevoflurane may present an increased risk in patients with known sensitivity to volatile halogenated anesthetics.

PREGNANCY
During the maintenance of anesthesia, increasing the concentration of sevoflurane produces dose-dependent decreases in blood pressure, and to sevoflurane in CN rats. Its concentration in a circle absorber system increases with increasing absorber temperature and increasing sevoflurane concentrations and with decreasing fresh gas flow rates. In compliance with the definition of Compound A, a dose of Compound A does not contain enough of the compound to cause malignant hyperthermia.

The clinical syndrome is signaled by hypercapnia, and may include muscle rigidity, tachycardia, fever, hypotension, tachycardia, and unstable blood pressure. Some of these nonspecific signs may also appear during light anesthesia, acute hypoxia, hypercapnia, and hypovolemia.

Trendelenburg positioning in hypercapnia includes disconnection of triggering agents, administration of intravenous dantrolene sodium, and administration of high concentration of carbon dioxide. The result producing information for dantrolene sodium intravenous for additional information on patient management. Renal failure may appear later, and urine flow should be monitored. Sevoflurane may present an increased risk in patients with known sensitivity to volatile halogenated anesthetics.

Drug Interactions
In clinical trials, no significant adverse reactions occurred with other anesthetics or drugs used in the perioperative period, including central nervous system depressants, autonomic drugs, skeletal muscle relaxants, and sympathomimetic and synthetic derivatives, and cardiovascular drugs.

Sevoflurane administration is compatible with barbiturates, propofol, and other commonly used intravenous anesthetics.

Benzodiazepines and Propofol
Benzodiazepines and propofol should be expected to decrease the MAC of sevoflurane in the same manner as with other inhalational anesthetics. Sevoflurane administration is compatible with benzodi- azepines and opioids as commonly used in surgical practice.

Nitrous Oxide
As with other halogenated volatile anesthetics, the anesthetic requirement for sevoflurane increases when administered in combination with nitrous oxide. Using 50% N2O, the MAC equivalent dose requirement is reduced approximately 50% in adults, and approximately 25% in pediatric patients (SEE DOSAGE AND ADMINISTRATION).

Neuromuscular Blocking Agents
As with any other volatile anesthetics, sevoflurane increases both the intensity and duration of neuromuscular blockade induced by nondepolarizing muscle relaxants. When used to supplement anesthesia, neuromuscular blocking agents in concentration may result in delayed onset of conditions suitable for endotracheal intubation or inadequate muscle relaxation.

Adult Patients
Cardiovascular: Bradycardia 5%, Hypotension 4%, Tachycardia 2%
Nervous System: Agitation 7%
Respiratory System: Laryngospasm 8%, Airway obstruction 8%, Breathing 5%. Physiological 5%
Digestive System: Increased salivation 2%

Pediatric Patients
Cardiovascular: Tachycardia 8%, Hypotension 4%
Nervous System: Agitation 15%
Respiratory System: Laryngospasm 5%, Cough increased 5%
Laryngospasm 3%, Apnea 2%
Digestive System: Increased salivation 2%

Adverse Events During the Induction Period (from onset of anesthesia to mask induction surgical incisional) 1%

Adult Patients (N = 118)
Cardiovascular: Bradycardia 5%, Hypotension 4%, Tachycardia 2%
Nervous System: Agitation 7%
Respiratory System: Laryngospasm 8%, Airway obstruction 8%, Breathing 5%. Physiological 5%

Pediatric Patients
Cardiovascular: Tachycardia 8%, Hypotension 4%
Nervous System: Agitation 15%
Respiratory System: Laryngospasm 5%, Cough increased 5%
Laryngospasm 3%, Apnea 2%
Digestive System: Increased salivation 2%

Adverse Events During the Maintenance Period (from onset of anesthesia to mask induction surgical incisional) Incidence >1% (N = 2906)

Age of Patient (years) Sevoflurane in Oxygen Sevoflurane in 65% O2/D0% N2O
0 – 1 months 3.3% 3.3% 3.3%
1 – 6 months 2.8% 2.8% 2.8%
6 months – 2.5% 2.5% 2.5%
2.5% 2.5% 2.5%
25 2.6% 1.4%
40 2.1% 1.1%
60 1.7% 0.9%
80 1.4% 0.7%

# Neotenes are full-term gestational age. MAC in premature infants and neonates, 5 – 3% sevoflurane with or without the concomitant use of nitrous oxide. Sevoflurane can be administered with any type of anesthesia circuit.

MAC Values for Adults and Pediatric Patients According to Age

Surgical levels of anesthesia can usually be achieved with concentrations of 0.5 – 3% sevoflurane with or without the concomitant use of nitrous oxide. Sevoflurane can be administered with any type of anesthesia circuit.

Dosage and Administration
The concentration of sevoflurane being delivered from a vaporizer during anesthesia should be known. This may be accomplished by using a vaporizer calibrated specifically for sevoflurane. The administration of general anesthesia must be individualized based on the patient’s response.

Pre-anesthetic Medication
No specific premedication is either indicated or contraindicated with sevoflurane. The decision as to whether or not to premedicate and the choice of premedication is left to the clinical judgment of the anesthesiologist.

Induction: Sevoflurane has a nonpungent odor and does not cause respiratory irritability; it is suitable for mask induction in children and adults.

Maintenance: Surgical levels of anesthesia can usually be achieved with concentrations of 0.5 – 3% sevoflurane with or without the concomitant use of nitrous oxide. Sevoflurane can be administered with any type of anesthesia circuit.