

# Pediatric Anesthesia: A Historical Perspective

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**The subspecialty of pediatric anesthesia has come a long way since its origin in Jefferson, Georgia,** when Dr. Crawford Long administered the first documented ether anesthetic to an 8-year-old boy for a toe amputation on July 3, 1842.<sup>1</sup> Thus began the practice of pediatric anesthesia in the hands of an observant rural physician. Dr. Long, however, did not publish his anesthetic practice until three years after William T.G. Morton, a dentist, performed the first demonstration of ether anesthesia at Massachusetts General Hospital. Overseas, Dr. John Snow in London advanced the practice even further by providing chloroform anesthesia to infants under the age of 1. In capable hands, this practice was a success, but in those less experienced, chloroform produced fatal hypotension and cardiac arrests.<sup>2</sup> From the very beginning, it was clear that children were at higher risk than adults for anesthesia-related complications and death because of differences in their physiology, anatomy and functional development. Indeed, between the 1840s and the 1940s, anesthesia for children was such a risky endeavor that few parents, surgeons or pediatricians would advocate for surgery except in the most dire circumstances.

The progression of pediatric anesthesia as a subspecialty arose from the evolution of pediatric surgery. On December 6, 1917, the city of Halifax, Nova Scotia, awoke to one of the largest man-made accidental explosions in history. A French cargo ship, the S.S. Mont-Blanc, carrying wartime explosives collided with an unloaded Norwegian S.S. Imo.<sup>3</sup> In response to the catastrophic emergency, a young surgeon/gynecologist



*Photo taken by Dr. Albert Miller, ca. 1897-98. It is the first operation done for appendicitis by Dr. Charles McBurney. Note the ether cone, which is the forerunner of the first open ether method developed by Dr. Miller. (Photo courtesy of the Wood Library-Museum of Anesthesiology)*

from Boston, William Ladd, M.D., traveled to Halifax to aid the 9,000 men, women and children who were injured in the blast. As a result of his experiences in Halifax, Dr. Ladd resolved to become a pediatric surgeon and dedicated his career to advancing the field of pediatric surgery. As the father of pediatric surgery, Ladd devoted his talents to creating this subspecialty at Children's Hospital of Boston. The advancements in abdominal, cardiac and neonatal surgeries of Ladd and his successors, Drs. Robert Gross and C. Everett Koop, demanded increasingly refined anesthetic skills.<sup>4</sup>



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Figure 1. Pediatric Anesthesia Timeline Before the 1960s

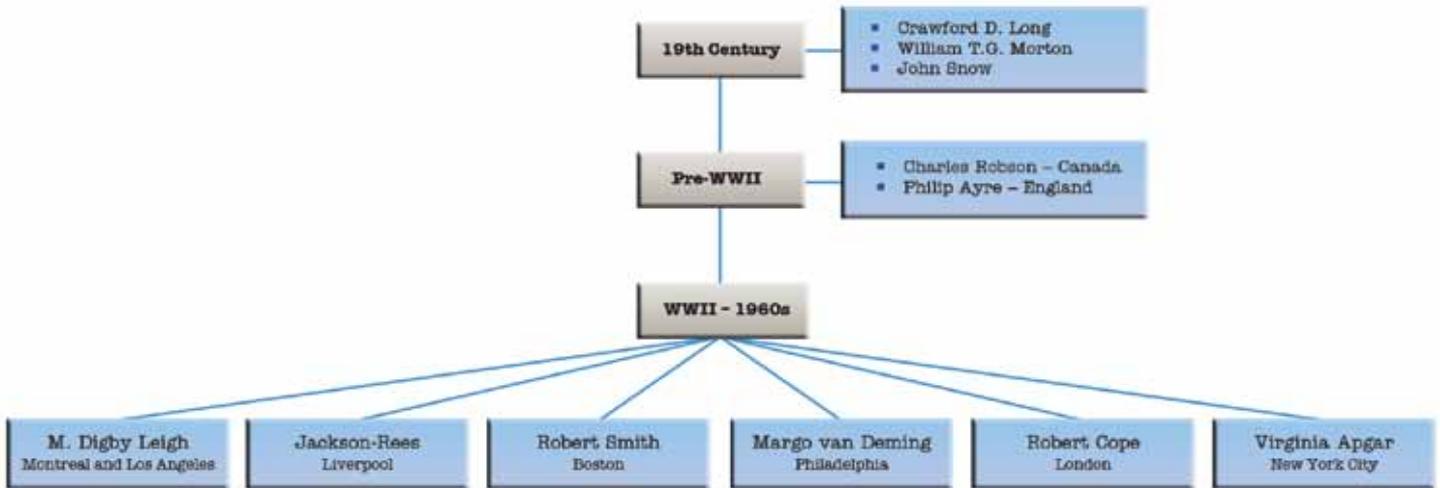
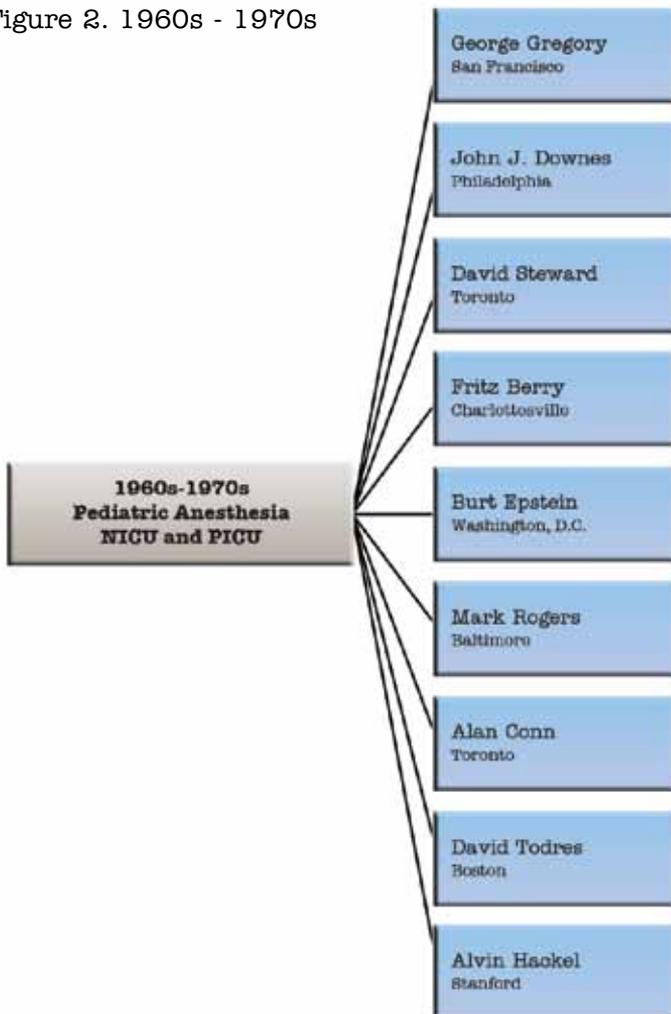


Figure 2. 1960s - 1970s



Dr. Charles H. Robson from Toronto's Hospital for Sick Children was perhaps the first pediatric anesthesiologist. His practices of administering open-drop ether and cyclopropane and his use of tracheal intubations in children in the 1930s demonstrated early research in pediatric anesthesia.<sup>2</sup> Dr. Philip Ayer's contribution of the "T-piece," Dr. Robert M. Smith's invention of the precordial stethoscope, Dr. Margo van Deming's works on anesthetic blood levels in infants, and Dr. Digby Leigh's pediatric breathing apparatus and first textbook are among the pioneering influences that helped shape the early phases of pediatric anesthesia (Figure 1).<sup>2,5</sup> These events coincided with the elevation of anesthesiology to a specialty rank distinct and equal to surgery and medicine, with its own board (1938) and training programs. In the 1960s and '70s, pediatric anesthesia entered into its first explosive period of growth fueled by translational discoveries in human biology, including fundamental understandings of the transition from fetal to postnatal circulation. Research on homeostatic regulation of fluids, electrolytes, metabolism, temperature regulation, physiologic monitoring of blood gas tension, mechanical ventilation and cardiopulmonary resuscitation helped to create entirely new subspecialties of pediatric and neonatal intensive care (Figure 2). The epidemics of polio in Europe and North America brought a need for mechanical ventilation and specialized units of health care providers. Among the leaders of this group of pediatric intensivists, Drs. John Downes and Leonard Bachman opened the first PICU in North America at Children's Hospital of Philadelphia in 1967. Concurrently, in San Francisco, Dr. George Gregory and his colleagues

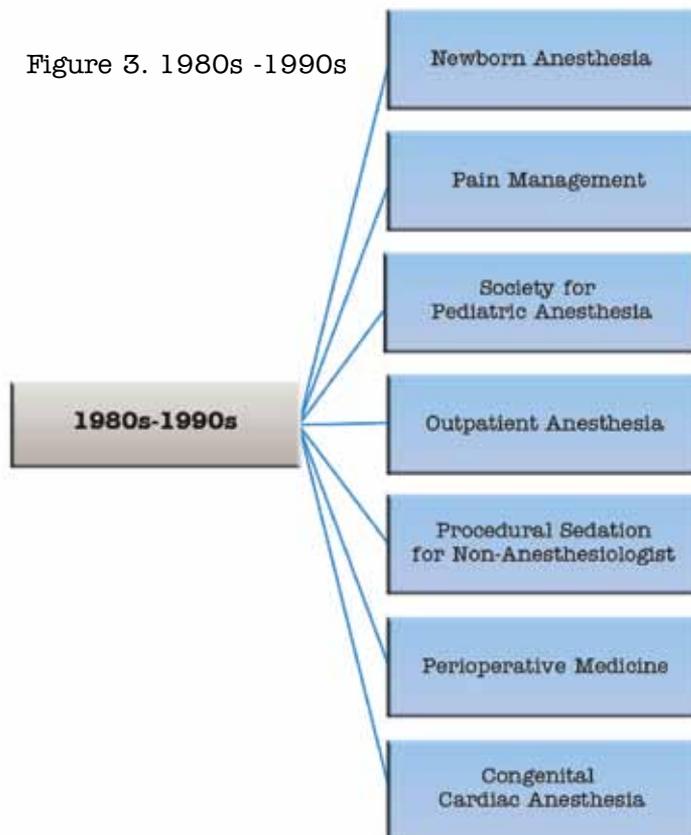
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provided therapeutic advances in pulmonary care for premature infants with respiratory distress syndrome. Dr. Gregory's invention of continuous positive airway pressure (CPAP) and his work in the NICU at UCSF paved the way for progress in neonatology. Subsequently, Drs. Stephan Kampschulte and Peter Safar of Pittsburgh, James Gilman and Norman Talman of New Haven, David Todres and Daniel Shannon of Boston, Alan Conn of Toronto, Peter Holbrook of Washington D.C., Mark Rogers of Baltimore, and Robert Crone of Boston, among others, formed critical care units in their respective hospitals.<sup>2</sup> These pioneers set the stage for the profession as it exists today.

The 1980s and '90s were transformative years that established pediatric anesthesia as its own formal subspecialty, with training programs, textbooks, journals and subspecialty organizations (Figure 3, page 12). During this "golden era," anesthesia moved from the confines of the operating room to become the mortar holding the bricks of the hospitals and outpatient centers by delivering comprehensive health care. It became clear to many leaders in the field that pediatric fellowship training, which had existed in an ad hoc fashion for at least four decades, needed to be formalized and recognized by the ACGME and RRC. A "Gang of Seven," including Drs. John Downes, Alvin Hackel, Peter Rothstein, Mark Rockoff, Michael Badgwell, Steven Hall and Raeford Brown, worked tirelessly to advocate for a pediatric anesthesia fellowship to be accredited by the ACGME in 1997. In the 1980s, patient safety concerns came to the fore with the growth of surgicenters, procedural sedation by non-anesthesiologists, and burgeoning remote anesthesia

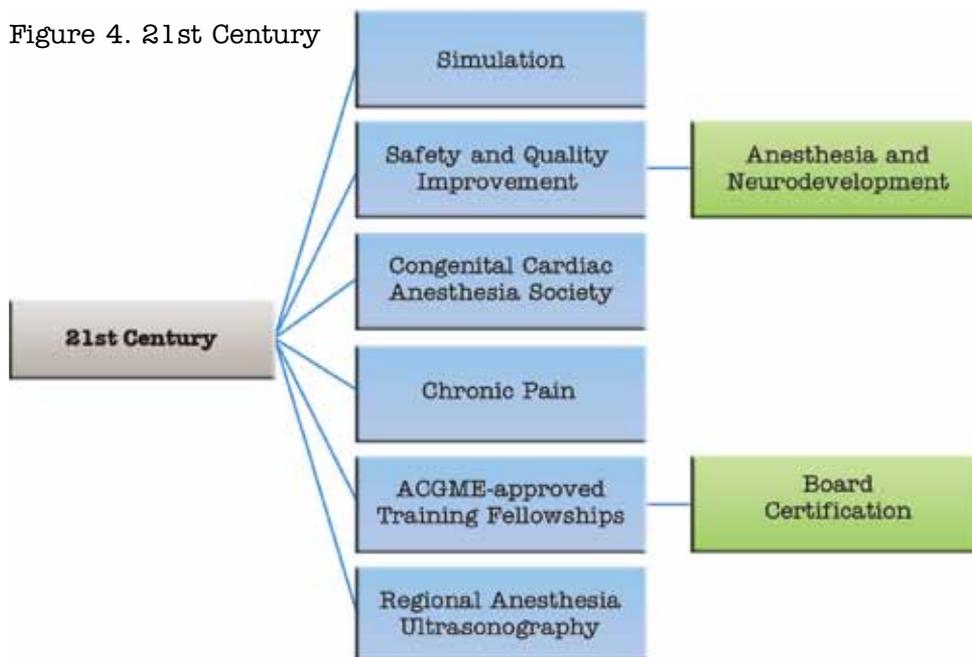
Figure 3. 1980s -1990s



sites outside of the operating rooms. Recognizing the potential for strengthening pediatric health care policies, Drs. Charles Coté and Theodore Striker wrote the "Guideline for Sedation and Monitoring of Children by Non-anesthesiologists," which was approved by the American Academy of Pediatrics as the

standard of safety. In 1991, Drs. Elliot Krane and Don Tyler of the Children's Hospital of Seattle (now at Stanford and Children's Hospital of Philadelphia, respectively) launched the first World Conference of Pediatric Pain. This conference was the springboard for the development of an entirely new subspecialty of acute and chronic pediatric pain management. Pediatric anesthesiologists expanded beyond the confines of the operating rooms and ICUs to provide pain management throughout the hospitals and outpatient centers. Among the founding pediatric pain pioneers were Drs. Elliot Krane, Don Tyler, Charles Berde, Myron Yaster and Steve Waisman, to name a few.

Figure 4. 21st Century



As popularity of this young subspecialty blossomed in the mid-1980s, recognition of the need for an inclusive subspecialty society for pediatric anesthesia (not of pediatric anesthesiologists) became apparent. The Society for Pediatric Anesthesia (SPA) was founded by one of the authors (Myron Yaster, M.D.) with the spirit to foster research, education and patient care, and to provide a venue for personal physician-to-physician networking. The first meeting took place in October 1987, the day before the ASA Annual Meeting, with only a handful of members. Today, SPA has over 3,000 members and two annual meetings. One of the key hallmarks of the society has been its openness, sense of familial camaraderie (“we are brothers and sisters with different parents”) and inclusivity.

The evolution of pediatric anesthesia continues at an ever-faster pace. The 21st century (Figure 4, page 12) has seen the development of two new subspecialty societies within pediatric anesthesia, namely the Congenital Cardiac Anesthesia Society, founded by Drs. Dean Andropoulos (Texas Children’s Hospital), Chandra Ramamoorthy (Stanford University) and others; and the Special Interest Group on Pediatric Pain Medicine, founded by Drs. Sabine Kost-Byerly (Johns Hopkins University), Rita Agarwal (Denver Children’s Hospital) and others. Several entirely new fields have been spawned as well, most notably simulation, patient safety and quality improvement. As stated above, pediatric anesthesia was once so dangerous that it was feared and avoided. We’ve obviously come a long way but can never become complacent. Starting with the Pediatric Perioperative Cardiac Arrest registry (Dr. Morray and colleagues) in the 1990s, the need for more systematic data collection

and quality and performance improvement has led to the development of “Wake up Safe,” a quality improvement multicenter consortium of SPA member institutions led by Drs. Dean Kurth (Cincinnati Children’s Hospital), Genie Heitmiller (Johns Hopkins University) and Don Tyler (The Children’s Hospital of Philadelphia); “Safe Kids,” a private-public partnership of FDA and IARS to study the effects of anesthesia on neurologic development; and the Pediatric Regional Anesthesia Network, developed by Drs. Lynn Martin (Seattle Children’s Hospital) and David Polaner (Children’s Hospital of Denver). Finally, after many false starts, the ACGME and the American Board of Anesthesiology have approved the formal training of pediatric anesthesia, with an accredited board certification coming in 2012-2013. This formal recognition of our specialty, along with the journals, textbooks and handbooks devoted to the field, provide a bright and unlimited future to young physicians entering into it and to our patients who benefit from their expertise and devotion.

**References:**

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Timeline of Pediatric Critical Care in North America	
1959	Baltimore City Hospital: Peter Safar, M.D., chief anesthesiologist, established first multidisciplinary adult and pediatric ICU in the U.S.
1967	Children’s Hospital of Philadelphia: John Downes, M.D. and Leonard Bachman, M.D. established the first PICU in the U.S.
1967	UCSF: George Gregory, M.D., helped establish NICU.
1969	UCSF: George Gregory developed a method to deliver CPAP to infants.
1969	Children’s Hospital of Pittsburgh established by Stephan Kampschulte, M.D. and Peter Safar, M.D.
1969	Yale-New Haven Hospital: James Gilman, M.D. and Norman Talner, M.D. established PICU.
1971	Massachusetts General Hospital, Boston: David Todres, M.D. and Daniel Shannon, M.D. established PICU.
1971	Hospital for Sick Children, Toronto: Alan Conn, M.D. established PICU.
1976	Children’s National Medical Center, Washington D.C.: Peter Holbrook, M.D. established PICU.
1976	Johns Hopkins Hospital, Baltimore: Mark Rogers, M.D. established PICU.
1980	The Children’s Hospital, Boston: Robert Crone, M.D. established PICU.