



# Fifty Years of General Anesthesia in California Oral and Maxillofacial Surgery

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A review of the general anesthesia techniques used in oral and maxillofacial surgery during the last 50 years of the 20th century cannot be fully appreciated without referencing at least briefly, what took place in the previous 106 years that encompassed the discovery and development of general anesthesia to the mid-20th century. Dental students learn with pride that W.T.G. Morton and Horace Wells were two dentists credited with the discovery of general anesthesia in the middle 1840s.<sup>1</sup> Nitrous oxide was the primary agent that found acceptance and widespread use in dentistry, largely through the actions of Gardner Colton, who established a group of dental practices that specialized in tooth extractions. Ether, ethylene, and chloroform were widely used in medicine, but nitrous oxide use was refined by Elmer I. McKesson and Jay A. Heidbrink, who developed anesthesia machines that could deliver precise proportions of oxygen and nitrous oxide.<sup>2</sup>

Oral surgeons in the early 20th century through the 1930s used nitrous oxide as their primary agent to induce general anesthesia. Alfred Einhorn of Germany discovered procaine in 1905 and local anesthesia became common in the United States three decades later for routine dental procedures. But it was the exodontists (later called oral surgeons)

who continued to use nitrous oxide to eliminate the pain associated with removal of teeth until intravenous anesthesia became available and popular.

In Southern California, Lock Hales, DDS, started an exodontia practice in Glendale in 1929. He first worked with Frank Chandler, DDS, in Hollywood and learned the nitrous oxide, oxygen desaturation method that was intro-

Berto Olson, DDS. In one year, he converted that nitrous oxide practice to a thiopental practice. He then moved to Long Beach where he opened his own practice, which eventually became a dominant force in Southern California and throughout the nation in popularizing the technique of intravenous thiopental and later methohexital (Brevital) for general anesthesia in oral surgery.<sup>5</sup>

Six of Hubbell's students, Frank M. McCarthy DDS, MD; Bill Bogart, DDS; Howard Davis, DDS; Bill Wagner, DDS; Ralph O'Brien, DDS; and Robert Steiner, DMD, staffed the first hospital-based outpa-

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tient thiopental dental general anesthesia training program at the Los Angeles County General Hospital in 1956. Marsh Robinson, DDS, MD, had become chief of oral surgery in 1954 and was able to enlist the support of Sam Denson, MD, head of medical anesthesia at the hospital at that time. That program continues today at the Los Angeles County/USC Medical Center, where future oral and maxillofacial surgeons are learning the latest techniques in office general anesthesia.

duced and popularized by McKesson 30 years earlier.<sup>3</sup> He learned that orally administered pentobarbital (Nembutal) improved his working time and did not require hypoxic levels of nitrous oxide. Orlan K. Bullard, DDS, in San Diego and Dr. Barkley Wykoff in Santa Barbara began using a new intravenous agent, hexobarbital (Evipal) in 1936, but both oral surgeons subsequently changed to thiopental (Pentothal) because of its greater versatility.<sup>4</sup>

Adrian Hubbell, DDS, learned about the studies being done at the Mayo Clinic with thiopental, and he spent three years in a surgical fellowship there to learn as much as possible about this technique. He returned to Los Angeles in 1940 and worked in Hollywood with Frank Chandler's successor in practice,

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Hubbell introduced the use of succinylcholine into oral surgery practice in order to treat laryngospasm. He described administering increasing doses to himself and colleagues. They discovered that 5 mg was sufficient to “break” most spasms and that a full depolarizing dose was not necessary. He developed an administration device that allowed him to administer a small dose of thiopental rapidly, which he called the “surge technique.” The “Hubbell Bubble” is still used by a few oral surgeons. It was possible for an oral surgeon to begin practice as Hales did using nitrous oxide and to progress through the use of oral barbiturates in combination with nitrous oxide, and then to go on to use intravenous thiopental and finally methohexital in a 30-year span of practice. Our predecessors in practice from 1930 to 1960 lived through a period when revolutionary changes took place.

The 1950s encompassed a period when refinement of techniques for intravenous general anesthesia occurred. The use of thiopental alone came under criticism from proponents of balanced anesthesia techniques in which meperidine (Demerol) was given as an adjunctive agent to raise the pain threshold, reduce the amount of thiopental needed, and reduce unpleasant and painful emergence from general anesthesia. It became common to administer local anesthesia after the patient was asleep to provide postoperative pain relief and to reduce intraoperative bleeding. Atropine and scopolamine were sometimes added to the balanced techniques to reduce secretions, and block the vagus nerve thus preventing bradycardia. Monitoring was still in its infancy, and no oral surgery office used intra-operative electronic monitoring. Monitoring was common although rudimentary in hospital general anesthesia.

Two schools of thought developed in dentistry and oral surgery regarding anesthesia techniques, represented by

the “purists” or single agent proponent — most prominently the Hubbell group and his disciples — and the “balanced technique” group, who used atropine, a narcotic such as meperidine, methohexital, and local anesthesia. Each group claimed superiority for their preferred technique, and gave convincing arguments for their favorite method.

The 1960s saw the introduction of benzodiazepines, principally diazepam (Valium), which was first administered

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orally and then intravenously. Some surgeons used diazepam as their only intravenous agent along with local anesthesia, nitrous oxide/ oxygen, and found this technique successful. Many surgeons began using methohexital as their principal barbiturate. The onset of methohexital anesthesia was similar to thiopental but the duration of action was shorter and the occurrence of laryngospasm less frequent. Methohexital was given in a 1 percent solution, and thrombophlebitis seemed less frequent than with the more concentrated 2.5 percent solution of thiopental. This unpleasant complication again became more frequent when diazepam was injected in small veins, with or without other drugs.

In the 1970s, fast-acting, short-duration synthetic narcotics were introduced. Fentanyl (Sublimaze) was being used in hospital general anesthesia cases often as the sole intravenous agent along with nitrous oxide/oxygen, and was found to be very safe for debilitated patients undergoing major procedures. One complication, “rigid chest syndrome,” occurred infrequently and only when higher doses of fentanyl were used. In the hospital environment, this complication can be easily treated with muscle

relaxants, but this is not practical in office oral surgery. When given in amounts up to 100 micrograms, Fentanyl has rarely been associated with this complication, and smaller doses were established for use in office general anesthesia. Fentanyl continues to be used in many practices. Fentanyl clearly raises the pain threshold, works quickly, and is short acting. Other synthetic narcotic agents such as pentazocine (Talwin) and oxymorphone (Numorphan) were introduced, but for the majority of surgeons they were not as useful as fentanyl.

Meanwhile, new monitoring devices were being introduced, and older progressive surgeons and young surgeons finishing training were more comfortable using these electronic devices to assess patients under anesthesia. Simple monitors to indicate pulse rate were first introduced. The electrocardiograph (ECG) was being used commonly in hospitals but was thought by oral surgeons to scare patients. Consequently, many surgeons were reluctant to use this device. It would be another decade before oral surgeons added the ECG to their monitoring armamentarium and then only after state regulations made possession and use of the device mandatory.

During that decade, the public became more aware of the ECG and chest leads through the entertainment media and television shows. The automatic sphygmomanometer was introduced and became well accepted. It is easy to use, gives the pulse rate in addition to the blood pressure, and alerts surgeons to sudden changes in blood pressure preoperatively, intraoperatively, and postoperatively.

In the 1980s even better things were in store for oral surgeons monitoring their patients. The pulse oximeter was introduced, displaying blood oxygenation as a percent of oxygen-saturated hemoglobin. Moment-to-moment

changes were revealed and at last, a monitor was available that could answer the most critical question, "Is the patient getting sufficient oxygen?" This device soon became the single most important monitor and is required to be present in every office utilizing pediatric oral sedation, intravenous sedation, or general anesthesia.

Today, the pulse oximeter, the ECG, and continuous blood pressure devices form the basis for monitoring patients undergoing office general anesthesia in oral surgery practices in California and throughout the United States.

A new benzodiazepine agent midazolam (Versed) appeared in this decade. This agent was found to have a rapid onset of action, much faster metabolism than diazepam, and above all was not a cause of thrombophlebitis. Midazolam has become the standard intravenous benzodiazepine for the vast majority of surgeons who utilize these drugs.<sup>5</sup>

By the 1990s, research in anesthesia had seen the development of another class of intravenous anesthetic agents. The new drug propofol (Diprivan) is a white liquid that looks much like milk when seen in the syringe. Propofol has a smooth, rapid onset of action and duration of action similar to methohexital. However, many patients exhibit a markedly rapid emergence when the drug is used alone. Since methohexital was being used primarily by oral and maxillofacial surgeons (a relatively small market segment) and not by medical anesthesiologists, the manufacturer sold the rights to produce the drug and during the early 2000s, methohexital was intermittently unavailable. Some surgeons returned to using thiopental, but many took the lead of medical anesthesiologists and began using propofol as their main intravenous agent.<sup>6</sup>

A few surgeons began to rely on ketamine (Ketalar), an intravenous or intra-

muscular drug that had been available since the late 1960s but which displayed hallucinogenic side effects that many felt were unacceptable. Emergence hallucinations, which were not prominent in children, were very distressing to adults. Very often, ketamine acted much like an LSD experience that persisted in some individuals for a prolonged period.

In very much reduced dosage, ketamine has been used in children and adults to produce a dissociative state,

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where the patient appears awake but is cooperative and retains protective reflexes. The drug is commonly used in medical emergency rooms in the management of the very young. Still, one-third of dentists using this drug report that they have seen emergence hallucinations in their patients.<sup>5</sup>

During the 50 years that oral and maxillofacial surgeons were depending on intravenous agents, the search for an ideal inhalation anesthetic continued. In the late 1950s halothane (Fluothane) was introduced. This potent agent displayed rapid onset, a relatively pleasant odor, and the ability to produce a surgical plane of anesthesia quickly. It became very popular in hospital-based anesthesia and was the standard until newer gases in the same class displayed better characteristics. The reason halothane did not become more popular in the office environment was that it had the potential to cause cardiac arrhythmias and death if not carefully monitored and precisely given.

In 1996, a new inhalation anesthetic was introduced and again was initially used in hospital-based operating rooms. This agent, sevoflurane, has most of the properties of an ideal inhalation anesthetic.<sup>7</sup> It is pleasant to smell, nonirritat-

ing to the airway, and does not increase pharyngeal secretions or stimulate laryngospasm. The onset of anesthesia is rapid and when used in children, there is usually very little or no excitement phase. Most important, sevoflurane does not cause myocardial irritability common with Halothane. The major disadvantage to its use at this time is cost.

Presently, sevoflurane is used primarily in children to produce a smooth induction of anesthesia before placement of an intravenous line and in some very short cases, as the sole anesthetic agent. In adults, sevoflurane has the potency to permit the removal of four third molars while providing for a rapid and smooth emergence.

Postoperative nausea has been very infrequent with sevoflurane. It has been predicted that this agent will become increasingly popular with oral surgeons during the coming decade.

### Summary

In summary, the advances of the last half of the 20th century in general anesthesia delivery by oral and maxillofacial surgeons are the following:

1. Oral and maxillofacial surgeons in training are exposed to significantly more hospital general anesthesia training and in addition spent much of their residency training performing general anesthesia on outpatient dental patients undergoing dentoalveolar surgery. Training programs increased from one year to three years, then to four years and finally, many six-year programs were developed that award the MD degree during or following completion of the residency program.

2. Self-evaluation programs were initiated in the late 1960s and evolved into mandatory in-office evaluation by peer practitioners and later into state-regulated evaluation. These programs began in Southern California and spread to encompass the entire United States.

3. Intravenous ultra-fast acting bar-

biturate office anesthesia became very refined and several combination drug “balanced” techniques developed.

4. Benzodiazepines, first diazepam then midazolam were introduced and gained wide acceptance by the dental profession.

5. New synthetic narcotic agents were introduced, which give the oral surgeon another pain control and anesthesia supplement. The new agents were short acting but very effective for the period necessary to complete most office surgical procedures. Fentanyl is the prototype for these agents.

6. Monitoring devices were incorporated into practice, and currently all oral surgeons use the pulse oximeter, the electrocardiograph, and blood pressure monitoring devices. All of these

monitors are required by the California general anesthesia regulations.

7. Propofol, an entirely new type of intravenous agent, was introduced and is used by more than half of oral surgeons reporting in a survey of drugs used in 2003.<sup>5</sup> Propofol may be used by incremental injection or by continuous infusion incorporating an automatic infusion pump.

8. Sevoflurane, a potent inhalation anesthetic that has many properties of an ideal agent — rapid onset, potent, easily delivered by calibrated vaporizers, rapid emergence, infrequent post-operative nausea, and favorable acceptance by almost all patients about to undergo general anesthesia — is gaining acceptance and use by oral and maxillofacial surgeons. **CDA**

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