

## Survey of Anesthetic Fatalities in Oral Surgery and a Review of the Etiological Factors in Anesthetic Deaths\*

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■ Anesthetic fatalities, when they occur in a dental office, are usually highly publicized in the press. These reports present a picture completely out of proportion to the frequency of such fatalities. On the other hand, anesthetic deaths occurring in hospitals are not considered newsworthy and are seldom, if ever, reported in the lay press.

The employment of any anesthetic agent, regional or general, is accompanied by the danger of possible loss of life. This holds true whether it is administered by a physician, nurse, or dentist, and whether it is for medical, surgical, or dental procedures. Fatalities directly attributed to the use of anesthetics, local and general, in hospitals, have been reported in the literature by Beecher<sup>1</sup> and others.

A comprehensive survey of the safety of anesthesia in the dental office was published by Seldin and Recant in 1955<sup>2</sup>. We undertook this survey to determine the mor-

tality rate directly attributed to the use of anesthetics for ambulatory patients in dental offices in the City of New York. We also compared this rate with that resulting from the administration of anesthetics in hospitals and medical offices by physicians or nurse anesthetists supervised by physician anesthesiologists. In this comparative study only those anesthetic mortalities in hospitals and medical offices were used in which anesthesia had been administered for procedures of approximately similar severity and duration to those performed in dental offices. Only those medical cases where the physical status of the patient might be assumed to have been similar to that of patients usually encountered in dental and oral surgical procedures were included in the survey.

In New York City all deaths, regardless of cause, must be reported to the Medical Examiner's office. The mortality files are classified according to the cause of death, as determined by the death certificate, hospital reports and autopsy, when possible. The survey was made from

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the records in the Medical Examiner's office of anesthetic deaths for the ten-year period 1943 to 1952 inclusive. It was estimated that during that ten-year period about 90,000,000 administrations of local anesthetics and about 1,000,000 administrations of general anesthetics were made by dentists in New York City.

The ten-year total of anesthetic deaths was 1,867. Total anesthetic mortalities in dental offices was 8; anesthetic deaths during tonsillectomies and/or adenoidectomies was 51; and anesthetic fatalities during ophthalmological procedures was 15.

Thus we see that the mean percentage of the 10-year total of anesthetic mortalities in New York City in dental offices was 0.43 per cent; for tonsillectomies and/or adenoidectomies, 2.7 per cent; and for ophthalmological procedures, 0.80 per cent. It is of interest to note that of the ten-year total of anesthetic deaths in dental offices, two were caused by local anesthetics and six by general anesthetics. If we consider the fact that about one general anesthetic is administered to every 90 local anesthetics, we see that percentage-wise the local anesthesia safety record surpasses by far the excellent record of general anesthesia.

Recently I made a nation-wide survey of anesthetic mortalities in oral surgery for the years 1950 to 1956 inclusive. A questionnaire was sent to each member of the American Society of Oral Surgeons and a total of 406 questionnaires were answered. Of these, 314 were complete and 92 were incomplete (no records were given of the approximate number of administrations). These 92 oral surgeons simply stated that they had no anesthetic fatalities during the years 1950 to 1956 and that they kept no record of the number of administrations. The 314 completed questionnaires indicated that these oral surgeons administered approximately 7,956,627 anesthetics in their offices and/or hospitals. Of these, 4,244,449 were local and 3,712,178, general. There were 59 fatalities reported. Fifteen occurred in their offices, 43 occurred in hospitals and one in a patient's home. The agents used were as follows:

Sodium Pentothal® anesthesia — 19 fatalities.

Sodium Pentothal®, nitrous oxide-oxygen anesthesia—16 fatalities.

Sodium Pentothal®, nitrous oxide-oxygen, ether anesthesia—1 fatality.

Nitrous oxide-oxygen anesthesia — 9 fatalities.

Nitrous oxide-oxygen, ether anesthesia—2 fatalities.

Nitrous oxide-oxygen, trichlorethylene anesthesia—2 fatalities.

Nitrous oxide-oxygen, Vinethene® anesthesia—1 fatality (explosion).

Ether anesthesia—5 fatalities.

Regional anesthesia—3 fatalities.

Of the 59 anesthetic deaths three were caused by regional anesthetics and 56 by general anesthetics. Of the three local anesthetic deaths one was in a hospital and two in offices. Of the 56 general anesthetic deaths 42 occurred in hospitals, 13 occurred in offices and one in a patient's home, in spite of the fact that there were significantly more general and local anesthetics administered at the offices of oral surgeons than at hospitals for oral surgery. Intravenous barbiturates were administered in 37 of the 59 mortalities due to general anesthetics.

### **The Safety of Anesthesia in Oral Surgery**

The safety of anesthesia in oral surgery is certainly commendable and compares favorably with other surgical specialties. The six-year total of anesthetic mortalities for oral surgical procedures in offices and hospitals was one death in 1,414,816 administrations of regional or local anesthesia, and one in 66,289 administrations of general anesthesia, as compared to the report by Beecher and Todd<sup>3</sup> of one death in 2,300 administrations of intravenous anesthesia, one in 3,178 administrations of inhalation anesthesia and one fatality in 7,600 administrations of regional and topical anesthesia.

Some oral surgeons prefer to hospitalize all patients who need

prolonged or extensive surgical procedures, but the majority do most of these operations in their offices. The fact that 43 of the 59 mortalities occurred at hospitals and only 15 occurred in offices shows that anesthesia administered in oral surgery offices has a much higher safety record than anesthesia administered in hospitals for oral surgery procedures. This is probably due to the fact that poor-risk patients are usually hospitalized.

Intravenous barbiturates, when employed in anesthetic doses, produce depression of respiration and circulation. The fact that 37 of the 59 deaths occurred where intravenous anesthesia was employed and 19 fatalities where sodium Pentothal<sup>®</sup> was the sole agent would indicate that the intravenous barbiturates in general anesthesia are not as innocuous as some people claim them to be.

The intravenous barbiturates should be used as hypnotics for induction and not as the sole anesthetic agents. A combination of drugs, utilizing the advantageous properties of each to produce a balanced anesthesia, is the safest method to employ. Clinical experience has shown that the use of sodium Pentothal<sup>®</sup> for basal hypnosis and nitrous oxide and high oxygen mixtures for maintenance with small intermittent increments

of sodium Pentothal®, as needed, is the most reliable method of managing most anesthetic situations.

### **Complications with Local Anesthetics**

In spite of the excellent safety record of local anesthesia, fatalities do occur from allergic reactions to these drugs. Waters and Gillespie<sup>4</sup> found six deaths in 4,835 administrations of local anesthetics. Crip<sup>5</sup> reported three deaths within one year from allergic reactions to procaine. Adriani and Campbell<sup>6</sup> reported ten fatalities in 15 years at Charity Hospital, New Orleans, caused by the topical application of tetracaine to the mucous membrane. The August, 1953, *NewsLetter of the American Society of Anesthesiologists* states: "There is a deep rooted impression among doctors that any form of local anesthesia is automatically safer than general anesthesia, and that limited local anesthesia is so innocuous that it may be used on poor-risk patients without special precautions. Nothing could be further from the truth. All locally-acting anesthetic drugs have the same inherent dangers of circulatory collapse if the blood concentration is high, even for a short time."

The excellent safety record of local anesthesia in dental offices is due in large measure to small dosage. This safety can be further en-

hanced by using an aspirating syringe as advocated by Monheim<sup>7</sup>. In our office we have found that in the inferior alveolar block injection, over 30 per cent demonstrated the aspiration of blood, indicating entrance of the needle into a blood vessel. The complications arising from the administration of local anesthetics in dentistry are usually from the accidental injection of the drug into a blood vessel. An anesthetic dose may then become a toxic dose. This can only be prevented by making an aspiration test in every block injection.

The early symptoms of toxic overdose are primarily those of central nervous system stimulation. This is followed by a proportionate degree of central nervous system depression. Usually the manifestations of toxic overdose are mild and transitory. Should the stimulation result in convulsions, intravenous barbiturates should be administered slowly.

Though allergic reactions to local anesthetics are rare, they may occur, and this hypersensitivity to local anesthetic drugs may produce anaphylactoid reactions that can prove fatal. The symptoms of an anaphylactoid reaction consist of a sudden loss of vasomotor tonus, with the absence of pulse and blood pressure. Respirations become shallow and finally cease. Prompt and

correct treatment can be life saving. The administration of antihistamines such as diphenhydramine (Benadryl®), 20 to 30 mg. intravenously, vasoconstrictors such as epinephrine 1:1000, 0.3 to 0.5 ml. intramuscularly, aminophylline, 7½ grains intravenously, and 20 mg. hydrocortisone hemisuccinate (buf-fered) in 5 cc. of sterile saline, intravenously, can be used to combat anaphylactic reactions. Oxygen should also be administered under pressure.

### **Complications with General Anesthetics**

Cardiac arrest, cardiac standstill or cardiac asystole, untreated, will terminate promptly in death. No anesthetic agent can be specifically blamed for cardiac asystole. Misuse of an agent and errors incidental to its administration are the responsible etiological factors in anesthetic fatalities.

According to Ruth, Buckley and Krown<sup>8</sup> two or more of the following ten conditions are present when cardiac asystole occurs:

“1. Anemia and decreased circulatory fluid volume. Inadequate oxygen carrying capacity of the blood is well known as a cause of major dysfunctions of both heart and brain.

2. Overdose of anesthetic agent. Effects of this on the respiratory centers or vasomotor center or both, can result in secondary heart failure.

3. Anxiety of the patient; increased epinephrine outflow sensitizes the myocardium to cardiac arrhythmias.

4. Increased carbon dioxide level in the blood. The ensuing chemical imbalance may cause respiratory depression and cardiac dilatation.

5. Cardiac and cardiovascular valvular disease (acquired or congenital).

6. Hypoxia, either acute and pronounced or chronic, in form, as found in long standing pulmonary disease. Efficient oxygenation at all times is a basic concept of acceptable anesthetic practice.

7. Inadvertent administration of an undesirable drug or inaccurate dosage of the correct drug.

8. Unrecognized administration of an undicated and harmful compressed gas. Labels on gas cylinders, as well as on containers for drugs, require identification before administration.

9. Cardiovascular effects of anesthesia or surgery. Reflexes, possibly of vagal origin.

10. Certain endocrine and metabolic disturbances.”

Though cardiac arrest may occur at any time during anesthesia, it most frequently occurs during induction and emergence. Cardiovascular emergencies are usually secondary to respiratory emergencies. Mechanical or physiologic obstruction of the airway, inefficient carbon dioxide elimination and insufficient oxygen in the anesthetic mixture are the prime causes of respiratory difficulties.

Our efforts as dentist anesthesiologists should be directed toward improving our excellent record and providing still greater safety for our patients. This can be accomplished by a correct evaluation of the patient and selection of the anesthetic agent or agents that conform to the physical status of the patient. Hypotension and anoxia should be

**Anesthetic Deaths in Oral Surgery  
1950 - 1956 inclusive**

From Members of the American Society of Oral Surgeons:

Total number of replies ..... 406  
 Total number of complete replies ..... 314  
 Total number of incomplete replies ..... 92

Total number of LOCAL anesthetics administered..... 4,244,449  
 Total number of GENERAL anesthetics administered..... 3,721,178  
 Total number of mortalities ..... 59

ANESTHETICS ADMINISTERED	OFFICE	HOSPITAL	HOME	TOTAL
Nitrous Oxide-Oxygen	7	2		9
Nitrous Oxide-Oxygen Vinethene®	1*			1
Nitrous Oxide-Oxygen Trichlorethylene	1	1		2
Nitrous Oxide-Oxygen Ether		2		2
Sodium Pentothal®	3	15	1**	19
Sodium Pentothal® Nitrous Oxide-Oxygen	1	15		16
Sodium Pentothal® Cyclopropane Local		1		1
Sodium Pentothal® Gas Oxygen Ether		1		1
Ether		5		5
Local	2	1		3
TOTAL	15	43	1	59

\* Explosion, in office—anesthetic was nitrous oxide-oxygen Vinethene®.

\*\* Intravenous barbiturate administered in patient's home.

**Local Anesthetic Deaths in Medicine and Dentistry —  
Comparison of Published Statistics**

REPORTER	TOTAL CASES	PROCEDURES	ANESTHETIC	ANESTHETIC DEATHS	MEAN MORTALITY PERCENTAGE
Furstenberg and others <sup>1</sup>	30,000	Tonsillectomies	Cocaine Hydro- chloride	3	0.010
Ireland, Ferguson & Stark <sup>2</sup>	39,298	Ear, nose, and throat	Cocaine Hydro- chloride and Tetracaine Hydrochloride	7	0.018
Schindler <sup>3</sup>	22,251	Gastroscopy	Cocaine Hydro- chloride and Tetracaine Hydrochloride	3	0.013
Williams <sup>3</sup>	6,378	Nose and throat	Cocaine Hydro- chloride	2	0.013
Seldin and Recant <sup>4</sup>	90,000,000	All dental procedures	Local anesthetics, mainly, procaine hydrochloride	2	0.00002
Beecher and Todd <sup>5</sup>	7,600	General surgery	Topical and Regional	1	0.01
Seldin	4,244,449	Oral surgery	Local Anes- thesias	3	0.00007 +

1. Furstenberg, A. C., and others, "Evaluation of cocaine anesthesia: Perpetuation of the equivocal concepts," *Tr. Am. Acad. Ophth.* 55:643 July-Aug. 1951.
2. Ireland, P. E., Ferguson, J. M. W., and Stark, E. J., "Clinical and Experimental Comparison of Cocaine and Pontocaine as Topical Anesthetics on Fatalities in Otolaryngological Practice," *Laryngoscope* 61:767, Aug. 1951.
3. Schindler, R., "Results of Questionnaire on Fatalities in Gastroscopy," *Am. J. Digest Dis.* 7:293, July 1940.
4. Seldin, H. M., Recant, B. S., "The Safety of Anesthesia in the Dental Office," *J. of O., S.* Vol. 13, pp. 199-208, July 1955.
5. Beecher, Todd, *Ann. Surg.* 140:2, 1954.

avoided, especially in patients with cardiovascular disease.<sup>9</sup> Adrenocortical insufficiency should be corrected with cortisone. Atropine should be used for patients taking rauwolfia alkaloids. High oxygen percentages should be administered with the anesthetic agent and an open airway maintained at all times.

Marked apprehension should be controlled. It is advisable to postpone surgery for a cardiac patient who comes to the office in a state of marked anxiety and apprehension.

### Conclusion

The studies and reports presented in this paper clearly show that anesthesia in the office of the oral surgeon and dentist, when administered by a qualified anesthesiologist, dentist or nurse, has a much lower mortality rate than anesthesia administered in hospitals or medical offices.

### Addendum

Since the completion of this report five additional replies to our questionnaire were received making a new total of 8,099,290 anesthetics administered, of which 4,316,027 were local and 3,783,263 were general. There were four additional deaths occurring in hospitals under Pentothal®-cyclopropane anesthesia, two of which were cardiac failures and two, pulmonary em-

bolisms. Therefore, the mean mortality percentage, instead of being 0.00007+, is now 0.000069.

With the additional figures received and recompiled, the total is one death in 63,054 general anesthetics administered and one death in 1,438,678 regional or local anesthetics.

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