Anesth Prog 38:39–44 1991

Major Morbidity or Mortality from Office Anesthetic Procedures: A Closed-Claim Analysis of 13 Cases

J. Theodore Jastak, DDS, PhD,* and Robert M. Peskin, DDS†

*Department of Hospital Dentistry, Oregon Health Sciences University, Portland, Oregon; †Departments of Dental Medicine and Anesthesiology, Long Island Jewish Medical Center, New Hyde Park, New York

A closed-claim analysis of anesthetic-related deaths and permanent injuries in the dental office setting was conducted in cooperation with a leading insurer of oral and maxillofacial surgeons and dental anesthesiologists. A total of 13 cases occurring between 1974 and 1989 was included. In each case, all available records, reports, depositions, and proceedings were reviewed. The following were determined for each case: preoperative physical status of the patient, anesthetic technique used (classified as either general anesthesia or conscious sedation), probable cause of the morbid event, avoidability of the occurrence, and contributing factors important to the outcome. The majority of patients were classified as American Society of Anesthesiologists (ASA) status II or III. Most patients had preexisting conditions, such as gross obesity, cardiac disease, epilepsy, and chronic obstructive pulmonary disease, that can significantly affect anesthesia care. Hypoxia arising from airway obstruction and/or respiratory depression was the most common cause of untoward events, and most of the adverse events were determined to be avoidable. The disproportionate number of patients in this sample who were at the extremes of age and with ASA classifications below I suggests that anesthesia risk may be significantly increased in patients who fall outside the healthy, young adult category typically treated in the oral surgical/dental outpatient setting.

Received March 2, 1991; accepted for publication May 5, 1991.

Address correspondence to Dr. J. Theodore Jastak, Department of Hospital Dentistry, Oregon Health Sciences University, 3181 S.W. Sam Jackson Park Road, Portland, OR 97201-3098.

Various pharmacologic techniques for general anesthesia, deep sedation, and conscious sedation are frequently used by dentists in the United States, Canada, and abroad. A recent survey of fellows of the American Dental Society of Anesthesiology has identified at least 82 different drugs and drug combinations currently in use for anesthetic/sedative purposes.[1] Although precise data are unavailable, one can estimate from the numbers of dental practitioners certified by governmental agencies to provide anesthetic services that well over one million parenteral and inhalation anesthetics are administered per year by dentists in the United States and Canada. The caseload of nitrous oxide conscious sedation is much larger, perhaps approaching ten million cases per year. The number of individuals administering oral sedation, with or without nitrous oxide, cannot even be estimated, as most dental licensing bodies do not regulate the use of oral medications.

Severe morbidity or mortality has been occasionally reported with virtually all forms of conscious sedation. With outpatient general anesthesia and deep sedation, the incidence of adverse anesthetic outcomes is increased. A review of trends in anesthetic use suggests, that, while the dangers of outpatient anesthesia have decreased, further improvement is still possible.

Anesthetic techniques and drugs have changed markedly over the past 50 years. During the 1940s and 50s office general anesthesia mostly consisted of "smash and grab" hypoxic nitrous oxide, diethyl or divinyl ether inhalation anesthesia or intravenous sodium thiopental. Sedation as we know it today was uncommon, with only a few pioneers such as Jorgensen advocating intravenous conscious sedation[2] and Langa, propounding nitrous oxide and oxygen relative analgesia. More recently, nitrous oxide has been widely used with oxygen for conscious sedation and as a supplement to intravenous agents. Diethyl and divinyl ether have essentially disappeared from the dental pharmacopeia and have been replaced by a number of intravenous drugs. The most common single drug techniques employ a benzodiazepine, such as diazepam (Valium®) or midazolam (Versed®), or a barbiturate,

ISSN 0003-3006/91/$3.50

Table 1. Trends in Anesthetic/Sedative Agents Used by Oral Surgeons

Popularity	*1973*[a]	*1978*[b]	*1988*[a]
1	Nitrous oxide	Methohexital	Methohexital
2	Methohexital	Nitrous oxide	Nitrous oxide
3	Diazepam	Diazepam	Diazepam
4	Meperidine	Halothane	Meperidine
5	Succinylcholine	Fentanyl	Midazolam
6	Pentobarbital	Meperidine	Fentanyl

[a] Data from Lytle and Stamper.[4]
[b] Data from the Massachusetts Society of Oral and Maxillofacial Surgeons.

such as methohexital (Brevital®). In addition, there is widespread use of multiple drug regimens, which include benzodiazepines, opioids, and/or ultrashort-acting barbiturates.[1] Inhalation anesthesia with agents such as halothane remains useful, especially with children, although it is less frequently administered today. Over the past 15 to 20 years, the use of mask or endotracheal anesthesia for office-based oral surgery cases has also declined, being gradually replaced by intravenous techniques combined with local anesthesia (Table 1).[4]

As a result of highly significant technical changes in the delivery of anesthetics by both dentists and physicians in the past 5 decades, many claims of improved safety have been made. Although anesthetic mortality rates are not easily compared, it appears that they have markedly improved. In this regard, a hospital-based anesthetic mortality rate of 1 : 1560 reported in 1954[5] versus the more recent rates of 1 : 11,660[6] and 1 : 27,838[7] suggests a major improvement in health care outcome. Likewise, mortality data derived from outpatient dental practice have seemingly shown similar improvement during the past 30 years. The difficulty with this view is that much of the published material is not easily compared because of differences in patient populations, surgical procedures, interpretations of cause of death, time of death, and practice environment. Table 2 highlights five such studies,[7–11] illustrating the problems with comparative interpretation.

Comparison of outpatient anesthetic morbidity and mortality studies is further compromised because reporting of adverse events is often voluntary, incomplete, or founded on a limited data base. Furthermore, gross estimates are used in lieu of actual total caseloads in calculating incidence. This situation is especially true for studies conducted in the United States. In contrast, dental mortality studies from Great Britain offer more precise information. The practice of dentistry in the United Kingdom is tightly controlled by a national health system. This permits access to accurate statistics on total caseload and calculation of the actual incidence of adverse occurrences within differing practice settings. The specifics of drug use and personnel training are also available.[12]

In general, however, there is such a lack of useful comparative data that one highly respected professor of anesthesia has suggested that there has not been a decrease in anesthetic mortality rates over the past 20 to 30 years, based on the following reasons[13]:

1. No data exist to support this contention.
2. Surgical procedures and risks have changed, adding newer mechanisms of morbidity/mortality at the same rate as others have been eliminated.
3. Most mortal events are due to human error, which has not changed.

The current study is a retrospective analysis of closed anesthesia claims that resulted from significant morbidity or patient mortality. These cases originated from an uncertain total number of anesthetic administrations; thus, an accurate incidence rate cannot be calculated. However, similarities among these cases can be identified to help practitioners recognize circumstances in which the risk of catastrophe is increased.[14]

Table 2. Five Morbidity and Mortality Studies from United States and Foreign Sources Demonstrating Wide Differences in Anesthetic Safety and Study Criteria

Source	*Study Years*	*Time Span Studied*	*Calculated Mortality Ratio*	*Comments*
Phillips et al, 1960[8] (Baltimore)	1953–1959	48 hr	1/2500	No recovery rooms.
Marx et al, 1973[11] (New York City)	1965–1969	7 days	1/53	Excluded all obstetrical cases.
Olsson and Hallen, 1988[7] (Sweden)	1967–1984	Intraoperative	1/27,838	Cardiac arrest study only.
Harrison et al, 1990[9] (South Africa)	1956–1987	24 hr	1/98	——
Cohen et al, 1990[10] (Canada)	1982–1987	72 hr	1/2656	Pediatric anesthetics only.

METHODS

All available closed files classified as anesthetic-related by a leading insurer of oral and maxillofacial surgeons and dental anesthesiologists were reviewed (St. Paul Fire and Marine Insurance Co.). These anesthetic mishaps occurred between 1974 and 1989, with the majority after 1980. From this large source of material, data were compiled only from office-based cases involving severe anesthetic morbidity or mortality.

A total of 13 cases were included in the analysis. In each case, both office and hospital records were reviewed as well as the reports of various consultants, depositions by experts, and statements of the clinician(s) involved describing the specific incident in detail. When available, preexisting medical records of patients were analyzed to confirm health history data. Finally, autopsy reports were reviewed to confirm medical diagnoses and to help identify specific causation. Considerable effort was made to determine the drugs and dosages, as well as the monitoring practices used. Dental records unfortunately were sometimes poor, but piecing together data from all available sources often gave a satisfactory picture of the critical events leading up to the outcome. Specific data tabulated included:

1. Age, sex, and health history of the patient.
2. Dental procedure initiated and its reported duration.
3. Anesthetic/sedative technique used.
4. Monitoring and personnel utilized.
5. Specific drugs and dosages administered.
6. Type of complication and time of occurrence.
7. Management and outcome.

From this basic information, as well as corroborating medical, hospital, and legal information, several judgments were made. These included the estimated preoperative American Society of Anesthesiologists' (ASA) classification of each patient; the probable cause of the morbid event; whether the occurrence was avoidable, possibly avoidable, or probably unavoidable; and the contributing factors important to the outcome.

The broad range of terminology used to describe office anesthetic procedures was simplified down to two categories: general anesthesia and conscious sedation. For the purposes of this article, deep sedation, ultralight anesthesia, and standard general anesthesia were all treated as general anesthesia. The use of methohexital, regardless of intermittency or dose, was classified as an anesthetic technique and not conscious sedation due to its potential for causing altered airway reflexes and loss of purposeful patient response typical of general anesthesia. This approach was used since operator intent is usually impossible to ascertain.

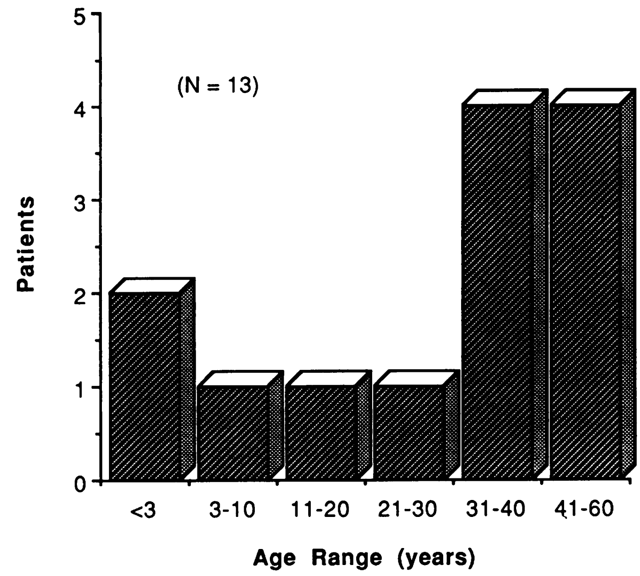

Figure 1. Age versus severe morbidity/mortality.

RESULTS

Although patient ages were widely distributed, with the youngest 21 months old and oldest 59 years, a disproportionate number were over the age of 35 (Figure 1). Most of the patients were treated by oral surgeons. Inasmuch as oral surgery practices are largely based upon younger patients requiring third molar removal, the predominance of older adults in this series appears to be important. There were five male and eight female patients in this series, with the only survivors being female. The majority of patients were classified as ASA status II or III, with only two individuals being class I. This was true regardless of age. For instance, the three youngest patients, aged 21 months, 2 years, and 5½ years, were all classified as ASA II. Survival in general was poor—10 of 13 died—and one of the three survivors had spastic hemiplegia, blindness, and developmental regression secondary to profound hypoxic brain damage (Table 3).

Preexisting medical conditions identified in these pa-

Table 3. ASA Status Versus Outcome (n = 13)

	ASA Status			
Patient Outcome	*I*	*II*	*III*	*Total*
Survived healthy	1[a]	1	—	2
Survived disabled	—	1	—	1
Died	1	6[b]	3	10
Total	2	8	3	13

[a] Borderline ASA II
[b] One case borderline ASA III

Table 4. Significant Medical Diagnoses Found in Patients with Major Morbidity or Mortality Due to Anesthesia ($n = 11$)

n	*Underlying Medical Conditions*
3	Obesity (including Pickwickian Syndrome)
3	Cardiac disorder
3	Heavy smoker
2	Hypertension
2	Epilepsy
1	Barbiturate allergy
1	Local anesthetic "allergy"
1	Anemia
1	Hiatal hernia
1	Asthma
1	Chronic obstructive pulmonary disease
1	Diabetes
1	Upper respiratory infection
1	Hyperthyroidism
1	"Bull neck"

tients were revealing. Three patients were grossly obese (one with Pickwickian Syndrome), and another three had some manifestations of cardiac disorder (ie, mitral valve disease, uncontrolled cardiac symptoms, hypertensive cardiac disease with cardiomegaly). Three were heavy smokers, two were epileptics, and one had chronic obstructive pulmonary disease. Several of these patients had multiple medical diagnoses (Table 4).

The anesthetic agents used were typical for dental or oral surgical practice during the 1970s and 80s and were very similar to those reported by Lytle and Stamper in 1989.[4] Polypharmacy (defined in this instance as the use of 3 or more drugs with CNS depressant properties) was frequent, with eight of the patients receiving an average of 4.4 drugs. In four cases two agents were utilized, and in only one case was a single drug (methohexital) administered (Table 5).

Various personnel were involved in the delivery of anesthesia, with the most frequent approach being the team

Table 5. Frequency of Anesthetic Agents Used

n[a]	*Agent*
10	Methohexital
10	Nitrous oxide
7	Diazepam
4	Halothane
4	Fentanyl
2	Meperidine
2	Thiopental
1	Midazolam

[a] Total exceeds 13 due to multiple drug use

Table 6. Anesthetic Personnel Versus Outcome

Personnel	*n*	*Patient Outcome*		
		Healthy	*Disabled*	*Died*
Operator-Anesth	4	1	0	3
Team	5	1	1	3
CRNA	2	0	0	2
DDS/DMD Anesth	2	0	0	2

concept (ie, anesthetic assistant monitoring and administering drugs), followed by an operator-anesthetist technique, and then use of a nurse anesthetist or dental anesthesiologist (Table 6). In no instance was a physician anesthesiologist utilized.

Evaluation of intraoperative monitoring revealed a common lack of vigilance. Four patients had virtually no monitoring, while another three received only intermittent digital palpation of pulse. Pulse and blood pressure or electrocardioscopy (ECG) were used in the remaining cases. In three instances, blood pressure and ECG monitoring was available in the office, but unused until the emergency was finally identified. Specific written confirmation identified that inattentiveness was a problem in one case, even when monitoring was reported (Table 7).

The main cause of morbid events appeared to be hypoxia secondary to airway obstruction or respiratory depression. In all such cases the patient died, except one who survived with severe brain damage. Other causes of untoward events included drug overdosage, cardiac arrhythmia, and undiagnosed diabetic acidosis (Table 8). The great majority of cases (10 of 13) were considered avoidable either by use of appropriate patient selection criteria or, most particularly, by timely monitoring and effective response to adverse occurrences (Table 9). In two patients the issues were less clear, but the occurrences were still felt to be possibly avoidable. In only one instance did it appear that an unavoidable occurrence probably took place. Conditions contributing to the poor outcomes seen in this study included the use of obsolete and/or uncalibrated anesthetic machines, interference with emergency personnel, lack of prompt emergency care, and unfamiliarity with pediatric anesthesia.

Table 7. Intraoperative Monitoring Versus Outcome

Monitoring	*Patient Outcome*		
	Healthy	*Disabled*	*Died*
None	0	1	3
Pulse	0	0	3
Pulse + BP	2	0	2
Pulse + ECG	0	0	2

Table 8. Probable Cause Versus Outcome of Morbidity/Mortality

Cause	n	Patient Outcome: Healthy	Severely Disabled	Died
Hypoxia (airway obstruction or respiratory depression)	8	—	1	7
Arrhythmia	2	1[a]	—	1
Drug overdose	2	1	—	1
Diabetic acidosis	1	—	—	1

[a] Possible anaphylaxis

DISCUSSION

The data presented in this study suggest that young children and older patients, especially those with less than ASA I health status, are at an increased risk for severe anesthetic complication in the dental office. This statement is based on the assumption that the majority of patients receiving sedation or anesthesia are young, healthy adults. Certainly, the relationship between age and anesthetic risk is well known. Extremes of age (under 1 year or over the fifth decade) are often thought to carry increased anesthetic risk. A more subtle relationship may even exist with healthy middle-aged individuals having some increased risk of anesthetic complication (Figure 2).[11]

A number of recent hospital-based studies have documented that anesthetic-related mortality or cardiac arrest is much more prevalent in patients ranked lower than ASA I (Table 10).[7,15,16] In these studies, the largest number of anesthetics were administered to healthy patients (ASA I), who had the fewest morbid events. Similarly, the most complications occurred in those patients ranked ASA III/IV. Recent office anesthesia evaluations have not specifically evaluated ASA status vs. anesthetic outcome. However, the 1974 ASOS survey did identify that three of seven general anesthetic deaths occurred in older patients with an estimated ASA II or III rankings, and all local anesthetic-related deaths were in such individuals.[17]

The causes of the adverse events outlined in this study were similar to those in previously published reports. Hypoxia or overdose predominated with other causation much less important regardless of whether the patient was an outpatient[18,19] or hospital inpatient (Table 11).[6,9] The contribution of gross human error in this study was also very similar to that previously reported, including poor patient selection, lack of help, haste, and inattention.[20]

Table 9. Avoidability Versus Outcome

Avoidability	n	Patient Outcome: Healthy	Disabled	Died
Avoidable	10	1	1	8
Possibly avoidable	2	1	0	1
Unavoidable	1	0	0	1

CONCLUSIONS

In spite of wide differences in reporting methodology, caseload, country of origin, and operative procedures, there remains a strong similarity between our results and those of previous authors. Hypoxia remains the principal cause of unanticipated morbidity and mortality in the perioperative period. Since hypoxia may occur during conscious sedation,[21] monitoring for its incipient onset is a critical concern with all forms of dental sedation-anesthesia. Also, great care should be given to patient selection for in-office general anesthesia or deep sedation, especially with individuals who have preexisting systemic med-

Figure 2. Age versus anesthetic-induced cardiac arrest/death. Data adapted from Marx et al.[11]

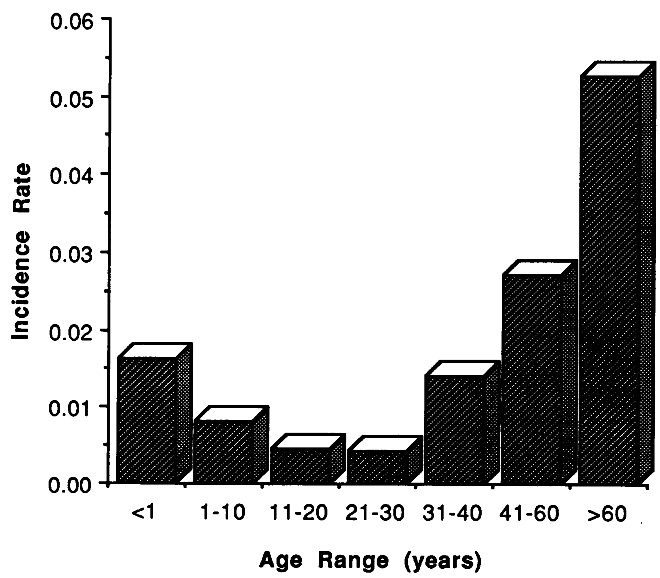

Table 10. ASA Status Versus Anesthesia Caused Cardiac Arrest or Death

ASA Class					
1	*2*	*3/4*	*Event*[a]	*Anesthetic Cases*	*Author/Year*
0	9	10	D	11,925	Bradley, et al, 1988[15]
11	53	46	CA	250,543	Olsson & Hallen, 1988[7]
4	8	9	CA	113,074	Chopra, et al, 1990[16]

[a] D = Death; CA = Cardiac Arrest.

Table 11. Cause of Anesthetic Mortality

N	*Hypoxia (airway–ventilation)*	*Overdose*	*Other*[a]	*Author/Year*
27	12	15	—	Keenen and Boyan, 1985[6]
27	24	—	3	Atrash et al, 1988[18]
76	53	—	23	Harrison, 1990[9]

[a] Arrhythmia, aspiration, drug reaction, hypovolemia.

ical conditions and who lie outside of the 2 to 35 year age range.

Even though general anesthesia can be safely administered to many ASA III–IV patients who are critically ill, the statistical incidence of morbid events is higher in those individuals. Also, unlike most dental office practices, when complications occur in a hospital help is immediately available. Finally, because outpatient dental procedures are not perceived as potentially lethal, the public at large does not fundamentally accept the idea of an anesthetic death in a dental office. Such occurrences, even at the current infrequent rate, could ultimately lead to restrictions on dental practice, regardless of the profession's overall expertise and competence with anesthesia.

REFERENCES

1. Dionne RA, Gift HC: Drugs used for parenteral sedation in dental practice. Anesth Prog 1988;35:199–205.
2. Jorgensen NB, Leffingwell FE: Premedication in dentistry. J S Cal St Dent Assoc 1953;21:25–30.
3. Langa H: Analgesia for modern dentistry. NY J Dent 1957;27:228–237.
4. Lytle JJ, Stamper EP: The 1988 anesthesia survey of the Southern California Society of Oral and Maxillofacial Surgeons. J Oral Maxillofac Surg 1989;47:834–842.
5. Beecher HK, Todd DP: A study of the deaths associated with anesthesia and surgery based on a study of 599,548 anesthesias in 10 institutions 1948–52 inclusive. Ann Surg 1954; 140:2–35.
6. Keenan RL, Boyan CP: Cardiac arrest due to anesthesia: a study of incidence and causes. JAMA 1985;253:2373–2377.
7. Olsson GL, Hallen B: Cardiac arrest during anaesthesia. A computer aided study in 250,543 anaesthetics. Acta Anaesth Scan 1988;32:653–664.
8. Phillips OC, Frazier TM, Graff TD, et al: The Baltimore Anesthesia Study Committee. JAMA 1960;174:2015–2019.
9. Harrison GG: Death due to anaesthesia at Groote Schuur Hospital, Cape Town—1956–1987. S Afr Med J 1990;77: 412–415.
10. Cohen MM, Cameron CB, Duncan PG: Pediatric anesthesia morbidity and mortality in the perioperative period. Anesth Analg 1990;70:160–167.
11. Marx GF, Mates CV, Orkin LR: Computer analysis of postanesthetic deaths. Anesthesiology 1973;39:54–58.
12. Coplans MP, Curson I: Deaths associated with dentistry. Br Dent J 1982;153:357–362.
13. Keats AS: Anesthesia mortality in perspective. Anesth Analg 1990;71:113–119.
14. Keats AS: The closed claim study. Anesthesiology 1990;73:199–201.
15. Bradley JP, Beem MF, O'Donnell JE, et al: Mortality audit in a large teaching hospital. Anaesth Int Care 1988;16:94–97.
16. Chopra V, Bovill JG, Spierdijk J: Accidents, near accidents and complications during anaesthesia. Anaesthesia 1990; 45:3–6.
17. ASOS Anesthesia Morbidity and Mortality Survey. J Oral Surg 1974;32:733–738.
18. Atrash HK, Cheek TG, Hogue CJ: Legal abortion mortality and general anesthesia. Am J Obstet Gyn 1988;158: 420–424.
19. Peterson HB, Grimes DA, Cates W, et al: Comparative risk of death from induced abortion at ≤12 weeks gestation performed with local versus general anesthesia. Am J Obstet Gyn 1981;141:763–768.
20. Derrington MC, Smith G: A review of studies of anaesthetic risk, morbidity and mortality. Br J Anaesth 1987;59: 815–833.
21. Hovagim AR, Vitkun SA, Manecke GR, et al: Arterial oxygen desaturation in adult dental patients receiving conscious sedation. J Oral Maxillofac Surg 1989;47:936–939.