ing certification in basic life support. Additionally, each member of the office team should have a thorough knowledge of the office emergency plan so that all duties are accomplished without delay. The office emergency plan should be rehearsed regularly. Emergency drugs and equipment should be checked at frequent intervals, and the phone number of the nearest emergency squad/paramedic unit should be prominently displayed.

The principles of basic life support, i.e. (A) open the *A*irway by proper neck extension and jaw lift, (B) check for *B*reathing and give artificial ventilation if necessary, and (C) check a pulse for *C*irculation and give closed chest cardiac compressions if needed, should be applied in all medical emergencies. The use of (D) *D*rugs may be beneficial in emergency situations, but generally are administered only after the ABCs have been accomplished. An adequate supply of oxygen and equipment to deliver it by positive pressure and suction equipment for aspiration of vomit or secretions from the airway should be in all dental offices. Other drugs such as epinephrine, an antihistamine, a glucocorticosteroid, and anticonvulsant, and nitroglycerin sublingual tablets would comprise a basic emergency drug kit.

Dentists with advanced training in anesthesia who utilize deep intravenous sedation, ultralight general anesthesia, or general anesthesia should also have additional "advanced" emergency drugs and equipment immediately available, including but not limited to, atropine, lidocaine, sodium bicarbonate, aminophylline, calcium chloride, 50% glucose, succinylcholine, laryngoscopes and blades, oral and nasopharyngeal airways, and endotracheal tubes. Advanced cardiac life-support certification is strongly urged for these individuals. A supply of dantrolene should be nearby for those using volatile inhalation anesthetics or succinylcholine as part of their pain control armamentarium. The narcotic antagonist naloxone should be available whenever parenteral narcotics are administered. A 10-gauge intravenous catheter-over-needle with a #3 endotracheal tube connector inserted in the hub or similar device may provide rapid entry into the trachea via cricothyroid puncture when respiratory obstruction cannot otherwise be corrected. For those dentists with a cardioscope, a defibrillator can rapidly terminate life-threatening dysrhythmias.

It must be emphasized that compromise of the airway and/or hypoventilation are the two major complications most frequently observed during sedative and anesthetic accidents in outpatient dentistry. Untiring vigilance particularly of this aspect of patient care should permit early correction by extending the head and pulling the mandible forward before major irreversible physiologic changes occur.

Balancing Efficacy with Safety in General Anesthesia and Sedation

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The fact that "the dentist scares millions of us" as recently headlined in a *USA Today* newspaper is not news to anyone. And, although exact figures are not available, those of us in clinical practice would have to agree with the ADA's estimate that at least 36 million Americans are severe dental phobics.

Perhaps there are even a few in the group whose experiences are such that they feel certain that they have personally treated all 36 million. No doubt all will agree that "dental treatment" is frequently a harrowing experience for both patient and practitioner.

Over the years general anesthesia has been successfully and safely employed for both the control of operative pain as well as the management of the obstreperous patient. Recently, however, the use of various conscious techniques for the control of anxiety and for modification of behavior have gained tremendous popularity.

As the lay public becomes increasingly aware of the availability of such techniques the demand for services is certain to rise. The dental profession must arm itself to deliver these services not only in a convenient, efficient, and cost-effective manner, but in a safe one as well.

This is not to imply that conscious techniques will totally supplant general anesthesia. Rather, they will serve as a complement to it, thereby allowing the profession to treat those patients who require "something more" than local anesthesia alone yet "something less" than general anesthesia.

General Anesthesia versus Conscious-Sedation

For purposes of contrast, the definitions and concepts of conscious sedation and general anesthesia must first be examined.

General anesthesia—discovered in 1844 by Horace Wells[1]—was defined by Oliver Wendell Holmes[2] as the inability to appreciate all sensations through the production of unconsciousness brought about by pharmacologic depression of the central nervous system. Since the ability to appreciate all sensations is eliminated, it becomes apparent that general anesthesia is a powerful pain control technique.

Conscious-sedation, on the other hand, defined as a drug-induced state in which the conscious patient is rendered free of fear and anxiety while remaining pleasantly relaxed is an anxiety rather than a pain control technique.[3]

For this reason, the key to the success of conscious-sedation is the judicious application of regional analgesia. No attempt should ever be made to "cover up" for poor local anesthesia or to provide amnesia of painful episodes by increasing the dose of sedative agents. This practice is fraught with danger and only serves to encroach on the production of unconsciousness.

In addition to their roles in the control of pain, another major conceptual difference between techniques must be noted. General anesthesia is accompanied by the production of unconsciousness while conscious-sedation is not.

In my opinion and experience the significance of this second conceptual difference is of major importance when balancing efficacy and safety in dental anesthesia and sedation.

Consciousness

Consciousness is defined as a state in which the patient is capable of rational response to verbal command and has all protective reflexes intact, including the ability to maintain his own airway in a patent state.[4]

The inherent safety of conscious-sedation hinges on the maintenance of consciousness at all times. Similarly, it is the presumed maintenance of consciousness that allows the teaching of sedation techniques at undergraduate and continuing education levels.

Studies carried out at the University of Pittsburgh have demonstrated that blood pressure, heart rate and rhythm, cardiac output, arterial blood gases, as well as respiratory rate and depth, remained within normal limits during conscious-sedation as long as consciousness was maintained. Increasing drug doses to produce a state of unresponsiveness resulted in major changes in all parameters within one minute.[5]

Those patients intentionally or inadvertently rendered unconscious by the hands of one not trained or skilled in the administration of general anesthesia become victims of a medical emergency. It must also be noted, however, that any dental patient may lose consciousness at any time for a variety of reasons. Therefore, all dental personnel that have patient contact should be proficient in the management of this potentially life-threatening emergency situation.

Unconsciousness

Perhaps the primary consideration to accompany unconsciousness is protective reflex obtundation, the most important of which involves the respiratory system. Without exception, all patients having been rendered unconscious must be presumed to have obstructed airways, the leading initiating factor in a sequence of events that produces hypoxia, brain damage, and death.

It is the propensity for reflex obtundation that accompanies loss of consciousness that separates conscious and unconscious techniques into two distinct categories.

Although a pharmacologic continuum of effects may be noted as one progresses from sedation to general anesthesia, loss of consciousness is an abrupt event that is immediately accompanied by diminution of homeostatic reflex actions.

Once the patient has been placed in this precarious physiological state, he deserves the undivided attention of the attending anesthetist. In the event that unconsciousness was an unexpected event, attention must be afforded the *victim* until the emergency has been corrected. Note that the patient becomes a victim when loss of consciousness was not a preconceived notion.

In the event unconsciousness was produced intentionally—as in the induction and maintenance of general anesthesia—the anesthetist must direct his undivided attention to monitoring vital parameters and taking necessary measures to maintain the life and welfare of the patient while continuing to sustain the unconsciousness state.

Without doubt the key to safe and successful general anesthesia is attentive patient monitoring.

The Balancing Act: Efficacy versus Safety

Balancing efficacy and safety during conscious-sedation or general anesthesia may be discussed in the following categories.

(1) educational requirements, (2) patient selection and preparation, (3) drug selection, (4) drug administration (titration), (5) patient monitoring, (6) dismissal criteria.

Educational Requirements

Due to their inherent safety, conscious-sedation techniques may be taught at the undergraduate as well as the continuing education levels. Present recommendations by the ADSA include a minimum of 60 hours of didactic study coupled with 10 cases of supervised clinical participation.[4]

Without doubt, inadvertent production of unconsciousness is the leading cause of mortality and serious morbidity-asssociated sedation techniques. Practitioners employing conscious-sedation must be thoroughly familiar with recognition and management of unconscious victims.

By contrast, due to inherent dangers associated with general anesthesia—a state accepted by the ADSA to include "deep sedation"—a minimum of one year of academic and clinical training is recommended. To presume that one having had minimal training in sedation techniques is also capable of safely employing so called "deep sedation"—a state in which conscious as well as adequate reflex activity is permitted to wax and wane—is sheer folly. For the sake of safety "deep sedation" must be considered synonymous with general anesthesia. Patients in the deeply sedated state should be afforded the same attention as those under classical general anesthesia.

Patient Selection

Generally speaking, all patients capable of presenting for dental treatment are satisfactory candidates for conscious-sedation. That is not to say that a history and physical examination need not be performed. Quite to the contrary. Familiarization with the patient's physical and emotional condition will allow the practitioner to tailor the conscious-sedation technique to the requirements of each patient. Nevertheless, patients presenting for dental care will rarely, if ever, be of physical status III or greater and will present few absolute contraindications to sedation. In fact, the converse is true, the poorer the patient's physical condition the greater is the indication for the application of stress-reducing sedative procedures.

By contrast, the safety of ambulatory general anesthesia will be greatly enhanced by selection of patients in the physical status I or II categories only. General anesthesia, even when expertly administered, is capable of producing physiological deviations of major significance that do not justify its use in the office environment in less than healthy patients.

Patient Preparation

All patients to receive either sedation or general anesthesia require minimal but specific preparation.

With the exception of those patients to receive N_2O/O_2 sedation, all patients must be escorted from the office by a responsible adult. These arrangements should be made prior to the sedative experience.

Loose-fitting comfortable garments should be worn by all.

Those to be sedated may eat a light liquid meal 2 to 3 hours prior to the procedure, while patients about to undergo general anesthesia should refrain from food or drink for 6 to 8 hours prior to the appointment.

A history and physical examination should be obtained on all patients. Hemoglobin and hematocrit determination is recommended for those patients about to undergo general anesthesia. Additional laboratory data (e.g., urinalysis, EKG, etc.) are warranted as indicated. Laboratory tests are not required for patients who will receive sedation.

Premedication prior to either sedation or general anesthesia is at the discretion of the operator and is usually based on anxiety levels noted in the patient.

Drug Selection

Regardless of whether the technique of choice is conscious-sedation or general anesthesia, careful drug selection is paramount to both efficacy and safety. One must select agents with the greatest therapeutic ratio for the objective desired. Extremely potent or long-acting agents should be avoided when possible.

Proper drug selection will minimize both in-office and post dismissal recovery time.

Drug Administration

Without doubt, the key to the success of conscious sedation or general anesthesia is proper drug administration. It has been said that most physicians treat by prescription while the anesthesiologist treats by titration. It is only by this method that both safety and efficacy can be assured. Since toxicity (e.g., respiratory depression) of injected agents is a direct extension of their pharmacology, careful drug administration titrated to the patient's response is not apt to result in misadventure.

Patient Monitoring

Just as drug titration is the key to producing the desired effect, careful, attentive, patient monitoring is the key to safe maintenance of the sedative or anesthetic state. However, monitoring requirements, skills, and equipment vary markedly between sedation and general anesthesia.

As mentioned previously, conscious-sedation is employed to minimize both physical and psychological stress. Assuming this premise to be correct, it follows logically that the patient in the conscious sedative state is "safer" than he would be when treated under local anesthesia alone. Furthermore, there are no emergencies that are apt to occur in the sedated patient that cannot take place under local anesthesia alone.

In addition, the patient properly titrated to the sedative state is not apt to experience any physiological derangement once drug administration has ceased.

For these reasons the consciously sedated patient does not require the use of any special monitoring devices or techniques. Continual monitoring of heart and/or respiratory sounds with a precordial stethoscope, frequent blood pressure determination, the use of a pulse oximeter, digital pulse detector, or an electrocardiogram are of little value.

To recommend the use of such equipment in the consciously sedated patient would by inference also apply to the patient receiving treatment under local anesthesia alone. In either case, extensive monitoring is not called for.

Once baseline blood pressure and heart rate have been established the patient need only be observed for the presence of three parameters: consciousness, comfort and cooperation. It is inconceivable that major and/or significant deviations in vital functions can take place in the conscious, comfortable, and cooperative patient. Personal experience with over 70,000 cases attests to this fact.

By contrast, monitoring of vital signs is mandatory by an anesthetist whose sole responsibility is to maintain the life and welfare of the patient under general anesthesia. Under these circumstances the anesthetist must essentially become the reflex system of the patient. Only by attentive, conscientious, and continual observation of vital functions can patient safety be assured.

Regardless of whether local anesthesia alone, conscious-sedation, or general anesthesia is being employed, patient welfare must be of primary importance. All offices must be adequately equipped and personnel properly trained in the management of medical emergencies.

Emphasis must be placed on the early detection and prompt management of mild deviations in physiologic function. Minor emergencies are certain to develop into major problems if uncorrected.

Without doubt the most frequently encountered problem surrounding the use of sedation and/or general anesthesia involves upper airway obstruction coupled with hypoventilation.

The number of cases in which mortality or serious morbidity have occurred as a result of upper airway obstruction is startling. They are particularly regrettable when one realizes that, in most cases, tragedy could have been averted with one finger. By simply extending the victim's head an airway would have been re-established, and in most cases, this simple maneuver is all that would have been required.

One must bear in mind that endotracheal intubation is not an emergency procedure. Its accomplishment should not be attempted by the uninitiated or those not thoroughly familiar with the procedure. It should only be carried out under as nearly ideal conditions as possible.

Those trained in conscious-sedation techniques need not be familiar with or equipped for endotrachael intubation. There is not substitute for manual control of upper airway obstruction coupled with artificial ventilation.[6]

Dismissal Criteria

Efficacy and safety of anesthesia and sedation do not end when the patient leaves the dental office. Most medications used in conjunction with either sedation or general anesthesia have the potential to produce minimal albeit noticeable effects for up to 24 hours after administration. This effect may be minimized to a degree by proper drug selection and dose titration.

If a safe and trouble-free recovery is to continue following dismissal, the patient must be detained and observed until considered "street fit"—that is to say, ready for discharge to the custody of a responsible adult with only minimal drug effects observable.

Criteria for a "street-fit" discharge include:

1. Alert and oriented (under no circumstances should a patient be dismissed in an unconscious state)
2. Vital signs stable and within acceptable limits
3. Ambulate with minimal assistance
4. Nausea, vomiting, and vertigo absent when standing
5. Possess the ability to tolerate orally administered fluids (e.g., water, carbonated beverages)
6. No stridor or only minimal hoarseness in patients having been intubated.

Patients should also be given written postoperative instructions that include the avoidance of sudden movements (sitting, standing, etc.), consumption of alcoholic beverages, or the engagement of any potentially hazardous activity for 24 hours.

Instructions should also include pertinent telephone numbers that may be called in the event a problem develops.

Conclusion

The efficacy and safety of anesthesia and sedation are of paramount importance if the dental profession is to serve the public well. Anesthesia in dentistry need not carry undue risks. Attainment of these goals are easy when practitioners work within the limits of their training and expertise and rather simply state—"use common sense."

References

1. Archer WH: Historical notes on Horace Wells. Dental Rays, 14(3), 1939.
2. Archer WH, Asbell MD Toby, WB: The history of the development of anesthesia, oral surgery and hospital dental service in the United States of America, chapters 11-14. Oral Surgery Directory of the World, ed. 4, 1971.
3. Bennett CR: *Conscious Sedation in Dental Practice,* ed. 2, St. Louis, C.V. Mosby Company, 1978.
4. Guidelines for Teaching the Comprehensive Control of Pain and Anxiety in Dentistry, American Dental Association Council on Dental Education, May 1985.
5. Giovannitti JA, Henteleff HB and Bennett CR: Cardiorespiratory effects of meperidine, diazepam, and methohexital conscious sedation. J Oral Maxillofac Surg 40:92-95, 1982.
6. Safar P: *Advances in Cardiopulmonary Resuscitation.* New York, Springer Verlag, 1977.