Point of Care

The "Point of Care" section answers everyday clinical questions by providing practical information that aims to be useful at the point of patient care. The responses reflect the opinions of the contributors and do not purport to set forth standards of care or clinical practice guidelines. Readers are encouraged to do more reading on the topics covered. This month's questions were answered by members of the Canadian Academy of Dental Anaesthesia.

QUESTION 1

What factors should I keep in mind in performing dental anesthesia?

Background

The regular use of regional anesthesia is one of the aspects of dental practice that sets dentists apart from most other health care practitioners. The ability to anesthetize the dental tissues has been one of the most important advances in dentistry. Many, if not most, of the dental procedures performed today could not be done on conscious patients without local anesthesia. Anesthetics are probably the most common type of drug used in dentistry; a 1995 report estimated that 11 million cartridges were used annually in Ontario alone.[1] For the most part, dental anesthetics are used well; however, a number of commonly accepted but incorrect beliefs may prevent dentists from providing the best possible service to patients.

Maximum Amount of Local Anesthetic for Adults

Five local anesthetic agents are commonly used in North America: lidocaine, articaine, prilocaine, mepivacaine and bupivacaine. These agents differ in terms of their properties and preparations, but their safety guidelines are similar. The maximum dose of local anesthetic is generally calculated in terms of milligrams per kilogram (mg/kg) body weight. For lidocaine, articaine, prilocaine and mepivacaine, the approximate maximum is 7 mg/kg if the preparation contains a vasoconstrictor. This guideline applies to a "typical" healthy young adult with a body weight of 70 kg, for whom the total dose would be about 500 mg (or almost fourteen 1.8-mL cartridges of lidocaine). The notable exception to this guideline is bupivacaine, which has a dosage limit of 2 mg/kg (i.e., 150 mg for the typical adult). Interestingly, these recommendations from the drug manufacturers can differ from other published recommendations.[2] Nonetheless, these guidelines have worked well in both dentistry and medicine.

The other component of regional anesthetics that is of concern for toxic or unwanted effects is the vasoconstrictor, usually epinephrine. Other vasoconstrictors include levonordefrin and felypressin. The purpose of the vasoconstrictor is to decrease circulation in the area of administration, which in turn allows more molecules of the local anesthetic to penetrate the nerve sheath and exert sensory blockade. The intraneural area is not highly vascular, so the presence of a vasoconstrictor can affect the depth and duration of anesthesia. Of course, vasoconstrictors also have systemic effects. Of particular concern are the cardiovascular effects (e.g., increased cardiac workload and increased peripheral vasoconstriction). The accepted maximum dose of epinephrine for young, healthy adults is 0.2 mg (200 μg), which represents about eleven 1.8-mL cartridges of local anesthetic containing epinephrine at 1:100 000. Again, this guideline was not reached empirically, but has worked well.

In terms of safety considerations, each patient's age and medical status must be considered. Issues related to either or both of these factors will reduce the allowable total of local anesthetic.

Appropriate Size of Needle for Administering Local Anesthetic

Although patient comfort is of paramount importance, thin dental needles offer few advantages and present some significant disadvantages. First, research has suggested that there are no significant differences in terms of pain perception with needles of different gauges.[3,4] Second, reliable aspiration results are less likely with thinner needles, which could lead to systemic adverse effects as well as failure of anesthesia due to intravascular injection. Third, thinner needles will deflect more in tissue than larger-gauge needles,[5,6] which could introduce inaccuracies that might result in failure of anesthesia.

As a general rule, for safety, comfort and effectiveness, it is advisable to use 25-gauge needles (either long or short), as well as topical anesthesia, when administering local anesthesia.

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QUESTION 2

What oral sedatives can I use for my adult patients?

Background

For adult patients, the most common use of oral sedation is to reduce anxiety before and during dental appointments. Occasionally, oral sedation is used the night before the appointment to ensure a more restful sleep, so that the patient can be more relaxed during the dental appointment.[1]

If an oral sedative has been used, the patient should be advised not to drive or consume alcohol for a period of approximately 24 hours after the appointment. When leaving the dental office after the appointment, a patient who has been sedated must be escorted by a responsible adult. It is recommended that any oral sedative be administered in the controlled and monitored environment of the dental office. This allows the presence of an escort to be confirmed; in addition, the treatment can be confirmed and informed consent obtained before the patient takes the sedative medication. If the sedative is given the night before, the same precautions are needed: the patient's safe travel to and from the dental office must be ensured and dental treatment confirmed before sedation is administered.

Choosing and Administering an Oral Sedative

The sedative drug should be selected on the basis of the patient's age, weight and medical history, rather than the length of time required for the dental treatment. The choice of medication also depends on the clinician's experience with and knowledge of the pharmacology of the particular drug. For example, sensitivity to benzodiazepines increases with age and in the presence of liver disease and decreases with smoking, recent use of alcohol and in the presence of other benzodiazepines.[2]

Ideally, the selected sedative should be administered in a shorter trial appointment, to determine its effectiveness for the particular patient. The amount administered should always be the lowest effective dose. Following the initial appointment, discussions with the patient will determine the drug type and dose to be used during subsequent appointments.

In dentistry, benzodiazepines are commonly used as oral sedative agents (**Table 1**). For dental procedures of short to moderate duration (up to 2 hours) in adults, triazolam, a short-acting benzodiazepine can be given. Higher doses (0.375 to 0.5 mg) have been used for some patients, but caution is required for these higher doses. Triazolam is a popular choice among clinicians because of its predictable anxiolytic, hypnotic and amnestic effects, which are desirable for dental patients. This drug has a relatively short half-life, with little residual hangover effect the next day. For longer appointments (2 to 4 hours), a longer-acting benzodiazepine such as lorazepam may be prescribed.

Antihistamines such as diphenhydramine and hydroxyzine have also been used as sedatives for

Table 1 Recommended doses of oral sedatives

Oral sedative	Brand name	Dose	Timing of dose before the procedure	Half-life
Benzodiazepines				
Triazolam	Halcion (Pfizer)	0.125 to 0.25 mg	1 hour	1.5 to 5 hours
Lorazepam	Ativan (Biovail Pharmaceuticals)	1 to 4 mg	Oral preparation: 1 to 2 hours Sublingual preparation: 30 to 60 minutes	10 to 20 hours
Antihistamines				
Diphenhydramine	Benadryl (Pfizer)	50 mg	1 hour	4 to 8 hours
Hydroxyzine	Atarax (Pfizer)	50 to 100 mg	1 hour	3 to 20 hours
Promethazine	Phenergan (Novartis)	25 to 50 mg	1 hour	7 to 15 hours

short to long procedures (**Table 1**). Yet another antihistamine with a half-life similar to that of hydroxyzine is promethazine. Patients taking this drug may experience anticholinergic side effects such as dry mouth. For patients with angle-closure glaucoma, these antihistamines should be avoided.

Use of Oral Sedatives in Elderly Patients

Many physiological and psychological changes take place with age, such as decreases in cerebral blood flow, cardiac output, renal and hepatic blood flow, and pulmonary function. Furthermore, older individuals tend to have at least 1 chronic condition, such as heart disease, hypertension, arthritis, osteoporosis or diabetes mellitus, all of which necessitate long-term control with drug therapy and occasionally surgery. In addition, there are pharmacodynamic and pharmacokinetic differences between younger and older patients.[3]

Pharmacokinetically, oral absorption, hepatic metabolism and renal clearance all decrease with age. Pharmacodynamically, oral sedatives and other depressants of the central nervous system tend to have a greater effect in elderly people. These differences, together with the occurrence of polypharmacy in this patient population, have led to the use of lower dosages and shorter-acting medications to avoid oversedation.[3]

In older patients, a short-acting benzodiazepine such as triazolam at a starting dose of 0.125 to 0.25 mg, given 1 hour before the dental appointment, may be effective. For longer appointments, lorazepam 0.5 to 1 mg may be given orally 1 to 2 hours before the procedure (30 to 60 minutes before for the sublingual preparation). The long half-life of diazepam is further extended in elderly patients; thus, the use of this drug is not recommended for this patient population.

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QUESTION 3

How does nitroglycerin work, and when should I use it?

Background

For dental office emergencies, nitroglycerin is supplied as either a sublingual metered-dose (0.4-mg) spray or a rapidly dissolving sublingual tablet (0.3 to 0.6 mg). This drug can also be obtained as an intravenous solution, a paste, a transdermal patch or oral extended-release tablet, but these forms should not be kept in the emergency kit in a dental office.

There is some evidence that the effect from the sublingual spray is more rapid than that of the sublingual tablet, possibly because of occasional failure of the tablet to dissociate under the tongue. Also, once the bottle of sublingual tablets is opened and there is exposure to light or air, the tablets have a short shelf-life of about 3 months.

Mechanism of Action

A common misconception is that nitroglycerin works primarily by dilating the coronary arteries, thereby increasing myocardial oxygen flow. Although this effect does occur to some degree and will aid in the relief of angina pectoris caused by vasospasm, the function of nitroglycerin as a peripheral venodilator is its primary mechanism of action. Because nitroglycerin allows blood to pool in the peripheries, less blood is available to return to the heart. As a result, the heart pumps less blood against less resistance, so there is a lesser myocardial demand for oxygen.

Management of Angina Pectoris

The symptoms of angina pectoris include a burning or squeezing sensation in the chest or substernal area, often accompanied by shortness of breath, dizziness, diaphoresis and nausea or vomiting. Its cause is simple: the myocardial demand for oxygen exceeds supply, which leads to areas of ischemia within the heart and consequent pain.

If you believe that a patient is experiencing angina, immediately stop the procedure. Do your best to help the patient to relax, to minimize endogenous production of catecholamine, which will increase myocardial oxygen demand. Place the patient in the Fowler position (upright or semi-upright), and give oxygen by mask. Take a blood pressure reading; if the systolic pressure is above 90 mm Hg, administer nitroglycerin sublingually every 5 minutes until the symptoms pass. Remember to retake the patient's blood pressure after every dose.

If the pain persists after 3 doses, nitroglycerin is unlikely to be effective. In this situation, contact emergency medical services. Assume that the patient is experiencing myocardial infarction, and administer acetylsalicylic acid (160 or 325 mg), provided the patient has no contraindications to this drug. To help control pain at this point, consider adding morphine or nitrous oxide, if available (this gas significantly reduces the pain of myocardial ischemia).

Nitroglycerin must not be administered within 24 hours after a patient takes sildenafil (Viagra) or vardenafil (Levitra) or within 48 hours after tadalafil (Cialis), as significant and irreversible hypotension may result from these combinations.

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QUESTION 4

What do I need to know about the use of oxygen in the dental office?

Background

Oxygen, an element that is essential for life, is naturally present in atmospheric air at a concentration of 21%. Although contained in the air we breathe, oxygen is considered a drug and is in fact the most important emergency drug available. It is indicated in all medical emergencies except hyperventilation and is routinely given during inhalational, oral and parenteral sedation. A portable source of oxygen should be present in every dental office, and dentists should be confident about its safe and proper use. The location of the oxygen source should be known to all staff members, and the equipment should be checked regularly and serviced to ensure optimum performance.

How Is Oxygen Stored?

Oxygen is stored under pressure (as a compressed gas) at room temperature in cylinders of various sizes, each designated by a letter. The E cylinder is the size recommended for emergency use in dental offices because of its portability and the amount of oxygen available. Gas cylinders are colour coded for ease of identification. In Canada, the cylinders are white, which is the international coding for oxygen. In the United States, the cylinders are green.

How Much Oxygen Is Contained in an E Cylinder?

A full E cylinder contains about 660 L of oxygen at a pressure of 2000 to 2200 psi (**Fig. 1**). Since oxygen remains a gas under pressure (above its critical temperature of –119°C), the pressure of the cylinder can be used to determine its volume. For example, if the pressure gauge reads 1000 psi, the cylinder is half full and therefore contains about 330 L of oxygen.

How Does the Oxygen Get from the Cylinder to the Nozzle?

For the delivery of oxygen to the patient, a regulator (**Fig. 2**) is attached to the oxygen tank, which reduces the pressure from high (2000 psi for a full cylinder) to low (approximately 50 psi). The regulator contains a pressure gauge as well as a flowmeter, which is calibrated to deliver oxygen in litres per minute. The flowmeter valve can be adjusted to deliver oxygen from 0.5 or 1 L/min to 15 L/min.

How Do I Operate the Flowmeter and Cylinder Valve?

A wrench is used to open and close the cylinder valve; this wrench should be chained to the regulator to prevent misplacement. The cylinder valve should be opened during use and closed during storage and when attaching and removing the regulator, to prevent leakage. When changing cylinders it is important to note the presence of the washer (**Fig. 2**), which can be easily lost, resulting in a leak. Spare washers should be readily available (preferably placed in a bag attached to the regulator).

The flowmeter valve is turned to the desired flow rate, which depends on the delivery system and the patient's oxygen demand.

Figure 1: Pressure gauge for an oxygen tank showing 2000 psi.

Figure 2: Regulator for an oxygen tank; note the presence of the washer.

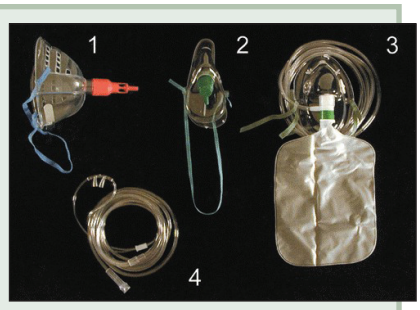

Figure 3: Oxygen delivery devices: Venturi mask (1), simple mask (Hudson) (2), partial rebreather mask (3), and nasal cannula (4).

Table 1 Methods of oxygen delivery

Delivery system	Flow (L/min)	Oxygen delivered (%)
Nasal cannula	1 to 6	24 to 44
Simple mask	5 to 10	35 to 50
Partial rebreather mask	6 to 10	40 to 70
Nonrebreather mask	10 (minimum)	60 to 80
Venturi mask	4 to 10	24 to 55

How Is the Oxygen Delivered to the Patient?

If the patient is breathing spontaneously, oxygen can be delivered by nasal cannula (nasal prongs), simple face mask (Hudson RCI, Teleflex Medical, Research Triangle Park, N.C.), Venturi mask (Ventimask, Flexicare, Wales, U.K.), or a partial rebreathing or non-rebreathing mask (**Fig. 3; Table 1**).

The nasal cannula is the least intrusive method of oxygen delivery. It works by filling the oropharynx and nasopharynx with oxygen. Because this volume is relatively small, room air is entrained during inspiration, which dilutes the concentration of oxygen. As a rule of thumb, each litre per minute of oxygen delivered increases the inspired concentration of oxygen (FiO_2) by approximately 4%. Beyond 6 L/min, the oropharynx and nasopharynx are completely filled with oxygen and no additional increase in concentration is achieved with greater oxygen flow rates. These high flow rates will cause drying and irritation of the nasal mucosa and are not recommended. The approximate maximum concentration of inspired oxygen is 20% + (6 L/min × 4%) = 44%.

Simple face masks can deliver higher concentrations (35% to 50%) than nasal cannulae, depending on the flow rate and minute ventilation. The inspired concentration is limited by the entrainment of room air and rebreathing of expired gases. Partial rebreathing masks (delivery of 40% to 70% oxygen) have a reservoir bag to decrease rebreathing and entrainment of room air, whereas non-rebreathing masks (delivery of 60% to 80% oxygen) have both a reservoir and valves. The valves prevent expired gases from entering the reservoir bag and also prevent entrainment of room air during inspiration. These masks should be used with a flow rate of at least 6 L/min.

Colour-coded Venturi masks deliver a fixed oxygen concentration. The oxygen is delivered at high velocity through a narrow tube which entrains room air to deliver a specific oxygen concentration at a specific flow rate.

For a non-breathing patient, a bag-valve-mask is used for resuscitation. As its name suggests, this device consists of a bag, which is squeezed to deliver positive pressure ventilation; a valve, which prevents rebreathing and entrainment of room air; and a full face mask. A reservoir bag allows delivery of 100% oxygen when the flow rate is equal to the minute ventilation. Use of this device is limited to people with adequate training because of the difficulty of maintaining a patent airway, mask seal and minute ventilation.

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