Chapter 4 Implants and anesthesia

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I. Local anesthesia

Details of local anesthesia for implants are mentioned in the clinical practice edition, "Implantation techniques for the AQB implant", therefore, the characteristics of local anesthesia, local anesthetics and vasoconstrictors, and the effects of local anesthetics and their complications will be mentioned in this section.

A. Characteristics of local anesthesia used in the dental field

The local anesthetics used in the dental field are required to reach and effectively numb the hard tissues (bones and teeth) after administration at soft tissue sites, through the pores in the bone. Therefore, the majority of uses of anesthetics in dental practice involve actions on hard tissues, in contrast to other medical practice. Consequently, the properties that characterize the anesthetic medicines used in dental practice are: use of high concentrations of local anesthetics, and the concomitant use of high concentration of vasoconstrictors in order to maximize the anesthetic effects and stop bleeding. There is a significant number of pain points present intra-orally. The anxiety and uneasiness that patients have towards dental treatment, coupled with the discomfort and pain of the needle used for the induction of local anesthesia, can trigger systemic accidental complications such as neurogenic shock and hyperventilation. Therefore, the local anesthetics used for pain management in implant treatments are often administered together with topical and conduction anesthetic agents, or psychosedative agents, to prevent the onset of accidental complications.

B. Local anesthetics and vasoconstrictors

1. Dental local anesthetic

The local anesthetic agents that are used in the field of dental surgery are listed in Table 3-4-1. (For details of pharmacological effects of each local anesthetic agent, refer to Chapter 5. Implant-related medicines, or the Clinical Edition).

Brand name	Local anesthetic	Concentration	Vasoconstrictor	Measure
Xylocaine cartridge for dental use	Lidocaine hydrochloride	2%	Adrenalin 1/80,000 (0.0125mg/ml)	1.8 ml
Ora cartridge	Lidocaine hydrochloride	2%	Hydrogen tartaric acid adrenalin 1/73,000	1.8 ml 1.0 ml
Citanest cartridge for dental use	Propitocaine hydrochloride	3%	Hydrogen tartaric acid adrenalin 1/300,000	1.8 ml
Citanest-octapressin cartridge for dental use	Propitocaine hydrochloride	3%	Felypressin 0.03IU	1.8 ml
Scandonest cartridge	Mepivacaine hydrochloride	3%	NA	1.8 ml

Table 3-4-1 Main dental local anesthetic agents

2. Vasoconstrictors

The local anesthetic agents used for implant surgery are often combined with vasoconstricting agents, taking into account the anesthetic effect, the duration of surgery, and the need to stop bleeding. The common vasoconstricting agents currently in use are adrenaline and felypressin.

a. Pharmacological effects

The main pharmacological effect of adrenaline is peripheral vasoconstriction and an increase in heart rate and stroke volume, with significant central nervous system effects, and in particular an increase in myocardial oxygen consumption. Felypressin has a lesser vasoconstricting effect in comparison to adrenaline, but administration of large doses has been reported to result in coronary artery constriction and diminished blood flow [1) 2)].

b. Contraindications

The contraindications to adrenaline can be divided into absolute and relative contraindications; in the latter case, it can be used under some circumstances. Adrenaline is absolutely contraindicated in patients with hypertrophic cardiomyopathy and uncontrolled hyperthyroidism. If these conditions are well controlled under the supervision of an internist, vital signs can be monitored, and if a reduced amount will be effective, these subjects can be regarded as having a relative contraindication. Other relative contraindications include high blood pressure, diabetes, ischemic heart disease, hyperthyroidism and arteriosclerosis. In addition patients who are regularly taking ß-blockers, tricyclic and tetracyclic antidepressants, and digoxin are also considered to fall into the conditional category.

The local anesthetic formulations of adrenaline typically contain 12.5 µg/ml. Taking this fact into consideration, at least one cartridge (1.8 ml) may be adequate. Up to two of these cartridges can be administered even in the presence of moderate circulatory disease (a relative contraindication) [3)].

Relative contraindications to felypressin include ischemic heart disease and coronary arteriosclerosis, and old age; the reasoning is obvious from the effect this agent has on coronary blood flow. If these conditions can be well controlled, up to three cartridges can be administered. The implant treatments often involve replacement of a number of teeth therefore it is essential to adhere to the dosages listed for effective pain management.

C. Anesthetic effects [4)]

1. Anatomical factors

When administering local anesthetic in the region of the mandibular molars, because the bone in this area is compact, and has few pores; it may be necessary to administer conduction anesthesia into the mandibular foramen or into the papillary or peridontal space. In the case of implant surgery, concomitant use of conduction anesthesia is recommended.

2. Inflammation

Where acute inflammation is present, lactic acid accumulates in this area, making the environment acidic. This causes difficulty in producing free basic groups that pass through the neurilemma, thereby reducing anesthetic effects. Improved anesthetic effects can be gained by the concomitant use of conduction anesthesia, but for implant surgery, it is recommended that one waits for the acute inflammation to subside before surgery is performed.

Moreover, if the tissue has local chronic inflammation, the conditions resulting from formation of granulation tissues such as hyperplasia of nerves, reactive densification of bone and increases in blood flow act to weaken the anesthetic effect [4].

3. Psychological factors

In cases where there is extreme mental tension or anxiety towards a dental treatment or where the patient is in poor physical condition, his/her pain tolerance is often impaired. Furthermore, if the patient has preconceptions about his/her reaction to treatment, for example that anesthetics do not work properly on them, or are ineffective, this can adversely affect the outcome of local anesthetic use. If this becomes the problem, psychosedation can be administered concomitantly, as described below.

4. Dose administered

A sufficient dose should be administered, as too little can be ineffective in providing an anesthetic effect.

5. Speed of injection

If the injection speed is too fast, the local anesthetic drug can disperse from the point of introduction, thereby reducing its action at the desired site.

6. Timing

If the surgical procedure is started before enough time is given after the injection of local anesthesia, the patient will feel the painful stimulus as the anesthetic agent has not yet started to work. Even if sufficient time has passed, and the pain threshold has become raised, not only the sense of pain, but also pressure sensation and touch may act together to produce a painful sensation. Therefore, it is essential to defer surgery until sufficient anesthetic action has been achieved, which usually takes five minutes.

7. Site of injection

It is imperative to limit the number of injection sites to a minimum, to avoid leakages of the anesthetic drugs from these sites, as this results in the efficacy of these agents being reduced.

D. Complications and how these are addressed [5]

Accidental occurrences before, during and after surgery are mentioned in the chapter “Accidental disease and complications”; therefore, in this chapter, we will only talk about the main local complications that can arise from use of local anesthesia.

1. Accidental swallowing of the injection needle, and its entry into the trachea

Poor attachment of the needle to the local anesthetic delivery device at the time of anesthesia or in particular, application of pressure while infiltrating local anesthetic, can result in the needle entering the oral cavity. This is problematic, especially in the elderly where the gag reflex is less efficient, and may result in swallowing of the needle or its entry into the trachea.

a. Management

Stop the procedure, and let the patient cough to eject the injection needle. Confirm the presence of the needle, and remove using needle forceps, Péan forceps, or artery forceps. If the needle cannot be removed, the patient should be referred to a specialist medical organization.

b. Preventative measures

Take great care to lock the injection needle. Before intra-oral injection, test outside the oral cavity to ensure smooth exit of the drug, and determine that the needle does not shoot off upon application of pressure.

2. Needle breakage, and deviation

Generally, this can occur as a result of re-usage of needles, use of unsuitable needles, and misjudgment of the depth, direction or site of injection. Further, deviation of needles in the tissues can occur as a result of placing the needle deeply, upon which breakage of the needle within the tissues can occur, particularly if there is any change in the direction of the needle, whether this is due to movement of the needle by the operator or the patient moves his/her face. This complication is most prevalent with delivery of conduction anesthesia to the mandibular foramen.

a. Management

Use a mouth opener to ensure that the mouth remains open. Firmly grip, and remove the needle using needle forceps, Péan, or artery forceps. Avoid the use of tweezers as they do not grip effectively. If the needle cannot be removed, the patient should be referred to a specialist medical organization (e.g., dental/oral surgery department of a general hospital).

b. Preventative measures

Use new injection needles. Use needles of a designated thickness and length. Examine the needle before use. Do not bend the needle before use. Do not insert the needle into its base. Do not change the direction of the needle once injection has started. The direction of the needle should be altered only once it has been pulled back to the level of the submucosal membranes before proceeding. Hold the injection body in a position where a rapid response to any sudden changes in patient's facial expression or body movement is possible.

3. Facial paralysis

Occurs either as a result of misjudgment in the direction or the position of insertion of the needle, or due to the administration of an excessive dose. Common symptoms that manifest are inability to close the eye, loss of the nasolabial sulcus, inability to whistle and sagging of the angulus oris.

a. Management

Clearly explain what has happened to the patient, protect the eye with an eye-patch if the eye cannot close, and refer to a specialist organization.

b. Preventative measures

Administer the correct dosage of anesthesia, direct the needle accurately, and insert the needle correctly.

4. Trismus

This can arise as a result of damage to or infection within the soft or hard tissues, arising from the injection needle during the administration of conduction anesthesia at the mandibular foramen. In the case of infection, onset occurs around 24 hours, with symptoms reaching a maximum within 72 hours from the time of induction. Regarding muscular damage or internal bleeding without infection, pain occurs at the time of insertion or on mouth opening, and the symptoms will show improvement after a few days to a week.

a. Management

Administer antibiotics early on

b. Preventative measures

Disinfect the oral cavity sufficiently before the procedure, and take great care in determining the

direction and the depth of injection.

5. Internal bleeding, hematoma, and swelling

These commonly occur as a result of damage to blood vessels or a venous plexus by the injection needle, and in particular, in patients with a hemorrhagic diathesis or those who are currently taking anticoagulants. The internal bleeding from infiltration anesthesia spreads from the submucosal layer to the subcutaneous tissues and into muscular tissues, resulting in purpura.

a. Management

Perform pressure hemostasis and give antibacterial agents to prevent infection.

b. Preventative measures

Take great care in determining the direction and the depth of injection. In addition, test whether there is any back-flow of blood before injecting liquid medicines. Pay particular attention to patients who suffer from a hemorrhagic diathesis and those taking anticoagulants.

6. Sensory paralysis

Caused by nerve injuries, hematoma and nerve compression from the injection needle. Sensory paralysis may occur along the direction of nerve flow from 24 hours to a few weeks after injection. The symptoms can persist for up to few months.

a. Management

On inducing conduction anesthesia at the mandibular foramen, it is imperative to identify the nerve that is to be anesthetized, between the inferior alveolar and the lingual nerve. Explain to the patients in detail the aftercare, and that the recovery period is largely dependent on the extent of the nerve damage. It can take from a few months to over a year, and, where necessary, a specialist in the field will need to be consulted.

b. Preventative measures

Take great care in determining the direction and the depth of injection, as well as identifying factors that could lead to infection or bleeding.

7. Local ulcers, necrosis and stomatitis

Factors such as an overdose of local anesthetics and exertion of excess pressure at the point of injection can result in these conditions. Additionally, the use of expired local anesthetics, or the administration of high concentrations of vasoconstrictors or local anesthetics can be the cause. These can occur particularly when injecting into the interdental papilla or the palatal mucosa. Symptoms such as redness and pain at the injection site can occur within 24 hours, followed by an ulcer that forms within 48 hours and that can also result in the exposure of bone surfaces.

a. Management

Wash with a non-irritant disinfecting agent, followed by application of ointment, and then administer agents such as antibiotics and anti-inflammatory drugs.

b. Preventative measures

Take great care to avoid an overdose of local anesthetic agents or application of excess pressure at the point of insertion.

II. Psychosedation

Recently, concomitant psychosedation has been used more often in association with implant treatments. It has been developed to enhance patient comfort and ease dental treatment by relieving the patient's tension during the procedure. The methods used are currently classified into inhalational sedation and intravenous sedation, based on the different induction routes. The distinction from general anesthesia is that the latter acts on the central nervous system (CNS) as a profound depressant that manifests as unconsciousness, analgesia, muscular relaxation, and altered autonomic reflexes, respiration and circulation. With psychosedation, on the other hand, patients retain consciousness and their protective mechanisms and reflexes; however, with implant treatment, which is associated with substantial pain, use of local anesthetics is also a requirement [6]. During implant surgery in recent years there has been a rise in the number of procedures that are associated with the use of methods of deep sedation, which has a strong suppressant effect on consciousness, breathing and circulation. This method requires control of breathing with airway maintenance. During dental surgery, where surgical and respiratory control are both necessary, the use of conscious sedation is recommended, as the risks are lower and the patient does not lose consciousness.

A. Inhalation sedation with nitrous oxide

1. Advantages and disadvantages

This intervention is very safe, with a fast recovery rate and no significant effects on breathing or the circulation. A disadvantage is that its sedative effect can be influenced by conversation and mouth breathing, and therefore can vary. Furthermore, the route of administration is via the nasal passage with a nasal mask, and therefore administration can be difficult in patients with nasal congestion, and the mask can interfere with the surgical procedure. The fact that the surgical area is full of nitrous oxide can also be a disadvantage.

2. Medication used, route of induction and dosages

Nitrous oxide is usually administered at a concentration of 30%, mixed with oxygen. It is a clear, tasteless, and non-irritant gas at room temperature and at atmospheric pressure. It is denser than air, and is more soluble in water than oxygen or nitrogen. It is not flammable in itself but, in a similar way to oxygen, it acts as an aid to combustion [7]. Its rapid onset of action and rapid awakening, with no significant influence on the respiration or circulatory systems, absence of muscle relaxation, and lack of apparent hepatotoxicity and nephrotoxicity, makes it a safe agent for use as a sedative. However, neuropathy that is symptomatically similar to vitamin B12 deficiency has been reported, therefore, management and awareness of operating room exposure to waste nitrous oxide is required.

3. Indications/contraindications

Use of this agent is indicated in patients with psychological stress such as marked anxiety with, and fear of dental treatment, or in cases where the procedure is complicated and requires either a long duration of time or where surgery is very invasive. It is also effective in the patients who have systemic disorders such as hypertension or other cardiovascular diseases that affect the whole body and are exacerbated by stress; and in those where past dental trauma occurred during treatments that resulted in harm or loss of consciousness. The concomitant induction of local anesthesia is required in invasive surgical procedures that are often associated with strong pain, such as implant surgery or tooth extraction [8].

On the other hand, administration of nitrous oxide is contra-indicated in early pregnancy, in intellectually impaired patients with whom conversation is difficult, and in those that have difficulty breathing through a nasal mask due to nasal congestion. Further contraindications are conditions where air is trapped within the body, including otitis media, pneumothorax, bulla, and pneumoperitoneum, as internal pressure in a closed, gas-filled cavity can rise with the inhalation of nitrous oxide. There have also been cases where the interaction between a medical gas that has been used in eye treatment and nitrous oxide has resulted in deterioration in eyesight with a rise in intra-ocular pressure. This risk can be anticipated based on the initial consultation, and should be considered a contraindication [9].

4. Equipment used for inhalational sedation

In order to establish continuous outflow of nitrous oxide/oxygen, a continuous flow-type inhaler technique is employed, that uses a "reservoir bag" to accumulate the gas in the bag, and aid the inhalation of nitrous oxide/oxygen by the patient. The ratio of nitrous oxide to oxygen can be decided with a mixing ratio adjustment dial. The machine has been designed with a stopper that limits the concentration of the nitrous oxide to 30%, therefore, in cases where concentrations higher than this are necessary, the stopper has to be lifted to enable the use of highly concentrated formulations [10]. (Fig. 3-4-1)

Fig. 3-4-1
Inhalation sedation device for nitrous oxide

5. Perioperative control

a. Preoperative preparation

During the consultation period, necessary patient information such as the current and past history and current medication use should be obtained. Contact the general practitioner for the specifics of any physical conditions if necessary. Obtain baseline vital signs such as the blood pressure, heart rate, and respiration rate. As patient cooperation is essential, the symptoms that occur at the time of nitrous oxide administration must be explained, and the clinician must ensure that the patient fully understands and consents to the procedure. In addition, the patient must be informed of the likely symptoms present when an optimal level of sedation is achieved (refer to the next section). There are no fasting requirements, however, to prevent vomiting, surgery should be avoided straight after eating (on a full stomach). In addition, advise the patient to get enough sleep and to be physically prepared for the day of operation [11].

b. Level of optimal sedation

(1) Maintenance of consciousness

(2) Gain patient cooperation for treatment

(3) The vital signs (respiration rate, blood pressure and heart rate) must be stable.

With nitrous oxide inhalational sedation, a feeling of warmth is noted, starting in the hands and feet and

then involving the whole body; subjects feel no pain, and become euphoric and relaxed. Different individuals vary in their sensitivity to nitrous oxide, and the following symptoms indicate an excessive concentration of nitrous oxide: loss of ability to open the mouth, complaints of discomfort, nausea, excitation and becoming uncooperative [11].

c. Intra-operative management

(1) Position and placement of monitoring equipment

Sit the patient in a reclining or dorsal position, in a position of comfort. Then attach a sphygmomanometer and a pulse oximeter (SpO_2) to measure and record the patient's initial blood pressure, pulse, respiration rate and SpO_2. Repeat this every five minutes after starting the nitrous oxide inhalation.

(2) Nasal mask equipment, and confirmation of nasal respiration

Fit the nasal mask so that there is no leakage of the inhalation gas. Check that the patient is breathing through the nasal passages by allowing inhalation of either air or 100% oxygen (Fig. 3-4-2).

Fig.3-4-2
Inhalation scene

(3) Determining the flow rate

The total flow rate of the combination of nitrous oxide and oxygen should be set to be greater than the patient's respiratory minute volume. The respiratory minute volume of a grown adult is roughly six to seven liters per minute. To be more precise, it is the product of the tidal volume (approx. 10 ml/kg) and the respiration rate (approx. 12 / min) [11]. Adjust the flow rate according to the ease of nasal respiration in the patient.

(4) Inhalation and maintenance of nitrous oxide

Use an initial concentration of nitrous oxide of 10%. While carefully observing the patient, increase the concentration in 5% increments to arrive at a concentration that provides optimal sedation. The optimal concentration of nitrous oxide differs for every patient but it is usually about 30%. Roughly 10 minutes is required to arrive at an optimal state of sedation. Mouth-opening during surgery can inhibit nasal delivery of nitrous oxide; the patient's nasal respiration should thus be monitored by observing the movement of the reservoir bag, and the exhalation valve of the nasal mask. If the patient complains of pain, maintain the concentration of nitrous oxide and add local anesthesia to relieve the pain. If he/she complains of discomfort, loses consciousness, or becomes excitable or uncooperative, an immediate reduction in the concentration of nitrous oxide is required [11].

(5) Terminating treatment

At the end of the surgical procedure, stop the nitrous oxide inhalation, and allow 100% oxygen to be inhaled.

d. Postoperative management

After inhalation of oxygen, leave the patient in a seated position for 5 minutes, and monitor their level of consciousness, blood pressure, heart rate and respiratory rate. If no abnormality is observed, they should sit quietly in the waiting room for over 10 minutes. Having confirmed that the patient is fully conscious, with no abnormalities in their vital signs, and that they can walk in a straight line, the patient can be permitted to go home.

6. Common complications and their treatment

Long-term inhalation (continuous use for six days) has been reported to inhibit myelopoiesis and spermatocyte function, and can result in dependency. As a safety precaution, the nitrous oxide concentration in confined spaces has been recommended to be kept below 25 ppm [10]. As a result of this recommendation, preventative measures should be in place, including restriction of the duration of use (less than 8 hours/week), use of ventilation systems and opening of windows, use of a scavenging system to collect expired gas from the patient, and sealing the nasal mask to prevent leakage of nitrous oxide.

B. Intravenous Sedation

1. Comparison with the nitrous oxide/oxygen inhalation technique

This method differs from the method described previously in that the drugs are administered intravenously to achieve sedation. The advantages of this approach are that there is no effect on the ability of the patient to communicate and that oral breathing is unimpaired. The effects are more immediate and more predictable, and amnestic effects can be obtained. Furthermore, the equipment required for inhalational sedation is not needed and there is no air pollution from the inhaled gas.

However, due to increased sedation with the administration of various pharmacological drugs, differences in the speed of administration, and differences in the details of treatment and patients' systemic conditions, loss of consciousness can occur, as well as suppression of respiration and circulatory depression, a condition commonly referred to as “deep sedation”. Therefore this technique should only be used by those who have a thorough knowledge of the techniques of anesthesia.

2. Medication used, route of induction and dosages (Table 3-4-2)

The main pharmacological agents used for intravenous sedation are: benzodiazepines (diazepam, flunitrazepam, and midazolam) and intravenous anesthetics (propofol). (Refer to the clinical edition for details).

3. Indications/contraindications

As for nitrous oxide inhalational sedation, this technique is applicable in all dental treatments. In contrast to nitrous oxide-based inhalational sedation, however, there are no sedative effects on conversation or oral respiration, and in cases where reliable sedation and an amnestic effect are important, this method should therefore be chosen. This method is particularly effective in procedures such as implant treatments and wisdom tooth extraction where it is performed in association with local anesthesia, where the surgery is relatively invasive, and during surgery that takes a long period of time. In addition, patients who are very anxious or are afraid of dental treatments, or those who have in the past become unwell or had impaired consciousness during treatment, should undergo this form of sedation.

	Benzodiazepine			Intravenous anesthetics
	Diazepam	Flunitrazepam	Midazolam	Propofol
Brand name	Selsyn Horizon	Rohypnol Silece	Dormicum	Diprivan Propofol
Administration method	Intermittent administration. Additional administration should be a third to a half of the initial dose.	Intermittent administration. Additional administration should be a third to a half of the initial dose.	Intermittent administration. Additional administration should be a third to a half of the initial dose.	Intermittent administration Continuous medication with syringe pump
tandard of sedative dos	0.2-0.4 mg/kg	0.010-0.015 mg/kg	0.05-0.075 mg/kg	Introduction amount 0.3-1 mg/kg Maintenance dose 2-3 mg/kg/hr
Rate of administration	1-2 mg/30 seconds	0.1-0.2 mg/30 seconds	0.5-1 mg/30 seconds	Ajustable
Strandard of maximum dose	20 mg	1 mg	5-7 mg	Depends on sedation time
Dilution method	Improper	Total dose of 1A (2 mg) Dilute to 12ml or 20ml	Total dose of 1A (10 mg) Dilute to 10ml	Improper (Risk of bacterial infection)
Important points during induction and maintenance	Possibility of angialgia and phlebitis	Sedactive effect is strong. Respiratory depression by dosage and rate of administration	When rate of administration is fast, respiratory depression	Angilalgia hurts. Dosage and rate of administration leads to respiratory depression and loss of consciousness
Anxiolytic and amnestic effects	Strong	Strong	Strong	Weak
Awakening	Possibility of delay	A little slow	Relatively fast	Very fast
Chracteristic	Less respiratory depression	Effects for mental retardation and autism	Suitable for short time treatment	Has variety of regulatior
Postoperative considerations	Risk of resedation in after 6-8 hours	Using other drugs toghether leads to delay awaking. Consider hospitalization	Possibility of delaying psychomotor impairment	Possibility of delaying recovery of subjective findings

Table 3-4-2 Properties of the typical pharmacological agents used in intravenous sedation

This technique is contraindicated in early pregnancy, where micrognathia causes difficulty in maintaining an open airway, and with obesity, obstructive sleep apnea, and in patients who have a serious systemic disorder that should be treated prior to dental treatment. However, in the cases where local anesthesia is inadequate for sedation, another option needs to be considered. Use of benzodiazepines is contraindicated in patients suffering from medical conditions such as acute angle closure glaucoma and myasthenia gravis, and alternative agents should therefore be used for these patients. It is difficult to determine the level of sedation in infants, who are less inclined to cooperate with intravenous techniques; great care is therefore required.

4. List of apparatus and monitoring equipment

Prepare the pharmacological agent, a syringe (10-20 ml), an injection needle (21-22G), a tourniquet, alcohol swabs, a butterfly needle, an indwelling venous cannula (20-22G), a fluid infusion, a drip infusion circuit, an extension tube, a three-way stopcock, bandages, and a syringe pump.
For monitoring, prepare the sphygmomanometer, pulse oximeter and electrocardiogram.

5. Implementation methods

The practitioner and medical institutions should be fully aware of the following in using the intravenous sedation technique [12].
First, before surgery, a pre-operative medical examination is necessary with a general health evaluation and assessment of the risks. Checking whether the patient has eaten, and proceeding in accordance with the concept of informed consent are essential. During surgical procedures, the following skills are required: the ability to obtain intravenous access, assessment of vital signs, familiarity with setting up and operation of the monitoring equipment, sufficient knowledge of the pharmacologically active components of the sedatives and emergency medicines, technical ability to secure the airway during an emergency, and preparation of equipment and drugs should an emergency arise.
Post-operative management requires an explanation of the evaluation criteria for discharge, understanding of systemic symptoms that arise as sedation wears off, and the ability to identify and treat complications should they arise.

6. Preoperative management

a. Preoperative preparation

During the consultation period, the required patient information such as the current and past history and use of any current medications should be acquired. Contact the general practitioner for the specifics of any physical conditions, if necessary. Obtain baseline values of blood pressure, heart rate, respiration rate, body weight, and obtain patient consent, after explaining the need for sedation, and intravenous sedation methods. The patient should be advised to avoid taking solids before surgery, and should fast for two to three hours prior to the procedure. After surgery, the patient should not drive a vehicle, engage in any intensive work, or make important decisions. Furthermore, in the case of elderly patients, a family member or a care giver should be present to support them after treatment [8), 13)].

b. Level of optimal sedation

The optimal level of sedation for intravenous sedation differs among individuals depending on the drug

used, in addition to variation in the rate of induction, even with the same agent, and the sedated state may also vary between individuals. It is therefore important to monitor the patient's response and vital signs in order to achieve adequate, gradual induction of sedation with the use of sedative agents [11]. The general features of optimal sedation are: anxiety and tension are eased but consciousness is retained; the patient becomes relaxed, followed by drowsiness, stabilization of blood pressure, heart rate, and respiration rate; the patient follows instructions but with a delay in his/her response.

c. Intra-operative management

(1) Placement of monitoring equipment

Seat the patients comfortably, then attach the sphygmomanometer, pulse oximeter, and electrocardiogram as necessary.

(2) Secure intravenous access and administer sedative agents

Wrap one arm in a sphygmomanometer cuff and insert the needle into a forearm vein. Choose a vein that is thick and straight, and avoid tortuous or thin veins. Having established venous access, ensure that the arm position is fixed.

Measure baseline vital signs (blood pressure, heart rate and respiratory rate) and record these. If diazepam or propofol is administered, the patient should be informed of the venous pain that occurs prior to the drug being administered. The vital signs and the general condition of the patient should be monitored and conversation maintained throughout the procedure. Stop the infusion if signs of over-sedation are observed, even if the pre-planned dose has not yet been reached. These signs include slowing of the speed of the patient's verbal response, incoherent speech, and slight closure of the eyelids.

As a precaution, it is important to stop the patient from falling asleep, and gradual induction is necessary while monitoring the state of the patient. Reduce the dose in elderly patients [11].

(3) Management during the procedure

Administration of local anesthesia can be started once the patient has reached his/her optimal sedation level, and the vital signs have been checked. During the treatment procedure, it is important to record any changes in facial expression, verbal responsiveness, and vital signs (blood pressure, heart rate and respiratory rate) every 5 minutes.

(4) A precautionary note

As the area of operation and the respiratory tract are in the same region, effective management of the airway is essential. Pay particular attention when fitting a mouth gag, as it can result in airway obstruction. Any pressure on the mandible or tongue exclusion by the surgeon or the assistant can also lead to airway obstruction and dysphagia. Notify the surgeon, and raise the mandible if necessary. Any pooling of blood, saliva, debris or liquid from washing should be avoided by adequate suction. Stop the procedure if the patient starts coughing, and only continue once coughing has stopped.

d. Postoperative management

(1) The end of the procedure

Termination of continuous infusion of propofol is dependent on the treatment and the level of sedation. The termination period should be determined by evaluating the time to awaken taking the properties of the drug into consideration. Once the procedure is complete, check for the presence of any abnormalities, including bleeding or inflammation in the oral cavity, and evaluate the level of consciousness, respiration, blood pressure, and heart rate. If no abnormalities are observed, seat the patient on the bed or a sofa so

that they can rest. Leave the monitors as they were. Observe, in particular, for any recurrence of sedation, vomiting, or bleeding [11].

(2) Criteria for discharging the patient

The basic criteria for determining the time of patient discharge are the vital signs and motor function, although the time is also dependent on patient's physical condition, the duration of treatment, and the drug used and dose administered.

As a guide to evaluate the vital signs, clear responsiveness, recovery of consciousness to the level present before the operation, and normal respiration, blood pressure and heart rate should be present. On assessment of motor function, the patient should not stagger and must be able to walk in a straight line, and there must be sufficient recovery of muscle strength. Other tests include checking the patient's ability to drink water, swallow, and urinate [12]. Along with a means of transport and consideration of the distance they will have to travel, and the presence of a supporting person, the decision to discharge the patient should be made after taking all relevant factors into consideration.

(3) Important precautions for the patient

Caution the patient to avoid the following: driving vehicles, doing work that involves fine detail or important decision making, drinking alcohol, and vigorous exercise. Advise them to call for help if the following occur: fever, vomiting, bleeding, or pain at the site where local anesthetic was injected.

III. General anesthesia

A. Introduction to general anesthesia

In terms of elimination of surgical pain, both local anesthesia and general anesthesia appear similar. With more invasive surgical techniques, the body's reaction increases commensurately, and an anesthetic agent is therefore required to act on the central nervous system and suppress biological reactions. By suppressing the central nervous system with general anesthesia, along with an analgesic effect, there is also loss of consciousness; muscular relaxation; immobilization; and depression of respiration, the circulation, and autonomic reflexes, and therefore effects on the whole body become important. These effects do not occur simultaneously and appear in the following order: amnesia, loss of consciousness, muscular relaxation, analgesia, and impairment of autonomic reflexes, depending on the depth of anesthesia. It thus becomes necessary to manage all aspects of bodily function.

B. Systemic management

1. Preoperative preparation and evaluation of the patient's condition

a. The patient's past history

Refer to the patient's medical records and note present and past medical conditions, any current medications, family history, surgical details and results of clinical tests.

b. Medical examination

The dentist in charge of anesthesia should take note of any prior medical conditions, previous surgery, and any anesthetic exposure.

c. Evaluation of the patient's condition before surgery

Evaluate preoperative problems in order to determine the risks of anesthesia and the surgical procedure for this patient by means of history-taking, visual examination (physique and appearance, jaw and neck,

respiratory conditions, and the condition of the arms and legs), palpation, and auscultation, along with laboratory results.

d. Explanation to the patient

Explain to the patient and their family the anesthetic methods that will be used, dietary restrictions and any pre-anesthetic medications.

e. Notes

Describe the anesthetic method along with surgical details, the state of the body, and how the airway will be secured, including the discussion with the physician in charge

2. General anesthesia techniques

a. Pre-anesthetic medication

The aim of this medication is to relieve mental strain due to the prospect of surgery and anesthesia, suppress saliva and airway secretions, restrict harmful reflexes, obtain analgesia and prevent conditions such as aspiration pneumonitis. Recent advances in general anesthetic techniques and anesthetic agents have reduced the need for pre-medication in some facilities, therefore, listing of different agents and the details of their pharmacological effects will be omitted here.

b. General anesthetics (refer to Chapter 5: Implant-related drugs, and the clinical edition for more details)

(1) Inhalational agents

These are administered with assisted respiration in order to reach levels required for general anesthesia. Often the combination of nitrous oxide, a gaseous anesthetic agent, and sevoflurane or isoflurane as volatile anesthetic agents, are administered through assisted respiration.

(2) Intravenous agents

An intravenous infusion can be used to provide sedation. The main drugs in current use are barbital, propofol, benzodiazepines, ketamine, and narcotics. These are often co-administered with inhalation anesthesia.

(3) Alternative agents used for general anesthesia

A neuromuscular blocking agent such as vecuronium is used if relaxation of the muscles is necessary.

c. Options for securing the airway [14)]

(1) Endotracheal anesthesia

The surgical area and airway are in the same region, therefore, general anesthesia in dental surgery often uses endotracheal intubation that involves inserting a tube through the trachea in order to secure the airway. The different routes of insertion can be divided into, oral, nasal and via the trachea (tracheotomy).

(2) Mask anesthesia

A face mask cannot be used in the field of dental surgery, as it covers the area of surgery. The use of laryngeal masks for general anesthesia in selected cases has recently become prevalent.

d. Inpatient or outpatient

Generally, patients come in on the day before the surgery, and leave after a few days. With recent developments in the agents and methods used for anesthesia, it has become possible to come in on the day of surgery and leave, after fully awakening, and if there are no problems. This way, dental surgical

patients can be treated as outpatients.

3. Intra-operative management

a. Respiratory management

The aim of respiratory management is to supply sufficient oxygen to the lungs and eliminate excessive carbon dioxide produced during metabolism by ensuring appropriate ventilation. Ventilation should be maintained through the use of endotracheal intubation and assisted ventilation to overcome the loss of consciousness, loss of the airway and suppression of respiration that are effects of general anesthetics.

b. Circulatory management

It is vital to maintain adequate circulatory function with an acceptable heart rate and blood pressure in order to transport oxygen, carbon dioxide, hormones, and other components vital for the maintenance of life. It is essential to maintain the blood pressure and heart rate by stabilizing the autonomic nervous system and preserving the circulating blood volume.

c. Metabolic management

To enable sufficient anaerobic respiration at a cellular level, it is essential to maintain the basics of acid-base equilibrium, fluid and electrolyte balance, and body temperature .

d. Observation of vital signs and monitoring

For patient surveillance, monitoring during general anesthesia and surgery should include respiration, circulation and metabolism.

(1) Respiration

Respiration rate, tidal volume, pulmonary auscultation, fraction of inspired oxygen, pulse oximetry (SpO_2), blood gas analysis, end-tidal carbon dioxide monitoring, etc.

(2) Circulation

Cardiac sounds, heart rate, blood pressure, arterial pressure, the electrocardiogram, central venous pressure, etc.

(3) Metabolism

Body temperature, blood sugar level, urinary sugar, urine ketones, acid-base equilibrium etc.

(4) Central nervous system

Electroencephalography, Bispectral index (BIS)

(5) Others

Urinary output, muscular relaxation, anesthetic gas concentration, etc.

e. Notes

The area where dental surgery is performed is rich in blood vessels and, in addition, general anesthesia results in a vasodilatory effect. Consequently, copious bleeding is often encountered. Dental anesthetics that contain vasoconstrictors are often used in anticipation of bleeding during surgery. By using local anesthesia, the dose of general anesthesia can be reduced, with the additional benefits of decreased bleeding and less sedation after surgery. For these reasons, the concomitant use of local and general anesthetics is often seen in dental surgery [14].

4. Postoperative management

a. Prevention of postoperative complications

Support the whole body based on monitoring of factors such as the level of consciousness, respiration, heart rate, blood pressure, body temperature and urinary output. Patient monitoring devices that should be prepared include a sphygmomanometer, electrocardiography, a pulse oximeter, as well as an oxygen supply, and suction, emergency medications and an emergency cart (containing emergency medical devices and drugs).

The main postoperative complications are: respiratory depression, airway obstruction, hypertension, hypotension, arrhythmia, delayed awakening, agitation, shivering, seizures, fever, hypothermia, retching, vomiting, hepatic dysfunction and renal dysfunction.

b. Pain management

Postoperative pain control not only relieves pain but also prevents postoperative complications. It is common to administer non-steroidal analgesics (suppository and intramuscular/ intravenous injection).

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