Emergency Drugs

411MDS

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Collapse of a patient in the dental surgery is an infrequent occurrence whose incidence is largely unknown. Dentists must be aware of the potential medical complications that may arise through the delivery of dental care to compromised patients. In one study, all final-year dental students and recent dental graduates failed a practical test assessing their ability to perform cardiopulmonary resuscitation.

During the last decade, many dentists have expressed concern about the management of medical emergencies and requested the introduction of an official emergency kit into surgeries.

In all cases of emergencies, the best method of managing medical emergencies is by preventing them from occurring in the first place. With this in mind, it is essential to take a comprehensive medical history from any patient about to receive dental care.

The following section reviews the more common emergency drugs that the dental team may have to administer in general dental practice.
**OXYGEN**

**Indications**

Oxygen is indicated in all medical emergencies except hyperventilation. Oxygenation prevents hypoxia that may be damaging to vital organs such as the brain and heart.

**Administration**

*Ensuring Airway Patency*

Before oxygen can be delivered, it is essential to ensure that the airway is patent. Foreign bodies, blood, vomit, and soft tissues may occlude the air space. The airway may be reestablished by using the head tilt and chin lift or jaw thrust techniques. Airway adjuncts such as oropharyngeal (Guedel) airways may be used in the unconscious patient to hold the tongue in an anterior position away from the posterior pharyngeal wall. These airways are contraindicated in conscious or semiconscious patients where protective reflexes are active.

*Oxygenation*

If the patient is breathing spontaneously, a facemask with an attached oxygen supply, running at a flow rate between 4 and 6 l/min, may be used to deliver oxygen and help prevent hypoxia. Positive pressure ventilatory support may be provided in respiratory arrest.

*Dose*

During cardiorespiratory arrest, the chest compression to ventilation ratio for adults 15:2 if one resuscitator is present and 5:1 if two are present.

**Adrenaline**

**Indications**

Adrenaline may be administered in the following situations:

* anaphylactic shock;
• cardiac arrest.

**Anaphylactic Shock**

An allergic (type 1 hypersensitivity) reaction may be precipitated by any material or drug to which the patient has been sensitized. Life-threatening events include cardiovascular collapse (90%), bronchospasm (30%), angio-oedema (25%), and pulmonary oedema (49%). Severity varies, and onset of anaphylaxis may be delayed for up to 6 hours or be biphasic, reoccurring in 5% of patients after clinical recovery.

In addition to adrenaline, high flow oxygen should be administered to all patients in anaphylactic shock. Second-line drugs, used to prevent relapse, are chlorpheniramine and hydrocortisone.

**Cardiac Arrest**

Adrenaline is used in advanced cardiac life support protocols.

**Mode of Action**

Adrenaline is a sympathomimetic amine that activates both alpha and Beta adrenoceptors.

• Contraction of vascular smooth muscle (*alpha-mediated*). An increased blood pressure helps maintain cerebral and coronary perfusion.

• Increased force and rate of cardiac contraction (*Beta1-mediated*). This action increases cardiac output, which helps to maintain the blood pressure. However, this may be damaging as it increases myocardial oxygen requirements and may precipitate ischemia.

• Relaxation of bronchial smooth muscle (*Beta2-mediated*). Increasing the caliber of the airway in acute anaphylaxis helps to re-establish airflow restricted by bronchospasm and oedema.

• Inhibition of histamine release by mast cells (*Beta2-effect*). Histamine is an important early mediator, responsible for some of the haemodynamic changes encountered in anaphylactic reactions.

**Administration**

Adrenaline may be given intramuscularly, subcutaneously or intravenously.
Dose

Adrenaline is obtainable in two concentrations: 1:1000 (reserved for intramuscular and subcutaneous use) and 1:10 000 (for intravenous administration). It is available in ampoules or prefilled. The following Table outlines the recommended volume of 1:1000 adrenaline that should be administered according to age during anaphylactic reactions.

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Volume of 1:1000 adrenaline (ml)</th>
<th>Dose (µg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.2</td>
<td>200</td>
</tr>
<tr>
<td>3-4</td>
<td>0.3</td>
<td>300</td>
</tr>
<tr>
<td>5</td>
<td>0.4</td>
<td>400</td>
</tr>
<tr>
<td>6-12</td>
<td>0.5</td>
<td>500</td>
</tr>
<tr>
<td>Adult</td>
<td>0.5-1.0</td>
<td>500-1000</td>
</tr>
</tbody>
</table>

Table: Recommended volume of 1:1000 intramuscular adrenaline for the treatment of acute anaphylactic shock.

**GLYCERYL TRINITRATE**

Indications

Glyceryl trinitrate (GTN) is used for the prophylaxis and relief of angina. Angina, defined as discomfort due to myocardial ischaemia, occurs whenever there is an imbalance between myocardial oxygen supply and demand. Atherosclerotic narrowing of the coronary lumen results in insufficient oxygenated blood being delivered to the myocardium during periods of increased activity.

Mode of Action

The principle site of action of GTN is smooth muscle. Within the smooth muscle cell, GTN is converted to nitric oxide which activates the enzyme soluble guanylate cyclase (SGC). Activation of SGC results in increased cyclic-guanosine monophosphate (cGMP) production, which leads to relaxation of the smooth muscle cell.

GTN improves the myocardial oxygen supply: demand ratio by:
• reducing cardiac workload
• increasing the blood supply to the myocardium

Adverse effects of GTN include headaches, postural hypotension, and flushing.

Administration

1. Tablets (300 micrograms). Uptake is delayed because of the initial time taken for the tablet to dissolve.
2. Spray (400 micrograms metered dose). This is preferable to tablets as the solution is rapidly absorbed, no special storage is required, and the spray has a shelf life of

Dose
If a patient known to suffer from angina experiences chest pain, they should be placed upright to facilitate respiratory movements. In adults, a dose of 0.3 to 1 mg should produce symptomatic relief within 3 minutes. The effective duration of action is only 20 or 30 minutes; thus, dosing may have to be repeated. Oxygen should also be administered to all patients experiencing acute chest pain.

If symptoms are not relieved within 10 minutes, myocardial infarction should be suspected.

• **Nitrous Oxide**

Indications
Nitrous oxide may be used for its analgesic properties in the initial management of myocardial infarction (MI). The pain experienced during an MI is often more severe and of longer duration than that in angina. It may lead to further deterioration of cardiac function as it increases sympathetic output,
which will elevate the oxygen demands of an already starved myocardium.

**Mode of Action**

Many theories of the mechanism of action of general anaesthetic agents such as nitrous oxide have been proposed. It is thought that these agents alter, either directly or indirectly, the function of the membrane proteins involved in the conduction of nervous impulses. Theories that may be applicable include the following.

1. *The protein theory*
2. *The lipid theory.*

**Administration and Dose**

A combination of 50% nitrous oxide and 50% oxygen is used to produce analgesia without loss of consciousness.

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**GLUCAGON**

Glucagon is a pancreatic hormone that stimulates hepatic glycogenolysis and gluconeogenesis.

**Indications**

Glucagon may be given to the unconscious hypoglycaemic patient when intravenous access cannot be secured for the administration of glucose. In conscious patients, a sweet drink is sufficient to elevate plasma glucose levels. Oral glucose must not be given to unconscious patients because of the risk of pulmonary aspiration.

Hypoglycaemia, defined as a blood glucose concentration of less than 2.5 mmol/l, most commonly occurs in insulin-dependent diabetes.

Hypoglycaemia may result if
• a patient takes an insulin overdose;
• the patient takes the correct dose but with no food; or
• the patient exercises or undergoes a stressful situation.

Mode of Action
Glucagon increases plasma glucose by stimulating glycogenolysis and gluconeogenesis in the liver. An additional action is inhibition of glycogen synthesis and glucose oxidation. In adipose and hepatic tissues, glucagon causes lipolysis, resulting in the production of fatty acids which further increase gluconeogenesis.

Administration and Dose
In adults, 1 mg (0.5 mg in children up to 12 years) may be given intramuscularly into the deltoid or gluteal areas.

GLUCOSE

Indications
Glucose may be administered to the conscious or unconscious hypoglycemic patient.

Administration
Glucose may be given orally, intravenously or transmucosally. Intravenous administration is the most rapid and effective method of elevating plasma glucose levels.

SALBUTAMOL

Indications
Salbutamol, a potent bronchodilator, is used in the management of acute asthma.
Mode of Action
Salbutamol is a selective Beta2-agonist which relaxes bronchial smooth muscle.

Administration
To minimize the chance of adverse effects and to produce the most rapid onset of action, salbutamol is administered by inhalation (nebulizer).

HYDROCORTISONE

Hydrocortisone, an endogenous adrenal hormone, possesses predominantly glucocorticoid activity and is essential for human survival.

Administration of steroids for therapeutic purposes has a negative feedback effect on the hypothalamus and anterior pituitary gland, which eventually leads to atrophy of the adrenal cortex and resultant inability to secrete hydrocortisone in response to stress (acute adrenal insufficiency). Under these circumstances, a patient may collapse due to hypoglycaemia and hypotension if a stressful situation, such as dental treatment, is encountered. Therefore, exogenous hydrocortisone should be administered pre-operatively to susceptible patients to restore the normal physiological response to stress. If acute adrenal insufficiency does occur, prompt administration of steroids and immediate hospitalization is recommended.

Administration and Dose
Hydrocortisone may be administered by the oral, intramuscular or intravenous routes. The dose varies according to the age and situation (25 to 200 mg).
**Indications**

Diazepam is indicated in patients suffering from status epilepticus. Status epilepticus is the term applied to prolonged seizures or multiple seizures occurring without recovery of consciousness between them. The patient is at risk of brain damage due to cerebral hypoxia and inhalation of vomit or saliva. It is a life-threatening disorder, demanding urgent emergency treatment and hospitalization.

**Mode of Action**

Epilepsy is a disorder in which there are recurrent episodes of altered cerebral function associated with outbursts of excessive discharge of cerebral neurones. It is likely that both a reduction in inhibitory neuronal discharge and excessive excitation play a part in the genesis of seizures.

The anticonvulsant mechanism of the benzodiazepines is thought to result from the augmentation of the pharmacological effects of the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) acting at GABA$_A$ receptors within the central nervous system. The benzodiazepine is thought to bind to the GABA$_A$ receptor and induce conformational changes that increase the affinity of the receptor for GABA. This results in an increased, number of inhibitory chlorine channels being opened for any given concentration of neurotransmitter.

**Administration and Dose**

Diazepam may be administered by the intravenous route or per rectum. In adults, 10 mg may be given intravenously over 2 minutes. The recommended intravenous dose for children is 200 to 300 microgram/kg. If intravenous access cannot be achieved, diazepam solution is available and is absorbed rapidly when administered by the rectal route. Intramuscular midazolam has anticonvulsant activity comparable to that of intravenously administered diazepam.
**FLUMAZENIL**

Flumazenil, an imidazo-benzodiazepine, was the first specific benzodiazepine antagonist to undergo extensive clinical trials.

**Indications**

Flumazenil is used for the reversal of accidental oversedation in patients sensitive to benzodiazepines, and reversal of benzodiazepine-induced respiratory depression.

**Mode of Action**

Flumazenil is a competitive benzodiazepine antagonist. It binds with high affinity to the same site as benzodiazepine agonists and thus prevents the enhancement of the effects of GABA induced by these agents. Potential adverse effects may include nausea, vomiting, sweating and shivering. Flumazenil may also lower the seizure threshold and should be used with caution in epileptic patients or any patient on long-term benzodiazepine therapy.

**Administration and Dose**

Flumazenil is administered by the intravenous route. The adult dose should be titrated according to the individual patient's response: initially, 200 micrograms over 15 seconds, then 100 micrograms at 60-second intervals to a maximum of 1 mg, if required. There is insufficient data at present to make dosage recommendations for children. It should therefore be administered only if the potential benefits outweigh the risks.

**CHLORPHENIRAMINE**

**Indications**

Chlorpheniramine is used for second-line management of anaphylaxis and treatment of allergic reactions localized to the skin.

**Mode of Action**
Chlorpheniramine competitively antagonizes the effects of histamine, which is released by mast cells and basophils, on histamine-1 receptors. It helps to reverse the following histamine-induced effects:

- increases in vascular permeability;
- bronchial smooth muscle contraction; and
- bronchospasm.

**Administration and Dose**

The drug may be given orally, intramuscularly, subcutaneously or intravenously. For the management of allergic reactions localized to the skin, a dose of 4 mg in adults may be administered orally every 4 to 6 h, to a maximum of 24 mg/day.