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PEDIATRIC EMERGENCIES-A SYSTEMATIC REVIEW

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ABSTRACT

The treatment of children presents particular challenges to any healthcare professional. Since the anatomy and physiology of a child differ significantly from that of an adult, these differences must be considered while treating them. Also children are unable to cope up with the treatment protocol due to anxiety or fear. All these factors combine to produce a situation that may be conductive to medical emergencies, especially those that are induced or aggravated by stress. Emergency situations are the most troublesome in the dental setting. However certain emergencies can be anticipated during and after local anaesthesia, during tooth extraction and endodontic procedures. The pediatric dentist must be well prepared to handle the situation, which involves personal, staff and office preparation. A four-member dental team with preassigned duties should have an organised approach in managing the emergency. The basic plan of action for any emergency situation should include the "PABC" approach; appropriate positioning (P) of the patient, assessment of the airway (A), breathing (B), circulation (C) and definitive treatment (D) in order. Since the primary responsibility of a pediatric dentist in handling an emergency lies in prevention and preparation, the dental team should share their responsibilities with the medical team in the management of the same.

Keywords: Pediatric emergencies, pediatric dentist, PABC approach, sharing responsibilities.

Introduction

Pediatric dentistry is a branch of dentistry that deals with children. Anxiety is normal developmental pattern that is exhibited differently by children. Anxiety is controlled, in part or completely by pharmacological and non pharmacological techniques. All drugs, whether antianxiety agents, local anaesthetics, antibiotics, sedatives-hypnotics or analgesics carry the potential for producing drug over dosage or allergy. Reminisce about anatomy and physiology of a child, how it differs from an adult must be considered while treating them. The commonly encountered paediatric emergencies in the dental office will include: drug overdose, anaphylaxis, asthma, seizures, and respiratory obstruction [1-4].

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other rare emergencies are foreign body ingestion, shock, endocrine emergencies, angioneurotic oedema, diabetes mellitus, haemophilia and allergy. The primary responsibilities of the pediatric dentist in the area of medical emergencies fall into the area of prevention, preparation, basic life support (BLS) and procurement of help and transport. A four-member dental team should have duties preassigned to handle any emergency situation. The team members should always begin with the orderly "PABC" approach, which includes appropriate positioning (P) of the patient, followed by assessment of the airway (A), breathing (B) and circulation (C) [5-6]. After addressing the PABC, further definitive treatment (D) should be considered. But there are certain limitations for a pediatric dentist in handling an emergency. So, the pediatric dentist should share his/her responsibilities with the medical team in the management of such emergencies in children.

Understanding the importance of Pediatric anatomy and physiology

Since the body of a child is not a miniature version of an adult, there are certain anatomic and physiologic

differences which must be considered before studied in a systematic manner according to each system[7].

In adults, the normal respiratory rate is 12 to 15 breaths per min (BPM). In children, the rate is higher, with an 8-year old averaging 18 BPM and a 4-year old averaging 22 BPM. Children have: Narrow nasal passages, disproportion of tongue/oral cavity, decreased airway diameter, more elastic nature of the chest wall, less rigid sternum that provides less support for the ribs and intercoastal muscles and more horizontally positioned ribs in resting position.

Number of alveoli in children will reach adult number by 6th year of life, there is greater proportion of alveolar surface area to lung size, and diaphragm as the primary breathing muscle with increased salivary secretions.

Clinical significance

Always avoid procedures in supine position that exert pressure on the diaphragm. Lower gas concentrations (Nitrous oxide/Halothane) are required to anaesthetize due to low ventilation pressure required to expand lungs[9]. Avoid tightly clamped mask over the nares and mouth packs. Therefore, it is essential that vital signs are carefully monitored in children who are undergoing inhalant anaesthesia for dental procedures.

Cardiovascular System

The child's heart is relatively inelastic and noncompliant to the sudden changes in functioning of the body. Heart rate averages to about 120 BPM in the newborn, decreases throughout childhood, by 4 years of age, rates is less than 100 and adult rates is generally reached by 10 to 12 years of age. Cardiac output also changes with age. It is highest in the newborn and gradually declines in the first several weeks of life. Blood pressure (BP) tends to rise throughout childhood. The mean systolic blood pressure in a 4 year-old is 100/60 mm Hg and in a 10 year-old is 110/60 mm Hg and adult values of 120/80 mm Hg are generally reached by early adolescence[10-12].

Clinical significance

40% of cardiac output perfuse the brain in a child, increased anaesthetic uptake is associated with decreased cardiac output, depress the central nervous system. Action of these anaesthetic agents is more rapid in children, so they must be sedated by lower gas concentrations. Children should also be well hydrated prior to sedation to minimize the hypotensive response associated with potential drops in heart rate. Infant myocardium adapts poorly to sudden changes in fluid undergoing treatment. These differences can be

Respiratory System

Overload and systemic hypertension produce cardiac failure more quickly[8].

Gastrointestinal tract

The physiologic differences of a child that varies with adults are as follows:

Gastric mucosa of a child is immature hence secretes lower levels of acid and the adult values are reached by 3 years of age. Gastric emptying time also differ between child and adult. It is significantly longer during infancy (8 hours) and adult values (2 to 3 hours) are reached by 6 to 8 months of age. Hepatic enzymes, like cytochrome P-450, glucuronyl transferase and pseudocholinesterase, which play a significant role in altering or detoxifying a drug, are relatively deficient in children.

Clinical significance

Longer emptying times will result in slower absorption of drugs and drug dosages should be properly calculated, to prevent toxicity[13].

Renal system

Kidneys are also immature in children and less competent to excrete drugs. Vast majority of drugs undergo renal excretion, via glomerular filtration rate (GFR) or tubular transport or both. Most commonly used paediatric drugs such as penicillin's, short acting barbiturates and phenobarbitol are excreted via GFR. Other drugs like morphine, atropine and sulpha antibiotics are excreted via tubular transport.

Clinical significance

Drug dosages in children must be calculated considering their low GFR and decreased tubular transport rates in order to prevent renal toxicity[14].

Body fluids and tissue composition

Body fluid weight of the child is mainly composed of water (about 80%) compared to 50 to 60 % in adults. Plasma proteins such as serum albumin and plasma globulin are relatively deficient in children with lower levels of body fat compared to adults and are more sensitive to drugs.

Clinical significance

In order to attain therapeutic concentration levels, any water-soluble drug must be administered at higher levels per unit of body weight. Any protein-bound drug must be administered at lower levels per unit of body

weight. Lipid-soluble drugs will extensively bound to fatty tissue and their serum drug levels will decrease. So, the commonly used drugs in dentistry like sedatives must be used with caution. Weight-based formulas for calculation of drugs are safe compared to age-based formulas. BSA method is a more accurate parameter for calculating drug dosages, but it cannot be for children under 10kgs weight hence are rarely used in the clinical setting[15].

Importance of physical examination

Children are particularly vulnerable to hypothermia because of the larger ratio of BSA to weight and a limited ability to cope with cold stress. So, measurement of vital signs and body size are particularly important in children [16].

Preparation for Emergencies

Despite various preventive measures taken in the dental setting, medical emergencies occasionally occur. The paediatric dentist must be adequately prepared to handle such emergency events which involve preparation of personal, staff and office [17].

Personal preparation: It includes knowledge regarding the signs, symptoms, course and therapy for an emergency situation. Training in basic life support (BLS), cardiopulmonary resuscitation (CPR) is an essential part for any practicing health professional. If conscious sedation techniques are to be used, advanced cardiac life support (ACLS) training for adults and paediatric advanced life support (PALS) is desirable.

Staff preparation: In order to reduce panic in actual emergency, the team approach should be organized in such a way that each staff member who is well trained in BLS is able to handle an emergency situation. The specific roles of team members will depend, in part, on the number of people on the team. Most dental offices have at least 3 team members: a dentist, a dental assistant and a receptionist. Additional team members may be other dentists or support staff in the office.

Each staff member should have a pre assigned role in case of emergency so that emergency equipment should be brought and maintained by an assigned person. Emergency drugs will be prepared by another person/ staff so that all tasks will be performed in an organized fashion [18]. (Table 1)

Table 1: EMERGENCY DUTIES OF A FOUR-MEMBER DENTAL TEAM

TEAM MEMBER 1: LEADER
Directs team members
Positions the patient and stays with him or her
Performs ABCs of cardiopulmonary resuscitation(CPR)
Takes command and appears calm
States instructions directly and clearly
Requests acknowledgement from team members that instructions are understood
Fosters open exchange among team members
Concentrates on what is right for the patient, not who is right
TEAM MEMBER 2
Brings emergency kit
Brings oxygen tank and attaches appropriate delivery system
Brings automated external defibrillator
Assists with ABCs of CPR, including monitoring vital signs
Checks oxygen tank regularly
Checks emergency kit regularly
Prepares drugs for administration
TEAM MEMBER 3
Telephones emergency medical services (1-0-8)
Meets paramedics at building entrance
Keeps chronological log of events
TEAM MEMBER 4
Assists with ABCs of CPR
Assists with other duties as needed

Team communication during an emergency situation is as effective as understanding each other's roles. The team leader should consider using a 'closed-loop' approach model. This means that when the leader sends a message, the team member acknowledges receiving the instruction, thereby confirming that he or she heard and understood the message.

Office preparation

Essentials can be divided into emergency equipment and emergency drugs. The preparations of dental office are tabulated below [19]. (Table 2)

Back up medical assistance should be secured in advance and this forms the final essential part of office preparation. It involves having current telephone numbers of the nearest rescue squad and emergency room facility and prearrangements with a nearby physician for immediate assistance.

Table 2: OFFICE PREPARATION

EQUIPMENT	ESSENTIAL DRUGS	ADDITIONAL DRUGS
Oxygen delivery system	Oxygen	Glucagon
High volume suction device	Epinephrine	Atropine
Stethoscope	Nitro-glycerine	Ephedrine
Blood pressure cuffs	Antihistamines	Hydrocortisone
Mouth props	Salbutamol/ Salbutorol	Morphine
Oral and nasal airways	Aspirin	Nitrous oxide
Cricothyrotomy kit		Naloxone
Laryngoscope		Lorazepem/ Midazolam
Endotracheal tubes		Flumazenil
Armamentarium for establishing an IV line		
Haemostat		
Syringes and needles		
Tourniquet		
Tongue blades		
Adhesive tape		

Management of Medical Emergencies [20]

The management of basically all medical emergencies should be approached in an orderly "PABC" approach. The basic line of management for any emergency includes:

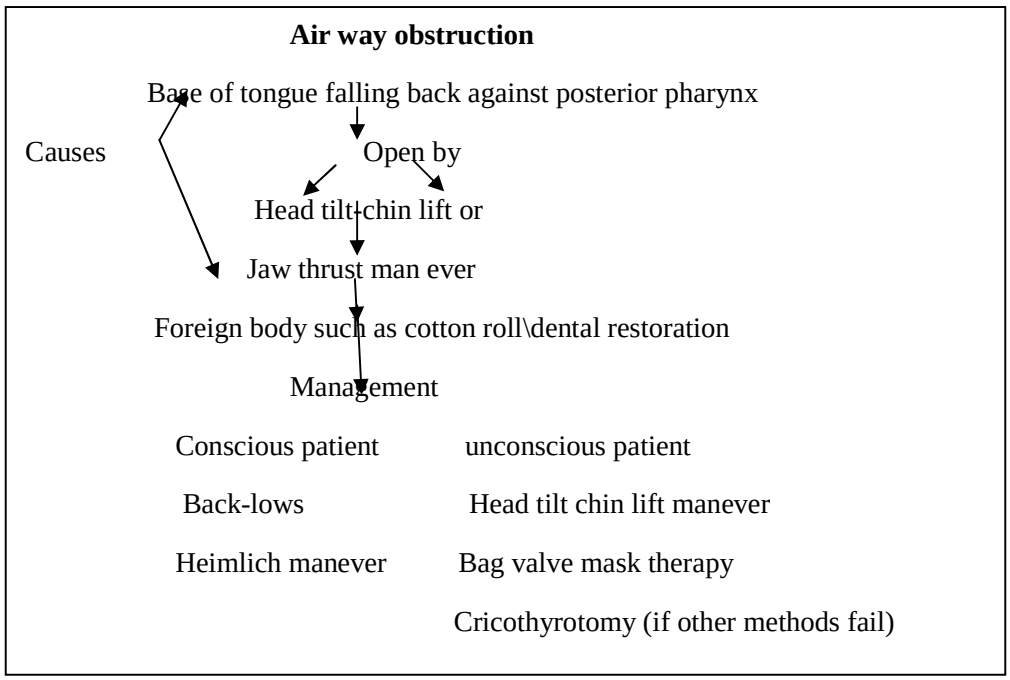
1. Position (P)
2. Airway (A)
3. Breathing (B)
4. Circulation (C)
5. Definitive therapy (D)

Position

The best position for managing emergency is to place the patient flat on his/her back with feet elevated slightly to about 10° to 15° above the level of heart. This position minimizes the work of the heart[22] increases return of blood pooled from the extremities which in turn increases vital blood flow to the brain. It can be easily accomplished on the dental chair. For medical emergencies in conscious patient involving respiratory distress or chest pain, semi sitting position is advised [21,22].

Airway (A) [23, 24]

The first priority in management is the establishment of patent, functioning airway. (Table 3)



Breathing (B)

For adequate breathing, the chest should be observed for expansion and nose and mouth for air flow during respiration by listening and feeling (look, listen and feel principle of BLS).

If the patient is not breathing, rescue breathing should be initiated by giving 4 rapid breaths to expand the lungs, followed by 1 breath every 3 seconds for children and every 5 seconds for adult until respiration resumes. It is accomplished either by mouth to mouth or bag-valve-mask (ambu bag) technique[25].

1. A pulse oximeter should be readily available to assess the adequacy of oxyhemoglobin saturation in children[26].
2. Monitoring the adequacy of respiration also includes observing the color of the mucosa, skin and blood to rule out the signs of cyanosis.

Circulation (C)

The most rapid, convenient, and accurate method for assessing circulation is palpation of carotid pulse over the carotid artery under the sternocleido-mastoid muscle in the neck. If pulse cannot be palpated after 10 seconds, CPR should be initiated immediately[27].

Method: The chest is pushed hard and fast with the heel of one hand and with the other hand on top to allow full elastic recoil. Each compression should depress the chest $1^{1/2}$ to 2 inches in adult and 1/3 to 1/2 inches in children. The compression to ventilation ratio for one-person CPR in children and adults is 30:2, but for two-person CPR in children, ratio should be 15:2. If the pulse is present, a more accurate assessment of cardiovascular status by measuring heart rate and blood pressure should be obtained.

Heart rate

Heart rates typically are higher in children and decreases with increasing age. Changes in rate, tachycardia (above 100 BMP) or bradycardia (below 60 BMP) should be recorded. Fear and anxiety can also cause transient elevations in BP, primarily systolic BP. A full or bounding pulse often is associated with high BP and a weak and thready pulse is end with hypertension. Apart from pulse and BP, color of the mucosa and capillary filling are also

noting whether it blanches or not followed by quick regaining of color.

indicators of circulation adequacy. Pink and red mucosa indicates good peripheral circulation and pale or blue indicates inadequate peripheral circulation. Capillary filling can be determined by depressing the nail bed and

Definitive therapy(D)

Only after the PABC's of emergency management are accomplished, definitive therapy (D) for a particular emergency should be considered [28].

Conclusion

All office personal should be trained to assist in the recognition and management of emergencies, which includes reinforcement of regular emergency drills in the office and biannual renewal of BLS skills. The office staff should have preassigned specific responsibilities so that in the event of an emergency each person knows how to manage. Knowing our own limitations, the dental team should join their hands with the medical team in sharing their responsibilities and work in collaboration towards the management of paediatric emergencies.

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