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RESEARCH ARTICLE

RESPIRATORY DISEASES IN CHILDREN- ORAL FINDINGS AND DENTAL TREATMENT APPROACHES

Dr. Sujata Datta, Dr. Deepti Jawa, Dr. Shipra Jaidka, Dr. Shikha, Dr. Ashjan Ashraf Batha and Dr. Madhuri Gupta

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Abstract

Respiratory disease/condition is a medical term that encompasses pathological conditions affecting the organs and tissues that make gas exchange possible in the body. The most common respiratory disease which a pediatric dentist generally seen in practice is bronchial asthma, cystic fibrosis, tuberculosis etc. Dental work occur close to the airways, and dental environment's processes and setup also contribute to respiratory diseases. The management on the dental chair for this patient is different from the normal patient. Asthma affects about 1 in 10 children. The condition is characterized by acute respiratory distress and treated with medications aimed to reduce reaction to stimulants by the airway. Dental management involves attention to the status of the patient and awareness of stimulants of the reactive airway. Cystic fibrosis is an autosomal recessive disorder that effects epithelial cells of the respiratory, gastrointestinal and reproductive tracts leading to abnormal exocrine gland secretion. Management includes treatment of bronchial inflammation and infection. At Dental operatory patient should be treated under regulated temperature and others precaution. In this article, common oral findings related to respiratory diseases will be discussed and the precautions and treatment approaches of dentist will be mentioned.

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Introduction:-

Respiratory disease is defined as "Any of the diseases and disorders of the airways and the lungs that affect human respiration". Respiratory disease is broadly classified into acute and chronic according to onset and according to site upper and lower respiratory tract infection. The big five global respiratory conditions: Forum of International Respiratory Societies, 2013 is chronic obstructive pulmonary disease (COPD), Asthma, Acute respiratory disease, Tuberculosis and Lung cancer.¹ The most common respiratory disease effecting children is asthma then tuberculosis, cystic fibrosis, acute respiratory disease and lung cancer. Respiratory infections are the leading cause of death in developing countries.² The National Health Policy of India 2017 recommends that premature mortality from non-communicable diseases, including chronic respiratory diseases, should be reduced by 25% by 2025.³ As per the 2019 report of the National Health Portal of India, 41,996,260 cases and 3,740 deaths from respiratory infections were recorded across India in 2018. Acute respiratory infections (ARI) accounted for 69% of the total cases of communicable diseases, and this scenario is before the era of severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). After the corona virus disease 2019 (COVID-19) pandemic, the total number of infected numbers rose to millions. In 2019, Chronic respiratory disease were the third leading cause of death responsible for 4.0

million deaths (95% uncertainty interval 3.6–4.3) with a prevalence of 454.6 million cases (417.4–499.1) globally. In 2021, the Indian state of Rajasthan had the highest number of people affected with acute respiratory infections at over 3.6 million cases. The states of West Bengal and Andhra Pradesh occupied the second and the third place respectively.⁴The precautions for the children suffering from the respiratory diseases should be noted and taken care off.

Classification⁵

According to onset of respiratory diseases

Acute•Upper respiratory infection(common cold,pharyngitis,epiglottitis)
•Lower respiratory infection(pneumonia,bronchitis,bronchitis,laryngitis)

Chronic•Asthma

- Chronic obstructive pulmonary disease
- Cystic fibrosis
- Lung cancer

Discussion:-

A) Bronchial asthma

As defined by World Health Organization, asthma is a disease characterized by “recurrent attacks of breathlessness and wheezing, which vary in severity and frequency from person to person. In an individual, they may occur from hour to hour and day-to-day”.⁶ Based on allergic association bronchial asthma classifies into atopic and non-atopic and based on severity acute and chronic.⁷

Etiology and risk factors

Etiology of asthma is multifactorial. There are various etiological factors and risk factors for asthma like Genetic, Prenatal risk factor (Prenatal tobacco smoke, Diet and nutrition, stress, Antibiotic use, mode of delivery), Risk factor in childhood (Breastfeeding, Family structure, Socioeconomic status, Sex and gender, Allergic sensitization, Antibiotic and infections), Adult onset asthma (Occupational asthma, Other-smoking tobacco) etc.⁸

Pathophysiology of asthma

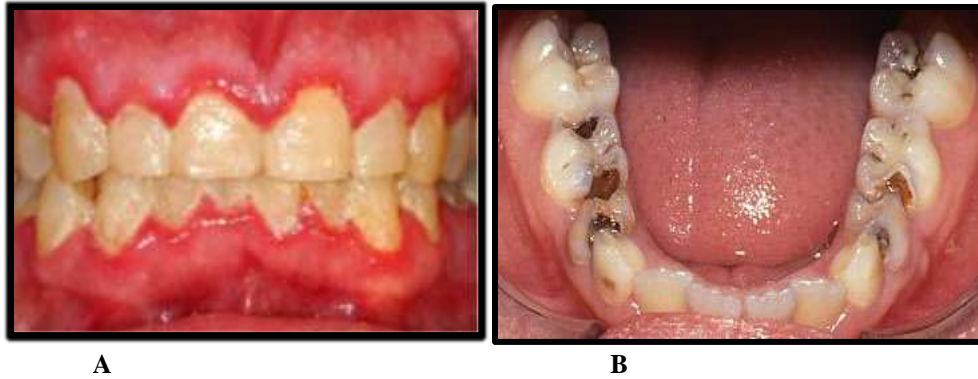
Asthma represents the clinical consequences of chronic exfoliative eosinophilic bronchitis, which is induced by the complex interactions of mast cells, eosinophils, and polymorphonuclear leucocytes. Current evidence suggests that the smooth muscle hyperirritability and epithelial cell damage within the airways is secondary to inflammation initiated by mast cell release of factors such as histamines, leukotrienes, and prostaglandins. Neurotransmitters, allergens, chemical irritants, and infections are but some of the factors that may act on mast cells to release these inflammatory mediators. The effect of this chronic airway inflammation is a heightened sensitivity of airway smooth muscle that will respond to any irritating factor with spasmodic narrowing and obstruction to airflow.⁹

General symptoms

The typical symptoms of asthma are coughing, wheezing, chest tightness and dyspnea (labored breathing). More severe bronchial obstruction results in tachypnea, tachycardia, pulsus paradoxus. In mild asthma, patients experience wheezing fewer than 2 days per week, lack nocturnal symptoms and have relatively good exercise tolerance. In moderate asthma, wheezing 2-5 days per week with nocturnal symptoms and limited exercise tolerance. In case of severe asthma, daily wheezing, exercise intolerance and frequent nocturnal symptoms is experienced by the patients.⁷

Oral manifestations

Prevalence of dental caries increases in children with moderate to severe asthma. This is due to BETA 2 agonist effects on salivary gland function. Children with chronic rhinitis and mouth breathing have a higher prevalence of increased upper anterior and total anterior facial height, higher palatal vaults, greater overjet, and posterior crossbite. Children with asthma breathe through mouth, may lead to the development of gingivitis, periodontitis and gingival enlargement in anterior part. Children with asthma commonly receive medication with steroids. These drugs may cause extrinsic discoloration in tooth surface. Corticosteroid can also change oral cavity pH and reduces salivary flow resulting in increase in the possibility of dental erosion.⁷



A- Gingivitis B-Dental caries
Fig. 1:- Oral Manifestation of Asthma.

Management in dental operator

1)History taking

Bronchial asthma may be due to many different causes and an exhaustive history is of fundamental importance in the specific diagnosis of this disease.

The Patient's exacerbation history is important with respect to the following:

- The frequency of asthmatic attacks.
- The type of medications used chronically and during acute attacks.
- The length of time since the child was last seen emergently with acute asthma.

2)Examination

Physical examination for asthmatic patient may include

- Observation of the rate and depth of respiration.
- Use of accessory muscle for respiration
- shortness of breath
- Coughing
- In selected patients, a determination of pulmonary function (chest radiograph and peak expiratory flow or spirometry) may be necessary to identify those who require adjustment of their asthma therapy prior to dental treatment.
- Pulmonary function tests can identify some patients who are asymptomatic but are significantly obstructed and have a below-normal FEV1 (the forced expiratory volume in 1 sec, a common measure of airway obstruction).

3)Drug therapy in asthma

Bronchodilator and anti-inflammatory drugs commonly used in asthmatic treatment. Commonly used bronchodilators are :

- Albuterol,terbutaline,bitolterol,metaproterol etc this are short acting inhaled beta2 bronchodilator.This are first line drugs recommended use "as needed" for symptoms.Effects of this drugs last for 4-6 hours.
- Salmeterol is long acting inhaled beta2 bronchodilator.Used as maintenance therapy with anti-inflammatory drugs.
- Ipratropium is inhaled anticholinergic drug,this is not used as first line drug in children.
- Theophylline is oral bronchodilator used as maintenance therapy.
- Beclomethasone,Triamcinolone,flunisolide this are most effective inhaled steroid anti-inflammatory agents but impact on growth in children remains controversial.
- Cromolyn and nedocromil this are the safest inhaled anti-inflammatory agent,first choice for children.

4)Drugs to avoid in asthmatic patient

Children with asthma may be at risk for significant adverse reactions to medications commonly used in dental practice.

- Nearly 4% of patients with asthma are allergic to aspirin and other nonsteroidal anti-inflammatory agents.Thus, acetaminophen usually is recommended for these children.
- Patients taking theophylline preparations should not receive erythromycin, because it interferes with the metabolism of theophylline and raises its blood level into the toxic.

•Narcotics and barbiturates are contraindicated owing to their histamine releasing properties ,which can lead to bronchospasm and potentiated allergic response.

5)Steps taken before dental treatment

- Patients who have anything more than mild asthma should have procedures performed where standard monitors (pulse oximetry, end-tidal SAGO₂, EKG, and blood pressure cuff) and intubation equipment are available.
- For severe asthmatic,consultation with the patient's primary care physician is recommended.
- Ideally,to minimize the risk of attack,the patient's appointment should be in the late morning the late afternoon.
- If a patient has been or currently using a metered dose inhaler bronchodilator ,it should be brought to each dental appointment and it should be made sure that patient has taken most recent scheduled dose of medication prior to the treatment.⁷
- Patient on long term corticosteroid therapy may additionally suffer from adrenal crisis and will not be in a capacity to deal with stress,these patient additionally need prophylactic administration of antibiotics to prevent infection ,also immunosuppressed patients need antibiotic prophylaxis.
- Asthmatic children exposed to systemic glucocorticoids (GC) may be at risk for developing adrenal insufficiency during major dental procedures or general anesthesia. They also have a greater risk (up to three times) than children without asthma for developing anesthesia-related complications postoperatively, Children with asthma on maintenance systemic GC (daily or every other day) are adrenally suppressed and need to be supplemented on the day of the dental procedure by doubling the patient's usual daily dose.
- Trigger factor for asthmatic attack are allergens,dust,things with strong smell,chemical agents and most importantly stress.Avoidance of all these agents is very important while treating asthmatic patients.
- Reschedule if patient is symptomatic.

6)Steps taken during dental treatment

- There is a significant reduction in pulmonary function during dental procedure.The reason behind this could be the reclined or semireclined position ,make sure that the patient is comfortable with his/her chair position and oxygen therapy is handy during the procedure.
- Dentist should be aware of potential hazardous material such as cotton rolls,fluoridetrays,pit and fissure sealants,dentrifrices and interim restorations containing methyl methacrylate. •Rubber dam should be use prudently to avoid possible respiratory compromise or aggravation.
- Use vasoconstrictors judiciously.
- Anxiety is a known asthma trigger,and dental environment is a common site for acute asthmatic attack.For relieving the anxiety substantive stress management technique should be use for asthmatic patient.
 - The analgesic and anxiolytic properties of nitrous oxide (N₂O), as well as the supplemental oxygen received during N₂O administration, are thought to help manage children with asthma.
 - According to Malamed, the use of N₂O in children with mild to moderate asthma can effectively prevent acute symptoms.¹⁰
 - However, because N₂O is somewhat irritating to the airway, its use in children with severe asthma is contraindicated, and medical consultation is recommended prior to N₂O use in these children.
- IV sedation should be used with extreme caution as asthmatics have limited control of their airways. Ketamine, a dissociative anesthetic with sedative, analgesic, and bronchodilating properties,has been used safely in asthmatic patients.

7) Managing an acute asthmatic attack

Assesment of severity

Acute exacerbations are manifested by episode of bronchospasm and resulting hypoxia and hypercarbia.The following indicate that the exacerbation is severe:

- a)Oxygen saturation is below 91 percent.
- b)Patient has difficulty in speaking
- c)Patient is struggling for air.
- d)Bronchodilator does not improve peak expiratory flow rate by atleast 10% after two treatment.

Management of patient

- Discontinue the dental procedure ,remove all intraoral instruments,cotton rolls,rubber dam and allow the patient to assume a comfortable position.
- Establish and maintain a patent airway and administer Beta2 agonists via inhaler and nebulizer.

- Administer oxygen via facemask ,cannula or nasal hood.If there is no improvement administer epinephrine subcutaneously (1:1,000 solution,0.01 mg/kg of body weight to a minimum dose of 0.3 mg)
- Alert emergency medical services
- Maintain a good oxygen level until the patient stop wheezing or medical assistance arrive.

8)General oral health care instruction

- Instruct patients to rinse their mouth after using inhaler.
- Give proper oral hygiene instructions to help minimize gingivitis.
- Prescribe fluoride supplements for all asthmatic patients,especially for those taking beta2 agonists.
- Be aware of possible need to Prescribe antifungal agents for patients who chronically use nebulized corticosteroid.

B) Cystic fibrosis

Cystic fibrosis is an autosomal recessive disorder that effects epithelial cells of the respiratory,gastrointestinal and reproductive tracts leading to abnormal exocrine gland secretion.It affects the entire body causing progressive disability and often early death .¹¹ Cystic fibrosis also known as Mucoviscidosis. Cystic fibrosis is broadly classified into two types,Classic cystic fibrosis and non-classic cystic fibrosis.¹²

Etiology

The exact etiology of this disease is unknown.But it has been found that genes play a important role in causing the disease.⁷⁸ Cystic fibrosis is due to a mutation in the CF gene on chromosome 7.The CF gene encodes a protein known as the cystic fibrosis transmembrane regulator(CFTR).Defect in gene cause changes in protein(CFTR) that regulates the movement of salt in and out of cells. The result is thick, sticky mucus in the respiratory, digestive and reproductive systems, as well as increased salt in sweat.¹³

Pathophysiology

It is an established fact that cystic fibrosis is caused due to abnormal CFTR protein. The abnormal CFTR protein in patients with cystic fibrosis leads to disruption of chloride channel on the cells.The CFTR protein is a channel protein that controls the flow of H₂O and Cl⁻ ions in and out of cells inside the lungs. When the CFTR protein is working correctly, ions freely flow in and out of the cells. However, when the CFTR protein is malfunctioning, these ions cannot flow out of the cell due to a blocked channel. This causes cystic fibrosis, characterized by the buildup of thick mucus in the lung.¹²

The hallmark pathophysiologic effects of cystic fibrosis include.

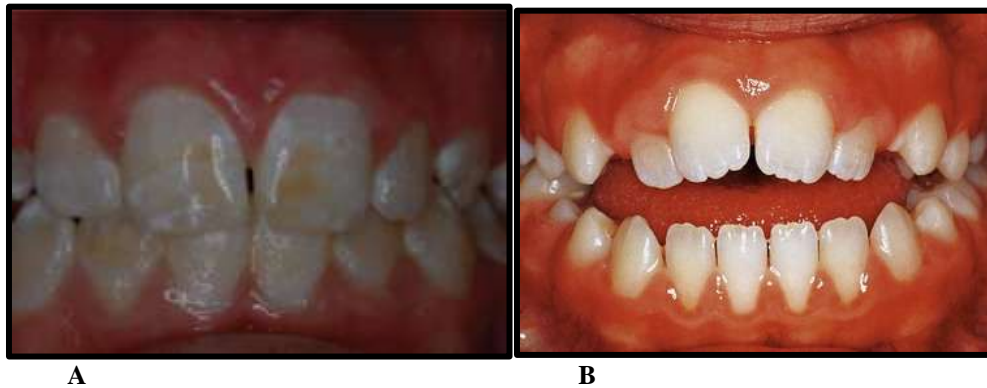
- a)Excessive mucous production in the respiratory tract with impaired ability to clear secretions and leading to airway obstruction.
- b)Pancreatic insufficiency and impaired enzyme secretion leads to impaired digestion and absorption of protein,carbohydrate and fats.
- C)Abnormal elevation of sodium and chloride concentration. Due to the defect in chloride channels,cystic fibrosis also causes the sweat to become very salty.

General signs and symptoms

- a. The thick and sticky mucus associated with cystic fibrosis clogs the tubes that carry air in and out of your lungs. This can cause signs and symptoms such as: a persistent cough that produces thick mucus (sputum),Wheezing,Exercise intolerance,Repeated lung infections, Inflamed nasal passages or a stuffy nose,Recurrent sinusitis.
- b.The thick mucus can also block tubes that carry digestive enzymes from pancreas to small intestine. Without these digestive enzymes, intestines aren't able to completely absorb the nutrients in the food. The result is often: foul-smelling, greasy stools,Poor weight gain and growth,Intestinal blockage, particularly in newborns (meconium ileus),Chronic or severe constipation, which may include frequent straining while trying to pass stool, eventually causing part of the rectum to protrude outside the anus (rectal prolapse).¹⁴
- c.In cystic fibrosis sweat will be very salty causing salty tasting skin.Hence it causes dehydration, increased heart rate, tiredness, weakness, decreased blood pressure, heart stroke and death which is very rare due to loss of large amount of salt when sweat.Cystic fibrosis can cause clubbing and low bone density leading to osteoporosis, and in rare cases it can present as a coagulation disorder.

Oral manifestation

Low incidence of dental caries due to frequent intake of antibiotics, increased pH, buffer capacity of saliva, together with the increased levels of calcium and phosphorus of saliva. **Primosch, et al.** concluded that significantly reduced dental caries prevalence in cystic fibrosis patients compared with an age and gender matched control group, with a greater reduction in caries prevalence in the primary dentition compared with the permanent dentition.¹¹ A high incidence of tooth discoloration and hypoplastic defects of the permanent teeth have been reported among patient with cystic fibrosis. **Wotman and coworkers** described increased amounts of calculus in children with cystic fibrosis and asthma compared with healthy children. High incidence of mouth breathing, malocclusions, anterior open bite associated with chronic nasal and sinus obstruction. Dental development and eruption are delayed.¹⁵



A-Tooth discoloration, B-Open bite
Fig 2:- Oral Manifestation of Cystic Fibrosis.

Management at dental operatory

1) Medical management

Management includes treatment of bronchial inflammation and infection with antibiotics and physiotherapy, pancreatic enzyme replacement therapy, and fat soluble vitamin supplementation. A high calorie, high fat diet is recommended for these patients, and high sugar foods are often eaten to maintain the increased calorific intake needed.

Pharmacotherapy includes the use of mucolytics, bronchodilator therapy, anti-inflammatory therapy and immunization against infection.

Cystic fibrosis patients have been reported to have abnormal dentitions, with dental effects related either to the disease itself or as a consequence of treatment.

2) Precaution taken before dental treatment

- a) Patients with cystic fibrosis should be treated under regulated temperature as high temperature might cause excessive sweating.
- b) It is important that these children are kept free of chronic dental sepsis as part of their general care. Even if such a patient is on prophylactic antibiotics, sources of dental infection should be reduced as much as possible.
- c) Patients should be treated in a more upright position to allow them to clear secretions more easily and the appointments should be kept short.¹⁶
- d) In a patient with severe pancreatic involvement, it would be wise to check the coagulation time of the blood before surgery, in view of the possibility of the lack of vitamin K.

3) Precaution taken during dental treatment

a) Treatment under local anesthesia- Routine dental treatment offers few problems and there is no contraindication to local anesthesia. Extractions can be carried out under local anesthesia normally.

b) Treatment under sedation

- Oral sedation- Use of sedative agents that interfere with pulmonary function should be avoided.
- Inhalation sedation- Children with cystic fibrosis have dry airways, and administration of inhalation sedation can be dangerous when the gases are not humidified.

Moderate to severe pulmonary disease can be aggravated and degenerate to severe respiratory distress when inhalation anesthetics are used. This is particularly so in conjunction with intravenous drugs that depresses the respiratory center of the central nervous system, and with anticholinergic drugs that may be administered during intubation.¹⁵

c) Treatment under general anesthesia

- General anesthesia is essentially a matter for in-patient care, and should never be attempted in the dental surgery except where the pulmonary involvement is negligible and the patient's physician has been consulted.
- Due to dry airway general anesthesia is also problematic because concurrent administration of anticholinergic drugs further aggravates airway dryness. If anesthesia is required for dental care, the patient should be hospitalized and managed by an anesthesiologist.
- General anesthetics for adult patients with pulmonary disease must also be used with caution. Mild COPD or restrictive lung disease is generally not problematic.

4) General oral health care instruction

- Regular professional care and good oral hygiene to be maintained due to persistent treatment limitation.
- Patients should remain under constant dental care according to the individual design programs of oral health promotion and caries prophylaxis.

Conclusion:-

The dental management of children with respiratory requires a thorough understanding of their medical conditions, careful planning, and coordination among healthcare professionals. Dentists are increasingly treating more patients who require complex services with more challenging dental treatment planning. By doing certain changes in dental operatory and treatment regarding modalities the dental treatment can be done with ease.

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