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RESEARCH ARTICLE

Oral complications of emerging Type 2 Diabetes Mellitus of young - A challenge for pediatric dentistry

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Abstract

India is being referred to as “The Global Capital of Diabetes Mellitus” with increasing burden of Type 2 Diabetes Mellitus in Asian Indians. The susceptibility of pubertal and pre-pubertal Asian Indians to develop diabetes is increasing as they are being subjected to urbanization, nutritional transition and an obesogenic environment. The pathway of oral disease and diabetes mellitus of children can be linked. Pediatric dentists with their adequate knowledge and experience can help intervene at early stages in undiagnosed patients and also help in improving the quality of life of diabetic children and adolescents. This review aims to illustrate the manifestations that can develop in children and adolescents with Type 2 Diabetes Mellitus. It also demonstrates a potential relationship between obesity, Type 2 Diabetes Mellitus and its oral complications. Thus, a team of health care workers is required to work in harmony with each other to help reduce co-morbidities of the diabetic child.

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Introduction:-

Oral cavity is the gateway into the body and also a mirror to the manifestations of systemic diseases which may even precede their medical complications. Pediatric dentists can bridge the oral-systemic connection, thereby providing a link to help establish diagnosis of systemic diseases such as diabetes mellitus. Diabetes represent a group of metabolic diseases indicating hyperglycaemia which may result from deficient insulin action or inefficient secretion of insulin, but more frequently both conditions co-exist making it uncertain, if either alone, existed as the primary cause. The development of diabetes involves various pathogenic processes which may range from abnormalities resulting from resistance of insulin action to autoimmune disease which causes destruction of the pancreatic beta cells and hyperglycaemia.¹

The WHO Classification of Diabetes Mellitus given in 2019 categorizes the disease using prerequisites of a clinically based classification system with reliable, equitable and readily available clinical parameters and resources with feasibility to implement. The classification is described as Type 1 diabetes mellitus (T1DM), Type 2 diabetes mellitus (T2DM), Hybrid forms of diabetes, other specific types, unclassified diabetes, and hyperglycaemia first detected during pregnancy.²

The origin and etiology of T2DM results from interactivity between environmental, genetic and behavioural risk factors. Despite the fact that T2DM is widely diagnosed in adults, its frequency has noticeably increased in the pediatric population over the past two decades.³This observation followed a marked increase in both the prevalence of T2DM and the obesity in children and adolescents.⁴ Childhood obesity is one of the leading risk factors and has

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serious implications on health across the lifetime. Several studies have reported a marked relationship between foetal undernutrition, early-life exposure to obesity and rampant development of T2DM. Obese children and adolescents are more likely to remain obese as adults and are at a higher risk for developing serious chronic diseases such as cardiovascular diseases, musculoskeletal disorders and cancers, at a younger age.⁵

Childhood obesity and development of T2DM:

Interactivity of genetics and sedentary lifestyle with lack of nutritious diet and the subsequent establishment of an obesogenic environment predisposes the development of T2DM.⁶ There is a strong hereditary component involved in the development of this disease.⁴ The risk of developing T2DM increases substantially with relatives having T2DM.⁷ It has been observed that 74-100% of children with T2DM provide family history of diabetes where in first or second degree relative may be diagnosed with diabetes.⁸ Similarity among monozygotic twins is close to 100%, and about 25% of those with the disease have a family history of diabetes. Additionally, obesity is also considered to be inherited in some cases.⁷

Lack of exercise leads to obesity (accumulation of visceral fat) and decrease in muscle mass which induces insulin resistance. The dietary changes such as increase in fat intake and simple sugars and decrease in dietary energy sources and starch also contribute in obesity and glucose intolerance. It has been noted that even mild obesity (Body Mass Index < 25) with increase in visceral fat causes 4 to 5 times increased risk of development of diabetes.⁹

S. No.	Factors Causing Increase In Visceral Fat
1	Stress-Related Factors
1.1	Overeating, especially excessive intake of simple sugars
1.2	Smoking
1.3	Increase in alcohol intake
1.4	Disorders of nervous and endocrine systems: increase in cortisol, abnormality in sex hormone secretion
2	Lowered energy consumption due to lack of exercise
3	Genetic factors
4	Aging

Table 1.1:- Factors causing increase in visceral fat⁹

The adverse effect of obesity is well evident in early childhood. Children with obesity develop hyperinsulinemia and as compared to non-obese children have 40% lower insulin stimulated glucose metabolism.⁴ Additionally, the inverse relationship between abdominal fat and insulin sensitivity is seen to be more significant for visceral fat than for subcutaneous fat.¹⁰

Diabetes and obesity are linked through a key component of subclinical inflammation with C-reactive protein (CRP) as its most consistent marker. The high levels of CRP signifies an increased risk to development of T2DM. A study conducted in UK in 2000 showed 104% higher CRP levels in south Asian children when compared to Caucasians.⁵

Most commonly, the disease is diagnosed around the age of 12-16 years as it coincides with pubertal phase.³ Puberty appears to play a pivotal role due to increased resistance to action of insulin caused by increased secretion of growth hormone and resultant hyperinsulinemia.⁸ A study conducted to report the prevalence of hyperinsulinemia in 14-19 year old children reported the same for 64% of the obese teenagers.¹²

These children and adolescents with insulin resistance are at increased risk of developing metabolic syndrome.⁵ A study demonstrating the high prevalence of insulin resistance in post pubertal children reported one-third of obese Asian Indian children with insulin resistance.¹¹

The long term consequences of these factors result in microvascular diseases (e.g. retinopathy, nephropathy and neuropathy), macrovascular diseases (e.g. cardiovascular and cerebrovascular conditions), increased susceptibility to infections, poor wound healing and periodontal disease.

Various socio-cultural issues have been observed in India with strong association to increasing childhood obesity. Indian parents feed the child in excess in an effort to keep him/her healthy. Increased academic competitiveness has

decreased participation in physical activities. Moreover indulging in fast food and more screen time has only added to physical inactivity.¹¹

Dental complications in diabetic children and adolescents:

Patients with T1DM commonly report with oral health complications such as xerostomia, dry mouth syndrome, soft tissue injury, periodontal disease, abscess and tooth loss whereas patients with T2DM report of complications such as diseases of periodontium, oral candida infection, loss of teeth, oral mucosal ulceration, disorders of taste, xerostomia and salivary hypofunction.¹³ It has been evaluated that the intensity of diabetic complications are seen to be proportional to the duration as well as degree of hyperglycaemia.¹⁴

Periodontal disease:

A bidirectional relationship can be established between periodontal disease and diabetes mellitus. Several authors have also addressed a relationship between obesity, a leading risk factor for T2DM, and periodontal disease.¹⁵ Periodontal destruction can begin at an early age in life and become more severe as the child enters into adolescence.¹⁶ Young children with controlled diabetes present with gingivitis with characteristic violaceous colour. There is extension in depth of gingival crevice and thickening of the gingiva. Increased tendency to calculus deposition often leads to some degree of bone atrophy.¹⁷

In older children, the severity of periodontal involvement is increased. There is heavy deposition of calculus, deep periodontal pockets and loss of bony support. The lesions are more prominent and periodontal abscesses may also occur.¹⁷

Additionally, periodontal disease may also present with a negative effect on diabetes control. Periodontal treatment aims to eliminate the pathogens which may result in decrease in the degree of inflammation. This further decreases the insulin resistance resulting in decrease of glucose levels.¹⁴

Dental caries:

Literature infers the effect of childhood obesity and dental caries on oral and systemic health as they may potentiate each other's deleterious impact leading to severe consequences. The multifactorial etiology of dental caries has been well established. It can be affected by diet composition, oral hygiene, socioeconomic status, bacterial load, salivary immunoglobulins and the fluoride intake. However, dietary intake has been proved to have most pertinent role in the etiology of caries. When diet energy intake exceeds the body energy requirements it results in excess body fat and obesity. Due to their dietary habits children with obesity are prone to have a higher prevalence of dental caries. A relationship between dental caries and systemic parameters of inflammation has also been suggested.¹⁸

Increase in incidence of dental caries in diabetic patients can also be due to reduced buffering and cleansing activity of saliva, increased level of oral yeasts and carbohydrates, *Streptococcus mutans* and *Lactobacilli*. The induced changes due to underlying diabetes are indicative of risk of development of caries in such children. Chronic hyperglycaemia may also cause irreversible pulpitis and pulpal necrosis.¹⁴

Thus, an interdependence can be illustrated between childhood obesity, the consequential risk factor for development of T2DM and its deleterious effects on dental tissues.

Xerostomia:

Xerostomia is the most commonly presented oral complication of the diabetes in children, with symptoms of dry mouth experienced by 53% of the adolescents.¹⁹ The chronic presence of hyperglycaemia affects the biochemical composition of saliva which reduces the salivary flow rate, and its pH.²⁰ A study conducted to analyse the relationship between dental, periodontal and salivary conditions in diabetic children reported hypo-salivation (<0.7 ml/min) in 50% of the study population.¹⁵ Patients may also complain of xerostomia due to presence of excessive thirst or polydipsia, a common clinical manifestation of diabetes.¹⁷

Oral infections:

Diabetic patients are more likely to develop oral and fungal infections. Reduced flow of saliva and absence of its antimicrobial effects with poor glycaemic control and impaired defence mechanism of host can lead to such infections. There is increased prevalence of opportunistic oral candida infections. However, patients with T2DM

report with lower candida colonization as compared to patients with T1DM.¹⁴ A rare and serious fungal infection, mucormycosis has also been reported in cases of uncontrolled diabetes. A case report presented a case of a 14 year old boy with mucormycosis associated to diabetes mellitus.²¹ However, studies demonstrating such infections in children with T2DM have not been reported.

Oral burning and taste alteration:

Taste dysfunction is reported by patients with uncontrolled diabetes. Assessment of oral health reveals impairment of sweet and salt taste sensation in some diabetic patients. It has been reported that 37% of T2DM patients complain of burning mouth or tongue which can have disturbing effect on physical and psychological health.¹⁴ The possible causes of burning can be xerostomia, candidiasis and peripheral neuropathy.¹⁷ There can be a rise in taste threshold due to salivary dysfunction and neuropathy.¹⁴ This may also lead to inability to maintain proper diet by the patient.

Traumatic ulcers and irritation fibromas:

Guggenheimer et al reported lower prevalence of oral traumatic ulcers and irritation fibromas in T2DM. This may be due to the poor wound healing in diabetics.²² Various factors can contribute in delayed wound healing such as reduced blood flow, delayed vascularisation, decline in innate immunity, decreased production of growth factor and psychological stress.²³

Management of a diabetic child:

To avoid diabetic emergency in dental clinic, a detailed history must be taken by the pediatric dentist including two critical aspects; the type of diabetes (Type 1 DM or Type 2 DM) and the level of control of disease (well or poorly controlled).¹⁷ Aspects such as physical activity, medications, diet and eating pattern, work or school schedule and cultural as well as personality factors should also be taken into consideration. An undiagnosed dental patient who may present with cardinal signs and symptoms of diabetes mellitus such as polydipsia, polyphagia, polyuria, weight loss or gain and weakness or an oral manifestation that may be due to presence of underlying systemic disease should be referred to a physician for diagnosis and management of the same.²⁴

In 2009 American Diabetes Association advocated glycated haemoglobin to assess the metabolic control. HbA1c <7%, pre-prandial glycaemia of 70-130 mg/dl and a post prandial <180 mg/dl indicate good metabolic control.¹⁷ The dentist should test the blood glucose level of the patient from their fingertip with the help of a glucometer before performing extensive dental treatment such as an extraction. This may prevent an emergency such as insulin shock or hypoglycaemia.²⁵

SIGNS AND SYMPTOMS	<ul style="list-style-type: none"> • Tremors • Tachycardia • Altered consciousness • Anxiety
<ul style="list-style-type: none"> • Increased Perspiration • Restlessness • Hunger 	
MANAGEMENT FOR A CONSCIOUS PATIENT	
Give 15 to 20 gm of Carbohydrate by mouth (e.g., 4 to 6 ounces of fruit juice, three to four glucose tablets or three to four pieces of hard candy	
MANAGEMENT FOR AN UNCONSCIOUS PATIENT	
Administer 30 to 40 ml of 50% dextran or 1 mg of glucagon intravenously or intramuscularly	
Blood glucose level should be checked within 12 minutes by finger-stick glucose test. IF the blood glucose isn't normal or near normal, repeat the carbohydrate dosage. If hypoglycaemia persists or symptoms become severe seek emergency medical care immediately.	

Table 1.2:- Identification And Treatment Of Hypoglycaemia²⁵

Scheduling of visits:

The appointment for diabetic patients should be scheduled in the morning as the endogenous cortisol level is higher. Vigilance should be taken in scheduling patients who are receiving insulin therapy, as it should not coincide with peaks of insulin activity which may potentiate a risk of developing hypoglycaemia.¹⁷

Diet:

Pediatric dentists must ensure that patient has eaten a proper meal and taken their medications prior to the dental treatment. For performing procedures under conscious sedation care must be taken to alter diet before the treatment. In such cases the physician must be consulted for any modification of dosage.¹⁷

Antibiotic coverage:

Supplemental antibiotic coverage should be provided to patients with poorly controlled diabetes as they are at risk of developing oral complications. Antibiotic coverage as a part of prevention protocol is important for conducting dentoalveolar surgeries in diabetic patients. Close monitoring of orofacial infections is important and cultures should be performed in cases of acute infections.¹⁷

Dental treatment interventions:

Oral examination for diabetic children should be done thoroughly. Counselling of the child and his/her parents regarding the comorbidities and complications of the disease is important. Pediatric dentists can incorporate testing of blood glucose level in patients showing manifestations related to diabetes mellitus.

Diabetic children must be provided with proper dietary counselling and restrictions to reduce their carbohydrate intake and cariogenic food. Preventing progression of periodontal disease by intervening at an early stage is considered most successful in management. Children must adhere to good oral hygiene habits.²⁶ Professional scaling must be performed to prevent progression of disease.

It is important that the clinician should focus on frequent brushing and interdental cleaning. Children below 6 years of age must be under parental guidance while brushing to help keep the oral complications under control. In older children, fluoridated toothpastes and mouth rinses must be prescribed. It is recommended to provide susceptible children with preventive treatment options such as sealants and fluoride varnish. Furthermore, a study in Mexico observed increased prevalence of fluorosis in diabetic children and adolescents.¹³ Thus, it is essential that a thorough oral examination is performed as recommended by American Diabetes Association in the initial visit of the diabetic child for proper planning of the treatment.²⁶

Sugarless gums, salivary substitutes and restriction on caffeine will help prevent dryness of mouth. Patients can be advised for frequent sipping of water and ice chips to help alleviate the dryness. Antifungal therapy must be prescribed for opportunistic oral infections.¹⁷ Treatment with amphotericin B-based preparations, azoles, and echinocandins have shown to be effective in neonates with candida infections and also predominantly immunosuppressed pediatric populations.²⁷

Diabetes may also result in diminished bone-mineral density, osteopenia and osteoporosis along with severe periodontal disease. Placement of orthodontic bands or separator may produce bleeding or potentially contaminate tissue and hence it must be done under antibiotic coverage. Orthodontic treatment is contraindicated in patients with poor glycaemic control.²⁸

Evaluation of BMI must be added in routine patient examination by pediatric dentist.¹⁵ This will help prevent development of systemic diseases or recognise the disease in early stages. Obese children must be referred for diet therapy and also counselling.

It is essential that pediatric dentists emphasise on regular professional care for prevention, early detection and the management of the oral complications of diabetes. Regular dental visits will help instil a positive attitude towards dentist as well as oral hygiene maintenance.

Conclusion:-

Oral complications in patients with diabetes mellitus can affect the quality of life of the child. Reported evidence suggests persistent oral complications in diabetic patients can also adversely affect their blood glucose level. With increased prevalence of Type 2 Diabetes Mellitus in children it is imperative that pediatric dentist must intervene to help reduce the subsequent burden of the disease.

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