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Dentistry

GENETICS: A MODIFICATION IN DENTISTRY

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ABSTRACT Genetics is a branch of biology which can be defined as the study of genes and heredity. Genetics when seen in relation to oral health can show various manifestations ranging from developmental disturbances to precancerous and cancerous lesions. Significant advances in research methods and newly emerging partnerships between private and public sector interests are creating new possibilities for utilization of genetic information for the diagnosis and treatment of human diseases.

The availability and application of genetic information to the understanding of normal and abnormal human growth and development are fundamentally changing the way we approach the study of human diseases. As a result, the issues and principles of medical genetics are coming to bear across all disciplines of health care.

In this review, we discuss some of the potential applications of human molecular genetics for the diagnosis and treatment of oral diseases. This discussion is presented in the context of the ongoing technological advances and conceptual changes that are occurring in the field of medical genetics.

KEYWORDS : Dental disorders, genetics, mutation, oral health.

INTRODUCTION

Gene is a basic unit which is mainly responsible for the transmission of various heredity characters from parent to offspring. Gregor Johann Mendel an Augustinian priest and scientist and is referred as the "*Father of genetics*".[1,2]

A genetic disease is any disease that is caused by an abnormality in an individual's genome. The abnormality can range from minuscule to major or from a discrete mutation in a single base in the DNA of a single gene to a gross chromosome abnormality involving the addition or subtraction of an entire chromosome or set of chromosomes.[3]

Mutation is a permanent change in the sequence of DNA. Mutations can be advantageous and lead to an evolutionary advantage of a certain genotype. Mutations can also be deleterious, causing disease, developmental delays, structural abnormalities, or other effects.[4] Various kinds of mutations include Deletion, Frameshift Mutation, Insertion, Missense Mutation, Nonsense Mutation, Point Mutation, Silent Mutation, Splice Site Mutation, and Translocation.[5]

GENETICS AND DENTAL TISSUES

Heredity conditions affecting oral soft tissues and dentition may occur as a part of systemic conditions or syndromes or may occur as a defect involving only oral tissues. Interruption of molecular pattern of genes coding for these oral tissues may have various consequences.[6]

The condition is most often transmitted as an autosomal dominant trait, though autosomal recessive transmission is also seen. Dentin is known to be affected in numerous syndromic and non-syndromic hereditary conditions.[7]

Most common include dentin dysplasia and dentinogenesis imperfecta. Dentin dysplasia is an autosomal dominant trait linked to molecular defect on chromosome 4q21. Dentinogenesis imperfecta is inherited as molecular defect in pro alpha chains of collagen type 1 gene on chromosome 17q. Many hereditary disorders of ectodermal/ecto-mesenchymal types such as trichodento osseous syndrome, tuberous sclerosis epidermolysis bullosa etc.[8,9]

GENETICS AND CLEFT LIP/PALATE

Prevalence of cleft lip and palate both in Caucasian population is 1:800–1000 while cleft lip alone is 1:1000. Incidence of cleft lip/ palate may be attributed to chromosomal disorders or they may be of multifactorial origin.[12]

Out of which 70% are non – syndromic while of 30% incidences are associated with Syndromes; which can be autosomal dominant, autosomal recessive oar X- linked. Sibling of the affected child is at a risk of 30 times more than the general population.[13]

Syndromes associated with cleft lip and palate

Autosomal dominant syndromes

- Apert
- Cleidocranial dysostosis
- Hay-Wells
- Treacher Collins
- Vander Woude
- Oculodentodigital

Autosomal recessive syndromes

- Cerebro-costo-mandibular
- Dubowitz
- Mohr
- Robert
- X-linked inheritance
- Oro-facial-digital
- Oto-palato-digital
- Chromosomal disorders Mutation in 3p arm, 5p arm, 9p arm and 18q arm
- Trisomy 4p, 9p
- Trisomy 13
- Trisomy 18

MALOCCLUSION

Dental occlusion in total represent the combination of various factors such as tooth shape and size, jaws position and size, growth patterns and affect of soft tissues on dental hard tissues.[10,11]

Various studies are done on developmental stages of I and II molars, craniofacial complex, palatal height and width, etc. The conclusion drawn was that the dental development for most part is genetically determined and hereditary plays an important role in malocclusion.[14]

GENETIC INSTABILITY IN ORAL CANCER

It can be due to mutations in proto-oncogene (polymorphism in GST gene: GSTM1 and GSTT1 or CYP (cytochrome P450) or mutations in tumor suppressor gene (p16, 9p21, APC5q21–22 and p53) this may lead to loss of heterozygosity or failure to repair.[15]

Knudson suggested that multiple "hits" to DNA were necessary to cause cancer. Cancer predisposition syndromes include Werner's syndrome, Bloom syndrome, Fanconi's anemia or disorders like Ataxia telangiectasia.[16]

GENETICS AND DENTAL CARIES

Approximately 35–55% of caries phenotypic variation in the permanent dentition is attributable to genes. Other predisposing factors include: The density or structural integrity of the dental Enamel, Topical and/or communal water fluoridation, composition of the secretions of the salivary glands, Nutrition and day-to-day dietary

habits and Personal and professional oral hygiene. Inherited disorders of tooth development, salivary flow and immune system increase the incidence of dental caries.[17]

PERIODONTAL DISEASES

Periodontal diseases are a heterogenous group of diseases that affect more than 50 million people across the world. Main etiology behind the periodontal diseases is the major role of microbial agents. Various environmental factors such as stress , smoking,etc. Susceptibility of periodontal diseases is inherited as an X-linked dominant trait. Evidence of attachment loss, pocket probing depth, gingival index and plaque index has been confirmed by studies of identical twins reared together, fraternal twins reared together and identical twins reared apart.[18]

RECENT ADVANCES

Biochips

Biochips are also referred as DNA chips, usually helpful in drug discovery, pharmacogenomics, toxicological research, and toxicogenomics.

DNA vaccination

A direct injection of the plasmid DNA encoding antigenic proteins enables expression of the protein intracellular.

Human cloning

It is used for mass production of animals engineered to carry human genes for the production of certain proteins that could be used as drugs and genetically modified organs that could be safely transplanted into humans.

Recombinant DNA technology

This can be used in variable number tandem repeated in forensic medicine, this technology is helpful for gene therapy production of transgenic animals and plants and also recombinant drug.

Proteomics

It aims to characterize all proteins in a biological sample at the functional level.

CONCLUSIONS

The traditional epidemiologic approach has proved useful for generating hypotheses and unraveling disease etiologies. But now it is possible to go beyond these methods and look inside the “black box” of the disease process which would be able to change the definition of the risk factors or clarify their location in the casual model. The control of genetic diseases should be based on an integrated and comprehensive strategy combining best possible treatment and prevention through community education, population screening, genetic counseling, and the availability of early diagnosis.

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