Case Report

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Future Prospects of DNA Fingerprinting

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Abstract

One of the most remarkableinnovations of twentieth century was DNA Fingerprinting, which revolutionized the forensic investigation. In recent years, the technology has been increasingly used in medical sciences for providing substantial information for diseases and their diagnosis and treatment. Other than this, it also has imperative role in several other fields. This article briefly reviews the history, process, clinical application and future prospects of the pivotal DNA Fingerprinting technology.

Keywords: DNA Fingerprinting; Short Tandem Repeat (STR); hemophilia; Huntington's disease.

History

In early days, individuals were identified using fingerprinting from impression of fingers. This unique way of distinguishing individuals in censes was used by Sir William Herschel for the first time in 1860 [1]. Then came the Bertillon's system of Anthropometry, introduced by Alphonso Bertillon in 1882 [2]. The inadequacy was that it was applicable only for adults as there is not much alteration in dimensions of human skeleton. Later on in 1892, a whole 'Galton system' was proposed by Galton which was a voluminous work on various patterns found in the fingerprints of individuals as loops, whorls etc. It revealed that this remains unchanged throughout life and no two individuals have similar pattern, not even twins [3]. There were limitations like absence of fingerprints from scene of crime and no role of it in genetic identification in civil disputes therefore workers moved to methods based on blood grouping involving ABO and Rh systems. These tests only exclude the accused but do not state with certainty the identity of a particular person. More efficient components such as HLA improved the basis of technology by enhancing exclusion power higher upto 96% in combination with ABO, Rhtyping. Still they could not be used for stored, embalmed, decomposed and burnt or charred tissues or partially degraded samples. Also the blood samples had issues with coagulation and conditions like duration of time and temperature, transportation etc[4].

Wyman and White in 1980 were first to observe a polymorphic locus for identity testing [5]. Finally all shortcomings were compensated by discovery of DNA as it was a unique and individual- specific biological material. This profound finding is credited to Sir Alec Jeffery who used polymorphic nature of human genome to make the genetic prints of individuals. These showed high power of discrimination with somatic and germ line stability except in monozygotic twins who differed only in fingerprint pattern. Apart from this, DNA was also found to be more resistant to denaturation by external features[6,7].

Process

In order to make a DNA fingerprint, DNA is extracted from a sample. Even a trace amount in nanograms is sufficient enough to provide data. Blood, hair, saliva, cheek cell or any other cell with DNA can be used for the purpose. Through processing by chemicals and heat, unwanted components are removed and pure DNA suspended in liquid is obtained. Nowadays in procedure, region having each Short Tandem Repeat (STR) is PCR amplified and resolved according to morphology as size, providing a complete profile of STR sizes [8].

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The 13 core STR vary in length from 100 to 300 bases. This is exceptionally valuable information and helps in analyzing even partially degraded DNA samples. The various alleles of an STR can be differentiated by even a single nucleotide. So, in order to differentiate such minute intricacies, automated DNA sequencing technologies with advance software are employed for resolution of PCR products. STR locus from the evidence sample is compared with various suspects and genotype frequency of suspects for each STR locus is calculated by simple Hardy-Weinberg calculations. Factors which further influence the process are decay / decomposed tissue samples, embalmed, cremated samples, poorly preserved samples etc. Moving from electrophoresis, RFLP, PCR based RAPD, AFLP, technology has advanced at a high pace in all these years[9].

Clinical Applications

In medicine, DNA fingerprinting has a major role in diagnosis of inherited disorders in all prenatal, antenatal and postnatal conditions. It includes detection of disorders such as cystic fibrosis, hemophilia, Huntington's disease, familial Alzheimer's sickle cell anemia, Thalassemia etc. Genetic counselors carry out pedigree analysis and utilize the obtained information to help prospective parents to comprehend the risk and clinicians further use it for appropriate treatment as it makes diagnosis possible at quite early stage[10].

DNA database samples are kept upwell maintained by investigating agencies all over the globe.FBI has developed a database named as Combined DNA Index System (CODIS) in U.S.A which compares case samples by automatic system software. Such databank system facilitates in resolving crimes to a great extent. With advent of possibly storing samples for an indefinite period of time, the dilemma of validity is probably slightest and outdated[11].

In food and technology sector, DNA fingerprinting plays a vital role in product identification, analysis of genetic diversity and also in traceability testing. Agrarians and expertise of agriculture segment have utilized the technology in patenting varieties and molecular breeding in plants along with seed-stock identification. In dairy industries, animal husbandries etc, it is used in sex-determination of cattle's for desired progeny. Not only this, the DNA fingerprinting has its universal application in knowing the extent of genetic variation in animals and determining purity of species. It is also helpful in wildlife conservation of endangered and rare species. In records of military troops, the recognition and identification of mutilated and severely injured individuals becomes quite effortless by comparing the previously stocked up individual's data with the obtained one. Law enforcement organizations with the help of technology have become morecompetent to resolve parenting disputes, legacy matters and immigration cases as well [12,13].

Mounting public understanding and awareness of the DNA fingerprinting technology helps lawmakers come to a decision on the issues so that it sustains a tangible balance amid defending individual's genetic privacy and ruling out innocent individuals from getting involved in crime investigations and trials. So not only the technology is in par with value in Judiciary of modern era but also have consistent relevance in relation to scientific, community associated, industrial and social arena.

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