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Molecular Techniques in Histopathology

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Pathology focuses on the morphological aspects of disease research for the most part. Molecular techniques are used in conjunction with pathology to isolate and identify specific infectious disease agents, to give more accurate illness diagnosis, to define the function of differential gene expression in disease aetiology, and to provide customised medicine approaches to therapy. In both clinical and anatomical pathology laboratories, molecular approaches have become indispensable. Many molecular applications in anatomical pathology have demonstrated their worth and effectiveness. Molecular approaches can help define disease more precisely, discover predictive and prognostic markers, and aid in the identification of novel molecular targets for specific therapeutic techniques. In situ hybridization or fluorescent in situ hybridization (FISH) polymerase chain reaction is two of the most commonly used molecular techniques in pathology and histology (PCR).

The era of personalized medicine has come, and treatment regimens are more centred on the patient, the disease, and how to manage prognosis and medication response in diseases like cancer. Immunohistochemistry is one of the histological foundations of molecular tests (IHC). To better control the patient's malignancy, IHC can restrict tissue cell proteins and project molecular assays and treatment regimens. IHC can be used to investigate cellular markers that commonly define specific phenotypes, which can provide crucial diagnostic, prognostic, and predictive information for disease biology.

With the primary goal of combining tissue-based testing with proteomic information, IHC has been a continuous effort to increase sensitivity for the detection of unique antigenic targets. Antibodies have necessitated the adaptation and development of IHC techniques in fixed tissue specimens because to their usage in the molecular investigation of tissue disease.

For newly diagnosed cancers, IHC and in situ hybridization are frequently employed. In some circumstances, molecular technologies have been used to create multigene expression outlines, although the results are largely unknown. IHC and molecular tests can be combined to supplement cancer diagnosis testing in regions like colon, head and neck, prostate, and breast malignancies. To name a few, IHC was a pioneer in the creation of GIST, Her2, CISH / FISH, and microsatellite instability (MSI). The use of IHC on some malignancies has certainly projected new molecular testing applications, thanks to new and enhanced monoclonal antibodies. IHC has pioneered the door for molecular testing in histotechnology.

The invention of LCM is particularly useful for separating specific cells or cell populations from preserved or frozen tissue sections for use in other experiments like genetic research. The creation of morphologically proven cellular populations is one of the unique advantages of micro dissection. The molecular testing for "tissue floaters" to separate particles of a probable floater from the rest of the tissue sample is one histological application of micro dissection. Measurement of rare individual neoplastic cells, such as the isolation of Reed-Sternberg cells from surrounding lymphoid infiltrates, is another use.

In situ hybridization is a technique for detecting specific DNA/RNA sequences, specifically in tissues. To detect DNA or RNA sequences, probes are employed instead of antibodies. The chemical reaction between the probe and the DNA/RNA to be identified is known as hybridization. This is referred to as "in situ" when performed on tissue slices or cells to determine the spot where the DNA/RNA may be located. This is a one-of-a-kind method for detecting certain mRNA species in individual cells in tissue slices. It may reveal information about physiological systems and disorders.

The technique of "DNA fingerprinting" is frequently employed in forensics to identify DNA. A reference sample, which is a sample of the person's DNA, is taken. A buccal smear is usually the recommended sample since it decreases the risk of contamination. Blood, sperm, saliva, and other bodily fluids can be used as well. This sample can be examined to create a DNA profile, which can then be compared to see if a genetic match exists. DNA fingerprinting is frequently used to establish if a patient's tissue was mistakenly switched or mixed up in the histology laboratory during tissue preparation.