Journal of Medical and Surgical Pathology
ISSN: 2472-4971
OPEN ACCESS Freely available online
Short Communication

Advances in Cancer Diagnosis through Molecular Pathology

Jamin Chigher*

Department of Pathology, University of Sydney, NSW, Australia

DESCRIPTION

Molecular pathology is an evolving and specialized branch of pathology that focuses on the study and diagnosis of diseases through the examination of molecules, particularly in tissues and bodily fluids. By integrating molecular biology techniques with traditional pathology, molecular pathology provides detailed knowledge into the genetic and molecular basis of diseases, enabling more accurate diagnoses, targeted therapies and personalized medicine. This field has revolutionized the way diseases are diagnosed and treated, particularly in oncology, genetic disorders and infectious diseases [1-4].

One of the key areas where molecular pathology has made significant contributions is in the diagnosis and treatment of cancer. Cancer cells exhibit genetic mutations, structural changes and alterations in gene expression that are often unique to each tumor type. Molecular pathology allows pathologists to identify these genetic alterations, providing essential information on the type of cancer, its aggressiveness and its potential response to therapy. Techniques such as Fluorescence *In Situ* Hybridization (FISH), Polymerase Chain Reaction (PCR) and Next-Generation Sequencing (NGS) are commonly used to detect specific genetic mutations, chromosomal abnormalities and alterations in gene expression profiles associated with different types of cancer.

For example, in breast cancer, molecular pathology can identify the presence of Human Epidermal Growth Factor Receptor 2 (*HER2)* gene amplification, which is associated with a more aggressive form of cancer. If *HER2* is overexpressed, targeted therapies like trastuzumab can be used to treat the cancer more effectively. Similarly, in Non-Small Cell Lung Cancer (NSCLC), the identification of mutations in genes like Epidermal Growth Factor Receptor (EGFR) or Anaplastic Lymphoma Kinase (ALK) can help determine whether targeted therapies such as tyrosine kinase inhibitors will be effective in treating the cancer [5-7].

Molecular pathology is also fundamental in diagnosing genetic disorders. Many inherited diseases are caused by mutations in specific genes and molecular testing can provide definitive diagnoses. For instance, in cases of cystic fibrosis, molecular pathology can identify mutations in the Cystic Fibrosis Transmembrane Conductance Regulator (*CFTR*) gene, which causes the disorder. Similarly, sickle cell anemia can be diagnosed by detecting the mutation in the Hemoglobin Subunit Beta (*HBB*) gene that encodes hemoglobin. In addition, preconception genetic screening and prenatal testing increasingly depends on molecular pathology techniques to identify genetic abnormalities in embryos or fetuses, such as down syndrome or muscular dystrophy, helping families make informed decisions about their health.

Molecular pathology also plays a significant role in pharmacogenomics, the study of how genetic variations affect individual responses to medications. By analyzing genetic variants in patients, pathologists can identify whether a patient is likely to respond to a particular drug or experience adverse side effects. This has significant implications for the field of personalized medicine, as treatments can be modified to the patient's genetic profile, leading to more effective therapies with fewer side effects. For example, certain genetic mutations in Cytochrome P450 (CYP450) enzymes can affect how a patient metabolizes drugs, influencing the choice and dosage of medications used in conditions such as psychiatric disorders, cardiovascular diseases and cancer [8-10].

CONCLUSION

In conclusion, molecular pathology is a transformative field that has revolutionized the diagnosis and treatment of diseases. By enabling the detection of genetic and molecular alterations in tissues and fluids, molecular pathology provides important information that allows for earlier diagnosis, more accurate prognostication and more targeted treatments. Whether in oncology, genetics, infectious diseases or pharmacogenomics, molecular pathology continues to play an essential role in advancing healthcare and improving patient outcomes. As technology continues to evolve, molecular pathology will remain a core of modern medicine, offering new opportunities for diagnosis and personalized treatment.

Correspondence to: Jamin Chigher, Department of Pathology, University of Sydney, NSW, Australia, E-mail: chimin@ja.org.au

Received: 20-Nov-2024, Manuscript No. JMSP-25-36589; **Editor assigned:** 22-Nov-2024, PreQC No. JMSP-25-36589 (PQ); **Reviewed:** 06-Dec-2024, QC No. JMSP-25-36589; **Revised:** 13-Dec-2024, Manuscript No. JMSP-25-36589 (R); **Published:** 20-Dec-2024, DOI: 10.35248/2472-4971.24.9.317

Citation: Chigher J (2024). Advances in Cancer Diagnosis through Molecular Pathology. J Med Surg Pathol. 9:317.

REFERENCES

1. Huntsman DG, Ladanyi M. The molecular pathology of cancer: From pan-genomics to post-genomics. J Pathol. 2018;244(5):509-511.
2. Wood LD, Adsay NV, Hruban RH. Molecular pathology of pancreatic cancer. Mol Pathol. 2012:17-42.
3. Foo WC, Wang H. Pathology and Molecular pathology of pancreatic Cancer. Pathol Epidemiol Cancer. 2017:489-509.
4. Gentles AJ, Newman AM, Liu CL, Bratman SV, Feng W, Kim D, et al. The prognostic landscape of genes and infiltrating immune cells across human cancers. Nature Medicine. 2015;(8):938-945.
5. Hanahan D, Weinberg RA. Hallmarks of cancer: The next generation. Cell. 2011;144(5):646-674.
6. Pavlova NN, Thompson CB. The emerging hallmarks of cancer metabolism. Cell Metab. 2016;23(1):27-47.
7. Diaz LA, Bardelli A. Liquid biopsies: Genotyping circulating tumor Deoxyribonucleic acid (DNA). J Clin Oncol. 2014;32(6):579.
8. Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer. 2015;136(5):359-386.
9. Cheng F, Su L, Qian C. Circulating tumor DNA: A promising biomarker in the liquid biopsy of cancer. Oncotarget. 2016;7(30): 48832.
10. Reya T, Morrison SJ, Clarke MF, Weissman IL. Stem cells, cancer and cancer stem cells. Nature. 2001;414(6859):105-111.