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Perspective

Thyroid FNA (Fine Needle Aspiration) in Molecular Pathology

Poller Sengya*

Department of Pathology & Cancer Laboratory, Queen Alexandra Hospital, Portsmouth, UK

DESCRIPTION

This Study provides an overview of thyroid FNA-relevant molecular pathology methods. Thyroid tumours' molecular pathology is now pretty well known. Molecular techniques may be used as a rule-in test to determine whether thyroid nodules are cancerous. Molecular techniques may also be used to rule out the presence of cancer in thyroid nodules. This study discusses the value of molecular diagnostics in thyroid FNA as well as concrete instances of molecular techniques applied to thyroid FNA in typical clinical practice. With some useful applications of molecular approaches to diagnosis and prognosis of thyroid nodules and thyroid cancer, it summarizes the breadth of molecular abnormalities observed in thyroid nodules and thyroid tumours.

The variety of molecular anomalies found in thyroid nodules and thyroid tumours are discussed, along with some real-world examples of how molecular approaches can be used to diagnose thyroid nodules and thyroid cancer and predict their prognosis.

The development of Next-generation Sequencing (NGS) for DNA and RNA during the past few years has significantly advanced molecular pathology procedures. The understanding of thyroid tumour pathology has also advanced. Molecular diagnosis can be utilized as a marker for focused therapy, for differential diagnosis, and for patient prognostication. Thyroid tumour molecular pathology is now reasonably well known. Multiple mutational events are assumed to be the root cause of thyroid tumour development. Despite how frequently they occur, most thyroid nodules are benign. Any given thyroid nodule's likelihood of developing thyroid cancer is influenced by the patient's age, genetics, and medical history, including radiation exposure. The thyroid gland's metastatic tumours, which are found in 1.4% to 3.0% of patients with probable thyroid cancer, are also significant 85% of thyroid cancers are Papillary Thyroid Carcinomas (PTC), which can be either the traditional type or a variation. Due to RAS or BRAF mutations, RET or NTRK rearrangements or somatic mutations in the MAPK pathways, classical type PTC manifests somatic changes. Greater mutation frequencies are present in PTCs with taller cells than in PTCs with shorter cells. The PTC columnar cell variation is uncommon. About 10% or less of thyroid carcinomas is follicular thyroid cancers. BRAF K601E mutations are possible; however BRAF V600E mutations are extremely uncommon.

2%-4% of thyroid cancers are Medullary Thyroid Carcinomas (MTC). The majority of cases of MTC are sporadic, but familial cases, including MEN 2A, MEN 2B, and familial medullary thyroid carcinoma, account for 15%-30% of cases. If particular gene mutations or phenotypic changes can be found, thyroid FNA can be used as a prognostic indication. The BRAF V600E mutation alone has a small negative impact on prognosis in any given situation, but recent research shows that combinations of BRAF V600E mutation with other gene mutations and ALK fusions have significant negative effects. These combinations can all be detected using multigame next-generation sequencing panels.

The reported results of these tests in the literature are ambiguous because they depend on the clinical setting that is, the risk of malignancy of the specific FNA being submitted for molecular testing and the institution in question and the results range from 18% to 100% sensitivity, 86%-100% specificity, 56%-100% NPV, and 19%-100% NPV. The ETA guidance comes to the conclusion that BRAF, RET/PTC, PAX8/PPARG, and RAS mutational analysis should be taken into consideration for cytological indeterminate nodules, though the significance of RAS mutations needs to be clarified.

Molecular testing for malignancy can be used as a rule-in or a rule-out test. The test's performance is influenced by the test's Positive Predictive Value (PPV) and Negative Predictive Value (NPV) for malignancy, although both PPV and NPV are also influenced by the likelihood of malignancy prior to the test. The understanding of the pathogenesis of thyroid cancer and the development of tools for diagnosis, prognosis, and treatment now heavily rely on molecular methods. If resources are available, many of these techniques can be applied preoperatively to small samples of DNA, RNA, or micro-RNA from thyroid FNA aspirates. However, given the difficulties in testing and test validation, the majority of the techniques described are best used in a specialized referral laboratory setting.

Correspondence to: Poller Sengya, Department of Pathology & Cancer Laboratory, Queen Alexandra Hospital, Portsmouth, UK; E-mail: pollerse@uhs.uk

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