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New insights in the role of artificial intelligence (AI) for the diagnosis of thyroid nodules

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OBJECTIVES

Artificial intelligence (AI) is becoming increasingly important in anatomic pathology for auxiliary diagnosis in histology and cytology. AI techniques can examine enormous volumes of data and uncover patterns that the human eye may miss. Several research have looked into the possibility of such techniques to improve the sensitivity and specificity of thyroid cytopathology, in particular regarding the indeterminate categories of 'the Bethesda system for reporting thyroid cytopathology' (TBSRTC). The aim of our review is to discuss and take stock of the advancements made in this field, the problems that still need to be solved, and the challenges that remain.

METHODS

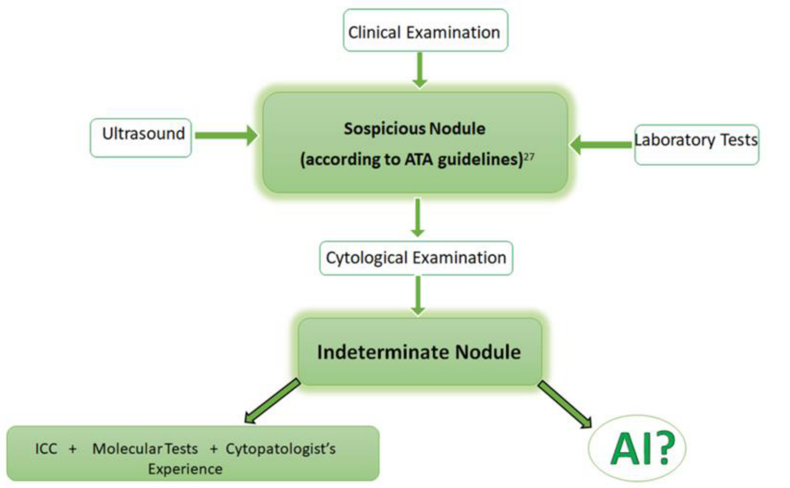
We have performed PubMed research concerning artificial networks in thyroid nodular pathology in the last 25 years.

RESULTS

Starting in 1999, Karakitsos et al. classified benign and malignant follicular and Hurthle cell nodules using a neural network, with 90.61% overall accuracy on test data. Five years later, Ippolito et al. made the first attempt to address the issue of indeterminate nodules, proving that an artificial neural network (ANN) model could differentiate between benign and malignant thyroid lesions with higher sensitivity and specificity compared to conventional cytologic criteria. In 2006, Cochand-Priollet et al. classified 25 morphometric nuclear data from May Grunwald-Giemsa-stained smears as benign or malignant using statistical classifiers, and in the same year, Poloz and Tarkov suggested using intraoperative cytological pictures to diagnose thyroid follicular lesions using a neural network method. One year later, Shapiro et al. analyzed several ANN types and designs using nuclear features in 197 thyroid follicular tumours (adenomas and carcinomas). Following this path, Daskalakis et al. successfully used a multi-classifier system to differentiate between benign and malignant nodules based on nuclear texture and morphology, and Varlatzidou et al. demonstrated how neural networks and morphometry might be combined to improve thyroid fine-needle aspiration cytology (FNAC) accuracy, notably in Hürthle cell tumours and suspected follicular neoplasms.

In more recent years, the widespread use of whole-slide imaging (WSI), which enables the digitization and preservation of entire histological slides, has greatly advanced the use of AI in thyroid cytopathology. In 2020, Girolami et al. demonstrated comparable diagnostic abilities between automated models and expert pathologists, particularly for differentiating between encapsulated lesions and malignant and benign nodules in the indeterminate cytological categories.

GRAPHS & TABLES



CONCLUSION

While AI algorithms have significantly increased thyroid cytology diagnostic accuracy, data biases may impact algorithm performance, making standardization and larger multicentric studies necessary. Additionally, regulatory and ethical issues must be resolved. Although there is a considerable amount of evidence that AI is useful in thyroid cytopathology, additional research is required before AI-based diagnostic tools can be integrated and standardized into clinical workflows.

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