Unveiling the Role of Artificial Intelligence in Endoscopic Ultrasound – A Systematic Review

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BACKGROUND

EUS is a key tool for GI tract imaging and tumor staging.

Challenges: Operator dependency, tumor seeding risks, inter-observer variability.

AI's Role :

Enhances tumor detection, resectability assessment, and personalized treatment. Uses machine learning (CNN, deep learning) for image analysis.

METHODS

• **Search Strategy:** Databases: PubMed, Medline, Google Scholar, PsycINFO (up to April 2024).

• **PICO Criteria:**
P: AI in EUS, **I:** AI intervention, **C:** Controls (traditional EUS), **O:** Diagnostic accuracy, clinical outcomes

• **Study Selection:** 324 studies screened → **96 included** (PRISMA flow diagram).
Tools: Rayyan for data extraction, SPSS for analysis.

RESULTS

Study	Lesions	Results	Relevant Metrics
Gomes et al.	Subepithelial lesions (GIST) and GIST vs GIL (Gastrointestinal Leiomyoma)	AI-EUS: Sensitivity 92%, Specificity 80%. For GIST vs GIL: Specificity 90%. Non-AI: Sensitivity 72%, Specificity 70%.	Sensitivity: 92% (AI-EUS), 72% (Non-AI) Specificity: 80% (AI-EUS), 70% (Non-AI) Specificity for GIST vs GIL: 90% (AI-EUS)
Huang et al.	Sub-epithelial lesions, esophageal cancer, gastric cancer, pancreatic lesions	AI-EUS superior to traditional methods in diagnosing various lesions, including esophageal and gastric cancers.	Diagnostic Superiority: AI-EUS is superior to traditional methods for various lesions.
Dumitrescu et al.	Pancreatic cancer	AI-EUS: Sensitivity 92%, Specificity 90%, Odds Ratio 128.9.	Sensitivity: 92% Specificity: 90% Odds Ratio: 128.9
Njei et al.	Malignant biliary strictures, cholangiocarcinoma	CNN-Cholangioscopy: Accuracy 94.9%, Sensitivity 94.7%, Specificity 92.1%.	Accuracy: 94.9% Sensitivity: 94.7% Specificity: 92.1%
Luo D et al.	Early esophageal cancer (EEC) and early gastric cancer (EGC)	EEC: Sensitivity 95%, Specificity 95%, PLR 10.76. EGC: Sensitivity 87%, Specificity 88%.	EEC Sensitivity: 95% EEC Specificity: 95% EEC PLR: 10.76 EGC Sensitivity: 87% EGC Specificity: 88%
Knabe et al.	Barrett's esophagus	AI accurately diagnosed and categorized Barrett's carcinoma with high diagnostic performance.	Diagnostic Performance: Accurate diagnosis and categorization of Barrett's carcinoma.
Barron et al.	Dysphagia	Machine learning algorithms align with the Penetration Aspiration Scale, showing high diagnostic accuracy.	Diagnostic Alignment: High alignment with the Penetration Aspiration Scale.

CONCLUSIONS

1.Enhanced Diagnostic Accuracy:

1. AI (e.g., CNN, deep learning) improves tumor detection, staging, and invasion depth assessment.
2. Reduces inter-observer variability, leading to more consistent interpretations.

2.Clinical Applications:

1. Effective in **GI cancer diagnosis**, **lymph node characterization**, and **pathological prediction**.
2. AI-assisted EUS achieves high AUC values, PLR/NLR ratios, and diagnostic odds ratios (DOR).

3.Limitations:

1. Most studies are **preclinical** (image-based) with few prospective trials.
2. Need for standardized AI models and real-world validation.

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