Diagnostic Utilization of Artificial Intelligence, Machine Learning, and Deep Learning in Identification of Reproductive Organ Cancers: A Systematic Review and Analysis

Saloni Mehta, Shivam Gupta, Aditya Shah, Jhanvi Shah

Background

- The integration of artificial intelligence (AI), machine learning (ML), and deep learning (DL) techniques into oncologic diagnostics has gained momentum due to potential diagnostic enhancements of accuracy and efficiency, particularly for high-burden cancers.
- This systematic review and analysis aimed to assess the performance of AI technologies in detecting reproductive cancers, specifically breast, cervical, ovarian, and prostate cancer.

Methods

- We performed a systematic review using the PRISMA protocol to identify articles describing the role of AI in diagnosing reproductive organ cancer.
- Using PubMed search engine, we identified English, full text, observational studies or clinical trials mentioning the role of AI to describe Ki67, cytopathology, microsatellite instability from 2013.
- We used keywords like (("artificial intelligence"[Title/Abstract] OR "machine learning"[Title/Abstract] OR "AI"[Title/Abstract] OR "deep learning"[Title/Abstract] OR "artificial neural network"[Title/Abstract]) AND …

Methods

- …("Ki67"[Title/Abstract] OR "breast cancer"[Title/Abstract] OR "cytopathology"[Title/Abstract] OR "ovarian cancer"[Title/Abstract] OR "prostate cancer"[Title/Abstract] AND 2013/01/01:2023/12/31[Date - Publication] AND 2021/01/01:3000/12/31[Date - Publication]) AND ((clinicaltrial[Filter] OR observationalstudy[Filter] OR randomizedcontrolledtrial[Filter]) AND (fft[Filter]) AND (humans[Filter]) AND (english[Filter])).
- Data on the type of technique and its precision, accuracy, sensitivity, and specificity were screened, collected, and analyzed.
- The following metrics were used for extraction: sensitivity, specificity, accuracy, and area under the curve (AUC).
- OpenMeta[Analyst] was used for analysis

Results

- Out of 9,238 studies screened, 44 were included, focusing on breast, cervical, ovarian, and prostate cancers.
- For breast cancer, AI showed high diagnostic performance with 89.4-95.0% accuracy, 85.1-100% sensitivity, about 95% specificity, and AUC up to 0.962.

Results

- AI-based digital pathology and Ki-67 analysis improved reproducibility and efficiency over manual methods.
- For cervical cancer, AI achieved 95.6% accuracy and sensitivity, with 79.9% specificity in identifying precancerous and malignant lesions.
- Ovarian cancer models reached 69.0-92.4% accuracy and AUC up to 0.968, effectively differentiating tumor types.
- Prostate cancer AI systems, using radiologic-pathologic correlation, reported AUCs of 0.81-0.86 and up to 80% accuracy in distinguishing malignant from benign MRI lesions.

Results

- AI-based diagnostic systems demonstrate high performance with promising accuracy and efficiency for breast, cervical, ovarian, and prostate cancers.
- These results support the continued development and validation of AI tools to augment cancer diagnostics.
- However, further studies are warranted to assess clinical integration and cost-effectiveness.