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Snap diagnosis: pilot study of AI-powered smartphone application for penile cancer detection from the comfort of your home.

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Introduction:

Penile cancer is rare but sinister disease. Early recognition and treatment are paramount to preserving function and long-term survival. However, many men present with advanced disease due to a lack of awareness and social stigma. There is an urgent need to reduce barriers to subspecialist penile cancer care, especially for men from low socioeconomic backgrounds. AI (utilizing machine learning combined with enhanced smartphone photography analysis) has demonstrated growing utility by outperforming clinicians in diagnosing skin cancer. This pilot study aims to evaluate the accuracy of an artificial intelligence algorithm for stratifying penile lesions.

Methods:

Images with histological confirmation were obtained from peer-reviewed medical journal. Search terms used include "penile cancer", "penile squamous cell carcinoma (SCC)", "penile lesion", "benign penile lesion", "penile carcinoma in situ (CIS)", "penile neoplasm in situ (PeIN)". Images were categorized as benign, pre-malignant, and penile SCC. A convolutional neural network (CNN) was created to extract and automatically segment images into pixels. Contours of pixel edges were used to generate a "mask" representation of the lesion from normal skin. Features such as lesion elevation, erythema, ulceration, redness, and irregularity were extracted and compared. A hold-out validation methodology was performed for training and internally assessing accuracy. The image samples are divided into training (64%), validation (16%), and test (20%) subsets.

Results:

One hundred thirty-eight images were included – 67 invasive PSCC, 44 carcinoma in situ (CIS), and 27 benign. The CNN had good AUROC, sensitivity, and specificity when differentiating between benign penile lesion from penile SCC. The CNN struggled to differentiate between PeIN and superficially invasive SCC.

Overall, the AI algorithm demonstrated an overall accuracy of 87.5%

Objective	AUROC	Sensitivity	Specificity	PPV	NPV
benign vs cancer	0.94	0.82	0.87	0.95	0.72
cancer vs precancer	0.737	0.75	0.65	0.45	0.88

Conclusion:

We present the first study to identify the role of AI in accurately categorizing penile lesions. Penile lesions beneath non-retractile foreskin were identified as a limitation. Further image incorporation and validation with clinical images from electronic medical records are underway. An opportunity exists to refine artificial intelligence as an education, triage, and referral optimization tool via a smartphone.

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