

Computerized Diagnostic Decision Support System for the Classification of Preinvasive Cervical Squamous Lesions

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Previous studies have revealed considerable interobserver and intraobserver variation in the histological classification of preinvasive cervical squamous lesions. The aim of the present study was to develop a decision support system (DSS) for the histological interpretation of these lesions. Knowledge and uncertainty were represented in the form of a Bayesian belief network that permitted the storage of diagnostic knowledge and, for a given case, the collection of evidence in a cumulative manner that provided a final probability for the possible diagnostic outcomes. The network comprised 8 diagnostic histological features (evidence nodes) that were each independently linked to the diagnosis (decision node) by a conditional probability matrix. Diagnostic outcomes comprised normal; koilocytosis; and cervical intraepithelial neoplasia (CIN) I, CIN II, and CIN III. For each evidence feature, a set of images was recorded that represented the full spectrum of change for that feature. The system was designed to be interactive in that the histopathologist was prompted to enter evidence into the network via a specifically designed graphical user interface (i-Path Diagnostics, Belfast, Northern Ireland). Membership functions were used to derive the relative likelihoods for the alternative feature outcomes, the likelihood vector was entered into the network, and the updated diagnostic belief was computed for the diagnostic outcomes and displayed. A cumulative probability graph was generated throughout the diagnostic process and presented on screen. The network was tested on 50 cervical colposcopic biopsy specimens, comprising 10 cases each of normal, koilocytosis, CIN I, CIN II, and CIN III. These had been preselected by a consultant gynecological pathologist. Using conventional morphological assessment, the cases were classified on 2 separate occasions by 2 consultant and 2 junior pathologists. The cases were also then classified using the DSS on 2 occasions by the 4 pathologists and by 2 medical students with no experience in cervical histology. Interobserver and intraobserver agreement using morphology and using the DSS was calculated with κ statistics. Intraobserver reproducibility using conventional unaided diagnosis was reasonably good (range, 0.688 to 0.861), but interobserver agreement was poor (range, 0.347 to 0.747). Using the DSS improved overall reproducibility between individuals. Using the DSS, however, did not enhance the diagnostic performance of junior pathologists when comparing their DSS-based diagnosis against an experienced consultant. However, the generation of a cumulative probability graph also allowed a comparison of individual performance, how individual features were assessed in the same case, and how this contributed to diagnostic disagreement between individuals. Diagnostic features such as nuclear pleomorphism were shown to be particularly problematic and poorly reproducible. DSSs such as this therefore not only have a role to play in enhancing decision making but also in the study of diagnostic protocol, education, self-assessment, and quality control.

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