18-5 Expert System Computer-Guided Diagnosis of Sellar Lesions

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While computer-guided diagnosis is not a new concept, its practical applications are only beginning to be explored. We developed a bayesian-based expert system to aid the radiologic diagnosis of sella/ juxtasellar lesions. The expert system generates a probablistic differential diagnosis by comparing the radiologic findings of new cases to a large existing knowledge base.

A well-defined patient population of 320 patients with known sellar lesions was used to construct the knowledge base. A priori incidences of specific lesions were as follows: adenoma 39%, glioma 17%, meningioma 13%, craniopharyngioma 11%, aneurysm 10%, other (germinoma, hamartoma, lipoma, arachnoid cyst, rathke's cyst, colloid cyst) 10%. The radiologic appearance of each lesion was analyzed using a standardized vocabulary of 54 specific descriptors. To maintain standardized description of radiologic appearance, a visual glossary of laserdisk video images was incorporated to define and illustrate descriptive terminology.

Preliminary analysis of the data shows that certain clusters of radiologic findings are particularly significant in generating a probablistic differential diagnosis. In addition, other clusters of findings show interdependence that suggests underlying physiologic or pathologic processes. A prospective evaluation of the expert system is currently being conducted: the expert system will generate a differential diagnosis for 30 new cases of pathologically confirmed sellar lesions; an expert neuroradiologist will also diagnose the 30 new cases; the accuracy and efficiency of the expert system will be compared to that of the expert neuroradiologist.

New cases will be added to the existing knowledge base. The cumulative effect of adding new cases provides for a dynamic and "intelligent" expert system whose performance improves with experience.

18-6 COMPUTERIZED LEARNING OF CLINICAL IMAGING ALGORITHMS

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The object of the project undertaken is to challenge the student to construct optimal imaging sequences for hypothetical clinical problems, with the intent to orient and introduce the student to diagnostic imaging from a realistic clinical viewpoint. Students are forced to consider the cost, radiation dose, and availability of examinations, and information desired in the imaging test as well as the next step to be taken when the information is obtained.

A computer work station is utilized. The clinical scenario is presented on screen and the student picks an imaging technique. The image is presented along with the "results". This will necessitate an additional response by the student. A discussion will then ensue defining the advantages of the formulated imaging algorithm. Cost is held to a minimum by the use of a random access slide projector which is able to demonstrate visual materials corresponding to the presented clinical scenario.

The initial testing of the program was carried out with selected medical students participating in clerkships in Radiology. These initial efforts indicated that the scenarios were weighted too heavily on the interpretation of images, and the presentation was altered to provide formal interpretation. The computer is now in a location which has wide availability to all medical students. The amount of utilization and the responses are recorded by the computer and evaluated on a biweekly basis to determine whether alterations in the program are needed.

Computerized learning of clinical imaging algorithms has been able to be accomplished at a very low cost. This approach has allowed us to challenge the student to integrate imaging into a clinical scenario and optimize utilization of examinations.

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18-7 Computer-Based Training--Who Cares? A Statistical Look

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Computer-assisted instruction (CAI) with interactive video is an exciting training modality for radiologic education, but its potential acceptance and usefulness of the general radiologist is only anecdotal. A prototype interactive tutorial and electronic survey was jointly sponsored by the Radiologic Society of North America and the American College of Radiology. Attendees at the RSNA 1988 scientific meetings were invited to participate by random invitation and on walk-in basis. The tutorial, created using a high-level authoring language and a laser videodisc produced at the University of Utah, presented normal and suprasellar anatomy and radiologic differential diagnosis of common lesions in that region. The electronic survey consisted of general demographic questions such as age, practice setting, and level of computer experience. The survey also included questions to assess the response to the sample tutorial, as well as evaluate interests and attitudes regarding electronic education aids and future development of CAI. The tutorial was presented on eight individual workstations located in the RSNA scientific exhibit hall. Each workstation consisted of an IBM AT computer with an InfoWindows touch-screen, a Pioneer laser videodisc player, and an IBM-compatible printer. Over 1100 attendees participated in the exhibit, 79% of whom completed the full 15-minute demonstration and survey. The response across all age groups and specialty interests in both academic and private settings was extremely positive: 71% of all participants thought that the radiologists in their group would use this type of program if it were available. 70% thought the videodisc images were of excellent or above-average quality. 62% would use this program. Detailed statistical analysis of this data will be presented.

19-1 SATISFACTION OF SEARCH IN DIAGNOSTIC RADIOLOGY

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Some underreading errors (false-negatives) in radiology have been attributed to "satisfaction of search," which occurs when lesions remain undetected following detection of an initial lesion. This phenomenon has not been previously studied in the laboratory because of difficulty in generating an appropriate control condition. We designed an experiment to document and characterize the existence of satisfaction of search.

Our method compared detection accuracy for various naturally occurring, subtle lesions with that for those same lesions when a simulated lung nodule was added to each radiograph. Eight radiologists served as observers. The case sample included 70 chest radiographs, 38 with and 32 without inherent lesions. Simulated and actual lesions were not spatially superimposed and the inherent abnormalities were physically identical with and without the nodules.

Only responses related to the inherent lesion were analyzed. Accuracy parameters of individual-reader ROC curves were estimated by the method of maximum likelihood. Detection accuracy of native lesions was substantially and significantly reduced in the presence of nodules (e.g. for A_z, $t(7) = 2.36$, $P < 0.05$).

The existence of satisfaction-of-search was rigorously demonstrated. The findings of this and future investigations using this experimental paradigm may lead to the understanding necessary to reduce these errors.

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