

11:30

**688 Evaluation of CT air bronchogram sign in malignant solitary pulmonary lesions**

J.-A. Choi, H.-S. Kim, Y.-W. Oh, E.-Y. Kang; *Seoul/ROK*

**Purpose:** To evaluate prevalence and pattern of air bronchogram sign in malignant solitary pulmonary lesions (SPLs).

**Methods and Materials:** CT scans of 78 patients with malignant SPLs including air bronchogram were reviewed. Lesions were classified into 4 cell types as squamous cell, small cell, adenocarcinoma, bronchioloalveolar carcinoma (BAC), according to degree of differentiation, size, and location. Air bronchogram patterns were classified into obstructing (I), patent (II), displacing (III), or tapered narrowing (IV) types.

**Results:** Eighty patterns were analyzed. According to cell types, squamous cell carcinoma showed most often type I (45.8%) but no type II pattern, most common in BAC (77.8%) and adenocarcinoma (34.8%). Small cell carcinoma showed most often type IV pattern (41.7%). In all 3 degrees of differentiation, type III was most common. No significant differences existed according to size. According to location, central types were seen more often (63.75%) with more commonly type I and IV patterns, whereas peripheral ones had more often type III and II patterns.

**Conclusion:** We conclude that in SPLs with air bronchogram sign of either obstructing or displacing pattern, squamous cell carcinoma should be suspected. In SPLs with patent air bronchogram, either BAC or adenocarcinoma should be considered.

*(Submitted by Internet)*

11:40

**689 CT of the mucin-producing lung adenocarcinoma**

M. Gaeta, A. Blandino, G. Ascenti, E. Scribano, I. Pandolfo; *Messina/IT*

The aim of this work is to describe the CT findings in 28 primary mucinous adenocarcinoma of the lung.

**Methods and Materials:** Histological proof was obtained by transthoracic or transbronchial biopsies (n = 12), open lung biopsies (n = 3), and surgical specimens (n = 13). The following subtypes were classified: 15 bronchioloalveolar, 3 acinar, 2 papillary, and 2 cystic adenocarcinomas. Six cases were unclassified. CT scans were reviewed by 3 thoracic radiologists.

**Results:** Four CT patterns were found: (a) solitary nodule (n = 5); solitary mass (n = 5); segmental or lobar consolidation or ground-glass opacity (n = 6); and (c) multicentric or diffuse disease (n = 12). In 13 cases the tumor-density was lesser than 30 UH. In all of these cases, contrast enhancement was lesser than 20 UH. In 3 cases follow-up CT scans showed progression of disease, in 2 cases by aerogenous spread, and in a case by aerogenous and hematogenous spread.

**Conclusion:** Mucinous adenocarcinoma is a polymorphic cancer with unique CT features.

11:50

**690 Mucinous versus non-mucinous type of bronchioloalveolar carcinoma on CT**

H.S. Seo, J.Y. Rhee, C.J. Kim, Y.H. Oh, E.Y. Kang; *Seoul/ROK*

**Purpose:** To evaluate helpful CT findings differentiating mucinous from non-mucinous type of bronchioloalveolar carcinoma (BAC).

**Methods and Materials:** This study included chest CT scans of twenty two patients with BAC. Ten were mucinous type twelve were non-mucinous type of BAC confirmed by histopathologic examination. CT findings of the lesions were classified as either solitary or multiple and as either mass/nodule or consolidation pattern. The internal characteristics of lesion such as air-bronchogram, pleural tag, and surrounding halo were evaluated.

**Results:** In 10 cases of mucinous type, 6 were solitary and 4 were multiple. There were mass/nodule (n = 3), consolidation (n = 5), and mixed (n = 2) pattern. Air-bronchogram and pleural tag were observed in 1 case of solitary lesion.

In twelve non-mucinous type, 6 were solitary and 6 were multiple. There were mass/nodule type (n = 11) and mixed type (n = 1). Air-bronchogram and pleural tag were observed in 4 cases of solitary lesion. Surrounding halo was seen in 2 cases of solitary lesion.

**Conclusion:** Mass/nodule was more frequent finding in non-mucinous type of BAC. Consolidation was more common finding in the mucinous type. According to solitary or multiple lesion, there was no difference between two types. Air-bronchogram and pleural tag were relatively common in solitary lesion of non-mucinous type.

*(Submitted by Internet)*

10:30-12:00

Room G

**COMPUTER APPLICATIONS**

**SS 905 Computer assisted diagnosis perception**

Chairpersons: F.H. BARNEVELD BINKHUYSEN (Amersfoort/NL)  
S. FEUERBACH (Regensburg/D)

10:30

**691 Model- and knowledgebased segmentation of hand radiographs for maturity determination**

F. Vogelsang, M. Kilbinger, F. Weiler, M. Kohnen, B.B. Wein, R.W. Günther; *Aachen/D*

**Purpose:** Determining a patient's skeletal maturity by hand radiographs is an important procedure in pediatric radiography. We present a new method for the automatic segmentation of hand radiographs.

**Methods and Materials:** The proposed algorithm uses an active shape method for model initialization and an extended active contour model for segmentation of hand bones. This incorporates a-priori knowledge of shape and topology of bones. This "scene knowledge" is integrated in a complex hierarchical image model which is used for image analysis. Our new method yields an automatic complete segmentation of the phalangeal and metacarpal bones and ROIs of the epiphysis. This allows an intensive examination of bones regarding existence, shape and texture. The results of these examinations are used to perform a maturity determination.

**Results:** The algorithm has been applied to 150 hand radiographs of which 142 were automatically and correctly segmented. The remainders needed small interactive correction.

**Conclusion:** Higher processing like image analysis and interpretation will only be reliable if the preceding segmentation step is of high quality. This, however, depends on the correct use of relevant model knowledge. Our method of shape modelling, scene knowledge and initialization of active contour model shows the desired accuracy. The described concepts can directly be applied to other scenarios by using a different initialization algorithm.

*(Submitted by Internet)*

10:40

**692 Computer-assisted scoring of rheumatoid arthritis**

K. Boegl, F. Kainberger, K.-P. Adlassnig; *Vienna/A*

**Purpose:** Evaluating radiographs of rheumatoid arthritis by scoring systems is internationally established. An accurate quantification of erosive diseases gives an appropriate assessment of the disease status at a given time, serial measurement of radiographic damage provides a view of the disease course and the essential data for calculating a progression rate.

**Methods and Materials:** We have developed a computer program that allows a fast, accurate, and reliable documentation of erosive and degenerative changes on radiographs of hands, wrists, and feet in rheumatoid arthritis. Based on these data the program is able to calculate the score (we are currently using the Larsen Score but the software is able to support other scoring systems as well) and to deliver diagnostic hints based on the characteristics of morphologic changes. Examinations are stored in a database to facilitate the assessment of the longterm follow-up of patients. The system has been programmed

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in Java to provide cross-platform- and Internet-compatibility. In addition to a fully operative Java stand-alone application, a demo version is available in form of a Java applet in the WWW.

**Results:** We are currently testing the software in an evaluation study. Two groups of radiologists and rheumatologists are involved, of which the first scores by using the traditional paper-based method whereas the other employs the new software.

**Conclusion:** The preliminary results indicate that both the reporting time and the error rate can be drastically reduced.

10:45

#### **693 Optimizing parameters for computer-aided diagnosis in mammography**

S. Buchbinder, P. Bamberger, R. Lederman, S. Fields, B. Novak, I. Leichter; *Jerusalem/IL*

**Purpose:** To compare the performance of two discriminatory analysis classifiers (DAC) for mammographically detected cluster microcalcifications (CMC), one based on features extracted automatically from digitized image along, while the other added a demographic factor, age, as an additional variable.

**Methods and Materials:** CMC identified on mammograms were digitized at high resolution (600 dpi., 8 bit). An algorithm was developed to automatically extract from this image quantitative parameters which characterize the CMC: shape; variability of brightness, length and area; compactness; proximity; and average number of neighbors, were the variables chosen. The Wilcoxon and Welch modified t-test were used to confirm significance. A DAC assigned the cluster a single value based on these parameters. Age, an important demographic factor, was added as an eighth variable to determine its affect on the classification scheme. 134 randomly chosen retrospective cases (age 31–77 years) with proven pathology of CMC were studied. The Jack-knife procedure was used to classify each case independently. The performance was evaluated by ROC analysis.

**Results:** All seven parameters differentiated significantly ( $p < 0.001$ ) between malignant and benign cases. The area under the ROC curve ( $A_z$ ) describing the results of the classifier based on the seven mammographic parameters was 0.93. When age was added as an eighth variable, the  $A_z$  did not change significantly ( $A_z = 0.92$ ).

**Conclusion:** A DAC using seven quantitative parameters extracted automatically from an image proved to be highly indicative in differentiating malignant from benign clusters. Inclusion of a demographic factor, age, did not affect the result.

10:55

#### **694 Automatic detection of microcalcifications for computer-aided diagnosis**

D. Manrique, A. Vilarrasa, J. Rios; *Boadilla del Monte/E*

Microcalcifications are often a presenting sign among early breast cancer. We present a novel system for computerized localization of microcalcifications from digitalized mammograms. The algorithm is based on mathematical morphology theory combined with segmentation and dynamical statistics methods specially designed for microcalcifications extraction.

In order to test the system, we retrospectively reviewed 154 mammographic studies showing microcalcifications in 104 of them, for which surgical verification was available. The film screen mammograms were digitalized with a resolution of 8 bits per pixel in order to make the system suitable for real time diagnosis and a spatial resolution of 790 pixels/cm.

The discriminating power of the process was corroborated via the ROC analysis which shows an area under the curve of  $A_z = 0.89$ . The percentages of errors made by the algorithm were the following: Isolated microcalcifications: 7%. Clustered microcalcifications: 8%. Microcalcifications with an associated nodule: 5%. Normal cases: 3%.

The proposed system is able to detect isolated and clustered microcalcifications independently from the breast tissue and the parameters used in the digitalization process. This system could be used as a Radiologist Aid System (RAS) and it would allow improving the efficiency in large screenings.

(Submitted by Internet)

11:05

#### **695 Contrast enhancement for soft-copy reading of mammograms**

A. Bödicker, C.J.G. Evertsz, H. Jürgens, H.-O. Peitgen; *Bremen/D*

**Introduction:** Because of the expected availability of digital mammography units in the near future, for interpretation and diagnosis a growing number of digital mammograms has to be displayed on computer monitors. Softcopy reading provides the possibility to use computerized elaborated contrast enhancement techniques.

**Purpose:** Development of a highly efficient contrast enhancement tool for softcopy reading of digital mammograms, which preserves the typical mammographic visual impression radiologists are accustomed to.

**Methods and Materials:** The coefficients of a redundant wavelet transform are modified by a nonlinear function providing a significant improvement in local contrast without requiring additional radiation. In particular, areas of low contrast are enhanced more than areas of high contrast. Additional to the resulting edge enhancement, the whole information of the mammogram is visible in one window setting, including the skin and the details of the dark subcutaneous tissue.

In cooperation with radiologists, the algorithm has been optimized with regard to the restoration of the typical mammographic visual impression making the powerful tool acceptable for clinical routine.

**Results:** The present results suggest that computerized elaborated enhancement tools will be inevitable for softcopy reading of mammograms.

**Conclusion:** Additional studies with many radiologists are recommended for further optimization of our enhancement tool.

(Submitted by Internet)

11:15

#### **696 Feasibility of wavelet image compression for digital mammograms**

M. Lang, W. Berghorn, T. Boskamp, H. Bettag, H.-O. Peitgen; *Bremen/D*

**Purpose:** Show the feasibility of lossless and lossy wavelet compression for archiving and transmitting radiological images with the example of digital mammograms.

**Methods and Materials:** The wavelet methods SPIHT and MT-WICE are applied to the Nijmegen database of 40 digitized mammograms with microcalcifications. For archiving, lossless compression is used. The feasibility of lossy compression is evaluated using the FROC performance of a state of the art algorithm for detection of microcalcification clusters.

**Results:** Lossless compression of the Nijmegen database results in a reduction of the file size by a factor of 7.78 (MT-WICE) and 6.84 (SPIHT) respectively. For lossy compression with factors 8, 12, and 16 MT-WICE performs consistently better than SPIHT in terms of FROC. A compression factor near 12 leads to an improvement of the FROC compared to the original data. For factors larger than 16, FROC starts to degrade with better performance of MT-WICE for FP values less than 1. Compression time of SPIHT is larger than that of MT-WICE by a factor of about 1.6.

**Conclusion:** Wavelet compression can be used both for losslessly archiving mammograms and for lossy transmission at higher compression factors without significantly affecting their diagnostic value.

(Submitted by Internet)

11:25

#### **697 Can the perception of diagnostic features of medical ultrasound images be improved by further processing or real-time display? A subjective study**

V. Jayaram, F.G. Fuechsel, G.G. Attridge, J.C. Bamber, D.O. Cosgrove; *London/UK*

**Purpose:** To prove that: 1. Certain image processing algorithms can enhance feature perception in ultrasound images. 2. The perception of motion in ultrasound examinations highlights rather than degrades perception of diagnostic features.

**Methods and Materials:** Videoclips from B-mode breast ultrasound examinations of eight patients with solid breast lesions ( $n = 8$ ) were