Software System for the Computer-Assisted Diagnosis or Early Stage Pleural Mesothelioma

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SOFTWARE SYSTEM FOR THE COMPUTER-ASSISTED DIAGNOSIS OF EARLY STAGE PLEURAL MESOTHELIOMA

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1. Introduction

Pleural mesotheliomata, which are normally a rare malignant tumor, were found 1000 times more often in the asbestos exposed professional than in the normal population. Due to a long latency period of, on the average, 35 years after asbestos exposure, occurrence of pleural mesothelioma in Germany is expected to peak during 2010s [1]. Pleural mesothelioma might develop from benign pleural thickening or from healthy pleura, and is known to grow rapidly after manifestation. In case of diagnosis most of the pleural mesotheliomas still are advanced stage disease, which leads to a survival time, documented to be between 4 to 18 months without any therapy.

2. Problem description

The diagnosis is based on a visual investigation of CT images, which is time-consuming and is considered as being often subjective. There is a strong need for the improvement of early detection of mesothelioma. Besides molecular markers, a detection system which is sensitive to detect pleural thickening in early stages and which sensitively detects growth of pleural thickening is promising tool to improve early detection and prognosis of malignant pleural mesothelioma in its early stage [2].

3. Solution method

An automatic detection system was developed and implemented [3]. It performs a prescreening of the dataset using the techniques of computer visions, including probabilistic detection of pleural contours, convex hull calculation, rule-based determination of the genuine pleural thickenings, and the interpolation of pleural wall to assess its size.

Afterwards the system offers all pleural thickenings detected with volume and thickness information visually to the physician. The physician can control, whether a detected thickening is a true or false positive finding. The confirmed findings are summarized in a report, containing data on the localization of the pleural thickening (table position), right or left side, volume and maximum thickness. In follow-up examinations the results of both exams are then listed and growth rates of each pleural thickening can be calculated automatically, based on the user-defined anatomical landmarks towards the coregistration of two consecutive datasets.

3D visualization gives an impression on distribution and extent of pleural thickenings detected and serves as a visualized summary of the evaluation..

4. Experimental results

In terms of the segmentation of the pleural contour, an evaluation showed that only small parts of the endopulmonary vascular and bronchial indentations along the mediastinal boundary and the posterior costophrenic angle of both inferior lobes of lung were not correctly detected. An overall performance of 99% was obtained.

With respect to the detection of the pleural thickenings, the system made an improvement in the diagnosis of about nearly 2%, with higher accuracy of 88%. But 11% error and the very low precision of 26% require a refinement of the applied techniques.

Semi-automatic spatiotemporal matching showed changes of each matched thickening significantly.

5. Innovative contribution

A software system to assess the growth rate of pleural thickening was initially tested and showed its potential to assist the physicians with reliability and minimal user interaction.

References

[1] Hagemeyer O, Otten H, Kraus T. Asbestos consumption, asbestos exposure and asbestos-related occupational diseases in Germany. *Int Arch Occup Environ Health.* 2006, 79(8):613–620.

[2] Armato III SG, Oxnard GR, Kocherginsky M, Vogelzang NJ, Kindler HL, MacMahon H. Evaluation of Semiautomated Measurements of Mesothelioma Tumor Thickness on CT Scans. *Acad Radiol.* 2005, 12:1301–1309.

[3] Chaisaowong K, Jäger P, Vogel S, Knepper A, Kraus T, Aach T. Computer-assisted Diagnosis for Early Stage Pleural Mesothelioma: Towards Automated Detection and Quantitative Assessment of Pleural Thickenings from Thoracic CT Images. *Methods Inf Med.* 2007, 46(3):324-331.