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Titel des Beitrags: [Fractal surface analysis of intrapulmonary space-occupying lesions from high-resolution CT studies]

Abstract: PURPOSE: The visual assessment of shape and surface structures of pulmonary nodules (PN) (smooth edges vs. spiculae) serves as a qualitative, subjective criterion in differential diagnosis. These properties must be quantified by computer-assisted evaluation, an adequate mathematical model, and new quantitative shape parameters. METHODS: 12 patients were investigated by high resolution CT. Based on 3D reconstructions with increasing thresholds, the PN surface $S$, volume $V$, fractal dimension ($FD = \frac{\ln(S)}{\ln(\text{square root of } V)}$), and fractal index ($F1 = \text{square root of } \frac{S}{\text{square root of } V}$) were calculated. RESULTS: The relations between the reconstruction threshold and the calculated tumour surface, respective volume, are of a fractal nature: $S = c1 \times \text{thres1}^{1/d}$, $V = c2 \times \text{thres1}^{1/D}$ ($c1$, $c2$, $d$, $D$: real constants). Whereas the absolute values of surface and volume strongly depend on the chosen threshold (mean volume differences of 249%), the derived parameter of the fractal dimension for a specific PN is nearly constant for all thresholds under review ($r = 0.998$, $SD = 0.05$). CONCLUSIONS: FD and FI are new diagnostic features for the assessment of PN surface structure and morphology. Thus, the assessment of pulmonary nodules can be supported by new quantitative parameters representing surface irregularity due to invasive tumour growth into adjacent tissue.