

Pulmonary nodule follow-up: be careful with volumetry between contrast enhanced and unenhanced CT

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Abstract: Incident pulmonary nodules are a frequent finding on chest computed tomography (CT) of the lungs requiring follow-up. This case illustrates the importance of taking differences in CT scanning techniques (contrast versus non-contrast enhanced) into account. Comparing nodule size on unenhanced follow-up CT's with initial contrast-enhanced CT may consequently underestimate growth and mask malignant growth rates as demonstrated by our case report.

Keywords: Computed tomography (CT); follow-up; lung cancer; nodule; volumetry

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Introduction

Incident pulmonary nodules are a frequent finding on chest computed tomography (CT) of the lungs. In a majority of cases careful follow-up of these nodules is warranted to exclude malignant growth. With the advent of increasingly better scan techniques but also because of lung cancer screening an increasing number of pulmonary nodules is found requiring follow-up.

Case presentation

A 47-year-old smoking female underwent contrast enhanced chest CT scanning for evaluation of a small nodular density seen on routine chest X-ray. On the chest CT a corresponding solid pulmonary nodule of 7 mm (255 mm³) was found in the left upper lobe and follow-up to evaluate growth was indicated (*Figure 1A*). According to the recent British Thoracic Society (BTS) guidelines follow-up with volumetry is indicated, first to assess significant growth (>25% volume increase) and in case of growth, second to identify nodules with a rapid volume doubling time (400–600 days) (1). The protocol in our hospital is to first

perform a low-dose non-contrast enhanced CT as a baseline measurement for follow-up if the solid nodule was detected on a contrast enhanced CT. On the non-contrast enhanced baseline CT 3 months later the volume was 196 mm³ (*Figure 1B*). On the non-contrast enhanced follow-up scan after 1 year the volume had increased to 299 mm³ (*Figure 1C*). Comparing this volume to the contrast enhanced CT scan volume (255 mm³) showed that the nodule had not grown significantly (17%, with a volume doubling time of 2,340 days). However, when the nodule volume was compared with the 'baseline' low-dose non-contrast enhanced CT made after 3 months the nodule did grow significantly with a suspicious growth rate (61%, with a volume doubling time of 418 days). Therefore an ¹⁸F¹⁸FDG PET-CT was performed showing intense ¹⁸F¹⁸FDG accumulation in the nodule corresponding to a high suspicion for malignancy (*Figure 2*). Surgical resection of the nodule was performed and pathology showed invasive adenocarcinoma.

Discussion

Recent British Thoracic Society guidelines recommend volumetry as the preferred measurement method in

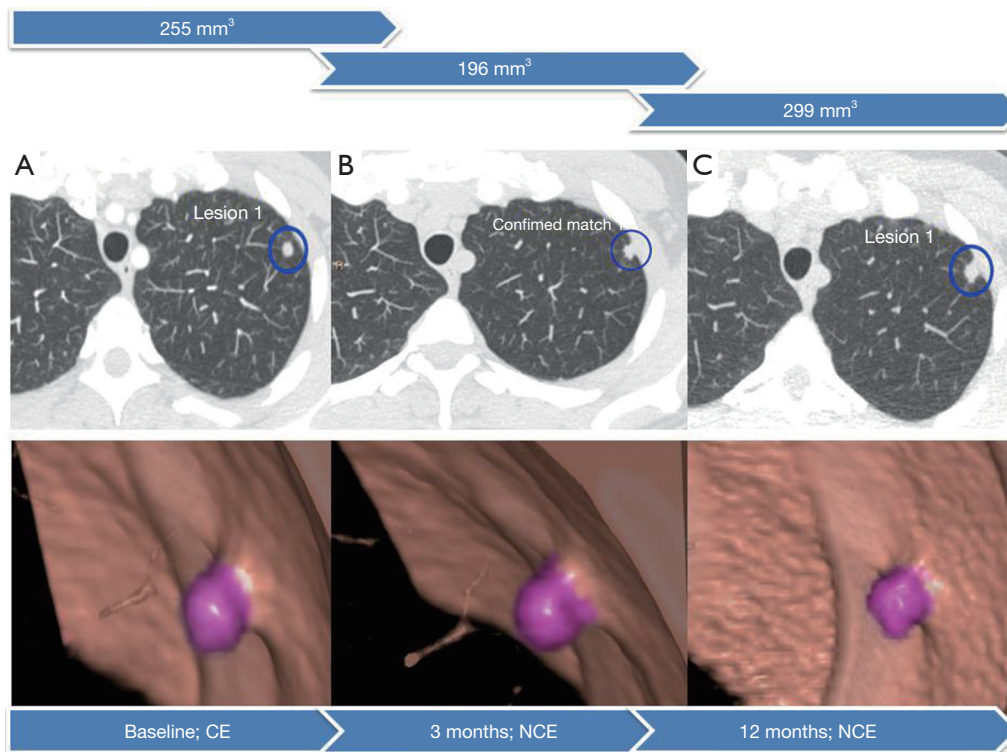


Figure 1 Results of the automatic volume measurements. (A) On the left the initial contrast-enhanced (CE) CT; (B) on the middle the non-contrast enhanced (NCE) CT after 3 months; (C) on the right the follow-up NCE CT after 18 months. (B,C) On unenhanced CT 3 and 12 months later the volume was 196 and 299 mm³, respectively. Comparing this volume to the first contrast enhanced CT scan volume (255 mm³) indicated no significant growth [17%, volume doubling time (VDT) 2,340 days]. When the nodule was compared with the “baseline” low-dose unenhanced CT made after 3 months, there was significant growth (61%, VDT 418 days).

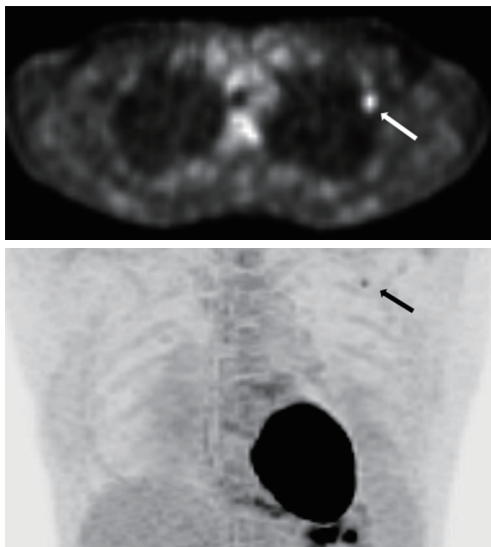


Figure 2 ¹⁸F-FDG PET maximum intensity projection (MIP) showing intense pathological uptake in the small nodule in the left upper lobe indicating a high suspicion of malignancy.

evaluation of incidentally detected solid pulmonary nodules on chest CT. This case illustrates the importance of taking differences in scanning techniques, especially the difference between contrast-enhanced vs. non-contrast enhanced scanning, into account. In our experience low-dose scanning or iterative reconstruction does not significantly alter nodule volumes, but volumes can be significantly higher on contrast-enhanced CT and possibly also with edge enhancing algorithms (2). Comparing nodule size on non-contrast enhanced follow-up CT's with initial contrast-enhanced CT may consequently underestimate growth and mask malignant growth rates as demonstrated by our case report. In conclusion, volumetry is an excellent method for the follow-up of solid pulmonary nodules as recognized by the BTS, but scanning techniques, especially contrast enhancement requires careful attention.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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