CHEST

# Quantitative CT Scanning Analysis of Pure Ground-Glass Opacity Nodules Predicts Further CT Scanning Change

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**BACKGROUND:** We sought to determine whether quantitative analysis of lung adenocarcinoma manifesting as a ground-glass opacity (GGO) nodule (GGN) on initial CT scans can predict further CT scanning change or rate of growth.

**METHODS:** This retrospective study included patients with lung adenocarcinoma manifesting as pure GGN on initial CT scans who were followed up with interval CT scanning until resection. All pure GGNs were classified based on CT scanning interval change in three subgroups as follows: group A (development of solid component), group B (growth of GGO component), and group C (no change in size). Nodule size, volume, density, mass, and CT scanning attenuation values were assessed from initial CT data sets.

**RESULTS:** Fifty-four pure GGNs were enrolled and classified into group A (n = 9), group B (n = 25), and group C (n = 20). Nodule size, volume, mass, and density of the GGNs in each subgroup were not significantly different. The 97.5th percentile CT scanning attenuation value and slope of CT scanning attenuation values from the 2.5th to the 97.5th percentile were significantly different among the three subgroups ($P = .02$, $P < .00$). Three of nine (33%) pure GGNs showing a new solid component developed a solid component within 6 months.

**CONCLUSIONS:** The 97.5th percentile CT scanning attenuation value and slope of CT scanning attenuation values from the 2.5th to the 97.5th percentile could be helpful in predicting future CT scanning change and growth rate of pure GGNs. Pure GGNs showing higher 97.5th percentile CT scanning attenuation values and steeper slopes of CT scanning attenuation values may require more frequent follow-up than the usual interval of 6 months.

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**KEY WORDS:** CT scanning; ground-glass opacity nodule; lung cancer

**ABBREVIATIONS:** AIS = adenocarcinoma in situ; GGN = ground-glass opacity nodule; GGO = ground-glass opacity; HU = Hounsfield unit; MIA = minimally invasive adenocarcinoma; ROC = receiver operating characteristic

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Ground-glass opacity (GGO) nodules (GGNs) are detected in 0.2% to 0.5% of the screened population in clinical practice.[1] The evaluation of GGNs has emerged as an important topic because of their increasing frequency because previous advancements in CT scanning and the high malignancy rate of persistent GGNs.[2-4] The Fleischner Society proposed recommendations for management of subsolid nodules[5]; however, the standard diagnostic scheme and optimal management strategies of GGNs remain controversial.[6,7]

The proportion of the GGO component in GGNs seen on CT scans is significantly associated with the extent of lepidic tumor growth at histopathologic examination.[8,9] Generally, a multistep progression from adenocarcinoma in situ (AIS) to invasive adenocarcinoma in pulmonary lepidic growth tumor has been described.[10,11] Over time, GGNs increase in size and then develop a solid component, and finally the solid component increases in size.[11,12] Therefore, the presence of a solid component or growth of a GGO component within a GGN is considered an important predictor of tumor progression and indication for surgical intervention.[8,13]

Several studies have been performed to find the parameters that could be used to discriminate invasive adenocarcinomas from preinvasive adenocarcinomas. Our previous study demonstrated that the 75th percentile CT scanning attenuation value on the CT scanning performed immediately before surgery could help distinguish invasive adenocarcinoma from preinvasive adenocarcinoma.[14] Ikeda et al[15] also identified that invasive adenocarcinoma showed two peaks on the CT scanning number histogram. The clinical course of pure GGN is classified in three main ways: persistent pure GGN with or without size increase and change from pure to mixed GGN. However, there are no studies that describe the clinical courses of these subgroups. Although GGNs are generally known to grow slowly, the rate and pattern of growth are still unclear due to limited clinical experience.[16] The purpose of this study was to determine whether quantitative analysis of lung adenocarcinoma manifesting as pure GGN on initial CT scans can predict further CT scanning change or rate of growth.

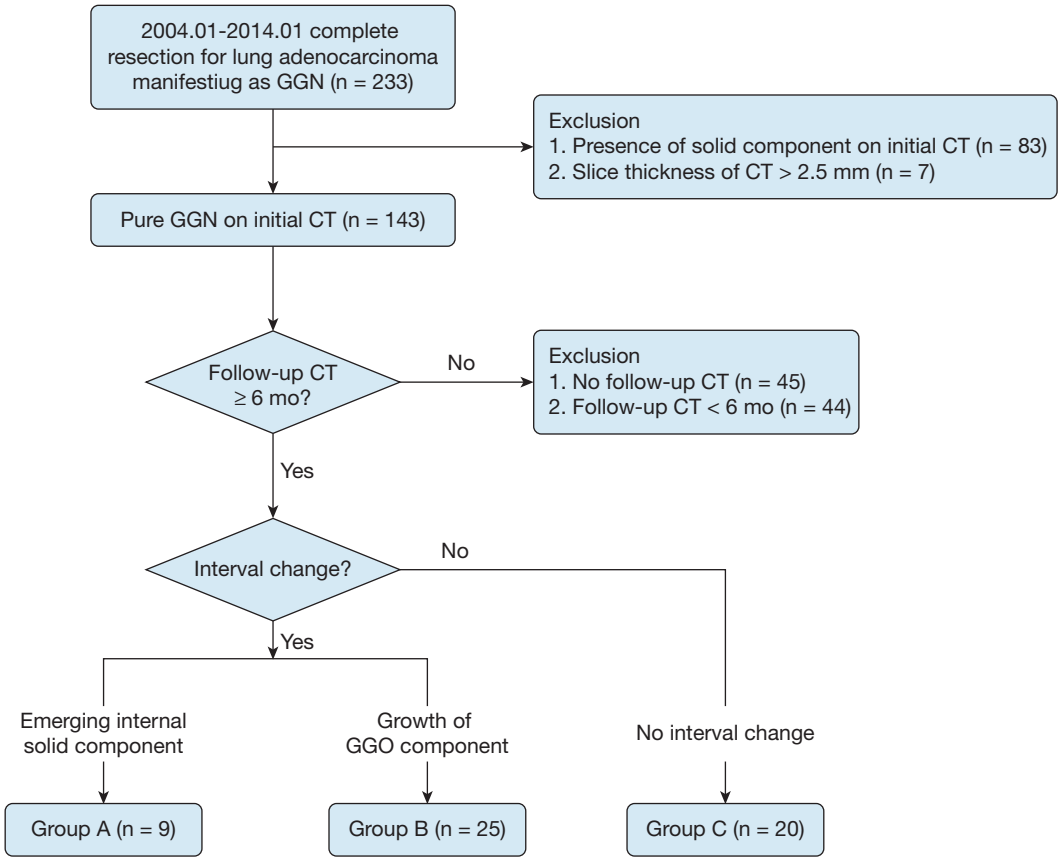


Figure 1 – *Flowchart of study population. GGN = ground-glass opacity nodule; GGO = ground-glass opacity.*