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Technical Note

Oxygen-Assisted Breath-Holding in Computed Tomography

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Abstract: To achieve prolonged breath-holding, oxygen was administered just before dynamic CT and high resolution lung CT. Oxygen administration has proved to be a supportive means to improve the quality of CT studies. **Index Terms:** Computed tomography, techniques—Image quality—Computed tomography.

It is essential to obtain CT examinations with the diaphragm at the same level to assure well-defined cross sections of organs adjacent to the diaphragm (lungs, liver, etc). To achieve this goal, oxygen was administered before dynamic CT and high resolution lung studies.

MATERIALS AND METHODS

Two hundred ten patients undergoing dynamic CT (50 cardiac cases, 160 noncardiac cases) and 183 patients undergoing high resolution lung CT were studied with Siemens Somatom DR-H scanner. The duration of the examination was 48 s with 3 s scans and 3 s intervals. Immediately before the examination, oxygen was administered at a flow rate of 4–6 L/min with nasal cannula for 3–5 min. For dynamic CT, contrast medium was injected intravenously with a mechanical injector. For high resolution lung CT, sequential incremental scanning was performed with 4 s scans and 4 s intervals following oxygen administration.

RESULTS

Most multiplanar images in dynamic CT were held at the identical level. With the incremental technique, sequential images were obtained in anatomic continuity. There were only a few patients who could not hold their breath. Two representative cases are shown.

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Figure 1 demonstrates dynamic CT of a small mass lesion in the left hepatic lobe. To prevent the lesion from moving out of scan level, we performed a 48 s breath-holding scan and obtained eight serial scans. The levels of each scan are the same and the characteristics of the hemangioma are well demonstrated.

Figure 2 shows high resolution CT of acute pulmonary fibrosis. Since difficulty with breath-holding was expected, the examination was performed with oxygen administration. The patient held his breath for 40 s and the five continuous scans were obtained.

DISCUSSION

According to the literature (1), breath-holding time breathing room air varies from 20 to 80 s and depends on the initial lung volume. There is a prolongation of breath-holding capacity regardless of initial lung volume when oxygen is inhaled as compared to when room air is inhaled. Hyperventilation has also proved to be an effective method of prolonging breath-holding time. Hyperventilation with oxygen for 2 min increases breath-holding time ~3 times above normal room air value.

Based on these physiological facts and our clinical experiences, breath-holding with oxygen was evaluated as an adjunct to dynamic CT, which requires ~50 s. Scans of abdomen and thorax normally require repeated breath-holdings with reproducible diaphragmatic position to ensure the well-defined cross sections. The smaller the object to be imaged and the thinner the scan section, the more critical becomes the problem. Other authors have

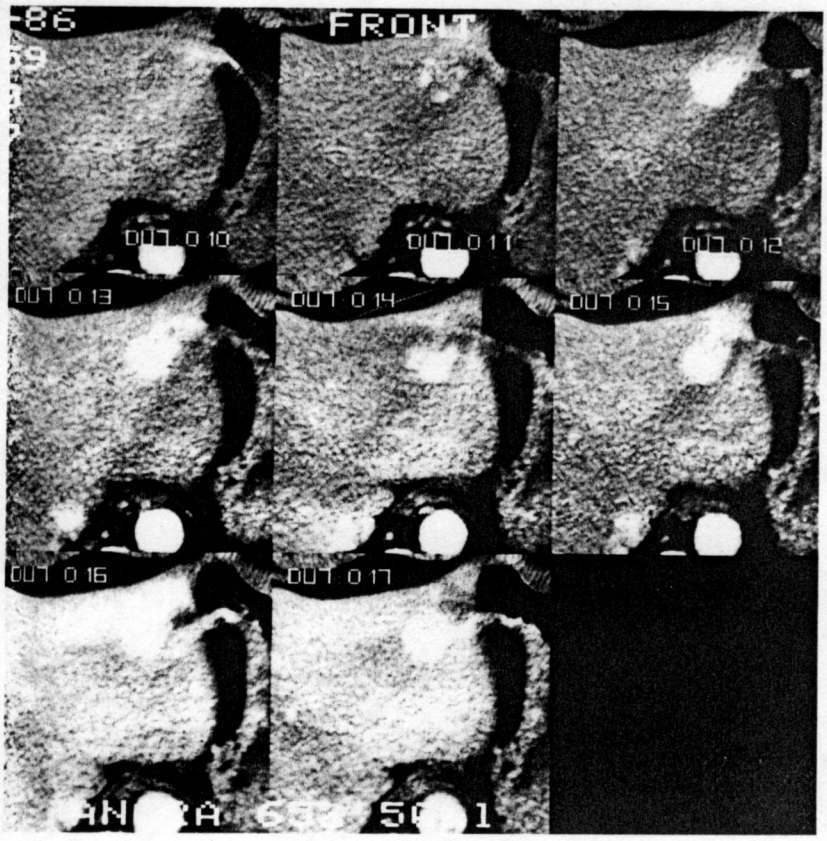

FIG. 1. Dynamic CT scans of small hemangioma in the left hepatic lobe. Dense accumulation of contrast material progressively spreads throughout lesion in eight sequential scans acquired during a single breath-holding.

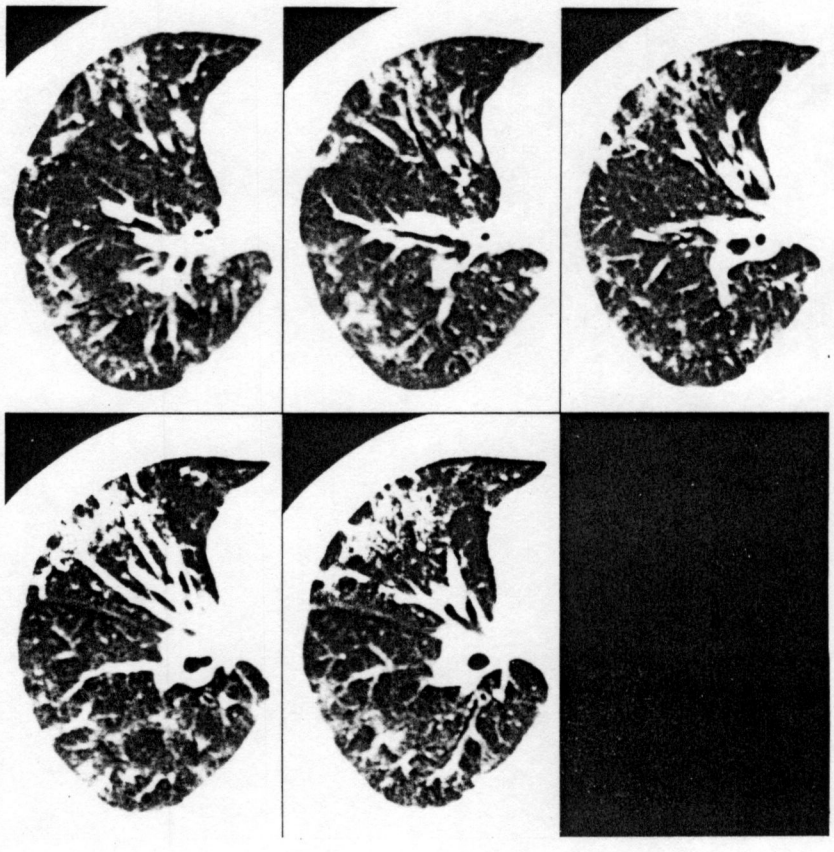

FIG. 2. High resolution lung CT was performed on a 72-year-old man with suspected acute pulmonary fibrosis. Arterial blood gas analysis at the examination while breathing oxygen via nasal cannula at the flow rate of 6 L/min was pH 7.457, Pco_2 35.7, Po_2 79.3. Five serial scans make it possible to distinguish small arteries from nodular lesions.

proposed unique devices that are not widely used (2,3). Our method of breath-holding following oxygen administration covers 50 s, which enables eight serial scans in dynamic CT (3 s scans and 3 s intervals). Other indications for oxygen administration are high resolution lung CT, especially when a patient shows severe respiratory disorder (Fig. 2). Sometimes sequential scannings with thin sections are required for recognition of subtle pulmonary structures.

Finally, it should be emphasized that, although oxygen can be given to patients with interstitial lung disease without substantial CO_2 retention, in patients with chronic obstructive pulmonary disease oxygen administration may be potentially dangerous and, hence, is contraindicated.

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