Adult Sail Sign: Radiographic and Computed Tomographic Features

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Background: The sail sign is a well-known radiographic feature of the pediatric chest. This sign can be observed in an adult population as well, but for a different reason.

Purpose: To investigate the sail sign appearing in adult chest radiography.

Material and Methods: Based on two anecdotal adult cases in which frontal chest radiographs showed the sail sign, we prospectively screened radiographs of 10,238 patients to determine the incidence of the sail sign found in adults in their 40s or older. The cause of the sail sign was assessed using computed tomography (CT).

Results: The sail sign was revealed in 10 (seven males, three females; median age 60.6 years) of 10,238 patients. Of these 10 patients with a sail sign on frontal radiographs, eight underwent CT. The frontal radiographs of these 10 patients showed a concave superior margin toward the lung in nine patients, a concave inferior margin in five, and a double-lined inferior margin in three. Lateral radiographs disclosed a focal opacity over the minor fissure in five of six patients, which was either fuzzy \((n=4)\) or sharp \((n=1)\) in its upper margin, and was sometimes double lined in the inferior margin \((n=3)\). CT revealed the anterior mediastinal fat to be the cause of the radiographic sail sign, which stretched laterally from the mediastinum to insinuate into the minor fissure.

Conclusion: The incidence of sail sign on adult chest radiographs is about 0.1%. The sign is specific enough to eliminate the need for more sophisticated imaging.

Key words: CT; digital radiography; lung; mediastinum

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Accepted for publication September 7, 2007

The right lobe of the pediatric thymus is often known to have a flattened inferior border near the minor fissure, producing the so-called “sail sign” (1). Also, in pediatric patients with pneumomediatinum, the thymus can become elevated to produce a thymic spinnaker-sail sign (2, 3).

So far, the sign has been known to exist only in infants and children. We report here for the first time adult cases presenting with the sail sign. In addition, we report the results of our investigation concerning the incidence of this sign on frontal radiographs, its appearance on lateral radiographs, and the cause of this sign as apparent on computed tomography (CT).

Material and Methods

Patients
At institutions A and B (tertiary hospitals), we encountered two anecdotal cases of adult patients (a 42-year-old male and a 71-year-old male) presenting with a radiographic abnormality bearing a remarkable resemblance to the pediatric sail sign. CT of both patients showed that the anterior mediastinal fat stretched laterally to form a radiographic shadow resembling a pediatric thymus. A minimal amount of thymic tissue was present in the former patient.

Based on those experiences, it was decided to prospectively evaluate the frontal chest radiographs.
of adult patients (age >40 years) to determine the incidence of the sail sign, and to evaluate such shadows using CT. The prospective study was carried out at institution C (secondary hospital) during the period between March 1, 2006, and August 31, 2006.

Non-contrast-medium-enhanced chest CT was recommended for most of the patients showing sail sign on frontal radiographs, unless a particular need for contrast enhancement CT scan was otherwise indicated. Medical records were reviewed to find out whether there was any history of chemotherapy, malignancy such as lymphoma, long-term steroid therapy, or myasthenia gravis.

**Image techniques**

Frontal chest radiographs were obtained in all patients. CT was performed using a multidetector-row CT scanner (GE Lightspeed 16; GE Medical Systems, Milwaukee, Wisc., USA).

**Data analysis**

Institutional review board approval was obtained for the study (IRB# 06-2006-48).

All frontal radiographs of patients over 40 years of age obtained during the study period were screened for sail sign by a chest radiologist at institution C. Whenever a patient was suspected of having a sail sign, the image file was sent over to the other authors for approval. Later, the frontal and lateral radiographs and the CT scans obtained during the study period were reviewed by four chest radiologists by consensus. Frontal chest radiographs were analyzed for the concavity or convexity of the outer margins toward the right lung. The size of the sail-like shadow was also assessed on the frontal radiographs, by measuring three sides of the triangular area covering the sail-like shadow. The lateral radiographs were analyzed for the presence or absence of an identifiable opacity over the minor fissure, and the margin (sharp or fuzzy) of the opacity if present. In both frontal and lateral radiographs, it was recorded if the inferior margin of the opacity was double lined. Axial and coronal CT images were reviewed to assess internal density and to find out what formed the horizontal inferior boundary of the radiographic sail sign.

**Results**

During the study period, 10,238 patients were examined with one or more frontal radiograph(s). Of the 10,238 patients, 10 (0.1%) patients were
considered to have a sail sign. CT was obtained in eight of the 10 patients (non-contrast-enhanced CT in six, contrast-enhanced CT in the other two). Coronal and sagittal reformation images were available in all eight patients.

The median age of the 10 patients was 60.6 years (range 45–84 years). There was no history of chemotherapy, malignancy such as lymphoma, long-term steroid therapy, or myasthenia gravis in any of the patients.

The clinical, radiographic, and CT findings of the two anecdotal patients and the 10 studied patients are summarized in Table 1.

On the frontal chest radiographs (Figs. 1A and 2A), the superior margin of the triangle was concave toward the lung in nine patients and flat in one patient. The inferior margin was concave in five, convex in one, and flat in four patients. In addition, the inferior margin was double lined in three patients.

Lateral radiographs (Fig. 1B), which were available in six patients, disclosed a focal opacity over the minor fissure in five patients, with a fuzzy (n=4) or sharp (n=1) upper margin. The inferior margin was double lined in three patients.

In all eight cases that had CT (Figs. 1C, 2B and C), anterior mediastinal fat stretched laterally into the minor fissure to form the sail-like shadow on the frontal radiographs. Thymic soft tissue, which was present in one of the two anecdotal cases, was not
seen in any of the patients studied. There was no evidence of mediastinal lipomatosis in any them.

**Discussion**

It is known that, on conventional radiographs, the thymus is visible only in infants and young children, in whom three radiographic signs aid its identification: the thymic notch sign, the thymic wave sign, and the thymic sail sign. Of them, the sail sign is known to be present in 5% of infants (4).

This study is the first to show that the sail sign can be seen in adults, and that, when it is seen, it does not represent thymic hyperplasia or any other pathology in the mediastinum. The incidence of the sail sign among adults appeared to be about 0.1% after the screening of frontal radiographs.

Although anterior mediastinal fat belongs to the mediastinum, this study shows that mediastinal fat sometimes gets into a position between the two layers of the visceral pleura of the right upper and middle lobes, producing the sail sign in adult patients. Here, the fat tissue, with the mediastinal pleura enveloping it laterally, insinuates into the minor fissure as a normal pediatric thymus often does to produce the thymic sail sign (5). However, frontal radiograph alone may not clearly show that such fat tissue is located within the minor fissure, especially when only a part of the minor fissure is visualized.

Because of its triangular shape and its location near the hilum, a sail-like shadow needs to be distinguished from genuine abnormalities such as mass, loculated effusion, or atelectasis. However, we believe that a true mass usually shows one or more convex margins toward the lung, and that a loculated effusion is usually associated with an obliterated costophrenic angle or a diffuse haze over the hemithorax.

We believe that, when there is a sail sign in patients with no suspicion of malignancy, the above radiographic signs should be adequate to prevent the need for further imaging. In the presence of known or suspected malignancy, however, CT is probably still warranted.

There are limitations in our study. First, since the screening of frontal radiographs was done only by one radiologist, a small number of frontal radiographs showing a sail sign may have been overlooked. Second, of the 10 patients considered to show a sail sign, only eight patients were evaluated using CT.

In conclusion, the current study found that the sail sign is sometimes (0.1% incidence) detected among adults, in whom anterior mediastinal fat stretches out in the lateral direction. When a frontal radiograph reveals the sail sign, it is usually specific enough to eliminate the need for more sophisticated imaging.

**Acknowledgments**

This study was supported by a grant from Boramae Municipal Hospital.

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