Age-Related Change in Calcifications in the Thoracic Aorta: A Study with Computed Tomography

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Calcifications in the thoracic aorta at the level of the 11th and the 12th thoracic vertebrae in 592 men and 333 women were studied using computed tomography. The ages ranged from 40 to 88 years. Incidence of calcification increased proportionally to the advancing age from the forties to the eighties in men, and from the fifties to the seventies in women: incidence of calcification (\%) = 2.41 \times \text{age (years)} - 113 in men (p < 0.01); incidence of calcification (\%) = 3.16 \times \text{age (years)} - 160 in women (p < 0.01). Calcification index (CI) was calculated as an indicator of calcification in the thoracic aorta: (calcified portion along the entire circumference of the aorta) × 80. The CI in the subjects with calcifications increased with the advancing age both in men and women: CI = 0.200 \times \text{age (years)} - 4.47 in men (p < 0.01); CI = 0.312 \times \text{age (years)} - 12.7 in women (p < 0.01). Calculations; thoracic aorta; computed tomography

It is essential in clinical medicine to diagnose and treat atherosclerosis which causes cerebrovascular disease and ischemic heart disease. Atherosclerosis has been studied on pathological preparations (Gore and Tejada 1957; Baker et al. 1967; Mae 1971) and on chest or abdominal x-ray films (Fujii and Yazaki 1970). Particularly arteriography has been thought to be the best diagnostic method of atherosclerosis (Tatelman 1958), but it is invasive and less quantitative. As computed tomography (CT) has a high resolving power to detect calcifications on arterial walls, we developed a quantitative method of measuring for calcifications in the aorta using CT (Watanabe et al. 1983).

In this report, we investigated age-related change in calcifications in the thoracic aorta at the level of the 11th and the 12th thoracic vertebrae on CT.

Materials and Methods

Subjects. The subjects of the study (592 men and 333 women) were selected from
patients who were scheduled for abdominal CT scans in Sendai Kosei Hospital, Sendai, during the period between February 1982 and March 1985. Their ages ranged from 40 to 88 years. Most of them had malignant tumors in the abdomen, primary or metastatic.

Indicator of calcifications in the thoracic aorta. CT scans of the abdomen were performed at the level between the upper border of the 11th thoracic vertebra and the lower border of the 12th thoracic vertebra using the General Electric CT/T 8800 scanner. Slice thickness was 10 mm and slice interval was 10 mm. The tomograms were photographed using a window width setting of 250 in CT number and a window level setting of 35 in CT number. Calcification profile (CP) of the thoracic aorta on each slice was defined as follows (Fig. 1): CP = 0 for no detectable calcified portion (C) along the entire circumference of the thoracic aortic wall; CP = 1 for 0 < C ≤ 1/8; CP = 2 for 1/8 < C ≤ 1/4; CP = 3 for 1/4 < C ≤ 3/8; CP = 4 for 3/8 < C ≤ 1/2; CP = 5 for 1/2 < C ≤ 5/8; CP = 6 for 5/8 < C ≤ 3/4; CP = 7 for 3/4 < C ≤ 7/8; CP = 8 for 7/8 < C ≤ 1. Calcification index (CI) was calculated as follows: CI = 10 × sum of the CP on all slices/(number of all slices used for measurements, about 5 slices).

All data were expressed in terms of mean ± s.d. Differences between mean values were analyzed with Student's t test and judged to be significant when p values were less than 0.05.

Results

Age-related incidence of calcification

When the subjects were divided into age groups by one year (more than one subject in a group), incidence of calcification increased proportionally to the advancing age from the forties to the eighties in men (Fig. 2), and from the fifties to the seventies in women (Fig. 3): incidence of calcification (\%) = 2.41 × age (years) − 113 (r = 0.925, n = 40, p < 0.01) in men; incidence of calcification (\%) = 3.16 × age (years) − 160 (r = 0.940, n = 34, p < 0.01) in women.

![Fig. 1. Schematic representation of calcified profile (CP) of the thoracic aorta.](image-url)
When the subjects were divided into age groups by decade, incidence of calcification increased from the forties to the eighties in men (Table 1), and from the fifties to the seventies in women (Table 2) with statistical significances.

Age-related change in the CI in the subjects with calcifications

When the subjects were divided into age groups by one year (more than one subject in a year), the CI in the subjects with calcifications increased with the advancing age both in men (Fig. 4) and women (Fig. 5): $CI = 0.200 \times \text{age (years)} - 4.47 \ (r = 0.578, \ n = 32, \ p < 0.01)$ in men; $CI = 0.312 \times \text{age (years)} - 12.7 \ (r = 0.566, \ n = 24, \ p < 0.01)$ in women.

When the subjects were divided into age groups by decade, the CI in the...
subjects with calcifications increased from the sixties to the seventies both in men (Table 1) and women (Table 2) with statistical significances.

**DISCUSSION**

Incidence of calcification increased proportionally to the advancing age from the forties to the eighties in men, and from the fifties to the seventies in women. The CI in the subjects with calcifications increased with the advancing age both
in men and women. These results indicate that atherosclerosis progresses proportionally to the advancing age (increase in incidence of calcification by 2-3% and increase in CI by 0.2-0.3 in a year in this report) (Baker et al. 1967; Mae 1971).

While calcification in the thoracic aorta could be detected earlier in men (in the forties) than in women (in the fifties), incidence of calcification increased more rapidly in women (3.16% in a year) than in men (2.41% in a year), and the CI in the subjects with calcifications increased more rapidly in women (0.312 in a year) than in men (0.200 in a year). Mae (1971) obtained the similar results: 1) Atherosclerosis in the aorta developed about 10 years earlier in men than in women until the sixties. 2) The severity of atherosclerosis was nearly identical between both sexes in their seventies. 3) Atherosclerosis was more severe in women than in men over 80 years. The rapid progress of atherosclerosis in women of far advanced age might be related to their climacterium.

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References


