Hiroshima Journal of Medical Sciences
Vol.34, No.4, 431~436, December, 1985
HIJM 34-61

Roentgenographic Study of the Chest of the Aged — special reference to "senile lung" and the paraspinal line —

Hiroyuki SHIMAMOTO[1], Yoriko SHIMAMOTO[2], Eiko SAKODA[2], Hiroichi FUJIHATA[2], Hideo NAKAMURA[2], Yuichiro MATSUURA[3] and Shojiro KIMURA[4]

1) *The First Department of Internal Medicine, Hiroshima University School of Medicine, 1-2-3, Kasumi, Minami-ku, Hiroshima 734, Japan*
2) *Nakamura Hospital, 818-1, Tsuboi, Itsukaichicho, Saeki-ku, Hiroshima 731-51, Japan*
3) *The Department of Thoracic and Cardiovascular Surgery, Hiroshima Prefectural Hospital, 1-5-54, Ujinakanda, Minami-ku, Hiroshima 734, Japan*
4) *The Department of Radiology, Hiroshima Prefectural Hospital, Hiroshima 734, Japan*

(Received September 25, 1985)

Key words: Aging, Senile lung, Paraspinal shadow

ABSTRACT

The characteristics of the changes of "senile lung" and normal values of the width of the paraspinal shadows on the chest roentgenographs were studied among 235 subjects aged from 70 to 97 without frank chest diseases. The ratio of upper transverse diameter (at the level of posterior 6th rib) to lower transverse diameter (at the top of right hemidiaphragm) on the frontal radiographs was significantly higher over the age of 85 than under 84, only in the female subjects. However, a lack of differences could be found in males. Therefore, "senile lung" was considered to be characteristic of the aging process, only for women.

The width of the paraspinal shadow over the age of 70 was estimated to be normal in up to 19.9mm, and the index divided by the distance of descending aorta was up to 0.61, obtained from the value of 99% confidence limits.

As the number and proportion of aged individuals in the population increases, knowledge of normal chest X-ray changes associated with aging becomes more important. Cardiovascular, pulmonary disease, and the change of the thoracic cage can only be identified in an aging population, in fact, with reference to age adjusted norms.

So far, it has been reported by Mayer et al[11] that there is a characteristic thoracic cage designated as "senile lung", which shows the upper part of the chest appears distended, while the lower half appears contracted on the contrary[5,6] (Fig. 1).

Meanwhile, the width of the thoracic paraspinal shadow is also considered to increase according to an aging process[2,4,9].

The purpose of this study is to examine how

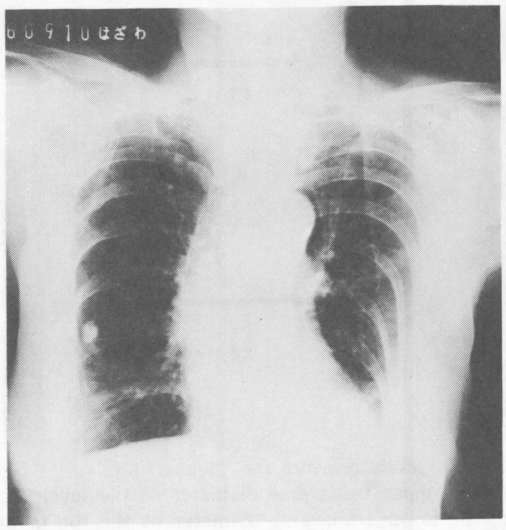


Fig. 1. The typical radiograph of "senile lung"

the aging process reflects the degree and incident of "senile lung" and determine the standard value of width of thoracic paraspinal shadow.

METHOD

The study population consisted of 235 subjects aged from 70 to 97 years without pulmonary or cardiovascular signs and symptoms. All subjects showed no evidence of chest wall abnormalities, lung diseases, and coronary arterial, valvular or hypertensive diseases, judging from physical examinations, electrocardiograms, chest X ray films, and if necessary, using echocardiography.

Measurements were made on posteroanterior and lateral chest radiographs or in addition, anteroposterior films of the thoracic spine (Fig. 2,3). As shown in Fig. 2, the transverse diameters of the chest from the inner margins of the ribs were measured on the frontal radiographs at the level of the posterior 6th rib (a) and top of the right hemidiaphragm (b). Likewise, in the lateral view the anteroposterior diameters of the chest were measured at the tracheal carina level (c) and top of the right hemidiaphragm (d)(Fig. 2). When the ratio of the upper transverse diameter/the lower one (a/b) was over 1.0, these chests were defined as "senile lung".

Meanwhile, the cardiothoracic ratio (CTR) was calculated as the quotient of the cardiac transverse diameter divided by the greatest width of the thorax on the frontal chest film according to the ordinary method. These parameters were compared with each other.

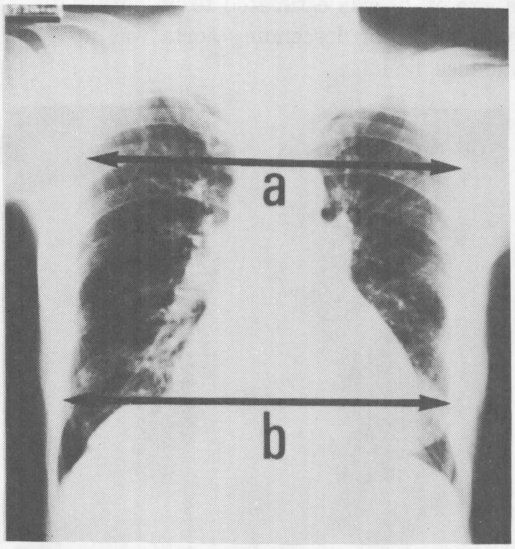
While, the width of paraspinal shadow was measured at the level of the Th10 from the midpoint of lateral vertebral border on well-penetrated frontal chest film or anteroposterior film of the thoracic spine. And the index of paraspinal width divided by the distance from the vertebral lateral border to outer margin of the discending aorta (e/f) was obtained to examine the influence of unfolded aorta upon lateral deviation of paraspinal line[4,9] (Fig. 3).

Subjects are also divided into five 5-year age branckets, the means and standard deviations of each group for variables were calculated. The significance of any difference between the groups was assessed using the Student's t test. And the relationship between age and the obtained parameters was analized using linear regression analysis.

RESULTS

1) The changes of "senile lung" attributable to aging

The relationship between age and the ratio of



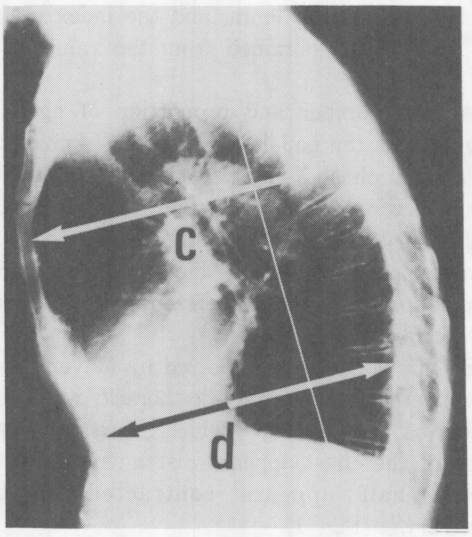
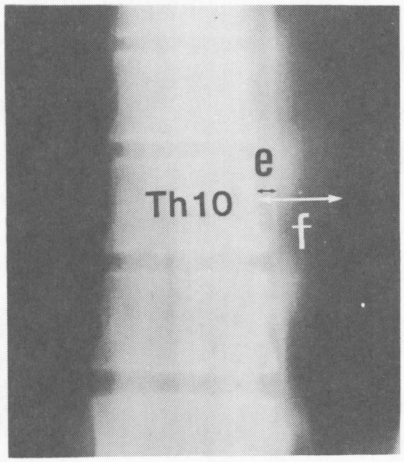


Fig. 2. Measurements for "senile lung"
a: the upper transverse diameter at the level of the posterior 6th rib
b: the lower transverse diameter at the top of hemidiaphragm
c: the anteroposterior diameter at the tracheal carina level to make it as short as possible
d: the anteroposterior diameter at the top of right hemidiaphragm, parallel to c-line



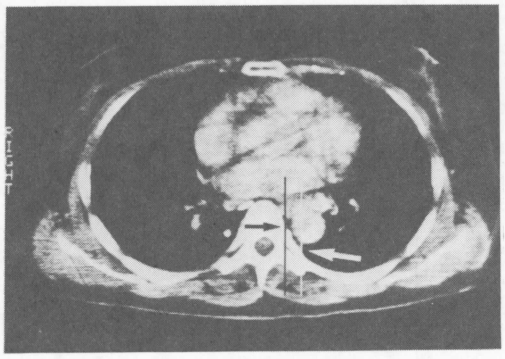


Fig. 3.
Top; measurements for paraspinal line
e: the distance from the midpoint of vertebral lateral border to paraspinal line at the level of Th 10
f: the distance from the midpoint of vertebral lateral border to the outer line of descending aorta
Bottom; computed tomographic scan shows that left paraspinal area is confined medially by vertebral bodies (black arrow) and laterally by parietal pleura (white arrow) which covers mediastinal soft tissues

the upper transverse diameter / the lower one (a/b) was shown in Fig. 4 and 5 in both sexes. Only in women shown in Fig. 4, this scatter diagram displays that the ratio of a/b is not so closely, but significantly correlated with ages. Similarly, as shown in Fig. 5, the ratio of a/b was also significantly higher in all patients over the age of 85 than under 84 ($p<0.001$) in female groups. Above all, special attention should be given to the result that 32 subjects of ages 80 to 84 had a mean value of 0.956 ± standard deviation of 0.057, significantly lower than that of 30 subjects of age 85 to 90 ($p<0.05$). On the other hand, in respect to male groups, a lack of difference could be found between age groups and the ratio of a/b (Fig. 5).

Comparing a/b ratio representative of "senile lung" with other parameters of CTR or anteroposterior diameter, the scatter diagrams, in which no linear correlation was between those two are depicted, were presented in the figures, (Fig. 6,7), respectively.

2) The standard of the width of the left paraspinal shadow in the aged

The average of the width of the left paraspinal shadow measured 8.8mm ± 4.3mm over the age of 70 in all subjects of this study, and the value of the 99% confidence limits was estimated to be up to 19.9mm. Likewise, the standard ratio of e/f and that of the 99% confidence limits were estimated to be 0.33mm ± 0.11mm and up to 0.61, respectively. All these values did not note any difference between age groups in both sexes (Table 1).

Table 1. The relation of the width of paraspinal shadow to aging

Age	Width of paraspinal shadow	n
70—79	8.0mm ± 4.1mm	50
80—89	9.6mm ± 4.2mm	50
90—97	8.8mm ± 4.5mm	14
total (70—97)	8.8mm ± 4.3mm	114

Results are expressed mean ± SD

DISCUSSION

It has been reported by Mayer et al[11] the diagnosis of "senile lung" was made only in the absence of symptoms and signs pertaining to obstructed breathing and hyperinflated lungs in contrast to "senile or atrophic pulmonary emphysema" which is not a real disease. On inspection, the upper part of the chest might or might not appear distended and the lower halves might appear contracted. The chest as a whole, however, was not distended. Likewise, on chest radiographs the lung fields appeared diminished, due particularly to narrowing of the chest cage in its lower third, where the ribs appeared to be more closely approximated. By comparison, the heart often appeared enlarged. And the up-

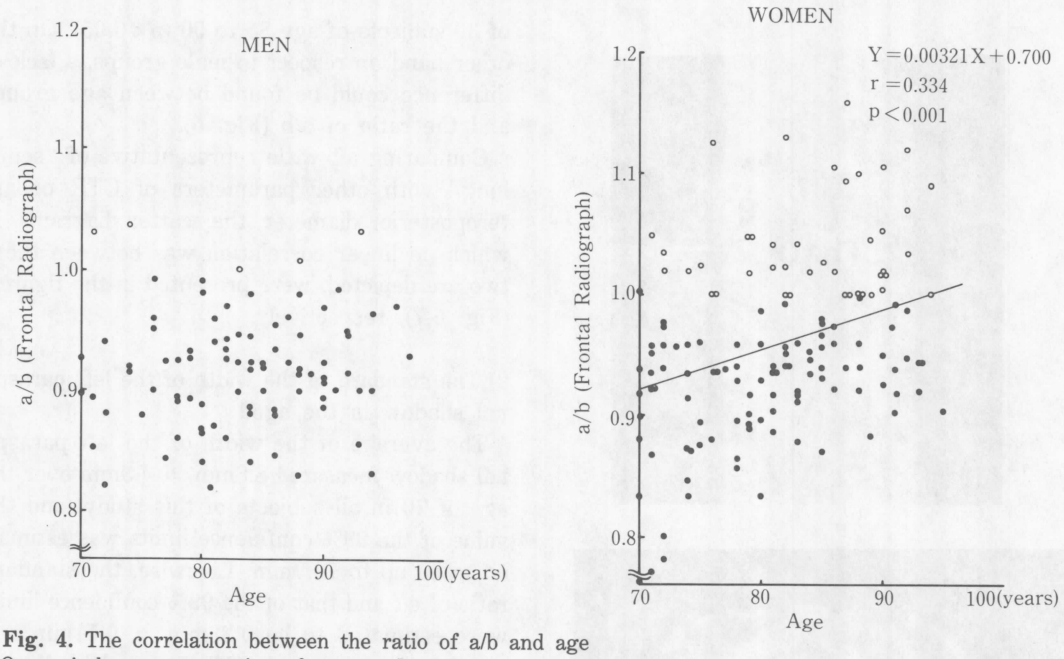


Fig. 4. The correlation between the ratio of a/b and age
Open circles representative of cases, a/b>1.0
Solid circles representative of cases, a/b<1.0

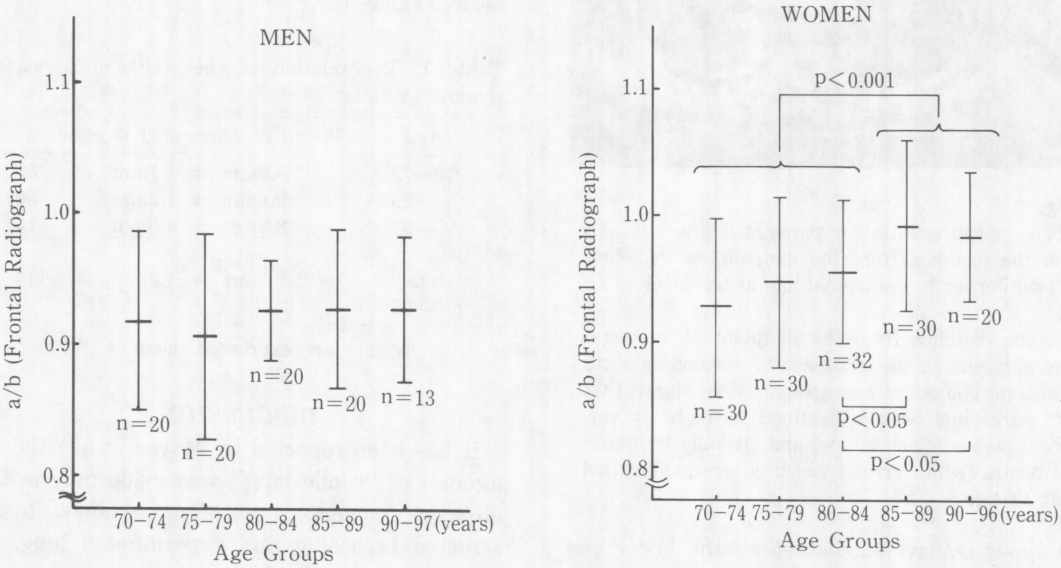


Fig. 5. The relation between the ratio of a/b and the age groups divided into five 5-year age branckets
Results are expressed as mean ± SD

per halves of the chest were often vaulted. However, not all persons showed this change, even at this advanced age. It was emphasized by the authors that it had a characteristic feature that this change became clinically demonstrable particularly after age 80 and predonimantly in women. In other words, in the aged who had led a life of vigorous activity, senile lung changes, particularly in men, appeared to be delayed or absent. Therefore, the most important cause to undergo this change was described as being due to stooped posture, which might result from "atrophy through disuse" when their functions appeared quite sufficient for them with their reduced activity.

In this study, we confirmed this change is real-

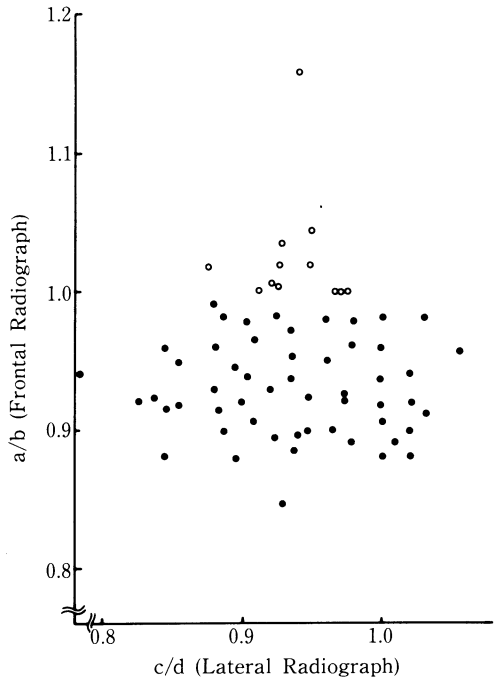


Fig. 6. The correlation between the ratio of a/b and c/d

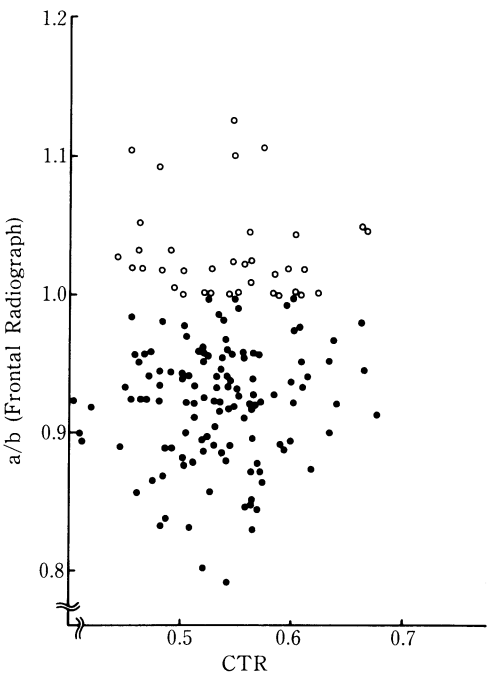


Fig. 7. The relation between CTR and the ratio of a/b
Open circles representative of cases, a/b > 1.0
Solid circles representative of cases, a/b < 1.0

ly present in the aged, especially in women. Moreover, the ratio of the upper transverse diameter to the lower one (a/b) is raised with increasing age, among other things, over the age of 85 the value becomes significantly higher than under 84 in women. Considering in connection with our findings, a possibility exists that the changes of the thoracic cage may develop rapidly around the age of 85, together with other aging processes and their behaviors. However, seeing that the subjects of this study have almost the same physical activities, it seems very improbable that the changes of senile lung come mainly from "atrophy through disuse". In addition, in case of men the incidence of "senile lung" remains unchanged regardless of physical activities. In view of the results mentioned above, it might be that "senile lung" results from aging process peculiar to women. Furthermore, the "senile lung" is also found to have no connection with the ratio of c/d or CTR. To put it another way, this change has nothing to do with the development of "barrel chest" or kyphosis.

The paraspinal area on the left side is confined laterally by the parietal pleura over the paraspinal soft tissues, medially it lies against the lateral margin of the vertebral bodies. The area contains the sympathetic trunks, the hemiazygos vein, accessory hemiazygos vein, intercostal arteries, veins, and nerves, and intercostal lymphnodes[7].

In the previous papers, clinically, the lateral deviation of the paraspinal line may give valuable information about the following diseases[1~4,7~10,12], — spinal diseases, aortic aneurysms, aortic ruptures, neurogenic tumors, pleural fluids, enlarged left atrium, lung diseases, mediastinal lymphadenopathies, esophageal rupture, abnormal fatty infiltration, extramedullary hematopoiesis, venous abnormalities and etc. On the other hand, even in normal subjects the width of paraspinal shadow was considered to increase with advancing age. Doyle et al[2] also reported the mean value of the measurements at Th 7,8 and 9 to be varying from 0 to 19mm above the age of 45. Gupta and Mohan[4] found the left paraspinal shadows at the level of Th 7 or 8 from 6mm to 15mm above

40 years. When the results of present study and previous accounts are considered together, it seems, therefore, appropriate to assume that the standard value of the distance of left paraspinal shadow should be up to 20 mm in the aged. It was also reported a degree of the linear relationship between its width and the degree and duration of hypertension due to the aortic unfolding in young patients[4]. For these reasons, we calcutated the ratio of its width divided by the distance of the descending aorta to exclude the influence of aortic unfolding. It appears permissible to make this index available as the standard values in patients having aortic unfolding, regardless of sex and age.

REFERENCES

1. **Crowe, J.K., Brown, L.R. and Muhm, J.R.** 1977. Computed tomography of the mediastinum. Radiology **128**:75-89.
2. **Doyle, F.H., Read, A.E. and Evance, K.T.** 1961. The mediastinum in portal hypertension. Clinical Radiology **12**:114-129
3. **Felson, B.** 1973. Chest Roentgenology p.409. W.B. Saunders, Company, Philadelphia.
4. **Gupta, S.K. and Mohan, V.** 1979. The thoracic paraspinal line: further significance. Clinical Radiology **30**:329-335.
5. **Harasawa, M., Fukuchi, Y., Minami, H., Yano, K. and So, K.** 1980. Chest X-ray film "lung". (Japanese) Geriat. Med.**18**:162-168.
6. **Harasawa, M., Handa, N., Fukuchi, Y. and Yoshikawa, M.** 1968. Clinical study of so-called "senile lung". (Japanese) Korei Igaku **6**:27-39.
7. **Heizman, E.R.** 1977. The Mediastinum, Radiologic correlations with anatomy and pathology. p.158-215. C. V. Mosby, Company, Saint Louise.
8. **Heizman, E.R.** 1981. Computed tomography of the thorax: current perspectives. A.J.R. **136**:2-12.
9. **Kakitsubata, Y., Inakura, M., Hoshi, H., Morita, S., Mihara, K., Kusuhara, T. and Watanabe, K.** 1984. Clinical significance of the paraspinal line. Nippon Act. Radiol. **44**:1347-1355.
10. **Lien, H. H. and Kolbenstvedt, A.** 1982. The thoracic paraspinal shadows: normal appearances. Clinical Radiology **33**:31-35.
11. **Mayer, E., Blazsik, C. and Rappaport, I.** 1958. Emphysema and the lungs of the aged, A clinical study. Dis. Chest **34**:247-256.
12. **Witten, R.M., Foyos, J.V. and Lampe, I.** 1965. The dorsal paraspinal mass in Hodgkin's disease. A.J.R. **94**:947-951.