Physical Development of Surgically Treated Patients With Primary Spontaneous Pneumothorax*

Shozo Fujino, MD; Shuhei Inoue, MD; Noriaki Tezuka, MD; Jun Hanaoka, MD; Satoru Sawai, MD; Masutaro Ichinose, MD; and Keiichi Kontani, MD

Study objectives: There have been many studies on the physical characteristics at the time of contraction of a primary spontaneous pneumothorax (PSP), but it has not been shown when and how such physical characteristics develop. These issues were investigated.

Patients and design: Physical development of 27 male patients with PSP were examined. Their physical records were collected with the patients' permission, and standard curves, estimated from the Japanese nationwide records in the year corresponding to the ages of the patients, were plotted as control values.

Results: The height of patients was already greater at 6 years of age. It showed a marked increase from 11 to 14 years. The body weight was more than the standard until 9 years, but it became less after age 11, and this difference increased after age 15. Rohrer's index was significantly lower than the standard at all ages, and the difference was particularly large from 11 to 15 years. In the standard group, there was a balance between the annual height and weight gain. In the patient group, annual weight gain was similar to that in the standard group whereas height began to increase 2 years earlier, and as a result, ectomorphy, which was also observed before this age, became marked at this age.

Conclusions: The rapid increase in the vertical dimension of the thorax compared with the horizontal dimension during the period of rapid physical development is considered to affect intrathoracic pressure at the apex of lung, which would have some influence on enhancing cyst formation.

Key words: height; physical development; primary spontaneous pneumothorax; Rohrer's index; weight

Abbreviations: PSP = primary spontaneous pneumothorax; RI = Rohrer's index

A correlation between primary spontaneous pneumothorax (PSP) and ectomorphy has been noted.1-3 Ectomorphy, which describes a tall figure with a flat thorax, is typically observed in Marfan syndrome. Inasmuch as some patients with PSP are not ectomorphic, physique is not the only cause of PSP, but there is no doubt regarding its involvement. There have been a number of studies on the physical characteristics at the time of contraction of the pneumothorax, but it has not been shown when and how such physical characteristics develop.4 In this study, we investigated these issues.

Materials and Methods

Of 95 patients with PSP who were treated surgically during a study period of 7 years in our hospital, 27 male patients whose physical development could be examined participated in the present study. Four female patients whose physical development could be examined were not included in this study.

The backgrounds of the 95 patients were as follows. The right side was surgically treated in 48 patients, the left in 43 patients, and both in 4 patients. The patients consisted of 78 men and 17 women. The overall mean age at operation was 27.5 years (range, 11 to 46 years), 26.8 years (range, 11 to 42 years) in the male patients, and 30.7 years (range, 15 to 46 years) in the female patients. The age distribution of the patients was such that patients in their 20s were most frequent, followed by the teens and then the 30s.

At the time of surgery, the mean height of the male patients was 170.8 cm, their mean body weight was 54.7 kg, and Rohrer's index (RI), which is defined as body weight / height³, was 109.8. Those values in female patients were 159.2 cm, 47.8 kg, and 118.5, respectively, indicating that the male patients showed a higher degree of ectomorphy.

To investigate the characteristics of physical development in these patients, their physical records were collected from their primary and junior and senior high schools with the patients'
permission. Records kept by the patients themselves were used in
some cases. Standard curves estimated from the Japanese nationwide records of mean height and body weight in the year corresponding to the ages of the patients were plotted as control values.

**RESULTS**

Because schools in Japan are allowed to discard physical records of the students 5 years after their graduation, complete records from primary to senior high school could be examined in only 31 young patients. Of these 31, 27 male patients were examined in this study. Because some low- and middle-teenage patients were included in this group, the overall number of patients examined was 27 in the age group from 6 to 11 years, 26 from 12 to 13 years, 25 at 14 years, 24 at 15 years, 23 at 16 years, and 20 at 17 years.

The mean age of the 27 patients analyzed in this study was 21.5 years (range, 11 to 32 years), which was much younger than that of the total patient population for the reason cited above. The mean age at the first occurrence was 20.7 years, mean height 172.9 cm, mean body weight 54.2 kg, and RI 104.8, showing a slightly higher degree of ectomorphy than the total male patient population. This may have been because older patients were excluded.

**Development of Height and Body Weight**

The height of patients was already greater than the standard at 6 years of age and increased with a time course similar to the standard curve. It showed a marked increase from 11 to 14 years, but the increase slowed down from age 15 years and on. The difference between the patients and the standard was significant at all ages (p < 0.05; Fig 1). The body weight was more than the standard from 6 to 9 years. After 11 years of age, it became less than the standard, with a similar course of increase up to age 14. After age 15 years, the rate of increase became slower, and the difference between the patients and the standard increased. The difference was significant at ages 15 and 16 (p < 0.05; Fig 1). As a result, RI was lower than the standard at all ages, with the difference between the patients and the standards being particularly large from age 11 to 15 years. The difference was significant at all ages (p < 0.05; Fig 2).

**Annual Changes in Height and Weight Gains**

Annual changes in height and weight gains were compared in each group. In the standard group, there was a balance between the height gain and weight gain (Fig 3, left, A). In the patient group,
years earlier than weight. As a result, ectomorphy, which was also observed before this age, became marked at this age (Fig 3, right, B).

**Discussion**

Most cases of spontaneous pneumothorax were regarded as being secondary to pulmonary tuberculosis, until 1932, when Kjaergard described PSP as a separate entity occurring in previously healthy adults. As noted in the article by Withers et al, Devilliers was the first to suggest the rupture of subpleural blebs as a cause for spontaneous pneumothorax. Since then, there have been many studies on factors related to the formation and rupture of subpleural cysts.

West showed that the size of alveoli in the apex of the lung is larger than that in the base of lung, which was considered to reflect a considerable difference in the intrathoracic pressure between these regions. This difference in size of alveoli is considered to be one of the causes of the higher incidence of cyst formation in the apex of the lung. Withers et al argued that a long and narrow lung is prone to ischemia because of rapid growth of the parenchyma, which can cause formation of subpleural cysts in the visceral pleura, especially in the apex region. Fukuda et al found degeneration of elastic fibers caused by a focal imbalance between elastase and α1-antitrypsin. It is generally considered that negative pressure in the apex of the lung causes formation of cysts if the vertical dimension of the thorax is large.

Although the risk of PSP occurrence or recurrence is probably multifactorial, including physical characteristics, smoking habit, anatomic abnormality of the bronchial tree, sex, and genetic factors, the causes of PSP are often related to the physical characteristics of the patients. Physical characteristics of patients with PSP have been investigated in many studies, some of which compared patient data with those of normal subjects by age group. However, few studies have focused on the physical development of individual subjects.

It is difficult to clarify how the formation of subpleural cysts is related to such characteristics of patients as being tall, thin, and young. However, rupture of one isolated subpleural cyst may be related to a narrow upper thorax. The results of the present survey clearly showed that at least several patients with PSP were ectomorphic from childhood. It is also clear that they showed even more rapid growth in the vertical direction than in the lateral direction during the period of rapid physical development. This differential growth would increase the negative pressure at the apex of the lung as West pointed out, having some influence on enhancing cyst formation during this period. Kasagi et al also suggested that sex differences in the rate of height increase during the period of rapid physical development may account for the sex difference in the prevalence of PSP. In the present study, comparison between sexes could not be studied because there were only a few female patients. In recent years, the frequency of PSP is believed to be increasing, espe-
cially in women. It is possible that there are some changes in physical development in young women.

**Summary**

Physical development was investigated in patients with PSP, and the following results were obtained: (1) Patients with PSP are ectomorphic from childhood. This is primarily because of their greater than average height, but their body weight is also greater than average in early childhood. (2) This ectomorphy is further exaggerated in the period of rapid physical development as a result of more rapid increase in height than weight. (3) The rapid increase in the vertical dimension of the thorax compared with the horizontal dimension during this period is considered to affect intrathoracic pressure at the apex of the lung, which would have some influence on enhancing cyst formation.

**References**