CHANGE IN THE QUANTITY AND CHARACTER OF ELASTIN IN THE DEVELOPMENT OF THE HUMAN LUNG

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The differentiation of human lung within post-conceptional (p.c.) age is roughly divided into four phases which are the pseudoglandular phase (6-16 weeks), canalicular phase (16-24 weeks), terminal sac phase (24 weeks-term) and alveolar phase (36 weeks-term-8 years). In order to reveal the role of elastin in the process of growth of the lung, especially in the formation of alveoli, we examined the change in the quantity and character of elastin in the developing human lung. Moreover, from histological aspects, we discussed the distribution of elastin in the formation of alveoli.

MATERIALS AND METHODS

Human lung tissues were obtained at autopsy from neonates at various gestational ages and from infants. The quantity of elastin was determined by means of isodesmosine (Ide) and desmosine (Des)-elastin calibration curves which were prepared from the lung of a child 1 year and 5 months old according to the procedure reported previously\(^1\). On the other hand, for amino acid analysis, elastin was prepared from various lung tissues obtained at autopsy by a modification of the method of Robert et al.\(^2\). Each ultrathin section of these lung tissues was stained with uranyl acetate and lead citrate, followed by tannic acid for elastin\(^3\) and observed under the transmission electron microscope.

RESULTS AND DISCUSSION

Calibration curves of human lung used in this study showed the linear relationships between the Ide and Des concentrations and the quantity of elastin similar to those described previously in human aorta\(^1\) (data not shown). However, the magnitude of each slope of these curves in human lung was almost equal to half that in human aorta. This suggests that the content of cross-linking amino acids such as Ide and Des in elastin may be different in all organs. At the lowest gestational age (20-22 weeks) examined, the quantity of elastin was 5.3 mg/g defatted dry weight (d.d.w.) and the amino acid composition of isolated elastin preparations showed a great amount of polar amino acids and a small amount of cross-linking amino acids. With increasing gestational age,
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The quantity of elastin increased linearly and the amount of polar amino acids in elastin decreased markedly and the content of cross-linking amino acids increased gradually. At the oldest gestational age (39-40 weeks) the quantity of elastin was 26.5 mg/g d.d.w. and in the post natal age (1-2 years) the quantity of elastin reached 55.0 mg/g d.d.w. The amino acid composition of elastin from lungs of these ages was very similar to that of the matured elastin. The marked increase in the quantity of elastin around term may be correlated to the difference in their respiratory mechanism. Although the quantity of elastin in the lung at 10 weeks gestational age (pseudoglandular phase) was too small to determine by means of biochemical procedures, the transmission electron microscopic picture demonstrated the presence of elastin in the interstitium (Fig.1-a). In the canalicular phase, secondary crests lined with elastin were observed, and this elastin seemed to assemble along with microfibrils (Fig.1-b). In the alveolar phase, elastin was clustered in a large fibrous aggregate and diffusely distributed not only in alveolar septae but also throughout all of the interstitial tissue (Fig.1-c).

Fig.1. Transmission electron microscopic pictures of elastin (arrows) in interstitial tissue in developing human fetal lung.

a: pseudoglandular phase (10 weeks), b: canalicular phase (22 weeks),
c: alveolar phase (39 weeks)

REFERENCES