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Radionuclide imaging study of long-term pulmonary function after lobectomy in children with congenital cystic lung disease

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Abstract

Purpose: We evaluated the long-term pulmonary function after lobectomy for congenital cystic lung disease, in both infants and children, using radionuclide imaging (RI).

Methods: We performed a retrospective review of 93 patients who underwent resection of cystic lung lesions between 1974 and 2001. The results of postoperative lung volume/perfusion scintigraphy at 1 (n = 64), 5 (n = 32), and 10 years (n = 18) after surgery (V1, 5, 10/Q1, 5, 10) and mean transit time (MTT—a marker for air-trapping) at 1, 5, and 10 years after surgery (MTT1, 5, 10) were compared with respect to age at operation, preoperative infection, underlying disease, and type of surgery.

Results: Patients who were younger than 1 year at the time of surgery showed a significantly lower MTT5 (1.09 ± 0.08) and MTT10 (1.15 ± 0.11) than patients who were older than 1 year at the time of surgery (MTT5, 1.49 ± 0.67; MTT10, 1.54 ± 0.33). The noninfected group had significantly higher Q10 and lower MTT10 values ($P < .05$) compared to the infected group. No significant differences were observed between patients with single lobe vs multiple lobe resection.

Conclusions: The optimal age for surgery in patients with congenital cystic lung disease appears to be less than 1 year.

The optimal time to operate on patients with asymptomatic congenital malformation of the lung is controversial, and no consensus has been reached. Some experts recommend early surgery [1,2], whereas others recommend observation for as long as the patient is asymptomatic [3,4]. Most previous reports have discussed operative timing based on the risk of malignancy and the safety of the operation [1,2,5]. Few reports have considered the use of pulmonary function (PF) studies [6-8] to guide the timing of the surgery.

Pulmonary function develops with growth. Although studies of the PF after lobectomy in childhood has been reported [6-9], there is still scant information regarding the long-term assessment of PF after lobectomy, as well as the

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factors affecting it. It is important to determine the degree of improvement in PF after surgery and what factors can influence it.

Radionuclide imaging (RI) of the lung can be performed in pediatric patients, including newborns, and is a valuable long-term assessment of pulmonary function, both pre- and postoperatively.

We conducted a retrospective analysis of postoperative RI pulmonary function at 1, 5, and 10 years after surgery and determined the optimal timing for surgery based on an analysis of several factors, including disease, age, type of surgery, and the presence of infection.

1. Patients and methods

A retrospective review of the hospital records of 93 patients (43 men, 50 women) who underwent lobectomy at Tokyo Metropolitan Kiyose Children's Hospital (Tokyo, Japan) from 1976 to 2001 was conducted. Age at the time of operation ranged from 2 days to 15 years, with a median age of 5.24 years.

The patients' diagnoses at the time of lobectomy included 33 cases of lung cysts, 23 cases of bronchial atresia, 16 cases of pulmonary sequestration, 12 cases of inflammatory lung disease, 5 cases of congenital cystic adenomatoid malformation (CCAM), and 4 cases of lung cysts (unclassified). The surgical procedure included right upper lobectomy in 9 patients, right middle lobectomy in 4 patients, right lower lobectomy in 22 patients, left upper lobectomy in 15 patients, left lower lobectomy in 38 patients, and bilobectomy (right upper/middle and right middle/lower) in 5 patients by open thoracotomy.

Radionuclide imaging lung function was evaluated at 1 (n = 64), 5 (n = 32), and 10 (n = 18) years after lobectomy in patients with cystic lung disease and included pulmonary volume (*V*) and mean transit time (MTT) using 133Xe lung volume scintigraphy and pulmonary blood flow (*Q*) using 99mTc-macroaggregated albumin (MAA) lung perfusion scintigraphy.

1.1. Radionuclide imaging of the lung using 133Xe lung volume scintigraphy (*V* and MTT)

Pulmonary volume was measured after equilibrium was attained using inhalation of 133Xe gas via a mask (Fig. 1A). Mean transit time (seconds) was the time measured from opening the mask after equilibrium was attained until the 133Xe gas disappeared (Fig. 1B). The entire lung was set to 100, and the value of the right and left lung was shown as a percentage of *V*. For the MTT evaluation, the ratio of the MTT value of the affected side to that of the unaffected side was calculated. For example, the MTT of the affected side was 18.4 seconds and that of the unaffected side was 12.7 seconds. The MTT value was expressed by the ratio of the MTT value of the affected side to that of the unaffected side; in this case, 18.4 divided by 12.7 yields a result of 1.45, which means that the MTT was 1.45 times longer (ie, more air-trapped) on the affected side than on the unaffected side.

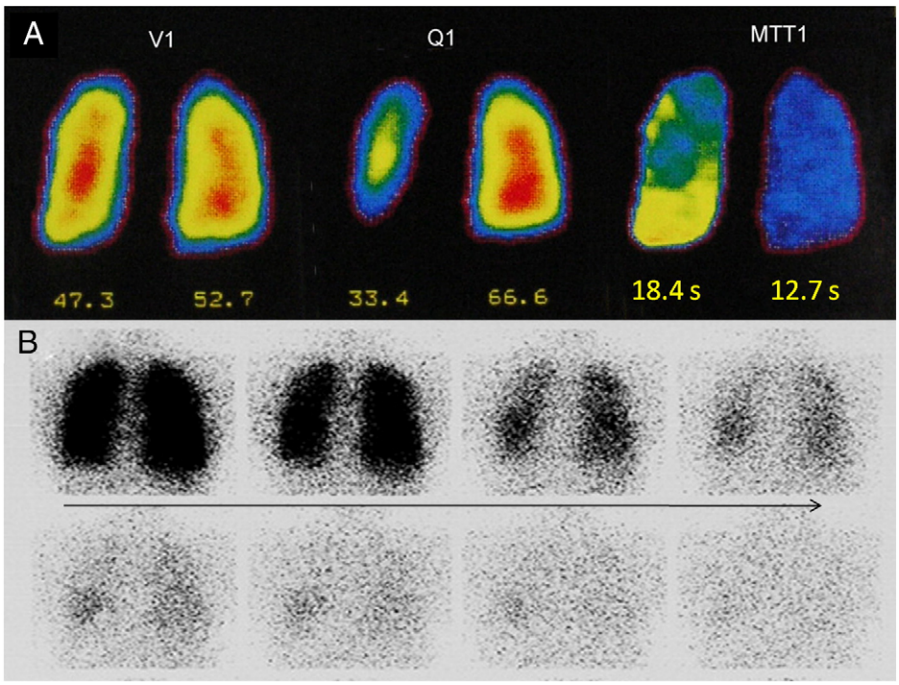

Fig. 1 A, Representative case showing the RI pulmonary function test; *V* (%), *Q* (%), MTT (seconds). B, Representative case showing the ventilation portion of the RI pulmonary function test. Mean transit time (seconds) is the time from equilibrium (top left) until the 133Xe gas disappeared (bottom right); a delay signifies air-trapping.