Agenesis of the Lung

Review and Report of Three Cases

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Agenesis of the lung was first described by Morgagni in 1762 at necropsy in a young man. Munchmeyer in 1885 apparently made the first diagnosis of unilateral pulmonary agenesis during life, but later verified it by necropsy. The patient was a two year-old boy who died from pneumonia.

In 1893, Schmidt described bilateral agenesis of the lungs in an eight month fetus. The trachea was not separate from the esophageal wall, but there was a well developed larynx. There was no pleural membrane and no vestige of pulmonary veins. The pulmonary arteries were connected to the descending aorta. Large series of cases have since been collected and reviewed from time to time in the literature.

The classification of stages of arrested growth of the lung established by Schneider in 1912 has been adopted by most authors. (a) agenesis—complete absence of a lung; (b) aplasia—presence of bronchial rudiments without alveolar tissue; (c) hypoplasia—deficient growth of regularly differentiated pulmonary components.

Between 1762 and 1900, 24 cases of agenesis of the lung were reported in the literature and another 95 were reviewed from 1900 to 1955. Statistical analysis by Schaffer and Rider showed: 1. agenesis is more common on the left; 2. patients with absent right lung tend to have more symptoms; 3. the likelihood of survival to age 40 years and over is greater with agenesis of the left lung. The percentage survival at one year, 10 years and 40 years for left-sided agenesis, was 63 per cent, 58 per cent and 35 per cent, as compared with 44 per cent, 30 per cent and 10 per cent for the right side; 4. Males are affected more often than females—in some series with a ratio of 3:2; 5. Approximately 60 per cent of these patients have associated congenital defects, 25 per cent of which are vascular. A major ventricular defect was the most common associated lesion.

The etiology of this defect is unknown. The lung buds appear in the human embryo at 28±1 days after fertilization. Thus, when there is complete absence of a main stem bronchus, the anomaly must occur close to the end of the first lunar month. If the main stem bronchus is rudimentary or more or less fully formed, the failure in development must occur at a correspondingly later period.

Morphogenesis in the embryo is regulated by organizers. These are the areas of the embryo which produce chemical substances (evocators), which bring about the differentiation of the organs and tissues. Damage to these organizers may occur in various ways:

(a) gene mutations. The abnormal gene has a specific effect on a certain area. In associated malformations gene linkage may be responsible especially if the deformities are hereditary.

A single pleiotropic gene may be associated with a series of congenital defects; the fundamental anomaly here may be metabolic.

(b) environmental interference with the early developing embryo.

(c) infection, for example, rubella in the mother.

(d) fetal rats of vitamin A deficient mothers, may show lung agenesis along with cardiovascular and other anomalies. It is unlikely that maternal malnutrition in humans could be severe enough to account for agenesis. However, a local interference in fetal blood supply could produce the same effect.

(e) irradiation can cause hereditary changes in the offspring.
(f) mechanical factors in utero, such as malposition, hydraulic pressure, constriction by amniotic bands.

In an effort to shed some light on the problem of the embryology of lung anomalies, Parke8 has made an embryologic study of the consistently "anomalous" lung of the short tailed shrew. The main features that may be implicated in lung malformations have been shown by this study to be the temporal sequences involved in closure of the pleuroperitoneal canals, and the plasticity of the lung primordia.

"Abnormal caudal extension of the lung, delayed differential expansion of the thorax or untimely liver growth separately or in combination would bring pressure to bear on the lower lung segments. Prolonged patency of the left pleuroperitoneal canal not only enhances these hazards, but also increases the probability of a transient or permanent herniation of the gut into the left pleural space. This accounts for the remarkable left sided preponderance of agenesis, lower accessory lobes and diaphragmatic hernias and eventration."

The symptoms of agenesis are variable or lacking, and are usually related to broncho-pulmonary disease. Morbidity and mortality depend more on distortion of the airway than of the blood vessels. These patients seem to be susceptible to respiratory infections and pneumonia, the latter being a common cause of death.

The following signs may be noted: diminished respiratory excursion, dullness on percussion and absent breath sounds or bronchial breathing on the affected side; scoliosis, dyspnea, stridor or cyanosis. Usually the chest is symmetrical. If the heart is displaced into the left chest, then heart sounds will be heard in the left axilla and over the posterior chest wall.

The potentially vacant chest space is filled with the displaced heart, thymus, other mediastinal contents and occasionally fluid.

Other anomalies may be present such as narrowed trachea, extracartilaginous rings, supernumerary bronchi of the normal lung, absence of pleura on the affected side, tracheo-esophageal fistula, esophageal stenosis, synostosis of various ribs, absent diaphragm on the affected side, atresia of the anus, hypoplasia of the face, absence of one ovary and tube, dermoid of the eye, agenesis of the spleen, kidney and ureter, accessory or hypertrophied thymus, exencephaly, absent

![Figure 1 (Case 1): Chest x-ray film of infant before bronchoscopy, showing absent heart shadow and absence of aerated lung in the right chest.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21366/ on 06/27/2017)
vagus nerve and various bones, and cardiovascular anomalies.

**Differential Diagnosis:** 1. atelectasis—especially in the newborn; 2. bronchiectasis with atelectasis; 3. postpneumonectomy chest; 4. blockage of the main bronchus by tumor; 5. fibrothorax.

The diagnosis is made by bronchoscopy and bronchogram. Because of the small size of the bronchial tree in infants, definite diagnosis may only be possible by bronchograms. X-ray film of the chest shows the affected side to be opaque. The intercostal spaces are narrowed and the diaphragm elevated. The hypertrophied remaining lung protrudes across the mid line, and the heart, which is displaced to the opaque side, may not be seen. An angiocardiogram will outline the heart, great vessels and congenital malformations and may show compression of the airway by blood vessels.

The prognosis must be guarded owing to the possibility of other serious anomalies being present, and also since involvement of the remaining lung by infection, trauma or foreign body might be fatal. However, there are quite a number of reports in the literature of patients with agenesis living to over 50 years of age. One died of cerebral hemorrhage at age 72, and the agenesis was discovered at necropsy.

From 1945 to 1959, three cases of pulmonary agenesis were diagnosed at the Vancouver General Hospital—one at necropsy and two during life.

**CASE 1** *(FIG. 1)*

This infant, 30 hours old, was admitted June 15, 1956. Delivery was uneventful, full term, and he weighed six pounds nine ounces. At birth, positive pressure was required for 25 minutes to establish regular breathing. He was cyanotic during this time. In the isoelette, the baby was still in respiratory distress, but his color was good. Excess mucus was suctioned frequently from the bronchial tree, and as a result, bleeding occurred from the nasopharynx.

The red blood cell count was 5,600,000, hemoglobin 123 per cent and platelets 418,000. The white blood cell count was 28,050 and the differential count showed polymorphonuclear leukocytes 76 per cent, lymphocytes 15 per cent and monocytes 1 per cent.

On x-ray film inspection, the right hemithorax was opaque and the intercostal spaces on the right side were narrowed. The heart and other

![Figure 2 (Case 2): Bronchogram showing complete absence of the left bronchial tree with no vestige present.](image-url)
mediastinal structures were shifted into the right hemithorax, and the left lung appeared somewhat emphysematous. Opinion: "The appearances could be the result of agenesis of the right lung or massive obstructive atelectasis."

A 3 mm. bronchoscope was passed with difficulty. However, no visualization of structures was obtained.

The baby died June 16. At necropsy, the thymus weighed 7 gm. The heart was shifted markedly to the right and lay in the right chest cavity. The outer aspect of the pericardium was attached to the lateral chest wall by fibrinous adhesions. No right lung was present and the right pleural space was obliterated by the presence of the heart. The left pleural cavity contained no fluid or adhesions. There was congestion of both lobes of the left lung but no consolidation. The right bronchus was absent and there was no dimpling or nubbin of bronchus to indicate a rudimentary form. Patent ductus arteriosus was present. The right pulmonary artery and veins were absent. The heart valves were normal and there was a patent foramen ovale. The myocardium, auricles, coronary vessels and aorta were normal.

Microscopic examination of the lungs showed pulmonary edema with congestion and patch atelectasis, with diffuse scattering of inflammatory cells. Early bronchopneumonia was present.

CASE 2 (FIG. 2)

This infant of eight months, admitted on February 24, 1956, had a history of difficulty in breathing and wheezing for two months. The delivery was normal and he weighed seven pounds and six ounces at birth. He was bottle-fed. The symptoms gradually increased, but there was no cyanosis. He was being treated for pneumonia in a local hospital just prior to being admitted to the Vancouver General Hospital.

On admission, there were diminished movement, dullness on percussion and absent breath sounds over the left side of the chest. Numerous rhonchi, but no crepitations were heard over the right side of the chest. The hemoglobin was 84 per cent and the white cell count was 5,900. The differential white cell count showed polymorphonuclear leukocytes 40 per cent, lymphocytes 53 per cent, monocytes 2 per cent and eosinophiles 3 per cent. The tuberculin patch test and the Mantoux test 1:100 were positive. The gastric washings were negative for tubercle bacilli.

On x-ray film inspection and fluoroscopy, the entire left lung field was opaque. There was marked overexpansion of the right lung with its left border in the left and mid clavicular line. At no time was the left lung seen and density-penetrated roentgenograms showed no evidence of bronchi to the left lung. Thirteen ribs were noted on each side. A barium swallow showed the esophagus displaced to the left.

A tentative diagnosis of endobronchial tuberculosis of the lung was made and the child was treated with INH and streptomycin. No improvement or change in the chest roentgenograms was noted over the next few months.

FIGURE 3

FIGURE 3 (CASE 3): Chest x-ray film showing a portion of the hypertrophied right lung present in the upper part of the left chest. FIGURE 4 (CASE 3): Bronchogram showing a stub of left main bronchus (without any secondary bronchi) tapering to a point.
On June 19, 1956, a 3 1/2 mm. bronchoscope, usually sufficient for a child of this age, could not be passed, so a 3 mm. instrument was used. It could only be inserted a short distance owing to congenital narrowing of the trachea. No information regarding the state of the bronchi was obtained. On June 28, 1956, a bronchogram showed no evidence of a left bronchus or even a vestige.

During his stay in the hospital, the child gained four pounds in weight and continued to have stridorous breathing and wheezing. He was discharged on July 19, 1956. A letter from the mother in October, 1957 stated the baby was developing well and had no further trouble.

CASE 3 (FIGS. 3 AND 4)

This well developed patient, aged 18 years, was admitted May 9, 1960, for investigation. Previous roentgenograms of the chest had shown opacity of the left chest and a presumptive diagnosis of agenesis of the left lung had been made. She had had measles and chicken pox as a child, and was recovering from an attack of whooping cough which had developed two weeks prior to admission. There was no history of susceptibility to respiratory infections, or of cyanosis, dyspnea, wheezing, cough or hemoptysis.

The only congenital anomaly noted on physical examination was, apart from the findings in the chest, the absence of two upper lateral incisors. This anomaly had been noted when she was a child.

Clinical examination showed only abnormalities related to her chest and spine. The chest was symmetrical, with diminished respiratory excursion of her left chest, and dullness on percussion with diminished breath sounds over her left axilla and left chest posteriorly. The trachea was deviated to the left side. The apex beat could not be localized, but heart sounds could be heard over the left axilla and left chest posteriorly. There was no murmur. She had scoliosis of the lower dorsal spine convexity to the left with slight prominence of her right lower ribs posteriorly. X-ray film inspection showed gross emphysema of the right lung of a compensatory nature, with the medial border of the right lung extending across the midline to the left side. The trachea was deviated markedly to the left. The heart shadow was seen in the left hemithorax laterally. The pulmonary vessel markings were those of the right pulmonary artery.

On May 9, 1960, a 7 mm. bronchoscope was passed through a normal larynx and trachea. Beyond the carina the two divisions were not sufficiently large to accommodate the bronchoscope. The secondary divisions could be seen in the right branch with a foroblique telescope, but no positive details could be made out in the left branch with the telescope.

On May 11, 1960, a bronchogram showed a rudimentary left main stem bronchus. This tapered to a point and measured 3 cm. in length. Branches from the right upper lobe bronchus deviated across the mid line to supply the lung tissue on the left side in the left upper lobe region.

The patient was discharged on May 12, 1960 in good condition.

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References