Acquired Nonneoplastic Neonatal and Pediatric Diseases

J. Thomas Stocker, Aliya N. Husain, and Louis P. Dehner

The lung biopsy is an established procedure to procure a pathologic diagnosis in a child with a suspected pulmonary process of undetermined etiology. Improvements in pediatric anesthesia and surgery have reduced the operative complications to a minimum. A biopsy can usually be taken through a small intercostal incision when localization is not especially important in a patient with diffuse changes (see Chapter 1). The alternative method for tissue sampling is the endoscopic transbronchial biopsy. There is less risk to the patient, but the specimen is smaller and crush artifacts from the instrument are more common.

Rapid tissue processing of the biopsy for routine histologic preparation is preferred to a frozen-section consultation because these specimens in children are often very small and may be exhausted in the preparation. If the clinician is mainly interested in knowing whether granulomas or recurrent tumor is present, however, a frozen section can serve that immediate purpose. Another function of the frozen section is to give the surgeon some indication whether lesion tissue has been sampled. A number of series have been published and should be consulted about the results of open lung and transbronchial biopsies in children.1

Another diagnostic procedure is the fine-needle aspiration biopsy,2 in which the needle is guided by computed tomography (CT) or ultrasonography. The application of fine-needle aspiration biopsy is mainly confined to the presence of a discrete mass with the clinical prospects of recurrent or metastatic tumor. A diagnosis by this biopsy technique has medical and economic advantages. If the changes in the lung(s) are diffuse in nature, rather than a single localized lesion, the positive yield in our experience has been quite low.

Some of the disease entities presented in this chapter are also discussed elsewhere in this volume for adult patients, and the reader is referred to those chapters. Many other entities discussed here, however, do not pertain to adults.

Hyaline Membrane Disease

It is important to understand the difference between hyaline membrane disease (HMD) and the formation of hyaline membranes (HMs). The term hyaline membrane disease is used almost exclusively to describe the neonatal respiratory distress syndrome (RDS) associated with prematurity, which is due to the immature lungs’ failure to synthesize adequate amounts of surfactant.3 The risk of developing HMD is increased in males, infants of diabetic mothers, patients with preeclampsia,4 and after cesarean section. In contrast, the formation of HM is associated with many other primary diseases such as infection (congenital or acquired), meconium aspiration, hemorrhage, and shock. Hyaline membrane disease in the classic form, as described by Lauweryns5 in 1970, has been largely prevented by inhaled surfactant therapy on the first day of life, which has become the standard of care since the early 1990s. Today, HMD is seen as the cause of death, at autopsy, only infrequently, usually in the extremely premature infant (23 to 25 weeks’ gestation) who dies in the first day or two of life. Infants who survive severe RDS for longer than 3 or 4 days before death usually display the changes of bronchopulmonary dysplasia (BPD) described below. Formation of hyaline membranes can also be seen in postmature infants. Seo and colleagues6 described their occurrence in 17 of 21 postterm infants dying within 10 days of birth. Amniotic and meconium aspiration was present in 95% of these cases.

Clinically, RDS is characterized by tachypnea, intercostal retractions, and hypoxemia. Radiographically, there is a typical ground-glass appearance of the lungs with air bronchograms and diffusely scattered reticulogranular opacities. On gross examination the lungs are firm, atelectatic, and typically sink when placed in water. The pleura is smooth and deep tan to red. The cut surface reveals a deep red parenchyma that oozes bloody fluid and resembles liver more than lung.
7. Acquired Nonneoplastic Neonatal and Pediatric Diseases

Microscopically there is a diffuse atelectasis that accentuates the bronchi and dilated bronchioles and alveolar ducts (Fig. 7.1). Smooth, homogeneous pink membranes, the HMs from which the disease derives its name lie free in the lumen or are closely applied to surfaces of respiratory bronchioles and alveolar ducts (Fig. 7.2). The membranes are composed of necrotic alveolar lining cells, plasma transudate, inhaled amniotic fluid, and, if hemorrhage is present, fibrin. Homogeneously pink or finely granular transudate is often present in alveolar saccules, occasionally extending to bronchiolar and bronchial levels. Hemorrhagic material may be present focally throughout the lung. Pulmonary lymphatics are dilated particularly around pulmonary veins.7

Hyaline membranes may be seen in infants dying as early as 1 to 4 hours after birth. Well-formed membranes are usually present by 12 to 24 hours, and by 36 to 48 hours, in cases of uncomplicated disease, organization of these membranes occurs with separation of the membrane from the underlying wall and engulfment of the material by macrophages (Fig. 7.3). Final repair of the bronchiolar and alveolar duct wall is accomplished by resurfacing of the wall by bronchiolar epithelial cells or type I and II alveolar lining cells.8,9 In the majority of

FIGURE 7.1. Hyaline membrane disease. Autopsy section of lung with hyaline membrane disease displays diffuse atelectasis of alveolar sacs and alveoli with slight overdistention of alveolar ducts and terminal bronchioles. Smooth hyaline membranes are closely applied to walls of these airways. Note the areas of focal interstitial and alveolar hemorrhage.

FIGURE 7.2. Hyaline membrane disease. In this 1-day-old infant’s lung, homogeneous membranes cover the surface of the alveolar duct.

FIGURE 7.3. Hyaline membrane disease in 4-day-old infant. Hyaline membranes are undergoing organization by macrophages and regenerating alveolar lining cells, which separate membranes from the wall of the alveolar duct. Note “rounded-up” membrane material.