The airways consist of a series of branching tubes. The trachea divides into the left and right main bronchi, which in turn divide into lobar then segmental bronchi. This process continues down to the terminal bronchioles (TB) which are the smallest airways without alveoli. Since none of the airway up to this point (the conducting airway) takes part in gas exchange it is called the anatomical dead space. This accounts for approximately 150ml in adults. Everything distal to the TBs is the respiratory zone and from each TB is an acinus. TBs divide into respiratory bronchioles and alveolar ducts. The distance from the TB to the most distal alveolus is only a few millimeters but the respiratory zone makes up most of the lung, its volume about 2.5-3 litres at rest. Because the area increases so dramatically the forward velocity drops away dramatically, as a result most of the gas movement in the distal airways is by diffusion which is important from a gas exchange perspective.

Each lung has a large pulmonary artery supplying blood to it and two pulmonary veins draining blood from it. The right and left pulmonary arteries arise from the pulmonary trunk at the level of the sternal angle. The pulmonary arteries carry poorly oxygenated (“venous”) blood to the lungs for oxygenation. The pulmonary arteries pass to the corresponding root of the lung and give off a branch to the superior lobe before entering the hilum. Within the lung, each artery descends posterolateral to the main bronchus and divides to lobar and segmental arteries. Consequently, an arterial branch goes to each lobe and bronchopulmonary segment of the lung, usually on the anterior aspect of the hilum. The pulmonary veins, two on each side, carry well-oxygenated (“arterial”) blood from the lungs to the left atrium of the heart. Beginning in the pulmonary capillaries, the veins unite in larger and larger vessels. Intrasegmental veins drain blood from adjacent bronchopulmonary segments into the intersegmental veins in the septa, which separate the segments. A main vein drains each bronchopulmonary segment, usually on the anterior surface of the corresponding bronchus. The veins from the parietal pleura join the systemic veins in adjacent parts of the thoracic wall. The veins from the visceral pleura drain into the pulmonary veins. The bronchial arteries supply blood to the structures making up the root of the lungs, the supporting tissues of the lung, and the visceral pleura. The left bronchial arteries arise from the thoracic aorta; however, the right bronchial artery may arise from an intercostal artery or bronchial artery. Small bronchial arteries provide branches to the superior esophagus and then pass along the posterior aspects of the main bronchi, supplying them and their branches as far distally as the respiratory bronchioles. The most distal branches of the bronchial arteries Anastomose with branches of the pulmonary arteries in the walls of the bronchioles, and in the visceral pleura. The bronchial veins drain only part of the blood supplied to the lungs by the bronchial arteries, primarily that distributed to or near the more proximal part of the root of the lungs (Fig. 1.228). The remainder of the blood is drained by the pulmonary veins. The right bronchial vein drains into the azygos vein, and the left bronchial vein drains into the accessory hemiazygos vein or the left superior intercostal vein.

Insertion of an Intercostal Catheter The layers should be described and are shown adjacent. Most clinicians insert the chest tube via an incision at the fourth or fifth intercostal space in the anterior axillary or mid-axillary line. This is the so-called safe triangle for insertion. For evacuation of a pneumothorax, the second intercostal space in the mid-clavicular line has been suggested as an alternate site; however, this requires dissection through the pectoralis muscle and leaves a visible scar. We suggest this approach only for a loculated anterior pneumothorax with the use of a small bore catheter (10 to 14 Fr) rather than a standard chest tube. For evacuation of a pneumothorax, the chest tube should be directed apically, while for drainage of a pleural effusion the chest tube should be directed inferiorly and posteriorly.

Tracheostomy A transverse incision through the skin of the neck and anterior wall of the trachea (tracheostomy) establishes an airway in patients with upper airway obstruction or respiratory failure. The infrahyoid muscles are retracted laterally, and the isthmus of the thyroid gland is either divided or retracted superiorly. An opening is made in the trachea between the first and second tracheal rings or through the second through fourth rings. A tracheostomy tube is then inserted into the trachea and secured.

Cricothyroidotomy On the anterior neck, palpate the laryngeal prominence, which forms the superior edge of the thyroid cartilage and is popularly called the Adam’s apple. It is especially prominent in men. Next, palpate the trachea and note that it is the caudal continuation of the larynx and no longer palpable as it enters the mediastinum. The trachea is comprised in large part by a row of C-shaped cartilaginous rings that are deficient posteriorly where the trachea rests against the anterior esophagus.

Next, identify and palpate the cricoid cartilage, which is a complete cartilaginous ring, shaped like a signet ring, with its widest part found posteriorly. The boundaries of the cricoid cartilage are the thyroid cartilage superiorly, the cricoid cartilage inferiorly, and the cricothyroid muscles laterally on both sides. Palpate the cricothyroid membrane. It is located about 2 cm caudal to the laryngeal prominence. It can be identified by a slight depression in this area. The anatomical relationship between the thyroid and cricoid cartilages and the cricothyroid membrane is the most important landmark when performing cricothyroidotomy. The cricothyroid arteries are branches of the superior thyroid arteries that course alongside both sides of the cricothyroid membrane and anastomose in the midline, closer to the superior border of the membrane. Try to avoid these arteries (although this can be difficult) when performing the procedure by incising the membrane in its lower third.