



**FIGURE 20-2** Schematic depiction of the lines constructed to measure the Cobb angle of scoliosis (A) and kyphosis (B).

For a given degree of spinal deformity, individuals with kyphoscoliosis due to a neuromuscular disease have more respiratory impairment than those with idiopathic kyphoscoliosis. Factors that contribute to respiratory failure in patients with kyphoscoliosis include inspiratory muscle weakness, underlying neuromuscular disease, sleep-disordered breathing, and airway compression due to distortion of lung parenchyma and twisting of airways.

Treatment consists of general supportive measures such as immunizations against influenza and pneumococci, smoking cessation, maintenance of a normal body weight, supplemental oxygen, and treatment of respiratory infections. It is important to recognize nocturnal hypoventilation because it can be treated with noninvasive positive-pressure ventilation. This is typically delivered through a nasal or full face mask. Indications for instituting noninvasive ventilation include symptoms suggesting nocturnal hypoventilation, signs of cor pulmonale, nocturnal oxyhemoglobin desaturation, or an elevated daytime  $Paco_2$ .

### Obesity

Obesity is a major health problem that affects children and adults throughout the world. Body fat usually constitutes 15% to 20% of body mass in healthy men and 25% to 30% of body mass in healthy women. In cases of obesity, the body fat content may increase by as much as 500% in women and 800% in men. The degree of obesity can be assessed by the body mass index, which is the ratio of body weight (BW) in kilograms to the square of the height (Ht) in meters ( $BW/Ht^2$ ). Individuals with a BMI between 18.5 and 24.9  $kg/m^2$  are normal, and those with a BMI greater than 40  $kg/m^2$  are considered severely or morbidly obese.

Reductions in functional residual capacity and expiratory reserve volume are the most common pulmonary function abnormalities in obesity, whereas vital capacity and total lung capacity may be only minimally reduced. Obesity promotes breathing at low lung volumes, which reduces lung compliance and increases the work of breathing. A subgroup of individuals with obesity hypoventilate and become hypercapnic. When obesity is associated with hypoventilation, it is called the *obesity-hypoventilation syndrome* (i.e., pickwickian syndrome). The mechanism underlying hypoventilation is unknown. Obesity-hypoventilation syndrome may result from factors that reduce respiratory center chemosensitivity, such as hypoxia, sleep apnea, or adipokines such as leptin. The most important consequences



**FIGURE 20-3** Computed tomography of a patient with unilateral right hemidiaphragm paralysis and associated right lower lobe atelectasis.

of chronic hypoventilation are hypoxemia and pulmonary hypertension.

Nocturnal noninvasive positive-pressure ventilation can help to reverse these abnormalities. Weight loss is the optimal therapy, but it is not always attainable, and long-term weight loss maintenance is even more difficult. Pharmacotherapy or bariatric surgery should be considered for obese individuals who do not achieve weight control with conventional methods (i.e., diet, enhanced physical activity, and behavioral therapy).

### Diaphragm Paralysis

The diaphragm separates the thorax from the abdomen and is the major muscle of inspiration. Diaphragm weakness or paralysis can involve one or both hemidiaphragms. Unilateral diaphragm paralysis is more common than bilateral diaphragm paralysis. The most frequent causes of unilateral paralysis include traumatic phrenic nerve injury, herpes zoster infection, cervical spinal disease, and compressive tumors. Patients may be asymptomatic, or the abnormality may be discovered as an incidental finding of an elevated hemidiaphragm on a chest radiograph (Fig 20-3). The diagnosis is confirmed by seeing on fluoroscopy a paradoxical upward motion of the affected diaphragm during a vigorous sniff maneuver. There is no specific treatment for this disorder, but recovery after the initial injury occasionally occurs. When the patient has disabling symptoms and significant elevation of the diaphragm is seen on the chest radiograph, surgical plication of the diaphragm may provide some relief of symptoms.

Bilateral diaphragm paralysis is most often seen in the setting of a disease producing generalized muscle weakness or motor neuron disease such as amyotrophic lateral sclerosis. Pulmonary function test results are associated with severe restrictive impairments. When the patient assumes the supine position, there may be a further reduction ( $\leq 50\%$ ) in vital capacity. It is not surprising that orthopnea is an especially prominent symptom, and patients often have difficulty sleeping in the supine position. Patients also complain of dyspnea when bending or lifting objects.