INTRODUCTION

Pregnancy is a period of profound physiological change. During gestation, alterations in sleep and breathing are common. In some cases, these normal physiological alterations may result in sleep-disordered breathing (SDB). The purpose of this chapter is to describe the normal physiological changes seen in sleep and breathing during pregnancy and discuss the pathological implications of these alterations as they relate to snoring and obstructive sleep apnea (OSA).

SLEEP ARCHITECTURE AND QUALITY IN NORMAL PREGNANCY

Estrogen and progesterone levels rise progressively during pregnancy with implications for sleep and wakefulness. Estrogen reduces rapid eye-movement (REM) sleep (1–3), whereas progesterone has a sedating effect (4) and can increase non-REM sleep (5). The alterations in the sleep patterns of a pregnant woman are most notable in the first and third trimesters. During the first trimester there is an increase in total sleep time and daytime somnolence, whereas the third trimester is characterized by a decrease in total sleep time and an increase in nocturnal awakenings (6). The etiology of these awakenings is multifactorial and may be caused by fetal movements, urinary frequency, leg cramps, back pain, heartburn, or generalized discomfort (6,7).

RESPIRATORY CHANGES DURING PREGNANCY

During pregnancy a variety of physical and hormonal factors influence breathing. Some of these factors are detrimental and may predispose pregnant women to SDB, whereas others may be protective. The most obvious mechanical factor appreciated during pregnancy is the enlarging uterus, which alters intra-abdominal pressure and leads to deformation of the diaphragm and intrathoracic structures. Spirometric studies reveal a progressive decrease in functional residual capacity (FRC) and expiratory reserve volume as term approaches (8–11). These alterations can cause closing volume to be greater than FRC, resulting in shunting and hypoxemia (12). The reduced FRC is also associated with reduced lung oxygen stores, which may have obvious implications in the setting of a nocturnal respiratory dis-
turbance (13), such as OSA. A number of studies have demonstrated that oxygen saturation is reduced in normal late pregnancy (14–16). This effect is magnified when a pregnant woman is in the supine position (14,17). Fortunately, pregnant women have a preference for sleeping in the lateral position (15,18), which may improve oxygenation and protect them from SDB. Pregnancy is also a physiological state in which body weight increases dramatically over a short time period. In nonpregnant individuals, weight gain is directly correlated with severity of SDB over time (19). It is not known whether gestational weight gain is an independent risk factor for SDB during pregnancy, but some authors suggest that it may exacerbate SDB, especially among obese women (20).

In addition to physical alterations of pregnancy affecting respiratory mechanics, hormonal changes may also lead to detrimental mechanical alterations in the respiratory system. For example, the rising estrogen concentration during pregnancy leads to changes in airway mucosa such as hyperemia and mucosal edema (21). This effect is most prominent during the third trimester, when significant nasal obstruction occurs and snoring is observed. Forty-two percent of pregnant women at 36 weeks gestation complain of rhinitis and nasal congestion (22). In addition to the changes seen in the nasopharynx, the oropharynx is also altered during pregnancy. A study of 242 pregnant women revealed an increase in Mallampati scores between 12 and 38 weeks gestation (23).

The hormonal alterations of pregnancy may be associated with mechanisms that protect the pregnant woman from SDB. The rising progesterone concentration of pregnancy is associated with hyperventilation as a result of enhanced respiratory center sensitivity to carbon dioxide (24,25). This augmented respiratory drive also increases the responsiveness of upper airway dilator muscles to chemical stimuli (26,27), theoretically protecting against airway obstruction.

The myriad alterations of pregnancy are associated with profound changes in the respiratory system—some changes protect pregnant women from developing SDB, whereas others predispose pregnant subjects to SDB. The remainder of this chapter is devoted to the discussion of abnormal breathing during sleep—from snoring to OSA.

SNORING AND PREGNANCY

In nonpregnant women, the prevalence of habitual snoring is only 4% (28,29). This is in stark contrast to the prevalence of self-reported snoring in pregnant women, which ranges from 11–23% for self-reported habitual snoring (28–30) to 41% for self-reported intermittent snoring during pregnancy (29). Because snoring is a marker for OSA, this increase in snoring during pregnancy has prompted further investigation.

Two questionnaire studies have demonstrated conflicting results regarding fetal outcomes in pregnant snorers. Loube et al. (28) found no significant difference in mean birthweight, Apgar scores, or complications in newborns of snorers compared with the newborns of nonsnorers. In contrast, Franklin et al. (30) demonstrated that habitual snorers were more likely to have infants with lower Apgar scores and growth retardation than nonhabitual snorers. In this study, witnessed