Obesity, Gender and Sleep

Since the days of Haldane and Priestley, investigators have been unfolding the story surrounding the mechanisms that control ventilation. Some of these studies have addressed resting physiologic measurements, while others have stimulated the brain stem by the rebreathing of gas mixtures lean in oxygen or rich in carbon dioxide. Over the last several years, with the development of such physiologic measurements as airway occlusion pressure, researchers have been able more accurately to describe the complex output from the human brain stem's respiratory center. The thrust of this research has dealt with awake subjects; more recently, it has also included similar investigations into respiration during sleep. With increasing familiarity and use of these methods, clinical studies have evolved which investigate the relationships between several variables and their effect upon ventilatory responsiveness to external stimuli.

The concept that ventilatory responsiveness may differ between male and female subjects developed out of these early studies.1 Hormonal factors have been implicated as being at least partially responsible for these changes.2 Within-gender perturbations among women during different phases of their menstrual cycle have also been observed.3

Nonhormonal variables have also been shown to influence ventilatory responsiveness. Examples of these variables include oxygen consumption, CO₂ production and body mass. Extreme obesity is known to influence pulmonary function. One way obesity may affect lung function is simply by its relationship to an increase in body mass. Early work by Sharp et al4 demonstrated that mechanistically excessive obesity resembles mass loading of the abdomen or elastic loading of the thorax. Confusion develops, however, as one evaluates the chemosensitivity response in obese subjects. In simple obesity, resting minute ventilation has been shown to increase commensurately with increasing oxygen consumption.5 Furthermore, the increase in ventilation, in response to hypoxia, has been associated with increased neural drive, as measured by mouth occlusion pressure. It is possible that the attenuation of this hypoxic drive, to overcome the mass load, is responsible for development of the obesity hypoventilation syndrome.

The above studies were performed on awake human subjects. During wakefulness, subjects generally have volitional control over automaticity of their respiratory center. As one passes from a physical state of being fully conscious to a state of somnolence, these same variables, as well as others, may take on a different degree of importance. Thus, cortical factors constitute another variable in the regulation of respiration.

In summary, hormonal factors, nonhormonal variables and cortical influences are all important in the regulation of respiration. From the existing research, it is apparent that differences in the control of ventilation are influenced by multiple factors.

The key issues being addressed in the article by Kunitomo et al (see page 968) are the roles of two of these variables (gender and obesity) in the pathogenesis of sleep-related oxygen desaturation and sleep-related apnea. They showed that there is no sex-related difference in ventilatory or occlusion pressure responses to hypoxia or hypercapnia in either obese subjects or normal control subjects. However, they demonstrated respiratory compensation with mass loading in obese women but not in obese men. This lack of load compensation in obese men is of interest, particularly in view of the work by Block et al5 who established sleep apnea as a disorder, primarily of men, with the severity of apnea correlating well with body weight and age.

The current study, therefore, goes a step beyond earlier investigations and implicates differences in awake respiratory control parameters to explain the differences in respiratory events during sleep in obese subjects. Though the hormonal status of most of the obese female subjects is unclear, some interesting observations are made: (a) there are no sexual differences in the awake respiratory physiologic parameters measured, (b) the incidence of sleep apnea and oxygen desaturation was markedly greater in obese men compared to obese women, and (c) obese women demonstrated augmentation of their hypoxic ventilatory and occlusion pressure responses over their normal female counterparts. During added load, awake obese female subjects maintained ventilation and increased respiratory neural drive in response to hypoxia. The authors suggest that this finding of intact load compensation, during wakefulness, may be important for the maintenance of ventilation during sleep. Thus, in women during sleep, even in the presence of obesity, maintenance of ventilation may prevent desaturation. Whether these differences in load compensation between men and women are explained solely on a hormonal basis or otherwise has not been established.

This and several other studies make it increasingly clear that the respiratory center's responsiveness is ever so complex. In the clinical arena, where so many variables are in operation (hormones, metabolism,
neurotransmitters, temperature, anatomic factors, cerebral cortical factors, drugs, etc.), it is difficult to implicate individual factors in the pathophysiology of such processes as sleep apnea and nocturnal desaturation. This study by Kunitomo et al emphasizes the importance of examining load compensatory mechanisms. Additional investigations along these lines may clarify our current understanding of respiration during sleep.

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Thoracic Empyema—Back to Basics

Thoracic empyema generally refers to a pyogenic infection of the pleural cavity, and its successful resolution, as with other “space” problems, depends upon apposition of the visceral and parietal pleura. It is widely accepted that drainage of the infected pleural space is an important part of the treatment of empyema. However, with the proliferation of “easy to insert” trocar-bearing chest tubes and CT-guided needle aspiration of virtually every body crevice, basic principles of management of empyema are being forgotten, and therapy may be far from ideal. Infected pleural fluid per se does not constitute an empyema, and similarly all infected pleural fluid does not require surgical drainage. A number of recent publications have stressed the need for chest tube drainage of pleural fluid with a low pH and glucose level, a high lactic dehydrogenase level, the presence of bacteria on Gram stain, or a positive culture, as though these are indications of empyema. Let’s get back to basics!

The initial diagnostic step in a patient with a radiographic pleural effusion and suspected empyema is a thoracocentesis (not a CT scan) to obtain a sample of the fluid for analysis. And the most important piece of information regarding the need for surgical drainage is the character of the fluid, not its cell count, protein level, specific gravity, pH, LDH, Gram-stain result, or culture report. Parapneumonic effusions, for example, frequently contain bacteria, but if thin and serosanguinous, often respond to appropriate antibiotic therapy and repeat thoracocentesis which allows expansion of the lung and obliteration of the infected pleural space. On the other hand, thick viscous pus in the pleural cavity simply cannot be aspirated adequately with a thoracocentesis needle, and when encountered, requires formal surgical drainage.

Drainage of pus is not new to the profession, but far too often, little if any attempt is made to define the size, shape and exact location of the empyema cavity, so that ideal dependent drainage can be instituted. In this regard, a chest CT scan is unnecessary and not nearly so helpful as an empyemagram, a study of which many physicians now caring for chest infections have never even heard! When frank pus is obtained at thoracocentesis, the reflex to insert a chest tube should be resisted. Rather, while the Gram-stain and culture and routine physical and chemical studies of the pleural fluid are being performed, the patient should be transported to the radiology department. The thoracocentesis should be repeated, 30 to 60 ml of pus aspirated, and leaving the needle in the empyema cavity, an equal amount of oily propyhydrone (Dionosil) or 3-5 ml of iodized oil (Lipiodol) instilled. Upright PA, lateral, and decubitus films will demonstrate the contrast material in the most dependent portions of the empyema cavity and provide precise localization for drainage. One does not tap a keg at the top of the barrel, and likewise, knowledge of the location of the lower-most portion of the empyema is vital for optimal drainage. And the final issue is: "What is optimal drainage?"

In our recent experience with 70 adult patients with thoracic empyemas (37 percent associated with primary bronchopulmonary infections, 33 percent postoperative, 10 percent from an intra-abdominal source, and 10 percent iatrogenic), when used as the initial mode of drainage, repeat thoracocentesis was successful in only 36 percent and closed tube thoracostomy in only 35 percent, while rib resection provided cure or control in 91 percent of the patients.8 The etiology of the empyema clearly influences the outcome of initial chest tube therapy, as 67 percent of our parapneumonic empyemas were treated success-