INTRODUCTION

Nosocomial pneumonia is the second most common nosocomial infection hospital-wide (1), and ventilator-associated pneumonia (VAP) is the most common nosocomial infection acquired by patients in the intensive care unit (ICU). VAP accounts for nearly one-third of all nosocomial ICU infections (2). Additionally, VAP carries the highest case/fatality ratio of any of the nosocomial infections (3,4).

Depending largely on the diagnostic methods, the rates of VAP vary from 8% to 22% for patients admitted to critical care units (5), with rates higher in surgical intensive care units (SICU) compared to medical units, and higher still in certain populations of SICU patients (6). Of those patients admitted to a SICU, trauma and burn patients have the highest rates (7) with a prevalence in these subsets up to 36.6% (8) and 44.2%, respectively (9). The determination of attributed mortality is fraught with the pitfalls associated with comparisons to historic or case-control populations. Despite these difficulties, published studies suggest that the mortality associated with VAP may lie somewhere between 13.5% and 43% (10-15). While VAP is more common in the SICU population, the mortality in this group appears to be less than that in critically ill patients admitted to a medical intensive care unit (16), and is perhaps related to the overall health of patients before admission to these units.

DEFINITION

The cardinal symptoms and signs of community-acquired pneumonia, including fever, leukocytosis or bandemia, cough, purulent sputum production, signs of consolidation on physical examination, and an infiltrate on chest roentgenogram, are neither sensitive nor specific in intubated postoperative patients. Indeed, establishing the diagnosis of VAP is difficult, with no universally accepted agreement. A prospective assessment of all roentgenographically apparent infiltrates in a SICU population revealed that pneumonia occurred most commonly (30%), followed closely by noninfectious etiologies: pulmonary edema (29%), acute lung injury (15%), and
atelectasis (13%) (17). Symptoms and signs of sepsis or of an inflammatory response may also be present in some of these conditions or may be present as the result of an infection at a different site.

The Centers for Disease Control and Prevention (CDC), recognizing this difficulty, noted that while the diagnosis of VAP can be determined by a variety of investigative tools, "of these (methods), endotracheal aspirate culture appears to be the most practical. The use of these bronchoscopic and nonbronchoscopic diagnostic tests can be a major step in better defining the epidemiology of nosocomial pneumonia, especially in patients with mechanically assisted ventilation; however, further studies are needed to determine each test's applicability in daily clinical practice" (18). The most appropriate method to define the onset, the causative agent and, indeed, the very presence of VAP is an area of considerable investigation and debate and is discussed in greater detail below.

PATHOGENESIS AND RISK FACTORS

Early/Late-Onset VAP

The source of VAP varies in different patient populations and also in the timing of the onset of the pneumonia. It is often helpful in terms of etiology to categorize the cause of VAP into patient-dependent or intrinsic variables and hospital/environment-related or extrinsic variables. In addition, a distinction should be made between pneumonia that occurs soon after intubation and mechanical ventilation (early-onset VAP), and that occurring following a specified time, usually after 5 days (late-onset VAP).

Early-onset VAP is more likely to be the result of events surrounding intubation, such as aspiration, or to such host factors as chronic lung disease including chronic bronchitis, acute lower respiratory tract infection, or bronchiectasis. Direct contamination of the lower airways by gastric and/or upper airway secretions or dental flora likely contributes to VAP in this population. Hemophilus influenzae and Streptococcus pneumoniae are much more likely to be causative agents in patients with early-onset VAP. Late-onset VAP is more commonly caused by organisms that are indigenous to the ICU and have a greater likelihood of resistance to antibiotics.

This distinction in the timing of the onset of pneumonia may also be important when considering empiric antibiotics. Early-onset infections are less likely to be caused by resistant organisms, unless harbored by the host, whereas late-onset infections are more likely to result from enteric gram-negative organisms with multiple resistance patterns or to methicillin-resistant Staphylococcus aureus.

Aspiration

During intubation, the normal host defenses against aspiration, an intact cough reflex and glottic closure, are bypassed. In addition, patients with an endotracheal tube