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Ventilator-Associated Tracheobronchitis and Ventilator-Associated Pneumonia

Truth vs Myth

In this issue of *CHEST* (see page 32), Simpson et al[1] evaluate the occurrence of ventilator-associated tracheobronchitis (VAT) and ventilator-associated pneumonia (VAP) over a 2-year period in a pediatric ICU. Using US Centers of Disease Control and Prevention/National Healthcare Safety Network (CDC/NHSN) definitions of nosocomial infections, certified infection control practitioners documented the criteria establishing the presence of VAT/VAP.[2] Of the 645 ventilated patients who were assessed, 22 (3.4%) met criteria for VAT. Patients with VAT had longer lengths of stay but no increase in mortality. Interestingly, no cases of VAP were identified using this administrative approach to nosocomial infection surveillance.

This study represents one of the first pediatric ICU studies evaluating the occurrence of VAT/VAP. However, it raises similar concerns to adult studies using administrative surveillance methods to determine the incidence of VAT/VAP. These concerns can be summarized in two myths propagated by these types of studies: "Administrative surveillance methods reflect the true incidence of VAT/VAP" and "the occurrence of VAT/VAP does not adversely influence patient outcomes."

The accuracy of administrative surveillance used in the United States for establishing the incidence of VAT/VAP has been questioned. Most US hospitals use the CDC/NHSN definitions for probable nosocomial pneumonia including VAT/VAP.[2,3] Unfortunately, these criteria have not been validated, and at least one study found that clinical decision-making using these criteria was less accurate, potentially resulting in the withholding of antibiotics in patients in whom VAP was diagnosed from BAL samples.[4]

We recently compared the observed rates of VAP when using the CDC/NHSN surveillance method vs clinical criteria.[5] Over 1 year, 2,060 patients requiring mechanical ventilation for >24 h were prospectively evaluated. Of these, 83 patients (4%) had VAP according to clinical criteria, as compared with 12 patients (0.6%) according to the CDC/NHSN surveillance method. The corresponding rates of VAP were 8.5 vs 1.2 cases per 1,000 ventilator-days, respectively. Agreement of the two sets of the criteria was poor (κ statistic, 0.26). Other investigators have similarly demonstrated that infection control practitioners using administrative surveillance methods, usually applied retrospectively, consistently underestimate the incidence of VAP compared with clinical criteria often used with quantitative cultures.[6-8]

Another important piece of evidence suggesting that administrative surveillance of VAT/VAP is inaccurate is the comparison of US rates of VAP to those of other countries. The reported VAP rates are consistently lower in the United States than those from developing countries and from Europe.[9,10] Given the concern that the CDC/NHSN VAP surveillance method has been demonstrated to be time consuming and potentially less accurate than clinical/microbiologic criteria, and that the use of quantitative lower respiratory tract cultures for the establishment of VAP is not universally performed, the CDC and Prevention Epicenters Program has recently supported efforts aimed at shifting ICU surveillance away from VAP to a more objective marker of ICU quality. The CDC-Prevention Epicenters Program has proposed focusing on "complications" in general that might circumvent the VAP definition's subjectivity and inaccuracy, facilitate electronic assessment, make interfacility comparisons more meaningful, and encourage broader prevention strategies. Ventilator-associated complications (VACs) were selected as a more general, objective marker defined by sustained increases in patients' ventilator settings, positive end-expiratory pressure, and fraction of inspired oxygen, after a period of stable or decreasing support.[11] We are awaiting the results of clinical studies aimed at demonstrating whether surveillance using VACs will improve patient care and whether VACs can be demonstrated to represent preventable events and not just expected fluctuations or progression in the underlying disease process of critically ill patients.

It is important to recognize that one of the major clinical issues related to the management of VAP, as well as other nosocomial infections, is the increasing occurrence of multidrug resistant (MDR) or extremely drug-resistant (XDR) pathogens.[12] The available evidence suggests that the overall prevalence of nosocomial infections attributed to MDR/XDR pathogens, as well as the global use of antibiotics in the hospital setting, is on the rise despite efforts to curb these infections.[10] Disorders such as VAT and sepsis, which often are diagnosed in the presence of nosocomial pneumonia, seem to be more common, contributing, at least in part, to the increasing use of antibiotics in the ICU.[10,12] VAP is recognized to be among the most common infections associated with MDR/XDR bacteria, including *Pseudomonas aeruginosa*, *Acinetobacter* species, and *Klebsiella pneumoniae* carbapenemase-containing members of the Enterobacteriaceae. The recent recognition of Enterobacteriaceae containing the NDM1 gene on multiple continents raises the real possibility of endemic spread of common enteric bacteria possessing resistance to all currently available antibacterial agents.

The emergence of MDR/XDR pathogens as a cause of nosocomial infections has resulted in greater administration of inappropriate antimicrobial therapy, defined as an antimicrobial regimen that lacks in vitro activity against the isolated organism(s) responsible for the infection. This is associated with excess mortality in patients with serious infections, including VAP and severe sepsis.[10,12,13] Escalating rates of antimicrobial resistance lead many clinicians to empirically treat critically ill patients with presumed infection with a combination of broad-spectrum antibiotics, which can further perpetuate the cycle of increasing resistance. Conversely, inappropriate antimicrobial therapy can lead to treatment failures and adverse patient outcomes.[13] Moreover, the limited diversity of available antimicrobial agents has created a clinical situation where patients are repetitively exposed to the same class of antibiotic, or in some circumstances the exact same agent, resulting in an increased risk of treatment failures and mortality. Therefore, the broader concern for all intensivists is how to limit the emergence and spread of MDR/XDR pathogens, as well as the infections associated with these pathogens.

Recent studies have demonstrated that the attributable mortality of VAP is between 5% and 10%.[14,15] Studies showing that inadequately dosed antibiotics are associated with statistically greater treatment failure and mortality compared with more optimally dosed comparators also support the hypothesis that mortality attributable to VAP occurs.[16,17] Additionally, the duration of antibiotic therapy for VAP can influence patient outcomes, especially when attributed to MDR/XDR pathogens.[18]

Given the global increase in antibiotic resistance, especially in VAT/VAP, future initiatives are needed to optimize the management of patients who are mechanically ventilated. This will include improved surveillance methods to better assess quality of care, antimicrobial stewardship, development of new antibiotics and delivery systems, and development of more rapid and accurate microbiologic diagnostic techniques. Such advances should allow more targeted and rapid administration of appropriate antibiotic therapy, as opposed to empirical therapy that is often unnecessary or inappropriate for the infecting pathogen.

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Financial/nonfinancial disclosures: The author has reported to *CHEST* that no potential conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.
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DOI: 10.1378/chest.12-3015

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Empiric Postoperative Autotitrating Positive Airway Pressure Therapy

Generating Evidence in the Perioperative Care of Patients at Risk for Obstructive Sleep Apnea

Obstructive sleep apnea (OSA) is a prevalent sleep disorder characterized by recurrent episodes of complete or partial collapse of the upper airway that lead to intermittent hypoxemia and recurrent arousals from sleep. Although prevalence estimates of OSA from community-based studies have ranged from 5% to 28%, the prevalence of clinically significant and symptomatic OSA is significantly lower, at 2% to 9%.[1-4] In contrast, the prevalence of OSA in presurgical cohorts remains less well defined. Studies that have reported a high prevalence have been subject to significant selection bias, because not all patients underwent diagnostic testing.[5-7] In the largest single academic center registry study of presurgical patients undergoing anesthesia, Ramachandran et al[8] reported an OSA prevalence of 7%. Importantly, chronically untreated moderate to severe OSA has been associated with significant morbidity and mortality, and treatment with CPAP has been shown to reduce cardiovascular risk in patients with severe OSA.[9-11] Given the important long-term implications of untreated OSA, in 2006 the American Society of Anesthesiologists recommended screening patients prior to surgery and implementing treatment if OSA is present.[12] Interestingly, these recommendations were made despite the lack of significant empirical evidence in the perioperative diagnosis and management of OSA. Since the American Society of Anesthesiologists' publication, there has been a growing interest in the perioperative care of patients with OSA or suspected of having OSA. To date, most studies have focused on developing effective screening tools in the preoperative population[13-15] or have outlined adverse postoperative outcomes in patients with OSA.[5,16-21] However, despite this growing awareness, there is a paucity of well-controlled prospective studies examining the impact of OSA treatment on postoperative outcomes.

Consequently, the study by O'Gorman and colleagues[22] in this issue of *CHEST* (see page 72) is an important and timely contribution to the field. These investigators enrolled 86 CPAP-naive patients undergoing elective total knee or total hip arthroplasty who were deemed at high risk for having OSA based on a validated prediction model. The patients were randomized to either standard care or standard care plus empirical autotitrating positive airway pressure (APAP) therapy during the postoperative period. Although the primary outcome of interest was hospital length of stay (LOS), the authors also examined several other important postoperative outcomes. Based on an intention-to-treat analysis, they found no significant difference in the primary or secondary outcomes between the two groups. These unexpected results were in spite of a median APAP use of 373 min on the first postoperative night and a median of 185 min per night during the entire postoperative period. Post hoc analyses revealed that in patients with moderate or severe OSA (apnea-hypopnea index [AHI] ≥ 15, derived from a portable cardiorespiratory study performed the night before hospital discharge), the LOS increased by 1 day in patients treated with APAP (4 days vs 5 days; $P = .02$). Similarly, when the data were analyzed based on APAP adherence, the LOS increased by 1 day in patients with usage > 4 h