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Gram Stain Can Be Used to Safely Discontinue Vancomycin Therapy for Early Pneumonia in the Trauma Intensive Care Unit

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Methicillin-resistant Staphylococcus aureus (MRSA) is of increasing concern in the critically ill trauma population.[1] S. aureus is commonly found on parts of the human skin,

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especially in the axilla, groin, nares, and perirectal areas, and can be a causative organism of pneumonia in severely injured patients.[1] Some institutions feel there is a need for vancomycin therapy for early pneumonias diagnosed in the trauma intensive care unit (TICU). Finalization of culture results can often take up to 5 days, and this exposes some patients to excessively long therapy with an unnecessary antibiotic. We hypothesized that the Gram stain from an obtained pulmonary culture could accurately deter- mine the presence of a MRSA infection, because Gram- positive bacteria are more easily distinguished (dark purple on a light background) from Gram-negative bacteria, allowing the early termination of unnecessary vancomycin therapy.

After Institutional Review Board approval, medical records of patients admitted to the TICU at the University of Florida (UF) from June 1, 2011, to May 31, 2012, were retrospectively reviewed. Inclusion criteria included trauma patients admitted to the TICU where pulmonary cultures (sputum, tracheal aspirates, and bronchoalveolar lavages) with correlative Gram stains were obtained. The patients' demographics, medical histories, acuity assessments, and antibiotic regimens were documented. Suspected early pneumonia was classified as those patients whose respiratory samples were collected 5 days or less after hospital admission.

Frequencies of categorical variables were reported as a percentage and Fisher's exact test was used to test independence between categorical variables as appropriate. Continuous variables were reported as means and standard deviations and compared using Wilcoxon rank sum test because the normality assumptions were not satisfied. Sensitivity, specificity, positive predictive value, and negative predictive value of the Gram stain were determined using the final culture. All significance tests were two-sided with $a < 0.05$ considered statistically significant. Statistical analyses were performed with SAS (Version 9.3; SAS Institute Inc., Cary, NC).

A total of 1925 patients were admitted to the UF TICU during the study period. Sixty cultures met the inclusion criteria. The predominant mechanisms of injury were blunt trauma (Table 1). We found that the prevalence of early MRSA pneumonia to be 10 per cent (6 of 60) and 61.7 per cent (37 of 60) of the samples demonstrated Gram-positive organisms on Gram stain. The association between Gram stain and final culture was not statistically significant (odds ratio, 3.44; 95% confidence interval, 0.37 to 31.48; P 4 0.247). Using the final culture, we determined sensitivity, specificity, positive predictive value, and negative predictive value (NPV). We found a sensitivity and specificity for using Gram stain for the detection of early pneumonia with MRSA to be 83% (5 of 6) and 41 per cent (22 of 54), respectively. The positive predictive value of the Gram stain for predicting MRSA was 13.5 per cent (5 of 37). However, the NPV of the Gram stain was 96 per cent (22 of 23). We also observed that the Glasgow Coma Score (GCS) on admission and the prevalence of intubation after intensive care unit admission were higher for those with MRSA, although it did not reach statistical significance (Table 2).

We found that the prevalence of early MRSA pneumonia to be 10 per cent in the UF TICU patients. Giving vancomycin empirically to our entire early pneumonia patient population would be considered overtreatment at our institution, unless there were other risk factors for MRSA (e.g., the patient is from a nursing home). However, we found a high NPV associated

with the Gram stain to the final culture, allowing for safe de-escalation of vancomycin therapy. Although de-escalation of antibiotics has not shown to affect mortality, it has been shown to decrease antibiotic days, cost, and antibiotic resistance.[2]

We also assessed the subjects for the characteristics of age, GCS on admission, intubation after intensive care unit admission, and presence of traumatic brain injury. Although the difference in age from MRSA to no MRSA was not statistically significant, previous studies have quoted age older than 60 years old as a risk factor for MRSA colonization.[3] We found trends for early MRSA pneumonia infection to be associated with higher GCS on admission and intubation after intensive care unit admission. It is very possible that if more patients could have been analyzed, this could have reached significance. Traumatic brain injury and pneumonia are well described in the surgical and trauma literature with the rate of pneumonia ranging between 26 and 51 per cent in severely injured patients with Staphylococcus being the most common pathogen.[4] Early MRSA pneumonia is less well described.

Two of the disadvantages of this study are that it is underpowered for detailed patient analysis and that the institution was not using MRSA screening techniques during the time of inclusion. However, there are trends regarding patients who were diagnosed with early MRSA pneumonia that are consistent with previous studies.[3] Although this study shows that prevalence of early MRSA pneumonia for trauma patients at UF is 10%, it demonstrates that the NPV for a Gram stain lacking Gram-positive organisms is 96 per cent. We also assessed the NPV by method of obtaining the culture and found no significant difference in NPV. Thus, the practitioner that does use vancomycin for early pneumonia in their trauma patients could use the Gram stain to de-escalate vancomycin before the finalization of the pulmonary culture results.

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TABLE 1

Trauma Patients' Mechanism of Injury

Mechanism of Injury, No. (%)	n = 60
Motor vehicle collision	24 (40.0)
Motorcycle collision	16 (26.7)
Fall from greater than 10 feet	7 (11.6)
Pedestrian versus car	4 (6.7)
Industrial crush	3 (5.0)
Gunshot wounds	2 (3.3)
Assault with hammer	1 (1.7)
Fall from standing	1 (1.7)
Bike versus car	1 (1.7)
Other	1 (1.7)

TABLE 2

Demographic and Clinical Characteristics of Patients Stratified by MRSA Status

Characteristics	All (n = 60)	No MRSA (n = 54)	MRSA (n = 6)	P Value*
Age (years), mean (SD)	46 (19)	45 (20)	56 (14)	
Median (25th–75th)	49 (27–63)	47 (24–62)	56 (51–63)	0.262
Glasgow Coma Score, mean (SD)	8.8 (5.4)	8.4 (5.3)	12.7 (4.8)	
Median (25th–75th)	8 (3–15)	8 (3–15)	15 (13–15)	0.075
Intubation after ICU admission, no. (%)	11 (18)	8 (15)	3 (50)	0.069
Traumatic brain injury, no. (%)	23 (38)	20 (37)	3 (50)	0.666

*P values are obtained using Fisher's exact test for categorical variables and Wilcoxon rank sum test for continuous variables. MRSA, methicillin-resistant Staphylococcus aureus; SD, standard deviation; ICU, intensive care unit.