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72-HOUR CLINICAL PULMONARY INFECTION SCORE MAY HAVE PROGNOSTIC VALUE AMONG TRAUMA PATIENTS WITH VENTILATOR ASSOCIATED PNEUMONIA

Surgery

Gerard A. Baltazar DO FACOS, Department of Surgery, NYU Winthrop Hospital, Mineola, NY, USA

Amy Pate MD, Department of Surgery, Richmond University Medical Center, Staten Island, NY, USA
Department of Surgery, SUNY Downstate Medical Center, Brooklyn, NY, USA

Frederique Pinto MD, Department of Surgery, Richmond University Medical Center, Staten Island, NY, USA

Akella Chendrasekhar* MD, FACS, FCCP, Department of Surgery, SUNY Downstate Medical Center, Brooklyn, NY, USA *Corresponding Author

ABSTRACT

Background: Ventilator-associated pneumonia (VAP) is a common, serious nosocomial infection; reduction of morbidity and mortality is achieved by prompt diagnosis and early initiation of appropriate empiric antimicrobial therapy. While Clinical Pulmonary Infection Score (CPIS) on the day of VAP diagnosis has not been proven a consistently effective device, we postulate the CPIS 72 hours after VAP diagnosis may serve as a clinical prognostic indicator. The purpose of this study is to assess the potential value of CPIS in trauma patients with VAP.

Methods: We performed a retrospective chart review of 50 intubated trauma patients with VAP admitted to the intensive care unit (ICU) of an urban level-I trauma center from January-December 2013. Patients were consecutively identified via trauma registry, and data were abstracted on demographics; injury severity score (ISS); vital signs; laboratory values; microbiological cultures; ventilator settings; antibiotic therapy; time of VAP diagnosis; outcomes; and survival to discharge. We calculated modified CPIS at initial diagnosis and 72-hours post-diagnosis. Incomplete records were excluded from analysis.

Results: Forty-nine patients, 25 females and 24 males, with mean age of 66.1±5.2 years were analyzed. Overall mortality was 18.4% (n=9); mean ISS was 18.3±1.2; mean length of stay (LOS) was 20.7±3 days; mean ICU-LOS was 16.7±3.1 days; mean ventilator days was 15±3.2; mean day-1 CPIS was 5.8±0.5; and mean day-3 CPIS was 4.9±0.6. Multidrug resistant organisms (MDROs) were identified in 26 patients and associated with higher 72-hour CPIS (5.8±0.9 vs 3.7±0.7, p=0.025). 72-hour CPIS <6 was significantly associated with shorter LOS (16.8±3.1 vs 27.3±5.2 d), shorter ICU-LOS (12.4±2.9 vs 24.1±5.6 d), shorter duration of mechanical ventilation (10.8±3 vs 22.1±5.9 d), and earlier VAP diagnoses (hospital day 4.4±0.6 vs 7.1±1.4, p<0.001).

Conclusions: Initial CPIS calculations after VAP diagnosis have no clinical value. While not associated with survival to discharge, CPIS calculated 72 hours after VAP diagnosis may be used as a prognostic indicator for MDROs and improved short-term outcomes for trauma patients.

KEYWORDS

Ventilator-associated pneumonia (VAP), Clinical Pulmonary Infection Score (CPIS), Intensive Care Unit (ICU)

BACKGROUND

Ventilator-associated pneumonia (VAP) is a common, serious nosocomial infection, including among injured patients.[1] Reduction of VAP-related morbidity and mortality is achieved by prompt diagnosis and early initiation of appropriate empiric antimicrobial therapy.

While the initial Clinical Pulmonary Infection Score (CPIS) has not been proven a consistently effective device,[2] we postulate that the 72-hour CPIS may serve as a clinical prognostic indicator and may help inform diagnosis and treatment strategies.

The purpose of this study is to assess the potential value of CPIS in trauma patients with VAP.

METHODS

We performed a retrospective chart review of 50 intubated trauma surgery service patients with clinically-diagnosed (i.e. presence of systemic inflammatory response syndrome plus infiltrate on chest radiograph and/or tan colored secretions within the endotracheal tube and/or drop in PaO_2/FiO_2 ratio or at the discretion of the intensive care physician), culture-positive VAP admitted to the intensive care unit (ICU) of an urban level-I trauma center from January-December 2013. Patients were consecutively identified via the prospectively-accrued trauma registry, and data were abstracted on demographics; injury severity score (ISS); vital signs; laboratory values; microbiological cultures; ventilator settings; antibiotic therapy; time of VAP diagnosis; outcomes; and survival to discharge.

A single author (AP) retrospectively calculated modified CPIS at initial diagnosis of VAP and 72-hours post-diagnosis.[3] Incomplete records were excluded from analysis.

Patients were divided into cohorts of patients whose final cultures did and did not grow multidrug resistant organisms (MDROs) and also into a subgroup analysis of patients with MDROs who were administered empiric antibiotics that were appropriate (i.e. culture-proven organism sensitivity to initial antibiotics) and inappropriate.

Statistical analysis using student's t-test for continuous values and *chi*-squared test for ordinal values were performed with Wizard Pro for Mac (https://www.wizardmac.com/ accessed April 10, 2019), and significant p-value was set at ≤0.05 by convention.

RESULTS

One patient was excluded based on an incomplete dataset, and 49 patients met criteria for analysis. 25 (51%) were female. Mean age was 66.1±5.2 years-old. Injury severity was considered high with mean injury severity score (ISS) of 18.3±1.2, intensive care unit (ICU) length of stay (LOS) 16.7±3.1 days, mean ventilator days 15±3.2 days and mortality rate of 18.4%. Mean hospital LOS was 20.7±3 days.

Mean hospital day (HD) prior to VAP diagnosis was 5.4±0.7 days. Mean CPIS on the day of diagnosis was 5.8±0.5, and mean CPIS 72 hours after diagnosis was 4.9±0.6. The vast majority of patients, 39 (79.6%), received empiric antibiotics upon VAP diagnosis, using established hospital guidelines based on local anti-biogram data: intravenous vancomycin and meropenem.

Multidrug resistant organism (MDRO)-VAP occurred in 26 patients, 53.1% of the study population. Comparisons of patients who developed and did not develop MDRO-VAP as well as subgroup analysis of antibiotic appropriateness are summarized in Table 1.

Development of MDRO-VAP was associated with advanced age but not ISS and was also associated with delayed diagnosis and poorer

outcomes, including significantly lower survival, longer LOSs and increased ventilator days. Mean 72-hour CPIS was also significantly higher in the MDRO-VAP cohort although initial CPIS was not different.

Not unexpectedly, empiric antibiotics were frequently inappropriate among patients who developed MDRO-VAP with 9 (34.6%) of these patients requiring change of antibiotic course after finalization of culture and sensitivity results.

Subgroup analysis of patients who developed MDRO-VAP and had been started on inappropriate antibiotics revealed correlation of inappropriate antibiotic initiation and higher risk factors, delayed VAP diagnosis and poorer outcomes, including much higher mortality rate (88.9% vs 0, p<0.001).

72-hour CPIS score greater than or equal to six seemed to correlate well with delayed diagnosis and worse outcomes compared to 72-hour CPIS less than six and included longer LOSs and more ventilator days (TABLE 2). The inability of the patient to correct the CPIS score at 72 hours was clinically suggestive of failure of empiric therapy.

DISCUSSION

Despite advances in prevention efforts, diagnostic criteria and treatments for VAP, VAP remains a common and morbid condition suffered by severely-injured patients. Although advancements in antibiotic effectiveness and frequent use of empiric antibiotic coverage are useful tools for combating VAP, the emergence of MDROs can obviate the utility of these drugs; MDRO-VAP may present in patterns distinct from non-MDRO VAP; and MDROs may result from overuse of empiric antibiotics.[4,5]

The ability to predict the development of MDRO-VAP or to distinguish patients who may benefit from alterations of antibiotics perhaps through a tiered system of antibiotic escalation may help focus treatment of VAP and improve outcomes. We found that among severely-injured patients, 72-hour CPIS score greater than or equal to six was associated with development of MDRO-VAP and worse outcomes.

Our study suffers from the well-known limitations of retrospective study and the limited generalizability of single-center data. However, the prospective accrual of data suggests our patient population was representative of our urban trauma surgical service population. The retrospective calculation of CPIS may be subject to bias, and future studies should allow for multiple persons calculating CPIS or calculating CPIS prospectively in real-time. We also did not collect data on the types of injuries patients suffered, and variations in distribution of injuries more at-risk for pulmonary complications (e.g. chest trauma, traumatic brain injury, etc.) may have affected our analysis.

Despite our study's limitations, we conditionally recommend CPIS score be repeated daily after diagnosis of VAP among severely-injured patients and that antibiotic coverage change be considered if CPIS is six or greater 72 hours after VAP diagnosis especially if VAP diagnosis occurred later (i.e. after hospital day four) and among geriatric patients. Additionally, choice to narrow or discontinue antibiotics guided by repeat CPIS less than six is also indirectly supported by our data.

CONCLUSIONS

Initial CPIS calculations after VAP diagnosis have no clinical value. While not associated with survival to discharge, CPIS calculated 72 hours after VAP diagnosis may be used as a prognostic indicator for MDROs and improved short-term outcomes for trauma patients.

Notes

An abstract of these data was presented as a poster at the 2014 meeting of the Society of Critical Care Medicine in San Francisco, CA, USA: Pate A, Pito F and Chendrasekhar A. "736: 72-Hour Clinical Pulmonary Infection Score May Have Prognostic Value in Trauma Patients with VAP." *Critical Care Medicine.* Dec 2014;42(12):A1537. DOI: 10.1097/01.ccm.0000458233.92227.60

TABLE 1. Comparison of ventilator associated pneumonia (VAP) patients with multidrug resistant organism (MDRO) and non-MDRO infections and MDRO-VAP patients with inappropriate or appropriate empiric antibiotics. Development of MDRO-VAP did not correlate with injury severity but did correlate with older age and higher 72-hour clinical pulmonary infection score (CPIS). Initiation of inappropriate empiric antibiotic coverage was associated with increased risk factors and poorer outcomes compared to appropriate coverage. Delays in diagnosis of VAP were associated with MDRO-VAP, particularly those with inappropriate antibiotic coverage

	MDRO-VAP (n=26)	NON-MDRO-VAP (n=23)	p-value	MDRO-VAP Inappropriate Antibiotics (n=9)	MDRO-VAP Appropriate Antibiotics (n=17)	p-value
Age in years (SD)	74.6 (6.6)	56.4 (6.6)	<0.001	80.3 (10.9)	62.4 (5.6)	0.004
Injury severity score (SD)	17.7 (1.4)	18.8 (1.9)	0.16	23.6 (2.6)	16.9 (0.9)	<0.001
Mean ventilator days (SD)	21.2 (4.9)	8.0 (1.1)	<0.001	29.2 (8.4)	11.3 (2.4)	<0.001
Mean ICU-LOS in days (SD)	23.1 (4.6)	9.4 (1.1)	<0.001	29.4 (8.2)	13.4 (2.6)	<0.001
Mean hospital LOS in days (SD)	27.1 (4.3)	13.4 (0.9)	<0.001	31 (6.8)	18 (2.9)	<0.001
Mortality (%)	30.8	4.3	0.016	88.9	0	<0.001
Mean CPIS (SD)						
At diagnosis of VAP	5.6 (0.7)	6.1 (0.7)	0.18	6 (1.2)	5.4 (1.0)	0.22
72 hours after diagnosis of VAP	5.9 (0.9)	3.7 (0.7)	0.025	6.3 (1.8)	5.4 (1.1)	0.23
Mean hospital day of diagnosis (SD)	6.9 (1.0)	3.7 (0.3)	<0.001	8.2 (1.4)	4.7 (0.7)	<0.001

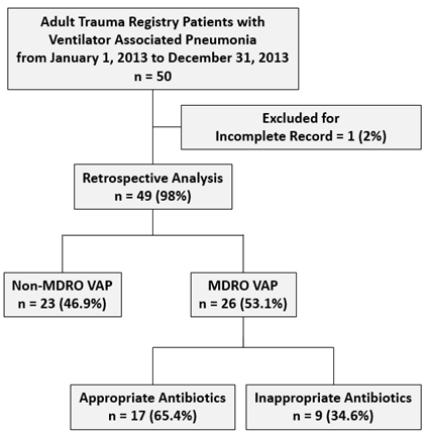

FIGURE 1. Study design examining trauma patients with ventilator associated pneumonia. Multidrug resistant organisms (MRDOs) and their antibiotic sensitivities were analyzed.

TABLE 2. 72-hour Clinical Pulmonary Infection Score (CPIS) greater than or equal to 6 is significantly associated with poorer outcomes.

	72-Hour CPIS <6 (n=31)	72-Hour CPIS ≥6 (n=18)	p-value
Male (%)	48.4	50	NS
Mean age (SD)	63.2 (6.6)	70.9 (8.9)	0.08
Mean ISS (SD)	17.8 (1.5)	19.2 (2.1)	0.12
Mean LOS in days (SD)	16.8 (3.1)	27.3 (5.2)	<0.001
Mean ICU-LOS in days (SD)	12.4 (2.9)	24.1 (5.6)	<0.001
Mean ventilator days (SD)	10.8 (3)	22.1 (5.9)	<0.001
Mean time to VAP diagnosis in days (SD)	4.4 (0.6)	7.1 (1.4)	<0.001
Mortality (%)	12.9	27.8	0.18

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