CONCISE COMMUNICATION

Impact of the Use of Procalcitonin Assay in Hospitalized Adult Patients with Pneumonia at a Community Acute Care Hospital

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A retrospective, quasi-experimental cohort study compared antibiotic use before and after implementation of a procalcitonin assay at a community acute care hospital. This study demonstrated that the implementation of the procalcitonin assay was associated with a decrease in antibiotic days of therapy in adult patients with pneumonia.

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Respiratory tract infections in the acute care setting are responsible for significant antibiotic exposure.[1] Routine laboratory testing may not provide timely information that would allow the discontinuation of unnecessary antibiotics. Biomarkers that differentiate bacterial and nonbacterial etiologies could be used as a tool in antimicrobial stewardship to help reduce unnecessary antibiotic exposure.

Procalcitonin (PCT) is a peptide precursor of calcitonin that increases in response to bacterial infections. Bacterial cytokines and toxins promote the release of PCT into the serum, whereas viruses inhibit the release of PCT. The level of PCT increases within 3–6 hours after the onset of a bacterial infection and will increase proportionally to the severity of infection.[2,3] Following the resolution of an infection, a decrease in the PCT level can be observed within 48 hours.[4] PCT has been shown to be a useful biomarker in guiding antibiotic therapy. In academic and nonacademic centers, a decrease in mean duration of antibiotic therapy of 2 days was observed in patients with lower respiratory tract infections with no difference in overall adverse outcomes.[5,6]

The objective of this study was to evaluate the impact of PCT assay on antibiotic days of therapy (DOT) in adult patients with pneumonia in a community acute care hospital.

METHODS

This single-center, quasi-experimental retrospective cohort study was conducted at Hoag Memorial Hospital Presbyterian in Newport Beach, California, a 498-bed community acute care hospital. This hospital had 3 adult intensive care units (ICUs), including a neurosurgical ICU, cardiac care unit, and cardiovascular ICU, with a total 33 ICU beds. The hospital had an intensivist program and 10 independent infectious disease (ID) physicians. This study design met the qualifications for an exemption from review by an institutional review board.

Patients who met study inclusion criteria were those ≥18 years old with an International Classification of Diseases, version 9 (ICD-9), diagnosis code for pneumonia (480.0–487.8) and either an ID consult and/or ICU stay. Because the PCT assay was acquired by the hospital laboratory in March 2010, patients were included in the No PCT (NP) group if they were admitted to the hospital within the time period of July through December 2008. Patients were included in the PCT group (P) if they were admitted to the hospital within the time period of July through December 2010 and had at least 1 PCT assay result. Medical staff were educated in June 2010 about the institution's PCT interpretive guidelines. The test was unrestricted. Guidelines provided recommendations on how to interpret PCT in sepsis and respiratory infections (Table 1).[7]

Midas Plus and Affinity were used to identify potential adult pneumonia patients meeting the inclusion criteria. Manual chart review by a single data abstractor was used to validate that the electronically identified patients met inclusion criteria. Electronic health records were used to collect antibiotic prescribing information, patient characteristics, and laboratory results. Data collected included patient demographic characteristics, antibiotic use, and laboratory and diagnostic results.

The primary end point was days of antibiotic therapy (DOT) during hospitalization. All antibiotics prescribed during a patient's admission were included regardless of indication. Appropriateness of antibiotics was not assessed.

PCT measurements were conducted using Vidas Brahms PCT with a functional assay sensitivity of 0.09 ng/mL. Assay run time was 20 minutes. Turnaround time for a PCT level was ~2 hours. The actual hospital cost to run a PCT assay was ~$40.

All data were entered into an Excel database and formatted for analysis. Statistical analyses were performed using SPSS

TABLE 1. Procalcitonin (PCT) Interpretation and Antibiotic Suggestion for Lower Respiratory Tract Infections

PCT (ng/mL)	Interpretation
<.1	Indicates absence of bacterial infection. Use of antibiotics strongly discouraged; also in presence of impaired pulmonary reserve.
.1 to <.25	Bacterial infection unlikely. Usage of antibiotics is discouraged.
.25 to <.5	Bacterial infection possible. Advise to initiate antibiotic therapy.
≥.5	Suggestive of the presence of bacterial infection. Antibiotic treatment strongly recommended.

NOTE. Clinicians should use the PCT results in conjunction with other laboratory findings and clinical signs of the patient, and interpret in the context with the clinical situation of the patient. The reference ranges above are given for orientation purpose only.

TABLE 2. Comparison of Patient Group Characteristics

Characteristic	NP group (n = 66)	P group (n = 50)	P
Age, mean ± SD	69.1 ± 12.7	67.1 ± 14.7	.44
Male	34 (52)	22 (44)	.46
Deaths[a]	10 (15)	8 (16)	1.00
ID consult	40 (61)	36 (72)	.24
ICU admission	32 (49)	19 (38)	.26
Other infections[b]	17 (26)	10 (20)	.51
Positive radiograph[c]	63 (96)	47 (94)	.73
Positive respiratory culture[d]	36 (55)	31 (62)	.42
Days of admission,[e] mean ± SD	9.3 ± 7.5	9.0 ± 7.9	.85
Days in ICU, mean ± SD	5.8 ± 4.8	6.3 ± 5.2	.72
Comorbidities			
Lung cancer or metastases[f]	8 (12)	11 (22)	.21
COPD	22 (33)	19 (38)	.60
Heart failure	9 (14)	10 (20)	.45
Asthma	10 (15)	4 (8)	.27

NOTE. Data are no. (%) of patients, unless otherwise indicated. COPD, chronic obstructive pulmonary disease; ICU, intensive care unit; ID, infectious disease; NP, no procalcitonin; P, procalcitonin; SD, standard deviation.

[a] Death from any cause.

[b] Suspected or confirmed infections other than pneumonia.

[c] Positive findings on chest radiograph or computed tomography of the chest.

[d] Bacterial growth from a respiratory culture.

[e] Days of hospitalization.

[f] Lung cancer or metastases to the lung.

for Windows 19 (SPSS). Demographic and outcome variables were compared between the 2 groups using appropriate statistical methods. Categorical variables were analyzed using χ^2 tests (or Mantel-Haenszel tests if indicated for nonparametric analysis); continuous variables were analyzed using an independent samples t test. All statistical tests were performed with 2-tailed analyses. Statistical differences between groups were considered significant when P values were less than .05.

RESULTS

A total of 325 patients were evaluated for eligibility (241 in the P group and 84 in the NP group). In total, 175 patients in the P group and 34 patients in the NP group were excluded from the study because they did not meet the ID Consult and/or ICU stay criteria. The final study population consisted of 116 patients (P group, n = 50; NP group, n = 66). Patient characteristics were not statistically different between the 2 groups (Table 2). The number of PCT results per patient ranged from 1 to 9. An average of 2 levels were drawn for each patient.

Median antibiotic DOT was 6 days (interquartile [IQR] range, 3–9) in the P group and 9 days (IQR, 5–13) in the NP group. This represents a reduction of 3 days in the primary end point (95% confidence interval [CI], 1.20–6.02; P = .004).

Antibiotic initiation and discontinuation were also evaluated. Antibiotics were initiated 100% of the time regardless of study group; however, over time there was a trend of earlier discontinuation of antibiotics in the P group than in the NP group (Figure 1).

DISCUSSION

This study demonstrates that the implementation of PCT in a community acute care hospital did not affect the initiation of antibiotics but was associated with a decrease in antibiotic DOT in adult patients with pneumonia. PCT may be an effective tool for community acute care hospital antimicrobial stewardship programs to help reduce unnecessary use of antibiotics in this population by decreasing duration of therapy.

Because this study was retrospective in design, it relied on the quality of chart documentation and administrative data.

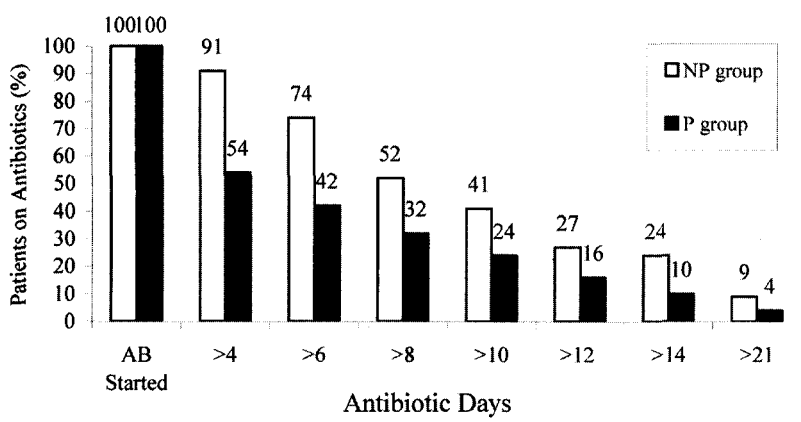

FIGURE 1. Percentage of patients on antibiotics from day 1 through 21 between the no procalcitonin (NP) and the procalcitonin (P) groups. AB, antibiotic.

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Additionally, the inclusion criteria requiring an ID consult and/or ICU stay may have selected for a more complicated patient population. Because this was a new unrestricted assay, the timing of testing may have varied. For this reason, the full benefits of PCT for earlier discontinuation of antibiotic therapy may not have been fully realized.

Future studies should be designed to evaluate how antimicrobial stewardship programs can use PCT effectively in other populations, such as outpatients or patients with other infectious syndromes. In addition to assessing outcomes such as DOT, future designs should evaluate other patient outcomes, such as readmission rates, resistance patterns, antibiotic toxicity, and costs.

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