ABSTRACT

Objective: The main goal of this study is to evaluate the efficacy of Procalcitonin (PCT) as a diagnostic tool in determining the appropriate time to stop antibiotic treatment, detecting bacterial infections in ICU, and avoiding the unnecessary use of antibiotics in clinical settings.

Methods: A cohort of 217 patients admitted to intensive care units was specifically chosen for investigation in this study. The participants' ages ranged widely from 15 to 93 years old, with an average age of 52.0 years and a standard deviation of 18.4 years. Detailed information regarding patient demographics, existing medical conditions, the use of invasive medical devices, and various imaging procedures were meticulously documented. Subsequently, the levels of serum PCT were quantified, and their relationship with different types of infections, antibiotic administration, and patient outcomes were thoroughly scrutinized. The statistical techniques utilised in this study included the application of log-rank tests, receiver operating characteristic (ROC) curves, and Kaplan-Meier survival curves to guarantee reliable data analysis.

Results: The predominant gender within the study population was male, accounting for 55.8% of the participants, while the majority of individuals were identified as non-smokers (61.8%) and had undergone invasive medical interventions (96.3%) and diagnostic imaging tests (90.3%). Among the cohort, diabetes mellitus (22.1%), chronic renal impairment (11.5%), and hypertension (32.3%) were the most common underlying medical disorders. Confirmed instances of infections were found in 73.3% of the patients, with respiratory infections as the most widespread (31.3%), postoperative site infections following (18.4%), bacteraemia (13.4%), and urinary tract infections (8.8%). In 76.0% of the cases, or a significant majority of the cohort, elevated serum levels of PCT (>0.5 ng/ml) were found. Antibiotic medication was started in 94.0 % of the patients, and it was stopped in 32.3 % of instances; nevertheless, a portion of these patients (30.3%) required more antibiotics to be administered. The overall mortality rate during the hospital stay was reported at 41.5%. Additionally, a clear relationship was shown between higher PCT levels and increased mortality risk; PCT levels increased from day 1 (3.81 ng/ml) through day 10 (2.66 ng/ml). The diagnostic specificity of PCT in identifying infections was remarkably low, with values of 80.0% for postoperative site infections, 85.2% for bacteraemia, 82.8% for respiratory infections, 87.5% for urinary tract infections, and 82.8% for sepsis, albeit the sensitivity remained consistently high, ranging from 19.6% to 31.8%. Analysis via ROC curves suggested substantial area beneath the curve (AUC) values for day three PCT levels in instances of sepsis (AUC = 0.6, p = 0.040) and bacteraemia (AUC = 0.6, p = 0.036). Survival analysis using Kaplan-Meier curves revealed higher survival probabilities among individuals with PCT levels below 0.5 ng/ml, albeit statistical significance was not achieved. Noteworthy, the monitoring of PCT levels led to a substantial reduction in the duration of antibiotic therapy (p = 0.001).

Conclusion: Procalcitonin emerges as a remarkably sensitive biomarker for the detection of diverse infections in critically ill patients within ICU settings, despite its constrained specificity. The findings from this study provide substantial evidence supporting the utility of PCT in guiding antibiotic regimens, thus curtailing inappropriate antibiotic utilization and potentially enhancing patient outcomes. The association between elevated PCT levels and heightened in-hospital mortality underscores the critical role of PCT monitoring in the management of severely ill patients within intensive care units. Further investigations are strongly recommended to refine and optimize PCT-based strategies for antibiotic stewardship in ICU environments.

Key points from the analysis…

**Evaluate Procalcitonin (PCT) as a Diagnostic Tool in the Cessation of Antibiotics**

Antibiotic Discontinuation: Out of 204 patients who were started on antibiotics, 66 (32.3%) had their antibiotics discontinued based on PCT levels, indicating PCT’s role in guiding antibiotic cessation.

Re-initiation of Antibiotics: Among those who had antibiotics discontinued, 20 (30.3%) required re-initiation, showing the dynamic use of PCT levels to manage antibiotic therapy.

**Use PCT to Determine Bacterial Infection in the ICU**

High Sensitivity: PCT showed high sensitivity in diagnosing infections with the following rates:

Surgical Site Infections (SSI): 80.0%

Bloodstream Infections (BSI): 85.2%

Respiratory Tract Infections (RTI): 82.8%

Urinary Tract Infections (UTI): 87.5%

Sepsis: 82.8%

Correlation with Infection Types: Majority of patients with confirmed infections had elevated PCT levels (>0.5 ng/ml), supporting its use as an indicator for bacterial infections:

Respiratory tract infections: 31.3%

Surgical site infections: 18.4%

Bloodstream infections: 13.4%

Urinary tract infections: 8.8%

ROC and AUC Analysis: Significant AUC for day three PCT levels in sepsis (AUC = 0.6, p = 0.040) and BSIs (AUC = 0.6, p = 0.036), suggesting PCT as a marker for these conditions.

**Use PCT to Guide Against Irrational Use of Antibiotics**

Reduction in Antibiotic Duration: There was a significant reduction in the duration of antibiotic use among patients with PCT levels < 0.5 ng/ml on arrival and discharge (p = 0.001), indicating that PCT helps in minimizing unnecessary antibiotic use.

In-Hospital Mortality and PCT Levels: Patients with higher PCT levels (>0.5 ng/ml) had higher in-hospital mortality rates (41.5%). Monitoring PCT levels helped identify patients at higher risk and guide appropriate antibiotic therapy.

Survival Analysis: Kaplan-Meier curves showed higher intrahospital survival rates for patients with PCT levels < 0.5 ng/ml, although not statistically significant, it supports the clinical relevance of PCT in improving patient outcomes.

**Additional Supporting Points:**

Patient Demographics and Comorbidities: Detailed recording of demographics, comorbidities, and clinical interventions provides a comprehensive overview, affirming the broad applicability of PCT in diverse ICU patient populations.

Invasive Procedures and Imaging: High prevalence of invasive procedures (96.3%) and imaging (90.3%) aligns with critical care settings, emphasizing the necessity of accurate infection markers like PCT.

PCT Trends and Outcomes: The median PCT values showed a trend of reduction from day 1 to day 7, followed by a rise on day 10, correlating with patient outcomes and highlighting the importance of ongoing PCT monitoring in managing infections.