Use of Procalcitonin and Antimicrobial Stewardship Intervention to Limit Antibiotic Utilization in Patients Admitted to a Community Hospital with SARS-CoV-2 Infection

Paula A. Politis, PharmD, BCPS, BCIDP, FIDSA; Michael Oravec, MPH; Lisa Hoisington, PharmD, BCPS; Michael J. Tan, MD, FACP, FIDSA; Shanu Agarwal, MD, FIDSA; Thomas M. File, Jr. MD, MSc, MACP, FIDSA, FCCP

Summa Health System, Akron, OH

Summa Health System–Akron Campus
525 East Market Street, PO Box 2090
Akron, OH 44304
Phone: 330-375-3375
Fax: 330-375-7622
Email: politisp@summahealth.org

Abstract

Background: Patients admitted with SARS-CoV-2 are often treated with antibiotics and antivirals, although bacterial co-infection is uncommon. Overuse of unnecessary antibiotics can lead to increased bacterial resistance, adverse events, and costs. Our Antimicrobial Stewardship (AS) Program routinely provides recommendations for appropriate therapy based on molecular/microbiologic tests, clinical findings, and procalcitonin (PCT). The purpose of our QI project was to review the appropriateness of antibiotics utilized for patients admitted with SARS-CoV-2 and to promote optimal patient care and AS at our institution.

Methods: We performed a retrospective review of SARS-CoV-2 patients from our institution's COVID-19 registry from March 2020-April 2021. We compared patients with PCT< 0.25 ng/mL vs. PCT≥ 0.25 ng/mL and assessed differences in patient characteristics and disease presentation.

Results: If prescribed antibiotics, median duration of antibiotic therapy was significantly reduced in the PCT < 0.25 group vs. the PCT ≥ 0.25 group. Median WBC, SOFA score, serum creatinine, and length of stay were significantly lower in the PCT < 0.25 group. Severity adjusted models showed significantly decreased duration and overall likelihood of antibiotic use for PCT < 0.25 vs. PCT ≥ 0.25. 30 day readmission and mortality were significantly lower in the PCT < 0.25 group.

Conclusion: Antibiotic utilization was reduced in patients admitted with SARS-CoV-2 infection and PCT < 0.25, and if prescribed antibiotics, duration was significantly shorter vs. those in the PCT ≥ 0.25 group.

Introduction

- Patients admitted to the hospital with SARS-CoV-2 infection are often treated with antibiotics, although bacterial co-infection is uncommon[1,2]
- Unnecessary use of antibiotics may lead to antimicrobial resistance, undesired adverse effects, disruption of the normal microbiome, and increased healthcare costs
- Use of PCT can provide additional evidence against the likelihood of concomitant bacterial infection
- One study evaluated implementation of guidelines that recommended no antibiotics in SARS-CoV-2 patients with a low PCT. Results demonstrated reduced antibiotic use in low PCT patients without increase in mortality[3]
- PCT, particularly with AS intervention, can be a useful tool in the decision to discontinue antibiotics if SARS-CoV-2 monomicrobial infection is suspected

Materials and Methods

- Retrospective review of SARS-CoV-2 patients from our institution's COVID-19 registry for patients hospitalized from March 2020-April 2021
- Compared patients with PCT< 0.25 ng/mL vs. PCT≥ 0.25 ng/mL and assessed differences in patient characteristics and disease presentation including: age, gender, WBC, SCr, culture results, disease severity, patient location, duration of antibiotics, length of stay, 30 day readmission and mortality
- Independent sample t-tests were used to compare means, Mood's median test to compare medians and Pearson's chi-squared test to compare proportions
- Multivariable linear and logistic regression used to adjust for severity

Results

Table 1: Demographics

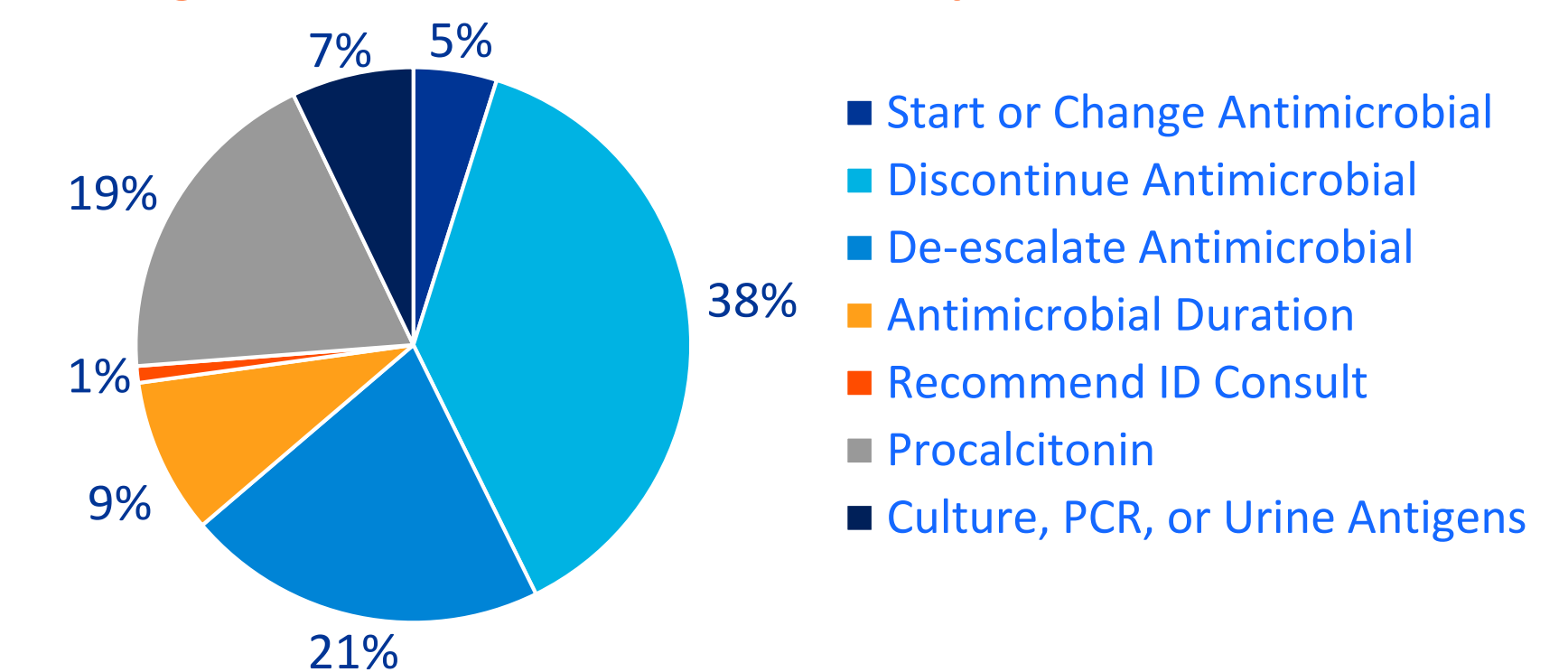|	PCT < 0.25 ng/mL (n =1486)	PCT ≥ 0.25 ng/mL (n = 520)	P-Value
Age, mean (SD)	65.3 (16.3)	67.3 (15.0)	0.011
Female, no. (%)	742 (49.9)	201 (38.7)	<0.001
ICU admission, no. (%)	336 (22.6)	255 (49.0)	<0.001
Max SOFA score, median (IQR)	4 (2-6)	7 (5-10)	<0.001
WBC baseline, median (IQR)	6.3 (4.7-8.5)	8.2 (5.8-12.0)	<0.001
SCr baseline, median (IQR)	0.89 (0.71-1.16)	1.37 (0.95-2.47)	<0.001
Positive blood culture, no. (%)	165 (11.1)	125 (24.0)	<0.001
Positive sputum culture, no. (%)	106 (7.1)	98 (18.9)	<0.001

Table 2: Outcome Data

	PCT < 0.25 ng/mL (n =1486)	PCT ≥ 0.25 ng/mL (n = 520)	P-Value
Given antibiotics, no. (%)	809 (54.4)	424 (81.5)	<0.001
Duration of antibiotics (days), median (IQR)	2 (0.5-4.7)	4.1 (1.9-8.1)	<0.001
Length of stay (days), median (IQR)	5 (4-8)	7 (5-13)	<0.001
30 day readmission, no. (%)	125 (8.4)	69 (13.3)	0.001
30 day in-house mortality, no. (%)	147 (9.9)	151 (29.0)	<0.001

Table 3: Adjusted Predictors for Antibiotic Use and Duration

	Adjusted difference in ABX duration, days (β, 95% CI)	P-value	Adjusted likelihood for no ABX use, (OR, 95% CI)	P-value
PCT < 0.25 ng/mL	-1.23 (-1.90, -0.56)	<0.001	2.29 (1.68, 3.12)	<0.001
Positive blood or sputum culture	2.46 (1.78, 3.13)	<0.001	0.25 (0.18, 0.36)	<0.001
Max SOFA score	0.19 (0.08, 0.30)	0.001	0.86 (0.83, 0.90)	<0.001
Admitted in 2021 vs. 2020	-1.61 (-2.28, -0.95)	<0.001	5.14 (4.11, 6.42)	<0.001

Figure 1: Antimicrobial Stewardship Interventions

- Start or Change Antimicrobial — 5%
- Discontinue Antimicrobial — 38%
- De-escalate Antimicrobial — 21%
- Antimicrobial Duration — 9%
- Recommend ID Consult — 1%
- Procalcitonin — 19%
- Culture, PCR, or Urine Antigens — 7%

Discussion

- ICU admission, median SOFA score, WBC and SCr all significantly lower in the PCT < 0.25 group
- Higher incidence of positive blood, sputum cultures in PCT ≥ 0.25 group
- 81.5% of patients in the PCT ≥ 0.25 group prescribed antibiotics vs. only 54.4% in the PCT < 0.25 group
- If given antibiotics, median duration of antibiotics significantly lower in the PCT < 0.25 group (2 days vs. 4.1 days in PCT ≥ 0.25 group)
- Median length of stay, 30 day readmission, and 30 day in-house mortality significantly lower in the PCT < 0.25 group
- Severity adjusted models showed significantly decreased duration and overall likelihood of antibiotic use for PCT <0.25 vs. PCT ≥ 0.25
- The AS Team at Summa Health – Akron Campus made a total of 309 interventions on SARS-CoV-2 patients during this time frame
- The most common recommendations included: discontinue antimicrobials, de-escalate antimicrobials, recommend PCT

Conclusions

- SARS-CoV-2 patients with PCT < 0.25 presented less severely, had shorter length of stay, lower readmission and mortality rates vs. patients with PCT ≥ 0.25
- Antimicrobial use was reduced in patients admitted with SARS-CoV-2 infection and PCT < 0.25, and if prescribed antibiotics, duration was significantly shorter vs. those in the PCT ≥ 0.25 group
- Use of PCT and AS intervention in SARS-CoV-2 patients can lead to more appropriate antimicrobial use (i.e. discontinuing antimicrobials if not indicated)

References

1. Langford BJ, So M, Raybardhan S, et al. Bacterial co-infection and secondary infection in patients with COVID-19: a living rapid review and meta-analysis. *Clin Microbiol Infect* 2020; 26:1622–9.
2. Langford BJ, So M, Raybardhan S, et al. Antibiotic prescribing in patients with COVID-19: rapid review and meta-analysis. *Clin Microbiol Infect* 2021; 27:520–31.
3. EJ Williams, L Mair, TI de Silva, et al. Evaluation of procalcitonin as a contribution to antimicrobial stewardship in SARS-CoV-2 infection: a retrospective cohort study *J Hosp Infect* 2021; 110:103-7.