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Brief report

Impact of a clinical microbiology–intensive care consulting program in a cardiothoracic intensive care unit

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A preintervention-postintervention study was carried out over a 4-year period to assess the impact of an antimicrobial stewardship intervention, based on clinical microbiologist ward rounds (clinical microbiology–intensive care partnership [CMICP]), at a cardiothoracic intensive care unit. Comparison of clinical data for 37 patients with diagnosis of bacteremia (18 from preintervention period, 19 from postintervention period) revealed that CMICP implementation resulted in (1) significant increase of appropriate empirical treatments (+34%, $P = .029$), compliance with guidelines (+28%, $P = .019$), and number of de-escalations (+42%, $P = .032$); and (2) decrease (average = 2.5 days) in time to optimization of antimicrobial therapy and levofloxacin (Δ 2009-2012 = −74 defined daily dose [DDD]/1,000 bed days) and teicoplanin (Δ 2009-2012 = −28 DDD/1,000 bed days) use.

Following recommendations of scientific societies, reliance on antimicrobial stewardship programs (ASPs) has recently increased worldwide.[1] The scope of ASPs is to preserve current and future antibiotics against the threat of antimicrobial resistance while simultaneously optimizing outcomes and possibly reducing costs.[2-4] Clinical microbiologists are among the core members of ASP teams.[1] However, literature data analyzing the real impact of clinical microbiologist's activity on clinical outcome and antibiotics consumption are lacking.

From 2011, we implemented an ASP intervention based on a clinical microbiology–intensive care partnership (CMICP) consisting in daily rounds of the clinical microbiologist in the cardiothoracic intensive care unit (ICU) of a tertiary care university hospital. In this work we retrospectively analyzed the impact of this CMICP model after 2 years of activity.

METHODS

Inclusion criteria

The study was performed at the 11-bed cardiothoracic ICU of Siena University Hospital. All patients admitted during a 4-year period (2009-2012) with a diagnosis of bacteremia were evaluated for inclusion. Patients with blood cultures positive for coagulase-negative staphylococci were included only if the same microorganism, with an identical antimicrobial susceptibility profile, was isolated from at least 2 positive blood cultures. Only the first episode of bacteremia was considered for each patient.

CMICP

From 2011, a clinical microbiologist visited the ICU daily (5 d/wk) and discussed with the intensivists the clinical-microbiologic conditions of each patient, focusing on (1) preliminary and definitive microbiology-virology results; (2) infection-related diagnostic and therapeutic issues; (3) infection control needs; and (4) optimization of anti-infective management based on preliminary microbiologic results and antimicrobial susceptibility testing.

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Microbiologic results were directly available during the consultation via electronic connection with the laboratory information system.

Outcomes

Clinical outcomes evaluated were length of mechanical ventilation, occurrence of renal failure, length of ICU stay starting from the first episode of diagnosed bacteremia, and all-cause 30-day mortality. The statistical analysis was performed using SPSS 11.5.0 software package (SPSS, Chicago, IL). The Kolmogorov-Smirnov test was used to test for normal distribution of the data. Binomial data were compared using χ^2 analysis or Fisher exact test with Yates correction, as appropriate. Continuous data were compared using unpaired Student *t* test or Mann-Whitney *U* test, as appropriate. Data are presented as mean ± SD unless otherwise indicated. A *P* value <.05 was considered statistically significant. The study was approved by the regional ethics committee (study code ICMP_2015).

Antimicrobial chemotherapy data

Antimicrobial prescriptions were recorded from the collection of the first positive blood culture to patient discharge. The antibiotic regimen was evaluated at initiation of empirical therapy, switch to a narrower-spectrum antibiotic (de-escalation), or modification of the regimen once identification and antimicrobial susceptibility data were available.

The antimicrobial therapy was judged appropriate when at least 1 of the agents was active in vitro against the causative organism(s) and was given at adequate timing and doses.

Compliance with guidelines was evaluated with reference to the Sanford Guide to Antimicrobial Therapy. Bacterial isolation, identification, and susceptibility testing were performed following standard laboratory procedures.

The consumption of vancomycin, teicoplanin, piperacillin-tazobactam, meropenem, and levofloxacin was obtained from hospital pharmacy records. Consumption data were converted in defined daily dose (DDD) per 1,000 bed days, according to the 2014 version of the ATC (Anatomical Therapeutic Chemical)-DDD classification.[5]

RESULTS

Overall, 37 patients matched the inclusion criteria. Eighteen (group 1) and 19 (group 2) patients were admitted before and after implementation of the CMICP, respectively.

The 2 groups were comparable with regard to preoperative and intraoperative data. The most frequent pathogens were *Staphylococcus aureus* in group 1 (28%) and *Escherichia coli* in group 2 (16%) (data not shown). The proportion of gram-negative and gram-positive isolates was substantially unchanged in the study period, with predominance of gram-negative isolates (61% vs 63%, *P* value = not significant), and no trend in the prevalence of antimicrobial resistance patterns was observed among bacterial pathogens isolated during the same period.

No statistical differences were found between groups 1 and 2 regarding morbidity and mortality. By contrast, significant differences were found in the proportions of patients receiving appropriate antimicrobial therapy: patients in group 2 more frequently received at least 1 active antibiotic empirically at the diagnosis (89% vs 55%, *P* value = .029) and a definitive therapy fully compliant with guidelines (72% vs 100%, *P* value = .019). Modification of the antibiotic regimen according to susceptibility testing or bacterial identification results was carried out in 10 of 18 cases (55.5%) in group 1 and in 14 of 19 cases (73%) in group 2 (not significant). Furthermore, in group 2, modification of the antibiotic regimen was more frequently a de-escalation (69% vs 27%, *P* value = .032). Interestingly, in group 2, the therapy was revised on average 2.5 days earlier (*P* value = .01) (Table 1).

Table 1
Clinical characteristics and operative, outcome, and antimicrobial prescription data

Variable	Group 1 (n = 18)	Group 2 (n = 19)	*P* value
Demographics data			
Age (y)	74 ± 7	67 ± 10	.03
Sex (male)	11 (61)	15 (78)	n.s.
Body weight (kg)	75.5 ± 16	77 ± 16	n.s.
BSA (m^2)	1.8 ± 0.2	1.8 ± 0.2	n.s.
Clinical characteristics			
Actively smoking	3 (17)	3 (16)	n.s.
COPD	3 (17)	4 (21)	n.s.
Arterial hypertension	12 (67)	13 (68)	n.s.
Recent AMI	1 (5)	1 (5)	n.s.
Diabetes on therapy	8 (44)	5 (26)	n.s.
Renal insufficiency (dialysis)	1 (5)	1 (5)	n.s.
EUROScore standard	9.3 ± 4	8.7 ± 3	n.s.
EUROScore logistic	21.1 ± 24	17.7 ± 14	n.s.
Operative data			
Elective surgery	12 (67)	11 (58)	n.s.
Emergency/urgency surgery	6 (33)	8 (42)	n.s.
Coronary surgery	4 (22)	3 (16)	n.s.
Valve surgery	3 (17)	2 (10)	n.s.
Coronary and valve surgery	6 (33)	8 (42)	n.s.
Heart transplantation	1 (5)	3 (16)	n.s.
Artificial heart implantation	0	1 (5)	n.s.
Other	4 (22)	2 (10)	n.s.
Postoperative morbidity and mortality			
Bleeding requiring reoperation	8 (44)	5 (26)	n.s.
Low cardiac output	10 (55)	9 (47)	n.s.
Atrial fibrillation	8 (44)	9 (47)	n.s.
Brain injury	9 (50)	5 (26)	n.s.
Renal insufficiency	3 (16)	7 (37)	n.s.
Tracheostomy	6 (33)	4 (21)	n.s.
Gut ischemia	0	1 (5)	n.s.
Pneumothorax	1 (5)	2 (10)	n.s.
Duration of mechanical ventilation (d)	14 ± 13	19 ± 13	n.s.
ICU length of stay (d)	24 ± 20	28 ± 16	n.s.
30-d mortality	4 (22)	6 (31)	n.s.
Antimicrobial prescription data			
Empirical treatment appropriate	10 (55)	17 (89)	.029
Therapy adjustment	10 (55)	14 (78)	n.s.
Time to therapy adjustment (d)	5.1 ± 3.1	2.5 ± 1.4	.011
De-escalation therapy	3 (27)	10 (69)	.032
Guidelines compliance	13 (72)	19 (100)	.019

NOTE. Values are n (%), mean ± SD, or as otherwise indicated.
AMI, acute myocardial infarction; *BSA*, body surface area; *COPD*, chronic obstructive pulmonary disease; *EuroSCORE*, European System for Cardiac Operative Risk Evaluation; *ICU*, intensive care unit; *n.s.*, not significant.

Considering the 2.5 days decrease in time to therapy revision, it was possible to calculate that for the treatment of patients in group 2, at least 30 DDD of broad-spectrum antibiotics were saved (meropenem, vancomycin, and piperacillin-tazobactam).

The analysis of the global consumption of antibiotics in the studied ICU revealed a significant reduction of teicoplanin (Δ 2009-2012 = −28 DDD/1,000 bed days) and levofloxacin (Δ 2009-2012 = −74 DDD/1,000 bed days) usage, with no variation in the usage of vancomycin after introduction of the CMICP model (Fig 1). Meropenem consumption increased significantly from 2010-2012, but it remained stable after the introduction of the CMICP model. Piperacillin-tazobactam use showed only a slight increase.

DISCUSSION AND CONCLUSIONS

Our study demonstrates that, as previously speculated by other authors,[6,7] the implementation of the CMICP can significantly