Surgical antimicrobial prophylaxis in intensive care unit (ICU) patients: a preliminary, observational, retrospective study

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Background: Surgical antimicrobial prophylaxis (SAP) is supported by evidence-based guidelines. Nevertheless, SAP guidelines do not cover all clinical scenarios. To our knowledge, no information is available regarding SAP in the critically ill patients. We designed a retrospective, observational and preliminary study which the objective was to describe our professional practices in intensive care unit (ICU) patients requiring SAP.

Methods: All patients admitted for more than 48 h in the ICU and requiring surgery were retrospectively included from January 1st to December 31, 2016. We collected data related to infection, colonization and antimicrobial treatments pre- and post-operatively. We assessed the compliance of SAP to guidelines.

Results: Among 41 included patients, 13 (32%) were treated for an ongoing infection and 21 (51%) received at least one antibiotic during the ICU stay. Seven (17%) were colonized. Twenty-one (51%) patients received SAP according to guidelines. Thirteen postoperative infections including 1 surgical site infection were reported. For 10 (24%) patients, the ongoing antimicrobial treatment was continued in the operating room. No surgical site infection and 1 lung infection was reported. In 3 (7%) patients, no SAP was administered and 1 episode of bacteremia was noted. Three (7%) patients had their ongoing treatment changed in the operating room. Two of them developed a lung infection. The other patients were assessed individually due to complex conditions.

Conclusions: These preliminary data showed a large heterogeneity in the management of SAP in the ICU, suggesting the need for specific guidelines based on clinical trials.

Keywords: Surgical antimicrobial prophylaxis (SAP); intensive care unit (ICU); microbiology

Introduction

The use of surgical antimicrobial prophylaxis (SAP) in the operating room is supported by evidence-based guidelines (1). The goal of SAP is to decrease surgical site infection (SSI) rates (2,3). The rules for prescription of SAP are stringent: the antimicrobial drug must be a narrow-spectrum agent (1), the drug should be administered 30–60 minutes before surgical incision (4-6) and the duration of prophylactic

treatment should not exceed 48 h (7,8).

Nevertheless, SAP guidelines do not cover all clinical scenarios and the efficacy of SAP depends on several factors, including selection of the appropriate antibiotic(s), the timing of antibiotic administration, its dosage, and route of administration. Patients admitted to an intensive care unit (ICU) are often exposed to broad-spectrum antibiotics, multi-drug resistant (MDR) pathogen carriage and recurrent infections (9). More than 75% of them receive at least one antimicrobial drug during their ICU stay (10). They are also exposed to endogenous (organ failure, immunosuppression) and exogenous (invasive devices) factors which increase the risk of healthcare-associated infection. In France, the RAISIN network showed that 10.6% of extended-spectrum beta-lactamase-producing Enterobacteriaceae (ESBL-E) and 9.3% of methicillin-resistant *Staphylococcus aureus* (MRSA) contaminations were found in ICU patients. In addition, around 11% of patients hospitalized more than 2 days in ICU were colonized by MDR pathogens (9,11).

To our knowledge, no information is available SAP in patients who recently received an antimicrobial therapy, in those with bacterial colonization, or in those at higher risk of carrying MDR pathogens. ICU patients may require transfer to the operating room for surgery, thereby requiring SAP. To assess this issue, we designed a retrospective study, with a primary objective of describing our professional practices in ICU patients requiring SAP. The secondary objectives were to report the incidence and ecology of postoperative infections in our ICU patients.

Methods

Study design and study participants

This descriptive, non-interventional, single-center, retrospective study was carried out in the department of Anesthesiology and Critical Care Medicine of the Teaching Hospital "Hôpital Nord" in Marseille, France, from January 1st to December 31st, 2016. Included were all adult patients admitted to the ICU and scheduled for surgical intervention in the operating room following at least 48 hours of ICU stay. We excluded from our analysis the patients with incomplete data, those in brain death undergoing organ donation and those dying during the surgery. Since our study was retrospective and non-interventional, ethical research committee oversight and patient consent were waived (IRB n°00010254-2016-126).

Clinical setting: in our 15-bed ICU, selective digestive tract decontamination is routinely administered only to severe trauma, brain trauma and cardiac arrest patients. Our patients with MRSA carriage or ESBL-E were isolated during the ICU stay. Cultures are not taken routinely for surveillance.

Data collection

Data were retrieved from medical files and clinical software used in our institution. For each patient, the following data were collected:

Preoperative data
- ❖ Preoperative colonization: pathogens, antimicrobial susceptibility, sites;
- ❖ Preoperative infections: pathogens, antimicrobial susceptibility, sites, antimicrobial therapy used;
- ❖ Administration of a preoperative empirical antimicrobial therapy.
- ❖ Screening for ESBL-E and MRSA with rectal and/or nasal swab respectively;
- ❖ Administration of selective digestive tract decontamination. This is defined in our center as:
  - ◆ Two grams of intravenous cefazolin every 8 hours for 48 hours and
  - ◆ Colistin, gentamicin and amphotericin B administered as an oral paste for the duration of mechanical ventilation.

Pathogens are grouped in the results as Gram-negative bacteria, Gram-positive cocci and non-fermenting Gram-negative bacteria to facilitate presentation.

Perioperative and postoperative data
- ❖ Type of surgery;
- ❖ Surgical wound classification (12);
- ❖ Antimicrobial drug (type) used in the operating room;
- ❖ Diagnostic of infection and/or colonization within 30 days after surgery;
- ❖ Site, microorganisms and drug resistance profile.

Definitions of pre and postoperative infection, colonization and drug resistance profiles:

Preoperative infection was diagnosed using criteria from the international sepsis forum consensus conference (13,14). Preoperative colonization was defined as a positive microbiological sampling without infection criteria and without antimicrobial therapy needed. Microorganisms were classified by their drug-resistance profile using criteria from the REA-RAISIN network (11):
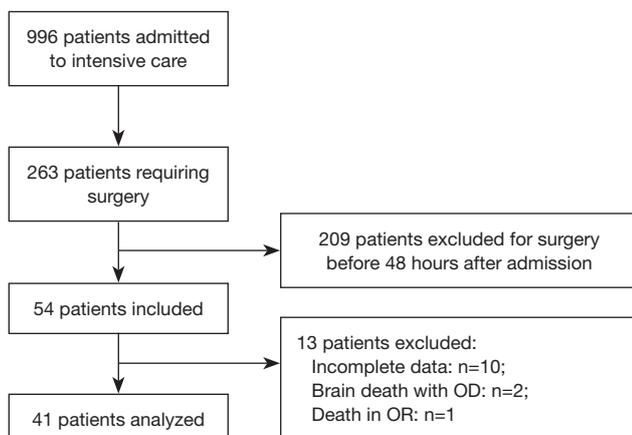- ❖ RAISIN 0: natural resistance profile;

Figure 1 Flowchart of inclusions. OD, organ donation; OR, operating room.

❖ RAISIN 1: low level of drug resistance (i.e., penicillinase secretion), MRSA susceptible to aminoglycosides;
❖ RAISIN 2: high level of drug resistance including cephalosporinase secretion, ceftazidime resistance for Gram-negative bacteria, MRSA resistant to aminoglycosides;
❖ RAISIN 3: multidrug resistance with broader resistance profile than RAISIN 2.

Pathogens with drug-resistance profiles RAISIN 0 and 1 were considered "low level of antimicrobial resistance". Pathogens with drug-resistance profiles RAISIN 2 and 3 were considered "high level of antimicrobial resistance".

Surgical wounds were classified following Center for Disease Control Hospital Infection Control Practices Advisory Committee.

Primary and secondary outcome measures

Our primary objective was to describe our professional practices in ICU patients requiring SAP, measuring the adherence to guidelines. The secondary objectives were to report the incidence and ecology of postoperative infections in our ICU patients.

Data from patient files were analyzed by the authors in order to assess the management of the antimicrobial prophylaxis drug prescription, regarding guideline adherence and preoperative infection anamnesis.

Statistical analysis

Statistical analysis was performed using R software version 3.4.1 (London, UK). Only descriptive analyses were used for the purpose of this study. Qualitative variables are presented as numbers and percents. Quantitative variables are presented as medians and interquartile ranges. The number of patients was not calculated before the study because no data were available in the literature. We performed several subgroup univariate analysis in order to identify characteristics associated with occurrence of colonization and infection after surgery. Comparisons between the continuous data were performed using Student's t-test and with the chi-square test for categorical variables. All comparisons were two-tailed and $P<0.05$ was required to exclude the null hypothesis. Thus, we considered the study as exploratory and collected the data for 1 year.

Results

Between January 1st and December 31st of 2016, 996 patients were admitted to the ICU. Among those, 263 (26%) underwent surgery during their ICU stay and 209 were not included because surgery was performed within the first 48 h after ICU admission. Fifty-four patients fulfilled inclusion criteria. Among these 13 were excluded as follows: incomplete data (n=10), brain death with organ donation (n=2), death in the operating room (n=1). The files of 41 patients were analyzed (*Figure 1*).

SAP management and postoperative impact

Preoperatively, 13 (32%) patients were being treated for an ongoing infection and 7 (17%) patients were colonized. At least 1 antibiotic was administered before surgery to 21 (51%) patients (*Table 1*). The surgical wounds were classified as reported above (14): clean, clean/contaminated, contaminated, and dirty in 20 (49%), 7 (17%), 1 (2%) and 13 (32%) of interventions respectively. According to guidelines, SAP was recommended for each patient.

For 10 (24%) patients (group 1), antimicrobial therapy that was already being administered in the ICU (either empirical or tailored to microbiological findings) was also continued in the operating room. Only one patient developed postoperative infection (ventilator-associated pneumonia) due to a Gram-negative bacterium with a low-

Table 1 Preoperative infectious data

Analyzed variable	All patients (n=41)	
	Preoperative infection	Preoperative colonization
Site of infection, n [%]		
Lung	6 [15]	5 [12]
Urinary tract	0	1 [2]
Digestive tract	1 [2]	1 [2]
Bacteremia	3 [7]	0
Soft tissues	1 [2]	0
Total	11 [27]	7 [17]
Type of microorganism, n [%]		
GNB low level	7 [54]	5 [50]
GNB high level	1 [8]	1 [10]
GPC low level	2 [15]	1 [10]
GPC high level	0	0
NF-GNB low level	3 [23]	3 [30]
NF-GNB high level	0	0
Clostridium difficile	0	0
Total	13 [100]	10 [100]
Preoperative antimicrobial drugs, n [%]		
Narrow-spectrum BL	9 [21]	–
BL combined with beta lactamase	14 [33]	–
Antipseudomonal BL	2 [5]	–
Carbapenems	5 [12]	–
Antistaphylococcal agent	3 [7]	–
Aminoglycoside	9 [21]	–
Total	43 [100]	–

The total number of antibiotics may exceed the total number of patients. GNB, gram-negative bacteria; GPC: gram-positive cocci; NF, non-fermenting; BL, beta-lactam; low level, low level of antimicrobial drug resistance; high level, high level of antimicrobial drug resistance.

level of antimicrobial resistance. No SSIs were identified. For 3 (7%) patients (group 2), the antimicrobial therapy given in the ICU was modified during the procedure. One patient received antimicrobial therapy in accordance with guidelines (1) and the 2 others received a combination of meropenem and amikacin. Two of the 3 patients developed postoperative pulmonary infections with highly resistant pathogens (Pseudomonas aeruginosa). Three (7%) patients (group 3) received no SAP in the operating room. One out of these 3 patients developed a bacteremia with a low-resistance pathogen.

Twenty-one (51%) patients (group 4) required SAP and the drug was chosen according to local guidelines. Thirteen postoperative infections were identified, including 1 SSI due to an ESBL Klebsiella pneumonia and methicillin-resistant Staphylococcus epidermidis. A total of 27 pathogens were found, including 17 (63%) pathogens with low antimicrobial resistance and 10 (37%) with high antimicrobial resistance. Details on postoperative infections are shown in *Table 2*. Details on postoperative colonization are found in *Table 3*.

We identified 4 (10%) patients with an infectious history that raised issues regarding SAP prescription. The patients were either colonized with resistant pathogens or had recently been treated with antimicrobials that were broader than the spectrum of the recommended SAP drugs. Two patients received SAP in accordance with local guidelines, but the drug chosen provided coverage that was narrower than the antimicrobial treatment administered in the ICU stay or that required to cover existing bacterial colonization. These patients did not develop postoperative infections. Two patients received SAP with a drug not recommended by the local guidelines, but the drug was chosen based on prior antimicrobial treatment during ICU stay or bacterial colonization. These two patients developed urinary tract infections with low-antimicrobial resistance pathogens (*Table S1*). The details of postoperative infectious data are shown in *Table 4*.

Explorative univariate analysis comparing patients presenting: (I) colonization; (II) infection; (III) both colonization or infection in the 30 days after surgery are presented in *Table 5* and in *Tables S2,S3*.

Discussion

Our study unveiled heterogeneity in practice of SAP for patients going to surgery more than 48 hours after ICU

Table 2 Details of postoperative infections and microbiological findings

Analyzed variable	Group 1 (n=10)	Group 2 (n=3)	Group 3 (n=3)	Group 4 (n=21)
Site of infection, n [%]				
Lung	1 [10]	2 [67]	0	5 [24]
Urinary tract	0	0	0	3 [14]
Digestive tract	0	0	0	1 [5]
Bacteremia	0	0	1 [33]	3 [14]
Soft tissues	0	0	0	0
SSI	0	0	0	1 [5]
Total	1 [10]	2 [67]	1 [33]	13 [62]
Type of microorganism, n [%]				
GNB low level	2 [67]	0	0	9 [41]
GNB high level	0	0	0	6 [27]
GPC low level	0	0	1 [100]	0
GPC high level	0	0	0	2 [9]
NF-GNB low level	1 [33]	0	0	3 [14]
NF-GNB high level	0	2 [100]	0	1 [5]
Clostridium difficile	0	0	0	1 [5]
All low level	3 [100]	0	1 [100]	13 [59]
All high level	0	2 [100]	0	9 [41]
Total	3 [100]	2 [100]	1 [100]	22 [100]

Group 1: continuation of an ongoing antimicrobial therapy; Group 2: modification of an ongoing antimicrobial therapy; Group 3: absence of SAP; Group 4: introduction of adequate SAP. SSI, surgical site infection; GNB, gram-negative bacteria; GPC, gram-positive cocci; NF, non-fermenting; low level, low level of antimicrobial drug resistance; high level, high level of antimicrobial drug resistance.

Table 3 Details of postoperative colonization and microbiological findings

Analyzed variable	Group 1 (n=10)	Group 2 (n=3)	Group 3 (n=3)	Group 4 (n=21)
Site of colonization, n [%]				
Lung	0	1 [33]	0	1 [5]
Urinary tract	0	1 [33]	0	3 [14]
Digestive tract	0	0	0	0
Bacteremia	0	0	0	0
Soft tissues	0	0	0	0
SSI	0	0	1 [33]	0
Total	0	2 [67]	1 [33]	4 [19]

Table 3 *(continued)*

Table 3 (continued)

Analyzed variable	Group 1 (n=10)	Group 2 (n=3)	Group 3 (n=3)	Group 4 (n=21)
Type of microorganism, n [%]				
GNB low level	0	0	0	2 [40]
GNB high level	0	1 [50]	0	1 [20]
GPC low level	0	0	2 [100]	0
GPC high level	0	0	0	0
NF-GNB low level	0	0	0	2 [40]
NF-GNB high level	0	1 [50]	0	0
Clostridium difficile	0	0	0	0
All low level	0	0	2 [100]	4 [80]
All high level	0	2 [100]	0	1 [20]
Total	0	2 [100]	2 [100]	5 [100]

Group 1: continuation of an ongoing antimicrobial therapy; Group 2: modification of an ongoing antimicrobial therapy; Group 3: absence of SAP; Group 4: introduction of adequate SAP. SSI, surgical site infection; GNB, gram-negative bacteria; GPC, gram-positive cocci; NF, non-fermenting; low level, low level of antimicrobial drug resistance; high level, high level of antimicrobial drug resistance.

Table 4 Postoperative infectious data

Analyzed variable	All patients (n=41)	
	Postoperative infection	Postoperative colonization
Site of infection, n [%]		
Lung	8 [20]	2 [5]
Urinary tract	5 [12]	4 [10]
Digestive tract	1 [2]	0
Bacteremia	4 [10]	0
Soft tissues	0	0
SSI	1 [2]	1 [2]
Total	19 [46]	7 [17]
Type of microorganism, n [%]		
GNB low level	12 [40]	2 [22]
GNB high level	6 [20]	2 [22]
GPC low level	1 [3]	2 [22]
GPC high level	2 [7]	0
NF-GNB low level	5 [17]	2 [22]
NF-GNB high level	3 [10]	1 [11]
Clostridium difficile	1 [3]	0
All low level	19 [63]	6 [67]
All high level	11 [37]	3 [33]
Total	30 [100]	9 [100]

SSI, surgical site infection; GNB, gram-negative bacteria; GPC, gram-positive cocci; NF, non-fermenting; low level, low level of antimicrobial drug resistance; high level, high level of antimicrobial drug resistance.

admission. SAP in intensive care patients is controversial. Current guidelines do not offer definitive answers but do comprise best practice recommendations. The guidelines suggest that when protocols are modified, potential infectious hazards should be clearly identified and the advantage of deviating from recommendations be evaluated against the potential harm such practice may have for the community (1). However, the impact of colonization or ongoing infection due to MDR bacteria on SAP efficacy remains poorly assessed. As a result, in routine practice adherence to this recommendation in ICU patients remains challenging.

Patients receiving antimicrobial therapy before surgery continued the same antibiotic regime in 77% of the cases. Among these, only a single case of postoperative pneumonia was reported. In contrast, we report a high rate of postoperative infection due to resistant pathogens in patients for whom ongoing antimicrobial therapy was modified or discontinued in the operating room. This finding would suggest an advantage for non-modification of ongoing antimicrobial treatment, although future studies are needed to confirm this hypothesis (15,16).

In ICU patients that were not receiving antimicrobial therapy prior to the operating room, adherence to guidelines was feasible in the majority of cases (84%). Among those patients, the rate of SSI observed in the current study (5%) correlates with that described in the general literature (0.1% to 50%) (17). The proportion of highly resistant pathogens found in the current study

Table 5 Explorative univariate analysis of patients presenting any postoperative colonization or infection

Analyzed variable	Patient without any postoperative colonization or infection (n=24)	Patient with any postoperative colonization or infection (n=17)	P value
Demographic characteristics			
Male gender [%]	22 [92]	15 [88]	0.71
Age ± SD (years)	46±4	42±5	0.48
BMI	23±0.9	24±0.8	0.79
Admission characteristics			
SAPS II score	49±4	45±4	0.56
SOFA score at admission	6±0.5	5±0.7	0.22
Type of admission, n [%]			0.29
Trauma	15 [63]	15 [88]	
Surgery	5 [21]	1 [6]	
Medical	4 [17]	1 [6]	
Evolution before surgery			
Time of MV before surgery (days)	11±4	5±0.6	0.24
Time before surgery (days)	11±4	5±0.6	0.28
Use of SOD before surgery [%]	11 [46]	10 [59]	0.41
Use of antibiotic for any infection before surgery, n [%]	6 [25]	0	0.03
Evolution after surgery			
SOFA score at surgery day	5±0.6	4±0.6	0.62
ASA score at surgery day	4±0.2	4±0.2	0.89
SAP group, n [%]			0.28
1	7 [29]	1 [6]	
2	2 [8]	3 [18]	
3	3 [13]	2 [12]	
4	12 [50]	11 [65]	
Total length of ICU stay (days)	28±9	33±5	0.61
Death, n [%]	5 [21]	3 [18]	0.80

Quantitative variables are presented with standard error. BMI, body mass index; SAPS, Simplified Acute Physiology Score; SOFA, Sequential Organ Failure Assessment; MV, mechanical ventilation; SDD, selective digestive decontamination; ASA, American Society of Anesthesiologist; SAP, surgical antimicrobial prophylaxis; ICU, intensive care unit.

(38%) was also in line with a previous study (18). These preliminary findings would suggest that SAP guidelines should be followed in ICU patients.

Data from our cohort shows that a clinical documentation of infection or colonization interferes with SAP prescription in only 10% of cases. In this situation, the heterogeneity of SAP management observed in our study underlines the need for large-scale studies and guidelines elaboration.

Our study suffers several limitations. The small number of patients included in the study does not allow definitive conclusions. The retrospective study design and the fact that the data was taken from only one center limits generalization of our results. We do not follow a preset protocol for patients undergoing surgery during their ICU

stay. Neither postoperative infections nor colonization can be attributed to surgery or SAP. Results of anal swabbing was not taken into account for SAP prescription. In our unit, we do not perform systematic screening at admission. To our knowledge, no definitive data showed a benefit of systematic ESBL-E screening in terms of outcome (19), even if this issue is still matter of debate (20). No conclusion can be drawn from our data regarding the issue of ESBL-E colonization in ICU patients.

In conclusion, this hypothesis-generating study comprises only a preliminary analysis. Our results raise several points that merit further assessment in large-scale prospective studies. Our data suggests that antimicrobial therapy given in the ICU should be continued in the operating room in patients that have spent more than 48 hours in the ICU. Adherence to guidelines for SAP seems feasible and safe in ICU patients. Most importantly, the heterogeneity of practice observed in a single team underlines the need for further guideline elaboration in this complex population of patients.

Acknowledgements

Footnote

Conflicts of Interest: M Leone receives fees from Pfizer and MSD for lectures. The other authors have no conflicts of interest to declare.

Ethical Statement: Since our study was retrospective and non-interventional, ethical research committee oversight and patient consent were waived (IRB n°00010254-2016-126).

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Table S1 Details of the four challenging situations

Analyzed variable	Patient A	Patient B	Patient C	Patient D
Preoperative findings	Amoxicillin/clavulanic acid used as empiric antimicrobial therapy	Preoperative digestive colonization with low-level of drug resistance *P. aeruginosa* and *E. cloacae*	Preoperative lung colonization with low-level of drug resistance *E. cloacae*	Amoxicillin/clavulanic acid used as empiric antimicrobial therapy
SAP used	Cefazolin	Cefazolin	Piperacillin/tazobactam	Piperacillin/tazobactam
Clinician choice	Adhesion to guideline protocols	Adhesion to guideline protocols	Modification of guideline protocols	Modification of guideline protocols
Postoperative infection	0	0	Urinary tract	Urinary tract
Postoperative microbiology	0	0	Low level of drug resistance *E. cloacae*	Low level of drug resistance *A. baumanii*

SAP, surgical antimicrobial prophylaxis.

Table S2 Explorative univariate analysis of patients presenting any postoperative infection

Analyzed variable	Patient without any postoperative infection (n=27)	Patient with any postoperative infection (n=14)	P value
Demographic characteristics			
Male gender, n [%]	25 [93]	12 [86]	0.48
Age (years)	45±4	43±5	0.79
BMI	23.5±0.8	23.8±0.9	0.83
Admission characteristics			
SAPS II score	49±3	44±4	0.45
SOFA score	6±0.5	5±0.5	0.11
Type of admission, n [%]			0.55
Trauma	18 [67]	12 [86]	
Surgery	5 [19]	1 [7]	
Medical	4 [15]	1 [7]	
Evolution before surgery			
Time of MV before surgery (days)	10±3	5±0.7	0.30
Time before surgery (days)	10±3	6±0.7	0.40
Use of SDD before surgery, n [%]	24 [89]	14 [100]	0.19
Use of antibiotic for any infection before surgery, n [%]	14 [52]	0	0.06
Evolution after surgery			
SOFA score at surgery day	4.9±0.5	4.2±0.5	0.46
ASA score at surgery day	4.1±0.1	3.9±0.2	0.41
SAP group, n [%]			0.27
1	7 [26]	1 [7]	
2	2 [7]	3 [21]	
3	4 [15]	1 [7]	
4	14 [52]	9 [64]	
Total length of ICU stay (days)	27±7	35±5	0.45
Death, n [%]	6 [22]	2 [14]	0.54

Quantitative variables are presented with standard error. BMI, body mass index; SAPS, Simplified Acute Physiology Score; SOFA, Sequential Organ Failure Assessment; MV, mechanical ventilation; SDD, selective digestive decontamination; ASA, American Society of Anesthesiologist; SAP, surgical antimicrobial prophylaxis; ICU, intensive care unit.

Table S3 Explorative univariate analysis of patients presenting any postoperative colonization

Analyzed variable	Patient without any postoperative colonization (n=34)	Patient with any postoperative colonization (n=7)	P value
Demographic characteristics			
Male gender, n [%]	30 [88]	7 [100]	0.34
Age ± SD (years)	45±3	39±9	0.47
BMI	24±0.7	23±1	0.68
Admission characteristics			
SAPS II score	47±3	49±5	0.12
SOFA score at admission	5±0.4	6±1.3	0.25
Type of admission, n [%]			0.89
Trauma	25 [74]	5 [71]	
Surgery	5 [15]	1 [14]	
Medical	4 [12]	1 [14]	
Evolution before surgery			
Time of MV before surgery (days)	9±3	6±0.5	0.38
Time before surgery (days)	9±3	5±0.6	0.35
Use of SOD before surgery, n [%]	16 [47]	5 [71]	0.24
Use of antibiotic for any infection before surgery, n [%]	10 [30]	4 [57]	0.16
Evolution after surgery			
SOFA score at surgery day	5±0.5	5±1.3	0.56
ASA score at surgery day	3.9±0.1	4.1±0.2	0.09
SAP group, n [%]			0.56
1	8 [24]	0	
2	4 [12]	1 [14]	
3	4 [12]	1 [14]	
4	18 [53]	5 [71]	
Total length of ICU stay (days)	28±6	40±8	0.44
Death, n [%]	7 [21]	1 [14]	0.70

Quantitative variables are presented with standard error. BMI, body mass index; SAPS, Simplified Acute Physiology Score; SOFA, Sequential Organ Failure Assessment; MV, mechanical ventilation; SDD, selective digestive decontamination; ASA, American Society of Anesthesiologist; SAP, surgical antimicrobial prophylaxis; ICU, intensive care unit.