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Please cite this article: INCIDENCE, IN-HOSPITAL MORTALITY AND RISK FACTORS FOR HOSPITAL–ACQUIRED PNEUMONIA IN PATIENTS WITH INTRA-ABDOMINAL SURGICAL PROCEDURES HOSPITALIZED IN A TERTIARY HOSPITAL IN BELGRADE, SERBIA: A MATCHED CASE–CONTROL STUDY

Naslov na srpskom


UDC:

DOI: https://doi.org/10.2298/VSP180521125T

When the final article is assigned to volumes/issues of the Journal, the Article in Press version will be removed and the final version appear in the associated published volumes/issues of the Journal. The date the article was made available online first will be carried over.
1. **Title:** Incidence, in-hospital mortality and risk factors for hospital–acquired pneumonia in patients with intra-abdominal surgical procedures hospitalized in a tertiary hospital in Belgrade, Serbia: a matched case–control study

2. **Authors:**
   
   1. Taušan Đorđe, Pulmonology Clinic, Military Medical Academy, Crnotravška 17, 11000 Belgrade, Serbia; tausandjordje@gmail.com
   2. Kostić Zoran, Clinic for General Surgery, Military Medical Academy, Crnotravska 17, 11000 Belgrade, Serbia; Faculty of Medicine of Military Medical Academy, University of Defence, Crnotravska 17, 11 000 Belgrade; sara_kostic@yahoo.com
   3. Slavković Damjan, Clinic for General Surgery, Military Medical Academy, Crnotravska 17, 11000 Belgrade, Serbia; damjanslavkovic@gmail.com
   4. Nešković Branimir, Clinic for General Surgery, Military Medical Academy, Crnotravska 17, 11000 Belgrade, Serbia; neskob@yahoo.com
   5. Bokonjić Dubravko, National Poison Control Centre, Crnotravska 17, Military Medical Academy, 11000 Belgrade, Serbia; Faculty of Medicine of Military Medical Academy, University of Defence, Crnotravska 17, 11 000 Belgrade; nckt@vma.mod.gov.rs
   6. Šipetić-Grujičić Sandra, Institute of Epidemiology, Faculty of Medicine, University of Belgrade, Višegradska 26, 1 1000 Belgrade, Serbia; sandra.grujicic2014@gmail.com
   7. Ratković Nenad, Clinic for Emergency Internal Medicine, Crnotravska 17, Military Medical Academy, 11000 Belgrade, Serbia; Faculty of Medicine of Military Medical Academy, University of Defence, Crnotravska 17, 11 000 Belgrade; ratkovic@eunet.rs
   8. Šuljagić Vesna, Department of Nosocomial Infections Control, Military Medical Academy, Crnotravska 17, 11000 Belgrade, Serbia; Faculty of Medicine of Military Medical Academy, Crnotravska 17, 11 000 Belgrade; suljagicv@gmail.com

**Corresponding author:** Taušan Đorđe, Pulmonology Clinic, Military Medical Academy, Crnotravska 17, 11000 Belgrade, Serbia; tausandjordje@gmail.com
ABSTRACT

**Background:** Hospital-acquired pneumonia (HAP) in surgical population significantly increases morbidity and mortality, prolonging hospitalization and increasing total treatment costs. In the present study, we aimed to determine incidence, in-hospital mortality and risk factors (RFs) of HAP in patients with intra-abdominal surgical procedures hospitalized in a tertiary hospital in Belgrade (Serbia).

**Methods:** Through regular hospital surveillance of surgical patients with intra-abdominal surgical procedures, we prospectively identified postoperative HAP during five years. In the matched case-control study, every surgical patient with HAP was compared with four control patients without HAP. In the group of patients with HAP, those who died were compared with those who survived.

**Results:** Overall 1.4% of all intra-abdominal surgical patients developed HAP in the postoperative period. The incidence of HAP (per 1000 operative procedures) was greatest in patients undergoing exploratory laparotomy (102.6), followed by small bowel surgery (36.6), gastric surgery (22.7). Multivariate logistic regression analysis (MLRA) identified three independent RF associated with HAP: multiple transfusion (p=0.011; OR: 4.26; 95% CI: 1.59-11.33), length of hospital stay (p=0.024; OR: 1.02; 95%CI: 1.00-1.03) and hospitalization in Intensive care unit (ICU) (p=0.043; OR: 2.83; 95%CI: 1.03-7.71). MLRA identified only surgical site infection as an independent RF associated with the poor outcome of HAP (p=0.017; OR: 5.929; CI95%: 1.37-25.67).

**Conclusion:** The results of the present study are valuable in documenting the relations between RFs and HAP in patients undergoing intra-abdominal surgical procedures.

**Key words:** hospital-acquired pneumonia, intra-abdominal surgical procedure, risk factor, incidence in-hospital mortality

BACKGROUND

Hospital-acquired pneumonia (HAP) is a very serious health problem in hospitals all over the world (1-3). It is the infection of lower respiratory tract that occurs clinically two or more days after hospitalization and was not incubating at the time of hospital admission (4). The reported incidence of HAP varied according to the type of population studied, ward location and length of hospital stay (1,2,5). Critically ill patients admitted to intensive care units (ICUs) carry higher risk of HAP than those treated outside ICUs. Ventilator-associated
pneumonia (VAP) refers to HAP that develops among patients on mechanical ventilators (MV) and presents more than 48 hours after endotracheal intubation (6). HAP in surgical population significantly increases morbidity and mortality, prolonging hospitalization and increasing total treatment costs (7-10). Surveillance of HAP provides useful data in identifying risk factors (RF) that contribute to the development and outcome of HAP. In the present study, we aimed to determine incidence, in-hospital mortality and RFs of HAP in patients with intra-abdominal surgical procedures hospitalized in a tertiary hospital in Belgrade (Serbia).

METHODS

Setting

The Military Medical Academy (MMA), Belgrade, Serbia, a teaching hospital of the University of Defense, is a 1200-bed tertiary healthcare center divided in 27 departments according to medical specialty. The Clinic for General Surgery is a 72-bed department of MMA. Department of Infection Control performs continuous surveillance of healthcare-associated infections (HAI), including HAP, on surgical patients of MMA.

Study population

Through regular hospital surveillance of surgical patients with intra-abdominal surgical procedures, we prospectively identified postoperative HAP during the study period, from 1st January 2007 to 31st December 2011. Reviewing the clinical chart information on patient characteristics, RFs related to health care were collected. We gathered data on the following variables: patients characteristics existing before operative procedures - gender, age, body mass index (BMI), the presence of underlying diabetes mellitus, tobacco use, preoperative infection, American Society of Anesthesiologists (ASA) score, factors related to health care including the length of hospital stay, ICU admission, MV, central vascular catheter (CVC), histamine-2-receptor antagonists (H2RAs), proton-pump inhibitors (PPIs) and preoperative antibiotic prophylaxis, red blood cell transfusion, outcome of treatment (live/dead) and characteristics of operative procedure – elective surgery, upper abdominal surgery, duration of operation, class of contamination of surgical site, drainage, duration of drainage and surgical site infection (SSI). In the case-control study, every surgical patient with HAP was compared with four control patients without HAP. Control patients were matched to the cases by age (± 5 years), ASA score and date of surgical operation. In the group of patients with HAP those who died were compared with those who survived.
Definition

Pneumonia is defined as "new lung infiltrates plus clinical evidence that the infiltrate is of an infectious origin, which include the new onset of fever, purulent sputum, leukocytosis, and decline in oxygenation" (11). HAP was diagnosed by the consultative specialist of pulmology based on the presence of radiographic shadowing (3,4,12). SSI is defined according to the CDC/NHSN (Centers for Disease Control and Prevention/National Healthcare Safety Network) surveillance definitions (12). All patients were assessed before operation by anesthesiologist for the ASA score (13). The National Research Council operative site classification was used by surgeon to class surgical wounds as clean, clean/contaminated, contaminated, and dirty/infected (14).

Multiple transfusions is defined as more than one pack of red blood cell.

Patients with preoperative pneumonia and pneumonia that developed after postoperative respiratory failure were excluded.

No post-discharge surveillance was performed.

Microbiological testing

The microbiological testing was performed at MMAs Institute of Medical Microbiology. The microbiological methods used according to the protocol for HAP included sputum or tracheal aspirate cultures and serial blood cultures.

Statistical analysis

Incidence rate (IR) was defined as the number of HAP per 1000 specific intra-abdominal operative procedures. The in-hospital mortality rate was defined as the number of deaths per 100 patients with HAP.

Data analyses were performed with SPSS, version 18.0 (SPSS, Inc, Chicago, IL). Results were expressed as the mean ± SD or as proportion of the total number of patients. The χ² test or Fischer exact test were used for categorical variables and relative risk, and their corresponding 95% confidence intervals (CI) were calculated. For parametric continuous variables, mean values were compared using Student t test. For nonparametric continuous variables, the Mann-Whitney U test was used. RFs independently associated with HAP were identified by the stepwise logistic regression analysis of variables selected by univariate analysis, with a limit for entering and removing variables at 0.05.
The informed written consent was obtained from all participants. The Research Ethics Board of the MMA approved the research protocol.

RESULTS

Study population

During 2007-2011 in the Clinic for General Surgery of MMA, the surveillance of HAIs during 8003 operative procedures was performed. In this study only patients with intra-abdominal operations were included. Among the sample of 3758 intra-abdominal operations, colorectal surgery was the most common operative procedure performed, accounting 1524 or 40.6% (Table 1). Appendix surgery was the second most common intra-abdominal operative procedure (accounting 474 or 12.6%), followed by small bowel surgery (accounting 464 or 12.3%), gastric surgery (accounting 441 or 11.7%) and bile duct, liver or pancreatic surgery (accounting 361 or 9.6%). Other associated operative procedures included exploratory laparotomy (accounting 39 or 1.0% o) and spleen surgery (accounting 36 or 1.0%)

Incidence of HAP

Overall 1.4% (51 of 3758) of all intra-abdominal surgical patients developed HAP in the postoperative period. The incidence of HAP (per 1000 operative procedures) was greatest in patients undergoing exploratory laparotomy (102.6 per 1000 operative procedures), followed by small bowel surgery (36.6 per 1000 operative procedures), gastric surgery (22.7 per 1000 operative procedures), gallbladder surgery (9.5 per 1000 operative procedures), colorectal surgery (8.4 per 1000 operative procedures), bile duct, liver or pancreatic surgery (5.5 per 1000 operative procedures) and appendix surgery (2.1 per 1000 operative procedures). Spleen surgery was not complicated by HAP.

Forty-one surgical patients with HAP were enrolled in the case-control study. A random sample of 164 control patients matched by age (±5 years), ASA score and date of surgical operation were selected from a total of 3707 potentially matched controlled subjects. For 10 patients data were incomplete, so we excluded them from the study of RF. Of 41 patients with HAP, 34 or 82.9% were treated in ICU more than 48h and 16 or 39.0% were at some time on MV. Twelve or 29.3% patients were diagnosed with VAP.

Risk factors for the acquisition of HAP
The HAP cases had mean age of 63.54 ± 12.85 and 61.0 % were the male.

Patients’ characteristics, procedures during hospitalization, and characteristics which depend on surgery procedure in the case and control groups according to univariate logistic regression analysis (ULRA) are shown in Table 2. According to ULRA, the next characteristics were more frequent in cases with HAP than in controls: better outcome, longer hospitalization, hospitalization in ICU, CVC, MV, H2RA or PPI, multiple transfusion, preoperative antibiotic prophylaxis, elective surgery, contaminated and dirty/infected class of contamination, drainage, longer duration of drainage and SSI.

Multivariate logistic regression analysis (MLRA) identified three independent RFs associated with HAP in surgical patients: multiple transfusion (p=0.011; OR: 4.26; 95% CI: 1.59-11.33), length of hospital stay (p=0.024; OR: 1.02; 95% CI: 1.00-1.03) and hospitalization in ICU (p=0.043; OR: 2.83; 95% CI: 1.03-7.71).

**Risk factors for the poor outcome of HAP**

The mortality rate in patients with HAP in this study was 48.8% and it was significantly higher in cases than in the control group (p < 0.001).

Patients’ characteristics, procedures during hospitalization, and characteristics which depend on the surgery procedure in the survived and patients who died according to ULRA are shown in Table 2. The patients with HAP who died had significantly greater frequency of the use of MV (p=0.045) and SSI (p=0.010) than surgical patients with HAP who survived. MLRA identified only SSI as an independent RF associated with the poor outcome in surgical patients with HAP (p=0.017; OR: 5.929; CI95%: 1.37-25.67).

**Microbiological etiology**

In 26.8% (11 patients) of HAP, microbiological etiology could be confirmed. *Pseudomonas aeruginosa* was the most frequent etiology, diagnosed in 5 cases: by blood culture in one case and by sputum or tracheal aspirate culture in four cases of HAP. *Klebsiella* spp. was diagnosed in 4 cases: by blood culture in two cases and by sputum or tracheal aspirate culture in 2 cases of HAP. *Staphylococcus aureus* was diagnosed in 3 cases: by blood culture in one case and by sputum or tracheal aspirate culture in 2 cases of HAP. *Acinetobacter* spp. was diagnosed in 4 cases by sputum or tracheal aspirate culture.

**DISCUSSION**
Incidence rate

HAP in surgical patients with intra-abdominal surgical procedures causes significant morbidity and mortality and prolongs hospital stays (8, 9). In this study we analyzed postoperative HAP in large cohort of intra-abdominal surgical patients. During the study period 51 or 1.4% of surgical patients were diagnosed with HAP in the postoperative period. The overall incidence of HAP was similar to incidence reported in the study of Delagdo-Rodriguez (15), but lower than that reported in studies of Mohri (7), Thompson (8), and Patel (9). These differences could be related to differences in type of operative procedures conducted, characteristics of hospital populations studied, surveillance methods used. In our study the incidence of HAP was greatest in the group of 39 patients undergoing exploratory laparotomy (102. 6 per 1000 operative procedures). In that population of patients, Thompson reported rate of 16.5, but their sample was 9054 operative procedures. Edwards et al. estimated rate of 6.0 postoperative pneumonias per 1000 colon surgery procedures (16). In our study, colorectal surgery was the most common operative procedure performed, accounting 1524 or 40.6% of the operative procedures with HAP rate of 8.3 per 1000 per procedures.

Spleen surgery was not complicated by HAP in our patients (only 36 patients with splenectomy as a separate operative procedure) because we most commonly performed that procedure in younger patients after trauma or to treat underlying medical conditions such as thrombocytopenia, certain leukemia, or lymphomas.

Risk factors for the acquisition of HAP

In the study of 571 elective operations for gastric cancer, Thompson at al. found that female patients were two times more likely than male patients to develop HAP (8). On the other hand, Mohri et al. found that after surgery for gastric cancer male patients had five times greater risk to acquire HAP (7). Our study showed that gender was not associated with HAP as well as with HAP poor outcome.

Our study identified three independent RFs for acquiring HAP: multiple transfusions, length of hospital stay and hospitalization in ICU.

Systematic review and meta-analysis of the randomized trials conducted among hospitalized patients showed that a restrictive RBC transfusion strategy compared with a liberal transfusion strategy was not associated with a reduced risk of health care–associated infection overall, although it was associated with a reduced risk of serious infection (17). In a survey of 2,809 colorectal resections, transfusion was the single most powerful
RF for postoperative infection (18). Intra- and/or postoperative blood transfusion were independent RFs for development of postoperative HAP after elective resection of gastric cancer (7). Our patients with multiple transfusions were four times likely than patients without history of multiple transfusions to develop HAP (p=0.011; OR: 4.258; CI95%: 1.59-11.33).

The prospective multicenter cohort study of 268 major elective abdominal surgery procedures showed that postoperative pulmonary complications, with pulmonary infection as most common (9% of all patients), had the most striking impact on hospital length of staying (median hospital length of stay was extended from 3 to 10 days) (9). Also, Thomson et al. reported that the mean length of hospital stay for intra-abdominal surgery patients who developed HAP was significantly greater compared with patients who did not develop HAP (17.10 ± 18.66 vs. 6.07 ± 5.37; p < 0.001) (8). In our study, the length of hospital stay in patients with HAP was 46.63 ± 30.38, and in patients without HAP it was 21.88 ± 19.96 (p=0.024; OR: 1.02; 95% CI: 1.00-1.03). Prolonged hospitalization in our patients explains the fact that the majority of our patients were primarily hospitalized at the Clinic for Gastroenterology of MMA because of the implementation of the preoperative diagnostic procedures, which was then followed by the hospitalization at the Clinic of Abdominal Surgery where surgery was performed.

HAP is a frequent and severe infection in ICU, with the highest morbidity and mortality (19). Alp et al showed that the rate of HAP, in patients in ICU was much higher in medical than in surgical patients (11.7% vs 5.8%). Also, they showed that MV was more frequently used in medical than surgical patients (p < 0.01) (20). In our study of intra-abdominal surgical patients with HAP, 34 or 82.9% were treated in ICU more than 48h and 16 or 39.0% were at some time on MV. In the study of ICU treated patients, Karhu et al. reported that 80% of the HAP patients needed MV (21). Our study showed that ICU and MV were associated with the acquisition of HAP, but MV didn't retain significance as an independent RF in MLRA.

In a large, hospital-based pharmacoepidemiologic cohort study, Herzig et al. found that acid-suppressive medication use was associated with 30% increased odds of HAP. In subset analyses, the risk for HAP was significantly increased with PPI, but not with histamine H2RA (22). Our patients with HAP received acid suppressive medications (H2RA or PPI) more frequently than patients in control group (90.4% vs 53.4%), but according to ULRA, only H2RAs significantly increased the risk of HAP (p=0.007), without being significant independent RF.
Risk factors for the poor outcome of HAP

The combination of hospital-acquired pneumonia and ventilator-associated pneumonia constitutes the most common cause of death among all hospital-acquired infections, with mortality rates of up to 33% (23). In surgical population, mortality from postoperative HAP ranges from 10.7% (8) to 45% (24). The prognosis in patients with HAP depends primarily on host defenses, existing comorbidities and initial empiric therapy. The mortality rate in patients with HAP in our study was 48.8% and it was significantly higher in case than in the control group (p < 0.001). In our patients HAP was not the primary cause of death but it was mentioned in the clinical chart information. We identified SSI as an independent RF for the poor outcome of HAP. Some previous study of the relationship between hospital-acquired infection and in-hospital mortality in surgical patients showed that the association of a SSI and either a respiratory tract infection or a bloodstream infection also increased significantly the risk of in-hospital mortality (25). The longitudinal study based on prevalence data from a large emergency and referral teaching hospital in Norway, found that hospital-acquired bloodstream infection, hospital-acquired lower respiratory tract infections or more than one simultaneous hospital-acquired infection were independently and strongly associated with increased mortality 30 days and 1 year after inclusion in the study (26).

Microbiological etiology

After systematic review Jones concluded that top six most prevalent pathogens (S. aureus, P. aeruginosa, Klebsiella species, E.coli, Acinetobacter species, and Enterobacter species) consistently cause 80% of all HAP or VAP episodes, in contrast to only 3.7%–7.3% by S. pneumoniae and Haemophilus species (27). As reported in the study of Sopena et al, the etiology of HAP was known in less than one-third of our patients because of the inability to perform the invasive diagnostic procedure in most of cases (5). In our study identification of the causative agent was possible in only 11 or 26.8% patients with HAP. Pseudomonas aeruginosa was the most frequent etiology of HAP.

Limitation and strength of the study

The limitations of the study. Firstly, limitation is the possibility of confounding variables that were not examined in our study. Although confounding variables were chosen after an exhaustive search of the literature, the potential for oversight and exclusion does exist. We did not include some parameters, namely
existing of chronic obstructive pulmonary diseases and other chronic lung diseases, alcohol use, appropriate empiric treatment and analyzing these factors could have enhanced the relevance of our results. Furthermore, we did not evaluate the HAP cases and the controls in relation to the age and ASA score, because HAP cases and controls were matched according to them.

Secondly, this was the single centre study and the number of patients with HAP was relatively small. Finally, our mortality outcome was limited to in-hospital mortality rate. However, it is unlikely that other measures of mortality, such as 30-day mortality, would give more precise RF for the poor outcome of HAP.

The strength of our study is that it could be generalized to surgical patients with intra-abdominal surgical procedures.

CONCLUSION

During the study period 1.4% of intra-abdominal surgical patients were diagnosed with Hospital acquired Pneumonia (HAP) in the postoperative period. We identified three independent risk factors (RFs) for acquiring HAP: multiple transfusions, length of hospital stay and hospitalization in Intensive care units (ICU). Also, we identified SSI as an independent RF for the poor outcome of HAP. The results of the present study are valuable in documenting the relations between RFs and HAP in patients undergoing intra-abdominal surgical procedures.

List of abbreviations:

HAP: hospital-acquired pneumonia; RF: risk factors; ICUs: intensive care units; VAP: ventilator-associated pneumonia; MV: mechanical ventilators; MMA: Military Medical Academy; HAI: healthcare-associated infections; BMI: body mass index; H2RAs: histamine-2-receptor antagonists; PPIs: proton-pump inhibitors; SSI: surgical site infection; CI: confidence intervals; ULRA: univariate logistic regression analysis; MLRA: multivariate logistic regression analysis

Declarations

Ethics approval and consent to participate
The informed written consent was obtained from all participants. The study was reviewed and approved by the the Research Ethics Board of the MMA (number MF VMA/1/13–15).
Consent for publication
Not applicable.

Availability of data and materials
All clinical data were obtained from medical records MMA, Belgrade, Serbia.

Competing interests
The authors declare that they have no competing interests.

Funding
This work was supported by the Ministry of Defence of the Republic of Serbia (Project MF/VMA/02/17-19) and by the Ministry of Education, Science and Technological Development of the Republic of Serbia (grants No. 175042).

Authors’ contributions
ŠV, ŠGS, RN participated in design of study. TD, AS and KZ took part in acquisition of data. BD performed the statistical analysis. ŠV coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

Acknowledgements
Not applicable.

REFERENCE


Table 1. Number and percentage of specific intra-abdominal surgical procedures among all intra-abdominal surgical procedures and hospital-acquired pneumonia (HAP) rate in the study population

<table>
<thead>
<tr>
<th>Surgical procedure</th>
<th>Frequency</th>
<th>% sample</th>
<th>HAP rate per 1000 surgical procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorectal surgery</td>
<td>1542</td>
<td>40.6%</td>
<td>8.4 (13)</td>
</tr>
<tr>
<td>Appendix surgery</td>
<td>474</td>
<td>12.6%</td>
<td>2.1 (1)</td>
</tr>
<tr>
<td>Small bowel surgery</td>
<td>464</td>
<td>12.3%</td>
<td>36.6 (17)</td>
</tr>
<tr>
<td>Gastric surgery</td>
<td>441</td>
<td>11.7%</td>
<td>22.7 (10)</td>
</tr>
<tr>
<td>Gallbladder surgery</td>
<td>419</td>
<td>11.1%</td>
<td>9.5 (4)</td>
</tr>
<tr>
<td>Bile duct, liver or pancreatic surgery</td>
<td>361</td>
<td>9.6%</td>
<td>5.5 (2)</td>
</tr>
<tr>
<td>Exploratory Laparotomy</td>
<td>39</td>
<td>1.0%</td>
<td>102.6 (4)</td>
</tr>
<tr>
<td>Spleen surgery</td>
<td>36</td>
<td>/</td>
<td>/</td>
</tr>
</tbody>
</table>

Table 2. Potential risk factors for acquisition and poor outcome of hospital acquired-pneumonia (HAP) in intra-abdominal surgical patients: results of univariate logistic regression analysis

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>With HAP (N=41)</th>
<th>Without HAP (N=164)</th>
<th>p</th>
<th>Survive (N=21)</th>
<th>Death (N=20)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (X±SD)</td>
<td>63.54 ± 12.85</td>
<td>64.27 ± 13.16</td>
<td>0.707</td>
<td>62.95 ± 13.07</td>
<td>64.15 ± 12.92</td>
<td>0.770</td>
</tr>
<tr>
<td></td>
<td>Number (%)</td>
<td>Number (%)</td>
<td>p</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td>p</td>
</tr>
<tr>
<td>--------------------------</td>
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<td>------------</td>
<td>------</td>
<td>------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Male (number, %)</td>
<td>25 (61.0)</td>
<td>90 (54.9)</td>
<td>0.482</td>
<td>14 (66.7)</td>
<td>11(55.0)</td>
<td>0.445</td>
</tr>
<tr>
<td>Body Mass Index (X±SD)</td>
<td>24.85 ± 3.65</td>
<td>25.01 ± 4.35</td>
<td>0.603</td>
<td>25.76 ± 3.54</td>
<td>23.90 ± 3.59</td>
<td>0.103</td>
</tr>
<tr>
<td>Diabetes mellitus (number, %)</td>
<td>6 (14.6)</td>
<td>10 (6.1)</td>
<td>0.077</td>
<td>3 (14.3)</td>
<td>3 (15.0)</td>
<td>0.948</td>
</tr>
<tr>
<td>Tobacco use (number, %)</td>
<td>14 (34.1)</td>
<td>44 (26.8)</td>
<td>0.461</td>
<td>6 (28.6)</td>
<td>8 (40.0)</td>
<td>0.442</td>
</tr>
<tr>
<td>ASA (number, %)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.138</td>
</tr>
<tr>
<td>2</td>
<td>15 (36.6)</td>
<td>60 (36.6)</td>
<td></td>
<td>10 (47.6)</td>
<td>5 (25.0)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>26 (63.4)</td>
<td>104 (63.4)</td>
<td></td>
<td>11 (52.4)</td>
<td>15 (75.0)</td>
<td></td>
</tr>
<tr>
<td>Preoperative infection (number, %)</td>
<td>3 (7.3)</td>
<td>4 (2.4)</td>
<td>0.143</td>
<td>1 (4.8)</td>
<td>2 (10)</td>
<td>0.529</td>
</tr>
<tr>
<td>Malignancy (number, %)</td>
<td>15 (36.6)</td>
<td>85 (51.8)</td>
<td>0.116</td>
<td>8 (38.1)</td>
<td>7 (35.0)</td>
<td>0.837</td>
</tr>
<tr>
<td>Treatment outcome (number, %)</td>
<td>20 (48.8)</td>
<td>11 (6.7) &lt;0.001</td>
<td>/</td>
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</table>

**Procedures during hospitalization**

<table>
<thead>
<tr>
<th></th>
<th>Number (%)</th>
<th>Number (%)</th>
<th>p</th>
<th>Number (%)</th>
<th>Number (%)</th>
<th>p</th>
<th>Number (%)</th>
<th>Number (%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative hospitalization (in days) (X±SD)</td>
<td>12.00 ± 18.27</td>
<td>7.61 ± 9.51</td>
<td>0.725</td>
<td>11.52 ± 18.90</td>
<td>12.50 ± 18.06</td>
<td>0.687</td>
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<tr>
<td>Length of hospital stay (in days) (X±SD)</td>
<td>46.63 ± 30.38</td>
<td>21.88 ± 19.96</td>
<td>&lt;0.001</td>
<td>47.19 ± 35.67</td>
<td>46.05 ± 24.56</td>
<td>0.906</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalization in ICU (number, %)</td>
<td>34 (82.9%)</td>
<td>60 (36.6%)</td>
<td>&lt;0.001</td>
<td>15 (71.4)</td>
<td>19 (95.0)</td>
<td>0.074</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Central Venous Catheter (number, %)</td>
<td>29 (70.7)</td>
<td>69 (42.1)</td>
<td>&lt;0.001</td>
<td>12 (57.1)</td>
<td>17 (85.0)</td>
<td>0.059</td>
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<tr>
<td>Mechanical Ventilation (number, %)</td>
<td>16 (39.0)</td>
<td>7 (4.3)</td>
<td>&lt;0.001</td>
<td>5 (23.8)</td>
<td>11 (55.0)</td>
<td>0.045</td>
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<tr>
<td>H2 receptor antagonist (H2RA)</td>
<td>24 (58.3)</td>
<td>56/159</td>
<td>0.007</td>
<td>9 (42.9)</td>
<td>15 (75.0)</td>
<td>0.077</td>
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<tr>
<td>Characteristic</td>
<td>Group 1</td>
<td>Group 2</td>
<td>P value</td>
<td>Group 1</td>
<td>Group 2</td>
<td>P value</td>
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<td>----------------------------------------------------</td>
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<tr>
<td>Proton-pump inhibitors (PPI)</td>
<td>13 (31.7)</td>
<td>29/159</td>
<td>0.059</td>
<td>8 (38.1)</td>
<td>5 (25.0)</td>
<td>0.572</td>
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<tr>
<td>Acid suppressive medications (H2RA or PPI)</td>
<td>37 (90.2)</td>
<td>85/159</td>
<td>&lt;0.001</td>
<td>17 (81.0)</td>
<td>20 (100.0)</td>
<td>0.107</td>
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<tr>
<td>Multiple transfusion</td>
<td>38 (92.7)</td>
<td>62/159</td>
<td>&lt;0.001</td>
<td>18 (85.7)</td>
<td>20 (100.0)</td>
<td>0.125</td>
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<tr>
<td>Characteristics depends of surgery procedure</td>
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<tr>
<td>Preoperative prophylaxis</td>
<td>40 (97.6)</td>
<td>137 (83.5)</td>
<td>0.046</td>
<td>21 (100.0)</td>
<td>19 (95.0)</td>
<td>0.488</td>
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<tr>
<td>Elective surgery</td>
<td>21 (51.2)</td>
<td>116 (70.7)</td>
<td>0.019</td>
<td>9 (42.9)</td>
<td>12 (60.0)</td>
<td>0.275</td>
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<tr>
<td>Upper abdominal surgery</td>
<td>17 (41.5)</td>
<td>61 (37.2)</td>
<td>0.746</td>
<td>9 (42.9)</td>
<td>8 (40.0)</td>
<td>0.853</td>
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<tr>
<td>Duration of operation (in minutes)</td>
<td>121.83 ± 56.68</td>
<td>118.78 ± 68.49</td>
<td>0.473</td>
<td>122.38 ± 59.21</td>
<td>121.25 ± 55.43</td>
<td>0.950</td>
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<tr>
<td>Class of contamination</td>
<td></td>
<td></td>
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<td></td>
<td>0.150</td>
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<tr>
<td>Clean</td>
<td>5 (12.2)</td>
<td>36 (22.0)</td>
<td>0.239</td>
<td>3 (14.3)</td>
<td>2 (10.0)</td>
<td>0.954</td>
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<tr>
<td>Clean/contaminated</td>
<td>12 (29.3)</td>
<td>82 (50.0)</td>
<td>0.315</td>
<td>8 (38.1)</td>
<td>4 (20.0)</td>
<td>0.794</td>
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<tr>
<td>Contaminated</td>
<td>6 (14.6)</td>
<td>17 (10.4)</td>
<td>0.001</td>
<td>2 (9.5)</td>
<td>4 (20.0)</td>
<td>0.383</td>
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<tr>
<td>Dirty/infected</td>
<td>18 (43.9)</td>
<td>29 (17.7)</td>
<td>0.008</td>
<td>8 (38.1)</td>
<td>10 (50.0)</td>
<td>0.541</td>
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<tr>
<td>Drainage</td>
<td>39 (95.1)</td>
<td>127 (77.4)</td>
<td>0.018</td>
<td>20 (95.2)</td>
<td>19 (95.0)</td>
<td>0.972</td>
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<td>Drainage (in days)</td>
<td>11.72 ± 8.93</td>
<td>12.70 ± 10.68</td>
<td>0.006</td>
<td>0.329</td>
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<td>(X±SD)</td>
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<td></td>
<td>6.35</td>
<td>4.93</td>
<td>7.55</td>
<td>4.77</td>
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<tr>
<td>Surgical site infection</td>
<td>16 (39.0)</td>
<td>14 (8.5)</td>
<td>&lt;0.001</td>
<td>4 (19.0)</td>
<td>12 (60.0)</td>
<td>0.010</td>
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Received on May 21, 2018.
Revised on June 15, 2018.
Accepted on June 19, 2018.
Online First July 2018.