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VENTILATOR-ASSOCIATED PNEUMONIA: COMPARING CADAVERIC LIVER TRANSPLANT AND NON-TRANSPLANT SURGICAL PATIENTS

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SUMMARY – Ventilator-associated pneumonia is a frequent complication in intensive care surgical patients, particularly those with high severity scores on admission. We studied the incidence and clinical outcome of ventilator-associated pneumonia among patients undergoing major general surgery procedures and those undergoing cadaveric liver transplantation in our hospital. Patients with the intensive care unit stay longer than four days having undergone surgery or transplantation and mechanically ventilated for more than 48 hours were included in the study. Ventilator-associated pneumonia diagnosis was based on a combination of radiological signs (progressive infiltrate on chest radiograph), clinical signs (fever >38.3 °C, leukocytes $>12\times10^9$/mL) and microbiological data (positive culture from tracheal aspiration $>10^5$ or bronchoalveolar lavage $>10^4$ colonies/mL). Medical records of 1037 patients were reviewed and 157 patients were found to have been mechanically ventilated for more than 48 hours: 62 transplanted and 95 non-transplanted. Only 39 (24.84%) patients matched the criteria for ventilator-associated pneumonia. There were no differences in sex, age, duration of mechanical ventilation, length of stay or outcome between the two groups. However, the main difference was the mean severity score on admission (Simplified Acute Physiology Score II) which was higher among non-transplant patients (42±16 *vs*. 31±9; p=0.03). Gram-negative bacteria were the leading causative agents (82.03%) and were multidrug-resistant. In the intensive care surgical population, transplantation *per se* does not seem to increase patient risk for either ventilator-associated pneumonia acquisition or worse outcomes.

Key words: *Pneumonia, ventilator-associated; Respiration, artificial; Liver transplantation; Organ dysfunction scores*

Introduction

Croatia has over 4.4 million inhabitants. There are 32 hospitals included in organ donation web and 5 major transplant centers. Organ donation is defined by law and donors are reported to the National Transplant Coordinator. Although donation rates have already increased significantly since 2004, Croatia continues to improve its organ donation and transplantation system owing to high level of awareness and continuous public education. Table 1[1] shows the number of donors, patients on waiting list and liver transplantations performed from 2007 to 2013, which may give the reader a better insight into our transplant program.

Liver transplantation is a widely accepted treatment for patients with end-stage liver disease. A number of complications can be anticipated after liver transplantation, predominantly perioperative surgical complications, immune and infectious disorders. Despite global improvements in survival over the last few decades, sepsis remains the leading cause of early postoperative mortality and lower respiratory tract infections also present a major concern. With the advent of newer and more potent immunosuppressive regimens, graft survival has improved, but at the expense of an

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Table 1. Total number of deceased donors, patients on waiting list and liver transplantation performed in Croatia from 2007 to 2013 (source: www.eurotransplant.org)[1]

Year		2007	2008	2009	2010	2011	2012	2013
Active liver recipients on waiting list (n)		56	61	54	75	77	73	63
Number of deceased donors (n)		33	79	77	127	144	147	138
Number of liver used (n)		22	66	62	111	125	138	119
Number of liver transplantation performed in our hospital (n)	Liver	22	61	58	99	115	120	110
	Right split liver	0	0	0	0	3	1	1
	Left split liver	0	0	0	0	2	0	1
	Liver + kidney	1	3	1	2	1	2	2

increased risk for the development of infections. Nosocomial infections are widely recognized as risk factors for prolonged intensive care unit (ICU) stay and mortality. Lungs are the second most common site of infection. A special form of nosocomial pneumonia is ventilator associated pneumonia (VAP), developing in patients after prolonged (48 hours or more) mechanical ventilation, with the incidence of 8%-28%[2]. The development of VAP is associated with several factors such as duration of mechanical ventilation, coincidence with chronic obstructive pulmonary disease (COPD), sepsis, acute respiratory distress syndrome (ARDS), neurologic diseases, trauma and previous antibiotic consumption[3,4].

Transplant patients have a distinct tendency to develop infections, with an emphasis on pneumonia due to immunosuppression, alveolar edema after multiple blood product transfusions and prolonged postoperative mechanical ventilation due to underlying (multi) organ failure. The incidence of VAP has been shown to vary from 5% to 48%, whereas estimates of the related mortality rate range from 36.6% to 53%[5,6].

The aim of this study was to compare the incidence of VAP and clinical outcome among patients undergoing liver transplantation (Tx) admitted to our surgical ICU with those observed in non-transplanted elective surgical patients (non-Tx).

Patients and Methods

This retrospective study was conducted at the Merkur University Hospital, Zagreb, Croatia, a 300-bed tertiary care university hospital. It is the leading hospital in Croatia for solid organ transplantation, namely liver and simultaneous pancreas and kidney transplantation. Surgical ICU is a 12-bed unit.

This study was conducted in accordance with the amended Declaration of Helsinki. The institutional review board (Ethics Committee, No 2013-06/4, July 18, 2013) approved this study. The investigation was conducted over a period of 1 year (March 2011 through April 2012).

Perioperative management

Liver allografts were harvested by our senior surgeons and were preserved with cold University of Wisconsin solution. In our center, the piggyback technique and preservation of the inferior vena cava is performed in all transplants. Venovenous bypass is never used.

For liver transplant patients, there are accurately defined clinical protocols for perioperative period. Preoperative antibiotic prophylaxis in transplant patients consists of piperacillin + tazobactam, or vancomycin + meropenem in case of allergy to penicillin, whereas non-transplant surgical patients receive cefazolin unless they have known allergy to it.

Liver recipient patients are systematically screened preoperatively for methicillin-resistant *Staphylococcus aureus* (MRSA) carriage (nose, throat, armpit and hurdle smear).

All patients receive ulcer prophylaxis with proton pump blockers and antithrombotic leg bandage or elastic stockings. Another difference is selective digestive decontamination (SDD, fluconazole with garamycin) used in transplant patients, which is omitted in surgical patients. Non-transplant patients also receive low-molecular weight heparin the evening before surgery.

Immunosuppressive therapy in transplant patients is started intraoperatively by the administration of the corticosteroid bolus (methylprednisolone 500 mg) before graft placing. Upon arrival in the ICU, additional

immunosuppression is gradually introduced with calcineurin inhibitors (cyclosporine or tacrolimus) and antimetabolite (mycophenolate mofetil). Prophylaxis against cytomegalovirus (CMV) is based on gancyclovir and prophylaxis for *Pneumocystis carinii* infection on sulfamethoxazole + trimethoprim.

Long-term sedation and, especially, muscle relaxation in all patients is avoided in the ICU, except when required by the patient's condition or to perform invasive diagnostic and/or therapeutic procedures.

In our ICU, fast weaning from mechanical ventilation is encouraged. Extubation is scheduled for early postoperative hours after hemodynamic and respiratory stability has been achieved. Our weaning protocols are physician directed. In this way, they are both flexible and adaptive to the needs of individual patients.

Pneumonia diagnosis

Patient charts and medical records were reviewed, as well as clinical culture isolates within records of the clinical microbiology laboratory of our hospital. Infection was considered to be nosocomial if it appeared 48 hours after hospital admission and with no evidence of pulmonary infection present on admission. All other infections were considered community acquired. All patients with an ICU stay longer than 4 days who had undergone surgery and had been mechanically ventilated for over 48 hours were included in the study. Subsequently, the patients were divided into two groups of liver transplant patients (Tx) and non-transplanted elective surgical patients (non-Tx).

Pneumonia was defined as a new infiltrate on radiological examination together with clinical signs and symptoms of infection (temperature >38.3 °C or <36 °C, leukocyte count >12×10^9/mL or <4×10^9/mL, and purulent respiratory secretions) and positive microbiological findings. *Per* protocol in all cases of suspected pneumonia, tracheal aspiration or bronchoalveolar lavage (BAL) specimens were sent for microbiological investigations. The diagnostic threshold for BAL quantitative culture was 10^4 colonies/mL and 10^5 colonies/mL in case of tracheal aspiration. Early-onset VAP is defined as pneumonia occurring within the first 4 days of hospitalization, whereas late-onset VAP occurs after this time point.

The patients were compared according to sex, age, length of stay in ICU, severity score on admission (Simplified Acute Physiology Score II, SAPS II) and clinical outcome.

Pathogens were identified with standard microbiological methods (culture and colony counting methods). Antibiotic susceptibility was tested with the Mueller-Hinton agar diffusion test. The production of extended-spectrum beta-lactamase was detected by the double-disk synergy test. The growth of facultative pathogenic bacteria such as coagulase-negative *Staphylococcus* or *Candida* species was characterized as colonization and did not necessitate therapy.

Statistical methods

Statistical analysis was performed using GraphPad Software (GraphPad Prism 6, Inc. 2012, La Jolla, CA, USA). Normality of distribution was tested with Kolmogorov-Smirnov test. Quantitative data were calculated as mean ± standard deviation (age, SAPS II score, ICU length of stay, duration of mechanical ventilation and VAP onset); qualitative analysis was reported in terms of percentages (sex, VAP incidence, clinical outcome). Comparison between the two groups was performed by the proportion t-test and χ^2-test where indicated. A p value ≤0.05 was considered significant.

Results

In this 1-year retrospective study, medical records and microbiology culture isolates of 1037 patients were reviewed. One hundred and fifty seven patients were found to have been mechanically ventilated for more than 48 hours, i.e. 62 transplanted (Tx) and 95 non-transplanted (non-Tx) patients.

Forty-four patients matched the criteria for VAP (28.0%). However, five patients were excluded from the study due to their microbiological data which were considered to be colonization (*Candida albicans* and coagulase-negative *Staphylococcus*) and those patients did not receive antimicrobial or antifungal therapy. Consequently, only 39 patients were treated for VAP (24.84%).

Data collection and valorization is shown in detail in Figure 1. Tx-group consisted only of liver recipients with an average Model for End Stage Liver Disease (MELD) score of 24±5. Non-Tx group consisted mostly of patients undergoing cancer surgery in the digestive tract (92.85% of gastric, pancreatic and

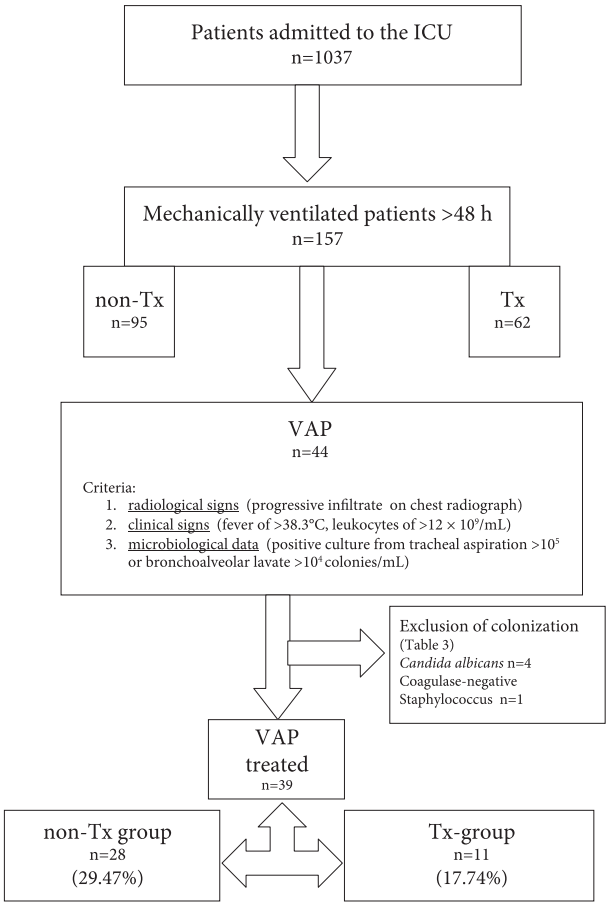

Fig. 1. Study flow.

colorectal carcinoma), whereas only 7.14% of patients underwent aneurysmatic vascular repair. When looking closely at this subgroup of patients, it is seen that the highest incidence of VAP was recorded in patients with colorectal cancer (n=12; 46.15%), followed by patients with pancreatic cancer (n=9; 34.61%) and gastric cancer (n=5; 19.23%).

The incidence of VAP appeared to be higher among non-transplant surgical patients (non-Tx 29.49% *vs*. Tx 17.74%), but not significantly (p=0.5327). There was no between-group difference according to sex (non-Tx male 68.75% *vs*. Tx male 74.3%), age (non-Tx 64.44±15 years *vs*. Tx 56.3±9 years), length of stay in the ICU (non-Tx 15.03±15 days *vs*. Tx 14.92±12 days) or outcome (non-Tx mortality 40.6% *vs*. Tx mortality 33.3%) (Table 2). However, the main and statistically relevant (p<0.05) difference was found in the mean severity score on admission (SAPS II) which was higher among non-transplant patients (non-Tx 42±16 *vs*. Tx 31±9; p=0.0303).

Table 2. Comparison of patients with ventilator-associated pneumonia between cadaveric liver transplant group (Tx) and non-transplanted major surgery patients (non-Tx)

	Non-Tx	Tx	p
Incidence (%)	29.47	17.74	0.5327
Sex: male/female (%)	68.75/31.25	74.3/25.7	0.5312
Age (years) mean ± SD	64±15	56±9	0.0915
ICU length of stay (days) mean ± SD	15±15	15 ± 12	0.9787
SAPS II mean ± SD	42±16	31±9	0.0303
Mortality (%)	40.6	33.3	0.0770

ICU = intensive care unit; SAPS II score = Simplified Acute Physiology Score II

Table 3. Duration of mechanical ventilation and onset of ventilator-associated pneumonia (VAP) among cadaveric liver transplant patients (Tx) and non-transplanted surgical patients (non-Tx)

		Non-Tx	Tx	p
Duration of mechanical ventilation (days) mean ± SD		8.93±11.65	7.45±6.79	0.6959
Onset of VAP (days) mean ± SD		6.07±2.67	8.18±3.09	0.0403
	Early VAP (<4 days), n	8	1	
	Late VAP (>4 days), n	20	10	
	Total VAP, n (%)	28 (71.79%)	11 (28.2%)	

There was no between-group difference according to the duration of mechanical ventilation either (non-Tx 8.93±11.65 *vs*. Tx 7.45±6.79). VAP onset was defined as late in both groups; however, earlier occurrence was recorded in non-Tx group (non-Tx 6.07±2.67 *vs*. Tx 8.18±3.09) (Table 3), which could be correlated with SAPS II score. Late VAP occurrence was predominant, which was consistent with the microbiological data obtained.

Table 4. Microbiological isolates (tracheal aspiration and/or bronchoalveolar lavage) in patients with diagnosed ventilator-associated pneumonia

	Microbiological isolate	Non-Tx (number of isolates)	Tx (number of isolates)	Total number of all isolates (%)
Gram-negative bacteria	*Acinetobacter baumanii*	11	5	16 (41.02%)
	Pseudomonas aeruginosa	7	3	10 (25.64%)
	E. coli (ESBL)	2	1	3 (7.69%)
	Klebsiella pneumoniae (ESBL)	1	1	2 (5.12%)
	Proteus mirabilis (ESBL)	1	0	1 (2.56%)
Gram-positive bacteria	Methicillin-resistant *Staphylococcus aureus*	6	1	7 (17.97%)
Total		28	11	39
Colonization	Coagulase-negative *Staphylococcus*	1	0	1
	Candida albicans	3	1	4

Tx = liver transplant patients; non-Tx = non-transplanted surgical patients; ESBL= extended-spectrum beta-lactamase-producing bacteria

The spectrum of causative pathogens was extremely diverse (Table 4). Gram-negative bacteria were leading in incidence (82.03%) and included multidrug resistant (MDR) bacteria (*Acinetobacter baumanii, Pseudomonas aeruginosa* and extended-spectrum beta-lactamase-producing *Escherichia coli, Klebsiella pneumoniae* and *Proteus mirabilis*). It is not surprising because of the type of surgery (gastroenteral origin of pathogens) and due to the late onset of VAP. Gram-positive bacterial VAP had a significantly lower incidence (17.79%).

Discussion

This study emphasized the importance of VAP problem among surgical and cadaveric liver transplant populations. We aimed to evaluate, on a retrospective basis, the incidence and outcome of VAP and also showed the spectrum of causative organisms. Overall, we found a VAP incidence of 24.84% and mortality rate of 36.1%. These data are comparable to data from other centers in Croatia[7]. In unselected populations of mixed ICU patients, the incidence of VAP has been reported to be between 5% and 34%[8,9], with excessive mortality from late-onset VAP, usually over 50%, despite appropriate antibiotic treatment[10].

Weiss *et al*. have reported an incidence rate of 15.5% specifically among liver recipients[5]. Our rate of 17.74% among liver recipients agrees with the previously reported rates of pneumonia after liver transplantation ranging from 5% to 34%. Two recent studies showed a rate of pneumonia of 21.1% in liver recipients receiving a 3-day prophylactic regimen of cefotaxime and ampicillin and a rate of 18% in living donor-related recipients receiving SDD[11,12]. Interestingly, previous studies have reported rates varying from 36.6% to 53%[13]. It suggests an overall improvement in the management of severe sepsis or septic shock in liver recipients over time, and it might have contributed to the improvement over time of postoperative survival after liver transplantation.

Liver recipients display a greater risk of respiratory tract infections than kidney recipients. One reason is the commonly present right sided pleural effusion in the early post transplantation period, which causes atelectasis[6]. Another reason is the presence of diaphragm dysfunction due to the type of surgery, which is related

to prolonged mechanical ventilation. From our data, we can anticipate that cadaveric liver transplant recipients and patients undergoing upper abdominal surgery have a high incidence of VAP.

All transplant recipients accumulate other risks factors for pneumonia, i.e. immunosuppression and underlying end-stage disease with repercussion on other organ systems. We also observed the risk of infectious complications to be proportional to the dose and number of immunosuppressive medications used. Due to the reasons mentioned above, we were rather surprised when we found that the incidence of VAP was similar in the transplanted and non-transplanted patients. Pellegrino *et al.* also report that liver transplantation does not increase the incidence of VAP compared to other surgical patients[14]. Despite the fact that the two groups were comparable in sex, age, length of stay in ICU and mortality, the main difference was found to be SAPS II score on admission to the ICU. A high percentage of patients having undergone major abdominal surgery due to cancer and patients with cardiac comorbidities having undergone major vascular surgery may explain this finding, since they had a higher SAPS II score. These findings can explain the difference between the groups. In fact, age, abdominal surgery and neurosurgery are independent risk factors for developing VAP in ICU patients[15].

Most of our patients underwent major abdominal surgery due to carcinoma. Generally, patients with malignant disease have diminished immune competence. Among less known but clearly important tumor-mediated immunosuppressive effects is the ability to induce T-cell apoptosis. The immune system of cancer patients can be compromised through multiple mechanisms including immune suppression by the tumor and by prior therapies such as chemotherapy and irradiation. In a wider point of view, cancer patients can be considered as immunosuppressed patients. Therefore, the loss of immune competence may be an important risk factor[16]. Unfortunately, there are no standardized tests for immune competence, nor is there agreement on what to measure and what is predictive of the outcome[17].

Daily VAP prevention strategies are performed in the ICU, such as mechanical ventilation protocols, sedation and weaning protocols, head of bed elevation above 30 degrees and oral care with chlorhexidine[18].

However, by examining medical records we found several differences between the two groups, besides immunosuppression. First was the use of SDD in transplant patient group, administered prior to anesthesia, according to our hospital protocol. In SDD, topical antibiotics are applied to the oropharynx and stomach for prevention of pneumonia and gut-derived infections, in an attempt of possible reduction of infection-related mortality.

Despite numerous clinical trials, SDD still remains controversial. SDD reduces the incidence of VAP diagnoses, but beneficial effects on the duration of ventilation or ICU stay, antibiotic use and patient survival have not been shown unequivocally. Several recent meta-analyses have demonstrated that the use of SDD is associated with significant reductions in the incidence of VAP and lower rates of hospital mortality, especially among surgical patients[19,20]. A recent study of SDD among surgical patients with a low prevalence of colonization with resistant bacteria found a statistically significant reduction in mortality rate without increasing overall colonization with resistant bacteria[21]. However, like antimicrobial oropharyngeal decontamination, SDD carries the potential risk of promoting more widespread antibiotic resistance[22]. Therefore, the use of SDD should be carefully monitored for the emergence of antimicrobial resistance.

Secondly, all transplanted patients were intubated with oropharyngeal tubes with subglottic aspiration device, again according to our hospital protocol. These tubes were omitted in surgical patients due to the economic policy and due to presumed fast weaning. Placement of tubes with subglottic aspiration device is considered to be one of the methods of VAP prevention, which does not create a selective growth advantage for resistant microorganisms. Use of this type of tubes is an attempt to minimize aspiration of pharyngeal secretions. Regular removal of subglottic secretions is thought to reduce the leakage of pharyngeal content past the tracheal tube cuff and into the lower respiratory tract. The use of these tubes is associated with a lower VAP incidence[23-25]. They are preferentially used in all patients suspected of needing oropharyngeal intubation for ≥3 days (72 h)[26]. The need of this especially exists in liver transplant patients due to underlying encephalopathy, type of surgery, diaphragmatic dysfunction and transfusion related overload that could lead to prolonged mechanical ventilation.

Randomized, controlled studies showed the beneficial effect of continuous suctioning of subglottic secretions on the incidence of VAP; however, none of the studies showed a corresponding effect on mortality rate, length of stay in ICU or duration of mechanical ventilation[27].

Although neither SDD nor subglottic aspiration tubes can individually demonstrate that they have a considerable impact on the incidence and mortality of VAP, the cumulative effect could be dramatic. In addition to standardized ventilator-weaning protocol designed to reduce time on mechanical ventilation, gastrointestinal feeding program that minimizes aspiration and oral-care regimen could markedly reduce VAP rate in ICU.

Many studies have been undertaken in order to evaluate prognostic factors in VAP and to improve treatment and clinical outcome. Most of them include the Clinical Pulmonary Infection Score (CPIS), serum procalcitonin and C-reactive protein (CRP) levels during the course of VAP[28,29]. Others include several scoring systems (SOFA, APACHE II and SAPS II)[9,30,31]. They are developed in order to ease the assessment of patients, so that physicians are able to accurately and reliably measure the severity of illness in ICU. Usually, the ability of a particular score to predict mortality is acceptable for a patient group as a whole, but this does not apply to predict mortality of the individual patient. The main reason for these shortcomings is the heterogeneity of ICU patient populations.

Prognostic values of other scoring systems in the evaluation of VAP-related mortality have been reported previously in general ICU patients. Studies showed that a high SAPS II was one of the three independent risk factors for mortality from nosocomial pneumonia[32], and also one of the early predictors of infection recurrence and death in VAP patients. Leroy *et al.*[33] and Froon *et al.*[34] showed that SAPS II upon ICU admission did not differ significantly between survivors and non-survivors, whereas SAPS II determined at the onset of VAP was greater in survivors than non-survivors. Leroy *et al.*[33] also found that SAPS II higher than 37 was an independent predictor of the VAP-related mortality. Our results suggest that it might be possible to use this scoring system to predict mortality in patients with VAP.

Patients with prolonged ICU stay are prone to be colonized and infected by MDR bacteria. In our study, the spectrum included many microorganisms, but the results were consistent with previous epidemiological data. Gram-negative bacteria were leading in incidence (82.03%). They are characterized by resistance to many antibiotics and the capability to develop resistance during therapy. In terms of frequency of the various pathogens, *Acinetobacter baumanii* is a particular problem. This is in accordance with microorganisms that occur during late-onset VAP in both surgical and non-surgical population. Similar conclusions can apply to transplant patients. It should be noted that during the study period, there was not an epidemic with MDR bacteria, but they rather occurred endemically. Depuydt *et al.*[35] have reported on 27% of VAP patients with MDR pathogens. The prevalence of MDR pathogens is known to vary depending on the patient population and the hospital. Furthermore, these patients have often their metabolic and neurohormonal reserves exhausted, while their immune response might be severely affected.

Despite the availability of guidelines for the management of VAP and recent advances in critical care medicine, the mortality rate from VAP is still high and varies from 24% to 50%[11,36]. It can even reach 76% when the underlying infection is caused by MDR bacteria. According to Fagon *et al.*[28], mortality related to *Pseudomonas* or *Acinetobacter* pneumonia was 87% compared to 55% due to any other microorganism isolated pneumonia[29].

Initial antibiotic therapy is a key factor influencing VAP outcome. Lee *et al.*[32] found that the mortality rate was significantly higher in those patients with inappropriate initial empirical antibiotic therapy, even when subsequent antibiotic therapy was appropriate.

Early identification of patients at high risk of VAP is essential for prevention and treatment, in terms of time and initial antibiotic therapy. Knowledge of the susceptibility of the local pathogens is necessary for choosing appropriate antibiotics. However, the worldwide emergence of MDR nosocomial gram-negative pathogens over the last decade has resulted in the increased use of many forgotten antibiotics. One of those is certainly colistin, a polymyxin used as last resort therapy for *Acinetobacter baumanii* isolates, which proved to be very effective in the treatment of our patients.

The microbiological ecology may vary greatly among ICUs. Consequently, empirical antimicrobial therapy guidelines should be tailored according to lo-

cal epidemiological data. On the other hand, antimicrobial consumption has indeed been proven to have major influence on microbial ecology. This also suggests that bacterial multi-resistance might be at least partly avoidable even in liver transplant patients.

Antimicrobial resistance is a growing threat especially to critically ill patients because treatment failure can have serious consequences. To control antimicrobial resistance, antimicrobial therapy according to local sensitivity result and multidisciplinary management is necessary. The US Center for Disease Control recommends several steps to prevent antimicrobial resistance among hospitalized patients, which includes prevention of infection, early diagnosis and effective treatment of infection, using the antimicrobials wisely, and prevention of transmission.

Our study had some methodological limitations. First, the information was obtained retrospectively from charts and medical records review and probably was not as complete and accurate as when data collection is done prospectively. Second, it must be considered that this was a single center study with a small sample size. Despite these limitations, our results provide important implications for similar demographic areas and clinical settings.

However, our study, although retrospective, had precise criteria for the diagnosis of VAP, which enabled us to draw a reliable picture of VAP in liver recipients, as well as in non-transplanted surgical patients. Our criteria for clinical suspicion of VAP are widely accepted[37]. The period of 4 days was chosen as the inclusion period for diagnosis of early VAP onset as outlined in the current American Thoracic Society/ Infectious Diseases Society of America guidelines[38].

Despite the small number of patients, we believe that these data can be applied to liver transplant patients in surgical ICU with similar issues and local microbiological situation.

In conclusion, this study demonstrated VAP to be a common complication in all surgical patients, including those after liver transplantation. The incidence of VAP especially rose among patients with a high severity score on admission to the ICU. SAPS II score might be useful in predicting mortality in the population of pulmonary patients but additional studies are needed on a larger number of patients. Liver transplantation itself did not seem to increase the patient risk of either VAP acquisition or worse outcome. Given the evidence for a greater morbidity and hospital mortality rate among VAP patients, the prevention of this nosocomial infection should be an important priority in the hospital setting.

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Sažetak

UPALA PLUĆA UZROKOVANA VENTILATOROM: USPOREDBA BOLESNIKA S KADAVERIČNIM PRESATKOM JETRE I KIRURŠKIH BOLESNIKA BEZ PRESATKA

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Upala pluća uzrokovana ventilatorom česta je komplikacija u jedinicama intenzivnog liječenja kirurških bolesnika, naročito onih s visokim stupnjem disfunkcije organa kod prijma. Ispitivala se učestalost i klinički ishod upale pluća uzrokovane ventilatorom kod bolesnika podvrgnutih velikim abdominalnim operativnim zahvatima te kod bolesnika nakon kadaverične transplantacije jetre. U studiju su bili uključeni bolesnici koji su u Jedinici intenzivnog liječenja boravili duže od četiri dana, koji su prošli operaciju ili transplantaciju te koji su bili mehanički ventilirani duže od 48 sati. Dijagnoza se temeljila na kombinaciji radioloških znakova (progresija infiltrata na snimkama prsišta), kliničkih znakova (vrućica >38,3 °C, leukociti $>12\times10^9$/mL) te mikrobioloških podataka (pozitivna kultura aspirata traheje $>10^5$ i/ili bronhoalveolarnog lavata $>10^4$ kolonije/mL). Pregledani su medicinski zapisi 1037 bolesnika od kojih je njih 157 bilo mehanički ventilirano duže od 48 sati: 62 transplantiranih i 95 netransplantiranih. Samo 39 (24,84%) bolesnika zadovoljilo je kriterije. Nije nađena razlika u spolu, dobi, trajanju mehaničke ventilacije, duljini boravka ili ishodu između ispitivanih skupina. Međutim, glavnu razliku činio je bodovni sustav disfunkcije organa kod prijma (*Simplified Acute Physiology Score II*), koji je bio veći kod netransplantiranih bolesnika (42±16 prema 31±9; p=0,03). Multirezistentne gram-negativne bakterije bile su vodeći uzročnik (82,03%). U jedinicama intenzivnog liječenja kirurških bolesnika transplantacija jetre sama po sebi ne povećava rizik za nastanak upale pluća uzrokovane ventilatorom kao ni lošiji ishod tih bolesnika.

Ključne riječi: *Upala pluća, uzrokovana ventilatorom; Respiracija, umjetna; Jetra, transplantacija; Organska disfunkcija, bodovanje*