Research Article (Araştırma makalesi)

Evaluation of Factors Associated With Mortality in Catheter-Related Urinary Tract Infections: A 5-Year Retrospective Study

Katater İlişkili Üriner Sistem Enfeksiyonlarında Mortalite ile İlişkili Faktörlerin Değerlendirilmesi: 5 Yıllık Retrosepektif Çalışma

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Özet

Amaç: Bu çalışmanın amacı, kateter ilişkili üriner sistem enfeksiyonlarında (Kİ-ÜSİ) mortalite ile epidemiyolojik faktörler, komorbid durumlar, antibiyotik direnci, ampirik antimikrobiyal tedavi ve laboratuvar parametreleri arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntemler: Yoğun bakım ünitesine 1 Ocak 2015 ile 1 Ocak 2020 arasında kabul edilen 18 yaş ve üzeri hastalarda retrospektif bir kohort çalışması tasarlanmıştır. Birincil sonlanım noktası hastanın kabulünün ilk 28 günü içinde ölüm, ikincil sonlanım noktası ise 28. günden sonra sağkalımdı. p<0.05 değeri istatistiksel olarak anlamlı kabul edildi.

Bulgular: Çalışmaya medyan yaşı 78, 198'i (%52.8) kadın toplam 375 hasta alındı. En sık saptanan mikroorganizmalar *Escherichia coli* (%50.9) ve *Enterococcus faecalis* (%16.8)'idi. Gram negatif bakterilerin üçüncü kuşak sefalosporinlere, siprofloksasine ve meropeneme direnci sırasıyla %41.3, %40 ve %8.6 saptandı. Gram pozitif bakterilerin %0.3'ünde vankomisin direnci tespit edildi.

Mortalite oranı %58.1 idi. Artmış mortalite riski ile ilişkili faktörler ≥65 yaş, malignite varlığı, mekanik ventilasyon, APACHE II skoru ≥20 ve septik şok tanısıydı. Daha düşük ölüm riski ile ilişkili tek faktör kültürde *E. coli*'nin saptanmasıydı.

Sonuç: Yaşlılığın, malignitenin, klinik skorlama sistemlerinin ve mikrobiyolojik sonuçların mortalite üzerine etkisi olduğu belirlendi. Bu çalışmanın sonuçları, kılavuzlarda yer alan enfeksiyon kontrol önlemleri ve tedavi önerileri ile birlikte değerlendirildiğinde, Kİ-ÜSİ'ye bağlı mortalitenin azaltılabileceğini düşünmekteyiz.

Anahtar kelimeler: Antibiyotikler, Üriner kanal enfeksiyonları, İdrar yolu kateterleri, İlaç direnci, Kateter kaynaklı enfeksiyonlar, Ölüm oranı

Abstract

Objective: The aim of the study is to evaluate the relationship between mortality and epidemiological factors, comorbid conditions, antibiotic resistance, empirical antimicrobial therapy, and laboratory parameters in catheter-associated urinary tract infections (CAUTI).

Materials and Methods: A retrospective cohort study was designed in patients aged ≥18 years admitted to intensive care unit between 1st Jan 2015 and 1st Jan 2020. The primary endpoint was death within the first 28 days of admission, while the secondary endpoint was survival after 28 days. p value <0.05 was considered statistically significant.

Results: A total of 375 patients with a median age of 78 were included in the study; 198 (52.8%) were female. The most commonly detected microorganisms were *Escherichia coli* (50.9%) and *Enterococcus faecalis* (16.8%). Resistance to third generation cephalosporin, ciprofloxacin, and meropenem was found in 41.3%, 40%, and 8.6% of Gram-negative bacteria, respectively. Vancomycin resistance was detected in 0.3% of the Gram-positive bacteria.

The mortality rate was 58.1%. Factors associated with an increased risk of mortality were age ≥65 years, presence of malignancy, mechanical ventilation, APACHE II score ≥20, and a diagnosis of septic shock. The only factor associated with the lower mortality risk was the detection of *E. coli* in culture.

Conclusion: It was determined that aging, malignancy, clinical scoring systems and microbiological results had an effect on mortality. Considering the results of this study together with the infection control measures, and treatment recommendations in the guidelines, we think that mortality due to CAUTI can be reduced.

Keywords: Antibiotics, Catheter-related infections, Drug resistance, Mortality, Urinary catheters, Urinary tract infections

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INTRODUCTION

Urinary catheterization is applied at least once during the hospitalization period in approximately 15-25% of the patients followed up in the hospital (1). Urinary catheters are used in acute urinary retention, infravesical obstruction, in the perioperative monitoring of urine output, and in cases where the amount of urine output must be closely monitored. The most common infectious complication of urinary catheterization include bacteriuria and catheter-associated urinary tract infection (CAUTI). Following placement of a catheter, the daily risk of developing bacteriuria varies between 1% and 10%, while this figure rises up to 10% to 40% at the end of the first week (2). Urinary tract infections (UTIs) develop in 24% of the patients with bacteriuria (3). Approximately 60% to 80% of UTIs developing during inpatient care have been reported to be CAUTIs (4). Although the risk of bacteriemia is low in patients with bacteriuria, the most common cause of secondary bloodstream infections is CAUTI (5). In a meta-analysis from the US, the cost of a patient with CAUTI followed in the intensive care unit was calculated to be approximately $10.197 (6). In a study conducted in Australia, it was found that CAUTI caused a four-day prolongation of hospital stay (7). Thus, CAUTI represents a major burden for healthcare systems, both due to significant prolongation of hospital stay as well as due to significantly increased treatment costs.

Invasive procedures are frequently utilized in intensive care units, leading to secondary infections that may elevate the risk of mortality. The 30-day mortality due to CAUTI was found to be 30.8% in Babich et al.'s study (8). In this study, high age, malignancy, heart failure, high APACHE-II score, nasogastric tube feeding, decrease in respiratory function capacity, and use of central venous catheter stand out as risk factors that increase the risk of mortality. On the other hand, Hekimoğlu et al. found that prolonged hospital stay, age >65 years or >80 years, diabetes mellitus, renal failure, secondary bloodstream infections, and intubation were associated with increased mortality (9). It is noteworthy that the mortality risk factors related to CAUTI show serious differences between studies. The lack of a clear consensus regarding these risk factors is a major obstacle for clinicians who aim to reduce mortality.

The objective of our study was to evaluate the relationship between 28-day mortality and epidemiologic factors, comorbid conditions, antibiotic resistance, empiric antimicrobial treatment, and laboratory parameters in CAUTI patients admitted to intensive care unit.

MATERIALS AND METHODS

This single-center, retrospective cohort study included CAUTI patients aged ≥18 years who were found to have a urinary bacterial growth of at least 103 CFU(colony forming unit)/ml and who were admitted to an intensive care unit in a tertiary academic hospital. Catheter-associated urinary tract infections were diagnosed using international diagnostic guidelines (1). CAUTI due to fungal pathogens were excluded since antifungal sensitivity tests were not available and there were problems in fungal identification in our center. Patients who were diagnosed with CAUTI during hospital follow-up but were referred to another center were excluded from the study. The day of sampling for the first positive urine culture was considered as day 1. The primary endpoint was death within the first 28 days. The secondary endpoint was survival after 28 days. The mortality group included those subjects who died within the first 28 days, while the surviving group consisted of those who survived for more than 28 days or those who were discharged with cure before 28 days.

Data were obtained using the hospital's electronic record system. Demographic characteristics, comorbid conditions, and APACHE II scores according to the day of admission were recorded. Empirical antibiotics and laboratory test results were recorded in the patient form using the data on the day the patient's positive urine culture sampling was taken. Surgical history was considered positive for patients who had any surgical procedures within the past 30 days before urine culture sampling. Use of any antibiotics within the past 90 days of positive urine culture sampling was considered as positive antibiotic usage. Inappropriate antibiotherapy was defined as resistance to initial empiric antibiotic according to antibiogram results, while moderately susceptible or susceptible results were considered appropriate antibiotherapy. The diagnoses of sepsis and septic shock were based on SEPSIS-1 criteria. Samples for blood cultures were obtained when patients had a body temperature of ≥ 38.3°C or when a diagnosis of sepsis was made. VITEK 2 system (bioMerieux, France) was used for bacterial identification and antimicrobial susceptibility testing in blood cultures. In addition, Kirby-Bauer disk diffusion method was used to determine the antibiotic susceptibility of the strains. Bacterial identification and culture results were assessed according to EUCAST (The European Committee on Antimicrobial Susceptibility Testing) criteria (10). Leukocyte count (WBC) was estimated using an automated hemogram device, where a WBC

count of 4000 to 10000 cells/mm^3 was considered normal. C-reactive protein (CRP) levels were determined using turbidimetric methods, with CRP levels between 0 and 5 mg/L being considered normal. The study was conducted in accordance with the ethical principles of Helsinki Declaration. The study protocol was approved by the Ethics Committee of Nigde Omer Halisdemir University Research and Training Hospital, with a decision no of 58178 dated 5th May 2021.

Statistical Methods

Mortality and survival were the dependent variables in the study, and patients were categorized into two groups based on survival status. Continuous variables were age, APACHE II score, WBC, CRP, and duration of time (days) between admission and sampling for cultures, and these were summarized as mean and standard deviation (as mean and minimum-maximum, when required). In addition, Age ≥60, APACHE II≥15, WBC≥12000/mm^3, and CRP≥100 mg/L were considered as categorical variables. Comorbid conditions, antibiotic resistance, inappropriate empiric antibiotherapy, survival, and positive findings in urinalysis were classified as present/absent for two-category variable analyses. Categorical variables were compared with chi-square or Fisher's test statistics. When comparing continuous measures between groups, distributions were examined. Student's t-test was used for variables with parametric distribution, and Mann-Whitney U test was used for non-parametric variables. Mean±-standard deviation was defined as $p>0.05$ if continuous variables were normal (Kolmogorov-Smirnov test or Shapira-Wilk test ($n<30$)), and medians if continuous variables were not normal. All binary categorical and continuous variables were compared to the variable patient survival using univariate binary logistic regression analysis. Significance was expressed as odds ratios (OR) and 95% confidence intervals (CI). Only variables significantly results associated with the variable patient survival in univariate analyses were entered into the multivariate binary logistic regression (Backward: Wald stepwise method), used to build a prediction model for CAUTIs mortality. Statistical analyses were performed using SPSS 23.0 software pack. A p-value of <0.05 was considered significant in all statistical methods.

RESULTS

A total of 375 patients with a median age of 78 years (33-98) were included. Overall, there were 327 patients (87.2%) aged ≥65 years, and 198 (52.8%) were female. Neurological disorders, hypertension, and diabetes mellitus were present in 138 (36.8%), 115 (30.7%), and 110 (29.3%) of the patients. Seventy-one patients (18.9%) had neurogenic bladder, 66 (17.6%) had benign prostatic hyperplasia, and 64 (17.1%) had chronic renal failure. Mechanical ventilation was required in 95 (25.3%) participants. Septic shock was detected in 74 (19.7%) and bacteremia in 63 (16.8%). The median APACHE II score was 19 (7-18), median WBC was 13.000/mm^3 (0-39.000), and median CRP was 145 mg/L (6-156). **Table 1** shows the demographic characteristics, comorbid conditions, and laboratory parameters of study participants.

Gram-negative bacteria (GNB) was detected in 290 patients (77.3%) based on culture results. The most common organisms were *Escherichia coli, Klebsiella pneumonia,* and *Pseudomonas aeruginosa*. Of the Gram-positive bacteria (GPB), 63 (74.1%) were *Enterococcus faecalis* and 22 (25.9%) were *Enterococcus faecium*. The resistance to third-generation cephalosporins, ciprofloxacin, piperacillin-tazobactam, meropenem, and colistin was detected in 41.6%, 40.0%, 16.3%, 8.3%, and 0.5% of the Gram-negative bacteria, respectively. Vancomycin resistance was found in 0.3% of the GPB. The most commonly preferred empiric antibiotics included third-generation cephalosporins (28.8%), piperacillin-tazobactam (22.7%), and carbapenems (18.9%). The distribution of microorganisms detected in culture, antibiotic resistance rates, and empirical antibiotic treatment choices are shown in **Table 2**.

The overall mortality was 58.1%. Advanced age, age ≥65 y, presence of malignancy, need for mechanical ventilation, elevated APACHE II score, an APACHE II score ≥20, septic shock, presence of *E. faecium*, presence of GNB infection, and imipenem and/or meropenem and/or amikacin resistance were found to be associated with an increased risk of 28-day mortality, while the detection of *E. coli* as a result of culture reduced the risk of 28-day mortality. A multivariate analysis based on these showed a 6.0, 8.1, 3.6, 1.8, and 3.6 fold increased risk of 28-day mortality for age ≥65 years, malignancy, mechanical ventilation, APACHE II score ≥20, and septic shock, respectively. On the other hand, detection of *E. coli* in cultures was found to be associated with a lower 28-day mortality rate. The result of these analyses is shown in **Table 3**.

DISCUSSION

Catheter-associated urinary tract infection represents one of the most common healthcare-associated infections in patients admitted to intensive care units. Li et al. In the meta-analysis study in which they examined a total of 8785 patients from 10 studies, the incidence of CAUTI was 13.79/1000 catheter days, and the prevalence was 9.33% (11). They determined that

Table 1. Baseline characteristics of patients

	Total		Non-Survivors		Survivors		p
	(n=375)	(%)	(n=218)	(%)	(n=157)	(%)	
Age*	78 (33-98)		78 (33-98)		78 (33-97)		0.006
Age ≥65 year	327	87.2	200	91.7	127	80.9	0.003
Female	198	52.8	120	55.0	78	49.7	0.346
Comorbidities							
Surgery history	39	10.4	21	9.6	18	11.5	0.609
Diabetes mellitus	110	29.3	57	26.1	53	33.8	0.135
Cancer	42	11.2	31	14.2	11	7.0	0.031
ND	138	36.8	82	37.6	56	35.7	0.745
CRF	64	17.1	39	17.9	25	15.9	0.677
MV	95	25.3	75	34.4	20	12.7	<0.001
BPH	66	17.6	39	17.9	27	17.2	0.891
Nephrolithiasis	42	11.2	27	12.4	15	9.6	0412
Neurogenic bladder	71	18.9	35	16.1	36	22.9	0.109
OUD	37	9.9	22	10.1	15	9.6	1.000
Septic shock	74	19.7	60	27.5	14	8.9	<0.001
Bacteremia	63	16.8	35	16.1	28	17.8	0.676
Drugs, laboratory parameters, and clinical scores							
Antibiotic used	62	16.5	43	19.7	19	12.1	0.066
APACHE II*#	19 (7-38)		19 (8-38)		16.5 (7-38)		0.052
APACHE II ≥20#	126	41.6	87	49.2	39	31.0	0.002
WBC /mm3*	13 (0-39)		12 (0-39)		13 (3-36)		0.450
WBC ≥12000	204	54.4	115	52.8	89	56.7	0.464
CRP (mg/L)*	145 (6-516)		150 (6-516)		126.5 (8-432)		0.417
CRP≥100 mg/L	248	66.1	148	67.9	100	63.7	0.439
Urinary leukocyte	268	71.5	160	73.4	108	68.8	0.355
Urinary nitrite	101	26.9	58	26.6	43	27.4	0.906

CRF: Chronic renal failure, ND: Neurological disorders, MV: Mechanical ventilation, BPH: Benign prostatic hyperplasia, OUD: Other urological diseases, WBC: White blood cell count, CRP: C-reactive protein, * Median (Minimum-Maximum)

CAUTI increased mortality approximately 3.5 times (11). The reported mortality rates in CAUTI patients in various studies are 30.8% in Babich et al.'s study, 43% in Clec'h et al.'s study, and 72% in Hekimoğlu et al.'s study (8,9,12). Although the results of this study are similar to the results of other studies, the difference between the study designs and the centers where the studies were conducted may be the reason for the difference between the results.

Aging is associated with reduction in CD4 T and B cells as well as specific antibodies, impaired phagocytic capacity, and decrease in neutrophil chemotaxis and phagocytic functions (13). These changes, which impair the immune response, cause infectious diseases to be seen more frequently in the elderly and their prognosis is worse. In patients with CAUTI, Melzer et al. that old age is associated with mortality, Hekimoğlu et al. It has been determined that being in the 65-80 age range or being over 80 years old increases the risk of mortality compared to patients under 65 years of age (9,14). Our results are generally supportive of such previous findings and indicate an approximately 6-fold increased risk of mortality among those aged ≥65 years, as compared to those <65 years. Although aging is not a preventable risk factor in CAUTI, several behavioral measures may contribute to a decreased rate of urinary catheter-associated infections and mortality among elderly, such as avoidance from prolonged use of urinary catheters and

Table 2. Distribution of microorganisms, antibiotics resistance, and antibiotherapy

	Total		Non-Survivors		Survivors		p
	(n=375)	%	(n=218)	%	(n=157)	%	
GNB	290	77.3	163	74.8	127	80.9	0.171
E. coli	191	50.9	100	45.9	91	58.0	0.022
Klebsiella spp.	57	15.2	38	17.4	19	12.1	0.190
P. aeruginosa	27	7.2	17	7.8	10	6.4	0.688
Others	15	4.0	8	3.7	7	4.5	0.792
GPB	85	22.7	55	25.3	30	19.1	0.171
E. faecalis	63	16.8	37	17.0	26	16.6	1.000
E. faecium	22	5.9	18	8.3	4	2.5	0.025
AB resistance for GNB							
Ampicillin	213	56.8	122	56.0	91	58.0	0.593
3 gen. CPH	156	41.6	88	40.4	68	43.3	1.000
4 gen. CPH	104	27.7	56	25.7	48	30.6	0.622
PIP-TAZO	61	16.3	37	17.0	24	15.3	0.470
Meropenem	24	8.3	19	11.7	5	3.9	0.019
Tigecycline	38	10.1	25	11.5	13	8.3	0.223
Colistin	2	0.5	0	0	2	1.3	-
Ciprofloxacin	150	40.0	86	39.4	64	40.8	0.191
TMP-SMX	161	42.9	95	43.6	66	42.0	0.287
Amikacin	35	9.3	26	11.9	9	5.7	0.028
Gentamycin	48	12.8	30	13.8	18	11.5	0.426
AB resistance for GPB							
Ampicillin	32	8.5	23	10.6	9	5.7	0.352
Clindamycin	24	6.4	17	7.8	7	4.5	0.615
Ciprofloxacin	49	13.1	33	15.1	16	10.2	0.648
TMP-SMX	28	7.5	20	9.2	8	5.1	0.471
Vancomycin	1	0.3	1	0.5	0	0	-
Gentamycin	30	8.0	20	9.2	10	6.4	0.817
Empirical AB							
Ampicillin	16	4.3	8	3.7	8	5.1	0.607
3 gen. CPH	108	28.8	55	25.2	53	33.8	0.083
PIP-TAZO	85	22.7	50	22.9	35	22.3	0.901
Carbapenem	71	18.9	40	18.3	31	19.7	0.790
Aminoglycoside	2	0.5	1	0.5	1	0.6	-
Glycopeptide	7	1.9	5	2.3	2	1.3	-
Colistin	8	2.1	7	3.2	1	0.6	-
Quinolones	49	13.1	31	14.2	18	11.5	0.535

AB: Antibiotic, GNB: Gram-negative bacteria, gen.: Generation, CPH: Cephalosporins, PIP-TAZO: Piperacillin-tazobactam, TMP-SMX:Trimethoprim/sulfamethoxazole, GPB: Gram-positive bacteria

Table 3. Univariate analysis and multivariate analysis of risk factors for mortality

	Univariate analysis		Multivariate analysis	
	Odds ratio (95% Cl)	p	Odds ratio (95% Cl)	p
Age		0.006		0.236
Age≥65 year	2.625 (1.405-4.905)	0.003	6.033 (2.616-13.915)	<0.001
Cancer	2.200 (1.070-4.525)	0.031	8.170 (2.516-26.529)	<0.001
Mechanical ventilation	3.593 (2.081-6.023)	<0.001	3.641 (1.911-6.937)	<0.001
APACHE II		0.052		0.794
APACHE II ≥20	2.156 (1.336-3.482)	0.002	1.895 (1.102-3.260)	0.021
E. faecium	3.443 (1.142-10.380)	0.025		0.380
E. coli	0.615 (0.406-0.930)	0.022	0.536 (0.316-0.909)	0.021
IMP/C resistance	3.029 (1.093-8.397)	0.029		0.859
Meropenem resistance	3.219 (1.168-8.877)	0.019		0.706
Amikacin resistance	2.488 (1.121-5.521)	0.028		0.750
Septic shock	3.879 (2.078-7.241)	<0.001	3.686 (1.768-7.684)	<0.001

stricter adherence to infection control measures. In a previous study from Holland, the presence of underlying conditions in the elderly was found to increase the risk of mortality (15). In Combacte-Magnet Rescuing study, factors that were associated with an increased risk of 30-day mortality included age, hematologic malignancy, and septic shock in this patient group (16). Similarly, Babich et al. found that advanced age, malignancy, and a history of myocardial infarction were associated with mortality (8). As in other studies with a large sample size, our study also found an association between mortality with malignancy and septic shock. We believe that in order to reduce mortality, CAUTI patients with malignancy require a multidisciplinary management strategy also involving oncologists, in addition to rapid administration of appropriate and effective treatments for septic shock based on the experience of each center.

Antibiotic resistance represents an increasing global healthcare crisis, particularly among bacteria leading to urinary system infections such as *K. pneumonia, P. aeruginosa,* and *E faecium* (17–19). In the Combacte-Magnet Rescuing study, 341 CAUTIs were examined and it was determined that the detection of multiple antibiotic resistant GNB was not a risk factor for mortality (16). Zilberberg et al. found that antibiotic resistance was not associated with mortality in his study involving complicated urinary tract infections (20). In our study, while presence of resistance to meropenem, imipenem, or amikacin emerged as a risk factor for mortality in the univariate analysis, these factors lost their significance in the multivariate analysis, consistent with these previous studies. The selection of appropriate antibiotics is the mainstay of treatment for CAUTI. In empiric antibiotic therapy, a recommendation to consider local antibiotic resistance patterns has been made (1). Because antibiotic resistance is so common, clinicians prefer broad-spectrum antibiotics for empirical antibiotic therapy. According to Clec'h et al., wide spectrum antibiotic treatment initiated within the first 48 hours can decrease the mortality risk (12). In contrast, appropriate antibiotherapy did not appear to be a significant factor for mortality in Babich et al.'s study (8). The results of Combacte-Magnet Rescuing study, published two years after Babich et al.'s, is supportive of this study (16). In our study, inappropriateness of empiric antibiotics and selection of antibiotics were not related with increased mortality, in both GNB and GPB infections. Although antibiotic resistance and treatment choice does not have a significant effect on mortality risk, the results of microbiological examination may have an effect. Logistic regression analysis suggested that detection of *E. coli* was associated with a lower mortality risk. In studies, *E.coli* is the most common GNB and *Enterococcus faecalis* is the most common GPB in CAUTI patients. The fact that antibiotic resistance in these microorganisms is not as common as *K. pneumonia, P. aeriginosa,* and *E. faecium* may explain that appropriate antibiotic therapy and broad-spectrum antibiotic therapy do not affect mortality.

The most serious complications of urinary tract infections include pyelonephritis, renal failure, and sepsis. The usefulness of certain biomarkers and clinical scoring systems in predicting mortality in patients with sepsis has been repeatedly established (21–25). Morkar et al. reported that APACHE II scores were the most sensitive marker for mortality, while urosepsis patients with elevated lactate or APACHE II had an increased risk of mortality in the study by Sheng et al (23,24). Jiang et al. reported that platelet and procalcitonin are useful markers for determining the severity and prognosis of urosepsis (25). In this study, mortality was not associated with the leukocyte count, CRP, and detection of pyuria, nitrites, protein, and erythrocytes in urinalysis. However, an APACHE II score ≥ 20 led to a 1.8-fold increased risk of mortality. In this study, certain laboratory parameters were different from those examined in previous study. In addition, another difference of this study includes both patients in the sepsis clinic and non-septic patients. Despite clinical differences in our population, APACHE II score was a significant predictor of mortality similar to previous findings.

According to our observations, APACHE II score, age, septic shock, mechanical ventilation, malignancy, and detection of *E. coli* in microbiological cultures affect the risk of mortality in patients with CAUTI. We believe that the assessment of multiple risk factors for mortality may represent a valuable contribution to the existing literature in terms of allowing more specific results with regard to bacterial agents. Also, since laboratory parameters that are widely available in many centers have been utilized, our findings may be useful for most clinicians. The limitations of our study include its single-center design and lack of examination of the association between fungal agents and mortality.

CONCLUSION

In conclusion, an APACHE II score ≥20, age ≥65 year, status of septic shock, mechanical ventilation, and presence of malignancy increase the mortality risk in patients with CAUTI. In contrast, detection of E. coli in microbiological cultures was associated with lower mortality. Catheter-associated urinary tract infections remain a major healthcare associated infection, particularly in the intensive care units, owing to prolonged hospital stay, significant increase in healthcare costs, as well as its ability to cause serious complications such as sepsis. A better understanding of factors associated with mortality and measures against preventable causes may help decrease deaths related with CAUTI.

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