

## Clinical Characteristics of Acute Pyelonephritis with Enterobacteriaceae Bacteremia in the Elderly

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**Background/Aims:** Acute pyelonephritis (APN) is reported as the most common cause of bacteremia in hospitalized patients. Urinary tract infection is the second most common infection leading to hospitalization in the elderly, following pneumonia. This study focused on clinical outcomes of APN in the elderly, particularly those aged 75 years and older.

**Methods:** We performed a single-center retrospective cohort study at tertiary care national hospital in South Korea from January 2013 to December 2022. All patients aged  $\geq 18$  years who were diagnosed with APN were recruited. For this study, we selected patients with APN caused by *Escherichia coli* and *Klebsiella pneumoniae* bacteremia. Using Student t-test for continuous variables and chi-square test for categorical variables, the baseline and result characteristics were compared. Multivariate logistic regression analysis was performed to determine odds ratios (OR) for composite poor outcomes.

**Results:** A total of 554 patients were included in the study, and Figure 1 demonstrates that when divided into four age groups, the elderly group with APN showed longer hospitalization periods and an increased mortality rate. The study divided the participants into an elderly group and a control group based on the age of 75. The elderly group exhibited longer hospitalization periods, and higher mortality rates compared to the control group. Additionally, there was a greater need for use of vasopressors and admission to the intensive care unit during hospitalization in the elderly group. In our additional analysis, we found that elderly patients with diabetes (OR 2.56, 95% CI 1.30-5.06,  $p=0.007$ ) and those performed procedures with nephrostomy tube or indwelling catheter (OR 3.06, 95% CI 1.03-9.14,  $p=0.045$ ) exhibited significantly worse composite outcomes.

**Conclusions:** The elderly group diagnosed with APN showed increased hospitalization days and mortality rates. However, there are not different approach and management for APN in geriatric patient from in younger patients. In our study, elderly patients with diabetes and foreign bodies showed a higher risk of adverse composite outcomes. Therefore, special attention should be given to these elderly patients.

Figure 1. Comparison of admission period and mortality by age.

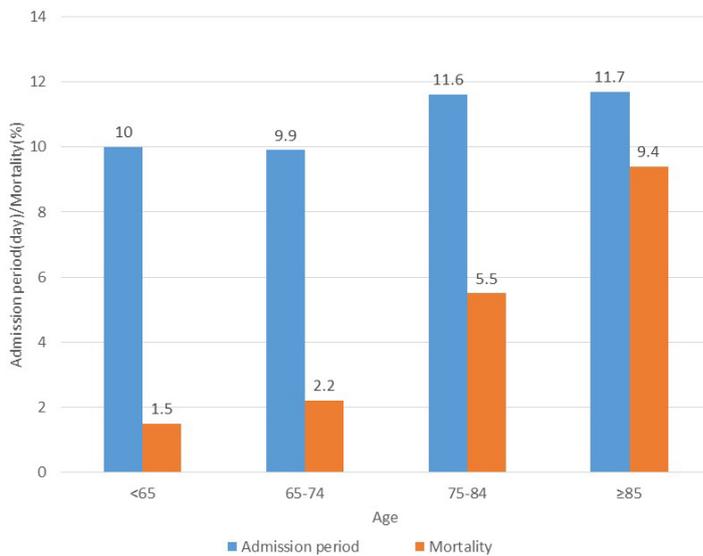


Table 1. Baseline characteristics and clinical outcomes

	Age < 75 yr N=270	Age $\geq$ 75 yr N=284	P value
Age (yrs)	61.8 $\pm$ 11.0	81.0 $\pm$ 4.6	<0.001
Sex, female (n, %)	204 (75.6)	217 (76.4)	0.892
Height (cm)	159.6 $\pm$ 8.7	160.0 $\pm$ 82.3	0.936
Body weight (kg)	60.6 $\pm$ 10.9	55.5 $\pm$ 11.2	<0.001
Systolic blood pressure (mmHg)	123.5 $\pm$ 25.6	121.9 $\pm$ 27.9	0.486
Diastolic blood pressure (mmHg)	74.3 $\pm$ 14.8	71.8 $\pm$ 16.8	0.062
Previous usage of antibiotics within 1yr (n, %)	66 (24.4%)	75 (26.4%)	0.665
Previous history of admission within 1yr (n, %)	94 (34.8%)	74 (26.1%)	0.032
<b>Outcome</b>			
Admission duration (day)	10.0 $\pm$ 7.3	11.6 $\pm$ 9.0	0.017
ICU admission (n, %)	6 (2.2%)	21 (7.4%)	0.009
RRT on admission (n, %)	7 (2.6%)	7 (2.5%)	1
CRRT on admission (n, %)	2 (0.7%)	5 (1.8%)	0.488
Inotropics (n, %)	14 (5.2%)	51 (18.0%)	<0.001
Death (n, %)	5 (1.9%)	18 (6.3%)	0.015
<b>Comorbid disease</b>			
Hypertension (n, %)	126 (46.7%)	193 (68.0%)	<0.001
Diabetes mellitus (n, %)	108 (40.0%)	122 (43.0%)	0.535
Liver disease (n, %)	16 (5.9%)	12 (4.2%)	0.472
Malignancy (n, %)	27 (10.0%)	29 (10.2%)	1
Chronic kidney disease (n, %)	38 (14.1%)	47 (16.5%)	0.49
Bedridden state (n, %)	3 (1.1%)	9 (3.2%)	0.17
<b>Laboratory findings</b>			
WBC ( $\times 10^3/\text{mm}^3$ )	13.4 $\pm$ 6.4	14.6 $\pm$ 7.6	0.042
Hemoglobin (g/dL)	11.4 $\pm$ 1.8	11.1 $\pm$ 1.8	0.041
Platelet ( $\times 10^3/\text{mm}^3$ )	191.1 $\pm$ 89.3	169.2 $\pm$ 90.4	0.004
Calcium (mg/dL)	8.6 $\pm$ 0.7	8.4 $\pm$ 0.7	0.006
Phosphate (mg/dL)	3.0 $\pm$ 1.2	2.9 $\pm$ 1.0	0.844
BUN (mg/dL)	27.3 $\pm$ 20.1	31.7 $\pm$ 18.5	0.008
Cholesterol (mg/dL)	138.8 $\pm$ 43.8	123.7 $\pm$ 39.4	<0.001
Protein (g/dL)	6.4 $\pm$ 0.8	6.1 $\pm$ 0.8	<0.001
Albumin (g/dL)	3.6 $\pm$ 0.6	3.4 $\pm$ 0.6	<0.001
AST (U/L)	36.5 $\pm$ 39.0	49.3 $\pm$ 83.9	0.021
ALT (U/L)	29.1 $\pm$ 24.4	29.0 $\pm$ 52.5	0.985
Creatinine (mg/dL)	1.7 $\pm$ 1.8	1.6 $\pm$ 1.2	0.757
eGFR (mL/min/1.73m <sup>2</sup> )	67.5 $\pm$ 33.9	54.7 $\pm$ 26.6	<0.001
Na (mmol/L)	135.5 $\pm$ 5.0	135.9 $\pm$ 5.2	0.308
K (mmol/L)	4.1 $\pm$ 0.7	4.2 $\pm$ 0.7	0.16
Cl (mmol/L)	99.5 $\pm$ 5.8	101.0 $\pm$ 6.0	0.003
Total CO <sub>2</sub> (mmol/L)	20.4 $\pm$ 4.1	19.4 $\pm$ 4.3	0.004
CRP (mg/L)	148.8 $\pm$ 96.8	137.8 $\pm$ 88.9	0.164

ICU: intensive care unit, RRT: renal replacement therapy, CRRT: continuous renal replacement therapy, WBC: white blood cells, BUN: blood urea nitrogen, AST: aspartate aminotransferase, ALT: alanine transaminase, eGFR: estimated glomerular filtration rate, CRP: C-reactive protein  
Na: sodium, K: potassium, Cl:chloride, Total CO<sub>2</sub>:Total bicarbonate