

# Evaluation of Patients Hospitalized from the Emergency Department with Pyelonephritis

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## Abstract

**Objective:** We aimed to evaluate the demographic, etiologic, and clinical characteristics, complicating factors, laboratory and radiodiagnostic evaluations, treatment practices, and follow-up processes of hospitalized patients diagnosed with acute pyelonephritis (APN).

**Materials and Methods:** The files of 241 patients diagnosed with APN in the emergency department and admitted to clinics in our center between May 1, 2012, and May 1, 2016, were accessed through the automation information system of our hospital. Demographic characteristics, seasonal distribution, complaints, clinical findings, laboratory tests and imaging results, treatment, follow-up, and outcome status of the patients were retrospectively scanned and evaluated.

**Results:** The mean age of the patients was  $66.00 \pm 19.61$  years. 54.4% were women. The most common presenting complaints were fever and flank pain; physical examination finding was suprapubic tenderness; predisposing factor was urinary catheterization; and comorbid diseases were chronic renal failure and DM. The most common causative agent was *Escherichia coli*. The most common imaging findings were hydronephrosis and urolithiasis. The duration of hospitalization was  $10.81 \pm 7.09$  days; 1.2% of patients died.

**Conclusion:** The most common predisposing factors for the development of APN were recent antibiotic use, particularly in the last two weeks, history of hospitalization in the last two weeks, chronic renal failure, and diabetes mellitus. APN may present as a spectrum ranging from mild to urosepsis.

**Keywords:** Pyelonephritis, urinary tract infection, predisposing factor, diagnosis

## Introduction

Acute pyelonephritis (APN) is a progressive infection of the parenchymal tissue of the kidney that can result in high mortality and morbidity [1-5]. The main symptoms are flank pain, fever, low back pain, and burning sensations during urination. It is more common in women than men, and it can be observed at any age [3-7]. Gram (-) enteric bacteria are frequently seen as causative agents. Pyelonephritis can be divided into two categories: complicated pyelonephritis associated with complicating factors, such as urinary system anomalies, urinary system stones, diabetes, pregnancy, catheter use, and similar foreign bodies, and uncomplicated

pyelonephritis, which is a disease without complicating factors. The determination of these factors is important for diagnosis and treatment. Treatment should be started as soon as possible in such patients. In untreated patients, it may progress to the loss of renal parenchyma, followed by sepsis and death [1,7-9]. The diagnosis of APN is made using the rational use of clinical findings, laboratory tests, and imaging methods [5,10].

In this study, we aimed to evaluate the demographic, etiologic, and clinical characteristics, complicating factors, laboratory and radiodiagnostic evaluations, treatment practices, and follow-up processes of hospitalized patients with APN.



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**Received:** 15.01.2024 **Accepted:** 19.02.2024



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## Materials and Methods

### Ethics Statement

The study was conducted according to the World Medical Association Declaration of Helsinki. Ethical approval was obtained from the Trakya University Faculty of Medicine Scientific Research Ethics Committee (decision number: 1707, date: 12.10.2016) of our university before starting the study.

### Study Design and Data Collection

The files of 241 patients diagnosed with APN in the emergency department and admitted to the clinics in our center between May 1, 2012, and May 1, 2016, were accessed through the automation information system of our hospital. The data were retrospectively scanned and recorded on the study forms.

Demographic characteristics, seasonal distribution, complaints, clinical findings, laboratory tests and imaging results, treatment, follow-up, and outcome status of the patients were retrospectively scanned and evaluated.

### Statistical Analysis

SPSS 20.0 for Windows® statistical software (IBM Inc. Chicago, IL, USA) was used. Minimum-maximum values and arithmetic mean±standard deviation were calculated as descriptive statistics, and numbers (n) and percentages (%) were calculated for qualitative data.

## Results

### Descriptive Characteristics of the Patients

We included 241 patients in the study. It was determined that 7.5% of the patients (n=18) had previously visited another clinic and were referred to our center for further examination and treatment. Furthermore, 54.4% of the patients were female, and the mean age was 66.00±19.61 years. The mean age of male participants was higher than that of female participants. When the patients' presenting complaints were questioned; 47.1% (n=114) had dysuria, 75.9% (n=183) had fever, 45.6% (n=110) had chills, 50.2% (n=121) had flank pain, 36.5% (n=88) had nausea, and 33.6% (n=81) had vomiting (Table 1).

**Table 1. Descriptive characteristics of the patients**

| Gender n (%)                              | Male                            | Female                          | Total                  |
|-------------------------------------------|---------------------------------|---------------------------------|------------------------|
|                                           | 110 (45.6)                      | 131 (54.4)                      | 241 (100)              |
| Age (year)<br>(mean±SD)                   | 74.00±14.06<br>(26-95)          | 58.00±20.68<br>(20-89)          | 66.00±19.61<br>(20-95) |
| Complaints at admission<br>n (%)          | Irritative voiding symptoms     | Dysuria                         | 114 (47.1)             |
|                                           | Pollakiuria                     | 19 (7.9)                        |                        |
|                                           | Polyuria                        | 8 (202)                         |                        |
|                                           | Urgency                         | 39 (16.3)                       |                        |
|                                           | Haematuria                      | 18 (7.5)                        |                        |
|                                           | Fever                           |                                 | 183 (75.9)             |
|                                           | Flank pain                      |                                 | 121 (50.2)             |
|                                           | Shaking chills                  |                                 | 110 (45.6)             |
|                                           | Nausea                          |                                 | 88 (36.5)              |
|                                           | Vomiting                        |                                 | 81 (33.6)              |
|                                           | Diarrhea                        |                                 | 15 (6.2)               |
| Physical examination<br>findings<br>n (%) | Vital parameters<br>(mean±SD)   | Respiratory rate (/min.)        | 15±2.21                |
|                                           |                                 | Pulse rate (/min.)              | 90±15.57               |
|                                           |                                 | Systolic blood pressure (mmHg)  | 110±19.10              |
|                                           |                                 | Diastolic blood pressure (mmHg) | 70±11.79               |
|                                           |                                 | Body temperature (°C)           | 38±1.02                |
|                                           | Fever                           |                                 | 62 (25.7)              |
|                                           | Unconsciousness                 |                                 | 91 (37.7)              |
|                                           | Hypotension                     |                                 | 67 (27.8)              |
|                                           | Tachycardia                     |                                 | 45 (18.6)              |
|                                           | Tachypnea                       |                                 | 22 (9.1)               |
|                                           | Dehydration                     |                                 | 95 (39.6)              |
|                                           | Costovertebral angle tenderness |                                 | 138 (57.3)             |
|                                           | Suprapubic tenderness           |                                 | 147 (60.9)             |

SD: Standard deviation, Min.: Minimum, Mean: Average

Complaints at Admission and Physical Examination Findings

When the vital parameters of the patients were evaluated; mean respiratory rate was 15±2.21/min., mean systolic blood pressure was 110±19.10 mmHg, mean diastolic blood pressure was 70±11.798 mmHg, mean axillary body temperature was 38±1.02 °C and mean pulse rate was 90±15.576 beats/min. According to the physical examination findings, 60.9% (n=147) had suprapubic tenderness, 57.3% (n=138) had costovertebral angle tenderness, 39.6% (n=95) had dehydration, and 37.7% (n=91) had impaired consciousness (Table 1).

Predisposing Factors

Predisposing factors were evaluated under the main headings of urinary system-derived factors, medical factors, and comorbid diseases. When the patients were questioned in terms of predisposing factors, the most common urinary tract-derived factors were foley catheter use (17.4%) and urolithiasis (17.0%); the most common medical factor was inappropriate and unindicated use of antibiotics (34.9%); and the most common comorbid diseases were diabetes mellitus (23.2%) and chronic renal failure (27.0%) (Table 2).

Laboratory Results

The mean urea value was 53.29±40.52 mg/dL, mean creatinine value was 1.36±1.03 mg/dL, mean C-reactive protein (CRP) value was 15.68±13.90 and mean sedimentation value was 65.58±30.61/h. In addition, a left shift (increased polymorphic

leukocytes) was detected in the peripheral smears of 91.3% of patients. Complete urine analysis revealed bacteriuria (80.1%), leukocyte cilia, microscopic hematuria (55.2%), and sterile pyuria (14.1%). When the urine culture results of the patients were analyzed, it was found that 61.8% had single microorganism and 22.8% had poly microorganism. Among these microorganisms, *Escherichia coli* (*E. coli*) (71.0%) is the most common (Table 3).

Imaging Findings

In the emergency department, 39.6% of patients underwent direct urinary tract radiography (DUSG), 85.5% underwent urinary tract ultrasonography, and 27.9% underwent urinary tract computed tomography (CT). When the patients who underwent imaging examinations were analyzed, the examination was normal in 65.8% (n=61) of those who underwent DUSG, 35.4% (n=73) of those who underwent Ultrasonography (USG), and 14.9% (n=10) of those who underwent CT. Stone-compatible radiopacity was observed in 25.8% (n=23) of patients who underwent DUSG. Heterogeneity in the renal parenchyma was found in 19.4% (n=40), hydronephrosis in 35% (n=72), renal calculi in 16.8% (n=33), and ureteral calculi in 15.2% (n=11) of patients who underwent urinary system USG. In patients who underwent CT scan, 32.8% (n=22) had renal calculi, 43.3% (n=29) had hydronephrosis, and 47.8% (n=32) had hydronephrosis (Table 3).

| Table 2. Predisposing factors          |                                                             |           |
|----------------------------------------|-------------------------------------------------------------|-----------|
|                                        |                                                             | n (%)*    |
| Urinary system related factors         | Foley catheter use                                          | 42 (17.4) |
|                                        | History of pyelonephritis/recurrent urinary tract infection | 32 (13.3) |
|                                        | Benign prostatic hypertrophy                                | 31 (12.9) |
|                                        | Nephrolithiasis/urolithiasis                                | 41 (17.0) |
|                                        | Genitourinary anomaly                                       | 13 (5.4)  |
|                                        | History of urological operations                            |           |
|                                        | Enterovesical-fistula                                       | 3 (1.2)   |
|                                        | Renal transplantation                                       | 4 (1.7)   |
|                                        | Nephrectomy                                                 | 12 (5.0)  |
| Medical factors                        | Inappropriate and unindicated use of antibiotics            | 84 (34.9) |
|                                        | Use of nonsteroidal anti-inflammatory drugs                 | 33 (13.7) |
|                                        | Immunosuppressive treatment                                 | 16 (6.6)  |
| Comorbid diseases and other factors    | Pregnancy                                                   | 5 (2.1)   |
|                                        | Diabetes mellitus                                           | 56 (23.2) |
|                                        | Chronic renal failure                                       | 65 (27.0) |
|                                        | History of tuberculosis                                     | 3 (1.2)   |
|                                        | History of malignancy                                       | 30 (12.4) |
|                                        | History of immune system disease                            | 9 (3.7)   |
|                                        | History of hospitalization within the last two weeks        | 79 (32.8) |
| *: A patient may have multiple factors |                                                             |           |

### Treatment, Prognosis, and Outcome

When the treatments applied to the patients in the emergency department and hospitalized ward were analyzed, 64.7% of the patients were started on a single antibiotic, whereas 35.3% were started on multiple antibiotics. When the clinics where

the patients were hospitalized were examined; 88.8% (n=214) of the patients were hospitalized in the infectious diseases clinic and 8.3% (n=20) in the urology clinic. In addition, 14.5% of patients had surgical indication (Table 4).

**Table 3. Laboratory and imaging findings**

| Laboratory results                                                               |                                       |              |
|----------------------------------------------------------------------------------|---------------------------------------|--------------|
| <b>Biochemical blood tests</b><br>(mean±SD)                                      | Urea (mg/dL)                          | 53.29±40.519 |
|                                                                                  | Creatinine (mg/dL)                    | 1.36±1.028   |
|                                                                                  | C-reactive protein level (mg/L)       | 15.68±13.898 |
|                                                                                  | Sedimentation rate (mm/h)             | 65.58±30.610 |
|                                                                                  | Left shift in peripheral smears       | 220 (91.3)   |
| <b>Urinalysis</b><br>n (%)*                                                      | Bacteriuria                           | 193 (80.1)   |
|                                                                                  | Sterile pyuria                        | 34 (14.1)    |
|                                                                                  | Proteinuria                           | 68 (28.2)    |
|                                                                                  | Leukocyte cast                        | 233 (96.7)   |
|                                                                                  | Microscopic hematuria                 | 133 (55.2)   |
| <b>Urine culture</b><br>n (%)*                                                   | Single microorganism                  | 149 (61.8)   |
|                                                                                  | Polymicroorganism                     | 55 (22.8)    |
|                                                                                  | Bacteria type                         |              |
|                                                                                  | <i>Escherichia coli</i>               | 171 (71.0)   |
|                                                                                  | <i>Proteus</i>                        | 4 (1.7)      |
|                                                                                  | <i>Enterobacter</i>                   | 18 (7.5)     |
|                                                                                  | <i>Klebsiella</i>                     | 13 (5.4)     |
|                                                                                  | <i>Pseudomonas</i>                    | 13 (5.4)     |
|                                                                                  | Others                                | 40 (16.6)    |
| Imaging findings n (%)*                                                          |                                       |              |
| <b>Direct urinary tract radiography</b><br>89 (36.9)                             | Stone-compatible radiopacity          | 23 (25.8)    |
| <b>Ultrasonography of the urinary tract</b><br>206 (85.5)                        | Kidney stone                          | 33 (16.8)    |
|                                                                                  | Ureter or bladder stone               | 11 (15.2)    |
|                                                                                  | Hydronephrosis                        | 72 (35.0)    |
|                                                                                  | Congenital urinary tract anomalies    | 26 (12.6)    |
|                                                                                  | Emphysematous pyelonephritis          | 1 (0.5)      |
|                                                                                  | Increased kidney size                 | 9 (4.4)      |
|                                                                                  | Pararenal abscess                     | 12 (5.8)     |
|                                                                                  | Heterogeneity of the renal parenchyma | 40 (19.4)    |
| <b>Computerized tomography</b><br>67 (27.9)                                      | Kidney stone                          | 22 (32.8)    |
|                                                                                  | Increased kidney size                 | 8 (11.9)     |
|                                                                                  | Emphysema                             | 2 (3.0)      |
|                                                                                  | Congenital urinary tract anomalies    | 17 (25.4)    |
|                                                                                  | Hydronephrosis                        | 29 (43.3)    |
|                                                                                  | Renal parenchymal damage              | 32 (47.8)    |
| *: A patient may have multiple factors,<br>SD: Standard deviation, Mean: Average |                                       |              |

The mean length of stay in the emergency department was  $1.10\pm0.32$  days, while the mean length of stay in the hospitalized clinics was  $10.81\pm7.09$  days. While 6.2% of the treated patients were transferred to another center, 1.2% of them had an exitus (Table 4).

Discussion

Pyelonephritis is more common in women and causes hospitalization five times more frequently than in men [6]. Karakeçili et al. [2] similarly reported that 39.5% of the patients were male and the mean age was 55.5 years. Işıkgöz Taşbakan et al. [1] found that 38% of the patients were male, and the mean age was  $48.8\pm18.7$  years. In our study, although the male sex ratio was similar to that reported in the literature, the mean age of our patients was higher.

The symptoms of APN are very variable. In a study in which 190 cases were evaluated, fever was reported in 84.7%, dysuria in 33.1%, nausea in 29.4%, and flank pain in 42.6% [1,2]. In a study evaluating APN cases in elderly patients, fever was found in 53%, dysuria in 35%, and nausea/vomiting in 18% [1,4]. In our study, the most common symptoms were fever, flank pain, dysuria, chills and chills, respectively, and our findings are consistent with the literature. In our study and other studies, fever was the most common symptom of pyelonephritis. This is followed by flank pain, irritative voiding symptoms, nausea, and vomiting. These findings suggest that patients with pyelonephritis may not always present with urinary system-specific complaints.

APN may present clinically on a spectrum ranging from a mild presentation to urosepsis. Altered consciousness, delirium, and agitation may indicate severe urinary tract infection [7,8]. Doyuk Kartal et al. [3] reported that 23% of their patients presented with urosepsis. In our study, 26.1% of patients developed urosepsis. The development of urosepsis increases the mortality rate of the disease, and early recognition is critical for diagnosis and treatment.

In our study, when the vital signs detected at the time of initial presentation were evaluated, the most common findings were fever and hypotension, and when the physical examination was performed, the most common findings were costovertebral angle tenderness, dehydration, and unconsciousness, respectively. However, tachycardia and tachypnea may not always be observed in elderly patients because of the failure of these mechanisms to reach their desired levels. A similar situation was found in the data. It should be noted that although urinary tract infection can progress to a very serious condition, such as sepsis, systemic inflammatory response syndrome symptoms are not always present, especially in elderly individuals.

Urinary catheters are frequently used for urinary retention, incontinence control, wound management, and patient comfort. Catheter-associated urinary tract infections are very common. This is associated with an increased risk of complications and morbidity. Long-term catheter use should be preferred only in patients with valid medical indications. The term complicated urinary tract infection is generally used to refer to infections in patients with structural or functional abnormalities that prevent urinary flow or cause changes in the defense system of the individual [3,11]. The presence of predisposing factors in patients with APN must be evaluated because they are the most important factors for guiding diagnosis and treatment. There are many predisposing factors for the development of complicated urinary tract infection. The most common of these are conditions that cause obstruction in the urinary tract. As a result of obstruction of the urinary tract and stasis of urine flow, the entry and attachment of pathogenic microorganisms into the urinary system becomes easier, and a focus that cannot be easily treated with antibiotics is formed and causes disruption of the local defense system [1,3,10,11]. Işıkgöz Taşbakan et al. [1] reported obstructive uropathy as the most common complicating factor and urinary catheterization as the second most common complicating factor in their study of 133 patients diagnosed with APN.

| Table 4. Treatment, prognosis, and outcome |       |                      |            |
|--------------------------------------------|-------|----------------------|------------|
| Clinics                                    | n (%) | Infectious diseases  | 214 (88.8) |
|                                            |       | Nephrology           | 7 (2.9)    |
|                                            |       | Urology              | 20 (8.3)   |
| Medical treatment (antibiotics)            |       | Monomicrobial agent  | 85 (35.3)  |
|                                            |       | Polymicrobial agents | 156 (64.7) |
| Surgical treatment                         |       |                      | 35 (14.5)  |
| Urosepsis                                  |       | 63 (26.1)            |            |
| Mortality                                  |       | 3 (1.2)              |            |
| Hospitalization duration (mean±SD) (days)  |       | 10.81±7.09           |            |
| SD: Standard deviation, Mean: Average      |       |                      |            |

The essential elements of successful patient treatment and management are effective history taking and detailed identification of risk factors. Awareness by emergency physicians of these factors will contribute positively to the prognosis of the disease. When other studies conducted in our country were examined, it was reported that the most common complicating factor was diabetes mellitus (27-41%). Similarly, diabetes mellitus was reported as the most common complicating factor, with a rate of 26%, in a study by Tanyel et al. [4], in which urinary tract infections in the geriatric age group were evaluated. Other complicating factors include diabetes mellitus, recent history of antibiotic use, congenital anomalies of the urinary system, urological interventions, immunosuppression, renal insufficiency (azotemia), renal transplantation, and neurogenic factors [1-5,7,11-13]. In our study, a history of not indicated and inappropriate antimicrobial use and hospitalization within the last 2 weeks were the two most common factors, followed by obstructive uropathy and urinary tract catheterization. Diabetes mellitus was present in about a quarter of our cases. Differences in the prevalence of other predisposing factors may vary according to the center where the study was conducted and the facilities of these centers. When our findings are evaluated; the high average age and number of comorbid diseases in our patients may explain the high rate of recent hospitalization history. In addition, since our hospital is a regional hospital, many patients with obstructive complication factors are referred to our hospital for surgical procedure evaluation. Another important point that we found in our study and that we think should be emphasized is that inappropriate antimicrobial use is quite common. Jansäker et al. [14] reported that appropriate antibiotic treatment decreased admissions and hospitalizations associated with pyelonephritis. In addition, Doyuk Kartal et al. [3] reported that not indicated and inappropriate antimicrobial use is an important factor that increases the risk of urinary tract infection in all age groups. In our study, approximately one-third of the patients had a history of not indicated and inappropriate antibiotic use (without paying attention to dose and posology). Based on these findings, we believe that this is a common facilitating disease factor. Recently, many meetings have been held both in our home country and abroad about rational drug use and unnecessary antibiotic use, and the importance of the dangers awaiting patients in the future has been emphasized. Physicians play a great role in raising public awareness regarding this issue.

When the laboratory tests of the patients at the time of first presentation were examined, it was found that 77% of the patients had leukocytosis, 71% had elevated sedimentation, and all patients who were examined for CRP had elevated CRP levels in the study by Işıkgöz Taşbakan et al. [1] In our study, we found elevated mean CRP and sedimentation values in the

tests performed at the time of first presentation. In peripheral smear examination, 91.3% of patients exhibited a left shift. APN, an infective event, was associated with leukocytosis secondary to increased neutrophil counts and increased sedimentation due to increased complement, along with increased CRP levels, which is known as an acute phase reactant.

In our study, no pathologic finding was detected on urinary system USG performed in 1/3 of the patients, whereas the most frequently detected pathologies were hydronephrosis, obstructive uropathy due to calculi, and pyelonephritis at a rate of 19.4%, respectively. In a study by Karakeçili et al. [2], USG was found to be normal in 62.7% of patients; stones were found in 20.3%, hydronephrosis in 18.7%, and benign prostatic hyperplasia in 7.8%. Işıkgöz Taşbakan et al. [1] found that urinary system USG was normal in 50% of the patients, stones were found in 14%, and hydronephrosis was found in 9% of the patients with pathologic findings. The studies showed partial similarity with the literature and with each other in terms of urinary system USG. Despite these data, there is not enough data in the literature to compare DUSG and CT.

Urine culture is one of the important tests that should be performed for treatment planning of APN. When the urine culture results of APN patients in the study by Karakeçili et al. [2] were analyzed, *E. coli* was found to be the most common organism at a rate of 62.6%, and *Klebsiella* was the second most common organism at a rate of 12.7%. In a study conducted by Işıkgöz Taşbakan et al. [1], *E. coli* was the most frequent pathogen (in 77% of the patients and *Klebsiella* was the second most frequent growth in 10% of the patients. In the study by Doyuk Kartal et al. [3], *E. coli* was the most common causative agent at a rate of 63%, and in the study by Tanyel et al. [4], *E. coli* was the causative agent with a rate of 55%. In our study, *E. coli* was the most common causative agent in 71% of the urine cultures of the patients and enterococcus was the second most common pathogen with a rate of 7.5%. Our study was consistent with the literature regarding the most frequent detection of *E. coli* in urine cultures.

In our study, the most frequently hospitalized service was infectious diseases 88.8% bacteremia was observed in 30.7% of patients, and 1.2% had a mortal course. In the study by van Nieuwkoop et al. [15], the bacteremia rate was 27% and the mortality rate was 5%. In a study by Karakeçili et al [2], the mortality rate was 4.7%. The lower mortality rate in our study compared with the studies in the literature was attributed to the fact that the mortality data of patients referred to external centers could not be accessed and therefore could not be recorded.

### Study Limitations

Our study has several limitations. First, this study was conducted at a single center with a small sample size. Some results may

differ among different populations. The results should be confirmed in future multicenter studies with large sample sizes. In our study, data about the operations performed by patients who underwent surgical operations.

## Conclusion

In our study, the most common predisposing factors for the development of APN were not indicated and inappropriate antibiotic use, history of hospitalization within the last two weeks, chronic renal failure, and diabetes mellitus. APN may present as a spectrum ranging from a mild picture to urosepsis. The essential components of successful patient treatment and management are effective history taking and detailed identification of complicating factors. Awareness of these factors by emergency physicians can contribute positively to disease prognosis.

## Ethics

**Ethics Committee Approval:** Ethical approval was obtained from the Trakya University Faculty of Medicine Scientific Research Ethics Committee (decision number: 1707, date: 12.10.2016) of our university before starting the study.

**Informed Consent:** Retrospective study.

## Footnotes

### Authorship Contributions

Concept: S.B., M.B.S., Design: Ö.S., A.Y., Data Collection or Processing: S.B., Analysis or Interpretation: M.B.S., Ö.S., A.Y., Literature Search: S.B., Ö.S., Writing: S.B., M.B.S., A.Y.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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