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Risk Factors for Mortality in Patients with Psoas Abscess: An 11-Year Retrospective Cohort Study

Levent Şensoy

leventsensoy@odu.edu.tr

Ordu University

Merve Kanber Tiryaki

Ondokuz Mayıs University

Aynur Atilla

Ondokuz Mayıs University

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Abstract

Background

The epidemiology and clinical presentation of psoas abscess (PA) have undergone significant evolution in recent years. This study aimed to describe the contemporary clinical characteristics of the disease in a large PA cohort and to identify independent risk factors predicting 90-day mortality.

Methods

A single-center, retrospective cohort study was conducted, including 307 patients with PA managed at a tertiary referral center. Demographic, clinical, and microbiological data were analyzed. Independent prognostic risk factors for 90-day mortality were evaluated using multivariable logistic regression analysis.

Results

The overall 90-day mortality rate was 15.3%. The classic symptom triad was rarely observed, and secondary abscesses constituted the vast majority of cases (73.9%). In the multivariable analysis, advanced age, a higher age-unadjusted Charlson Comorbidity Index (CCI) score, *Escherichia coli* isolation in culture, the presence of Gram-positive pathogens, and a leukocyte count > 18,500 /mm³ at presentation (OR: 4.69) were identified as independent predictors of mortality. Mortality due to septic shock was approximately four times higher in patients exceeding the leukocyte threshold of > 18,500 /mm³ compared to the rest of the cohort (21.3% vs. 5.7%, $p = 0.001$).

Conclusions

In modern clinical practice, PA has transitioned from a classic infectious syndrome into a severe condition predominantly affecting elderly hosts with a high multiple comorbidity burden. The prognosis is primarily determined by the host's clinical status rather than the pathogenesis of the abscess (primary vs. secondary). Marked leukocytosis (> 18,500 /mm³) at presentation should be considered an early warning laboratory sign indicating progression to severe sepsis, warranting prompt and aggressive management in high-risk cases.

INTRODUCTION

Psoas abscess (PA) is a deep-seated infection characterized by the accumulation of purulent fluid within the fascial compartment surrounding the psoas and iliacus muscles. Although rare, it carries significant life-threatening potential [1]. Historically, the "classic triad" of PA—comprising fever, back/flank pain, and a limp—is now observed concurrently in less than one-third of cases [2]. This non-specific and insidious

clinical presentation frequently leads to substantial diagnostic delays, thereby increasing the risk of mortality and morbidity [3].

Pathogenetically, PA is categorized into two main groups: primary and secondary. Primary abscesses typically develop via hematogenous or lymphatic spread from a distant focus. In contrast, secondary abscesses arise from direct contiguous extension from adjacent anatomical structures into the muscle tissue or as a complication of prior surgical or interventional procedures. While diabetes mellitus (DM), chronic kidney disease (CKD), and immunosuppressive states are major risk factors for primary PA, pathologies originating from adjacent tissues and organs—such as Crohn's disease, perforated appendicitis, colorectal malignancies, complicated pyelonephritis, and vertebral osteomyelitis/spondylodiscitis—are prominent etiologies for secondary PA [4, 5].

Clinical outcomes and mortality rates in PA cases vary significantly depending on underlying etiological factors, diagnostic delay, the isolated microbiological pathogen, and the complications that develop during the clinical course [5–7]. Despite the widespread availability of advanced imaging modalities and modern antimicrobial/surgical therapies, in-hospital mortality rates remain substantial. In this context, the early identification of specific factors predicting mortality is of critical clinical importance for optimizing patient management and improving survival. The current literature suggests that concurrent bacteremia, advanced age (> 65 years), presentation with septic shock, isolation of *Escherichia coli* (*E. coli*) from abscess cultures, and concomitant malignancies are directly associated with poor prognosis [1, 8, 9].

Given the high mortality potential of the disease and the heterogeneity of its risk factors, large-scale, long-term cohort data are necessary to optimize clinical management. To address this gap, our study analyzed the clinical characteristics, etiological distribution, and survival outcomes of an 11-year retrospective cohort comprising 307 PA patients. The primary objective of this study was to contribute robust data to the existing literature by identifying independent prognostic risk factors influencing in-hospital mortality in patients with psoas abscess.

MATERIALS AND METHODS

Study Design and Ethical Approval This single-center, retrospective cohort study was conducted at the Ondokuz Mayıs University Faculty of Medicine Hospital. The study protocol was officially approved by the Clinical Research Ethics Committee of Ondokuz Mayıs University (Date: October 27, 2020, Decision No: 2020/596). The research was conducted in full compliance with the principles of the Declaration of Helsinki.

Patient Selection and Data Collection Patients admitted to our institution between January 2015 and January 2026 who were clinically diagnosed with psoas abscess were retrospectively screened using the hospital's Electronic Medical Records (EMR). For preliminary identification, specific keyword searches were performed in Magnetic Resonance Imaging (MRI), Computed Tomography (CT), and Abdominal Ultrasonography (USG) reports within the system. To exclude false positives resulting from

radiological reporting, the medical records of all potential cases were reviewed in detail. Diagnoses were definitively confirmed by cross-validating radiological findings with clinical presentation symptoms, physical examinations, and patient history data. Adult patients aged 18 years and older were included in the study. Patients with unconfirmed diagnoses, a lack of radiological evidence, or incomplete follow-up/laboratory data were excluded. Following the application of these criteria, a total of 307 cases were included in the final analysis.

Variables Analyzed Demographic characteristics (age, sex), time to presentation (days from symptom onset to hospital admission), presenting clinical symptoms, concomitant comorbidities, and Charlson Comorbidity Index (CCI) scores reflecting baseline risk status were extracted from EMR records.

Cases were etiologically classified as primary or secondary PA; the underlying causes of secondary cases (gastrointestinal, urological, orthopedic, and vascular surgeries, inflammatory processes, interventional procedures, and trauma) were categorized in detail. The radiological diagnostic modality, anatomical location (right, left, bilateral), and maximum size of the abscess (cm) were analyzed. Laboratory parameters evaluated at admission included white blood cell (WBC) count, C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), procalcitonin (PCT), neutrophil-to-lymphocyte ratio (NLR), hemoglobin (Hb), platelets (PLT), and serum creatinine (Cr) levels. Microbiological evaluations assessed concurrent bacteremia (blood culture positivity), abscess culture results, and specific isolated microorganisms. Clinical outcome measures included the application of drainage therapy, total length of hospital stay, complications developed during follow-up (e.g., sepsis/septic shock), recurrence rates, and overall 90-day mortality.

Statistical Analysis Statistical analysis was performed using IBM SPSS Statistics version 29.0 (IBM Corp., Armonk, NY, USA). The conformity of continuous variables to normal distribution was tested using visual and analytical methods. Normally distributed variables were presented as mean ± standard deviation (Mean ± SD), while non-normally distributed variables were expressed as medians with interquartile ranges (IQR). Categorical data were presented as frequencies and percentages (n, %). For intergroup comparisons, the Independent Samples T-test was used for normally distributed continuous variables, and the Mann-Whitney U test was applied for non-normally distributed variables. The Pearson Chi-Square test or Fisher's Exact test, as appropriate, was used to analyze categorical variables.

Receiver Operating Characteristic (ROC) curve analysis and the Youden index were utilized to determine optimal cut-off points for the categorization of continuous variables. Logistic regression analysis was employed to identify independent risk factors for the categorical outcome variable (mortality). Variables with a $p < 0.05$ in the univariable analysis were included in the multivariable logistic regression model. Multicollinearity among independent variables was assessed prior to running the multivariable model. Because the standard Charlson Comorbidity Index (CCI) calculation incorporates age (1 point for every decade over 50 years of age), an *age-unadjusted CCI* and *age* itself were included as separate independent variables in the model to prevent the structural confounding that would result from utilizing age twice. Similarly, individual comorbidities (such as diabetes mellitus and chronic kidney disease) that

were significant in the univariable analysis were not included as separate independent variables to avoid multicollinearity, as they are already inherently scored within the CCI. Sepsis/septic shock, being a terminal intermediate variable, was excluded from the multivariable model. Cases with missing data in any of the predictor variables were handled using listwise deletion in the multivariable model. A two-sided $p < 0.05$ was considered statistically significant across all tests. Data visualization and graphical representations were generated using the Python programming language.

RESULTS

Demographic and Baseline Clinical Characteristics The majority of the 307 PA cases included in the study were male (62.9%) and of secondary etiology (73.9%) (Table 1). The overall mean age of the cohort was 57.3 ± 15.9 years. The primary PA group was found to be significantly older than the secondary group (61.5 vs. 55.8 years, $p = 0.004$). No significant differences were observed between the groups regarding sex distribution and the time from symptom onset to diagnosis (median 7.0 days).

Table 1
Demographic Characteristics, Comorbidities, and Presenting Symptoms of Patients with Psoas Abscess

Age (years) (Mean ± SD)	**Total (n = 307)**	**Primary (n = 80)**	**Secondary (n = 227)**	**p value**
	57.3 ± 15.9	**61.5 ± 14.4**	**55.8 ± 16.2**	**0.004[a]**
Sex				
Male	193 (62.9%)	46 (57.5%)	147 (64.8%)	0.307[b]
Female	114 (37.1%)	34 (42.5%)	80 (35.2%)	
Time to presentation (days) (Median, IQR)	7.0 (2.0–29.0)	10.5 (3.0–30.0)	7.0 (2.0–21.0)	0.104[c]
Clinical Scores and Comorbidities				
CCI Score (Mean ± SD)	2.8 ± 2.1	3.3 ± 2.0	2.6 ± 2.1	**0.007[a]**
Presence of comorbidity	203 (66.1%)	59 (73.8%)	144 (63.4%)	0.094[b]
Hypertension	112 (36.5%)	35 (43.8%)	77 (33.9%)	0.116[b]
Diabetes Mellitus	80 (26.1%)	29 (36.2%)	51 (22.5%)	**0.016[b]**
Chronic Kidney Disease	26 (8.5%)	8 (10.0%)	18 (7.9%)	0.567[b]
Malignancy	66 (21.5%)	18 (22.5%)	48 (21.1%)	0.800[b]
Rheumatological Disease	29 (9.4%)	7 (8.8%)	22 (9.7%)	0.804[b]
Presenting Symptoms				
Gastrointestinal symptoms	101 (32.9%)	19 (23.8%)	82 (36.1%)	**0.043[b]**
Musculoskeletal / Irritation	98 (31.9%)	39 (48.8%)	59 (26.0%)	**< 0.001[b]**
Systemic symptoms	32 (10.4%)	11 (13.8%)	21 (9.3%)	0.257[b]
Local mass / Cutaneous discharge	44 (14.3%)	6 (7.5%)	38 (16.7%)	**0.043[b]**
Atypical / Other symptoms	18 (5.9%)	6 (7.5%)	12 (5.3%)	0.580[d]
Radiological Features				

Statistical analyses used: a Independent Samples T-test (with Welch correction), b Pearson Chi-Square Test, c Mann-Whitney U Test, d Fisher's Exact Test. Significant P values ($P < 0.05$) are indicated in bold. Abbreviations: IQR, Interquartile Range; SD, Standard Deviation; CCI, Charlson Comorbidity Index.

Age (years) (Mean ± SD)	Total (n = 307)	Primary (n = 80)	Secondary (n = 227)	p value
	57.3 ± 15.9	**61.5 ± 14.4**	**55.8 ± 16.2**	**0.004[a]**
Diagnostic Method				0.134[b]
Computed Tomography (CT)	236 (76.9%)	55 (68.8%)	181 (79.7%)	
Magnetic Resonance Imaging (MRI)	57 (18.6%)	20 (25.0%)	37 (16.3%)	
Ultrasonography (USG)	14 (4.6%)	5 (6.2%)	9 (4.0%)	
Location				0.452[b]
Right psoas muscle	141 (45.9%)	35 (43.8%)	106 (46.7%)	
Left psoas muscle	126 (41.0%)	37 (46.2%)	89 (39.2%)	
Bilateral psoas muscles	40 (13.0%)	8 (10.0%)	32 (14.1%)	
Abscess size (cm) (Median, IQR)	6.0 (4.0–9.1)	5.4 (3.1–8.6)	6.1 (4.0–9.2)	0.164[c]

Statistical analyses used: a Independent Samples T-test (with Welch correction), b Pearson Chi-Square Test, c Mann-Whitney U Test, d Fisher's Exact Test. Significant P values (P < 0.05) are indicated in bold. Abbreviations: IQR, Interquartile Range; SD, Standard Deviation; CCI, Charlson Comorbidity Index.

At least one concomitant systemic comorbidity was present in 66.1% of the patients. The primary group exhibited a significantly higher CCI score ($p = 0.007$) and a higher prevalence of diabetes mellitus (36.2% vs. 22.5%, $p = 0.016$) compared to the secondary group (Table 1).

Clinical Presentation and Radiological Findings A detailed examination of specific symptoms at clinical presentation revealed that the most frequent complaints were abdominal pain (30.0%, n = 92), cutaneous discharge (12.1%, n = 37), and back pain (10.4%, n = 32) (Supplementary Table 1). The remarkably low incidence of the components of the "classic triad" of PA—fever (6.5%), back pain (10.4%), and difficulty walking/limp (3.9%)—in the current cohort was considered clinically noteworthy. Other specific complaints included flank pain (8.1%), leg pain (6.2%), hip pain (4.6%), and groin pain (3.6%) (Supplementary Table 1).

When symptoms were categorized by clinical group, musculoskeletal findings were significantly more prevalent in primary cases ($p < 0.001$), whereas gastrointestinal symptoms and localized mass/discharge complaints were significantly more common in secondary cases ($p = 0.043$). The majority of patients (76.9%) were diagnosed using Computed Tomography (CT), and the anatomical localization and median size of the abscesses (6.0 cm) were similar between the primary and secondary cases.

Etiological Distribution of Secondary Cases Analysis of the etiological profile of patients diagnosed with secondary PA (n = 227) identified previous surgical interventions (63.4%, n = 144) as the most common underlying cause. Within the surgical sub-distribution,gastrointestinal surgeries (n = 79) ranked first, followed by urological/renal surgeries (n = 31) and orthopedic interventions (n = 18) (Table 2). Among non-surgical secondary causes (22.9%, n = 52), inflammatory bowel disease (Crohn's disease) (n = 14), necrotizing pancreatitis (n = 12), and spondylodiscitis (n = 11) were the most prominent inflammatory processes.

Table 2
Detailed Etiological Distribution of Secondary Psoas Abscess Cases (n = 227)

Etiological Category and Sub-causes	n	%*
Post-surgical	**144**	**63.4**
Gastrointestinal surgery	**79**	**34.8**
Colorectal surgery	58	
Appendectomy	15	
Biliary and small intestine surgery	3	
Gastric, hepatic, and splenic surgery	3	
Urological and renal surgery	**31**	**13.7**
Renal surgery	23	
Bladder surgery	6	
Prostate surgery	2	
Vascular surgery	**11**	**4.8**
Orthopedic surgery	**18**	**7.9**
Spinal surgery	9	
Joint replacement surgery (Hip/Knee)	9	
Gynecological surgery	**5**	**2.2**
Infectious and inflammatory processes	**52**	**22.9**
Inflammatory bowel disease (Crohn's)	14	
Necrotizing pancreatitis	12	
Spondylodiscitis	11	
Intra-abdominal abscess	4	
Decubitus ulcer / Osteomyelitis	4	
Pyelonephritis	3	
Fournier's gangrene	2	
Pelvic inflammatory disease (PID / TOA)	2	
Interventional (invasive) procedures	**17**	**7.5**

* Percentages are calculated based on the total 227 secondary cases.

Etiological Category and Sub-causes	n	%*
Post-surgical	**144**	**63.4**
Gastrointestinal surgery	**79**	**34.8**
Endoscopic retrograde cholangiopancreatography (ERCP)	4	
Percutaneous nephrostomy / Double-J stenting	4	
Femoral catheterization	4	
Angiography procedures	3	
Prostate biopsy	1	
Lumbar anesthesia / puncture	1	
Trauma and occupational accidents	**14**	**6.2**
* Percentages are calculated based on the total 227 secondary cases.		

Laboratory and Microbiological Profile Baseline laboratory investigations at admission demonstrated a median WBC count of 10,755 (IQR: 8,123 – 15,980) /mm³, a mean CRP level of 154.3 ± 112.0 mg/L, and a mean ESR of 83.6 ± 30.9 mm/hour for the overall cohort. When laboratory parameters were categorized according to clinical cut-off values, 85.0% (n = 233) of the patients presented with anemia, and 57.5% (n = 169) presented with leukocytosis. Furthermore, reactive thrombocytosis was observed in nearly one-third of the cases (30.5%, n = 85), whereas thrombocytopenia was noted in only 9.3% (n = 26). Subgroup evaluation revealed that ESR levels were significantly higher in primary cases compared to secondary cases (90.9 vs. 80.0 mm/hour, $p = 0.041$) (Table 3). Secondary bacteremia was detected in 16.9% (n = 52) of the cohort.

Table 3
Laboratory and Microbiological Characteristics of Patients with Psoas Abscess

Laboratory Parameters	Total (n = 307)	Primary (n = 80)	Secondary (n = 227)	p value
White Blood Cell count (WBC, /mm³) (n = 294)†	10755 (8123–15980)	10140 (8085–15805)	10910 (8140–16055)	0.493[a]
C-reactive protein (CRP, mg/L) (n = 260)*	154.3 ± 112.0	150.2 ± 109.7	155.9 ± 113.1	0.712[b]
Erythrocyte sedimentation rate (ESR, mm/h) (n = 146)*	83.6 ± 30.9	90.9 ± 29.8	80.0 ± 30.9	**0.041[b]**
Procalcitonin (PCT, ng/mL) (n = 132)†	0.3 (0.1–1.4)	0.4 (0.1–2.3)	0.3 (0.1–1.3)	0.736[a]
Neutrophil-to-lymphocyte ratio (NLR) (n = 247)†	6.69 (3.92–13.18)	7.32 (3.98–13.62)	6.49 (3.92–12.17)	0.653[a]
Hemoglobin (Hb, g/dL) (n = 274)*	10.5 ± 2.1	10.5 ± 1.8	10.5 ± 2.2	0.882[b]
Platelet count (PLT, x10³/mm³) (n = 279)*	333.4 ± 161.9	333.9 ± 181.7	333.3 ± 155.0	0.979[b]
Serum creatinine (Cr, mg/dL) (n = 302)†	0.9 (0.7–1.3)	0.9 (0.7–1.6)	0.9 (0.7–1.2)	0.340[a]
Microbiological Findings				
Concomitant bacteremia (Positive blood culture)	52 (16.9%)	18 (22.5%)	34 (15.0%)	0.123[c]
Positive abscess culture	187 (60.9%)	46 (57.5%)	141 (62.1%)	0.467[c]
Profile of isolated microorganisms				
Gram-negative bacilli	111 (36.2%)	16 (20.0%)	95 (41.9%)	**< 0.001[c]**
Gram-positive cocci/bacilli	82 (26.7%)	30 (37.5%)	52 (22.9%)	**0.011[c]**
Polymicrobial infection	35 (11.4%)	4 (5.0%)	31 (13.7%)	**0.036[c]**

* Normally distributed data are expressed as Mean ± Standard Deviation (SD). † Non-normally distributed data are expressed as Median (Interquartile Range, IQR). (n=...) The numbers next to the laboratory variables indicate the valid number of cases included in the analysis after excluding missing data. Statistical analyses used: a Mann Whitney U Test, b Independent Samples T-test, c Pearson Chi-Square Test, d Fisher's Exact Test. Significant P values (P < 0.05) are indicated in **bold**.

Laboratory Parameters	Total (n = 307)	Primary (n = 80)	Secondary (n = 227)	p value
Specific agents (*M. tuberculosis, Brucella* spp.)	10 (3.3%)	4 (5.0%)	6 (2.6%)	0.293[d]
Fungal agents (*Candida* spp.)	8 (2.6%)	0 (0.0%)	8 (3.5%)	0.117[d]

* Normally distributed data are expressed as Mean ± Standard Deviation (SD). † Non-normally distributed data are expressed as Median (Interquartile Range, IQR). (n=...) The numbers next to the laboratory variables indicate the valid number of cases included in the analysis after excluding missing data. Statistical analyses used: a Mann Whitney U Test, b Independent Samples T-test, c Pearson Chi-Square Test, d Fisher's Exact Test. Significant P values (P < 0.05) are indicated in **bold**.

Among the 187 (60.9%) culture-positive cases, *Escherichia coli* (20.5%, n = 63) and *Staphylococcus aureus* (11.7%, n = 36) were the most frequently isolated pathogens (Supplementary Table 2). Within the Gram-negative spectrum, *Klebsiella* spp. (8.1%, n = 25) and *Pseudomonas* spp. (4.6%, n = 14) were prominent, while *Enterococcus* spp. (7.5%, n = 23) were frequently encountered Gram-positive pathogens. Isolation of Gram-negative bacilli (41.9% vs. 20.0%, $p < 0.001$) and polymicrobial infections ($p = 0.036$) were significantly more frequent in secondary cases, whereas Gram-positive cocci/bacilli (37.5%) dominated in primary cases. In 39.1% (n = 120) of the patients, a definitive microbiological etiology could not be established due to the inability to obtain cultures or negative culture results.

Treatment Management and Survival Analyses The median duration of treatment for the cohort was 30 days, and abscess drainage was performed in 68.4% of the patients (Table 4). During the follow-up period, 19.0% (n = 56) of the cases developed specific complications, with sepsis or septic shock being the most frequent (10.2%, n = 30) (Table 4). The disease recurrence rate was 20.1% (n = 58). The 90-day overall survival of the cohort was evaluated using a Kaplan-Meier curve, yielding an overall mortality rate of 15.3% (n = 47) (Fig. 1). There was no statistically significant difference in survival between the primary and secondary groups ($p = 0.527$).

Table 4
Treatment Approaches and Clinical Outcomes of Patients with Psoas Abscess

Treatment Approach	Total (n = 307)	Primary (n = 80)	Secondary (n = 227)	p value
Abscess drainage performed	210 (68.4%)	48 (60.0%)	162 (71.4%)	0.060[c]
Total duration of treatment (days) (n = 221)†	30.0 (17.0–53.0)	30.0 (15.5–60.0)	31.0 (18.0–52.0)	0.944[a]
Clinical Outcomes				
Development of any complication (n = 295)	56 (19.0%)	11 (13.8%)	45 (20.9%)	0.226[c]
Sepsis or septic shock	30 (10.2%)	6 (7.5%)	24 (11.2%)	0.426[c]
Gastrointestinal complications	9 (3.1%)	1 (1.2%)	8 (3.7%)	0.455[d]
Other complications*	17 (5.8%)	4 (5.0%)	13 (6.0%)	-
Recurrence of disease (n = 288)	58 (20.1%)	10 (12.8%)	48 (22.9%)	0.089[c]
30-day mortality rate	26 (8.5%)	9 (11.2%)	17 (7.5%)	0.299[c]
90-day mortality rate	47 (15.3%)	14 (17.5%)	33 (14.5%)	0.527[c]
Time of Mortality				
Time of mortality (days) (n = 47)†	30.0 (15.5–66.5)	24.5 (14.5–61.3)	32.0 (16.0–68.0)	0.650[a]

† Non-normally distributed data are expressed as Median (Interquartile Range, IQR). (n=...) The numbers indicate the valid number of cases included in the analysis after excluding missing data due to the retrospective design. *Other complications include secondary infection (n = 5), sinus tract development (n = 5), septic arthritis (n = 3), urological complications (n = 2), neurological complication (n = 1), and vascular complication (n = 1). Statistical analyses used: a Mann-Whitney U Test, c Pearson Chi-Square Test, d Fisher's Exact Test. Significant P values (P < 0.05) are indicated in **bold**.

Logistic Regression Analyses and Predictors of Mortality To categorize the effect of WBC count on 90-day mortality, an ROC analysis was performed. Using the Youden index, the optimal cut-off point was determined to be > 18,500 /mm³ (AUC: 0.598, $p < 0.05$). Given the high specificity (87.0%) of this threshold in predicting mortality, patients were divided into two groups (> 18,500 /mm³ and ≤ 18,500 /mm³) for inclusion in the multivariable model. Additional subgroup analyses revealed that the mortality rate due to septic shock was significantly higher in patients with a WBC > 18,500 /mm³ (21.3%, n = 10/47) compared to those below this threshold (5.7%, n = 14/247) ($p = 0.001$).

Univariable logistic regression analysis identified advanced age, a high CCI score, DM, CKD, elevated serum creatinine, a WBC count > 18,500 /mm³, the presence of Gram-positive growth, and specifically *E. coli* isolation as significant risk factors for mortality (Table 5).

Table 5
Univariate Logistic Regression Analysis for 90-Day Mortality in the Psoas Abscess Cohort (n = 307)

Potential Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p value
Demographic and Clinical Characteristics			
Age (per 1-year increase)	1.05	1.02–1.07	**< 0.001**
Sex (Female)	1.06	0.56–2.01	0.858
Time to presentation (per 1-day increase)	1.00	0.99–1.00	0.492
Classic Charlson Comorbidity Index (CCI)	1.53	1.30–1.80	**< 0.001**
Age-adjusted CCI (New Model Matrix)	1.69	1.34–2.14	**< 0.001**
Diabetes Mellitus (DM)	2.47	1.29–4.71	**0.006**
Chronic Kidney Disease (CKD)	2.76	1.12–6.78	**0.027**
Malignancy (Cancer)	1.92	0.97–3.81	0.062
Laboratory Findings			
White Blood Cell count (WBC, per 1,000 /mm³ increase)	1.06	1.03–1.10	**< 0.001**
WBC > 18,500 /mm³ (Categorical cut-off)	3.81	1.87–7.76	**0.0002**
Serum creatinine (per 1 mg/dL increase)	1.36	1.15–1.62	**< 0.001**
C-reactive protein (CRP)	1.00	1.00–1.01	0.095
Clinical Course and Treatment Management			
No abscess drainage performed	1.14	0.59–2.20	0.695
Microbiological Findings			
Concomitant bacteremia (Positive blood culture)	1.89	0.90–3.94	0.092
Presence of Gram-positive growth	2.12	1.11–4.06	**0.023**
Presence of polymicrobial growth	1.77	0.75–4.18	0.192
Escherichia coli growth	2.34	1.18–4.62	**0.014**
Staphylococcus aureus growth	1.39	0.57–3.40	0.465

Data were evaluated using univariate logistic regression analysis for 90-day mortality in 307 psoas abscess cases. The level of statistical significance was set at $P < 0.05$, and significant P values are indicated in **bold**. To prevent collinearity in the multivariate model, the Age-adjusted CCI score, which isolates the effect of age, is also presented in the univariate analysis.

To eliminate potential multicollinearity, the age-unadjusted CCI score was utilized in a 5-variable multivariable analysis (Pseudo $R^2 = 0.207$, $p < 0.001$). The model identified a WBC > 18,500 /mm³ at admission (OR: 4.69, 95% CI: 2.11–10.46, $p < 0.001$), each 1-point increase in the age-unadjusted CCI score (OR: 1.63, 95% CI: 1.26–2.11, $p < 0.001$), the detection of *E. coli* in culture (OR: 2.94, 95% CI: 1.35–6.42, $p = 0.007$), the presence of Gram-positive growth (OR: 2.39, 95% CI: 1.14–5.04, $p = 0.021$), and increasing age (OR: 1.04, 95% CI: 1.01–1.06, $p = 0.006$) as independent risk factors predicting 90-day mortality in PA patients (Table 6).

Table 6
Independent Risk Factors Predicting 90-Day Mortality in Patients with Psoas Abscess (Multivariate Logistic Regression)

Independent Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p value
WBC > 18,500 /mm³ at presentation	4.69	2.11–10.46	**< 0.001**
Age-adjusted CCI (per 1-point increase)	1.63	1.26–2.11	**< 0.001**
Escherichia coli growth (Detection in culture)	2.94	1.35–6.42	**0.007**
Presence of Gram-positive growth	2.39	1.14–5.04	**0.021**
Age (per 1-year increase)	1.04	1.01–1.06	**0.006**

Results of multivariate logistic regression analysis (n = 294, Pseudo R2 = 0.207, Model P < 0.001). Thirteen cases were excluded from the model due to missing WBC data at admission. The level of statistical significance was set at P < 0.05, and significant P values are indicated in **bold**. Sepsis/septic shock, which creates circularity as a terminal intermediate variable, and bacteremia, which was found to be non-significant in univariate analysis, were excluded from the model. To prevent collinearity between age and CCI, the age score was isolated from the CCI, and age was included in the model as a separate continuous variable.

A sensitivity analysis restricted to the 187 culture-positive patients demonstrated that while a WBC count > 18,500 /mm³, age-unadjusted CCI, and advanced age maintained their statistical significance as independent predictors of mortality, *E. coli* isolation ($p = 0.200$) and the presence of Gram-positive growth ($p = 0.393$)—which were associated with mortality in the entire cohort—lost their statistical significance in this sub-cohort.

DISCUSSION

In this study, a large single-center cohort of 307 patients diagnosed with PA was retrospectively analyzed to investigate independent prognostic risk factors influencing 90-day mortality. The overall 90-day mortality rate in our study was 15.3% (n = 47). This finding is consistent with the broad mortality spectrum of 2.3% to 25% reported in the literature for effectively treated PA cohorts [1, 7–11]. Our multivariable logistic regression analysis identified five variables as independent predictors of 90-day mortality: a WBC count > 18,500 /mm³ at admission, age-unadjusted CCI score, isolation of *Escherichia*

coli, the presence of Gram-positive growth, and advanced age. In the context of this deep-seated and insidiously progressing infection, early identification of these specific mortality-associated factors is critical for optimizing clinical management and improving patient survival.

The most substantial contribution of our study to the literature is the large case series of 307 patients derived from a single center. Due to the rarity of PA, the vast majority of existing literature consists of case reports, reviews, or small case series [4, 6, 7, 10, 12]. The rare cohorts that exceed 100 patients are typically multicenter studies reliant on heterogeneous data registries [8, 9, 11]. Considering a recently published study by Thai et al. [1] involving 233 cases, our cohort stands out by combining the homogeneous data advantage inherent to single-center studies with the highest patient volume currently reported in the literature.

The epidemiology of psoas abscess has undergone a radical clinical evolution over the past four decades. In stark contrast to the classic 1986 study by Ricci et al. [13], which compiled 367 cases globally, our contemporary series of 307 cases from a single center alone illustrates the massive scale the disease has reached today. Beyond mere numerical increases, the clinical profile of the disease has transformed entirely. As highlighted in the review by Shields et al. [14], classic teaching posits that primary abscesses typically occur in young populations without underlying disease. While data presented by Thakral et al. [15] suggest this classic pattern may still predominate in certain geographical regions, our cohort demonstrates that this paradigm has largely lost its validity in modern medical practice and in our region. Strikingly, patients diagnosed with primary abscesses in our cohort were significantly older (61.5 vs. 55.8 years, $p = 0.004$) and possessed a higher comorbidity burden (CCI, $p = 0.007$) compared to the secondary group. This clinical evolution is so pronounced that, contrary to literature expectations, whether the infection is of primary or secondary origin has lost its prognostic significance. The true determinant of mortality is no longer the pathogenesis of the abscess but the patient's existing comorbidity burden.

This fundamental shift in the demographic and etiological profile is also mirrored in clinical presentation. Historical medical teaching equated a PA diagnosis with the 'classic triad' of fever, back/flank pain, and a limp. However, Garner et al. [16], one of the pioneering studies challenging this dogma in modern literature, initiated an important paradigm shift by arguing that PA is not as rare as believed and that the clinical triad is present in only about one-third (33%) of patients. Despite this, our large, contemporary cohort reveals that even the rates contested by Garner have plummeted dramatically in today's practice. In our cohort, the incidence of specific triad findings is almost negligible (fever 6.5%, back pain 10.4%, difficulty walking 3.9%). Furthermore, the overall rate of any systemic symptoms, including fever, remained at only 10.4%. Conversely, the most common complaint among our patients was non-specific abdominal pain (30.0%), falling completely outside the classic triad. These data objectively demonstrate that in modern patient populations, PA presents with much more subtle and atypical signs rather than classic symptoms. Therefore, in contemporary clinical practice, the absence of the classic triad should by no means exclude the diagnosis; early radiological imaging must be prioritized for high-risk patients presenting with non-specific abdominal or flank pain. However, it is worth noting that while the classic

presentation has faded globally, musculoskeletal and local irritation symptoms remain significantly more prevalent in primary PA cases compared to secondary ones, reflecting the direct localized nature of hematogenous seeding in the psoas muscle.

The underlying mechanism of this atypical presentation becomes clear upon examining the etiological origins of the abscesses in our cohort. In complete alignment with current global literature, the vast majority of our series consisted of secondary psoas abscesses (73.9%, n = 227). However, when large series in the literature are reviewed, the etiological spectrum of secondary abscesses exhibits significant geographical heterogeneity. For instance, while infectious processes such as vertebral spondylitis are prominent in Asian cohorts, inflammatory bowel pathologies like Crohn's disease dominate in European series [1, 6, 7, 9, 14]. In our cohort, the etiological axis has shifted entirely. The most common triggering factor (63.4%) was previous surgical interventions (particularly colorectal surgeries). This striking difference indicates that today, PA is largely encountered as a severe complication of regional surgical interventions for adjacent organ pathologies, rather than as an isolated infection or a natural consequence of inflammatory diseases. This is a direct reflection of our institution being a tertiary referral center managing complex, multi-morbid cases. The significantly higher incidence of gastrointestinal symptoms in the secondary group ($p = 0.043$) is a clear clinical reflection of the infection spreading contiguously from these intra-abdominal pathologies and surgical sites.

The relationship between the established pathophysiology of PA and microbiological agents is also clearly observed in our culture results. The significantly higher rates of Gram-negative bacilli isolation (41.9%) and polymicrobial infections (13.7%) in secondary cases in our study directly corroborate the pathophysiological reality that the infection spreads via direct extension from the polymicrobial intra-abdominal flora. In contrast, in primary cases spreading via the hematogenous route, the dominance of Gram-positive cocci (37.5%) originating from skin and soft tissue flora was maintained. This pathophysiological and microbiological concordance aligns perfectly with our primary focus: the 90-day mortality analysis.

In our multivariable logistic regression model, the identification of *Escherichia coli* as an independent predictor of mortality may initially appear to contradict literature arguing that the specific type of microbiological agent does not directly determine survival [1, 6, 7, 9]. However, the attenuation of *E. coli*'s statistical power in our sensitivity analyses resolves this apparent contradiction, reflecting the clinical entanglement inherent in the disease's pathogenesis. Massive cohort studies such as WISS and IRIS, involving thousands of patients with intra-abdominal infections, have proven that although *E. coli* is by far the most frequently isolated pathogen, the primary determinants of mortality are the source of infection and the host's clinical status (advanced age, comorbidity, sepsis) rather than specific isolates [17, 18]. In light of these data, the *E. coli*-associated increase in mortality in our cohort is considered a consequence of an imbalance in the host-pathogen interaction rather than the high virulence of the bacterium itself. The translocation of *E. coli*, a dominant member of the gastrointestinal flora, in a host with a high comorbidity burden and compromised defense mechanisms sets the stage for an exceedingly difficult-to-manage systemic inflammatory response.

A similar rationale applies to generic Gram-positive growth, another independent predictor of mortality in our main model. Just like *E. coli*, the loss of statistical power for the Gram-positive variable in sensitivity analyses reinforces this host-pathogen dynamic. The failure of specific agents such as *Staphylococcus aureus* or *Enterococcus* species to reach statistical significance individually in univariable analyses is the clearest indicator of this. Specifically, the fact that approximately 70% of our *Enterococcus*-isolated cases were polymicrobial explains this statistical behavior. Therefore, the appearance of significance for specific agents in singular analyses, or the loss of statistical significance for broad agent groups in sensitivity analyses, is not a flaw in the data. On the contrary, these statistical fluctuations represent an expected clinical reality: the lethal burden created by microorganisms in PA cannot be evaluated independently of the host's comorbidity burden and the abdomen-derived polymicrobial landscape.

Our multivariable analysis demonstrated that a WBC count > 18,500 /mm³ at admission increased the 90-day mortality risk 4.69-fold. However, this finding must be interpreted with caution. The ROC analysis yielded an AUC of 0.598, which indicates a poor overall discriminative ability for leukocytosis as an isolated continuous predictive variable. While evaluating WBC as a continuous variable (e.g., per 1,000 /mm³ increase) is mathematically possible, establishing a high-specificity categorical cut-off provides a much more actionable and rapid decision-making tool in acute clinical settings. Nevertheless, the high specificity (87.0%) of the > 18,500 /mm³ threshold suggests that while most patients with PA will not reach this degree of leukocytosis, those who do are at a substantially elevated risk of progressing to severe sepsis. Our finding that mortality due to septic shock was approximately four times higher in patients exceeding this WBC threshold clearly corroborates this process. Therefore, rather than a definitive diagnostic tool, marked leukocytosis should be regarded as a practical, early-warning laboratory sign indicating a trajectory toward severe sepsis in vulnerable patient groups.

Our study has several important limitations. First, the retrospective design and single-center nature of the research may limit the generalizability of the findings to different geographical regions and patient populations. Second, in a significant portion of our patients (39.1%, n = 120), cultures could not be obtained, or results were negative. The fact that the study center is a tertiary referral hospital and that patients frequently received empirical antibiotic therapy at external centers prior to transfer likely contributed to this high negativity rate. Finally, the inability to routinely utilize anaerobic cultures and advanced molecular methods such as PCR may have led to an underestimation of the true etiological role of fastidious or anaerobic pathogens.

CONCLUSIONS

In conclusion, psoas abscess is a severe clinical condition carrying a high mortality risk, particularly in older patients with multiple comorbidities (high CCI score) and marked leukocytosis (> 18,500 /mm³) at admission. It must be recognized that patients with *Escherichia coli* and Gram-positive microorganisms isolated in cultures constitute a high-risk group requiring exceptionally close monitoring for 90-day mortality. The data obtained from this large cohort will significantly contribute to the early recognition of high-risk patients in emergency departments and outpatient clinics, facilitating the immediate

implementation of aggressive drainage and rational empirical antibiotic strategies to minimize adverse clinical outcomes.

Declarations

Ethics approval and consent to participate:

The study protocol was approved by the Clinical Research Ethics Committee of Ondokuz Mayıs University (Date: October 27, 2020, Approval No: 2020/596). Due to the retrospective design of the study, the requirement for informed consent was waived by the Clinical Research Ethics Committee of Ondokuz Mayıs University. All procedures were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

Consent for publication:

Not applicable.

Competing interests:

The authors declare that they have no competing interests.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used generative AI technology (Gemini) solely to translate and improve the English language of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Author Contribution

L.Ş. conceptualized and designed the study, performed data curation and advanced statistical analyses, and drafted the initial manuscript. M.K.T. and A.A. contributed to data acquisition, validation of clinical data, and critical review of the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Availability of data and materials:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Figures

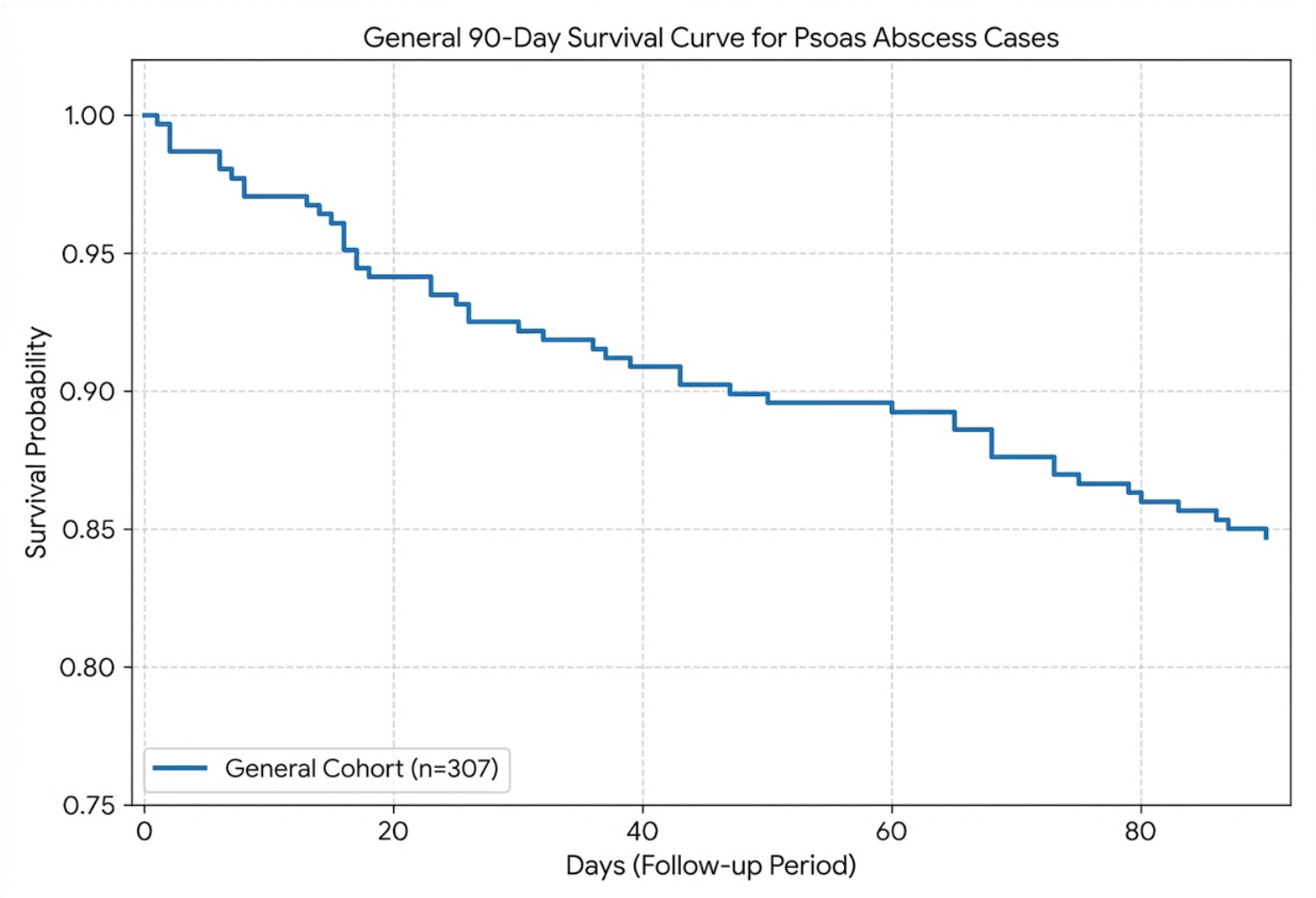


Figure 1

General 90-day survival curve for psoas abscess cases. The graph depicts the Kaplan-Meier estimates of survival probability for the entire cohort of 307 patients over a 90-day follow-up period.

Supplementary Files

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