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Clinical Profile and Immediate Outcome of Management of Emphysematous Pyelonephritis: A Matched Case-Control Study

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Abstract

Introduction: Emphysematous pyelonephritis (EPN) is a severe, life-threatening complication of acute pyelonephritis (APN), predominantly affecting diabetic patients. Differentiating EPN from non-emphysematous APN based on clinical and biochemical parameters remains challenging, and delayed diagnosis may lead to poor outcomes. Optimal management strategies for EPN remain controversial, particularly in resource-limited settings. **Aim of the Study:** To compare the clinical and biochemical profiles of EPN and non-EPN patients and to evaluate management strategies and short-term outcomes. **Methods:** This retrospective matched case-control study was conducted in the nephrology department of a tertiary care hospital from January 2018 to January 2022. A total of 35 consecutive patients with EPN were enrolled as cases. For each case, one control with non-emphysematous APN was individually matched by age and gender from patients admitted during the same study period. Clinical features, laboratory parameters, microbiological findings, management approaches, and outcomes at discharge were analyzed using SPSS version 20. **Results:** Baseline characteristics were comparable between groups. Chronic kidney disease (57% vs. 26%, $p = 0.007$) and recurrent UTI (45.7% vs. 22.9%, $p = 0.044$) were significantly higher in non-EPN patients. Clinical features at presentation did not significantly differ; however, pneumaturia was observed only in EPN patients (11% vs. 0%). Among biochemical parameters, random blood glucose (18.79 ± 10 vs. 14.4 ± 6 mmol/L, $p = 0.004$) and metabolic acidosis (low HCO_3: 47.1% vs. 38.2%, $p = 0.039$) were significantly higher in EPN. No significant differences were noted in serum creatinine ($p = 0.109$) or HbA1c ($p = 0.829$). *E. coli* was the predominant pathogen in both groups (75% - 81%). Conservative management was successful in 54% of EPN and 88% of non-EPN cases. Among EPN patients, 37% required open drainage and 9% underwent nephrectomy. Overall survival in EPN was 97%. **Conclusion:** Based on unadjusted comparisons, initial clinical and laboratory findings alone are insufficient to reliably distinguish EPN from APN; adjusted analyses accounting for baseline differences such as CKD, recurrent UTI, admission glucose, and acidosis are needed to confirm this. The presence of pneumaturia strongly suggests EPN. In resource-constrained settings, open drainage represents an effective kidney-sparing treatment strategy, with emphasis on organ preservation whenever feasible.

Keywords

Emphysematous Pyelonephritis, Acute Pyelonephritis, Diabetes Mellitus, Urinary Tract Infection, Open Drainage

1. Introduction

Urinary tract infection (UTI) is one of the most prevalent bacterial infections encountered in clinical practice, affecting millions of patients globally every year [1]. Acute pyelonephritis (APN), the most severe form of UTI, involves bacterial infection of the renal parenchyma and is associated with significant morbidity particularly in immunocompromised hosts. Diagnosing and managing acute pyelonephritis is not always straightforward, and its spectrum widens considerably in patients with diabetes mellitus (DM). In this population, the disease may present with grave complications, including renal and perirenal abscess, fungal infections, xanthogranulomatous pyelonephritis, papillary necrosis, and emphysematous pyelonephritis (EPN) [2]. Among these, EPN is the most life-threatening complication and warrants special clinical attention. EPN is characterised by the presence of gas in the renal parenchyma, collecting system, or perirenal and paranephric space [3]. It is a necrotising infection of the kidney driven primarily by gas-forming microorganisms. The most common causative organism is *Escherichia coli* (*E. coli*), followed by Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Bacteroides, and Clostridium species. Fungal pathogens including Candida, Aspergillus, Cryptococcus, and Amoeba have also been implicated in rare cases [3] [4]. The gas within the renal system is thought to arise from fermentation of glucose by these organisms in a substrate-rich environment, facilitated by the hyperglycaemia and impaired microcirculation characteristic of poorly controlled DM [5]. EPN was first described in 1898 by Kelly and MacCallum, who documented the presence of gas in the urinary tract [5]. The term "Emphysematous Pyelonephritis" was subsequently coined by Schultz and Klorfein in 1962.5-6. Since then, EPN has been recognised as a rare but potentially catastrophic condition, with mortality rates historically reported as high as 90%.6-7. Beyond the renal system, EPN may manifest with unusual systemic features such as pneumomediastinum, subcutaneous emphysema, and multiple septic emboli to the brain, lungs, and liver, further compounding the clinical challenge [6]. Although the exact pathogenesis of EPN has not been fully elucidated, existing evidence points to a convergence of several host and microbial factors. High blood glucose levels providing fermentable substrate, impaired tissue perfusion due to diabetic vasculopathy, the virulence of gas-forming organisms, and defective host immunity collectively create conditions conducive to the development of EPN [5] [7]. Despite this understanding, it remains unclear why some diabetic patients with pyelonephritis develop EPN while others do not. The clinical and biochemical presentation of EPN is frequently indistinguishable from that of non-emphysematous APN, making early diagnosis challenging and increasing the risk of delayed or inappropriate management [8]. Computed tomography (CT) of the kidney, ureter, and bladder (KUB) region remains the gold standard for diagnosis and staging of EPN, with the Huang and Tseng classification being the most widely adopted system [3]. There is considerable and ongoing controversy regarding the optimal management of EPN [9]-[11]. Historically, emergency nephrectomy was the mainstay of treatment; however, evolving evidence has shifted the focus towards organ-preserving strategies including medical management, percutaneous drainage (PCD), and open drainage (OD). Given the diversity of clinical presentations, limited evidence from large randomised trials, and the varying availability of resources across healthcare settings, treatment decisions remain largely individualised. In this context, this study was performed to observe and analyse the clinical profile, management strategies, and immediate outcomes of EPN, and to simultaneously compare these findings with those of acute non-emphysematous pyelonephritis, to generate a locally applicable management framework.

2. Methods

This retrospective matched case-control study was conducted in the Department of Nephrology of a tertiary care hospital in Dhaka, Bangladesh, from January 2018 to January 2022. Adult patients (≥18 years) presenting with features of urinary tract infection (fever, dysuria, flank pain, and/or renal angle tenderness) along with pyuria, with or without supportive laboratory findings (positive urine culture, leukocytosis, or elevated C-reactive protein), were included as suspected acute pyelonephritis (APN). All patients underwent ultrasonography (USG) of the kidney, ureter, and bladder (KUB). Patients with suspected gas formation in the renal or perirenal region underwent computed tomography (CT) to confirm and classify emphysematous pyelonephritis (EPN) using the Huang and Tseng system. A total of 35 consecutive EPN patients were enrolled as cases. For each case, one control with non-emphysematous APN was individually matched by age (±5 years) and gender from patients admitted to the same department during the same study period. Data collected included demographic characteristics, clinical features, laboratory parameters (complete blood count, serum creatinine, electrolytes, random blood glucose, HbA1c), microbiological cultures, imaging findings, treatment modalities, and outcomes at discharge. Management included antibiotics, glycemic control, and supportive care. Interventions included percutaneous drainage or open drainage, while nephrectomy was reserved for severe or refractory cases. Treatment failure was defined as clinical deterioration or lack of improvement after 72 hours of the initial management strategy, necessitating escalation to a more invasive intervention. Poor prognostic factors assessed were altered consciousness, shock, thrombocytopenia, and acute kidney injury. Data were analyzed using SPSS version 20. Continuous variables were expressed as mean ± SD and categorical variables as percentages. Between-group comparisons were performed using independent samples t-test for continuous variables and the chi-square test (or Fisher's exact test) for categorical variables. A p-value < 0.05 was considered statistically significant. Ethical approval and informed consent were obtained.

3. Results

Table 1. Baseline characteristics of patients with EPN and Non-EPN.

Criteria	EPN (n = 35) n (%)	Non-EPN (n = 35) n (%)	p-value
Age in years	47 ± 10 (20 - 65)	50 ± 11 (17 - 70)	-
≤50 years	21 (60)	15 (43)	-
≥50 years	14 (40)	20 (57)	-
Gender			-
Female (F)	26 (74)	26 (74)	-
Male (M)	09 (26)	09 (26)	-
F:M ratio	2.9:1	2.9:1	-
Co-morbidity			-
DM	35 (100)	35 (100)	-
Hypertension	10 (28)	16 (46)	0.070
CKD	09 (26)	20 (57)	0.007
Others	04 (11)	04 (11)	0.500
Recurrent UTI	8 (22.9)	16 (45.7)	0.044
History of pyelonephritis	10 (28.6)	11 (31.4)	0.794
History of EPN	0	1 (2.9)	1.000

Table 1 compares demographic and co-morbidity profiles of 35 EPN patients versus 35 age- and gender-matched non-EPN controls. Both groups were equally female-predominant (F: M = 2.9:1). All participants had Diabetes Mellitus. Statistically significant differences were noted in the prevalence of CKD (p = 0.007) and recurrent UTI (p = 0.044), both higher in the Non-EPN group.

In the EPN group, 14.3% had diabetes < 5 years and 85.7% had > 5 years. In the non-EPN group, 5.7% had < 5 years and 94.3% had > 5 years. Both groups showed predominance of long-standing diabetes (p = 0.001 and p = 0.003 respectively), without meaningful intergroup difference (Table 2).

Table 3 presents a comprehensive comparison of clinical signs and symptoms at admission between EPN and Non-EPN patients. Fever was the predominant

Table 2. Impact of duration of diabetes mellitus on EPN and Non-EPN.

Group	Duration DM < 5 years n (%)	Duration DM > 5 years n (%)	p-value
EPN (n = 35)	5 (14.3)	30 (85.7)	0.001
Non-EPN (n = 35)	2 (5.7)	33 (94.3)	0.003

Table 3. Clinical Characteristics and Presenting Features of Patients with EPN and Non-EPN.

Chief Complaints/ Findings	EPN (n = 35) n (%)	Non-EPN (n = 35) n (%)	p-value	95% CI
Fever	31 (88.6)	33 (94.3)	0.393	
Mean duration of fever (days)	10.66 ± 10.50	7.5 ± 7.9	0.398	−1.34 - 7.57
Flank pain	16 (42.9)	19 (54.3)	0.339	
Abdominal pain	16 (45.7)	12 (34.3)	0.329	
Nausea	28 (80)	26 (76.5)	0.722	
Vomiting	17 (48.6)	18 (52.9)	0.717	
Oliguria	3 (8.6)	1 (2.9)	0.303	
Altered consciousness	5 (14.3)	3 (8.6)	0.452	
Pneumaturia	4 (11)	0	0.114	
Diarrhoea	0	3 (8.6)	0.239	
Other features	13 (37)	10 (28)	0.611	
GCS score (<15)	06 (17.1)	03 (8.6)	0.284	
Temp Normal	20 (57.1)	15 (42.9)	0.339	
Temp ≤ 101˚F	11 (31.4)	19 (91.4)	0.090	
Temp > 101˚F	4 (11.4)	1 (2.9)	0.356	
Anemia	35 (100)	32 (91.4)	0.077	
Jaundice	2 (5.7)	1 (2.9)	1.000	
Dehydration	30 (85.7)	23 (65.7)	0.051	
RAT—Right	11 (34.4)	11 (31.4)	1.000	
RAT—Left	8 (22.9)	12 (34.3)	0.556	
RAT—Bilateral	3 (8.6)	2 (5.7)	0.653	
Ballotable kidney—Right	5 (14.3)	1 (2.9)	0.149	
Ballotable kidney—Left	0	1 (2.9)		
Ballotable kidney—Bilateral	0	0		

complaint in both groups. Notably, pneumaturia was observed exclusively in EPN patients (11% vs. 0%), though not statistically significant ($p = 0.114$). No single clinical feature was able to reliably distinguish EPN from Non-EPN at presentation. Dehydration ($p = 0.051$) trended toward significance in EPN patients.

Table 4 compares laboratory investigations between the two groups. The majority of biochemical parameters showed no statistically significant difference. Two notable exceptions: acidosis (low HCO_3, $p = 0.039$) and random blood sugar at presentation ($p = 0.004$) were significantly higher in EPN patients, supporting the pathogenic role of poor glycemic control and impaired tissue perfusion in EPN development. HbA1c showed no significant difference, possibly due to variation in laboratory sourcing. Readers should note that some reported percentages for the bicarbonate and hyponatraemia rows appear to reflect the total group rather than individual subgroup denominators; these figures should be rechecked against the raw data to confirm accuracy before final submission.

Table 5 evaluates the prevalence of AKI at admission in both groups. No

Table 4. Biochemical parameters in patients with EPN and Non-EPN.

Parameter	EPN (n = 35) n (%)	Non-EPN (n = 35) n (%)	p-value	95% CI
TLC < 11,000	3 (8.5)	1 (2.8)	0.614	
TLC > 11,000	32 (91.4)	34 (97.1)		
Platelet < 150,000	7 (20)	6 (17)	0.759	
Platelet > 150,000	28 (80)	29 (83)		
S. Creatinine (mg/dl)	3.03 ± 1.8	3.9 ± 2.6	0.109	0.173 - 0.175
Hyponatremia (<135 mmol/L)	33 (47)	28 (40)	0.150	
Hyperkalemia (>5.5 mmol/L)	7 (10)	3 (4.3)	0.305	
Low HCO_3 (<23 mEq/L)	32 (47.1)	26 (38.2)	0.039	
Normal HCO_3 (>23 mEq/L)	2 (2.9)	8 (11.8)		
RBS (mmol/L)	18.79 ± 10	14.4 ± 6	0.004	0.217 - 8.53
HbA1C (%)	12.31 ± 2.6	10.29 ± 2.2	0.829	0.352 - 3.69
Urine CS positive n (%)	24 (69)	27 (77)		
Blood CS positive n (%)	10 (29)	09 (26)		
Pus CS positive n (%)	03 (8.5)	01 (2.9)		

Table 5. Acute kidney injury (AKI) in patients with EPN and Non-EPN at admission.

Renal Status	EPN (n = 35) n (%)	Non-EPN (n = 35) n (%)	p-value	Odds Ratio
AKI	29 (41.4)	30 (42.9)	0.500	0.806
Stable renal function	06 (8.6)	05 (7.1)		

statistically significant difference was found between EPN (41.4%) and non-EPN (42.9%) patients (p = 0.500, OR = 0.806). Both groups had comparably high rates of AKI, suggesting that renal compromise is equally common regardless of the presence of gas-forming infection.

Table 6. Pattern of microbial growth in urine, blood and pus culture—EPN vs. Non-EPN.

Group	Organism	Urine Culture n (%)	Blood Culture n (%)	Pus Culture n (%)
EPN	*E. coli*	18 (75)	8 (80)	2 (67)
	Klebsiella	2 (8)	1 (10)	1 (33)
	Pseudomonas	1 (4)	1 (10)	
	Polymicrobial	1 (4)		
	Others (Enterococcus, Streptococcus)	2 (8)		
Non-EPN	*E. coli*	22 (81)	6 (67)	
	Streptococcus	2 (7)		
	Others (Klebsiella, Enterococcus, MRSA)	3 (11)		
	Others (Streptococcus, Staphylococcus, MRSA)		3 (33)	Pseudomonas (1, 2.9)

Table 6 catalogues the organisms isolated in urine, blood, and pus cultures from both groups. *E. coli* was the predominant pathogen across all culture types and in both groups (urine: 75-81%; blood: 67-80%). Klebsiella and Pseudomonas were secondary isolates seen mainly in EPN patients. No statistically significant difference in microbial aetiology was found between EPN and Non-EPN, suggesting that the type of organism alone does not determine disease severity.

Table 7. Management of EPN patients according to CT scan classification (Huang & Tseng).

CT Class (n)	Conservative Only	Open Drainage	Nephrectomy
Class 1 (02)	02	00	00
Class 2 (17)	10	05	02
Class 3A (04)	02	02	00
Class 3B (10)	03	06	01
Class 4 (02)	02	00	00
Total	19	13	3

Table 7 documents the treatment modality used for each CT scan class of EPN. Class 1 and 4 were managed entirely conservatively. Class 3B required the highest rate of surgical intervention (70%), followed by Class 3A (50%) and Class 2 (41%).

Three patients (9%) required nephrectomy two from Class 2 and one from Class 3B. Open drainage (OD) was employed as a kidney-sparing surgical alternative in the absence of percutaneous drainage (PCD) facilities.

Table 8. Relationship between surgical management, CT scan class, and number of risk factors.

Risk Factors	Surgery	Class 2	Class 3A	Class 3B	Total
≥2	OD	01	01	01	03
	Nephrectomy	00	00	01	01
<2	OD	04	01	05	10
	Nephrectomy	02	00	00	02

Table 8 cross-tabulates the surgical management decisions against CT scan class and the number of poor-prognostic risk factors (altered consciousness, shock, AKI, thrombocytopenia). Contrary to the widely cited Huang & Tseng criteria, which recommend nephrectomy for ≥2 risk factors in Class 3A/3B, the majority of surgical cases in this study with ≥2 risk factors still underwent open drainage. This underscores the centre's approach of organ preservation in a resource-constrained setting.

Table 9. Management, renal outcome, and survival by CT Scan Class.

CT Class	n = 35	Conservative (%)	Surgical (%)	AKI Resolved	AKI Not Resolved	Survival: Yes	No
Class 1	02	100	00	–	–	02	–
Class 2	17	59	41 (7/17)	04	–	17	–
Class 3A	04	50	50 (2/4)	01		04	
Class 3B	10	30	70 (7/10)	03	–	10	–
Class 4	02	100	00	01	01	01	01

This comprehensive outcome table presents the management approach (conservative vs. surgical), AKI resolution, and survival for each CT scan class. Overall survival was 97% in EPN patients (**Table 9**). AKI resolution was 90% in EPN at discharge, higher than in non-EPN ($p = 0.007$), likely due to prolonged hospital stay facilitating recovery. Class 4 had the worst outlook, with one death and one case of unresolved AKI. The data support conservative and organ-sparing approaches for Class 1-3B in an appropriate clinical setting.

4. Discussion

Various studies from developed and developing countries, including those from Bangladesh, have reported that the majority of EPN and non-EPN cases occur in the fourth and fifth decade of life [12] [13], with a female to male ratio ranging from 3:1 to 43:3, closely resembling the results of the current study [9] [14]. The predominance of female patients is presumably attributable to their greater anatomical susceptibility to ascending UTI [1]. DM is the single most important predisposing condition for EPN, 11 - 12 and all cases in the current study were diabetic, likely reflecting the diabetic hospital setting rather than a true epidemiological feature. This also accounts for the absence of cases with obstructed uropathy, which can occasionally precipitate EPN even without DM [10] [15] [16]. A case series from Bangladesh reported a mean DM duration of approximately 12 years and HbA1c of around 12%, consistent with our findings [17]. The significantly higher RBS in EPN cases supports the pathogenic role of vasculopathy and impaired immune response in facilitating anaerobic gas production [7] [18]. The clinical presentation of EPN closely resembled that of non-EPN in our series, consistent with published literature [14] [17]. Fever was the most common presenting complaint in both groups. The mean duration of fever before admission in EPN patients was 10.66 ± 1.50 days, with no statistically significant difference from non-EPN patients. Abdominal pain and ballotable kidneys were more frequently observed in EPN, and Samad *et al.* similarly noted that abdominal pain was more prominent in EPN while loin pain was more common in non-EPN [17]. These overlapping clinical features make it virtually impossible to diagnose EPN on clinical grounds alone, reinforcing the critical role of imaging in establishing the diagnosis [18]. A notable finding in our study was the presence of pneumaturia in four EPN patients. As patients with gut-renal fistulas were excluded, pneumaturia in these cases was directly attributable to EPN, subsequently confirmed by CT imaging. EPN should therefore be considered in any patient presenting with pneumaturia in the absence of a fistulous communication [3] [19] [20]. This may serve as an important clinical clue that prompts urgent CT evaluation in the appropriate clinical context. Metabolic acidosis and elevated RBS at admission were significantly more common in EPN cases, though no significant difference in HbA1c was observed between the two groups. Studies from Bangladesh and India have similarly reported high blood glucose and glycosylated haemoglobin in EPN patients [21] [22]. The non-uniform laboratory for HbA1c testing in our study may partly explain this discrepancy. *E. coli* was the dominant pathogen in urine [75%] and blood [80%] cultures, followed by Klebsiella species, consistent with published literature [3] [19] [23]. No significant difference in microbiological aetiology was found between EPN and non-EPN, 9 further highlighting the diagnostic indistinguishability of the two conditions without imaging. Non-resolved AKI was more prevalent in non-EPN patients at discharge, likely because EPN patients had longer admissions allowing more time for renal recovery. CT scan of the KUB region remains indispensable for the diagnosis and classification of EPN. In our series, the majority of patients belonged to class 2 (49%), followed by class 3B (28.6%), consistent with the distribution reported by Samad T *et al.* and other published series. 19,10 The Huang and Tseng CT classification was used as it directly informs management decisions and correlates with prognosis. It is well established that prognosis worsens with increasing CT class, with mortality reaching up to 50% in class 4 disease [3] [15]. In the present study, 88% of non-EPN cases were managed conservatively, with open drainage employed selectively for perirenal collections and obstruction [1]. For EPN, 54% of cases were managed conservatively, with the remainder requiring open drainage (37%) or nephrectomy (9%). The landmark Huang and Tseng classification algorithm2 recommends PCD for up to class 3B EPN with fewer than two risk factors, reserving nephrectomy for higher-risk subgroups and treatment failures. The risk factors in their series AKI, altered consciousness, shock, and thrombocytopenia—were present in our study at rates of 83%, 8.5%, 11%, and 20% respectively, yet we found no statistically significant association between these risk factors and poor outcome. In our centre, the management pathway was guided by a combination of CT classification and clinical status: patients with Class 1 or Class 4 disease and haemodynamic stability were managed conservatively with intravenous antibiotics, aggressive glycemic control, and supportive care. Patients failing to improve within 72 hours or those with perinephric collections were offered open drainage. Nephrectomy was reserved for grossly destroyed kidneys or failure of all organ-preserving measures. As percutaneous drainage was unavailable, open drainage served as the primary surgical option throughout. Falagas *et al.* [24] similarly found bilateral EPN and thrombocytopenia to be mortality predictors, but not hypotension, highlighting variability in risk stratification across different populations. Until the late 1980s, emergency nephrectomy was the cornerstone of EPN management, with mortality of 40% - 50% [9] [15]. The introduction of broad-spectrum antibiotics and PCD reduced mortality to 12% - 20% [3] [25]. While some authors still advocate nephrectomy for fulminant disease, [2] [9] [11] recent evidence demonstrates that organ-preserving strategies yield comparable or superior outcomes [15] [16] [26] [27]. As PCD was unavailable at our centre, we adopted OD as the primary surgical modality. Abourmarzouk *et al.*, Sharma PK *et al.*, and Chen MT *et al.* have similarly advocated OD, with some series reporting mortality as low as 6.6% [11] [13] [26]. Reports from resource-limited settings further validate OD as a feasible bridge between conservative management and elective nephrectomy [12] [27]. Of our two bilateral EPN cases managed conservatively, one did not survive. While recent reports describe successful medical management of bilateral EPN, nephrectomy should not be withheld when a kidney is beyond salvage [11]. We conclude that organ-sparing treatment should be prioritised in class 3A and 3B disease, with the treatment modality personalised to available resources and expertise. Nephrectomy should be reserved for grossly destroyed kidneys or failure of all conservative measures. A multicentre study with a larger sample size is recommended to establish a universally applicable management guideline for EPN.

5. Limitations of the Study

This study was limited by its single-center design and relatively small sample size, which may affect the generalizability of the findings. As the study was conducted at a dedicated diabetic hospital, all participants had diabetes mellitus; this all-diabetic population limits the applicability of findings to non-diabetic patients with EPN or APN. Percutaneous drainage was unavailable at our centre, precluding comparison with this now-recommended first-line intervention and limiting the broader relevance of our management algorithm. Follow-up data were restricted to outcomes at the time of discharge; medium- and long-term outcomes including renal function recovery, relapse, and progression to end-stage renal disease were not assessed. Finally, the absence of multivariable analysis means that independent predictors of EPN or of outcome could not be identified after controlling for baseline differences such as CKD, recurrent UTI, admission glucose, and acidosis.

6. Conclusion

Emphysematous pyelonephritis remains a diagnostic and therapeutic challenge, particularly in diabetic patients where clinical and biochemical features overlap substantially with non-emphysematous pyelonephritis. Based on unadjusted comparisons in this matched case-control study, elevated admission blood glucose and metabolic acidosis were more common in EPN, but no single clinical or biochemical feature reliably differentiated EPN from non-EPN at presentation. These findings should be interpreted cautiously until confirmed by multivariable analyses that adjust for baseline differences such as CKD, recurrent UTI, and glycemic status. Pneumaturia, although uncommon, is a strong clinical indicator of EPN and should prompt urgent CT evaluation. Imaging, particularly a CT scan, is essential for accurate diagnosis and staging. Conservative and organ-preserving approaches, including open drainage, can achieve favorable outcomes in most patients, especially in resource-limited settings. Early recognition and individualized management are key to reducing morbidity and mortality.

7. Recommendation

Early use of CT imaging should be strongly considered in all diabetic patients presenting with severe pyelonephritis to exclude EPN. In resource-limited settings where percutaneous drainage is not available, open drainage should be adopted as a viable kidney-sparing alternative. Greater emphasis should be placed on strict glycemic control and early intervention to prevent disease progression. Large-scale, multicenter studies are recommended to establish standardized, evidence-based management protocols for EPN across different healthcare settings.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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