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## Case Report

# Bilateral emphysematous pyelonephritis cured by antibiotics alone in a black African woman<sup>☆</sup>

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## ABSTRACT

A 78-year-old black woman with a 10-year history of diabetes mellitus was admitted to the intensive care unit. Upon admission, she presented with chills, nausea, and left flank pain. The presence of hyperglycemia (fasting blood glucose, 19.7 mmol/L) and an altered consciousness required immediate treatment with insulin analog. Laboratory investigations and enhanced computed tomography scan led to the diagnosis of bilateral emphysematous pyelonephritis (EPN). The patient responded well to conservative treatment with antibiotics, and was finally discharged after 22 days when the computed tomography scan showed resolution of all the pockets of air. This case and associated literature review of 25 previously reported cases of bilateral EPN show the changing trend of EPN management from emergency nephrectomy toward conservative treatment with potent antibiotics and/or percutaneous drainage, and has been associated with higher survival rates compared to emergency nephrectomy.

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## Introduction

Emphysematous pyelonephritis is a rare acute necrotizing infection affecting the renal parenchyma, the collecting system, and peri-renal tissue, which is potentially life threatening and it is identified by the presence of gas within these structures [1–5]. The first case of emphysematous pyelonephritis

was reported by Kelly and McCallum in 1898 [6], and since then “Pneumonephritis,” “renal emphysema,” and emphysematous pyelonephritis are eponyms that have been used to describe the condition [7]. Poorly regulated blood sugars (diabetes) and obstruction in the urinary tract are the major predisposing factors of emphysematous pyelonephritis, observed in approximately 90% and 20% of the cases respectively [8–10]. *Escherichia coli* is the most encountered organism in

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emphysematous pyelonephritis cases, accounting for 60%–70% of cases. Other gas forming organisms implicated in emphysematous pyelonephritis include *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Aerobacter aerogenes*, *Citrobacter*, and rarely yeast [1–12].

Emphysematous pyelonephritis is commonly seen in women, frequently involving the left kidney, with fewer cases (5%–10%) involving both kidneys (bilateral) [5,13]. Bilateral emphysematous pyelonephritis is extremely rare, accounting for approximately 10% of emphysematous pyelonephritis cases, and is often associated with increased risk of multiorgan dysfunction, sepsis, longstanding hemodialysis and hence higher mortality rate [4,5,14].

Emphysematous pyelonephritis has been known to be a rare disease, however, there has been an increase in the number of emphysematous pyelonephritis cases diagnosed over the years due to increasing use of computed tomography and increasing prevalence of metabolic syndrome and diabetes. Management options for emphysematous pyelonephritis ranges from conservative approach including antibiotics treatment, vigorous resuscitation, blood sugar control to percutaneous drainage (PCD) and nephrectomy [1,5].

In this study, we present an additional case of bilateral emphysematous pyelonephritis in a black African woman, who was treated successfully with antibiotics alone, which is one of the first cases reported in Ghana and Africa as a whole, and a review of 25 reported cases of bilateral emphysematous pyelonephritis with emphasis on management options and outcomes.

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## Case report

A 78-year-old black woman had a 10-year history of diabetes mellitus (DM; Type 2). A background history of poor compliance with medication was noted. Upon admission, she presented with fever, chills, nausea, and complained of pain at the left lumbar region (left-sided flank pain) which was relieved after urination. On further examination, there was evidence of visible weight loss with generalized weakness with altered consciousness but her hydration status was satisfactory. Her blood pressure was 110/60 mmHg; and pulse, 79 bpm with normal sinus rhythm.

Laboratory investigations revealed a white blood cell count of  $5.1 \times 10^9/L$ ; platelets,  $342 \times 10^9/L$ ; red blood cell count,  $3.64 \times 10^{12}/L$ ; hemoglobin, 10.4 g/dL and hyperglycemia (fasting blood glucose, 19.7 mmol/L) was present. The red blood cells were normal, and the platelets and white blood cells showed normal morphology and distribution. Acute renal impairment was noted, with serum creatinine, 1.7 mg/dL (reference range: 0.9–1.3 mg/dL) and blood urea 30 mg/dL (reference range: 7–20 mg/dL). Urinalysis revealed pH at 5.0, proteinuria, and hematuria. The urine culture showed positive for *E. coli*.

Enhanced computed tomography scan of the abdominal pelvis showed no evidence of obstruction. Pockets of air were noted within the dilated left pelvi-calyceal system with air fluid levels consistent with Type 1 left emphysematous pyelonephritis. Also, there was minimal loculi of air in the right pelvi-calyceal system consistent with Type

2 emphysematous pyelonephritis. Based on these findings, diagnosis of bilateral emphysematous pyelonephritis was confirmed.

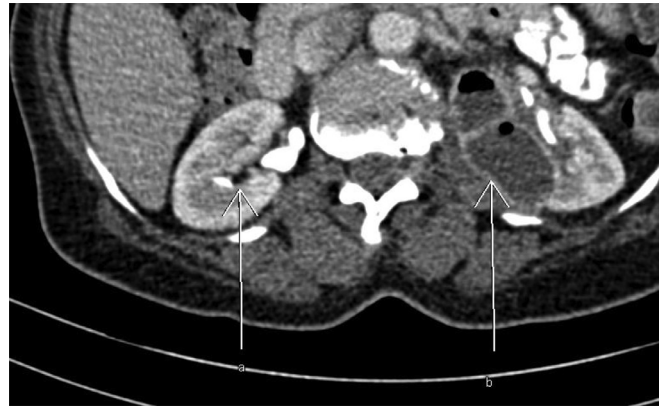
On admission, she was treated intravenously with antibiotics (Meropenem (1 g twice daily) and Gentamicin (80 mg twice daily). The hyperglycemia was initially treated with insulin analog but was switched to oral medication with metformin when significant improvement in glycemic control was observed. She responded well to antibiotics and was discharged 22 days after her initial admission.

Enhanced CT scan before the patient was discharged showed resolution of all the pockets of air within the calyceal collections in the left kidney. There was a significant reduction in the size of these collections too, the largest one which measured approximately  $7.4 \times 5.3$  cm now measured  $5.2 \times 3.6$  cm. The small focus of air in the right kidney had completely resolved. Improved renal function was observed, with urea and creatinine levels reduced to 15 mg/dL and 1.1 mg/dL respectively.

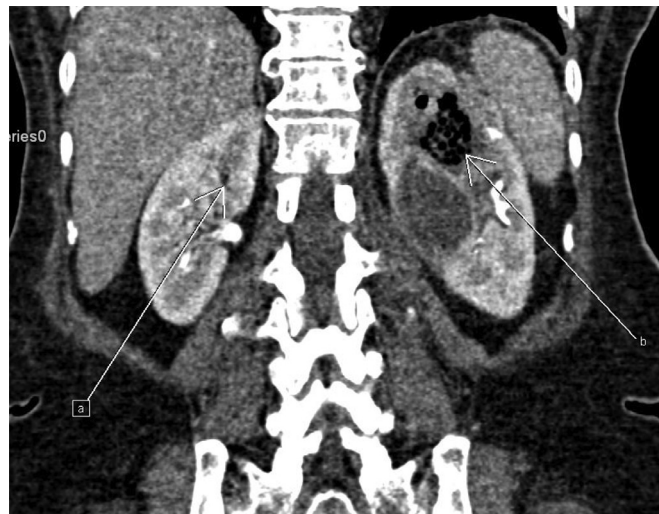
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## Discussion

Emphysematous pyelonephritis is a potentially life threatening necrotizing infection that affects the renal parenchyma, the collecting system, and peri-renal tissue, and it is characterized by the presence of gas within these structures [1–5]. The pathogenesis of emphysematous pyelonephritis appears to involve 4 factors: high tissue glucose, gas-forming bacteria, a defective immune response, and impaired tissue perfusion [15]. Predisposing factors indicating poor prognosis include acute renal failure, shock, altered consciousness, and thrombocytopenia [16]. In our case, poor regulation of blood glucose (DM) was the only predisposing factor observed, as her fasting blood glucose on arrival was 19.7 mmol/L. This was most likely due to the noncompliance with her medication. This further reinforces the observation by several studies that DM is the most prevalent comorbidity in emphysematous pyelonephritis patients, with an incidence of about 85% [1,2]. This trend is observed because DM offers an ideal environment for developing emphysematous pyelonephritis; high glucose concentrations in tissues, impaired tissue perfusion, and the presence of gas-producing organism [17]. The glucose serves as a substrate for the gas-producing organism, which in turn produces carbon dioxide and hydrogen by fermentation [17]. It is thought that urinary albumin serves as a substitute for glucose in nonDM patients [17] but glucose is the preferred substrate by the gas-producing organisms, accounting for the high prevalence of emphysematous pyelonephritis cases in DM patients. The most common presenting symptom of emphysematous pyelonephritis reported in literature is fever followed by flank pain, with other symptoms including nausea, vomiting, altered consciousness, renal impairment, and shock reported by some studies [1,2]. Our patient presented with fever, nausea, flank pain (left side), and altered consciousness. *E. coli* was the organism cultured from her urine sample. Several studies done in emphysematous pyelonephritis have also reported a 60%–70% prevalence of *E. coli* [1–12].



**Figure 1a** – Enhanced axial computed tomography scan of the abdomen. (A) A small focus of air in the right kidney. (B) Septated rim enhancing lesion with air fluid levels.



**Figure 1b** – Enhanced computed tomography scan of the abdomen with coronal reformatting. (A) A small focus of air in the right kidney. (B) Septated rim enhancing lesion with air fluid levels.

Radiological confirmation of gas within the kidney and/or collecting system is key to diagnosing emphysematous pyelonephritis alongside laboratory results, patients' history, and physical examination. Based on radiological findings, 2 types of emphysematous pyelonephritis have been identified by Chen et al. [15]. Type 1 is characterized by the presence of mottled or streaky appearing gas, parenchymal destruction, and the absence of fluid collection in the renal or peri-renal. Type 2 is characterized by fluid collection in the renal or peri-renal with air bubbles or loculated gas within the collecting system. Huang and Tseng further classifies EPN based on the localization of gas or abscess pattern; Class 1: gas is located inside the collecting system only, Class 2: gas is located in the renal parenchyma without extra renal extension, Class 3(a): there is extension of gas or abscess to perinephric space, Class 3(b): there is extension of gas or abscess to pararenal space, and Class 4: bilateral involvement or emphysematous pyelonephritis in solitary kidney [13]. The prognosis and mortality rate of emphysematous pyelonephritis are based on type

or class, with Type 1, Class 3, and Class 4 presenting with poor prognosis and associated with higher mortality rate [13,15]. Our patient was diagnosed as Type 1 (left) and Type 2 (right) bilateral emphysematous pyelonephritis based on CT findings, as shown in Figures 1a and 1b.

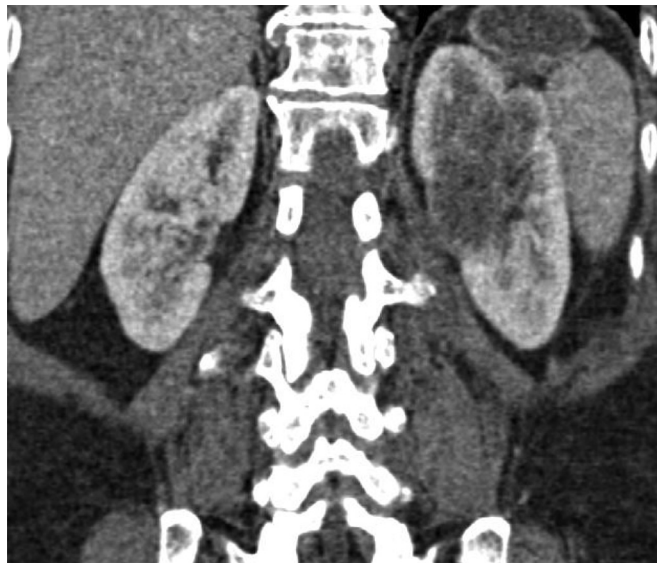
The study took into account 25 reported cases of bilateral emphysematous pyelonephritis in literature (from 2005 to 2017; Table 1). Women were the most affected, representing 72% of the selected cases. The average age at presentation was about 50 years, with a range of 20 to 86 years. The most prevalent comorbidity was diabetes, present in 88% of the patients, followed by hypertension (20%). However, none of the studies reported an obstruction in the urinary tract. The most commonly associated organism was *E coli* (n = 19, 76%), followed by *K pneumoniae*. These observations are in line with several previous reviews done in emphysematous pyelonephritis, with the only changing trend being the absence of urinary tract obstruction as earlier studies have reported a 20% prevalence in emphysematous pyelonephritis cases [8–10,18–20].

**Table 1 – Twenty-five reported cases of bilateral emphysematous pyelonephritis.**

S/N	Case report	Year of publication	Age	Sex	Diabetes	Obstruction	Organism	Other comorbidities	Therapy	Outcome
1	Vaidya et al. [31]	2005	55	F	+	–	<i>E coli</i>	None	Antibiotics	Survived
2	Karasavidou et al. [32]	2006	82	F	+	–	<i>E coli</i>	Hypertension	Antibiotics	Survived
3	Hart et al. [33]	2007	57	M	–	–	<i>E coli</i>	None	PCD and antibiotics	Survived
4	Shigemura et al. [26]	2009	86	F	+	–	<i>Anaerococcus</i>	None	Antibiotics	Survived
5	Su et al. [34]	2009	51	F	+	–	<i>Klebsiella</i> and <i>Pseudomonas</i>	Coronary artery disease and stroke	PCD and antibiotics	Survived
6	Darabi et al. [35]	2009	31	F	+	–	<i>E coli</i>	None	Left nephrectomy and antibiotics	Survived
7	Kumar et al. [27]	2009	29	F	-	–	<i>E coli</i> and <i>Klebsiella</i>	None	Antibiotics	Survived
8	Salvador et al. [36]	2010	52	F	+	–	<i>E. coli</i>	None	DJ stent and antibiotics	Survived
9	Harrabi et al. [37]	2010	64	F	+	–	<i>Candida</i>	None	Antibiotics and antifungal	Died
10	Wong et al. [38]	2011	42	M	+	–	<i>E coli</i> , <i>Enterococcus</i> and <i>Candida</i>	Adult polycystic kidney disease	Bilateral nephrectomy, PCD and antibiotics	Survived
11	Lakshminarayana et al. [39]	2012	43	M	–	–	<i>E coli</i>	ADPKD and hypertension	Bilateral nephrectomy and antibiotics	Survived
12	Lim et al. [40]	2012	46	F	+	–	<i>E coli</i>	Arthritis	Bilateral nephrectomy and antibiotics	Survived
13	Dutta et al. [4]	2013	38	F	+	–	<i>Klebsiella</i>	None	Antibiotics	Survived
14	Dutta et al. [4]	2013	36	F	+	–	<i>E coli</i>	None	PCD and antibiotics	Survived
15	Dutta et al. [4]	2013	52	F	+	–	<i>Klebsiella</i> and <i>E coli</i>	None	PCD and antibiotics	Survived
16	Dutta et al. [4]	2013	38	M	+	–	<i>E coli</i>	None	Antibiotics	Survived
17	Morioka et al. [41]	2013	66	F	+	–	<i>E coli</i>	Hypertension	PCD and antibiotics	Survived
18	Mahashabde et al. [16]	2013	61	M	+	–	<i>E coli</i> and <i>S Aureus</i>	None	DJ stent and antibiotics	Survived
19	Daoud et al. [28]	2014	27	F	+	–	None	Lepromatous leprosy	Antibiotics	Survived
20	Suzuki et al. [20]	2015	80	M	+	–	<i>E coli</i> and <i>Enterococcus</i>	None	Antibiotics	Survived
21	Cheng et al. [3]	2015	58	F	+	–	None	Hypertension	Antibiotics	Survived
22	Misgar et al. [29]	2015	56	F	+	–	<i>E coli</i>	None	Antibiotics	Survived
23	Misgar et al. [29]	2015	20	F	+	–	<i>E coli</i>	None	Antibiotics	Survived
24	Uscanga-Yépez et al. [42]	2017	33	F	+	–	<i>E coli</i>	Obesity and hypertension	PCD	Survived
25	Kim et al. [30]	2017	46	M	+	–	<i>E coli</i>	Hepatocellular carcinoma and hepatitis B	Antibiotics	Survived



**Figure 2a** – Enhanced axial computed tomography scan of the abdomen showing post antibiotic treatment with resolution of the focus of gas in the right kidney and reduction in size of the enhancing collection in the left kidney, additionally showing complete resolution of the intralesional gas.



**Figure 2b** – Enhanced computed tomography scan of the abdomen with coronal formatting, showing post antibiotic treatment with resolution of the focus of gas in the right kidney and reduction in size of the enhancing collection in the left kidney, additionally showing complete resolution of the intralesional gas.

The gold standard of care for emphysematous pyelonephritis patients involves either conservative medical management (MM) with antibiotics, or PCD with MM with or without nephrectomy [21]. The need for PCD or urethral stent placement is determined based on radiological findings. The largest series about treatment strategies of emphysematous pyelonephritis was reported by Olvera-Posada et al. [22] and they recommend combining different minimally invasive strategies before emergency nephrectomy (EN). Aboumarzouk et al. [2] in their meta-analysis of 628 patients from 32 studies noted that 45% of the patients had PCD, 26.6% had MM, 20% had EN and 2.8% had open drainage. The study further revealed that PCD and MM were associated with significantly higher survival rates than EN, thus concluding that EN should be the last option in the management of emphysematous pyelonephritis patients. This coincides with the observation by Olvera-Posada et al. [22] that the prognosis of pa-

tients with emphysematous pyelonephritis has changed over the last years, with a decline in mortality resulting from improved MM and minimal invasive strategies together with the widespread adoption of PCD and double J stent placement.

In the 25 selected cases (Table 1), patients were chiefly treated by conservative MM which included antibiotics (n = 24, 96%), PCD (n = 7, 28%), double J stent, with additional therapy for glycemic control in diabetic patients. Surgical treatment was implicated in 4 patients (16%) and included only nephrectomy. One patient out of the 25 selected EPN cases died. This supports several studies that have reported successful MM of emphysematous pyelonephritis [23–25] thus eliminating the need for long term hemodialysis associated with surgical treatment.

Successful management of bilateral emphysematous pyelonephritis cases with antibiotics only (MM) have been reported by several studies [3,4,20,26–30]. In our case, the patient

was conservatively managed with antibiotics (Meropenem and Gentamicin). However, due to the presence of hyperglycemia, human insulin analog and later on metformin were prescribed to achieve appreciable glycemic control. She was finally discharged after 3 weeks and one day, when the post CT scan showed resolution of all the pockets of air within the calyceal collections (Figures 2a and 2b).

## Conclusion

There has been a significant increase in the number of diagnosed emphysematous pyelonephritis cases over the years due to increase in utilization of computed tomography coupled with increasing prevalence of DM. Conservative MM with potent antibiotics and/or PCD is the preferred first line of treatment and it has been associated with high survival rates in reported cases, thus obviating the need for nephrectomy or surgical treatment. The patient in our case report was diagnosed with the aid of CT scan, and was successfully treated with only antibiotics in a bilateral presentation of emphysematous pyelonephritis, a condition in which treatment traditionally involved antibiotics and other additional interventions including nephrectomy.

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## REFERENCES

- [1] Sokhal AK, Kumar M, Purkait B, Jhanwar A, Singh K, Bansal A, et al. Emphysematous pyelonephritis: changing trend of clinical spectrum, pathogenesis, management and outcome. *Turk J Urol* 2017;43(2):202.
- [2] Aboumarzouk OM, Hughes O, Narahari K, Coulthard R, Kynaston H, Chlosta P, et al. Emphysematous pyelonephritis: time for a management plan with an evidence-based approach. *Arab J Urol* 2014;12(2):106–15.
- [3] Cheng ML, Nording H, Lim CH. Bilateral emphysematous pyelonephritis with hepatic portal venous gas: case report. *Malays J Med Sci* 2015;22(3):71.
- [4] Dutta D, Shivaprasad KS, Kumar M, Biswas D, Ghosh S, Mukhopadhyay P, et al. Conservative management of severe bilateral emphysematous pyelonephritis: case series and review of literature. *Indian J Endocrinol Metab* 2013;17(Suppl1):S329.
- [5] Kuchay MS, Laway BA, Bhat MA, Mir SA. Medical therapy alone can be sufficient for bilateral emphysematous pyelonephritis: report of a new case and review of previous experiences. *Int Urol Nephrol* 2014;46(1):223–7.
- [6] Kelly HA, MacCullum WG. Pneumatouria. *JAMA* 1898;31:375–81.
- [7] Schultz EH, Klorfein EH. Emphysematous pyelonephritis. *J Urol* 1962;87(6):762–6.
- [8] Kumar S, Ramachandran R, Mete U, Mittal T, Dutta P, Kumar V, et al. Acute pyelonephritis in diabetes mellitus: single center experience. *Indian J Nephrol* 2014;24(6):367.
- [9] Aswathaman K, Gopalakrishnan G, Gnanaraj L, Chacko NK, Kekre NS, Devasia A. Emphysematous pyelonephritis: outcome of conservative management. *J Urol* 2008;71(6):1007–9.
- [10] Tseng CC, Wu JJ, Wang MC, Hor LI, Ko YH, Huang JJ. Host and bacterial virulence factors predisposing to emphysematous pyelonephritis. *Am J Kidney Dis* 2005;46(3):432–9.
- [11] Ouellet LM, Brook MP. Emphysematous pyelonephritis: an emergency indication for the plain abdominal radiograph. *Ann Emerg Med* 1988;17(7):722–4.
- [12] Cook DJ, Achong MR, Dobranowski J. Emphysematous pyelonephritis: complicated urinary tract infection in diabetes. *Diabetes Care* 1989;12(3):229–32.
- [13] Huang JJ, Tseng CC. Emphysematous pyelonephritis: clinicoradiological classification, management, prognosis, and pathogenesis. *Arch Intern Med* 2000;160(6):797–805.
- [14] Zabbo A, Montie JE, Popowniak KL, Weinstein AJ. Bilateral emphysematous pyelonephritis. *J Urol* 1985;25(3):293–6.
- [15] Chen KW, Huang JJ, Wu MH, Lin XZ, Chen CY, Ruaan MK. Gas in hepatic veins: a rare and critical presentation of emphysematous pyelonephritis. *J Urol* 1994;151(1):125–6.
- [16] Mahashabde M, Kumar S, Borawake K. Extensive bilateral emphysematous pyelonephritis with calculi managed conservatively with antibiotics and DJ stent. *Med J DY Patil* 2013;6(4):447.
- [17] Kuzgunbay B, Turunc T, Tokmak N, Turunc T, Dirim A, Aygun C, et al. Tailored treatment approach for emphysematous pyelonephritis. *Urol Int* 2011;86(4):444–7.
- [18] Flores G, Nellen H, Magaña F, Calleja J. Acute bilateral emphysematous pyelonephritis successfully managed by medical therapy alone: a case report and review of the literature. *BMC Nephrol* 2002;3(1):4.
- [19] Schicho A, Stroszczyński C, Wiggermann P. Emphysematous cystitis: mortality, risk factors, and pathogens of a rare disease. *Clin Pract* 2017;7(2):930.
- [20] Suzuki R, Abe T, Uchida H, Niikura K. Successful management of bilateral emphysematous pyelonephritis with abscess formation in a chronic hemodialysis patient: a case report. *CEN Case Rep* 2015;4(1):90–4.
- [21] Somani BK, Nabi G, Thorpe P, Hussey J, Cook J, N'Dow J. Is percutaneous drainage the new gold standard in the management of emphysematous pyelonephritis? Evidence from a systematic review. *J Urol* 2008;179(5):1844–9.
- [22] Olvera-Posada D, Armengod-Fischer G, Vázquez-Lavista LG, Maldonado-Ávila M, Rosas-Nava E, Manzanilla-García H, et al. Emphysematous pyelonephritis: multicenter clinical and therapeutic experience in Mexico. *J urol* 2014;83(6):1280–4.
- [23] Angulo JC, Dehaini A, Escribano J, Sanchez-Chapado M. Successful conservative management of emphysematous pyelonephritis, bilateral or in a solitary kidney. *Scand J Urol Nephrol* 1997;31(2):193–7.
- [24] Grozel F, Berthezene Y, Guerin C, Tran-Minh VA, Croisille M. Bilateral emphysematous pyelonephritis resolving to medical therapy: demonstration by US and CT. *Eur Radiol* 1997;7(6):844–6.
- [25] Shimizu H, Hariu K, Kamiyama Y, Tomomasa H, Iizumi T, Yazaki T, Umeda T. Bilateral emphysematous pyelonephritis with autosomal-dominant polycystic kidney disease successfully treated by conservative method. *Urol Int* 1999;63(4):252–4.
- [26] Shigemura K, Yasufuku T, Yamashita M, Arakawa S, Fujisawa M. Bilateral emphysematous pyelonephritis cured by antibiotics alone: a case and literature review. *Jpn J Infect Dis* 2009;62(3):206–8.

- [27] Kumar N, Singh NP, Mittal A, Valson AT, Hira HS. An uncommon cause of postpartum renal failure—bilateral emphysematous pyelonephritis. *Ren Fail* 2009;31(2):171–4.
- [28] Daoud A, Elbendary A, Elfishawi M, Rabea M, Alfshawy M. Diabetic ketoacidosis with two life threatening infections: mucormycosis, and bilateral emphysematous pyelonephritis, precipitating erythema nodosum leprosum as the initial presentation of diabetes. *J Diabetes Metab* 2014;5(433):2.
- [29] Misgar RA, Wani AI, Bashir MI, Pala NA, Mubarak I, Lateef M, et al. Successful medical management of severe bilateral emphysematous pyelonephritis: case studies. *Clin Diabetes* 2015;33(2):76–9.
- [30] Kim CS, Ma SK, Kim SW. Bilateral emphysematous pyelonephritis. *J Korean Med Sci* 2017;32(11):1736–7.
- [31] Vaidya A, Bhatia M. Bilateral emphysematous pyelonephritis. *Armed Forces Med J India* 2005;61(4):393.
- [32] Karasavidou L, Nikolaou S, Archontakis S, Papatheodorou G, Koroneos V, Drakoulis C. Nonsurgical treatment of bilateral emphysematous pyelonephritis in a diabetic patient. *J Nephrol* 2006;19(5):664–7.
- [33] Hart PD, Vaseemuddin M, Egiebor O, Dunea G. Bilateral emphysematous pyelonephritis in a patient with no known risk factors. *J Natl Med Assoc* 2007;99(2):179.
- [34] Su CY, Lee LC, Lai CH, Wang YH, Yang YK, Ng HY, et al. Successful treatment of bilateral emphysematous pyelonephritis in a uremic patient without nephrectomy. *Ren Fail* 2009;31(2):167–70.
- [35] Darabi M, Keshvari M. Bilateral emphysematous pyelonephritis: a case report. *J Urol* 2009;2(2):118–19.
- [36] Salvador GS, Ernesto JV, Gloria GR, Karenina LR. Bilateral emphysematous pyelonephritis: a case presentation of successful treatment with minimally invasive procedure. *Rev Mex Urol* 2010;70(5):315–18.
- [37] Harrabi H, Marrakchi C, Daoud E, Elleuch E, Hammami B, Maâloul I, et al. Bilateral emphysematous pyelonephritis caused by *Candida glabrata*: an exceptional entity. *Nephrol Ther* 2010;6(6):541–3.
- [38] Wong EK, Hartley R, Main J. Successful management of bilateral emphysematous pyelonephritis in end-stage polycystic kidneys: bilateral native nephrectomies and preservation of functioning renal transplant. *Nephrol Dial Transplant* 2011;4(August6):452–3.
- [39] Lakshminarayana G, Mathew A, Rajesh R, Kurien G, Unni VN. Bilateral emphysematous pyelonephritis in autosomal dominant polycystic kidney disease. *Indian J Nephrol* 2012;22(2):136.
- [40] Lim SK, Park I. Bilateral emphysematous pyelonephritis. *Korean J Internal Med* 2012;27(3):366.
- [41] Morioka H, Yanagisawa N, Suganuma A, Imamura A, Ajisawa A. Bilateral emphysematous pyelonephritis with a splenic abscess. *J Intern Med* 2013;252(1):147–50.
- [42] Uscanga-Yépez J, González-Oyervides R, Barrera-Juárez E. Severe bilateral emphysematous pyelonephritis. *J Clin Urol* 2018;1:2.