SUMMARY
Emphysematous pyelonephritis is a severe infection characterized by the presence of gas within the renal parenchyma and perirenal tissues. It is a life-threatening complication of bacterial interstitial nephritis, and it mainly occurs in patients with diabetes mellitus. We report a case of a 58-year-old man who complained of fever and pain in the left lumbar region on admission. His past medical history included left-sided nephrolithiasis. Renal x-rays showed a gas shadow in and around the left kidney but no evidence of upper urinary tract obstruction. He was treated with intensive antibiotic therapy in high doses (urine culture revealed Escherichia coli). Clinical features improved. At the time of admission, thrombocytopenia and acute renal function impairment were present along with a glucose value of 9.5 mmol/L. Glycemia values during oGTT showed impaired glucose tolerance. Computed tomography of the left kidney demonstrated gas accumulation. The diagnosis of emphysematous pyelonephritis was confirmed.

INTRODUCTION
Emphysematous renal infection is a severe, rare complication of urinary tract infection associated with gas production, which frequently causes renal destruction and has a high mortality rate (1). It is termed emphysematous pyelitis when gas is confined to the collecting system, or emphysematous pyelonephritis if it also involves the parenchyma with or without the perirenal space (2,3). The radiological classification and appropriate therapeutic regimen are controversial, and the prognostic factors and pathogenesis remain uncertain (4).

Emphysematous pyelonephritis is a life-threatening complication of bacterial interstitial nephritis, and it mainly occurs in diabetics (5-10). The infection with optional anaerobic microorganisms, which are able to produce gas, is supported by a reduced state of resistance, a high glucose level in the tissue in diabetic derangement, and ischemia of the infected organ, e.g., by kidney infarction or obstructive uropathy (6,11,12). The inflammation mostly occurs unilaterally, and only in 10% of all cases both kidneys are affected. Computed tomography allows for a fast diagnosis by demonstrating gas accumulation in the kidney. Surgical measures and antibiotic therapy are the principal therapeutic methods (7,8).

CASE REPORT
We report a case of a 58-year-old male admitted to our hospital for evaluation of fever, chills and pain in the left lumbar region. His past medical history included left-sided nephrolithiasis, diagnosed 10 years before, treated by lithotripsy on 9 and by laser on 3
occasions. He had one and a half pack per day smoking history. His family history was unremarkable. Medication on admission included analgetics.

Physical examination revealed a 58-year-old male of good nutritional status. His vital signs were as follows: temperature 36.5 °C, pulse 90 beats per minute, and blood pressure 100/70 mm Hg. His liver and spleen were enlarged by up to 4 centimeters. The left lumbar region was sensitive on succussion. Otherwise, physical examination was unremarkable.

Routine hematologic and biochemical tests performed on admission yielded the following findings: ESR 98 mm/h; CRP 190.7 mg/L; WBC 5400/mm³; hematocrit 32%; hemoglobin 111 g/L; MCV 88/μm³; platelets 68000/μm³; glucose 9.5 mmol/L; serum iron 3 μmol/L; and UIBC 19 μmol/L. Serum sodium level was 133 mmol/L, potassium 3.9 mmol/L, chloride 98 mmol/L, and calcium 1.88 mmol/L. Blood urea nitrogen (BUN) was elevated to up to 15.1 mmol/L, and creatinine to 186 μmol/L. Bilirubin and urates were within the normal range. The levels of liver enzymes were elevated: alkaline phosphatase (AP) 111 U/L, serum glutamic oxaloacetic transaminase (AST) 72 U/L, and serum glutamic pyruvic transaminase (ALT) 54 U/L. The level of total serum protein was 53 g/L; electrophoresis: albumins 22.9 g/L, α globulins 3.2 g/L, β globulins 6.5 g/L, and γ globulins 14.3 g/L. Coagulation test revealed shortened prothrombin time.

Glycemia values during oGTT (especially at 120 min) indicated impaired glucose tolerance. Blood cultures were sterile. The urine was clear and amber in color, with alkaline pH and specific weight of 1010 g/ml. Microscopic examination showed 0-2 epithelial cells and 0-3 leukocytes.

Urine culture revealed Escherichia coli (pseudomonas, gentamycin). Total protein excretion in urine was 0.3 g/24 h (daily urine amount 3.42 L). Cytologic examination of the urine showed rare red blood cells, lots of granulocytes, and few squamous and transitional epithelial cells.

At the time of admission, renal x-rays showed a gas shadow in and around the left kidney. Diagnostic workup during hospitalization included abdominal sonography (on days 2, 9 and 15 of admission), which showed nephrolithiasis and pyonephrosis of the left kidney (Fig. 1). Intravenous urography (on day 10 of admission) revealed mineral shadows in the projection of the left kidney and its afunetion. The right kidney showed no abnormalities. Computed tomography of the kidneys (on day 15 of admission) confirmed the previous diagnostic workup with no changes of the right kidney. However, the dilated lumen of the left pyelon contained a dense content including gas and numerous concrements.

Figure 1. Abdominal sonogram showing nephrolithiasis and pyonephrosis of the left kidney

The diagnosis of emphysematous pyelonephritis was confirmed by the presence of gas in the left kidney, observed by computed tomography.

The patient was treated with high doses of antibiotics: pefloxacin 2x400 mg i.v. for 14 days and metronidazole 3x500 mg i.v. for 15 days. The patient’s condition improved. Control x-rays of the kidneys (on day 16, i.e. the last day of hospitalization) showed no gas shadow in or around the left kidney.

Unfortunately, the patient refused any further medical options (on day 16 of hospitalization). Computed tomography and intravenous urography images were given to the patient for additional urologic consultation.

**DISCUSSION**

Emphysematous pyelonephritis, a rare necrotizing infection of the upper urinary tract, is a life-threatening complication in patients with diabetes mellitus (5,6). Female diabetic patients and left kidney are more commonly affected (3,5). Both kidneys are involved in only 5% of cases. Obstruction of the corresponding renoureteral unit can be found in nondiabetic (>90%) and diabetic (50%) patients (3). The finding of gas within the renal structures is pathognomonic of emphysematous pyelonephritis (6).
Diagnosis can be confirmed by gas in the parenchyma or perinephric space by plain x-ray or computed tomography of the abdomen (3). *Escherichia coli* has been reported as the most common organism (>70% of urine cultures) (3).

As early diagnosis and aggressive medical and surgical treatment are imperative for recovery, plain abdominal radiographs must be considered the minimal screening tool in all diabetic patients or patients with newly detected impaired glucose tolerance (such as the case presented), who present to the hospital with suspected pyelonephritis.

Emphysematous pyelonephritis is a rare life-threatening infection in diabetes, characterized by suppurrative infection of the renal parenchyma and perirenal tissues. It usually presents with fever, nausea, vomiting, abdominal pain, shock, lethargy, and confusion. Diabetic ketoacidosis is an uncommon presentation (12,13).

According to radiologic findings and computed tomography scans, emphysematous pyelonephritis can be classified as follows: class 1 - gas in the collecting system only; class 2 - gas in the renal parenchyma without extension to the extrarenal space; class 3A - extension of gas or abscess to the perinephric space; class 3B - extension of gas or abscess to the pararenal space; and class 4 - bilateral emphysematous pyelonephritis or solitary kidney with emphysematous pyelonephritis (4).

Our patient was classified as class 1 emphysematous pyelonephritis according to his radiologic findings and computed tomography scan.

*Escherichia coli* and *Klebsiella pneumoniae* have been reported as the most common pathogens in emphysematous pyelonephritis (69% and 29%, respectively). According to literature data, the mortality rate in patients who received antibiotic therapy alone was about 40%. In patients with class 1 or 2 emphysematous pyelonephritis, treatment with percutaneous catheter drainage (PCD) or ureteral catheter combined with antibiotic therapy was associated with survival. Patients with extensive emphysematous pyelonephritis (classes 3 and 4) and with <2 or >2 risk factors such as thrombocytopenia, acute renal function impairment, disturbance of consciousness, or shock, could be successfully treated with the use of PCD in combination with antibiotic therapy (4).

Our patient had two risk factors at the time of admission, i.e. thrombocytopenia and acute renal function impairment with impaired glucose tolerance, which all responded well to antibiotic therapy and rehydration.

All urine cultures were positive for *Escherichia coli* (which produced a high level of gas) despite the absence of diabetes mellitus. Some bacterial strains are able to produce high levels of nitrogen, carbon dioxide and hydrogen, and such a high fermentation even in the absence of high serum glucose. This might explain the acute gas-producing bacterial renal infection (10).

The finding of gas in the renal structures is pathognomonic of emphysematous pyelonephritis. Because early diagnosis and aggressive medical and surgical management are imperative for recovery, we recommend plain abdominal radiography as a minimal screening tool in all diabetic patients and those with impaired glucose tolerance who present with presumptive pyelonephritis (6).

**Acute renal infection with Escherichia coli or Klebsiella pneumoniae in patients with diabetes mellitus and/or urinary tract obstruction is the cornerstone for the development of emphysematous pyelonephritis.** Mixed acid fermentation of glucose by Enterobacteriaceae is the major pathway of gas formation. For localized emphysematous pyelonephritis (classes 1 and 2), antibiotic treatment alone or in combination with PCD can provide a good outcome. Gas within the kidney can be diagnosed by plain radiography or rarely by ultrasound, however, gas location and extension are best evaluated by computed tomography (11).
REFERENCES


