Emphysematous pyelonephritis in a solitary kidney
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Section: Uroradiology & genital male imaging
Area of Interest: Kidney Urinary Tract / Bladder
Procedure: Diagnostic procedure
Imaging Technique: CT
Imaging Technique: Ultrasound
Imaging Technique: MR
Special Focus: Infection Case Type: Clinical Cases
Authors: Tonolini Massimo, MD1; Vella Adriana, MD1; Romanò Ai Ling, MD2; Granata Antonio, MD2.
Patient: 55 years, male

Clinical History:

Middle-aged man admitted to the emergency department with high fever, dysuria, distended tender abdomen without peritonism.
Laboratory studies including arterial blood gases revealed severe renal impairment (7.5 mg/dl serum creatinine), markedly increased C-reactive protein (411 mg/l), hyponatraemia, mild hypoxia, metabolic acidosis and hyperglycaemia consistent with new diagnosis of decompensated diabetes mellitus.

Imaging Findings:

At admission, ultrasound (Fig.1) and unenhanced CT (Fig.2) showed the previously unknown congenital severe hypoplasia of the left kidney. The compensatory enlarged right kidney showed diffuse parenchymal oedematous hyperechogenicity, two minute stones respectively at the lower calyx and vesico-ureteral junction, without significant hydronephrosis.
Despite intensive in-hospital treatment of urosepsis and acute renal failure including antibiotics, ureteral stenting and haemodialysis, fever and poor urine output persisted. Three weeks later, repeated CT (Fig.3) and subsequent unenhanced MRI (Fig.4) showed that the oedematous right kidney had developed multiple, sizeable gaseous and fluid intraparenchymal collections, consistent with a diagnosis of emphysematous pyelonephritis. Blood cultures tested positive for Klebsiella pneumoniae infection.
Afterwards, the patient's clinical conditions, renal function (2.0 mg/dl creatinine at discharge two months later) and acute phase reactants slowly improved, meanwhile follow-up ultrasound and CT (Fig.5) showed progressive decrease of renal emphysematous changes.

Discussion:

Emphysematous pyelonephritis (EPN) is a rare, severe necrotizing renal infection, which mostly affects women (3:1 predominance). The large majority of patients have poorly controlled diabetes mellitus, and non-diabetic cases are related to either immunosuppression or urinary tract obstruction. The usual pathogens isolated from pus cultures include Escherichia coli (49-71% of cases), Klebsiella pneumoniae (19%) and Proteus mirabilis (17%), frequently (approximately one-fourth of cases) antibiotic-resistant. The pathogenesis involves multiple factors, such as gas-forming bacteria, high tissue glucose level, impaired tissue perfusion, and defective immune response. The clinical presentation resembles that of acute pyelonephritis and includes fever, chills, flank pain, dysuria and pyuria.
Laboratory changes generally include leukocytosis, thrombocytopenia and altered renal function. If untreated, EPN progresses to potentially lethal sepsis [1-6].

The diagnostic hallmark of EPN is represented by abnormal gas collections within the renal parenchyma or perinephric space. Plain radiographs demonstrate “mottled” gas bubbles over the affected kidney or crescentic air collections within the Gerota fascia with 70% sensitivity, but misinterpretation as bowel gas is common. Ultrasound may detect nondependent hyperchoic gas foci with “dirty” reverberation artefacts. However, CT is by far the technique of choice to diagnose EPN, which manifests as variable degrees of parenchymal enlargement and destruction, with variably distributed gas (bubbly, linear, streaky or crescent-shaped), fluid collections, and possible associated urolithiasis and obstruction. The nephrographic enhancement is diffusely altered with or without focal tissue necrosis and abscesses, delayed excretion. In the past, Wan et al. differentiated type-1 (with a better prognosis) from the more aggressive type-2 EPN according to the absence or presence of renal or perirenal fluid collections. Nowadays, EPN should be staged according to classification proposed by Huang and Tseng (Fig.6), which includes the milder emphysematous pyelitis as its grade I [7-13].

Alternatively, gas in the urinary tract may result from surgery, instrumentation or catheterisation, fistulization to the gastrointestinal tract, exceptionally from penetrating trauma [11, 12].

With prompt diagnosis, conservative management is increasingly adopted, particularly in classes I and II EPN. Intensive fluid resuscitation, glycaemic control, antibiotics, plus dialysis and drainage of obstruction as needed result in decreased mortality, currently below 25%. Risk factors for unfavourable outcome include high (III-IV) CT grade, shock, emergency haemodialysis, altered sensorium, thrombocytopenia. However, conservative treatment fails in 32-43%. Nephrectomy is not associated with improved survival and is reserved for EPN classes III and IV with adverse prognostic factors or failed conservative treatment [1-4, 14-16].

**Differential Diagnosis List:** Emphysematous pyelonephritis. Congenital hypoplasia of contralateral kidney., Emphysematous pyelitis, Acute pyelonephritis, Uncomplicated pyeloureteritis, Xanthogranulomatous pyelonephritis, Renal carcinoma, Emphysematous cystitis

**Final Diagnosis:** Emphysematous pyelonephritis. Congenital hypoplasia of contralateral kidney.

**References:**


Description: The left kidney could not be visualized. The right kidney showed signs of compensatory enlargement, mild diffuse parenchymal hyperechogenicity (*), absent hydronephrosis, a lower pole simple cyst (+ in c). **Origin:** Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
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**Figure 5**

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
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<tbody>
<tr>
<td>I</td>
<td>Emphysematous pyelitis - gas in collecting system only</td>
</tr>
<tr>
<td>II</td>
<td>Intraparenchymal gas only (no extrarenal involvement)</td>
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<tr>
<td>IIIA</td>
<td>Gas extending into the perinephric space</td>
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<tr>
<td>IIIB</td>
<td>Extension of gas into the pararenal spaces</td>
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<tr>
<td>IV</td>
<td>Emphysematous pyelonephritis in solitary kidney or bilateral</td>
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</tbody>
</table>

**Description:** Table describes stages I to IV of emphysematous pyelonephritis according to classification proposed by Huang and Tseng (Ref.no.13) **Origin:** Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
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