Emphysematous pyelonephritis (EPN) is a severe form of urinary tract infection presenting as gas-producing inflammation of kidney. All the EPN occur in the patients suffering from diabetic mellitus (DM) or urinary tract obstruction. It needs early diagnosis and aggressive treatment for the survival of the patients with EPN. We describe a case of extensive EPN concomitant with perirenal urine leakage in a 48-year-old female patient with DM who was successfully treated by the control of blood sugar, long-term antibiotics, and percutaneous drainage of perirenal gas and fluid. Literature of the EPN in respects of epidemiology, pathogenesis, pattern of computed tomographic features, and optimal therapeutical choices among different combinations of antibiotics, percutaneous drainage, and nephrectomy are reviewed and discussed. Antibiotics combined with percutaneous drainage is a good alternative for management of emphysematous pyelonephritis but surgical intervention is suggested if initial fulminate course is present.

Key words: Emphysematous pyelonephritis, Computed tomography; Perirenal urine leakage, Percutaneous drainage

Emphysematous pyelonephritis (EPN) is a rare life threatening infection of kidney, which is characterized by the presence of abnormal gas and/or fluid collection in the renal pyelocalices and/or parenchyma and/or perirenal space and/or pararenal space. It occurs mostly in the diabetic patients and requires early diagnosis and early aggressive treatment because of its high mortality rate. We describe a case of the EPN in a patient with diabetic mellitus (DM) concomitant with perirenal urine leakage, which has not been discussed on literature before.

CASE REPORT

A 48-year-old-woman was admitted presenting with a 2-day fever, chill, nausea, vomiting, dizziness and general weakness. Past history showed she was a victim of non-insulin-dependent DM. Her body temperature was 37.7°C, blood pressure was 74/50 mmHg, and pulse rate was 109 beats/min. Physical examination was unremarkable and, specifically, there was no costovertebral angle tenderness. Laboratory data revealed hyperglycemia with blood sugar level being 560 mg/dl. Complete blood counts showed white cell count: 8530/cu mm with 90% of polymorphonucleus; red cell count: 4.43 million/cu mm; and platelet count: 215 thousand/cu mm. Blood urea nitrogen level was 20 mg/dl and creatinine level was 1.4 mg/dl. A centrifuged urine specimen showed 4+ bacteria, 30-35 white cells and 0-2 red blood cells per high power field. Supportive treatment with intravenous fluid, insulin, antibiotics and inotropic agent were given, but persistent high blood sugar and intermittent low-grade fever were still present. Sudden onset of left flank pain developed two days later and the blood white cell...
count increased to 11750/cu mm. Emergent plain radiographs of the abdomen (KUB) disclosed irregular curvilinear perirenal gas collection in the left aspect of the abdomen (fig 1). Abdominal sonograms showed air reverberation surrounding and embedding the left kidney, perirenal fluid accumulation, and part of the left kidney obliterated by gas shadowing. Pre- and post-intravenous contrast-medium enhanced computed tomography (CT) were done and clearly demonstrated focal rugged contour over upper pole of the left kidney (fig 2a), the gas collection in the left renal parenchyma and left perirenal space, fluid accumulation in left perirenal space, absence of densely concentrated urine excreted in the pyelocalices of left kidney (fig 2b), and some fluid collection in the left posterior pararenal space along the left psoas muscle. Sonography-guided percutaneous drainage (PCD) of perirenal gas and fluid was then performed with a pig-tail catheter for drainage after confirming that prothrombin time and activated partial thromboplastin time were within normal reference range and no thrombocytopenia (platelet count being 167 thousand/cu mm). About 80 mL of foul-smelling, turbid, brownish pus and debris was initially aspirated out as possible as we could. Klebsiella pneumoniae was isolated in all the specimens including blood, urine, and perirenal pus. Unexpectedly, persistent large amount of relatively clear light-yellowish fluid more than 1000 mL (1630-1250 ml) was drained out in the following week after PCD. The amount of protein loss in the perirenal drainage was 2299 mg/day and concomitant plasma albumin level decreased to 2.2g/dl. Electrolytes of the drained perirenal fluid was also analyzed with the results of Na 115mEq/ml, K 3.9mEq/ml, and Cl 99mEq/ml, which is similar to those of urine in consistency (Na 91, K 16.8, and Cl 115). Thereafter, the amount of PCD decreased gradually to less than 100 ml in the following next week. General condition of the patient did improve slowly. The follow-up intravenous

![Figure 1. KUB. Irregular curvilinear perirenal gas collection (arrowhead) in the left aspect of abdomen.](image1)

![Figure 2. Contrast-enhanced CT. a: Rugged surface of the upper pole of the left kidney (arrowhead) is noted. b: Left perirenal gas (arrow) and fluid collection, and absence of densely concentrated opaque urine excreted in pyelocalices of the left kidney are noted, whereas densely concentrated opaque urine is present in the pyelocalices of the right kidney (arrowhead).](image2)
contrast-medium enhanced abdominal CT was done 7-day after PCD and revealed minimal residual gas and fluid in the left perirenal space, densely concentrated opaque urine excreted in the pyelocalices of the left kidney (arrowhead) are noted. Pig-tail catheter (arrow) is noted in perirenal space.

Figure 3. Contrast-enhanced CT performed one week after PCD. Minimal residual left perirenal gas and fluid collection, and recovery of densely concentrated opaque urine excreted in the pyelocalices of the left kidney (arrowhead) are noted. Pig-tail catheter (arrow) is noted in perirenal space.

fermentation of glucose by anaerobes were the pathways by which EPN developed [1]. The female outnumber the male in developing EPN and the left kidney is far more commonly involved than the right kidney [1, 2]. Bilateral EPN was reported in approximately 5% of all EPNs [2]. The overall mortality rate is about 11% [3].

The symptoms and signs of EPN are nonspecific, and may present with fever, chill, nausea, vomiting, flank pain, abdominal pain, dyspnea, lethargy, confusion, pyuria, acute renal function impairment, thrombocytopenia, or shock. In case of nonvisualization or missed interpretation of the pathognomic gas shadows in the kidney or perirenal space as simple bowel gas on abdominal plain films or sonograms, the diagnosis is usually delayed.

Retrospective imaging review of Kuo YT et al. showed the sensitivity of KUB and abdominal sonography to detect abnormal renal or perirenal gas collection is 66% and 88%, respectively [3]. CT is the most sensitive tool and the most efficient method for diagnosis, staging, and treatment-guiding of EPN. For the case with unusually severe clinical manifestation or nonresponse to the treatment of UTI, abdominal CT is indicated because subtle gas shadows can be detected, which may not be disclosed on the abdominal plain films or sonograms [1, 3, 4]. Wan YL et al. characterized EPN into two categories by CT [5]. Type I EPN was characterized by parenchyma destruction with either absence of fluid or presence of streaky or mottled gas; and type II EPN was characterized with either renal or perirenal fluid collection with bubbly, loculated gas or gas in the collecting system. The histopathological features of the type II EPN show only inflammation and abscess formation of the kidney and those of type I EPN reveal some degree of vascular thrombosis and wedge infarction (impaired tissue perfusion) in addition to inflammation [5]. Patients with radiological type I EPN tend to have a more fulminate course with a significantly shorter interval from clinical onset to death and were with significantly higher mortality than those with type II EPN [1, 5, 6]. Huang JJ et al. further classified EPN to four groups according to the extent of the EPN on CT-- class 1: showing gas in collecting system only; class 2: showing gas in the renal parenchyma without extension to extrarenal space; class 3A: showing extension of
gas or abscess to perirenal space, and class 3B: showing extension of gas or abscess to pararenal space; class 4: showing bilateral EPN or solitary kidney with EPN [1]. This classification offers a practical principle for the treatment planning of EPN.

The treatment of EPN depends on the patient’s clinical status but control of blood sugar, and relief of urinary tract obstruction, if present, are mandatory. In addition, there are different combinations of regimens for treating EPN among long term antibiotics, percutaneous drainage of abscess and gas, and surgical drainage or nephrectomy. Some EPNs were treated by antibiotics alone successfully [1,7,8] but the overall mortality rate of treating EPN by antibiotics alone could be as high as 40% cases [1]. Earlier literatures suggested the importance of early surgical drainage or nephrectomy [9,10,11]. According to the reports by Huang JJ et al, the role of PCD in the management of EPN has been more emphasized [1,4,5,12]. All the patients with class 1 and 2 of EPN who were treated with PCD or ureteral catheterization combined with antibiotics survived; in extensive EPN (class 3 and class 4), 85% of the patients with fewer than 2 risk factors (ie. thrombocytopenia, acute renal function impairment, disturbance of consciousness, or shock) was successfully treated using PCD combined with antibiotics; and the patients with 2 or more risk factors had a significantly high rate of treatment failure [1]. In our case, a class 3B EPN with one risk factor (shock) is associated with a similar outcome.

Large amount of perirenal urine leakage was noted in this case. It could be due to renal tissue destruction with damage of uriniferous tubule and renal capsule, which was evident by the rugged surface of the upper pole of the left kidney on CT. Percutaneous drainage itself is a satisfactory management for perirenal or periureteral urine collection [13] and does render a chance for tissue healing to occur. The treatment course (4 weeks) was not prolonged by concomitant perirenal urine leakage in this case in comparison with that of Chen MT et al. (mean duration 5.54 week) [4].

CONCLUSION

We should keep in mind the possibility of emphysematous pyelonephritis in case of urinary tract infection associated with DM or urinary tract obstruction and should always try to detect the abnormal renal or perirenal gas collection on abdominal plain films or renal sonograms. If non-response to initial treatment or presence of severe deterioration, CT scanning for kidneys is indicated. Antibiotics combined with PCD is a good treatment choice for the initial management of EPN, even if there is concomitant perirenal urine leakage. It facilitates healing of renal tissue to occur under proper conservative medical support. Surgical drainage or nephrectomy may play their roles if clinical outcome is not satisfactory under PCD and antibiotics therapy or in the presence of initial fulminate course of EPN.

REFERENCES

產氣性腎盂腎炎併發腎周圍尿液滲漏：病例報告

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產氣性腎盂腎炎是一種少見有致命危險的腎臟感染性疾病。主要發生在糖尿病或有泌尿道阻塞的病患，女性好發率大於男性，而左腎產氣性腎盂腎炎機會大於右腎。早期正確的診斷以及積極的治療是非常必要的措施，以挽救產氣性腎盂腎炎患者的生命。我們提出一個產氣性腎盂腎炎的病例，這是一位48歲的糖尿病患者，因發燒、畏寒、嘔心、休克住院。腹部X光片、超音波都確定了左腎產氣性腎盂腎炎的診斷，但於靜脈腹部電腦斷層掃描才能清楚顯示腎臟受損程度，以及侵犯腎周圍和腎旁組織的範圍。在積極控制血糖、長期抗生素使用及經皮腎周圍引流的治療下，患者恢復情況良好。期間雖併發左腎周圍尿液滲漏，但並未因此延長住院療程。我們回顧了產氣性腎盂腎炎的文獻並討論了相關的流行病學、病理發生過程、電腦斷層的分類及分期和不同的治療組合。長期抗生素治療併合經皮腎周圍引流，對於產氣性腎盂腎炎的治療，是一種治療率極高的治療組合；但是緊急腎臓切除術對於病情急速惡化者仍有其必要性。

關鍵詞：產氣性腎盂腎炎，電解斷層；腎周圍尿液滲漏，經皮腎引流術