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Case Report

Preoperative renal arterial embolization in high-risk nephrectomy: A case report of a 48-year-old patient with severe emphysematous pyelonephritis ☆

Haili Luo, BHSc, MD[a,*], *Eric Starra, BSc Hons., MBBS, MPH*[b], *Hin F. Chan, MBBS, FRACS (Urol)*[b], *Rowan R. Stephenson, BSc, MClinTRes, MBBS, FRANZCR*[a]

[a] *Department of Medical Imaging, The Canberra Hospital, Yamba Drive, Garran, ACT, Australia, 2606*
[b] *Department of Urology, The Canberra Hospital, Yamba Drive, Garran, ACT, Australia, 2606*

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ABSTRACT

A 48-year-old female with a background history of alcoholic liver cirrhosis and noninsulin-dependent diabetes presented to our institution with emphysematous pyelonephritis of the right kidney diagnosed on CT. Both urine and blood culture grew multidrug-resistant Escherichia coli. The patient developed severe thrombocytopenia, hyponatremia, confusion as well as septic shock. Preoperative right renal arterial embolization was performed, followed by immediate primary nephrectomy. This article reports the first documented case of preoperative angioembolization to prevent severe intraoperative hemorrhage and vascular complications in severe emphysematous pyelonephritis.

Introduction

Emphysematous pyelonephritis (EPN), initially described by Kelly and MacCallum in 1898 [1], represents a gas-forming, rapidly progressing and necrotizing form of pyelonephritis, with mortality rates ranging from 11% to 42% [2]. Over the subsequent century, primary nephrectomy has become the mainstay of therapy for severe cases [2].

CT is regarded as the gold standard for the initial diagnosis of EPN, with its accuracy approaching 100% [3]. To date, 2 radiological classification systems have been proposed to categorize CT findings (Table 1): the Wan classification system, which differentiates between Type I (severe) and Type II (mild) by the extent of gaseous destruction to the renal parenchyma and presence of residual fluid [4]; and The Huang-Tseng classification system, which stratifies the emphysematous pyelitis-pyelonephritis continuum based on radiographic

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* Corresponding author.
E-mail address: kvw3835@gmail.com (H. Luo).

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Table 1 – The Huang-Tseng system and the Wan system [4,5].

Huang-Tseng Classification System (2000)			Wan Classification System (1996)	
Classification	Radiological findings	Management	Classification	Radiological findings
1	CT shows gas within the collecting system only; Also known as emphysematous pyelitis.	Antibiotic therapy combined with nephrostomy drainage or ureteric stenting (minimally invasive therapy)	II (mild)	Gas in the renal parenchyma (bubbled or loculated) or collecting system; renal or perirenal abscess may also be present.
2	CT shows emphysematous changes restricted to the renal parenchyma.			
3A	CT shows gas or abscess extending to the perirenal space	Consider primary nephrectomy if ≥2 risk factors	I (severe)	Parenchymal destruction with either an absence of fluid collection or the presence of streaky or mottled gas. May be further subclassified based on gas extension (local = within renal fascia; advanced = outside of renal fascia or bilateral EPN). Furthermore, the parenchymal destruction may be subclassified as limited (<1/3 renal volume) or extensive (>1/3 renal volume).
3B	CT shows gas or abscess extending to the pararenal space	(thrombocytopenia, acute renal failure, altered consciousness, or shock); or salvage nephrectomy if		
4	solitary kidney with EPN or bilateral EPN			

The Wan Class II is largely comparable to the Huang-Tseng Class 1 and 2. However, it includes a small subset of Huang-Tseng Class 3A where the gas is confined to the renal parenchyma but the abscess has extended to the perirenal space. Similarly, the Wan Class I is mostly comparable to the Huang-Tseng Class 3A, 3B, and 4. However, it excludes small subsets of Huang-Tseng Class 3A and 3B where the abscess is present in the perirenal or pararenal space.

evidence of the extent of gaseous necrosis, aiming to predict clinical outcomes by identifying risk factors [5]. In mild cases, antibiotic therapy combined with nephrostomy drainage or ureteric stenting has proven effective. In severe cases with more than 2 risk factors (thrombocytopenia, acute renal failure, altered consciousness, and shock), primary nephrectomy may be necessary [5].

Herein we present, to the best of our knowledge, the first published case report of preoperative renal arterial angioembolization to facilitate an immediate primary nephrectomy for a patient with emphysematous pyelonephritis related sepsis and cirrhosis related coagulopathy.

Case report

A 48-year-old female presented with a 3-day history of right flank pain, dysuria, and fatigue despite an empirical course of oral antibiotics for presumed uncomplicated urinary traction infection prescribed by a general practitioner. The patient presented in septic shock with hypotension, tachycardia, acute kidney injury, hyponatremia, and thrombocytopenia. Additionally, she was found to be in a hyperosmolar hyperglycemic state and demonstrated increasing confusion. Despite empirical intravenous antibiotics, she developed cardio-respiratory failure, requiring intubation and vasopressor support in the ICU. Blood cultures were positive for multidrug-resistant Escherichia coli and antibiotic coverage was upgraded to IV meropenem (see Table 2 for a list of admission observations and blood test results).

The patient had a background history of newly diagnosed cirrhosis secondary to alcoholic liver disease, requiring hospitalization 2 months prior for worsening abdominal ascites.

Table 2 – A list of admission observations and blood test results.

Observations		Normal, high or low (N/H/L)
Respiratory rate	33/min	H
Heart rate	128/min	H
Blood pressure	66/46	L
Temperature	36.6C^0	N
Blood test results		
Haemoglobin count	98g/L	L
White cell count	15.9×10^9/L	H
Platelet count	33×10^9/L	L
INR	1.9	H
Creatinine	271μmol/L	H
Sodium level	117mmol/L	L
Glucose level	47.7mmol/L	H
Calculated osmolality	325 mOsm/kg	H

During that admission, there were incidental findings of high serum HbA1c of 7.0% (53mmol/mol), and urinary retention of 750ml postvoid residual volume, as well as bilateral hydronephrosis on abdominal ultrasound scan. She was discharged with indwelling urinary catheter and her urinary retention resolved 2 weeks postdischarge, with an acceptable postvoid residual volume of 170ml.

A portal venous phase CT of the abdomen and pelvis (Fig. 1) revealed extensive emphysema involving the entirety of the right renal parenchyma and extensive perinephric inflammatory change, consistent with emphysematous pyelonephritis (Wan Type I). There were associated reactive inflammatory changes involving the gallbladder and adjacent hepatic flex-

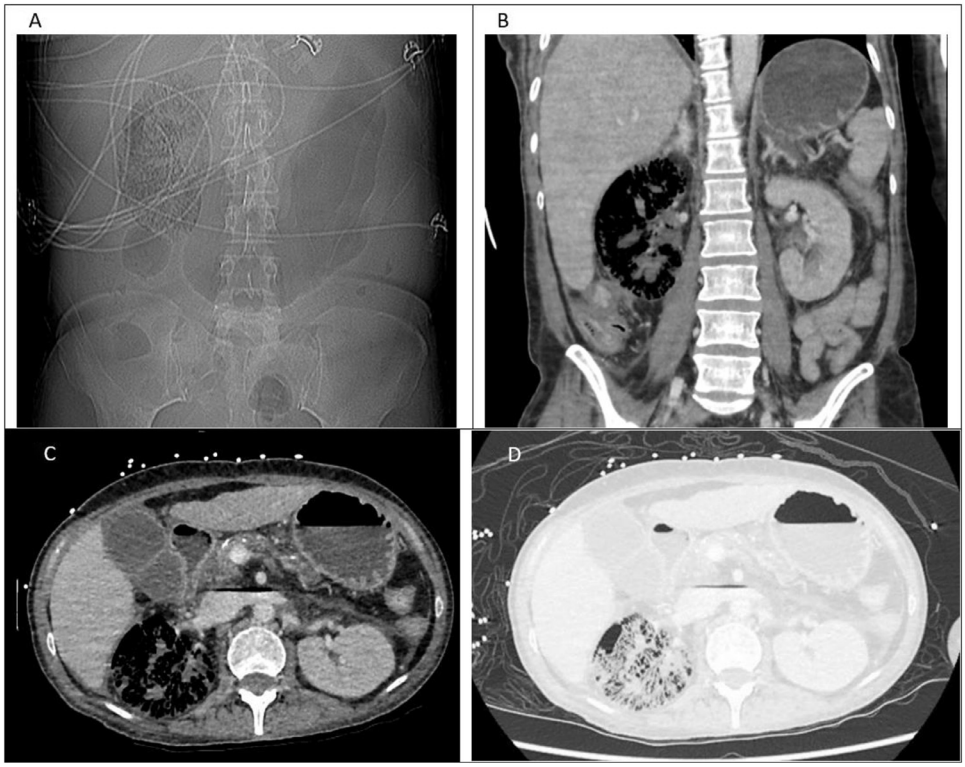

Fig. 1 – (A) PA prescan Xray showing mottled emphysematous change to the right kidney. (B) supine coronal CT showing almost complete gaseous replacement of the right renal parenchyma. (C) supine axial CT showing almost complete gaseous replacement of the right renal parenchyma, with air-fluid level in the left renal vein to the inferior vena cava. (D) same slice in C, with mottling and streaking emphysematous changes highlighted in lung window.

ure. Free gas was present within the inferior vena cava, the left renal vein, and the urinary bladder. The left kidney was normal in appearance.

Despite aggressive resuscitation and cardiopulmonary support, the patient's hemodynamic status continued to rapidly deteriorate and a decision to perform a right sided nephrectomy was made. Due to the intense inflammatory changes of the renal parenchyma on imaging, along with her severe coagulopathy, preoperative right renal arterial embolization was performed in an attempt to reduce the risk of intraoperative hemorrhage.

The right femoral artery was accessed in a retrograde fashion using a micro access kit (Merit Medical Systems, South Jordan, Utah). This was subsequently upsized to a 5 French Avanti+ sheath (Cordis Cashel, Cashel, Co Tipperary, Ireland). The right renal artery was cannulated with a 4 French Bern catheter (Merit Medical Systems, South Jordan, Utah) and embolized to the mid-point of the artery with 2 6mm x 170mm Azur CX 0.35 coils (Microvention Inc, Tustin, California) (Fig. 2). Postembolization hemostasis was accomplished with a 6 French Angioseal closure device (Terumo Medical Corporation, Somerset, New Jersey).

The patient then underwent open nephrectomy in a transperitoneal approach for optimal access to the right kidney. A right subcostal incision was made and extended 3cm left of midline. Upon entering the peritoneal space, 700ml of clear serous ascitic fluid was aspirated, and a heavily cirrhotic liver with a grossly dilated gallbladder was observed. The right colon was mobilized medially, and the duodenum was mobilized using the Kocher manoeuvre. The hilum was meticulously dissected. The renal vein was found to be friable proximally towards the caval confluence and very adherent distally, risking avulsion and/or caval tear with any attempt to retract the main renal vein to expose the main renal artery. Since the renal artery had been embolized preoperatively, the surgical team proceeded directly to renal vein ligation and division, thereby exposing the main renal artery for additional ligation and division. The right kidney was dissected away from its lateral and superior attachments, with the entire renal parenchyma noted to be replaced by pus. Estimated intraoperative blood loss was minimal. Postoperative recovery was complicated by the development of an infected renal bed hematoma requiring percutaneous drain insertion and extended intravenous antibiotic treatment. The patient was discharged after 9 weeks of hospitalization with resolution of the retroperitoneal hematoma 3 weeks postdischarge.

Discussion

Our case report highlights the inadequacy of the Huang-Tseng classification system, which relies solely on the assessment of gas extension into the kidney and its surrounding tissues. Despite a lack of radiological evidence of emphysematous extension through the renal capsule, the gas instead extended

Fig. 2 – Two images from angiography of the right kidney. (A) initial angiogram showing the right kidney, with much reduced vascular perfusion. (B) angiogram after coiling showing a complete obstruction of arterial flow, confirming embolization.

into the inferior vena cava and left renal vein, as well as the urinary bladder. Additionally, inflammatory changes to adjacent organs, including the gallbladder and ascending colon, were evident both on CT and during laparotomy. These factors are not accounted for by the Huang-Tseng system and would therefore result in an inadequate account of the disease extent and severity. Concurrently, the Wan system offers little guidance on the direction of care, despite correctly assessing the high severity of the EPN (Type I) by the complete replacement of renal parenchyma with gaseous emphysema.

Preoperative renal arterial embolization proved very beneficial in this case because it allowed for safer hilar vessel division and ligation, thereby preventing major vascular complications and blood loss. If the renal artery needed to be ligated first, as in a standard nephrectomy, there would have been a high risk of renal vein avulsion or IVC injuries. Ligation of the renal vein was difficult due to tissue friability and limited healthy tissue available for additional ligatures. In addition, damage to the IVC would have been extremely challenging to repair.

The decision for open nephrectomy was primarily based on the patient's rapid clinical deterioration and the presence of multiple mortality-associated risk factors, which made minimally invasive procedures such as nephrostomy inappropriate. In this case, the patient's recent presentation of lower urinary tract obstruction and hyperglycemic status already predisposed her to severe EPN. Furthermore, her clinical presentation of sepsis, thrombocytopenia, and hyponatremia with rapid progression to septic shock, as evidenced by confusion and hypotension were all high mortality risk factors suggested by Desai and Batura [3], in their meta-analysis of 1146 patients from 37 studies. Additionally, confusion and hyponatremia each were associated with a sevenfold increase in mortality.

Currently, there are no standardized guidelines on the management of thrombocytopenia for primary nephrectomy in EPN, which carries a 2.3-fold increase in mortality risk [3]. With an initial platelet count of 33×10^9/L, our patient was at high risk of intraoperative bleed, and a 4.6-fold risk of death [3,6]. The presence of liver cirrhosis also predisposed our patient to a 30-day postoperative mortality rate of up to 24% [7]. We therefore referenced the European Association of Urology guideline on urological trauma 2023, which recommends angioembolization in patients who remain haemodynamically unstable after primary resuscitation, especially for those with ongoing coagulopathy [8]. Angioembolization successfully prevented intraoperative mortality from ligation failure resulting from the friability of tissue. However, it did not prevent the formation of postoperative hematoma and its recurrent infection by E. coli, due to ongoing coagulopathy from overwhelming sepsis and chronic liver disease.

In conclusion, our case report demonstrates the use of preoperative angioembolization as a viable management option to reduce the risk of major vascular complications and blood loss in high-risk nephrectomy cases associated with friable renal vasculature.

Patient consent

Informed and written consent was obtained from the patient for the purposes of publication of this case report. The patient signed the appropriate consent statement according to the lo-

cal health authority guidelines. This document has been retained by the department and can be provided on request.

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