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Undetectable renal stone on computed tomography

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ABSTRACT

Noncontrast computed tomography(CT) is commonly recommended for the diagnosis of suspected renal stones. In this paper, we present a case of a renal stone that cannot be detected by CT. The stone was made of n-butyl α-cyanoacrylate, a kind of surgical adhesives commonly used in partial nephrotomy.

1. Introduction

Kidney stone imaging is a crucial diagnostic tool during the initial step in deciding the type of therapeutic option to use for managing kidney stones. In patients with kidney stones, CT imaging is most often used as it offers high sensitivity and high specificity assisting surgical decision making. The sensitivity of CT for detecting kidney stones is estimated to be 95 % which is the highest among all modalities studied.[1]

In this study, we describe a case with renal stone in whom the CT failed to identify the stone. However, the stone could be clearly detected by the ultrasound imaging. The renal stone was composed of n-butyl α-cyanoacrylate which is a type of surgical adhesives. The imaging characteristics and composition of this renal stone present a novel case study that is of considerable referential importance for long-term care of patients who have history of kidney surgery and use of cyanoacrylates adhesives.

2. Case history/examination

A 59-year-old male presented with frequent and urgent urination with pain for 10 years. The patient was diagnosed with horseshoe kidneys and underwent right partial nephrectomy for renal carcinoma in November 2010 in another institute.

3. Methods(Investigation and treatment)

A physical examination and complete blood test were conducted with normal results. Presence of leucocytes and bacteria was notable in urinalysis. A urine culture grew *Enterococcus faecalis*. Non-contrast-enhanced CT scan of the abdomen only revealed a 7 mm stone in lower pole region of right kidney with mild residual dilation of the right pelvicalyceal system (Fig. 1). However, ultrasonography showed a diameter of 23 mm hyperechogenic area with acoustic shadowing in the upper pole region of the right kidney (Fig. 2).

The decision was made with the patient to perform RIRS as CT showed a stone size that was relatively small. The patient was treated with antibiotics selected based on culture sensitivity results for 7 days prior to the surgery. During RIRS, we found the stone was much larger than what the CT showed preoperatively. The stone located in the upper pole and lower pole under endoscopic view was estimated to be greater than 20 mm. Considering the stone burden was large and the urine in collecting system was relatively cloudy, we ended the procedure after breaking a part of stones and placing a double-J stent.

Two weeks after the RIRS, the patient was taken up for right PCNL under general anesthesia. Under ultrasonic guidance, a right upper calyceal puncture was made and dilated to up to 18 Fr.

Under nephroscopy, 23 × 15 mm branched stones in the upper and lower calyces were seen. The stone was of higher density, dark brown in color, and appeared to be a common calcium oxalate stone (Fig. 3). Stone fragmentation was accomplished using pneumatic lithotripter. Complete clearance was documented fluoroscopically. A double-J stent and a 16 Fr nephrostomy tube were placed. The stone was later sent to a lab for composition analysis.

There was no significant bleeding during the procedure and no

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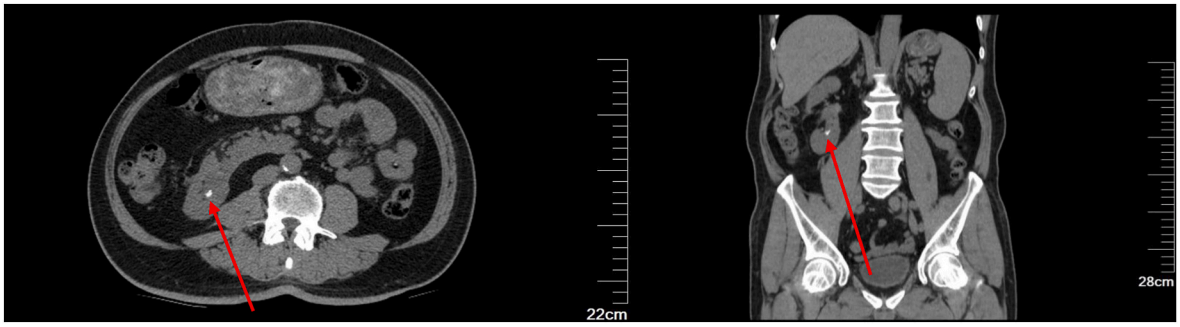

Fig. 1. Axial and coronal sections of non-contrast CT scan only showing a 7 mm stone in the right lower calyx.

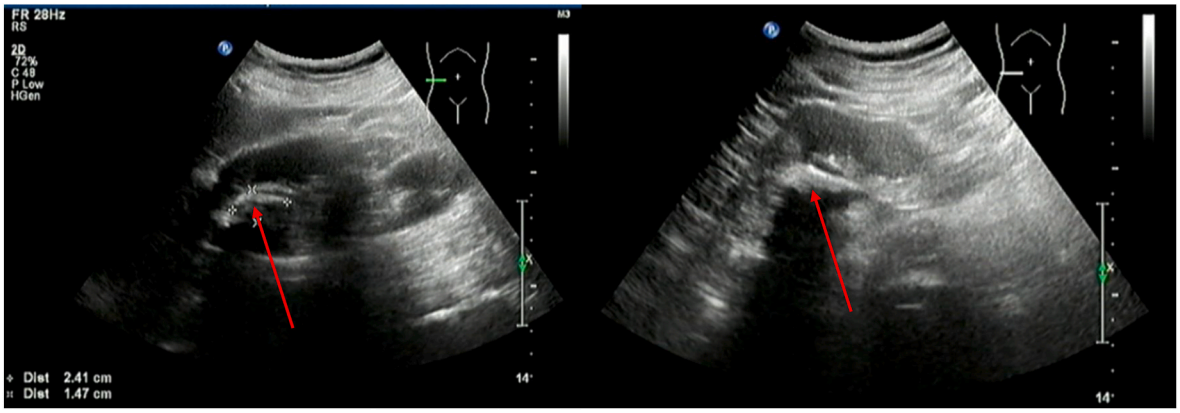

Fig. 2. Ultrasound showing a diameter of 23 mm hyperechogenic areas with acoustic shadowing in the right upper calyx.

Fig. 3. Photo shows the stone taken by PCNL.

intraoperative nor postoperative complications. Two days after surgery, the nephrostomy tube was removed. The patient was then discharged from the hospital within 3 days post-operation completely free of stones.

4. Conclusion and Results(Outcome and follow-up)

Stone analysis was conducted using the infrared spectroscopy technique. The stone composition was n-butyl α-cyanoacrylate which was a type of surgical adhesives (Fig. 4). We contacted the hospital where the patient underwent right partial nephrectomy in 2010. They confirmed a surgical glue containing n-butyl α-cyanoacrylate was applied to the resection stumps as hemostasis after partial nephrectomy.

At 3 months following PCNL, the patient did not experience further complications or episodes of lithiasis. Urine culture was performed twice, and results were negative. The patient is still being closely followed and monitored, and future events will be noted.

5. Discussion

Stone formation around suture materials or non-absorbable clips inside the collecting system has been previously reported.[2,3] However, no report was found regarding the possibility of stone formation due to surgical adhesives applied. In this study, we present an unusual case of renal stone associated with surgical glue containing n-butyl α-cyanoacrylate applied. The stone composition and imaging features has not been previously reported in the literature. Our case showed that PCNL technique can be considered in which repeat open surgery can be very challenging and can increase morbidity.

The EAU[4] and AUA[5] guidelines have recommended noncontrast CT for the diagnosis of suspected renal stones. CT scan portraits renal stones with higher accuracy comparing to plain radiography, sonography, nephrotomography, and excretory urography.[6] In this case, preoperative CT failed to accurately evaluate the stone burden that led us to select RIRS for managing renal stone initially. In contrast, ultrasound is more accurate to detect this renal stone. The possible cause is that the CT scan is unable to differentiate the n-butyl α-cyanoacrylate component from renal tissue while the dense material of normal kidney stone only

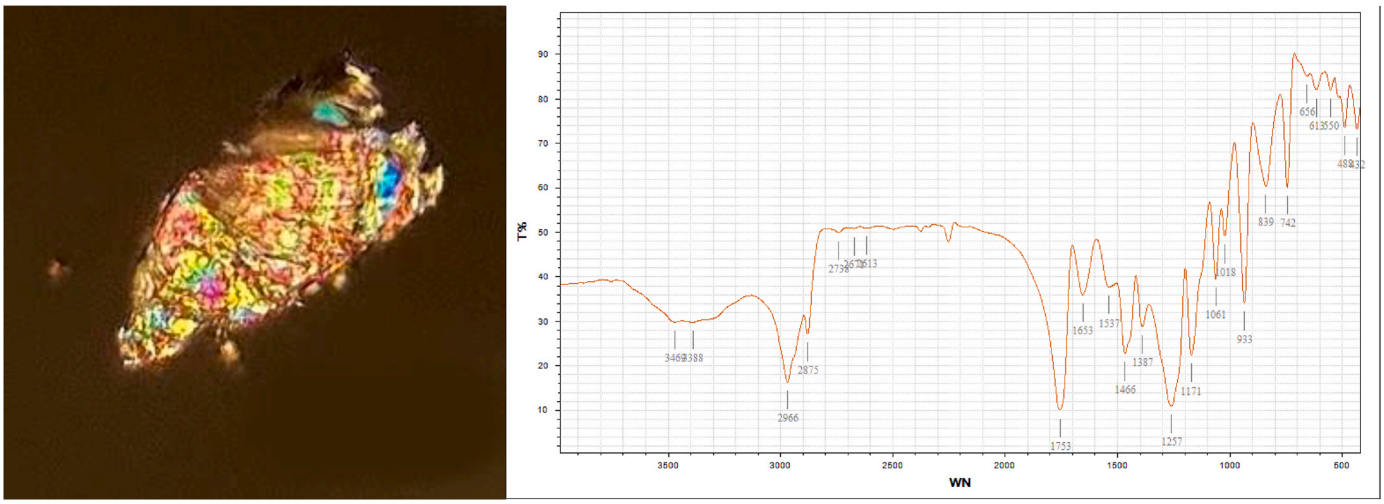

Fig. 4. Stone components were isolated as n-butyl α-cyanoacrylate with polarizing microscope and Fourier-transform infrared spectroscopy analysis.

accounts for a smaller proportion. Unfortunatley the latter part either was lost during surgery or too little for composition analysis.[7] Our results suggested that patients with nephrolithiasis should not undergo only CT imaging. Additionally, ultrasonic imaging is equally important and should be used as part the initial diagnostic imaging test. If the results from CT and ultrasound differ from one and another, an urography should be performed to further facilitate diagnosis.

Little is known regarding the pathophysiology of renal stones in patients using surgical glue containing n-butyl α-cyanoacrylate. Due to prolonged contact time with urine, the non-absorbable glue may act as a nidus in which crystallization, calcification or stone formation can occur. Such material could also act as a reservoir for chronic infection. The proposed mechanism of non-absorbable glue migration is that the glue was placed near the closed parenchymal defect, which might have contributed to its subsequent migration into the pelvicalyceal system, especially if the pelvicalyceal system was opened during excision of the mass. Overall, despite lack of substantial reporting of renal stones associated with surgical adhesives, the formation mechanism of these renal stones has yet to be thoroughly studied.

To conclude, surgical glue containing n-butyl α-cyanoacrylate may erode into the collecting system and promote renal stone formation. These stones formed as a result of the surgical glue cannot be detected by CT scans, but can be observed clearly on ultrasound imaging. The non-absorbed surgical glue containing n-butyl α-cyanoacrylate should be used as sparingly as possible during renal surgeries. Patients with this type of surgical glues applied should be more closely monitored for longer periods of time for potential lithiasis formation.

CRediT authorship contribution statement

Guanghan Zhang: Data curation, Writing – original draft. **Zhicong Huang:** Visualization. **Shaoying Li:** Methodology, Resources. **Guohua Zeng:** Methodology, Resources. **Wei Zhu:** Writing – original draft, Writing – review & editing.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the First Affiliated Hospital of Guangzhou Medical University, and the patient's informed written consent was obtained for publication of this manuscript and any accompanying images.

Consent for publication

Written informed consent was obtained from the patient for the publication of this manuscript and any accompanying images.

Availability of data and materials

All data and materials generated or analyzed during this study are included in this published article.

Competing interests

None.

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Declaration of competing interest

None.

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Abbreviations

CT	computed tomography; RIRS: retrograde intrarenal surgery
PCNL	percutaneous nephrolithotomy; EAU: European Association of Urology
AUA	American Urological Association

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