CASE REPORT

Spontaneous renal calyceal and ureteric rupture secondary to intravenous contrast during computed tomography intravenous pyelogram

Tatenda Calvin Nzenza,¹ Derek Barry Hennessey,² Tim Dunshea,³ Nathan Lawrentschuk⁴

¹Department of Urology, Eastern Health, Melbourne, Victoria, Australia

²Department of Urology, Craigavon Area Hospital, Portadown, UK

³Department of Radiology, Warringal Private Hospital, Heidelberg, Victoria, Australia

⁴Department of Surgery, Austin Health, Melbourne, Victoria, Australia

Correspondence to

Dr Tatenda Calvin Nzenza, calvintatenda@gmail.com

Accepted 14 September 2016

SUMMARY

Upper urinary tract rupture in the absence of trauma is typically related to ureteric calculi causing obstructive nephropathy. Spontaneous extravasation of contrast during CT intravenous pyelography (CT IVP) is infrequently reported. Two cases, who underwent CT IVP to further investigate positive urine cytology and microscopic haematuria, respectively, are described here. In both cases, there was spontaneous extravasation of contrast seen in the postcontrast scans in the absence of ureteric calculi or hydronephrosis which is very unusual.

BACKGROUND

Upper urinary tract rupture during intravenous pyelography resulting in extravasation of contrast from the pelvicalyceal system and ureter is rarely described.^{1 2} The majority of cases in the literature of spontaneous renal calyceal rupture or ureteric rupture in the absence of trauma are related to ureteric calculi and other uncommon aetiologies such as malignancy, pregnancy, posterior urethral valves, uretopelvic malformations with bladder ureteral reflux and pelvic-ureteric junction obstruction.^{3–6} Following written consent from both patients, we present two cases of spontaneous extravasation of contrast during CT IVP in which no cause of obstruction was found.

CASE PRESENTATION

Case 1

A 67-year-old man with a history of previous left nephroureterectomy for upper tract transitional cell carcinoma was found on follow-up to have suspicious cells for malignancy in their urine cytology. He had no flank pain and denied any obstructive urinary symptoms. There was no history of trauma. Examination was unremarkable. A flexible cystoscopy showed no lesions in the bladder. He then underwent a CT IVP to further investigate this. A multiphase CT IVP study was performed with 100 mL of intravenous contrast (Isovue). Precontrast scans showed fairly uniform contour of the ureter, with minor irregularity only in the middle third and no non-contrast evidence of a mass. In the postcontrast scans, there was marked contour irregularity, mild irregular wall thickening and extravasation of contrast (without a large urine collection) involving the proximal two-thirds of the right ureter over a length of 14 cm from the level of the pelvic ureteric junction (PUJ) to the level of

the S1 sacral segment (figure 1). There was mild prominence of the right pelvicalyceal system in keeping with a low-grade obstruction but no filling defects within the calyces and no lesion in the renal parenchyma. There was no distal ureteric or bladder lesion. It is important to note that he had not had prior instrumentation of the right collecting system, and thus the above findings were not considered iatrogenic.

He subsequently underwent a rigid cystoscopy, retrograde pyelogram (RGP) and flexible ureterorenoscopy 14 days later. Cystoscopy only demonstrated some very minor inflammatory changes adjacent to the left ureteric orifice. This was biopsied and showed cystitis only. The right orifice was normal. The RGP was normal with no filling defects. His renal function remained stable before and after the ureteric rupture with an estimated glomerular filtration rate of 70 mL/min/1.73 m² and 69 mL/min/1.73 m² before and after the CT IVP, respectively. A repeat CT IVP was performed 6 months later which showed normal appearance of the right ureter and kidney with no extravasation of contrast.

Case 2

A 66-year-old woman was referred for the investigation of persistent microscopic haematuria. She also reported of lower urinary tract symptoms related to overactive bladder and stress incontinence. She had previous abdominal hysterectomy and sacrocolpopexy repair for vault prolapse repair 10 years prior. She did not have any flank pain and denied any obstructive urinary symptoms. She had no risk factors of transitional cell carcinoma (TCC) such as smoking and occupational chemical exposure. There was no history of trauma. Abdominal examination was normal, but genital examination revealed a narrow introitus with a very minor cystocele. Urine microscopy and culture showed no growth, and urine cytology was negative for malignancy. She thus underwent a CT IVP to further investigate the cause of her microscopic haematuria.

CT IVP enhanced with 100 mL of Isovue was performed. Precontrast scans through the renal tracts were followed by postcontrast arterial phase scans through the kidneys and delayed scans through the renal tracts. Precontrast images showed no abnormality, however, after administration of contrast, extravasation from a ruptured minor calyx

CrossMark

To cite: Nzenza TC, Hennessey DB, Dunshea T, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2016-216275

Figure 1 (A) Delayed phase image illustrating ureteric rupture postcontrast during CT IVP in a 67-year-old man. The delayed phase image shows marked contour irregularity, mild irregular wall thickening and extravasation of contrast (without a large urine collection) involving the proximal two-thirds of the right ureter over a length of 14 cm from the level of the PUJ to the level of the S1 sacral segment. (B) Normal RGP 14 days later with no evidence of contrast extravasation. (C) Delayed phase image 6 months later showing normal appearance of the right ureter with no extravasation of contrast. CT IVP, CT intravenous pyelography; RGP, retrograde pyelogram.

Figure 2 (A) Arterial phase scan during CT IVP in a 66-year-old woman. (B) Delayed phase images illustrating calyceal rupture postcontrast. Contrast extravasated from a ruptured minor calyx in the upper pole of the left kidney on delayed scans. CT IVP, CT intravenous pyelography.

in the upper pole of the left kidney on delayed scans was seen (figure 2). No underlying cause was found, in particular there was no evidence of renal calculus or other cause of obstruction nor was there evidence of local inflammation or a urinoma to suggest that this could have been a chronic process. She went on to have a flexible cystoscopy 13 days later to further investigate the microscopic haematuria which was normal. No ureterorenoscopy was performed in this case. Her renal function remained stable at an estimated glomerular filtration rate of 68 mL/min/1.73 m². Both cases were managed conservatively, and this was in keeping with the European Association of Urology (EAU) and American Urological Association (AUA) guidelines.

DISCUSSION

Extravasation of urine from the collecting system in the absence of trauma or obstruction is rare.⁶ In 1952, Orkin⁵ was the first to describe non-traumatic rupture of the ureter, since then several cases have been reported. The majority of which have been associated with ureteric obstruction; 50% have involved ureteric calculi. Other less common aetiologies have been reported to cause extravasation of urine; these include pelvic and retroperitoneal malignancies, ureteric reflux, posterior urethral valves, pregnancy and pelvic-ureteric junction obstruction.^{3–6} In 1930, Fuchs *et al* first reported a case of extravasation of contrast during intravenous pyelography and since then more cases have been described particularly during emergency intravenous pyelography in the setting of renal colic.² These

cases usually describe a history of loin pain, nausea, vomiting and associated hydronephrosis.⁷⁻⁹ However, these features were not present in the above cases, but in case 1, there was mild prominence of the right pelvicalyceal system in keeping with low-grade obstruction. Nevertheless, repeat imaging and ureteroscopy showed no evidence of this obstruction. Yet, this temporary prominence of the right ureter may have caused a partial obstruction that may have added to an increase in intrarenal pressure.

A possible explanation to the extravasation of urine seen in these two cases could be a sudden rise in intrapelvic pressure as a result of contrast-induced rapid diuresis. In both cases, the CT protocol did not include the use of furosemide and both patients had not been instructed to drink large amounts of fluid prior which could have added to this effect. According to Laplace law, the intraluminal pressure is related to the tension and tubular diameter [pressure=(tension×wall thickness)/radius]. In the ureter, for example, it is able to a point to compensate for dilation with increased contractile tension similar to the Starling's length-tension curve for the heart. Thus, a sudden increase in pressure exceeding the tensile strength can lead to rupture of the calyx and extravasation of urine, resulting in a phenomenon that is potentially renoprotective by reducing the pressure in the collecting system. Thompson *et al* in 1983 demonstrated in urinary manometric studies that hydrostatic pressures above 150 cm of water in the renal collecting system is the threshold required to cause rupture.⁸ We do acknowledge that sudden high pressures might dilate the pelvicalyceal system, however, no evidence of hydronephrosis was present in our two cases, although there was mild prominence of the right pelvicalyceal system plus mild ureteric wall thickening in keeping with low-grade obstruction seen in case 1. There is also the chance of a missed calculus, but there was no evidence to suggest a passed stone and also no history of loin pain in both cases. Given this, we could also suggest that the rupture could have been through an area of weakness in one of the calyces that could not withstand the sudden pressure increase from the contrast-induced rapid diuresis.

In conclusion, spontaneous rupture of renal calyces secondary to contrast during CT intravenous pyelogram is very rare. Ureteric rupture as seen in case 1 is even rarer. In most cases described in the literature, it is usually in the setting of a calculus or an underlying obstructive cause is found. We present two very unique cases in which no evidence of obstruction was

found and nothing in the history or presentation to suggest the presence of a calculus or trauma.

Learning points

- ▶ Spontaneous rupture of renal calyces secondary to contrast during CT intravenous pyelogram is very rare.
- ▶ In most cases described in the literature, it is usually in the setting of a calculus, or an underlying obstructive cause is found.

Acknowledgements The authors thank Mr Peter Liodakis and Dr Jos Jayarajan for their support.

Contributors All authors involved in analysing the cases and explaining the results of the two cases. Contributions from all listed authors in writing up the cases include analysing the CT images. NL and TCN contributed to project design. TCN, TD and NL involved in data collection. TCN, TD and DBH involved in drafting the article. NL, TCN and DBH involved in critical revision of the manuscript. TCN, DBH, TD and NL provided final approval of the version to be published. TCN and DBH are guarantors.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Ashebu S, Elshebiny Y, Dahniya M. Spontaneous rupture of the renal pelvis. *Australas Radiol* 2000;44:125-7.
- 2 Hale J, Whitehouse G. Spontaneous extravasation of urine during emergency intravenous pyelography. *Br J Surg* 1970;57:302-6.
- 3 Upputalla R, Moore RM, Jim B. Spontaneous fornical rupture in pregnancy. *Case Rep Nephrol* 2015;2015:379061, 3 p.
- 4 Chen C-K, Su Y-J, Lai Y-C. Non-traumatic ureteral rupture despite initial normal appearance assessed by computed tomography. *Int J Gerontol* 2009;3:85-7.
- 5 Orkin LA. Spontaneous or nontraumatic extravasation from the ureter. *J Urol* 1952;67:272-83.
- 6 Gershman B, Kulkarni N, Sahani DV, *et al*. Causes of renal fornical rupture. *BJU Int* 2011;108:1909-11.
- 7 Bae W, Kim S, Choi Y, *et al*. Iatrogenic calyceal rupture in patient with unrecognized vesicoureteral reflux. *Urol J* 2014;11:1359-61.
- 8 Jan A, Qadir A, Zaman Q, *et al*. Spontaneous rupture of the renal system and caliceal system. *J Postgrad Med Inst* 1991;5(1):92-6.
- 9 Newman CE, Dawson-Edwards P, Howarth FH. Spontaneous rupture of the ureter. *Br J Surg* 1974;61:458-60.

Copyright 2016 BMJ Publishing Group. All rights reserved. For permission to reuse any of this content visit

<http://group.bmj.com/group/rights-licensing/permissions>.

BMJ Case Report Fellows may re-use this article for personal use and teaching without any further permission.

Become a Fellow of BMJ Case Reports today and you can:

- ▶ Submit as many cases as you like
- ▶ Enjoy fast sympathetic peer review and rapid publication of accepted articles
- ▶ Access all the published articles
- ▶ Re-use any of the published material for personal use and teaching without further permission

For information on Institutional Fellowships contact consortiasales@bmjgroup.com

Visit casereports.bmj.com for more articles like this and to become a Fellow