Eur. J. Anat. 20 (3): 227 - 230 (2016)

Congenital contralateral venous drainage of a right ectopic kidney to left common iliac vein: a rare case report

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SUMMARY

Arterial renovascular variation is common. However, specific reports of variations in renal venous drainage are limited. We report a case of a rare renovascular anatomical variant incidentally identified via abdominal computed tomography (CT). The right kidney was anteriorly rotated and low lying (iliac). The arterial supply entered the hilum of the kidney from two branches, specifically, from the abdominal aorta at L3/L4 and at the bifurcation of the aorta. Venous drainage was similarly variant with the superior pole draining into the inferior vena cava (IVC) at L3/L4. The inferior pole drained to the contralateral (left) common iliac vein coursing anteriorly to the right common iliac vein. To our knowledge, this particular venous variation has not been previously documented. This case is discussed in relation to renovascular embryology and clinical relevance for specialists operating within the retroperitoneum.

Key words: Renal circulation – Congenital abnormalities – Anatomy – Arteriovenous malformations

INTRODUCTION

Ectopic or pelvic kidneys are uncommon, occurring in one in every 2,200 - 3,000 people (Cinmanet al., 2007). In such cases, the kidney is located below the anatomically typical position, usually due to incomplete degeneration of embryological vascular branches following maturation. Renovascular variations associated with ectopic kidney development are highly variable, with many variations previously described via anatomical dissection being more commonly encountered with increased use of cross-sectional imaging in diagnostics (Bordeiet al., 2004; Dretleret al., 1971; Khamanarongetal., 2004; Kimet al., 2013). We report a rare, previously undocumented anatomical variation of an ectopic right kidney with an inferior right renal vein draining into the contralateral common iliac vein. The informed consent of the patient in question has been obtained.

CASE REPORT

A previously well 49-year-old Anglo-Australian man presented to the Emergency Department with renal colic, describing sudden-onset pain, localized to the right iliac fossa, constant and non-remittent for four hours with nausea and vomiting. Significant results from laboratory investigations included serum leukocytosis (14.3 x 10^9/L), neutrophilia

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Submitted: 4 April, 2016. *Accepted:* 24 May, 2016.

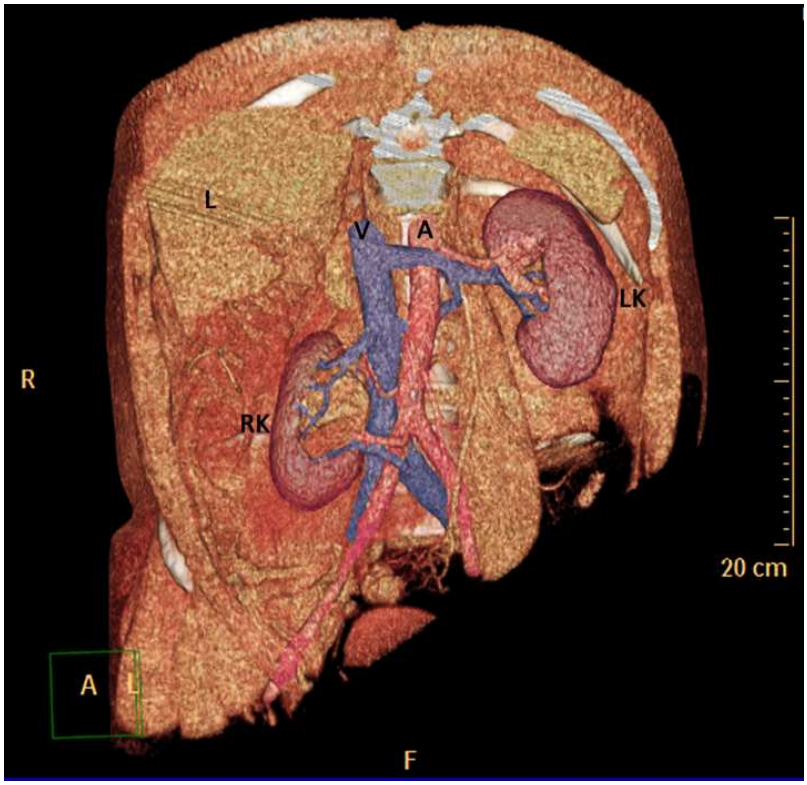

Fig. 1. Digital reconstruction with artistic representation of a computed tomography scan of the abdomen acquired in the portal venous phase. The right kidney appears anteriorly rotated and low lying (iliac) with arterial supply (red) provided by two branches, specifically, from the abdominal aorta at L3/L4 and at the bifurcation of the aorta. Venous drainage (blue) demonstrated branches from the superior pole draining into the inferior vena cava at L3/L4 and inferior pole draining to the contralateral (left) common iliac vein coursing anteriorly to the right common iliac vein. A=Aorta, L=Liver, LK=Left Kidney, RK= Right Kidney, V=Vena Cava.

(12.86 x 10^9/L), elevated creatinine (125 µmol/L) and estimated glomerular filtration rate of 58 ml/min, indicating acute kidney impairment. Following Computed Tomography (CT) of the abdomen with intravenous contrast and portal venous phase, performed using a Phillips Brilliance 64-slice CT Scanner, various renovascular anomalies were noted (Fig. 1).

The right kidney was anteriorly rotated and low-lying within the abdominopelvic cavity. The venous drainage was dual, with the inferior pole drained to the contralateral (left) common iliac vein coursing anteriorly to the right common iliac vein. The superior pole drained into the inferior vena cava (IVC) directly at L3/L4. The arterial supply entered the hilum of the kidney from two branches, specifically, from the abdominal aorta at L3/L4 and at the bifurcation of the aorta. Furthermore, and in relation to clinical scenario, a right 6mm mid-ureteric calculus with associated moderate hydroureter and hydronephrosis was identified, as well as right perinephric stranding. The left kidney was located in the usual position and appeared within normal limits.

Clinically, a diagnosis of obstructive nephropathy with associated pyelonephritis secondary to a 4mm distal right ureteric calculus situated approximately 15 mm proximal to the right vesico-ureteric junction was made.

DISCUSSION

Renal venous variants, which are more commonly right sided, are reported less than arterial variants, which are well documented (Bordei et al., 2004; Dretler et al., 2004; Kim et al., 2013). Following genesis in the pelvis, the metanephros and ureteric bud ascend from the beginning of the 5th week in a cephalo-caudal direction to assume its usual position between T12 and L3, becoming the definitive kidney (Saxenet al., 1987). During this process, arterial supply originates from the pelvic branches of the iliac arteries, which are sequentially replaced by more proximal vessels during ascent until union with the renal arteries, derived from aortic branches that initially supply the adrenal glands exclusively (Moore et al., 2011).

The developing kidneys are drained by the caudal-cardinal system via a series of embryonic channels that arise from the mesonephros (Gesase, 2007) prior to union with the renal veins. The renal veins and IVC share embryonic origins, specifically the subcardinal and supracardinal veins and associated anastomotic channels between them (Gesase, 2007; McClure et al., 1925). During the 5th to 7th weeks of embryogenesis, the subcardinal (kidneys), sacrocardinal (lower extremities) and supracardinal (body wall) veins are formed for more specific venous drainage. The subcardinal veins become the renal veins and IVC (renal segment), with the inferior remnants of the subcardinal veins becoming the IVC (right) and gonadal vein (left). The mechanism of this asymmetry is unclear and may be related to cessation in ascent of the metanephros, coinciding with a failure of anastomosis of the IVC branches during embryogenesis. In this context, expected degeneration of the distal vessels does not occur with premature cessation of kidney ascent, resulting in

a low lying ectopic kidney and more distal blood supply than expected. Owing to the embryogenesis, it is expected that ectopic kidneys receive distal blood supply directly from the great vessels (aorta, IVC).

The common iliac vein arises from the persistence of the posterior cardinal vein. During the early stages of development, the posterior cardinal drains the caudal aspect of the developing foetus. A number of small anastomotic vessels communicate with the lower aspect of the subcardinal vein and the posterior cardinal vein. In the later stages of venous development, the posterior cardinal veins regress, allowing drainage of the caudal feotus by the supracardinal and sacrocardinal veins (Eldefrawy al., 2011).

In our case, the venous drainage was conflicted, with the superior pole drainage directly into the IVC and inferior pole drainage into the contralateral common iliac vein. This anatomical variant is yet to be described, and may be a persisting pelvic vessel originating from the left subcardinal vein following failed ascent of the right kidney prior to final IVC formation. Alternatively, this may represent the persistence of anastomotic vessels between the lower subcardinal vein and the posterior cardinal vein. In contrast, the arterial supply to the right kidney was directly from the aorta, albeit at its lowest point at the bifurcation of the common iliac arteries for the inferior pole.

Anatomical variations pose significant challenges for surgical and radiological procedures, as limited knowledge or experience can result in significant, potentially fatal complications. For this anatomical variation, crossing of the right interior renal vein anteriorly to the right iliac artery may pose significant challenges for surgery in this area. Aortic surgery, such as aneurysm repair or aorto-femoral bypass, present operative scenarios which may be complicated by variation. When using an anterior approach to the lumbar spine in discectomy or corpectomy procedures, where a major vascular complication rate of 2.9% can be expected, with 2.6% attributed to injury of the common iliac vein (Fantiniet al., 2007). Laparoscopic retroperitoneal surgery including, but not limited to nephrectomy and lymphadenectomy, as well as retroperitoneal radiological intervention may also be affected. Up to 16% of laparoscopic nephrectomy patients suffer complications, with a 2.7% rate of vascular injury (Gillet al., 1995). This renal variation may also impact prognosis estimates for patients suffering renal cell carcinoma (RCC), where the formation of malignant venous thrombus, in up to 10% of patients (Riniet al., 2009), may be reduced with an inferior pole tumor. Infiltration of an inferior pole tumor into the common iliac vein may involve the presentation of a deep vein thrombosis on that side. This type of variant tumor thrombus may result in more extensive resection and may lead to more complicated post-resection vascular reconstruction.

Conclusion

We report a rare case of contralateral venous drainage of a right ectopic kidney's inferior pole vein to the left common iliac vein. In this context, we emphasize that clinically important renovascular variations extend beyond those involving arterial supply and ipsilateral phenomena. Awareness of these embryological development variations is important for specialists operating within the retroperitoneum. Further variations may be recorded with increased use of acute and pre-operative imaging and knowledge of these is crucial in providing optimal patient outcomes and anatomical education.

ACKNOWLEDGEMENTS

MJR is supported by a Doctor in Training Research Scholarship from Avant Mutual Group Ltd, Cancer Council Queensland PhD Scholarship and Professor William Burnett Research Fellowship from the Discipline of Surgery, School of Medicine, The University of Queensland.

Ethical standards: The authors declare that this case of anatomical variation was reported with the informed consent of the patient in question.

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