

An undetected common renal arterial trunk: surgical consequences and morbidity analysis

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Abstract We present a patient with a recurrent precaval left renal artery, stemming from a right-sided common trunk renal artery. The patient was a 44-year male who presented with a post-traumatic grade IV renal injury. After 3 months without renal function improvement and repeated urinary tract infection, a laparoscopic nephrectomy of the affected right kidney was performed, without upfront identification of the vascular variation, resulting in ischemia of the remaining left kidney. An anastomosis of the common renal trunk and the distal left renal artery was created in between the abdominal aorta and the inferior vena cava. This case describes the importance of upfront detection of renal vascular variations using the appropriate imaging techniques.

Keywords Acute kidney injury · Anomalies · Vascular variations · Ischemia · Kidney · Renal artery

Introduction

The increased use of laparoscopic renal surgery makes it essential to understand and document renal artery anomalies. Renal vascular variations are described in a wide

variety. Prevalences of 13.2–37 % have been reported [2, 6, 9]. Most common reported variations are the accessory (hilar) renal arteries and the aberrant (polar) renal arteries [6, 7, 10]. A less common variation is a precaval right renal artery with prevalences reported between 0.8 and 6.0 % [2, 4, 7]. A common trunk renal artery originating from the abdominal aorta is very rare, with only one previous case report [9]. We describe a patient with an undiagnosed common trunk right renal artery feeding a precaval left renal artery. The patient has given his consent to write this article.

Case report

A 44-year male presented, 4 months after grade IV renal injury, with a non-functioning right kidney. A computed tomography (CT) scan performed immediately after the trauma showed a fornix rupture with a dilated ureter, free fluid in the retroperitoneum and a torsion of the left kidney.

Although present, vascular variations were not detected or mentioned in the radiology report of the CT scan. A renogram was performed which demonstrated a non-functional right kidney. After 3 months without renal function improvement (creatinine 120 $\mu\text{mol/L}$, eGFR 58 ml/min), repeated urinary tract infection and persistent leukocyturia, laparoscopic nephrectomy was planned. Surgery was started as a total laparoscopic procedure. The combination of an organized fibrotic hematoma around a considerably enlarged right kidney made the urologic surgeons decide to convert to a hand-assisted procedure. The right renal artery and vein, as well as the ureter, were identified and clipped with three hemoclips. In addition a second right renal artery was identified and clipped. After clipping the second artery, the surgeons became suspicious that they had

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clipped a precaval artery which supplied the left kidney. The surgeons decided to review the preoperative CT scan during the procedure. On the preoperative CT scan a left renal artery originating from the abdominal aorta and two right renal arteries, one precaval and the other retrocaval, were thought to be identified. The presumption was made that this second right renal artery may have actually been an anatomic variation of the left renal artery. The right-sided kidney was removed and the procedure was terminated. Immediately postoperatively a computed tomography intravenous urography (CT/IVU) was ordered which confirmed this presumption. Postoperatively the patient was transferred to the intensive care unit. Vascular centers were consulted and the patient was transferred to our hospital. After arriving at our hospital, the patient was immediately reoperated. The retrocaval common trunk renal artery and the precaval renal artery were mobilized. Warm ischemia time had been nine hours. Subsequently an anastomosis of the common renal trunk and the distal left renal artery was created in between the abdominal aorta and the inferior vena cava (Fig. 1). Postoperatively, blood flow to the kidney was controlled by ultrasound and the patient was transferred to the intensive care unit. Renal function showed a slow recovery. A magnetic resonance angiography (MRA) scan confirmed restored blood flow in the kidney (Fig. 2). After 2 weeks of recovery with 10 days of hemodialysis, the patient was dismissed from our hospital without the need for renal replacement

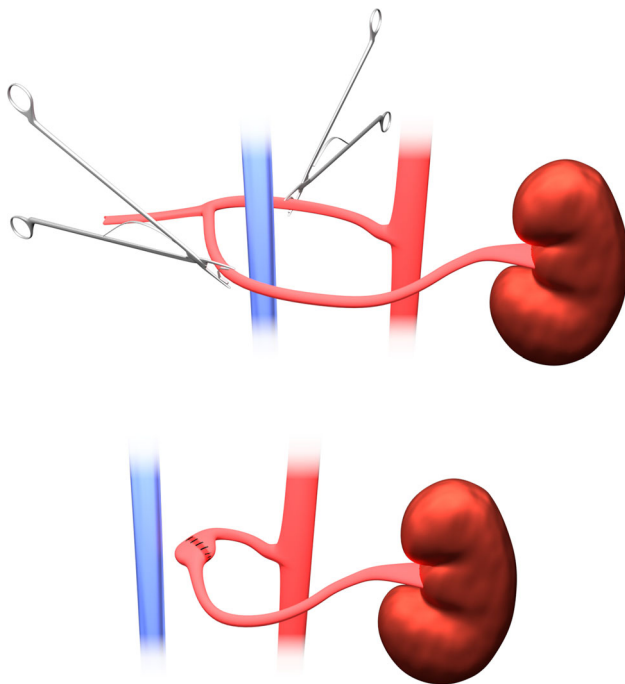


Fig. 1 *On top* The common trunk renal artery and recurrent precaval left renal artery. *Below* postoperative situation with end-to-end anastomosis of the renal artery

therapy. To evaluate the entire procedure, a 3D reconstruction of the preoperative CT scan was ordered which confirmed the common trunk right renal artery and the precaval left renal artery (Fig. 3). The hilum of the left kidney faced anteriorly, suggesting a non-rotational abnormality and the left renal artery penetrated the renal cortex from posterior. To our knowledge this transcortical path has never been described before [Fig. 4]. In retrospect, the failure to diagnose the common renal arterial trunk

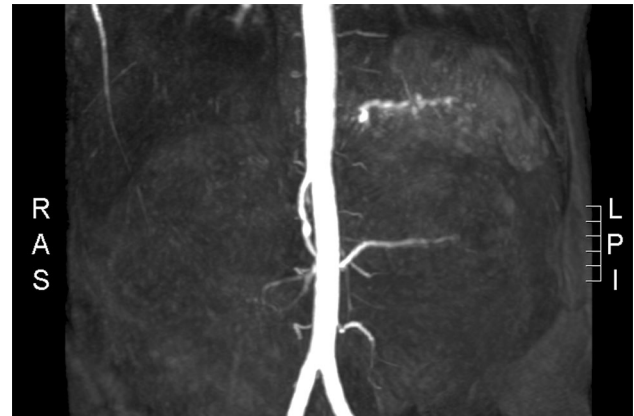


Fig. 2 Postoperative MRA scan confirming the restored blood flow to the left kidney and showing the end-to-end anastomosis just right from the aorta

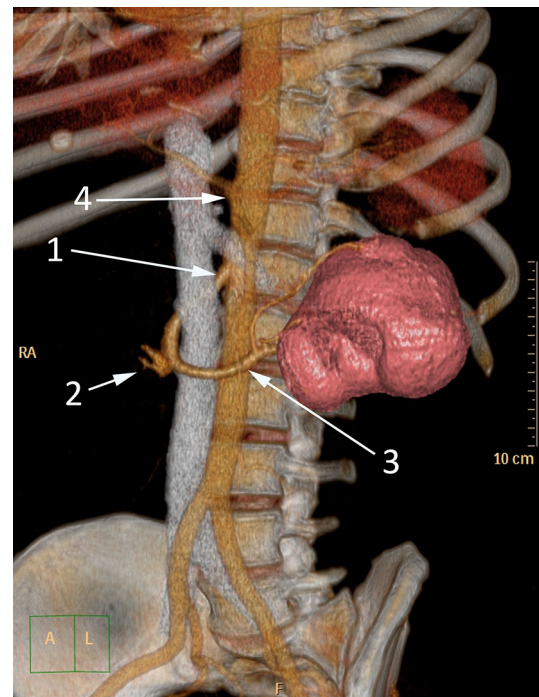


Fig. 3 3D reconstruction of the preoperative CT scan: **a** common trunk right renal artery **b** right renal artery **c** precaval left renal artery **d** common celiacomesenteric trunk. The right kidney is left out of the reconstruction because of its extended injuries



Fig. 4 CT scan of the preoperative anatomy with the heavily insured right kidney, the common trunk right renal artery, the precaval left renal artery and the anteriorly facing left kidney with the transcortical path of a renal artery

upfront had almost led to the loss of the patients' remaining left kidney. Recovery after 6 months to an eGFR of 22 ml/min, and a creatinine clearance after 24-h urine collection of 31 ml/min was measured.

Discussion

This case is the second in the literature presenting a common trunk renal artery originating from the abdominal aorta [9] and the first case describing a transcortical path of a renal artery.

Variations of renal arteries are explained by the development of mesonephric arteries. These arteries form a vascular net feeding the developing kidneys. Over time, this vascular net degenerates, leaving only one artery. Deficiency of the mesonephric arteries results in anomalies of the renal artery [6]. In this case the failure to diagnose the vascular variation of the renal arteries led to an almost total loss of renal function. Although a preoperative CT scan with contrast was performed and showed the vascular and renal variation, these variations were not detected upfront. The golden standard to detect vascular variations are CT/IVU or MRA [2].

In the literature a possible association between renal arterial and venous variations and renal malformations is described, although exact numbers lack [1, 3]. In retrospect, the torsion anomaly of the left kidney, visible on the preoperative CT scan, should have been a second upfront sign of the renal vascular variation encountered during the described surgical procedure (Fig. 4).

Furthermore, ischemia time is an important factor in determining final renal function outcome. Although the outcome after prolonged ischemia of an in situ-situated kidney is poorly described in literature, ischemia time should be minimized as much as possible, while renal

function outcome can be reduced in less than 20 min [5, 8]. In this case, the created anastomosis between the common renal trunk and the distal left renal artery resulted in the excellent recovery of the renal function.

These findings emphasize the importance of awareness and understanding of renal vascular variations and shows their implication in clinical practice, especially in laparoscopic renal surgery. The choice of preoperative imaging techniques, with intravenous contrast, and the careful examination of these images, with the knowledge of vascular and kidney anatomical variations, are the keystones in preventing unforeseen complications and belong to the preoperative workup before laparoscopic renal surgery.

Acknowledgments Figure 1 is designed and created by Roderik van Heijst.

Compliance with ethical standards

Conflict of interest None of the authors have any conflicts of interest or financial ties to disclose.

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