



## Case report

# Open surgical repair of abdominal aortic aneurysm and horseshoe kidney: A strange relationship

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## ARTICLE INFO

## Keywords:

Abdominal aortic aneurysm  
Horseshoe kidney  
Open surgical repair  
Tube graft

## ABSTRACT

**Introduction and importance:** The horseshoe kidney (HK) is the most common fusion defect of the kidneys. The simultaneous presence of HK and abdominal aortic aneurysm (AAA) is rare and comprises a technical challenge for the vascular surgeon due to variation of renal arteries and the renal isthmus overlying the AAA sac.

**Case presentation:** We present the first case in Nicosia General Hospital of Cyprus of an infrarenal AAA with a HK (Crawford Type I), which was successfully treated using an open surgical approach.

**Clinical discussion:** Review the technical challenges associated with the case and a brief reference to the relevant published articles.

**Conclusion:** The surgical repair of coexistence of AAA and HK continues to be a difficult technical challenge for the vascular surgeon from the past until today. There is a need to record the few cases and to create detailed specific guidelines to facilitate the surgical approach for the disease.

## 1. Introduction

Horseshoe kidney (HK) is the most common congenital abnormality of the urologic system, with an incidence of 0.25% of the total population, with a male preponderance of 2:1 [1,2].

The incidence of coexistent abdominal aortic aneurysm and horseshoe kidney is really rare and occurs in only 0.12% of patients [3,4].

We present a case of an infrarenal AAA with a HK, which was successfully treated with an open surgical approach, and discuss the associated technical challenges encountered in the case concerning a brief reference to the relevant published articles.

## 2. Case report [5]

A 72-year-old man with a history of hypertension, heavy smoking, percutaneous coronary angioplasty, and surgical treatment of urinary bladder cancer, presented with the inadvertent finding of a 5.8 cm infrarenal AAA in computed tomography (CTA) accompanied with a HK. The renal isthmus extended over the AAA and had one renal artery on each side from the proximal neck of the AAA, with no accessory renal arteries (ARA). According to the morphological imaging findings and the Crawford classification, the co-existence of AAA with HSK was classified as Crawford Type I (Figs. 1, 2).

The endovascular approach was rejected from the beginning, due to unsuitable anatomy (short neck and severe aneurysmal neck angulation) for endovascular aneurysm repair (EVAR). The patient underwent open AAA surgery repair, with interposition of a tube silver graft via the transperitoneal approach and isthmus preservation without the need for ARA reimplantation. The proximal and distal stumps were easily anastomosed with the graft. Finally, the aneurysmal sac wall covered the implanted graft (Fig. 3).

The patient received an uncomplicated postoperative course and was discharged from the hospital on the 4th postoperative day. His renal function was not affected intraoperatively and postoperatively. At follow-up, in the outpatient vascular surgery clinic, ten weeks later, the patient presented in good general condition and normal renal function.

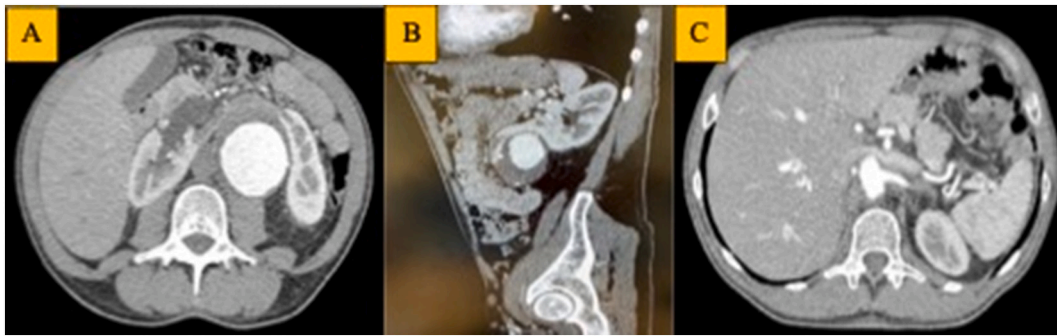
Six months later, the follow-up CTA abdomen (Fig. 4) revealed no signs of graft occlusion or renal dysfunction.

## 3. Discussion

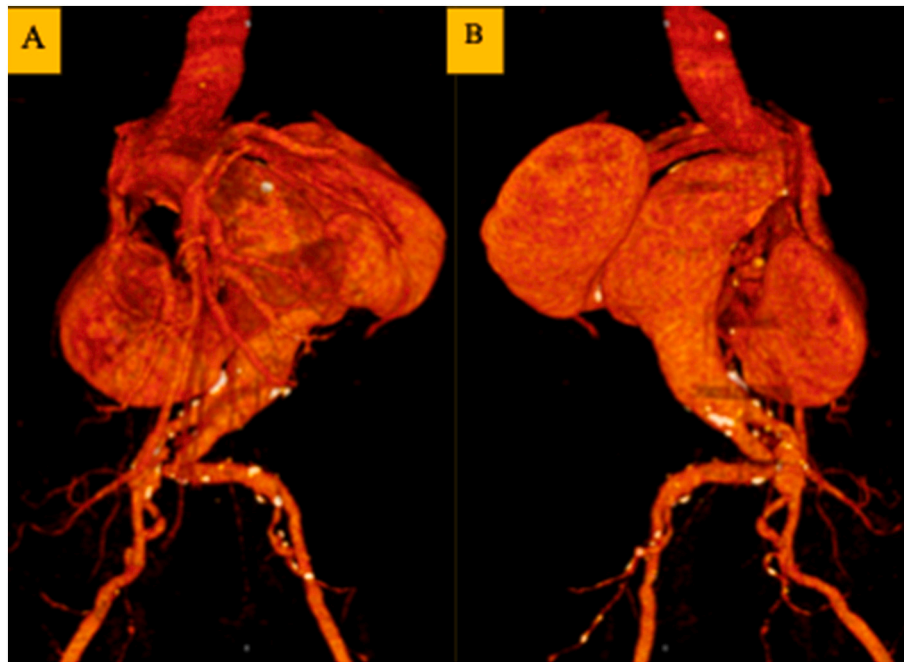
Horseshoe kidney (HK) is the most common congenital kidney anomaly, with a prevalence of 0.25%, characterized by the medial fusion of the kidneys anterior to the aorta [6]. The surgical anatomy of the HK is complex depending on the location of the isthmus and the associated blood supply [7].

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**Fig. 1.** Preoperative computed tomography angiography (CTA) revealed an infrarenal abdominal aortic aneurysm (AAA) with a co-existent horseshoe kidney, A. cross section, B. sagittal section, C. one renal artery for each side arises from the proximal neck of the AAA, without any accessory renal arteries (ARAs) being observed.



**Fig. 2.** Preoperative 3-dimensional CT of an AAA and a co-existent HK. A. Front side depicts the horseshoe kidney extending over the aneurysmal abdominal aorta, B. rear side shows the severe aneurysmal neck angulation.

According to autopsies published by various authors up to 1912 and 1913, Eisendrath et al. described five types of HK in 1924 [8,9], but the initial system, based on the number of renal arteries involved in HK blood supply, was introduced by Papin et al., in 1928 [10].

A small modification of this classification was proposed by Crawford et al. in 1988, who categorized the vascular supply according to the blood supply to each kidney segment [11,12], followed by Boatman et al. in 1971, who introduced six types of vascularization [13]. The most significant surgical system is Crawford's classification. According to Davidovic et al., only 21.95% of patients have normal renal artery anatomy, with most cases having aberrant renal arteries [14].

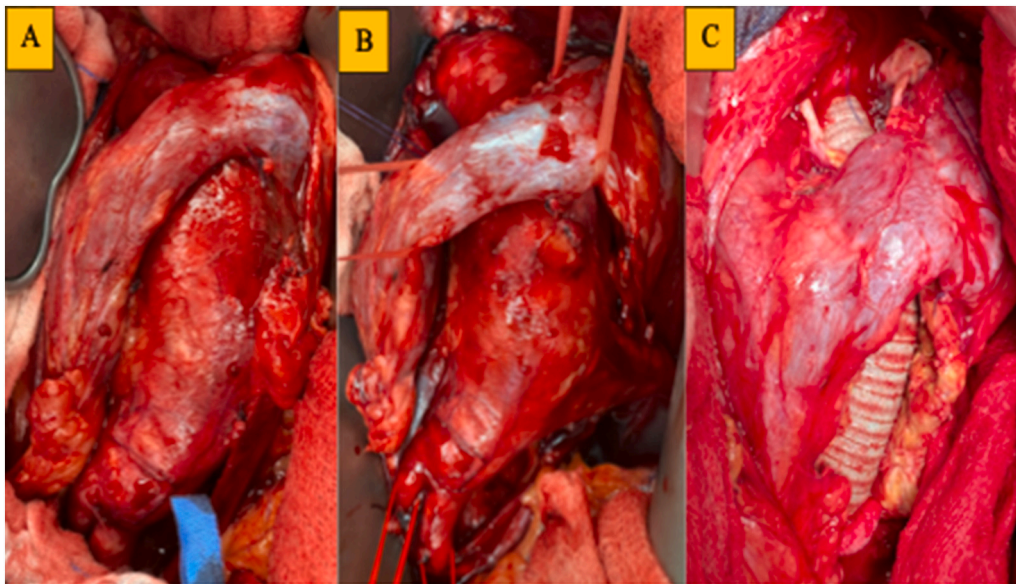
The co-existence of AAA and HK is rare, occurring only in 0.12% of patients [6]. The coexistence of the HK with inoperable AAA was first described by Julian in 1956. Phelan et al., the same year, replaced an AAA with a graft behind the mobilized kidneys isthmus, without the need to reconnect the ARAs [11,15].

Two years later, DeBakey et al., replaced an AAA by resection of the renal isthmus and ligation of the ARAs. Thus, a need was born for the development of techniques to reconnect arterial branches over a period of 10 years. Replacement of the AAA with preservation of the isthmus

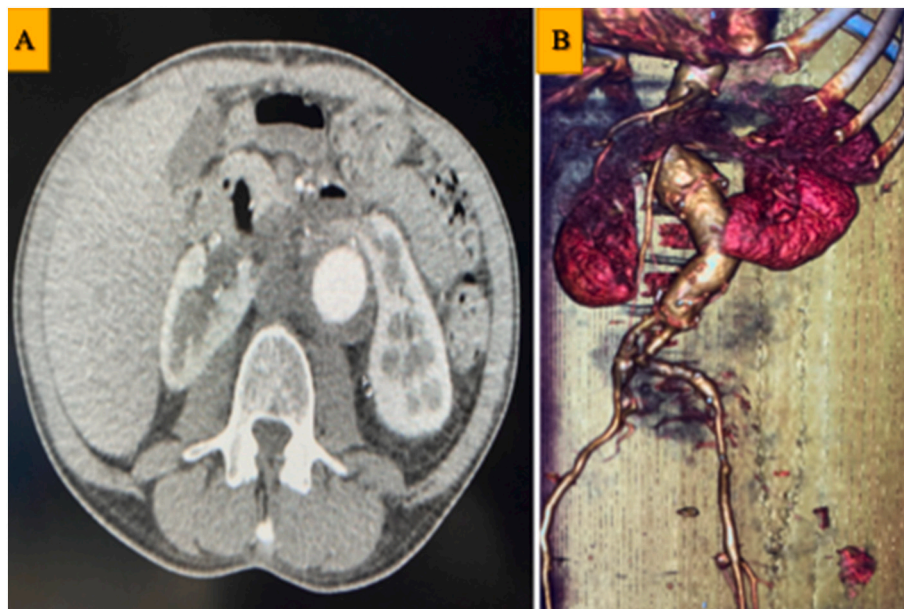
and reattachment of the ARAs was reported in 1967 [11,16]. According to Davidovic et al., renal artery ligation does not result in significant renal failure. During surgery of open surgical repair of AAA in the presence with HK, vascular surgeons encounter three major technical challenges [3,14]:

The first one is the choice of surgical access in an elective AAA associated with HSK; both transperitoneal and retroperitoneal approaches can be used. The main technical advantages of the transperitoneal approach include the ability to recognize the proximal and distal extent of AAA, the common iliac arteries, and the relationship between the aneurysm and the kidney. On the other hand, the visualization of the AAA and the aberrant accessory arteries arising from the aneurysm is facilitated with the retroperitoneal approach [14,17–19].

In our case, according to the CTA and anatomical characteristics of AAA, lack of iliac arteries involvement, the type of HK (Crawford type I), and the fact that the patient was thin, the transperitoneal approach with a midline incision was chosen, easily exposing the horseshoe kidney, the aneurysm and both iliac axes. Accordingly, the retroperitoneal space was revealed, the AAA and the HK projected right in front of us, as well as the proximal and distal extension of the AAA, the location of the HK,



**Fig. 3.** Intraoperative photos. A. An AAA and co-existent horseshoe kidney, B. Successful detachment of the horseshoe kidney from the AAA, C. the proximal and distal anastomosis, after the excluding of AAA and a horseshoe kidney.



**Fig. 4.** Postoperative photos. A. Follow-up CTA abdomen revealed no signs of graft occlusion. B. Preoperative 3-dimensional CT of the aorta and a co-existent HK.

and the relationship between them.

The second major technical challenge is the presence of a centrally positioned renal isthmus. If the transperitoneal approach is used, HK limits access to the distal abdominal aorta. Some authors suggested that the separation of renal isthmus should be avoided. Additionally, it has been noted that the kidneys, after this surgery return to their original location [14,20–22]. In our case, it was not necessary to dissect the renal isthmus, since it got easily separated, thereby preserving the anomalous vessels, without visually obscuring the proximal and distal segments of the AAA.

The third major technical challenge is associated with ARAs, which complicates furthermore the surgical repair [6,18]. For ARAs that are larger than 3 mm in diameter or supply more than 30% of renal parenchyma, preservation is recommended, while the division of the renal isthmus should be avoided [6,14]. As many ARAs as possible should be

re-anastomosed to the prosthesis [14,23]. No ARA reimplantation was required in our case. The patient had a normal preoperative renal function and continued to maintain this function postoperatively.

Bibliographic data are limited and relate mainly to case reports or small case series. Due to the limited state of knowledge, no consistent recommendations can be made [6]. Our literature review on the coexistence of AAA and HK revealed 42 published cases between 2002 and 2015, which were treated with open surgical rehabilitation, 26 case reports between 2001 and 2015, treated with endovascularly and 44 case reports during the period 1964–2021, with AAA rupture, treated either open or endovascularly [14,24].

In conclusion, the co-existence of a HK is not a contraindication to surgical treatment when the shape of the AAA and the patient's condition dictate it [18]. The preoperative planning for the coexistence of the HK and AAA is facilitated and achieved by the thorough preoperative

study of CTA, which is a useful diagnostic tool for better outcomes [19].

#### 4. Conclusion

The surgical repair of coexistence of AAA and HK continues to be a difficult technical challenge for the vascular surgeon from the past until today. We successfully performed an open surgical repair of AAA with HK (Crawford Type I); this case is the first in Cyprus, which was treated at the Nicosia General Hospital. There is a need to record the few cases and to create detailed specific guidelines to facilitate the surgical approach for the disease.

#### Funding

No sources of funding.

#### Ethical approval

Ethical approval has been given.

#### Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

#### Author contribution

Study concept or design: Panagitsa Christoforou, Konstantinos Kapoulas, Christos Bekos.

Data collection: Panagitsa Christoforou, Konstantinos Kapoulas, Christos Bekos.

Data analysis or interpretation: Panagitsa Christoforou.

Writing the paper: Panagitsa Christoforou, Konstantinos Kapoulas.

#### Research registration

5.25.083.

#### Guarantor

Panagitsa Christoforou.

#### Provenance and peer review

Not commissioned, externally peer-reviewed.

#### Declaration of competing interest

No conflict of interest.

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