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Reconstructive surgery of the abdominal aorta coexistent with a horseshoe kidney

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Abstract

Objectives. Improvement of surgical treatment of abdominal aortic diseases with concomitant horseshoe kidney. Material and methods. We present our experience of reconstructive abdominal aortic surgery associated with a horseshoe kidney. Three clinical observations with data of computed tomography angiography, intraoperative fotos were demonstrated with a discussion of different surgical techniques. Results. To date, due to the uniqueness of the pathology, reconstructive surgery of the abdominal aorta with concomitant horseshoe kidney in the literature is limited to small cohort studies or individual clinical cases, and the choice of treatment technique remains an active subject of discussion. Surgical methods of aortic reconstruction due to this rare anomaly determine the variety of operative strategies, from choosing surgical approach, crossing the renal isthmus, ligation or preservation additional renal arteries. Our clinical observations confirm the advantages of open surgical technique, which not only provided sufficient exposure of the operating area, but also allowed to perform optimal reconstruction of the abdominal aorta coexistent with a horseshoe kidney. Conclusions. Detailed preoperative diagnosis of renal anomalies determines the choice of optimal surgical strategy of abdominal aortic reconstruction. Open surgical treatment of abdominal aortic aneurysms and aorto-iliac occlusive diseases in combination with a horseshoe kidney is a safe and efficient method, which allows to provide satisfactory immediate and long-term results.

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Introduction.

Horseshoe kidney (HSK) is the most common urologic anomaly, occurring in 0.15-0.25% of the population, and its combination with pathology of aorto-iliac region is very rare [1-4]. Variable arterial blood supply of HSK, placement of the renal isthmus relative to the main vessels cause a high risk and significantly complicate reconstructive surgery of abdominal aorta. The issues of open and endovascular treatment, possibility of crossing the isthmus of the HSK, feasibility of reconstruction of additional renal arteries still remain controversial [3,5,6].

Objectives.

Improvement of surgical treatment of abdominal aortic diseases with concomitant HSK.

Material and methods.

In order to the rarity of this coexistent pathology, peculiarities of the diagnosis and surgical treatment, we consider expedient to share the following clinical case-reports.

Case presentation 1

62-year-old patient 20.01.2003 was admitted to the Department of Vascular Surgery and Transplantation of Lviv Regional Clinical Hospital with diagnosis «Atherosclerotic occlusion of aorto-iliac segments (Leriche syndrome). Chronic right lower limb threatening ischemia». The presence of threatening ischemia of the right lower limb has become a direct indication for surgical intervention – aorto-bifemoral bypass grafting (fig. 1): through femoral incisions common femoral arteries were mobilized, suitable for reconstruction. Atherosclerotic occlusion of superficial femoral arteries was revealed, deep femoral arteries were patent. Using transperitoneal approach (midline laparotomy) congenital anomaly – HSK with additional renal isthmus arteries was revealed. Abdominal aorta was mobilized under the main renal arteries. After systemic heparinization abdominal aorta was clamped proximally and distally of the inferior mesenteric artery. After longitudinal arteriotomy Dacron Y graft (D: 16.0x8.0 mm) was used for proximal anastomosis formation by «end to side» and passed under the renal isthmus without its division. After careful tunneling graft branches were anastomosed to the common femoral arteries by «end to side». The blood flow was restored. Hemostasis. Suturing of wounds.

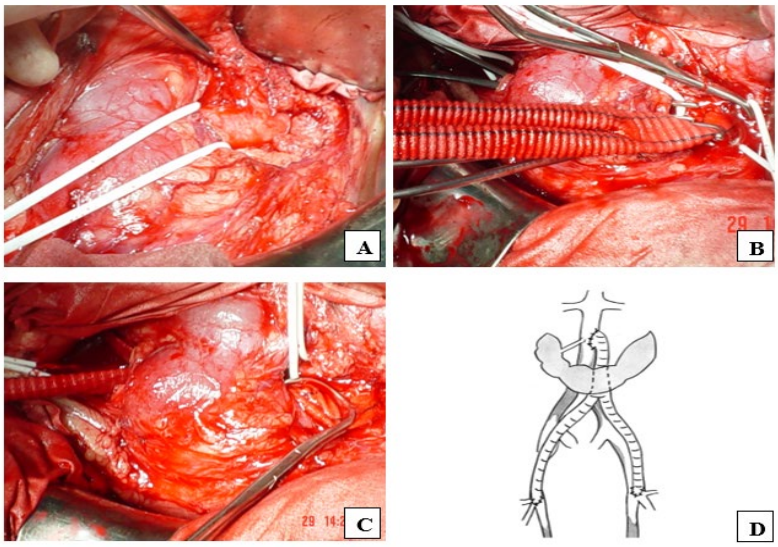

Figure 1. Intraoperative demonstrations: A – abdominal aorta was mobilized; B – aorto-bifemoral bypass grafting (proximal anastomosis formation); C – Dacron Y graft was placed under the isthmus of HSK; D – final view of vascular reconstruction.

Postoperative course was complicated with eventration on the 6-th day. Amputation of IV, V fingers of the right foot was performed due to the separation of necrosis. Creatinine and urea levels were within normal limits. Patient was discharged in a well condition on 20th day after surgery.

Case presentation 2

In the next clinical presentation, 71-year-old patient, 17.11.2019 was admitted to the Department of Vascular Surgery and Transplantation of Lviv Regional Clinical Hospital with complaints of a sense of pulsation in mesogastric region, frequent night urination, hernial protrusions of the anterior abdominal wall. From anamnesis: congenital anomaly – HSK. Urolithiasis of the left half of HSK. Chronic calculous pyelonephritis. Left-sided pyelolithotomy (1992), contact ureteral lithotripsy (2018). Ultrasonography (USG), computed tomography angiography (CTA) revealed (fig. 2): fusion of the lower poles of the kidneys (in front of the aorta). The left kidney was deformed, parenchyma of the upper pole was unchanged, parenchyma of the lower pole was expressively thinned. Renal pelvis was dilated. Concrements of renal calyces, with diameter of 6.0 mm, 1.0 mm, 23.0 mm, 3 right and 3 left renal arteries were detected. By 15.0 mm below the main renal arteries, saccular abdominal aortic aneurysm (AAA) was detected with a

maximum anterior diameter 63.0 mm and massive circular thrombosis of aneurysmal sac, which narrowed its lumen up to 60% and posterior wall intima dissection. Additional right and left renal arteries were branched from the aneurysmal sac. Iliac segments had normal sizes and departed from the aneurysm.

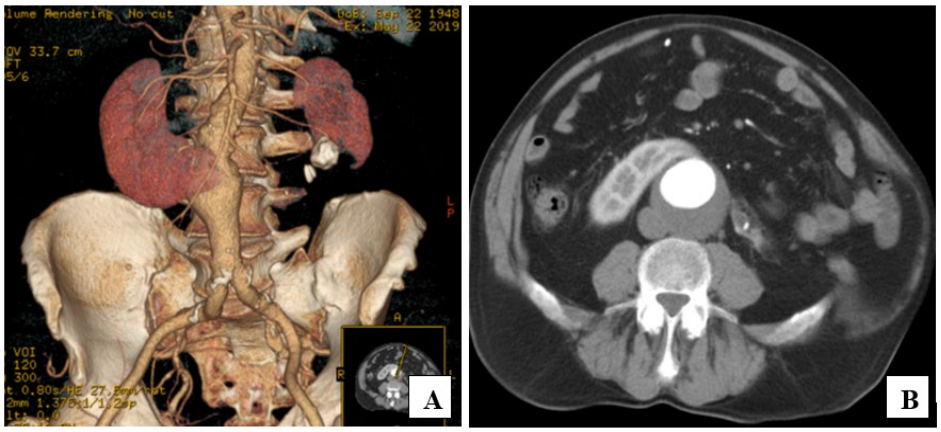

Figure 2. Abdominal CTA: A, B – AAA with concomitant HSK

19.11.2019 Operation – Infrarenal AAA resection with aorto-biiliac bypass grafting, preservation of blood flow through additional renal arteries, division of HSK isthmus, umbilical hernia repair (fig. 3). «Mercedes» surgical approach. In the retroperitoneal space large saccular infrarenal AAA with diameter of 65 mm was found. Anterior to the aorta HSK was identified, fused at the inferior poles by a narrow fibrotic tissue. After division and suturing of renal isthmus additional right and left renal arteries, arising from the aneurysmal neck, were detected. After systemic heparinization the proximal aorta was clamped under the right and left main renal arteries. The aneurysmal wall was longitudinally opened below the additional renal arteries. Hemostasis of the lumbar arteries was achieved, followed by proximal anastomosis of DacronY graft (D: 20.0x10.0 mm) to the infrarenal aorta by «end to end» with preservation of additional renal arteries. The blood flow through additional renal arteries was restored. Next, the branches of the Dacron Y graft were anastomosed by «end to end» to the common iliac arteries. The blood flow was restored. Hemostasis. The aneurysmal wall was closed covering the implanted graft and the abdominal wall was traditionally closed.

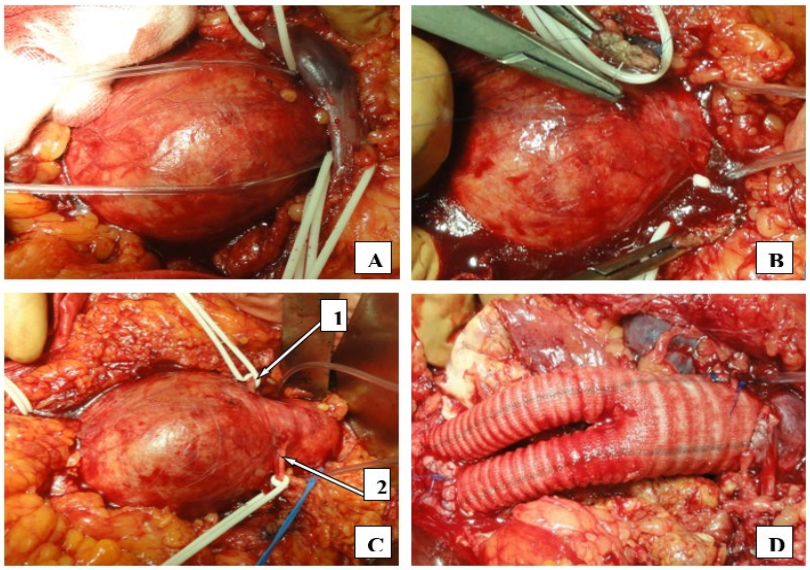

Figure 3. Intraoperative demonstrations: A – aneurysmal neck and renal isthmus were mobilized; B – division and suturing of renal isthmus; C – additional right and left renal arteries (1,2) were taken on tourniquets; D – final view of vascular reconstruction with preservation of blood flow through additional renal arteries.

There were no complications in the postoperative course. On 11th postoperative day the patient was discharged home with normal creatinine and urea levels.

Case presentation 3

61-year-old patient 28.11.2021 was admitted to the Department of Vascular Surgery and Transplantation of Lviv Regional Clinical Hospital, where by clinical examination, laboratory and diagnostic imaging (USG, CTA) the diagnosis of two infrarenal AAAs with a HSK was confirmed.

CTA revealed (fig. 4): fusion of the lower poles of the kidneys (in front of the aorta). Sizes of renal isthmus – 16.0x36.0 mm, parenchyma with sufficient thickness, small cysts (5.0 mm) and urolith (7.0x8.0 mm) in left half of HSK. HSK was supplied by main and additional (3.0 mm in diameter) right and left renal arteries. Two infrarenal AAAs were detected: proximal (fusiform) – by 18.0 mm below the main renal arteries, 42.0x62.0 mm in diameter; distal (saccular) – by 10.0 mm below the additional renal arteries, 28.0x34.0 mm in diameter.

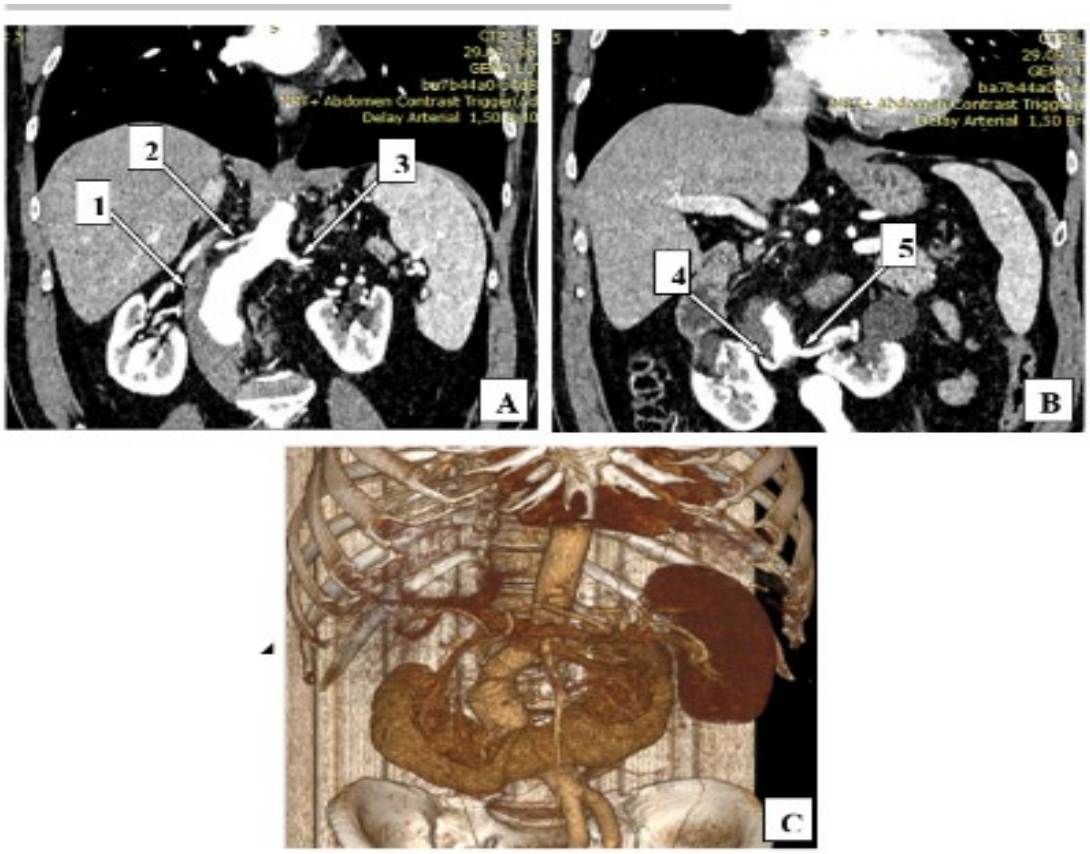

Figure 4. Abdominal CTA: A – AAA (1), main renal arteries (2,3); B – additional renal arteries (4,5); C – 3d-reconstruction of AAA and HSK

Two infrarenal AAAs (fusiform and saccular) coexistent with a HSK have become a direct indication for surgery. Analyzing the data of CTA preoperatively it was made a decision to preserve the functioning renal isthmus and consider the possibility of additional renal arteries reconstruction.

30.11.2021 Operation – using transperitoneal approach (midline laparotomy) abdominal aorta was mobilized under the main renal arteries and at the level of its bifurcation.

In order to prevent bleeding from the orifices of lumbar arteries, AAAs were excluded from the bloodstream followed by abdominal aorto-aortic prosthetic grafting (D: 20.0 mm), with reimplantation of renal isthmus arteries into the graft through a patch, that includes the origins of these arteries (fig. 5). Besides, the infusion of crystalloid cardioplegic solution via the additional renal arteries allowed to reduce the risk of parenchyma ischemic damage in this patient.

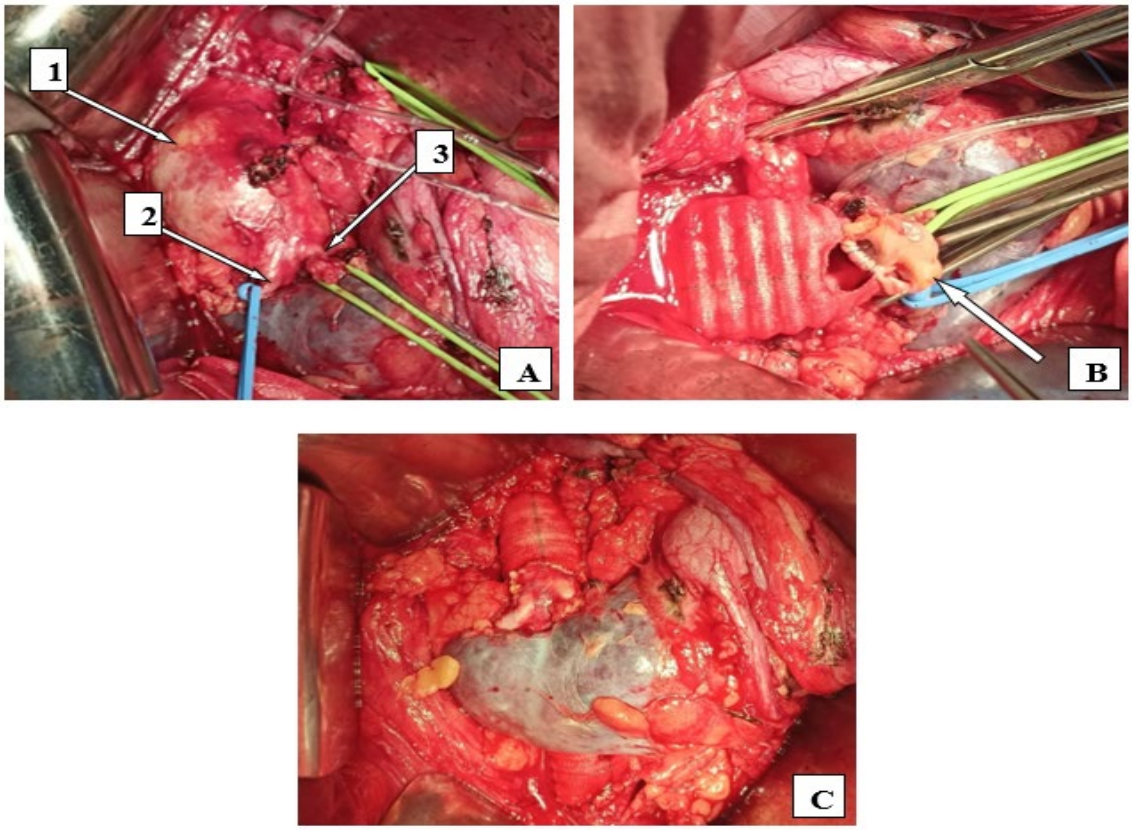

Figure 5. Intraoperative demonstrations: A – proximal fusiform AAA (1), additional renal arteries to the isthmus of HSK (2,3); B – reimplantation of additional renal arteries into the prosthetic graft through a patch; C – final view of vascular reconstruction

The patient had uneventful recovery and did not develop kidney dysfunction. He was discharged home on 8th postoperative day on good health. Follow up: at control USG on 3,6,12 months after surgery patients had no complaints, normal serum creatinine levels and patency of all reimplanted arteries were observed.

Discussion.

To date, due to the rarity of pathology, in the literature treatment of AAAs and aorto-iliac occlusion lesions coexistent with a HSK is limited by small cohort studies or individual clinical observations, as well as the choice of the method of aortic reconstruction continues to remain an active object of discussions [4,5,7,8]. In the first clinical case, the diagnosis of HSK has been confirmed during surgery, as CT is not routinely obtained preoperatively in patients with aorto-iliac occlusive diseases. Therefore, the accurate preoperative diagnosis (USG, CTA) is crucial, because it allows to obtain detailed information about the anatomical features of HSK, number of additional renal vessels, functional tissue of renal isthmus and justify the optimal surgical strategy [3]. Despite the significant success of endovascular technologies, open aortic surgery is considered the treatment of choice due to concomitant HSK [3,5,9]. Surgical methods of aortic repair with this rare anomaly determine the various operating technique – from the choice of surgical approach to AAAs, the possibility of renal ishmus division, ligation, or preservation of additional renal arteries. The literature data and analysis of our clinical observations confirm the advantages of transperitoneal surgical approach, which allowed to perform sufficient exposure of AAAs, renal isthmus, and iliac arteries. Left retroperitoneal approach offers the avoiding manipulations on renal isthmus, but it is not suitable for urgent cases of ruptured AAAs and has limited application due to insufficient visualization of the right iliac vessels [3,5]. The preservation or division of renal isthmus remains a controversial issue in the aortic surgery. In the second clinical case, isthmus of HSK was presented by a non-functional fibrotic tissue, that justifies its section for better mobilization of AAA. However, as well as most of the authors, we are trying to keep the integrity of the renal isthmus, as its division due to

functioning parenchyma may lead to urinary leaks, infections, renal ischemia, and postoperative renal failure [3,5,8]. The blood supply to the HSK is often presented by additional arteries, that may depart directly from the aortic aneurysm or from the iliac vessels. Moreover, the collateral blood flow between renal segments is often insufficient, so for decreasing the risk of renal isthmus ischemia and necrosis, it is recommended to preserve additional renal arteries with diameter more than 2.0 mm [3]. Reimplantation of additional renal arteries can be performed directly into the prosthetic graft or through a patch, that includes the origins of the arteries [8]. The last one was demonstrated in the third clinical case. With the active development of surgical technologies in the literature there are more often publications about endovascular techniques in the treatment of AAAs with associated HSK. The insertion of an endovascular stent graft may necessitate occlusion of accessory renal arteries, subsequently leading to postoperative impaired renal function, segmental renal necrosis, transient hypertension, and possibly endoleak [2,3,10]. Therefore, a potentially high risk of complications in the application of endovascular technologies does not allow the justification of this approach in such category of patients.

Conclusions.

Detailed preoperative diagnosis of renal anomalies determines the choice of optimal surgical strategy of the abdominal aortic reconstruction. Open surgical treatment of AAAs and aorto-iliac occlusive diseases in combination with a HSK is a safe and efficient method, which allows to provide satisfactory immediate and long-term results.

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