Surgical Treatment of Abdominal Aortic Aneurysm in Association with Horseshoe Kidney
Three Case Reports and a Review of Technique

Horseshoe kidney is a rare congenital anomaly that can create various technical problems during surgery for repair of abdominal aortic aneurysm. The diagnosis of this anomaly should be confirmed preoperatively in order to plan surgical strategy.

Nowadays, in more than 90% of all cases, ultrasonography, contrast computerized tomography, urography, and angiography are the best instrumental methods of detecting this anomaly in association with abdominal aortic aneurysm.

The transperitoneal approach assures the best exposure of the kidney, the ureters, the aneurysm, and both iliac vessels, but the renal isthmus can pose a problem in reimplanting aberrant renal arteries. When it is known preoperatively that renal revascularization should be performed, the left extraperitoneal approach is a better choice.

In any event, the coexistence of horseshoe kidney and abdominal aortic aneurysm does not preclude the treatment of the latter. In elective surgery of abdominal aortic aneurysm, the morbidity and mortality rates in the presence of horseshoe kidney are much the same as those in the presence of normal kidneys. The best results in this kind of surgery are obtained by adapting one’s surgical technique to each anatomical variant that is encountered. (Tex Heart Inst J 1998;25:206-10)

Horseshoe kidney (Fig. 1) is a complex congenital malformation arising from the fusion of renal parenchymas, usually of the inferior poles, in association with lower lumbar ectopia and anomalous rotation of the urinary tracts. Vascular anomalies are found in 60% to 80% of reported cases. The rate of occurrence of this anomaly is between 0.15% and 0.33%, which corresponds to 1 of every 400 people, with the frequency doubled in males. The association of horseshoe kidney (HSK) with abdominal aortic aneurysm (AAA) is very rare: about 1 case per every 710 observations at autopsy. Yet it is important to detect this association preoperatively, in order to prepare for intraoperative technical difficulties related to the renal isthmus or to arterial anomalies. Symptomatic manifestations of HSK are periumbilical abdominal pain, exacerbated by dorsal extension of the spine, or colic due to pyelocaliceal lithiasis. At the initial physical examination, symptoms of HSK should be differentiated from those of AAA, in order to determine whether both conditions are present and to establish the urgency of surgery. Various instrumental diagnostic methods, such as computerized tomography (CT), angiography, and urography, should be used to confirm the diagnosis and to define completely the association between the 2 conditions.

In 90% of cases, computerized tomography gives the most detailed information about the morphology of HSK and the anatomic relationships between the kidney, its blood vessels, and the aneurysm. Urography has an 88% sensitivity and reveals any anomalies of the urinary tracts. Angiography, always performed in 2 projections (postero-anterior and lateral) reveals the association between HSK and AAA in only 67%, of cases, and does not provide good visualization of the vascular anomalies of the kidney. Although ultrasound scanning is a simple and safe examination, it has a low success rate (38%) in visualizing HSK.

Overall, the success rate of diagnostic imaging in preoperative visualization of the 2 lesions is 80%; but in consideration of the rarity of reported cases, the data could be misleading.
Patients and Results

Of 648 patients who underwent surgical treatment of AAA at our institution between 1984 and 1994, we found 3 who had an associated HSK. All 3 were diagnosed preoperatively by ultrasound scanning, CT scanning, urography, or angiography and were treated electively.

Evaluation of kidney function yielded normal results in all 3 patients. One patient had a high cardiac risk as a consequence of a prior myocardial infarction. Computerized tomographic scans perfectly corresponded to subsequent surgical findings, in particular in regard to the position of the kidney, to the dimensions and morphology of the renal isthmus, and to the relationships between the renal parenchyma and the aneurysmal wall of the aorta (Fig. 2). Angiography visualized 1 case of abnormal vascularization to the isthmus arising from the aorto-iliac bifurcation (Fig. 3); the surgical findings later confirmed this and revealed, in a different patient, another abnormal vascular connection, this time between the isthmus and the left common iliac artery.

On all 3 patients, we used a median xiphopubic laparotomy as a surgical approach because it has no complications and gives a good exposure of the HSK, the urinary tract, the aneurysm, and both iliac axes (which were easily clamped). Dissection and mobilization of the fat renicapsule enables good exposure and good dissection of the renal hilum and the high urinary tract. In our 3 patients, the ureters passed in front of the renal isthmus. We did not find any other anomalies of the urinary tracts. Isthmectomy was not necessary even when the renal isthmus was of considerable size.

In all 3 patients, we mobilized the renal isthmus only as much as was necessary to separate it from the aneurysm’s wall. We then incised the anterior wall of the aortic aneurysm as far as the level of the renal isthmus, avoiding intersections of any vascular anomalies, and inserted a straight or bifurcated Dacron tube graft with aortic inclusion (Fig. 4). As mentioned above, we observed 2 vascular anomalies (1 in each of 2 patients), but we left them as we found them.
Surgery was performed with blood-saving procedures: in 2 cases, blood drawn preoperatively was autotransfused, and in the other case blood was recovered intraoperatively. The postoperative course of all 3 patients was unexceptional. Only 1 patient showed any loss of renal function, and that resolved within 5 days. All 3 patients were discharged between the 7th and 10th postoperative days.

**Discussion**

The surgical treatment of AAA associated with HSK gives rise to some technical difficulties. The 1st is the surgical approach: median laparotomy has the advantage of enabling complete exploration of the peritoneal cavity, in order to find associated anomalies and to check both iliac vessels; in the case of horseshoe kidney, however, the renal isthmus would hinder the approach to the aorta, and the reimplantation of any anomalous renal vessels would be difficult. The right retroperitoneal approach to the AAA is also possible, through a parietal-cholic incision; and, if necessary, the Kocher maneuver can be performed when the AAA is very close to the kidney.12,13 The left extraperitoneal approach appears, to date, to be well-tolerated because it is less traumatic, avoiding, as it does, interference with the renal isthmus, the urinary tracts, and the renal vessels; this approach has the further advantage of reducing ischemic time if the surgeon needs to perform endarterectomy or to reimplant anomalous renal vessels. However, the approach to the right iliac vessels is not easy.9,14-18 We prefer to use a midline incision as our surgical approach, because it easily exposes the horseshoe kidney, the urinary tract, the aneurysm, and both iliac axes.

The second problem lies in deciding whether to save the renal isthmus or to resect it in order to improve the approach to the aorta. The literature reports that isthmic resection is performed in 30% of all cases, but this practice is steadily declining.3,9,19

The isthmus should be spared if at all possible. As in our patients, the use of a prosthetic substitute for the aneurysmal segment of the aorta can save anomalous renal vessels. Isthmic resection should have a solid indication and should be performed very carefully, for it can have dangerous sequelae: bleeding, ischemia, or retroperitoneal urinary filtration, if the renal stump is not carefully sutured. The presence of urine near the prosthesis can be very harmful and life threatening, especially for patients with HSK, who in 15% to 30% of reported cases present with asymptomatic infections of the ascending urinary tract caused by very virulent, usually intestinal, gram-negative organisms (e.g., *Escherichia choli*, *Enterococcus faecalis*, and species of *Klebsiella*).5,20

Because of the terminal vascularization of the kidney, it would be better to perform a complete resection of the renal symphysis, or at least an isthmic-polar amputation, should the assay-clamping of anomalous vessels cause a wider extension of parenchymal ischemia.6 In the event that it is necessary to mobilize the horseshoe kidney to approach the aorta, it is best to perform a nephropexy at the end of the operation, to normalize the renal axes1 and to fix the fat renicapsule to the iliopsoas's aponeurosis. In our 3 cases, nephropexy was not necessary because we isolated the horseshoe kidney without resecting its isthmus, thereby preserving the anomalous vessels.

Identification of the urinary tract is usually not difficult, because the ureters are always found in a superficial position near the pelvis, in a renal fat cavity—which enables easy dissection. The ureters do not follow a medial course, as one might expect, but in most cases follow an ante-isthmic course. One should be careful to avoid the creation of iatrogenic lesions and to search for incomplete ureteral duplications: aside from the normal orthotopic urinary tract, it is possible, in approximately 1% to 10% of all cases,19,21,22 to find another that often converges below the isthmus into a single medial urinary tract. Evaluation of the degree of renal fusion is important in deciding whether or not to dissect the isthmus.

Unfortunately, one usually does not encounter a good fibrotic isthmus in association with AAA; the literature reports that in about 15% to 17% of cases, there is a large symphysis comprising normal and active renal parenchyma, and this has hindered several important clinic trials for the surgical correction of AAA.6,23

Various anatomic studies have demonstrated genetic abnormalities of vascularization in 70% of cases of HSK; 50% of these are accessory branches direct to the isthmus. In greater particular, vascular anomalies in cases of HSK are found in the following patterns: in 20% to 30% of cases, there is normal vascularization; in 50% to 60% of cases, there are
minor abnormalities (10% involving an origin beyond the AAA, 30% involving a small isthmic artery arising from the aneurysmal wall, and 20% involving more than 1 small isthmic artery arising from the aneurysm); and finally, in 5% of all cases, there are major vascular anomalies, especially large multiple arteries arising from the aneurysmal wall.6,22,24

Anomalous arterial branches smaller than 2 mm in diameter can be sacrificed without a real risk of renal ischemia. Bigger arteries must be left, or else the surgeon will have to perform resection of ischemic renal parenchyma. Revascularization is mandatory for multiple branches that arise together from the aortic wall and distribute blood to large areas of renal parenchyma, even if these branches are of small diameter.3

Technical opportunities to save or restore vascular perfusion are various. Revascularization of anomalous branches can be done by reimplanting an aortic patch that includes the origins of the vessels, by reimplanting the arteries directly into the prosthesis in accordance with the usual methods (after having performed thromboendarterectomy of the ostia), or by interposing a graft. Horseshoe kidney is not a contraindication for surgical treatment of AAA when the dimensions and evolution of the aneurysm indicate treatment.

From the technical point of view, repair of AAA by means of substituting a prostatic segment of aorta is not contraindicated in cases of HSK, nor does this renal anomaly affect the good results of such substitution—but concomitant lesions should be discovered noninvasively and studied as thoroughly as possible before surgery. To determine a prognosis in these patients, one should perform a preoperative cardiorespiratory examination and, of even greater importance, preoperative evaluation of renal function.

The literature on this subject emphasizes that high preoperative levels of serum creatine in association with extremely low filtration volumes increase the probability of early postoperative hemodialysis; moreover, early postoperative mortality rates are much higher for patients who require hemodialysis (67%) than for those who do not (6.3%).9 It is difficult to obtain definitive data regarding the overall morbidity and mortality rates of surgery of AAA associated with HSK.

Horseshoe kidney is rare, and even more so is its association with abdominal aortic aneurysm. Case reports in the literature are relatively few in number (80 as of 1987),8 are highly variable, and often amount to little more than observations encapsulated in time that are best considered as personal experiences. In the larger clinical studies of surgical management of AAA in association with HSK,5,22 the mortality-rate results are actually a little better than are those of classical surgical repair of AAA alone. However, experiences to date underscore the fundamental role that must be played by the surgeon in adapting his or her own technique to each anatomical variant that he or she encounters.25,26

References