Two-stage off-pump coronary artery bypass grafting and abdominal aortic aneurysm repair in a patient with horseshoe kidney

Coronary artery bypass grafting and abdominal aortic aneurysm (AAA) repair were performed in a 59-year-old male patient with horseshoe kidney (HSK). An abdominal mass was detected on physical examination. Ultrasonography revealed a partially thrombosed AAA with a length of 14 cm and a diameter of 6.5 cm. Computed tomography showed a coexistent HSK and the infrarenal location of the AAA ending at the aortic bifurcation. On magnetic resonance angiography, the renal veins were patent and the presence, size, and location of the aneurysm were confirmed. Coronary angiography revealed severe lesions in the left anterior descending artery and the right coronary artery. Renal functions were within normal limits. He was operated on for coronary artery disease with the off-pump technique, followed by a subsequent operation for AAA repair through a median incision. The renal isthmus was preserved and mobilized, providing good access to the aneurysm. A tubular graft was implanted and wrapped by the native aorta. The patient was discharged with no postoperative complications.

Key words: Aortic aneurysm, abdominal/surgery; coronary artery bypass/methods; kidney/abnormalities; renal artery/abnormalities/surgery.

Horseshoe kidney (HSK), a rare complex congenital malformation caused by the fusion of renal parenchyma, is reported to occur in 0.15% to 0.33% of the population, with a two-fold frequency in males. Vascular anomalies occur in 60% to 80% of reported cases. The coexistence of HSK and an abdominal aortic aneurysm (AAA) is very rare, being reported in 1 of 710 autopsy patients. The number of cases reported to have this association is relatively few (176 cases by 2001). Anatomic features related to the renal isthmus or arterial anomalies pose technical difficulties for AAA repairs.

This article presents a patient with HSK who underwent AAA repair and coronary artery bypass grafting (CABG).

CASE REPORT

A 59-year-old, hypertensive male patient presented with chest pain graded as class III according to the Canadian Cardiovascular Society Classification. An abdominal mass was detected on physical examination. Ultrasonography revealed a partially thrombosed AAA with a length of 14 cm and a diameter of 6.5 cm. Computed tomography (CT) showed a coexistent HSK
with a lower pole fusion. It also confirmed the presence of the AAA in the infrarenal location. The aneurysm ended at the aortic bifurcation. Magnetic resonance angiography confirmed the presence, size, and location of the aneurysm (Fig. 1). The renal veins were patent. Coronary angiography revealed severe lesions in the left anterior descending (LAD) artery and the right coronary artery (RCA). Renal functions were within normal limits.

The patient was first operated on for coronary artery disease. Revascularization was performed with the off-pump CABG technique using grafts from the left internal mammarian artery and saphenous vein for the LAD and RCA, respectively. The patient was monitored carefully to avoid hypertensive episodes.

The second stage of the operation was the AAA repair through a median laparotomy. The aneurysm was seen at the infrarenal level, with a length of 14 cm and an approximate diameter of 6.5 cm, ending before the aortic bifurcation. An HSK was identified, with its lower pole located anterior to the aneurysmal sac. The renal arteries above the aneurysm were normal. The renal isthmus was preserved, mobilized, and a good access to the aneurysm was achieved. The infrarenal abdominal aorta and iliac arteries were cross-clamped and the aneurysmal sac was opened (Fig. 2a). The thrombosed material inside the aneurysm was removed. A tubular graft was implanted and wrapped by the native aorta (Fig. 2b). The patient was discharged on the postoperative sixth day without any complication.

**DISCUSSION**

Patients with AAA often have concomitant coronary artery disease. It is still controversial whether a simultaneous operation or two-stage operation should be chosen for these patients. One-stage operation is thought to be an attractive option in selected patients with an aneurysm exceeding 7 cm in diameter. In a previous study from our clinic, a series of patients with AAA and concomitant coronary artery disease were treated with one-stage operations for aneurysms with a mean diameter of 8.25 cm and critical coronary artery disease.

In our patient, we performed a two-stage operation with off-pump CABG. The rationale for this choice was based on both the clinical condition of the patient, that is his chief complaints were due to coronary artery disease and the aneurysm diameter was less than 7 cm, and the presence of HSK. The existence of HSK would prolong the operation time, which would increase postoperative morbidity and the risk for mor-

![Fig. 1. Magnetic resonance angiography confirmed the presence and size of the aneurysm and gave information about its location at the infrarenal level.](image1)

![Fig. 2. (a) An operative view of the horseshoe kidney and the abdominal aortic aneurysm. The technique of hanging the isthmus without division enabled good access to the aneurysmal sac. (b) The view of the tubular graft after implantation and the horseshoe kidney.](image2)
tality (especially in those associated with renal insuf-
ficiency).

Nearly 15% to 30% of patients with HSK are report-
ed to have asymptomatic, ascending urinary tract infec-
tions caused usually by intestinal gram-negative organ-
isms, making the patient prone to infections. Since the
risk for an infection would be amplified in the more
traumatic one-stage approach, AAA repair was
reserved for a subsequent operation.

We used the off-pump technique for CABG in our
patient to avoid hemorrhagic, cerebral, and pulmonary
effect side effects and related mortality in cardiopulmonary
bypass surgery.

Identification of an HSK preoperatively will allow
the surgeon to prepare for the operation. Detection of
this abnormality may also be made at surgery, but this
will prolong the operation and significantly increase the
risk for injury to the isthmus. In our patient, the diag-
nosis of HSK was made before surgery.

Computed tomography is reported to give the most
detailed information regarding the HSK morphology
and the anatomic features and relations of the kidney, its
vessels, and the aneurysm in 90% of the cases. Intravenous pyelogram reveals anomalies of the urinary
tract, with an 88% sensitivity in visualization of an
HSK. The success rate of angiography (performed in
posteroanterior and lateral projections) to visualize an
HSK is 67%, while it is only 38% by ultrasound scan-
ing. Hence, to date CT has been the gold standard in the visualization of HSKs and their anatomic relation
with aneurysms.

During surgery for HSKs, the most important con-
ideration is the surgical approach to the aorta, avoiding
the renal isthmus and identifying the anomalous
renal arteries. Median laparotomy enables to com-
pletely explore the peritoneal cavity; therefore, both iliac
vessels can be checked and any coexistent anomaly
detected. However, in the case of an HSK, the renal
isthmus would hinder approach to the aorta and the
reimplantation of any anomalous renal vessel would be
difficult. If arterial disease is limited to the aorta, the
retroperitoneal approach would not cause problems
for the dissection of anomalous renal structures;
thus, making it an alternative approach. In our
patient, we preferred a median laparotomy for better
visualization.

Although resection of the renal isthmus facilitates
the approach to the aorta, it is associated with com-
lications such as bleeding, ischemia, retroperitoneal
urinary filtration, and graft sepsis. Therefore, this
practice is giving way to not performing isthmic resec-
tion. In our patient, the renal isthmus was preserved.

When clamping of the infrarenal aorta is not feasible,
suprarenal clamping or intraaortic occlusion should be
considered, in which circumstance renal protection
emerges as the main problem. This requires that the
cross clamping period of the aorta be minimized and
cold perfusion be performed to renal arteries.

Preoperative evaluation of renal functions is impor-
tant in determining the prognosis of patients with HSK,
as early postoperative mortality rates are reported to be
higher for patients requiring hemodialysis (67% vs
6.3%). Our patient had normal renal functions and no
complications developed postoperatively.

It can be concluded that the presence of an HSK is
not a contraindication to surgical treatment of AAA,
though it may somewhat make the surgical repair tech-
ically difficult. In case AAA is associated with coro-
nary artery disease, a two-stage operation should be
chosen with CABG on the beating heart to minimize
the adverse effects of cardiopulmonary bypass. Separation of the renal isthmus should be avoided
while repairing the AAA. Mobilization of the isthmus
obviates its division and provides good access to the
aneurysm.

REFERENCES

1. Bauer SB, Perlmutter AD, Retik AB. Anomalies of the upper
urinary tract. In: Walsh PC, Retik AB, Stamey TA, Vaughan
2. Bomalaski MD, Gardner AL, Madison DL. Aortic surgery
complicated by horseshoe kidney. Indiana Med 1988;81:
688-93.
Abdominal aortic surgery and horseshoe kidney. Arch Surg
4. Stroosma OB, Kootstra G, Schurink GW. Management of
aortic aneurysm in the presence of a horseshoe kidney. Br J
5. Friedman SG, Safa T, Nussbaum T, Pogo G, Levy M.
Combined off-pump coronary artery bypass and abdominal
aortic surgery is associated with low morbidity and mortal-
6. Endo M, Aomi S, Tomisawa Y, Uchikawa S, Kihara S,
Yamasaki K, et al. Selection of surgical strategy for abdomi-
nal aortic aneurysm coexisting with coronary artery disease;
one-stage versus two-stage, and off-pump versus on-pump.
7. Mansuroglu D, Omeroglu SN, Erentug V, Antal A, Goksedef
8. Kolln CP, Boatman DL, Schmidt JD, Flocks RH. Horseshoe
9. Kirklin JK, Westaby S, Blackstone EH, Kirklin JW,
Chenoweth DE, Pacifico AD. Complement and the damag-
ing effects of cardiopulmonary bypass. J Thorac Cardiovasc
A, et al. Combined off-pump coronary artery bypass and