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Use of tubularized bovine pericardium in left renal vein transposition for nutcracker syndrome

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ABSTRACT

Nutcracker syndrome is an extrinsic compression of the left renal vein by the superior mesenteric artery anteriorly and aorta posteriorly, resulting in hallmark manifestations of hematuria, proteinuria, and flank and/or pelvic pain. This report illustrates the case of a patient with a history of left flank pain and intermittent gross hematuria every 2 weeks. The patient denies any pelvic pain or gastrointestinal or lower extremity symptoms. Urinalysis revealed red blood cells, but no infection was noted. The cystoscopy findings were normal. Computed tomography urography showed left renal vein and duodenal compression between the aorta and superior mesenteric artery with a narrow aortic–superior mesenteric artery angle. The patient underwent left renal vein transposition to the distal inferior vena cava via a transabdominal approach. The left renal vein was transected at the inferior vena cava; however, the length was too short to create a tension-free anastomosis. Thus, a bovine pericardium sheet was tubularized and used as an interposition graft. The patient recovered well and is symptom-free. Left renal vein transposition is a well-described surgical technique in the treatment of nutcracker syndrome. The use of a vein or prosthetic graft has been described. This case demonstrates the use of an alternate conduit for reconstruction. (J Vasc Surg Cases Innov Tech 2023;9:101301.)

Keywords: Nutcracker syndrome; Pelvic congestion syndrome; Pelvic venous disorder; Renal vein transposition

CASE REPORT

The patient is a 22-year-old woman with a 4-year history of left flank pain and intermittent gross hematuria. She was initially seen and evaluated by a urologist for hematuria and symptoms suspicious for urinary tract infection, including a sensation of incomplete bladder emptying, urinary urgency and frequency, lower back pain, and lower abdominal cramping pain. She had a history of recurrent urinary tract infections. The laboratory test results were unremarkable, with normal blood counts and creatinine. The most recent urinalysis showed the presence of red blood cells, but no infection. She underwent computed tomography urography for evaluation to find the source of the hematuria, which demonstrated evidence of a narrow aorta–superior mesenteric artery (SMA) angle and associated compression of the left renal vein and duodenum (Fig 1). She underwent cystourethroscopy to ensure no bladder pathology was present, with normal findings. She was then referred to the vascular surgery team for evaluation for nutcracker syndrome. The patient's body mass index (BMI) was 18 kg/m^2, and the physical examination findings were unremarkable with a soft, nontender, nondistended abdomen and no audible bruits or palpable masses. Given that the patient's clinical and imaging results were highly suggestive of nutcracker syndrome, the management options were discussed with patient, including conservative therapy, diagnostic venography, or proceeding with therapeutic intervention. Because the clinical and imaging findings were convincing for nutcracker syndrome and the patient was significantly affected by her symptoms, we decided to proceed with treatment. The team discussed the options for treatment, including endovascular stenting of the left renal vein vs an open surgical approach with left renal vein transposition. Given the small-diameter left ovarian vein and the absence of concomitant signs or symptoms of pelvic venous congestion, she was not thought to be a suitable candidate for left ovarian vein transposition. After extensive discussion of the risks and benefits of each option, she elected to proceed with left renal vein transposition. The patient provided written informed consent for the report of her case details and imaging studies.

The patient was taken to the operating room electively, and a midline supraumbilical incision was performed for a transperitoneal approach. The small bowel was retracted to the right, and the duodenum was mobilized. Once the left renal vein was identified, it was dissected free of surrounding tissue toward the inferior vena cava (IVC). The IVC was dissected with sufficient length distally to reimplant the left renal vein ≥3 to 4 cm below its initial insertion site. A left lumbar collateral vessel,

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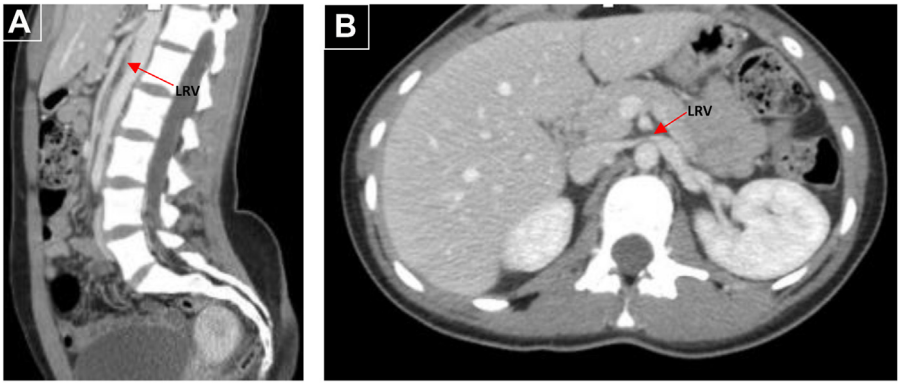

Fig 1. Computed tomography urogram demonstrating extrinsic compression of left renal vein by the superior mesenteric artery (SMA) and aorta on sagittal (**A**) and axial (**B**) views.

the left gonadal vein, and the left adrenal vein were ligated and divided to allow for sufficient mobilization of the left renal vein. After a heparin bolus was administered at 80 U/kg, a side-biting clamp was placed on the IVC at the location of the left renal vein, and the renal vein was clamped and transected at its junction with the IVC. The left renal vein stump on the IVC was oversewn with double-layer 5-0 Prolene suture. On inspection of the target site for reimplantation of the left renal vein to the distal IVC, the left renal vein was of insufficient length to reach the planned anastomosis site without the use of an interposition graft. Given our previous discussion with the patient in which she requested the avoidance of any prosthetic graft or stent, we decided to create an interposition graft crafted from a tubularized bovine pericardium patch. We considered the use of an autogenous conduit; however, given the diameter and length of the interposition graft required, this was not deemed a suitable option. A 4- × 5-cm bovine pericardium patch was obtained and folded along the 4-cm length to create a tube using running 5-0 Prolene suture. An end-to-end anastomosis was created between left renal vein and the tubularized bovine pericardium patch, and end-to-side anastomosis was created between the IVC and the interposition graft for a tension-free anastomosis (Fig 2). Venous flow was audible via Doppler of the renal vein at the completion of the case. The patient had an uneventful recovery and was discharged home on postoperative day 3 with instructions to take 81 mg of aspirin daily. Surveillance duplex ultrasound was performed at 1 and 6 months postoperatively and demonstrated a patent left renal vein and interposition graft with normal flow patterns. At 6 months of follow-up, the patient reported complete resolution of her flank and back pain, hematuria, and urinary symptoms. The patient will be followed up annually for clinical assessment and renal vein duplex ultrasound surveillance.

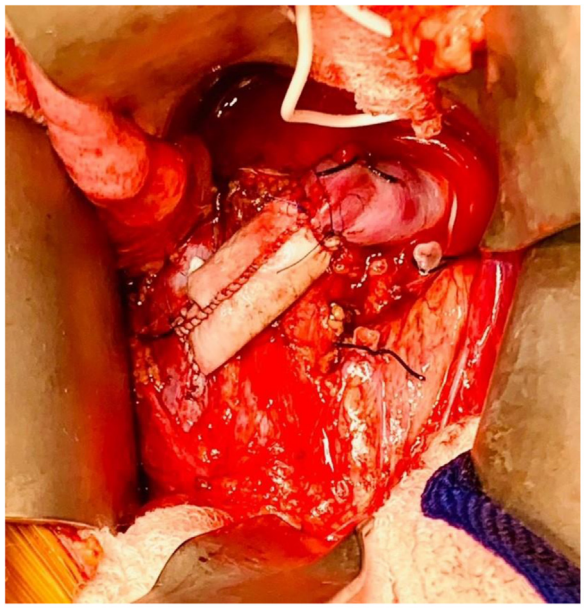

Fig 2. Tubularized bovine pericardium patch used as interposition graft in left renal vein transposition.

DISCUSSION

This case demonstrates the use of tubularized bovine pericardium as an alternative conduit for reconstruction in left renal vein transposition for the treatment of nutcracker syndrome. In this setting, adjunct techniques can be necessary to create a tension-free transposition of the renal vein sufficiently distally on the IVC to avoid persistent compression in the setting of a narrow aorta–SMA angle. The use of an autogenous vein and a prosthetic graft has been previously described.

Nutcracker syndrome was first described in 1972, illustrating the effect of a narrow angle between the SMA and aorta compressing the left renal vein. An aortomesenteric angle of $<35°$ to 39°, when accompanied by symptoms consistent with nutcracker syndrome, is considered diagnostic for this clinical phenomenon.[1-3] Various imaging modalities can be used in the diagnosis of nutcracker syndrome. Computed tomography, magnetic resonance imaging, and duplex ultrasound can all be used in patients with suspected nutcracker

syndrome to define the anatomic details. Often, diagnostic venography with pressure measurements across the compressed segment of the renal vein are used for definitive diagnosis.[4,5] In the present case, the patient had an acute aortomesenteric angle of 18°, with a complex of symptoms highly suggestive of nutcracker syndrome, including flank and back pain, hematuria, and urinary symptoms. In addition, other possible causes of her symptoms had been ruled out. Multiple studies have demonstrated a correlation between a low BMI and nutcracker syndrome, with efforts at increasing the BMI shown to improve symptoms. One explanation for this association is the paucity of fatty tissue in the retroperitoneum, which could lift the bowel and increase the angle between the aorta and SMA.[4-6] The typical manifestations of nutcracker syndrome are hematuria, proteinuria, and left flank and/or pelvic pain, which are related to renal venous congestion and increased pressure within the communicating venous structures.[7]

Renal vein transposition is the standard of care for patients with unremitting symptoms and is the most common surgical approach for nutcracker syndrome.[4,5] To create a tension-free anastomosis, the great saphenous vein can be harvested for use as an extension graft or patch onto the left renal vein.[4] Spiral vein grafts created from an autogenous great saphenous vein can also be used. However, given the anatomic factors, including the length and diameter of the required conduit, the use of an autogenous great saphenous vein was not considered a suitable option. The use of a polytetrafluoroethylene interposition graft has also been described in the literature; however, given the patient's strong desire to avoid any prosthetic conduit, we opted to create an interposition graft using a bovine pericardium patch. Other nonprosthetic conduit options include the use of homografts such as cryopreserved artery or vein; however, these options are costly compared with a bovine pericardium or autogenous conduit. In addition, the use of an extravascular polytetrafluoroethylene cuff around the left renal vein has been described in the treatment of nutcracker syndrome. However, this would not have been in line with the patient's desire to avoid a prosthetic graft.[8] We were able to achieve a good size match, it was an inexpensive option compared with a homograft that the patient was satisfied with, and the treatment resolved her symptoms.

CONCLUSIONS

Left renal vein transposition is a well-described surgical technique used in the treatment of nutcracker syndrome. Adjunct techniques can be needed to create a tension-free transposition of the left renal vein. The use of an autogenous vein and a prosthetic graft has been described in this setting. This case illustrates the use of tubularized bovine pericardium as an alternate conduit for reconstruction.

The data supporting the findings of this study are not openly available due to patient privacy, although they are available from the corresponding author on reasonable request.

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