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Surgical management of nutcracker phenomenon presenting as left varicocele in adolescents: A novel approach

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KEYWORDS
Nutcracker phenomenon;
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Abstract *Objective:* To present a new approach using a shunt operation for the management of nutcracker phenomenon presenting as left varicocele in adolescent patients.
Materials and methods: 12 adolescent patients with the nutcracker phenomenon presenting as left varicocele underwent a shunt operation consisting of anastomosis of the proximal part of the spermatic vein and inferior epigastric vein to lower the left renal vein (LRV) pressure. A simple ligation of the left spermatic vein was then used to repair the varicocele.
Results: 12 patients underwent surgery, and symptoms of hematuria, proteinuria, scrotum discomfort, and flank pain disappeared post surgery in all patients. Patients were followed for 24—72 months (mean 48 months). The diameters of the proximal LRV and the peak velocities in the aortomesenteric portion of the LRV were significantly decreased after surgery ($p < 0.001$). Left testicular volume significantly increased after surgery. One patient had recurrence of the left varicocele and one adolescent had minimal hydrocele requiring no intervention. No major complications were observed during and after surgery.
Conclusion: Anastomosis of the proximal part of the spermatic vein and inferior epigastric vein is an efficacious and safe surgical approach for the management of nutcracker phenomenon presenting as left varicocele in adolescents.
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Introduction

The nutcracker phenomenon, defined as compression of the left renal vein (LRV) between the aorta and the superior mesenteric artery (SMA), has been implicated in the development of varicocele in adolescents, particularly in tall and thin individuals [1—3]. As varicocele has been demonstrated to adversely affect testicular growth and function, adolescents with a testicular volume discrepancy of greater than 20% need to undergo corrective surgery [4]. A simple ligation of the left spermatic vein is an effective approach for managing patients with varicocele without the nutcracker phenomenon. However, for patients with the nutcracker phenomenon presenting as left varicocele, this approach is ineffective in resolving LRV hypertension; most patients have recurrence shortly after the procedure and symptoms of hematuria, proteinuria, and flank pain persist and may even become worse without the compensatory effect of the spermatic vein. Other surgical treatments, including nephropexy [2], LRV transposition [5—7], SMA transposition [8], left renal autotransplantation [9,10], and endovascular stenting of the LRV [11], have already been proven useful in adults, but they are relatively invasive or expensive, and have not been extensively performed in adolescent patients. In this study, we aim to share our experience in the surgical management of 12 adolescent patients with nutcracker phenomenon presenting as left varicocele.

Materials and methods

Subjects

Between July 2002 and June 2009, 35 consecutive adolescent patients (age range 9—18 years; mean 14.5 years) with readily visible varicocele were referred to the radiology department for ultrasound (US) evaluation of the varicocele and Doppler spectral analysis of the LRV. US was performed in both supine and upright positions using an HDI 3000 unit (Advanced Technology Laboratories, Bothell, WA, USA) equipped with a 2—4 MHz or a 4—7 MHz curved-array transducer. The anteroposterior diameter and peak velocity were measured in the transverse plane at two points in the LRV—one at the proximal portion of the LRV near the hilum in front of the lateral edge of the vertebral body, and the other where the LRV travels between the aorta and the SMA. The LRV diameter ratio and peak velocity ratio between the proximal LRV and aortomesenteric portion of the LRV were calculated. Kim suggested that a distal-to-proximal diameter ratio and flow velocity ratio exceeding 5.0 represented the nutcracker phenomenon cutoff levels [12]. Patients had aortomesenteric portion-to-proximal LRV diameter ratios and flow velocity ratios that exceeded 5.0, thus indicating that they had the nutcracker phenomenon (Fig. 1A—C). Computed tomography (CT) or magnetic resonance imaging (MRI) was performed for some of these patients to confirm the diagnosis (Fig. 2). Varicocele occurred on the left side in all 35 patients, although nine patients had bilateral varicocele. However, the 12 patients diagnosed with the nutcracker phenomenon also had a testicular volume discrepancy of greater than 20%. Of these 12 patients, all presented microscopic hematuria, mild proteinuria, and tolerable scrotum discomfort, and six presented with mild flank pain. Written informed consent was obtained from the patients or the patients' parents in the case of those younger than 18 years, and this study was reviewed by our ethics committee and considered ethically sound. The follow-up protocol included clinical examinations, urinalysis, and ultrasonography for all 12 patients. No additional invasive radiologic examination was performed because of the patients' young ages.

Surgical procedure

A skin incision of about 5 cm was made along the internal inguinal canal. The largest internal spermatic vein was exposed, and the other spermatic veins including the external spermatic veins were completely ligated near the external inguinal canal. The inferior epigastric vein was then exposed and an end-to-end anastomosis was performed with the previously isolated proximal part of the spermatic vein by a 7—0 vascular suture. As a result, blood in the LRV was able to flow into the spermatic vein and then into the inferior epigastric vein (Fig. 3). Magnifying glasses with 4× magnification were used during surgery for a clearer view of the procedure.

Statistical analysis

Absolute values and ratios of LRV diameter and peak velocity were compared with pre-surgery values using a paired t test. A two-tailed $p \leq 0.05$ was considered statistically significant.

Results

A total of 12 patients were enrolled in the study, and the mean age ± SD of the participants was 14.5 ± 2.9 years. All 12 patients met the criteria for the diagnosis of the nutcracker phenomenon.

Each patient underwent successful surgery consisting of end-to-end anastomosis of the spermatic vein and inferior epigastric vein combined with a simple ligation of the left spermatic vein. The mean operative time was 60 min. The average blood loss was less than 10 mL. All the patients were discharged 2 days post surgery. One patient had minimal hydrocele requiring intervention and no major complications, such as hematoma, infection, and testicular atrophy, occurred during and after surgery. In the 24—72 months (mean 48.0 months) of follow-up, each patient showed improvement post-operatively. No stenosis in the vascular anastomosis stoma was observed and blood flow was seen to increase significantly during the Valsalva maneuver (Fig. 4). Urine tests did not reveal any abnormalities. No patient had an increase in blood urea nitrogen and creatinine levels after surgery. Patients did not feel scrotum discomfort and flank pain post surgery, and there was only one recurrence of varicocele on the left side. After surgery, the increase in left testicular volume was 4.25 ± 1.6 mL and the testicular volume discrepancy disappeared.

The mean diameter of the proximal LRV was 9.6 ± 2.2 mm (range 6.6—13.1 mm) before surgery and 6.0 ± 0.9 mm

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