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Robotic microsurgical spermatic cord denervation for chronic orchialgia: a case series

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Abstract

Context: Chronic orchialgia is a frustrating urologic condition that is commonly refractory to conservative modes of therapy. Microscopic spermatic cord denervation is a proven solution for patients who do not achieve relief from nonsurgical treatments. However, current widely used techniques require additional training in microsurgery.

Objective: To describe an adaptation and improvement of spermatic cord microdenervation technique that leveraged the robotic surgical training common for new urologists and is also accessible for urologists not specifically trained in microsurgery.

Methods: Robotic-assisted microdenervation of the spermatic cord was performed in three patients using a fluorescence vascular imaging tool to improve visualization of vascular structures (Firefly™; Innovative Surgical, Sunnyvale, CA, USA), along with a tissue matrix allograft to allow for better healing (AminoFix™; MiMedx®, Marietta, GA, USA).

Results: All three patients (100%) experienced post-operative resolution of their chronic orchialgia, and none reported any new pain.

Conclusion: Utilization of robotic-assisted surgery offers more urologists the ability to use familiar techniques to treat chronic orchialgia when conservative measures are unsuccessful.

Keywords: orchialgia; pain; surgery; testicular pain; urologic; urology; vasectomy.

Chronic orchialgia is defined as intermittent or constant testicular pain lasting three months or more that is significantly disruptive to the patient's quality of life.¹ As conservative treatment options can have relatively low efficacy,¹ surgical intervention has been shown to be a valuable tool in managing this condition.^{2–4} Robotic-assisted microsurgical cord denervation (RMSCD) has been previously described as an effective option for treating chronic orchialgia;⁴ during RMSCD, which can be performed with tools such as the da Vinci Xi®, proper visualization of the testicular artery and other vessels are crucial. Techniques previously described in the literature for this purpose include intraoperative Doppler ultrasound and application of vasodilating agents to the cord.^{2,3} The Firefly™ fluorescence vascular imaging tool on the da Vinci Xi® has been previously described for a variety of urologic cases, including robotic-assisted partial nephrectomy,⁵ but to our knowledge, the incorporation of Firefly™ during RMSCD for visualization of the testicular vessels has not been published in the literature. Additionally, the use of AminoFix™ (MiMedx®; Marietta, GA, USA) during RMSCD to assist in healing of the spermatic cord has not been described to date. In this brief report, we present three cases in which an RMSCD technique with Firefly™-facilitated visualization and application of AmnioFix™ allograft for healing was used to treat chronic orchialgia.

Methods

The present study protocol was reviewed and approved by the University of Louisville Institutional Review Board (approval number: 20.0521). As this was a retrospective chart review, it was deemed exempt from human subject research protocols.

Case studies for each of three patients with chronic orchialgia from January 2017 to January 2020 are provided following the surgical technique description. These patients were selected retrospectively, and no patients during this period were excluded. Each patient's candidacy for RMSCD was determined by response to an

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in-office nerve block of the spermatic cord using 12 mL of lidocaine or bupivacaine without epinephrine, which is both diagnostic and therapeutic. The algorithm displayed in Figure 1 outlines the treatment approached used for each patient. All patients had resolution of their orchialgia following a cord block and were deemed likely to have a successful RMSCD based on previously published work.²

Surgical technique

After the patient was prepped and draped in standard sterile fashion, a 2 cm subinguinal incision was made. The spermatic cord was identified, carefully brought up to the skin level, and isolated. A Penrose drain was used to elevate the cord and secure the excision. Next, the da Vinci Xi[®] robot (Intuitive Surgical, Sunnyvale, CA, USA) was docked. Black Diamond micro-forceps (Intuitive

Surgical) were used for robotic arms as well as da Vinci Potts scissors (Intuitive Surgical) and Force Bipolar forceps (Intuitive Surgical). The external spermatic fascia and cremasteric muscle were dissected off the cord (Figure 2A). All RMSCD procedures were performed by the same surgeon (K.C.).

Firefly[™] fluorescence imaging was used at multiple points throughout each of the cases to identify vasculature structures (Figure 2B). After the testicular artery and vas deferens (as well as a few veins, lymphatic vessels, and small arteries) were identified and isolated using vessel loops (Figure 2C), all other structures were carefully dissected, ablated, and ligated to ensure adequate denervation. AmnioFix[™], a dehydrated human amnion/chorion membrane, was then wrapped around the remaining cord structures and secured using braided absorbable synthetic suture in running fashion. This promotes healing via increased angiogenesis and helps to reduce the risk of postoperative neuroma formation. After sufficient

Figure 1: Algorithm for treatment of chronic orchialgia.

RMSCD, robotic assisted microsurgical cord denervation; STI, sexually transmitted infections; TENS, transcutaneous electrical nerve stimulation.

Figure 2: (A) Division of the cremasteric fibers of the spermatic cord. (B) Identification of the deferential artery using Firefly™ fluorescence imaging. (C) Isolation of the testicular artery and vas deferens (as well as a few veins, lymphatic vessels, and small arteries).

hemostasis was established, the robot was undocked and ports were removed. The subinguinal incision was closed in two layers using both braided and monofilament synthetic absorbable sutures. Skin closure was then performed using monofilament absorbable synthetic suture and medical skin adhesive. Of note, an assistant was available at bedside to assist in visualization using Weck-cel™ (Beaver-Visitec International, Waltham, MA, USA) as well as small suction to dry the the cord structures.

therapy. Rectal diazepam (recommended after a physical therapy evaluation) and gabapentin did provide partial relief; despite these conservative measures, the orchialgia continued to worsen over the next year.

Fourteen months after the initial presentation, a trial of in-office spermatic cord nerve block showed immediate relief of orchialgia that lasted for six days. Following this successful trial, the patient wished to proceed with RMSCD of the right spermatic cord, as described previously.

Patients

Patient 1

The first patient was a 27-year-old man who presented to the office in March 2017 with a 10-day history of a progressively enlarging nodule of the right testicle that was associated with a pulling sensation and a burning pain that radiated to the lower abdomen for a few hours each day. The patient reported pain with ejaculation but denied erythema, tenderness, hematuria, or hematospermia. He also denied any trauma, though he had parachuted in the military until two years prior. The patient had never consumed alcohol or smoked cigarettes.

On exam, there was a 3–4 mm, mobile, round cyst of the right testicle. Testicular ultrasound revealed a moderate right hydrocele and a 4 mm right spermatocele. Urinalysis and sexually transmitted diseases panel were negative.

Conservative management was attempted via acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), scrotal support, and pelvic floor physical

Patient 2

The second patient was a 55-year-old man who presented in May 2019 with right groin pain radiating to the scrotum that was first noticed before ventral and right inguinal hernia repairs one year prior. Following the procedure, he noticed a painful “knot” in the right hemiscrotum that continued to bother him until office presentation. His past medical history was significant for right hydrocelectomy, hepatitis C, cirrhosis, and a gunshot wound 30 years prior that resulted in a lumbar fracture. He rated his pain as seven out of 10 on the visual analogue scale⁶ and reported partial relief with oxycodone. He denied any urinary symptoms. He had a history of heavy alcohol and tobacco use, and he denied a family history of genitourinary cancer. Upon examination, there was tenderness on palpation of the right spermatic cord with no appreciable mass.

An in-office right spermatic cord nerve block was performed secondary to a “thickened spermatic cord.” This resulted in alleviation of his pain within 5 min. Before resorting to surgery, the patient wished to try a more conservative approach. He completed a five-week course of

pelvic floor physical therapy, during which he reported significant resolution of the pain. However, it returned shortly after stopping the therapy. After discussion of his options, the patient elected to undergo RMSCD of the right testicle with the technique described previously.

Patient 3

The third patient in our series was a 30-year-old man with a history of acute inflammatory demyelinating polyradiculoneuropathy and spinal cord injury at L4–L5 who presented in December 2018 with a two-year history of left-sided orchialgia. Pain began following a vasectomy and worsened after an exploratory surgery eight months prior to presentation during which the left epididymis was removed. He described it as a sharp and constant squeeze exacerbated by movement and ejaculation that did not improve with ice, heat, or scrotal support. He had a previous nerve block following the exploratory surgery that did not provide relief of his pain. He denied any urinary symptoms or heavy alcohol use and reported previous tobacco use.

A testicular ultrasound was performed which revealed no gross abnormalities that could explain his symptoms. After 12 weeks of conservative management with pelvic floor physical therapy and rectal diazepam with no resolution of the pain, the patient underwent spermatic cord nerve block that successfully relieved this pain. The patient then agreed to undergo RMSCD of the left spermatic cord with the technique described above.

Results

Patient 1

The procedure lasted 2 hours, and there were no intraoperative complications. Pathology from this patient's surgical procedure showed nerve fibers and otherwise benign findings. Following the procedure, the patient reported resolution of pain as well as lack of sensation in the testicle; however, he still complained of urinary frequency and urgency that did not respond to mirabegron, and he is exploring other overactive bladder treatment options. At his 6-month follow-up appointment, the patient verbally reported to the surgeon that he had excellent pain relief as a result of the RMSCD treatment.

Patient 2

The procedure lasted 2 hours, and there were no intraoperative complications. Two weeks after his surgical

procedure, this patient reported complete resolution of the orchialgia. The pathology from the procedure showed “fibrovascular tissue with vascular congestion” and no evidence of malignancy. At his five-month follow-up appointment with the surgeon, the patient continued to report no pain in right testicle.

Patient 3

The procedure lasted 1 hour and 45 minutes, and there were no intraoperative complications. Two weeks following his procedure, the patient reported to the surgeon that he was completely pain-free. Pathology revealed fragments of fibroadipose tissue and skeletal muscle that did not show any evidence of malignancy. The patient was not seen after his two-week follow-up appointment.

Discussion

A previous study reported that as many as 30% of men with chronic orchialgia were unable to perform their normal daily activities.⁷ Though the literature has shown that as many as half of chronic orchialgia cases are idiopathic in nature,¹ two of the three patients in our series had trauma from surgery (hydrocelectomy and vasectomy) as the likely cause; the remaining patient's history of parachuting could have been a source of trauma that led to the development of his pain.

Ideally, chronic orchialgia should be managed via more conservative means. Conservative options described in previous literature include NSAIDs and tricyclic antidepressants such as amitriptyline and nortriptyline.⁸ Additional options utilized in our clinic have included pelvic floor physical therapy and rectal diazepam. Each patient in this series attempted to control their pain with conservative means but had limited success. Upon failing initial treatments, each patient showed significant improvement of their pain after administration of a diagnostic spermatic cord nerve block. Postoperative resolution of each patient's presenting orchialgia upholds a correlation from a previous study between nerve block success and microdenervation success.² Figure 1 outlines the management steps used in these cases. Other surgical options for the treatment of chronic orchialgia include epididymectomy, vasovasostomy, and orchiectomy, but previous studies have shown these interventions have much lower rates of complete pain relief.^{1, 9–11}

While use of the da Vinci Xi[®] robot (when available) can impact the cost and duration of procedures, it also

eliminates surgeon hand tremor,¹² improves visualization via magnification, and provides access to a wide range of integrated and innovative tools. Typically, an intraoperative Doppler ultrasound device is used in the non-robotic approach that requires the use of a microscope. One tool that was used for this case series efficiently was Firefly™ fluorescence imaging. In our case series, it allowed the vascular structures to be immediately and precisely located by the surgeon at multiple points throughout the procedures. Importantly, this technique can be utilized by all urologists, regardless of whether they have had additional microsurgery training. Over the years, robotic surgery's prevalence in urological training has grown, whereas microsurgery training has often been lacking.¹³ Robotic surgery is a beneficial and empowering tool that bridges this gap and allows more urologists to treat chronic orchialgia, a devastating condition that has proved difficult to manage.

AminioFix™ was used to wrap the spermatic cord prior to closure for the purpose of improved healing and reduced risk of postoperative neuroma formation. A previous study showed that the use of dehydrated amniotic membrane allograft in microscopic denervation of the spermatic cord reduced postoperative pain scores and decreased the likelihood that patients would require subsequent orchiectomy due to continued chronic orchialgia.¹⁴

Other previous studies have shown tremendous success with microdenervation procedures, with some reports displaying cure rates as high as 90%.^{3,8,15} Through our case series in which we utilized Firefly™ and AminioFix™, our 100% success rate using robotic-assisted microdenervation parallels the rates of previous studies and did not require the use of a microscope during the procedure. Additionally, none of our patients reported any new pain following their procedures.

This brief report of a case series had several limitations. First, the sample size of this report is very small; a much larger patient cohort would be needed to validate the study. Also, our follow-up period for these cases was very short, ranging from two weeks to six months. Having a consistent set of follow-up appointments at six months, one year, and five years would give a better idea of the long-term efficacy of the procedure. Finally, an appropriate comparison group is needed to determine how this method affects the outcome and cost of the procedure.

Conclusion

Chronic orchialgia is a relatively common and truly debilitating condition that has proved to be a difficult problem to manage as a urologist. Conservative measures, such as medications and floor-strengthening exercises, often do

not provide adequate or lasting relief of symptoms for many of these patients. As urology residency programs place a greater focus on robotic training, RMSCD is a great addition to a new urologist's repertoire. When managing chronic orchialgia, it is an effective and safe option to consider, especially when utilizing Firefly™ and AminioFix™ for successfully reproducible results.

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Competing interests: Authors state no conflict of interest.

Informed consent: Informed consent was obtained from all individuals included in this study.

Ethical approval: The present study protocol was reviewed and approved by the University of Louisville Institutional Review Board (approval number: 20.0521). It was not prospectively registered as a clinical trial.

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