Micro-Denervation of the Spermatic Cord for Post-Vasectomy Pain Management

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ABSTRACT

Introduction: Post-vasectomy pain syndrome (PVPS) is a challenging problem for the practicing urologist because of its unclear pathophysiology and no clearly established protocol for evaluation or treatment. PVPS is defined as at least 3 months of chronic or intermittent scrotal content pain after a vasectomy procedure once other etiologies for the pain have been ruled out.

Aim: To systematically review the current literature on the effectiveness of micro-denervation of the spermatic cord (MDSC) for PVPS.

Methods: A systematic literature search using PubMed, Scopus, Medline, Embase, and Cochrane databases for all reports pertaining to PVPS using the Medical Subject Heading terms *post vasectomy pain syndrome* and *micro-denervation of spermatic cord* through February 2017.

Main Outcome Measures: Scrotal content pain after MDSC for PVPS.

Results: There were nine retrospective studies evaluating MDSC for chronic testicular pain. After omitting repeated series, there were 213 patients who underwent MDSC for chronic orchialgia. Only one study specifically reviewed the outcomes of patients who underwent MDSC for PVPS. In this study, 17 patients underwent MSDC for PVPS, with 13 (76.5%) reporting complete relief of pain at their first follow-up visit. The other four patients had significant improvement in pain and were satisfied with the results. Long-term follow-up data were not available for this study.

Conclusion: MDSC remains a valuable approach with high success rates and should be considered for PVPS that is refractory to medical therapy. MDSC appears to have the most success for patients who experience a temporary relief from a cord block and can significantly improve the patient's quality of life and ability to return to daily activities. **Tan WP, Levine LA. Micro-Denervation of the Spermatic Cord for Post-Vasectomy Pain Management. Sex Med Rev 2018;6:328–334.**

Key Words: Micro-Denervation of Spermatic Cord; Orchalgia; Post-Vasectomy Pain Management; Post-Vasectomy Pain Syndrome; Testicular Pain

INTRODUCTION

Vasectomies are the most effective male contraceptive method available. It is one of the most common surgical procedures performed worldwide. It is estimated that 500,000 vasectomies are performed in the United States per annum, representing 10.2 of 1,000 in men 25 to 49 years old.[1] The vasectomy procedure involves excising a portion of the vas deferens and this is often performed under local anesthesia in an outpatient setting. Traditionally, this procedure involves making bilateral small scrotal incisions on the lateral portion of the scrotum to expose and visualize the vas deferens, excising at least 1 cm of the vas deferens, followed by electrocautery fulguration of the ends of the vas deferens, placing sutures or clips on each end, and interposing tissue between the two cut ends to further prevent recanalization. More recently, techniques such as scalpel-free vasectomies and single-incision vasectomies have been described. The success rate of a vasectomy as a form of contraception ranges from 98% to 99%.[1,2] The most common complications include bleeding, development of a hematoma, and infection of the scrotal incision sites.

Although rare, patients can experience chronic scrotal content pain after a vasectomy. The 2013 American Urological Association guideline states that 1% to 2% of men will develop pain that is severe enough to interfere with the patient's daily activities after vasectomy.[3] This syndrome has been labeled by many terms, including testalgia, chronic orchialgia, chronic scrotal

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content pain, post-vasectomy orchalgia, congestive epididymitis, and chronic testicular pain. Currently, the syndrome is widely accepted as post-vasectomy pain syndrome (PVPS).[4]

There is no clear pathway for the treatment of PVPS. However, pharmacotherapy options should be exhausted before considering surgical treatments, which include epididymectomy, excision of sperm granuloma, vasectomy reversal, and orchiectomy. In this article, we review the success rate of microdenervation of the spermatic cord (MDSC) for PVPS.

SEARCH STRATEGY

A computerized bibliographic search of the PubMed, Medline, Embase, and Cochrane databases for all reports pertaining to PVPS using the Medical Subject Heading terms *post vasectomy pain syndrome* and *micro-denervation of spermatic cord* through February 2017 was conducted. The reference lists of eligible studies and relevant reviews also were searched for additional articles that had not been found in the main search.

ELIGIBILITY CRITERIA AND PATIENTS

All studies pertaining to PVPS and MDSC were included in the review. Studies were excluded if they were published in languages other than English.

BACKGROUND

PVPS differs from acute post-procedure pain, which typically resolves 2 to 4 weeks postoperatively. PVPS is defined as constant or intermittent testicular pain for at least 3 months, sometimes debilitating the individual, prompting the patient to seek medical treatment.[5] The prevalence of PVPS is not known but the incidence has been estimated to be very low (<1% of patients after a vasectomy).[6] However, recent surveys have found that up to 15% of men have PVPS, with 1% to 2% of men reporting severe pain that affects daily quality of life.[7,8] One review reported that up to 1 in 1,000 men who undergo a vasectomy procedure will require a subsequent surgical intervention for chronic pain.[9] The American Urological Association added a statement to their guidelines, which was recently updated in 2013, stating that "Post-vasectomy pain syndrome is a chronic pain syndrome that follows vasectomy. The cause of this syndrome and its incidence are unclear. It is generally treated with anti-inflammatory agents. Occasionally, patients will elect to undergo vasectomy reversal in an attempt to alleviate this syndrome. Unfortunately, the response to surgical intervention is unpredictable."[3]

ETIOLOGY

The pathophysiology of PVPS remains unclear but postulations behind the etiology of testicular pain include damage to the scrotal and spermatic cord nerve structures by inflammatory effects of the immune system, back pressure effects in the post-vasectomy closed system, vascular stasis, nerve impingement, or perineural fibrosis.[4]

Histologic findings within the proximal segment of the vas after vasectomy include thickened basement membranes and increased phagocytosis by Sertoli cells, which are believed to play a part in maintaining normal physiologic epididymal pressure.[10] In patients with chronic testicular pain, this mechanism fails to compensate for the increase in pressure, resulting in epididymal blowout and the development of a sperm granuloma or vasitis nodosa, which tends to occur approximately 5 to 7 years after vasectomy.[11]

In post-vasectomy patients, the blood-testes barrier also is disrupted, leading to detectable levels of serum antisperm antibodies in 60% to 80% of men.[11] Approximately 7% to 30% of post-vasectomy patients also will have antisperm antibodies within the epididymis.[10] Animal studies have found that these antibodies can cause agglutination of sperm, resulting in activation of the complement cascade, leading to formation of immune complexes and deposition of these complexes in the basement membrane.[10,12] All these mechanisms together or individually can contribute toward the development of PVPS.

CLINICAL PRESENTATION

The mean duration to the onset of PVPS is 7 to 24 months.[13] Demographics (race, age, socioeconomic status) and operative techniques (scalpel free vasectomy, clips vs sutures) have not been shown to be associated with the development of PVPS.[14] Signs and symptoms of PVPS include scrotal content pain focusing on the site of the transected vas deferens, epididymis, and testis; fullness of the vas deferens and epididymis; dyspareunia; pain with ejaculation; premature ejaculation; and pain with bowel movement and straining of pelvic floor muscles.[15] Scrotal ultrasonography might show an engorged or thickened epididymis.

EVALUATION

Evaluation includes a thorough history and physical examination. The duration and nature of the pain, severity (on a 0−10 scale), location, radiation, aggravating factors (voiding, bowel movements, sexual or physical activities, prolonged sitting), associated symptoms, and previous therapeutic maneuvers should be obtained.[16] Surgical histories pertaining to the spine, inguinal, scrotal, pelvic, and retroperitoneal space also should be part of the history-taking process. Psychosocial questions to rule out any somatoform disorders, depression, Munchausen syndrome, or history of sexual abuse also should be included.[13]

Physical examination on the normal or less painful side while supine and standing, focusing on the genitalia and groin, also should be performed. A thorough examination of the testes, epididymis, vas deferens, and a 360° digital rectal examination also are recommended to evaluate for tenderness associated with

tight pelvic floor musculature. In patients with a history of spine abnormalities or previous surgery, a thorough neurologic examination of the lower limbs and genitals also should be performed to rule out radicular pain syndromes and neurosensory deficits. Laboratory investigations include a urinalysis and urine and semen cultures to rule out infection if indicated.[3] When microscopic hematuria is identified, computed tomography of the abdomen and pelvis is indicated because stones (especially in the intramural portion of the ureter) can cause testicular pain. All men with chronic orchalgia also should undergo a high-resolution scrotal ultrasound with color flow Doppler to evaluate the contents of the scrotum to rule out any pathologic processes, although the yield from this study has been found to be low.[7,17] The clinician also should consider obtaining a magnetic resonance image of the spine or hips in patients with a history of back or hip abnormalities to rule out nerve impingement.

Performing a spermatic cord block also is a vital part of the examination. A spermatic cord block will allow the clinician to determine whether the pain is being generated from within the scrotum. We recommend that this block be performed by injecting 20 mL of 0.25% bupivacaine or ropivacaine without epinephrine into the spermatic cord at the level of the pubic tubercle.[15] If the pain is conducted through the spermatic cord nerves, the pain should be temporarily relieved after performing the cord block. A saline control to exclude malingering remains controversial but can be offered if the clinician suspects malingering or Munchausen syndrome.

Differential diagnoses for PVPS include nerve impingement or injury (especially after an inguinal hernia repair), varicocele, hydrocele, infection, tumor, intermittent testicular torsion, inguinal hernia, trauma, referred pain, and psychogenic causes.[18] PVPS is a diagnosis of exclusion and the diagnosis should be made only after all these investigative studies have been performed and are negative.

TREATMENT

Currently, there are no published data with good evidence regarding non-surgical intervention for PVPS. However, pharmacotherapy should be considered first line followed by a series of spermatic cord blocks. Initial pharmacotherapy includes a course of non-steroidal anti-inflammatory drugs for 4 weeks. If non-steroidal anti-inflammatory drug therapy fails, then other options include tricyclic antidepressants (TCAs) or anticonvulsants.

The TCA works by inhibiting the reuptake of norepinephrine and serotonin in the brain. It also inhibits sodium channel blockers and L-type calcium channels that are believed to be responsible for its analgesic effect by modulating first-order neuron synapses with second-order synapses in the dorsal horn of the spinal cord. A TCA can take 2 to 3 weeks from initiation of therapy to be effective. The TCA has been shown to be beneficial for idiopathic testicular pain but not in patients with PVPS.[19] However, that study is limited by its small sample and its retrospective nature.

Gabapentin works by modulating the α-2-d subunit of N-type calcium channels, which affects the afferent pain fibers. Anticonvulsants such as pregabalin and gabapentin also have been used to treat idiopathic testicular pain. However, in a subset analysis, Sinclair et al[19] found that patients with PVPS treated with gabapentin also did not show any improvement of pain, similar to the results in patients with PVPS treated with TCA. This study is confounded by its small sample of four patients in the post-vasectomy arm.

Other non-invasive therapies that can be considered include pelvic floor physical therapy, acupuncture, and pulse radiofrequency of the spermatic cord and genital branch of the genitofemoral nerve for PVPS. These therapeutic interventions have some success in patients with chronic testicular pain but have not been looked at in PVPS. Chronic testicular pain can lead to chronic pelvic pain and this subgroup of patients can benefit from pelvic floor physical therapy.[20]

Patients whose medical therapy has failed should be considered for surgical intervention. Surgical intervention includes excision of sperm granuloma, MDSC, epididymectomy, vasectomy reversal, or orchiectomy. The success rates of these procedures remain unclear because of the availability of only small case series of men undergoing surgical treatment for PVPS.

MICRO-DENERVATION OF THE SPERMATIC CORD

MDSC is a relatively new surgical option, which has gained in popularity over the past two decades. The goal of the procedure involves transecting all nerves in the spermatic cord while preserving all arteries (testicular, cremasteric, and deferential) and several lymphatic channels to decrease the likelihood of developing a hydrocele.[21]

Informed consent is imperative because the pain can persist and in some situations worsen after surgery.[22] This could be due to accessory fibers from the pudendal nerve, incomplete cord denervation, or central nervous system sensitization or malingering. Other risks include the development of a hydrocele and testicular atrophy. Patients with bilateral pain are advised to undergo surgery on the more painful side first because pain at the contralateral site occasionally might resolve after MDSC.

There has been no article in the literature pertaining to MDSC specifically for PVPS. However, MDSC has been shown to be an effective treatment modality for chronic testicular pain. One of these series provided a subset analysis of patients with PVPS treated with MDSC. Ahmed et al[23] conducted a retrospective survey of 560 patients after vasectomy to which 396 patients replied. A total of 17 patients underwent MSDC for PVPS, with 13 (76.5%) reporting complete relief of pain at their first follow-up visit. The other four patients had significant

Table 1. Surgical treatment of orchialgia in the literature[22]

			Success, n (%)		
Microsurgical denervation	Units	Follow-up (mo)	Complete	Partial	No relief
Devine and Schellhammer[30]	2	N/A	2 (100)	0	0
Choa and Swami[31]	4	18.5	4 (100)	0	0
Levine et al[32]	8	16.6	7 (88)	1 (12)	0
Ahmed et al[22]	17	N/A	13 (76)	4 (24)	0
Levine and Matkov[33]	33	20	25 (76)	3 (9)	5 (15)
Heidenreich et al[24]	35	31.5	34 (96)	1 (4)	0
Strom et al[21]	95	20.3	67 (71)	17 (17)	11 (12)
Oliveira et al[34]	10	24	7 (70)	2 (20)	1 (10)
Marconi et al[35]	50	6	40 (80)	6 (12)	4 (8)

N/A = not available.

improvement in pain and were satisfied with the results. Long-term follow-up data were not available for this study.

However, multiple studies have shown good success with MDSC for chronic testicular pain (Table 1). We found nine retrospective series in the literature evaluating the success rate of MDSC for chronic testicular pain. We omitted patients from the same cohort. A total of 167 of 213 men (78.4%) based on all cases of MDSC in the English-language literature had complete resolution of scrotal content pain (Table 1). Heidenreich et al[24] reported on a series of 35 patients with 96% complete resolution of pain after MDSC. Strom and Levine[22] reported that durable relief was noted in 71% of men after MDSC. A total of 16% reported partial relief, whereas 9.9% reported no change in pain but no patient reported worsening pain. Men with PVPS were included in these studies but were not specifically addressed.

Larsen et al[25] reported on the most recent results from our institution on MDSC and found that patients who had not undergone a prior attempt at surgical correction for scrotal pain had a mean post-MDSC visual analog scale score of 2 (range = 0–10) and an average pain decrease of 79%. Patients in whom prior surgical correction had failed (ie, epididymectomy, varicocelectomy, and vas reversal) and who subsequently underwent MDSC had a mean postoperative pain score of 3 (range = 0–10) with an average decrease in pain of 67%.[25] We also found that a positive response to spermatic cord block was an independent predictor of MDSC response.[26]

TECHNIQUE

We typically perform the procedure in an outpatient setting under general anesthesia with the aid of an operating microscope

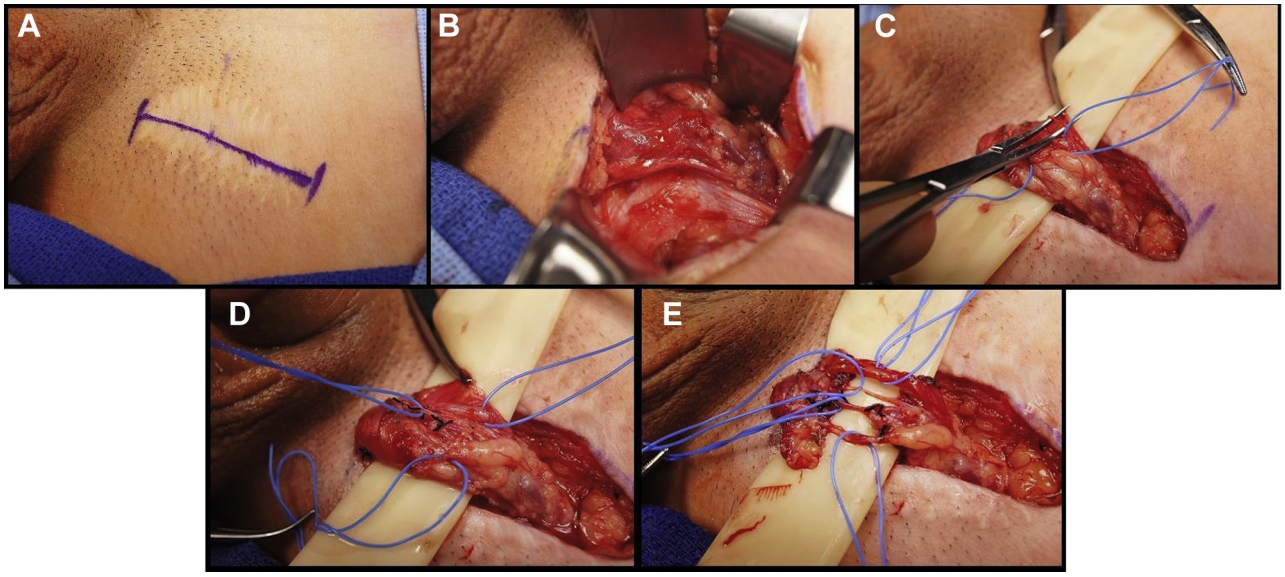

Figure 1. Micro-denervation of the spermatic cord. Panel A shows marking of the inguinal site. Panel B shows dissection to expose the spermatic cord. Panel C shows the spermatic cord supported by a 5/8-inch Penrose drain with the cord fascia opened. Panel D shows arteries secured by a blue vessel loop. Panel E shows that after completion of dissection, only the cremasteric artery, testicular artery, deferential artery, and lymphatics remain (top to bottom).[23,27] Figure 1 is available in color online at www.smr.jsexmed.org.

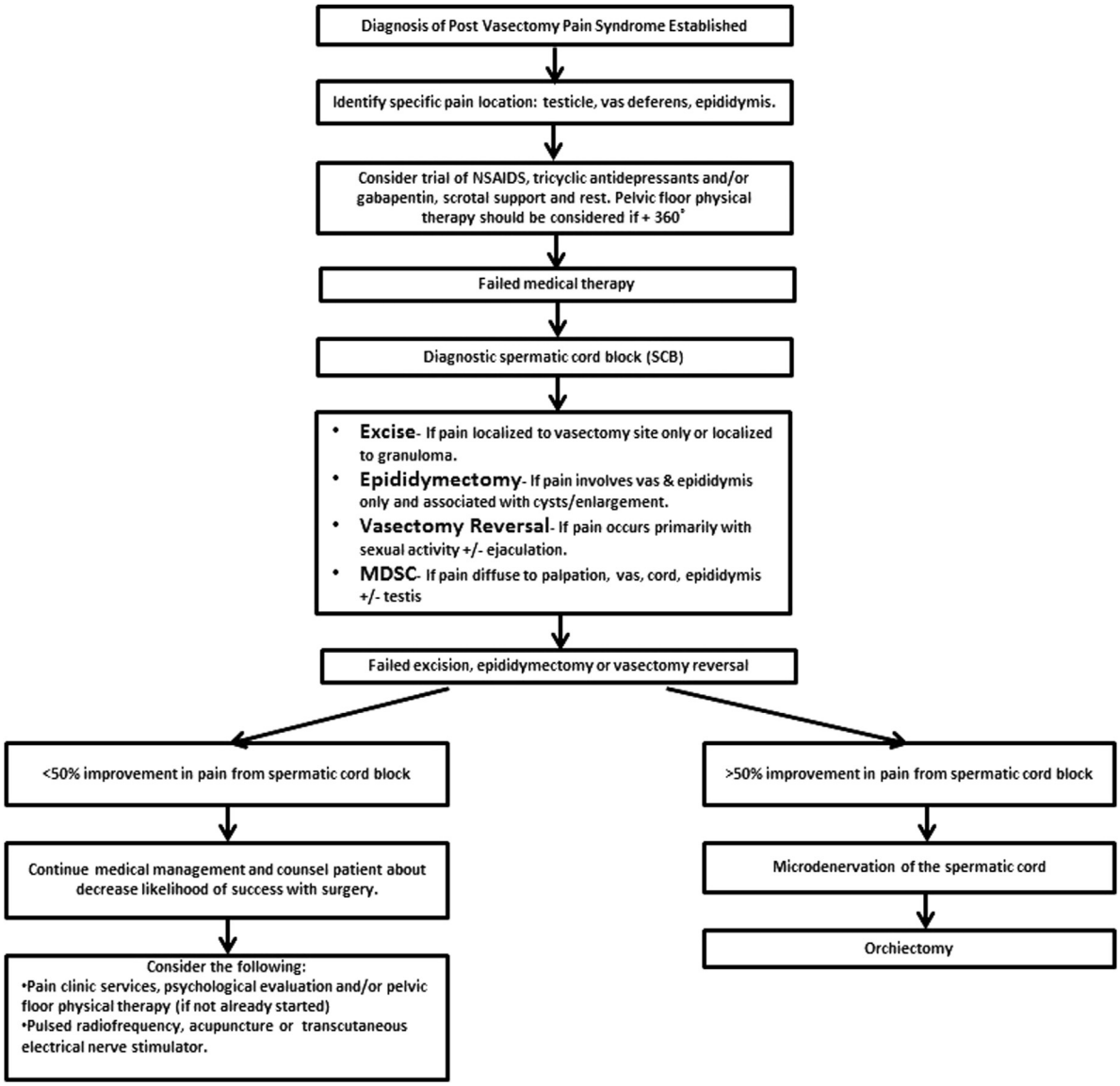

Figure 2. Treatment algorithm for patient with post-vasectomy pain syndrome.[23,27] MDSC = micro-denervation of spermatic cord; NSAIDs = non-steroidal anti-inflammatory drugs.

at 4× to 8× power. The patient is placed in a supine position and, after skin preparation with chlorhexidine, an oblique 3- to 4-cm inguinal incision is centered over the spermatic cord at the level of the external inguinal ring. After dividing the subcutaneous tissue and Scarpa fascia, the spermatic cord is grasped between the index finger and the thumb and isolated circumferentially and a (5/8-inch) Penrose drain is placed under the cord. The ilioinguinal nerve is identified and a 2- to 3-cm segment is excised and the cut ends are ligated with sutures. The ilioinguinal nerve typically runs laterally from the external inguinal ring. Subsequently, the nerve is buried under the external inguinal ring to decrease the risk of neuroma formation. Then, electrocautery is used to disrupt the fibers of the genital branch of the genitofemoral nerve, which typically runs along the floor of the inguinal canal. Then, the Penrose drain elevating the spermatic cord is secured to the surgical drape using two hemostats.

The operating microscope is brought to the field and surgery is performed under 4× to 8× magnification. The anterior spermatic cord fascia is incised to expose the cord contents. A 20-MHz Microvascular Doppler System ultrasound (Vascular Technology, Inc [VTI], Nashua, NH, USA) is used to identify the testicular, cremasteric, and deferential arteries. The arteries are secured with microvessel loops that are tagged with large surgical clips. All identifiable lymphatics are tagged with microvessel loops and spared to decrease the risk of a hydrocele formation. The vas deferens is once more ligated with 3-0 chromic suture after the excision of a 1-cm segment. This is because the vas deferens is richly innervated along its surface.[28] We believe that transecting the vas deferens will ensure that these nerve fibers are transected. The internal spermatic veins are subsequently divided and then ligated. The cremasteric musculature and spermatic cord fascia are divided using electrocautery (Figure 1).

Before closure, the micro-Doppler is used to check for pulsatile flow within the preserved arteries. A few drops of topical papaverine (30 mg/dL) are applied to the vessel surface to encourage vasodilation if poor flow is noted. Then, the cord is returned to its original position and 0.25% bupivacaine 10 mL without epinephrine is injected into the skin surrounding the incision. The incision is subsequently closed in layers and skin adhesive is applied to the skin incision.

OUR PROTOCOL

Once a diagnosis of PVPS has been established, our protocol involves a trial of oral ibuprofen 600 to 800 mg every 4 to 6 hours or oral celecoxib 200 mg daily for 10 to 14 days. If nonsteroidal anti-inflammatory drug therapy fails, then we recommend amitriptyline 10 to 20 mg nightly. After 1 month of TCA therapy without success, we recommend adding pregabalin 75 mg three times a day. The pharmacologic therapy is considered to have failed if the pain persists after initiating pregabalin for 4 weeks. Pregabalin onset of action for pain management has been noted as early as the first week after initiating therapy.[29]

Our next step is to perform a spermatic cord block with local long-acting anesthetic agents (bupivacaine or ropivacaine), which aims to disrupt the pain cycle in men with PVPS. This is therapeutic and diagnostic because patients who respond to a cord block are more likely to respond to MDSC. Should the patient experience relief of at least 90%, we offer a series of cord blocks every 2 weeks consisting of four to five blocks using 9 mL of 0.75% bupivacaine hydrochloride injection combined with triamcinolone acetonide 1 mL (10 mg). This approach works best when the duration of pain is less than 1 year. If there is no lessening of pain with a well-placed injection, we do not repeat the cord block.

If pharmacotherapy fails, then the next step is to consider excision of the granuloma, MDSC, epididymectomy, or vasectomy reversal. We recommend surgical excision of a granuloma should a tender mass be palpable at the site of the transected vas deferens without pain noted on other local structures. We typically perform MDSC in patients with diffuse pain involving the cord, epididymis, and/or testicle. An epididymectomy is an option and can be beneficial in patients with pain isolated to the epididymis only, especially in those with structural abnormalities such as cysts noted at examination or ultrasound. However, in our practice, we rarely perform epididymectomy because the pain identified at examination tends to be more diffuse than just the epididymis. In addition, there is limited evidence supporting this procedure. Should MDSC fail to relieve the pain and the testicle is still sensate on examination, we recommend orchiectomy using an inguinal approach particularly if a cord block results in temporary relief of pain. Davis et al[18] reported that orchiectomy through an inguinal approach had a 73% complete success rate compared with a scrotal orchiectomy in which the success rate was only 55%. In our practice, vasectomy reversal is rarely offered except in circumstances when the pain is localized to the vasectomy site and/or epididymis and when the pain increases during sexual activity and ejaculation. The patient also must understand the risk of failure with this approach and fertility might be restored (Figure 2).

LIMITATIONS

A limitation to our study is that there was no article in the literature pertaining to MDSC specifically for PVPS. One of the studies looking at MDSC for chronic scrotal content pain provided a subset analysis of patients with PVPS treated with MDSC. However, this study was a post-procedure survey that included only 17 patients. The articles reviewed mostly included patients who underwent MDSC for chronic scrotal content pain rather than PVPS and the data might not be transferable.

CONCLUSION

PVPS remains a challenge to clinicians because of its poorly understood pathophysiology. When non-surgical treatments fail, MDSC remains a valuable approach with high success rates and should be considered for PVPS that is refractory to medical therapy. MDSC appears to have the most success for patients who experience a temporary relief from a cord block and can significantly improve patients' quality of life and ability to return to daily activities.

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