Persistent orchialgia after inguinal hernia repair: diagnosis, neuroanatomy, and surgical management

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Chronic testicular pain (orchialgia) after inguinal hernia repair is a recognized and complex entity [1, 2]. In the post-herniorrhaphy pain cohort, a subset of patients present with orchialgia as a primary complaint or a coexisting problem. This disabling post-operative complication is often incorrectly attributed to neuropathy of the genitofemoral nerve (GFN), which is commonly mistaken as the sensory nerve of the testicle. The spectrum of operations ranging from resection of the GFN to orchiectomy has been suggested for its surgical management often with limited efficacy. This is exemplified by the cohort of patients who did not improve after orchiectomy in the recently published Finnish Audit. Complicating matters is the significant overlap of inguinal, scrotal, and testicular pain as well as nociceptive versus neuropathic causes [2]. Delineating the etiology and appropriate management is a diagnostic and therapeutic challenge for hernia surgeons and urologists alike.

The exact pathophysiology of testicular pain is poorly understood but, in the post-inguinal herniorrhaphy population, causes include ischemic orchitis, epididymitis, edema, infection, cord fibrosis and scarring, varicocele or hydrocele formation, torsion, referred pain from radiculitis or ureteral pathology, and entrapment or disruption of the paravasal nerve fibers or autonomic plexus within the cord [1–8]. Careful delineation of testicular pain from groin and scrotal pain is necessary to address the overlap of

orchialgia with inguinodynia and scrotal pain. Additionally, the difference between nociceptive versus neuropathic testicular pain must be understood as their treatments differ significantly.

Scrotal pain may be elicited by palpation of scrotum, pinching the scrotal skin, and dermatomal mapping. It is neuropathic and somatic in nature with symptoms of burning, hyper or hypoesthesia, allodynia, and radiation. Orchialgia may be elicited by compressing the testicle or epididymis and is typically a visceral sensation that is dull, aching, and constant. It may be accompanied by anatomic changes such as testicular enlargement or atrophy, epididymal swelling, and hydrocele or varicocele formation.

The anterior wall of the scrotum is primarily affected in post-inguinal herniorrhaphy inguinodynia and innervated by somatic fibers of the ilioinguinal nerve (IIN), the iliohypogastric nerve (IHN), and particularly the genital branch of the genitofemoral nerve (GFN) [1–3]. The posterior surface of the scrotum is innervated by scrotal branches of the superficial perineal nerves via the perineal branch of the pudendal nerve (S1–S3). Injury to the inguinal segment of genital branch of the GFN with anterior-based approaches may arise during removal of the cremasteric layer (protects the cord structures including the genital branch and vas deferens), cord mobilization, dissection or ligation of the hernia sac, suturing of the inguinal floor, or placement of plug. Injury to the preperitoneal segment of GFN may arise from preperitoneal mesh or plug placement. With open or laparoscopic posterior-based repairs, injury to the preperitoneal segment of genital branch, femoral branch, or GFN trunk can arise during dissection of the preperitoneal plane, mesh fixation, or placement of mesh within the parietal compartment of the preperitoneal space in direct contact with an unprotected GFN. Mirilas and associates have meticulously delineated

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the preperitoneal neuroanatomy and described the presence of a visceral and parietal compartment behind the transversalis fascia separated by a membranous layer of the preperitoneal fascia [3, 4].

It is a common misperception that the genital nerve plays a dominant role in sensory innervation of the testis [1–3]. Varying and often conflicting anatomic descriptions of testicular neuroanatomy exist with autonomic and somatic innervation often attributed to the genital branch of the GFN [1, 7, 8]. After extensive experience with over 900 triple neurectomies at the Lichtenstein Hernia Institute (now Lichtenstein Amid Hernia Clinic at UCLA), it is clinically apparent that orchialgia is refractory to neurectomy of the genital branch with open triple neurectomy or the proximal GFN trunk with open or endoscopic retroperitoneal neurectomy refuting this neuroanatomic description [5, 6].

The testes have no somatic innervation [7], instead they receive sensory fibers from paravasal nerves located within the lamina propria of the vas originating from pelvic plexus primarily providing cord and epididymal sensation [2, 3, 5–7, 9–11]. During its descent in intrauterine life, the testis carries autonomic nerve supply and vasculature with it. Both testes (T10–12) and epididymis (T12–L1) are innervated from the presacral ganglia and afferent fibers on the vas meet the superior hypogastric plexus, ascend through the aortic or lumbar plexus, and enter the spinal cord at T11–L1 segments [2, 3]. In anterior-based open repairs, these fibers may be injured due to vas entrapment or injury during cord dissection and in posterior-based open repairs during placement of plug or meshes in apposition to the vas proximal to the internal ring. In laparoscopic repair, injury may arise from preperitoneal dissection, disruption of the vas or perivasal nerves, fixation devices, or mesh placement adjacent to the vas deferens and perivasal autonomic plexus [3, 5, 6, 11].

Nociceptive testicular pain typically arises from testicular parenchymal insults including ischemia, edema, and infection. This visceral sensation is mediated by afferent autonomic nerve fibers on the testicular arteries, traversing the celiac plexus and upper lumbar or thoracic parts of the sympathetic chains to enter T10–12 segments of the spinal cord [3, 11]. Distinguishing between the different causes of orchialgia based upon subjective measures is unreliable and it is crucial to understand the most likely mechanisms of injury during the causative initial operation in order to provide the best possible options for management and remediation of pain. This involves a thorough understanding of the structures and nerves at risk specific to each type of repair.

Surgical management is reserved for patients refractory to pharmacologic treatment (anti-inflammatories, neuropathic medications, antidepressants, opioids) and

interventions (nerve blocks, spermatic cord block, radio-frequency ablation). The operative intervention for post-herniorrhaphy orchialgia should be based upon the symptomatology, clinical findings, and type of prior operation performed. Although orchiectomy may be effective for nociceptive testicular pain, it is ineffective for testicular neuropathic pain. In the absence of overt testicular parenchymal injury, atrophy, or inflammation, it should be reserved for truly refractory cases. Orchiectomy will not address most neuropathic causes of pain after inguinal herniorrhaphy, because transection of the affected nerves occurs distal to the site of injury. This pathology is within the preperitoneal space after laparoscopic (TEP, TAPP) and open (plug, PHS, Kugel patch) posterior-based repairs or at the level of the internal ring or within the inguinal canal after anterior-based repairs (Shouldice, Bassini, McVay, Lichtenstein, plug, PHS).

Neurectomy of the genital branch of the GFN after anterior repair or the GFN trunk after posterior repair, typically as part of a “triple neurectomy”, is the primary surgical treatment of scrotal pain [5, 6, 12–15]. Cross-innervation of the scrotum by the three nerves makes selective neurectomy less definitive [5, 13–15]. Because posterior repairs typically involve the genitofemoral trunk proximal to the internal ring, standard triple neurectomy is ineffective for its management. Extension of the open triple neurectomy to include the main trunk of GFN over the psoas muscle [6] and more recently laparoscopic retroperitoneal triple neurectomy [16] have effectively addressed this issue.

Microsurgical spermatic cord denervation of the spermatic cord is a commonly accepted treatment for refractory orchialgia. It is performed at the level of the external ring including neurectomy of the ilioinguinal nerve, identification and preservation of the testicular, cremasteric, and deferential arteries, ligation of the internal spermatic veins, electrocautery division of the cremasteric musculature and spermatic cord fascia, and division of the paravasal afferent nerve fibers. In a series of 79 men, durable relief was noted in 71 % of patients with a mean follow-up of 20 months [17]. While this remains one of the best surgical options for refractory orchialgia in the general population, its utility in the post-inguinal herniorrhaphy patient with orchialgia is limited. From a neuroanatomic perspective, it would be effective only if the source of neuropathy is distal to the external ring which usually is not the case in this cohort.

Patients who present with inguinodynia and have coexisting testicular pain will not be adequately addressed by neurectomy alone. In 2005, our clinical and histopathologic observations brought us to the understanding that neuropathy of the nerve fibers within the lamina propria of the vas deferens, referred to as “paravasal nerves” and originating from the deep pelvic plexus, may be

responsible for post-herniorrhaphy orchialgia [4–6]. In patients with groin pain associated with orchialgia, segmental resection of the lamina propria of the vas together with triple neurectomy has improved outcomes and may eliminate some of the neuropathic causes of testicular pain [4–6]. Resection of these fibers with or without vasectomy must be performed at the level of the internal ring proximal to the operative field and injury.

Surgical treatment of testicular pain after open and laparoscopic preperitoneal repair remains the greatest challenge in the post-herniorrhaphy orchialgia population because site of injury is within the preperitoneal space where access is more challenging and the fibers diverge into an autonomic plexus. Mesh and scar often obliterate the plane. Laparoscopic testicular denervation is effective and has been described, but is typically challenging or impossible after preperitoneal mesh placement due to obliteration of this plane by scar and mesh [18]. We have had recent success with access and neurectomy of the autonomic plexus and paravasal nerve plexus using Da-Vinci robotic dissection within the space of Retzius proximal to the mesh in a patient with orchialgia after prior laparoscopic TEP repair. This has provided a promising surgical option to what was considered a problem with no operative solution.

The management of orchialgia remains one of the most frustrating and challenging problems after inguinal herniorrhaphy. It is important to note that it can arise from all variants of repair including tissue and mesh, anterior and posterior, open and laparoscopic [6, 12, 16]. Neuroanatomic understanding is essential to guide treatment options and no one modality will definitely address this complex problem in every patient. Resection of the paravasal fibers or spermatic cord denervation is an option for patients with neuropathic testicular pain but must be performed proximal to the site of pathology. Orchiectomy remains an option, but should be reserved for refractory cases with evidence of nociceptive pain and parenchymal testicular compromise. As with inguinodynia, the best practice in the management of orchialgia is to prevent injury at the time of the original operation by thoroughly understanding the neuroanatomy of the groin and testes and practicing good surgical technique.

Conflict of interest D.C. declares no conflict of interest. P.A. declares no conflict of interest.

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