CLINICAL REPORT

Ultrasound Imaging of Embedded Shrapnel Facilitates Diagnosis and Management of Myofascial Pain Syndrome

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■ **Abstract:** Trigger points can result from a variety of inciting events including muscle overuse, trauma, mechanical overload, and psychological stress. When the myofascial trigger points occur in cervical musculature, they have been known to cause headaches. Ultrasound imaging is being increasingly used for the diagnosis and interventional management of various painful conditions.

A veteran was referred to the pain clinic for management of his severe headache following a gunshot wound to the neck with shrapnel embedded in the neck muscles a few years prior to presentation. He had no other comorbid conditions. Physical examination revealed a taut band in the neck. An ultrasound imaging of the neck over the taut band revealed the deformed shrapnel located within the levator scapulae muscle along with an associated trigger point in the same muscle. Ultrasound guided trigger point injection, followed by physical therapy resolved his symptoms.

This is a unique report of embedded shrapnel and coexisting myofascial pain syndrome revealed by ultrasound imaging. The association between shrapnel and myofascial pain syndrome requires further investigation. ■

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Submitted: May 01, 2012; Revision accepted: September 05, 2012
DOI. 10.1111/papr.12002

Pain Practice, Volume 13, Issue 5, 2013 405–408

Key Words: headache, ultrasound imaging, trigger points, myofascial pain syndrome, shrapnel

INTRODUCTION

Features of myofascial pain syndrome include taut bands, tenderness to palpation and trigger points having a nondermatomal referred pain with pressure.[1] Trigger points can result from a variety of inciting events including muscle overuse, trauma, mechanical overload, and even psychological stress.[1] When the myofascial trigger points occur on the cervical musculature, they have been known to cause headaches.[1] Until recently, myofascial pain syndrome has been essentially a clinical diagnosis. Ultrasound imaging is being increasingly used for guidance in the treatment of various painful conditions.[2] In addition, it has an established role in the diagnosis of various pathologies. The following is a report of cervicogenic headache associated with shrapnel that resolved following ultrasound-guided trigger point injections.

CASE DESCRIPTION

A 30-year-old, highly decorated, veteran was referred to the pain clinic for management of his headache. In 2005, the patient sustained a gunshot wound that entered through his left shoulder area and lodged in his neck approximately 4 centimeters anterolateral to his 4th cervical vertebral body. Since the injury, the patient had been experiencing severe headaches on a daily basis. The headache was described as originating over the upper back, radiating to the base of his left ear, before diffusing across the left side of his scalp. He described the pain as a fleeting "excruciating, burning pain", almost as if his "skin and soft tissues were on fire." This was the worst pain he had ever felt in his life. This brief intense pain was followed by a dull, throbbing headache for the remainder of the day. His past medical history was unremarkable, except for multiple similar shrapnel wounds. Physical examination was also unremarkable, except for a taut band and trigger point in the neck. Pressure to the taut band reproduced his typical severe headache.

As he had a shrapnel in his neck, we wanted to rule out shrapnel-associated cyst or bursa. Ultrasound imaging was performed using a linear array transducer at a frequency of 12 MHz, a frame rate of 14 Hz and with the acoustic output at 100% (model 12L-RS Linear Array Transducer of LOGIQ e BT08 US machine, GE medical systems, 9900, W. Innovation Drive, RP-2139, Wauwatosa, WI-53226-4856). A scout scan was performed to locate the area of the shrapnel. Ultrasound imaging of the neck over the taut band revealed a hyperechoic linear area with an acoustic shadow beneath it within the left levator scapulae muscle, as would be expected with any metallic object (Figure 1). Once the location and muscle was identified, longitudinal and axial views of the muscle were obtained. Besides the shrapnel, there was another hyperechoic area slightly superior and lateral to it, corresponding to the palpable taut band on physical examination (Figure 2). This was similar to the ultrasound appearance of trigger points reported earlier.[3] With the muscle in a transverse (axial) view using ultrasound imaging guidance, a 25G needle was inserted into this myofascial trigger point using an out of plane approach and a local twitch response was observed. Following the localization, 1 mL 1% lidocaine was injected, under real-time ultrasound guidance, into the myofascial trigger point resulting in immediate relief of the patient's dull, throbbing headache. At follow-up, 1 month after the initial injection, the patient reported a decrease in the frequency and intensity of his headaches for approximately 2 weeks following the trigger point injection. He received a subsequent trigger point injection with concurrent physical therapy that completely relieved his headache. He has since been continuing home exercise with sustained pain relief.

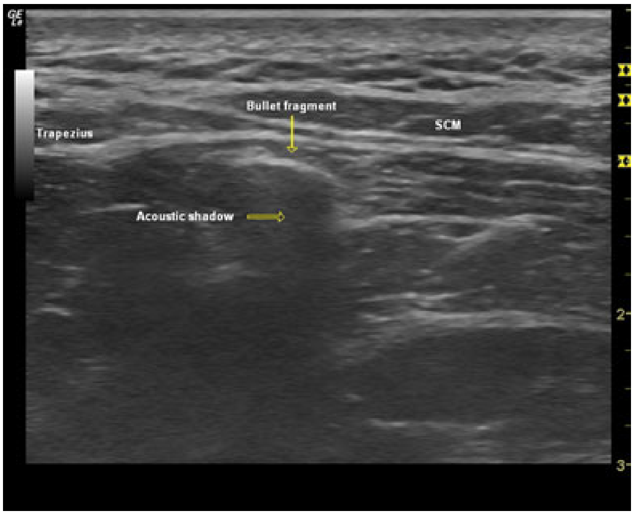

Figure 1. Transverse sonographic view of shrapnel in the levator scapulae muscle with an acoustic shadow.
SCM: Sternocleidomastoid muscle

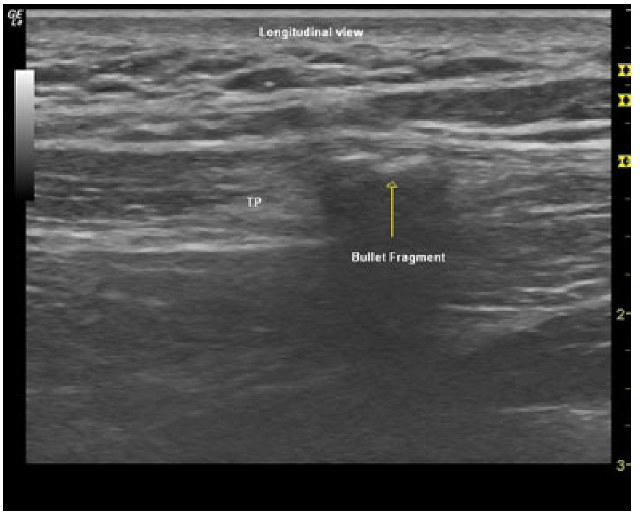

Figure 2. Longitudinal sonographic view of deformed shrapnel and trigger point in the levator scapulae muscle.
TP: Trigger point

DISCUSSION

Ultrasonography is ideal for musculoskeletal imaging due to its lack of radiation, portability, and real-time dynamic imaging.[2] Traditionally, myofascial trigger points have been identified by a palpable taut band with tenderness to palpation and radiation of pain in a referral pattern (trigger point). One of the earliest reports using ultrasound imaging for the identification of trigger points had described the visualization of a hyperechoic area similar to our patient.[3] After almost a decade, Sikdar et al. reported that on two-dimensional grayscale ultrasound imaging, myofascial trigger points "appeared as elliptically shaped focal areas of hypoechogenicity" that corresponded with the location of palpable trigger points.[4] In addition, they demonstrated increased vascularity in trigger points using Doppler imaging and reduced vibration resistance amplitude on vibration sonoelastography. Although Doppler imaging may be applicable in clinical practice, sonoelastography may not lend itself to everyday practice.[4] More recently, hyperechogenic areas corresponding with trigger points have also been described.[5] According to this report, this area of hyperechogenicity, when examined under three-dimensional imaging, revealed aberrancies in the organization of the fascicles at the point of the taut bands, unlike the linear fascicular pattern seen in normal muscles.[5] Hyperechogenic areas during ultrasound imaging are seen whenever the tissue has a high absorption coefficient, as in bone. In addition, muscle fascicles also appear hyperechogenic. Of note, atrophic muscle is very hyperechoic.[6] The angle of insonation may also be one of the reasons for this apparent difference in echogenicity among various studies, as at some angles, the reflected waves may not reach the transducer. In addition, as hyperechogenic areas are seen secondary to the greater reflection of the ultrasound waves, any area of hyperechogenicity can also create hypoechoic areas beneath it, as there is a decrease in the amount of ultrasound waves traversing further in from that area. This could potentially explain the reasons for the occurrence of hyperechoic and hypoechoic areas near a trigger point. This dispute in echogenicity, potentially, may only be resolved when a twitch response is also visualized during ultrasound imaging as was seen in this report. Further larger studies may provide clarification and address the validation of echogenic features of trigger points with ultrasound by blinding and randomization to eliminate bias. Shrapnel being a metallic object is hyperechoic and creates an acoustic shadow beneath it on ultrasound imaging.

Myofascial pain syndrome poses both diagnostic and treatment challenges due to their subjective nature and reliance on clinical examination for their diagnosis. Until recently, there were no imaging modalities that allowed objective visualization of myofascial trigger points.[1] Earlier reports had described a number of specific referred pain patterns arising from myofascial trigger points in the cervical musculature. This included the classic "fish hook" pattern of referred pain elicited by pressure on trigger points, assumed to be within the upper trapezius muscle, and very similar to the referred pain pattern described by our patient.[1]

Shrapnel injuries are usually managed conservatively without surgical removal.[7] Lead, depleted uranium, and tungsten alloy have been used in the manufacture of ammunitions. Civilian gunshot wounds with retained fragments have the potential to cause lead toxicity.[8] Lead toxicity is more likely when the fragments are in proximity to joints.[9] In addition, formation of cysts and abscesses has also been reported with embedded shrapnel.[10] Implanted depleted uranium causes elevated levels of oncogenes involved in tumorigenesis and has tumorigenic potential.[11,12] The poor penetration of alpha particles and the very little gamma radiation from depleted uranium decrease its health effects. More recently, a longitudinal follow-up, over 18 years, of army personnel who had retained shrapnel containing depleted uranium, did not reveal any renal or osseous damage, except for increased urinary concentration of uranium.[13] Concerns about the health effects of depleted uranium and lead found in ammunitions prompted a switch to tungsten alloy in many countries. Tungsten alloy, (91% tungsten, 6% nickel, and 3% cobalt), when embedded in animal tissue, has been shown to cause rhabdomyosarcoma.[14] Tungsten alloy releases reactive oxygen species which could potentially damage DNA.[15] On the basis of our limited search, there are no reports of shrapnel-associated myofascial pain syndrome. Although causation cannot be established based on one report, the onset of headache, chronologically, followed the shrapnel injury. It could be postulated that shrapnel could have altered the muscle milieu, leading to the onset of myofascial pain syndrome. It is intriguing that our patient had multiple shrapnel in various muscles without any features of myofascial pain syndrome in other muscle groups.

This is a unique report of a serendipitous association between myofascial pain syndrome and embedded shrapnel identified by ultrasonography. Larger studies are required to establish the causation of myofascial pain syndrome by embedded shrapnel.

REFERENCES

1. Fernandez C, Cuadrado ML, Arendt-Nielsen L. Myofascial trigger points and sensitization: an updated pain model for tension type headache. *Cephalalgia*. 2007;27:383–393.

2. Peng PWHBS, Narouze S. Ultrasound-guided interventional procedures in pain medicine: a review of anatomy, sonoanatomy, and procedures: part I: nonaxial structures. *Reg Anesth Pain Med*. 2009;34:458–474.

3. Gerwin RD, Duranleau D. Ultrasound identification of the myofacial trigger point. *Muscle Nerve*. 1997;20:767–768.

4. Sikdar S, Shah JP, Gebreab T, et al. Novel applications of ultrasound technology to visualize and characterize myofascial trigger points and surrounding soft tissues. *Arch Phys Med Rehabil*. 2009;90:1829–1838.

5. Shankar H, Reddy S. Two- and three-dimensional ultrasound imaging to facilitate detection and targeting of taut bands in myofascial pain syndrome. *Pain Med*. 2012;13:971–975.

6. Chhem R, Kaplan P, Dussault R. Ultrasonography of the musculoskeletal system. *Radiol Clin North Am*. 1994;32: 275–289.

7. Bowyer G. Debridement of extremity war wounds. *J Am Acad Orthop Surg*. 2006;14(10 Spec No.):S52–S56.

8. Akhtar AJ, Funnye AS, Akanno J. Gunshot-induced plumbism in an adult male. *J Natl Med Assoc*. 2003;95: 986–990.

9. Dougherty PJ, van Holsbeeck M, Mayer TG, Garcia AJ, Najibi S. Lead toxicity associated with a gunshot-induced femoral fracture. A case report. *J Bone Joint Surg Am*. 2009;91:2002–2008.

10. Ligtenstein DA, Krijnen JL, Jansen BR, Eulderink F. Forgotten injury: a late benign complication of an unremoved shrapnel fragment–case report. *J Trauma*. 1994;36:580–582.

11. Miller AC, Blakely WF, Livengood D, et al. Transformation of human osteoblast cells to the tumorigenic phenotype by depleted uranium-uranyl chloride. *Environ Health Perspect*. 1998;106:465–471.

12. Miller AC, Bonait-Pellie C, Merlot RF, Michel J, Stewart M, Lison PD. Leukemic transformation of hematopoietic cells in mice internally exposed to depleted uranium. *Mol Cell Biochem*. 2005;279:97–104.

13. McDiarmid MA, Engelhardt SM, Dorsey CD, et al. Longitudinal health surveillance in a cohort of gulf war veterans 18 years after first exposure to depleted uranium. *J Toxicol Environ Health A*. 2011;74:678–691.

14. Kalinich JF, Emond CA, Dalton TK, et al. Embedded weapons-grade tungsten alloy shrapnel rapidly induces metastatic high-grade rhabdomyosarcomas in F344 rats. *Environ Health Perspect*. 2005;113:729–734.

15. Harris RM, Williams TD, Hodges NJ, Waring RH. Reactive oxygen species and oxidative DNA damage mediate the cytotoxicity of tungsten-nickel-cobalt alloys in vitro. *Toxicol Appl Pharmacol*. 2011;250:19–28.