Expert's comment concerning Grand Rounds case entitled “Lead toxicity and management of gunshot wounds in the lumbar spine” (by B. Rentfrow, R. Vaidya, C. Elia, A. Sethi doi:10.1007/s00586-013-2805-6)

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I read with interest this case report [1] describing late-onset plumbism associated with gunshot wound (GSW) to the spine, with retained lead-based bullet fragments within the intervertebral disc space. I congratulate the authors on their well-written, interesting, detailed, and accurate discussion of the literature pertaining to GSW involving the spine. I particularly enjoyed their description of the various challenges that can be encountered in the treatment of projectile injuries to the spine and the indications for surgical intervention, which include the uncommon cases of spinal instability, the presence of neurological compression with progressive spinal cord injury, recalcitrant infection, and late-onset claudication, in addition to plumbism. The authors go on to describe the challenges that occur when having to address extensive scar formation in the epidural space and around the great vessels, both of which can be

predictably encountered when addressing delayed onset plumbism secondary to a bullet fragment. Their case report also emphasizes the difficulties that can be anticipated when trying to remove all bullet fragments due to the potential for proximity and adherence to vital structures, and subsequently, the uncertainty involved in deciding on the need for additional surgery if serum lead levels remain elevated postoperatively or gradually increase again over time in the setting of residual bullet fragments.

Although the onset of lead toxicity after GSW with retained bullet fragments is well described [2], it is an uncommon consequence of GSW. More specifically, the clinical scenario of lead toxicity resulting from bullet fragments lodged within the spine is indeed rare, but has been reported on at least three previous occasions. One of these citations is mentioned by the authors (Scuderi et al. [3]). Other reports, by Grogan and Bucholz [4] and by Cristante et al. [5] have been cited below. A common theme exists between the current case report and each of the prior reports. In each case, the bullet fragments were primarily located within an intervertebral disc space. Despite being initially asymptomatic, over the course of many years, the patients gradually developed symptoms suggestive of lead toxicity, which have been described in detail by the authors. Chelation therapy was successful in relieving symptoms in all patients, but not definitively. Long-term recurrence of symptoms was subsequently prevented only by removal of the bullet fragments, even when additional chelation therapy was required for a short time after removal of the metallic fragments.

A topic, which the authors do not address and which has been theorized but has not been well established to date, is the mechanism by which intradiscal bullet fragments result in increased serum lead levels. Presumably because they become encapsulated by fibrous tissue, bullet fragments

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within the soft tissues rarely result in absorption of lead within the bloodstream [6]. In contrast, the potential for absorption of lead particles from intrasynovial bullet fragments is sufficiently convincing that surgical removal of bullets located within synovial joints has become a routine recommendation to avoid lead toxicity [7]. However, this mechanism does not extrapolate well to the physiologic environment surrounding bullet fragments located primarily within an avascular intervertebral disc space. Although largely speculative, it has been postulated that motion within the intervertebral disc space surrounding the bullet fragment(s) produces a fibrous membrane containing bursa-like fluid, which, when combined with the frictional forces associated with excessive movement, may result in dissolution and absorption of lead particles [3, 6].

Some authors have recommended the routine removal of metallic projectiles located within the intervertebral disc [5]. However, I agree with other authors who feel that lead toxicity due to retained bullet fragments in the spine after GSW is too rare to justify the morbidity associated with routine removal of bullet fragments for this specific reason alone in asymptomatic patients [3]. Nevertheless, serum lead levels in these patients should be monitored postoperatively. Although definitive evidence-based recommendations do not exist, neither for the frequency of serum lead measurements nor for the threshold serum lead level that would warrant surgical intervention, removal of bullet fragments would seem reasonable, in general, if serum lead levels either exceed the current “minimum acceptable level” of 10 mcg/dl or, at most, the 25 mcg/dl level which constitutes the minimum concentration at which toxicity generally begins to manifest [8].

One last issue pertains to the patient’s preoperative radiographic findings, as illustrated in Figs. 1 through 4. There have been reports of a “discogram effect,” which may occur when lead from the bullet fragment gradually elutes into the surrounding disc tissue and may be a harbinger of lead toxicity. This radiographic finding may serve as a marker that warrants measurement of serum lead levels and surgical bullet fragment removal if elevated serum lead levels are confirmed [3, 4]. The preoperative imaging in this case report appears to be consistent with the previously reported discogram effect.

In this particular case, I would agree with the authors’ initial combined anterior and posterior surgical approach,

due to the need to maximize access for more complete removal of metallic fragments. As far as the current management of this patient, I share the authors’ concern regarding the upward trend in the patient’s serum lead levels, which are approaching 60 mcg/dl 2 years postoperatively. Since the postoperative images provided are from the immediate postoperative period (with radiographically visible staple lines), it would be useful to see if the amount of opacity in the area of the L5–S1 disc space is increasing due to continued elution. I suspect that the patient will eventually require the revision posterior procedure with additional resection of superior and inferior bullet fragments that the authors have alluded to. Particularly if the trend toward increasing serum lead levels continues, it would make sense to do so even before the eventual onset of symptoms. Clearly, this will be a challenging procedure and the radiopacities along the anterior aspect of the dura extending from behind the L4 vertebral body to behind S1 suggest that a complete removal of the offending metal is not likely to be possible.

Conflict of interest None.

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