Lead Levels Remain High After Gunshot Wounds and Retained Bullets

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INTRODUCTION:
Little is known about lead toxicity due to retained metallic fragments following a gunshot wound injury (GSW). Similarly, there is variability in the accepted upper limit of normal blood lead levels (BLLs); the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that BLL exposure be limited to 20 µg/dL, while the CDC recommends BLLs should be less than 3.5 µg/dL. Elevated blood lead levels are associated with various side effects ranging from vomiting, weight loss, anemia, and abdominal pain to renal failure, reproductive complications, and neurocognitive deficits. Measurement of blood lead levels after GSW is uncommon, and risk factors are unknown. Subsequently, there is no standard protocol for recommending or removing retained bullet fragments in adult patients following GSW. The purpose of the current study was to examine the relationship between blood lead levels (BLLs) and patient demographics, time from injury, number of gunshot wounds, injury of location, and retention of ballistic fragments.
METHODS: This prospective cohort study enrolled adult patients with gunshot wound injuries at a single urban Level 1 trauma center from November 1st 2022 to May 1st 2025. All patients with gunshot wound injuries underwent BLLs assessed on the day of injury. BLLs were subsequently measured at 14 days, 1 month, 3 months, 6 months, 9 months, and 1 year follow up after injury. Patient demographics comorbidities, location of GSW injury, number of gunshots, and history of previous GSW were obtained for all patients. The presence or absence of retained fragments was confirmed based on operative notes and review of X-rays. Linear regression, ANOVA, and T-tests were used in analysis.
RESULTS: During the study period, 126 patients enrolled and 91 patients (77 %) had BLLs drawn and thus were included in the study. The mean age of patients was 33.3 ± 10.7 years old, with 83.5 % being male. The most common injury locations were hip and femur (N = 43), shoulder (N = 19), and forearm (N = 17). A total of 25/91 (27.5 %) patients had surgical removal of retained bullet while 66/91 (72.5 %) had retained fragments. When patients were stratified by number of GSW wounds, 49.4 % had 1 GSW and 51.6 % had multiple GSWs. The mean BLLs across all time points was 8.76 ± 7.82 µg/dL. The highest recorded BLL found was 48.7 µg/dL recorded at the 3-month follow-up in a patient with 3 GSW and retained fragments. The lowest level was < 3.5 µg/dL and this was observed in 44 (48%) patients including those with removed and retained fragment. There was no difference in BLLs between those with retained fragments compared to those without retained fragments. BLLs significantly increased with time from injury ($p = 0.007$), but did not differ in those with retained ballistic fragments compared to those without retained fragments. Patients with multiple gunshot wounds had significantly greater BLLs at the one-year ($p = 0.004$) compared to patients with isolated GSW. Location was also correlated with BLLs with spine/pelvic/torso patients having the lowest BLLs and lower extremity patients having the highest BLLs ($p = 0.005$).
DISCUSSION AND CONCLUSION: This study suggests blood lead levels increase with increasing duration from injury and differ based on the location and number of gunshot injuries. However, the mean BLL across all patients was low (8.7 µg/dL) and removal of retained fragments did not affect blood lead levels. These results suggest that monitoring of BLLs should continue for a year, especially in patients with multiple gunshot injuries and those injuries in the lower extremity.