

Heavy Metals - fact or folklore: Are Lead and Copper Levels Associated with Gunshot Orthopaedic Injuries?

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INTRODUCTION: Conventional medical teaching suggests that gunshot related injuries may be associated with rising blood lead levels (BLLs) due to the theoretical potential of retained fragments (RFs) to leech lead into the surrounding tissues and blood stream. Unfortunately, a paucity of literature exists on the topic to support this with the preponderance of evidence from small scale or methodologically flawed studies. Federal regulations (CDC) suggest that levels greater than 3µg/dL are considered elevated with local and regional variations even in baseline populations. Levels above 25 µg/m³ are considered reportable due to potential for health concerns. Despite this there are currently no protocols or screening guidelines for adult populations. Given the theoretic risk for BLL to be elevated after gunshot injuries, we sought to better understand and document this relationship of blood heavy metal levels and gunshot injuries. We hypothesize that blood levels of heavy metals will not be associated with gunshot trauma (GSW) or retained fragments.

METHODS: A prospective cohort study of patients at a Level 1 Urban trauma center was conducted from November 1st 2022 to April 30th 2024. At our institution, lead levels and copper are obtained in all patients presenting after GSW injuries. All patients injured in a gunshot related mechanism were eligible and approached for consent to participate. Sociodemographic data, injury type, location, and number of gunshot injuries were recorded. X-rays were reviewed for the presence of retained fragments and operative notes for any surgical 'bulletectomy' procedures or removal of foreign bodies. Blood lead levels and copper levels were collected at standard visit follow-up for one year post injury.

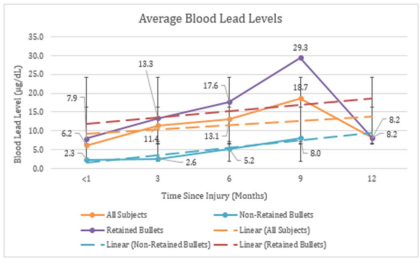
RESULTS:

Over the study period, 91 subjects consented, (76 men, 15 women). Of those consented 64% (58/91) of subjects completed the blood tests. Average subject age was 33 years old with a mean follow up from date of injury of 73.6 days (SD = 89.7 days). The injuries seen included: 14 upper limb, 23 lower limb, 9 torso, and 12 patients with multiple GSW across multiple zones of the body labeled "poly trauma". Of 58 patients, 41 subjects had retained fragments, 17 did not and 42 had more than 1 GSW.

The mean BLL in the population was 8.7 µg/dL with similar levels at initial, 3, 6, 9, and 12 months' time points (6.2 µg/dL, 11.4, 13.1, 18.7, and 8.2 respectively). In total, 6 subjects had lead levels above 20µg/dL and 2 patients above 30 µg/dL. Of note, these elevated levels were seen at baseline testing suggesting pre-injury exposure to lead. A relationship between number of GSWs and overall mean BLL was found for any time point. ($p=0.01$). After removing outliers (subjects above 30 µg/dL at presentation), sub-analysis continued to demonstrate a positive relationship between number of GSWs and BLLs ($p<0.001$). However, time from injury, despite retained fragments was not associated with BLL. Additionally, location of GSW and the presence of retained fragments were not associated with elevated BLLs ($p=0.08$).

DISCUSSION AND CONCLUSION:

The current study demonstrated that patients with multiple GSWs may be at risk of elevated blood lead levels however, no relationship between retained fragments, time from injury or the location of injury was seen in our cohort. This suggests a paradigm shift in the way we understand and treat GSW patients with and without retained fragments. Understanding individual patient risk, and the potential for pre-existing elevations in lead levels continues to be important to optimize interventions, provide evidence based care and minimize over treatment. At this time, we suggest that the need and utility of fragment removal should be evaluated on a case by case basis. Additional data points and larger sample size will help more clearly define these relationships.



*Outliers Removed

