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Frequent use of stun gun may be associated with vibration-induced Raynaud's phenomenon: A case series

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ABSTRACT

Introduction: Stun guns are energy-conducting weapons that are becoming more frequently used by law enforcement officials to subdue combative individuals, or civilians for the case of security. Although complications related to stun guns are well known for the victim, less is known about stun guns complications among their users.

Case Series: In this case series, we reported vibration-induced Raynaud's phenomenon in four individuals who were recurrent users of stun guns. Two patients were male and two were female. Symptoms varied from moderate to severe. Although both hands were involved, symptoms were more severe in the right hand. Nifedipine was prescribed for all cases. Two patients received Losartan, as well. All patients reported a decrease in their symptoms in follow-up visits.

Conclusion: While further research is needed, clinicians should remain vigilant to stun gun usage as a possible cause of Raynaud's phenomenon.

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INTRODUCTION

Stun guns have been developed as non-lethal devices for law enforcement officers to control potentially violent subjects. Thus, stun guns are used as alternatives for firearms. Stun guns apply high voltage, pulsatile electric shocks to the subject, which result in involuntary skeletal muscle contraction. As a result, the subject is unable to further resist [1].

The use of stun guns is showing an increase among law enforcement officials because of the increasing demand for non-lethal weapons to subdue combative individuals. In the United States, in the year 2005, stun guns were being used by about 40% of law enforcement agencies, with about 150,000 devices in use by police officers. However, the use of stun guns is not limited to law enforcement officers. Worldwide, 100,000 civilians own a stun gun [2, 3]. In Canada, in only one province, more than 10,000 stun gun uses were recorded during six years [4].

Literature has provided conflicting results regarding the safety profile of stun guns for the victims. Although some studies among healthy volunteers have shown safety of these weapons [5–8], severe injuries have also been reported with its daily usage [9–14]. Main

injuries reported in victims include basilar skull fracture, comminuted nasal fracture, and orbital floor fracture; concussion, facial laceration, and subarachnoid and epidural hemorrhage necessitate craniotomy. Penetration of the outer table and cortex of the cranium by stun guns are also reported [8, 15]. One study in the United States reported an incidence of 0.25% for significant injuries following the use of electrical weapons. Main complications in this study included intracranial injuries and rhabdomyolysis. Mortality has been also reported [16].

Published literature about the safety of stun guns is limited to the victims, not to the users. Herein, we reported four cases of vibration-induced Raynaud's phenomenon in the persons who fire the weapon, recurrently. In all cases, diagnosis was based on the user's history of firing the weapon, in addition to a clinical and laboratory examination. Standard clinical tests included cold stimulation test and nail-fold capillaroscopy. Antinuclear antibody (ANA), erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) were also measured for some cases [17]. In all cases, a thorough investigation ruled out diagnosis of vasculitis.

CASE REPORT

Herein, we reported four cases of Raynaud's phenomenon that may be related to stun gun use. Out of four patients, two individuals were users and the other two were sellers of stun guns. Two patients were men, and other two were women. Age ranged from 22 to 34 years.

Symptoms of Raynaud's phenomenon had developed between 1 and 48 months after the initial use of stun guns. Stress or cold was the stimulant in three patients. Symptoms were severe in only one patient, other patients reported mild to moderate problems. Although both hands were involved in some cases, symptoms were always more prominent in one hand.

In all cases, treatment included avoiding use of stun guns in addition to medications. Nifedipine (for 18 to 90 days) was prescribed for all cases and two patients received Losartan (for 21 and 38 days), as well. All our patients reported decrease in symptoms in follow-up visits (Table 1).

DISCUSSION

We believe that Raynaud's phenomenon in our patients may be related to vibration. Thus, we believe the diagnosis in our patients is vibration-induced Raynaud's phenomenon. This diagnosis should be considered as a new possible complication among the users of stun guns.

As explained before, most previously reported stun gun injuries of eyes, genitalia, and large blood vessels are related to the victims, not the weapon users [18, 19]. The mechanism of vibration-induced Raynaud's phenomenon is as follows:

Raynaud's phenomenon has been explained by pathology in the central nervous system, autonomic dysfunction, and vasodysregulation. Symptoms are known to be a result of receptor and nerve ending dysfunction [20]. Stoyneva et al. reported in 2003, that vibration induces endothelial damage, as a result of an increase in shear stresses and elevated plasma level of thrombomodulin and of von Willebrand factor and reduced endothelium-dependent vasodilator responses. In patients with vibration induced Raynaud's phenomenon, high concentrations of endothelin-1 especially in most advanced stages, and a decreased plasma thiol level have shown an increased production and activity of free radicals, which contributes to vasospastic paroxysms [21].

We used Nifedipine for all our cases in combination with Losartan for two of our patients. Calcium channel blockers such as Nifedipine and angiotensin II receptor antagonist alone or in combination have shown therapeutic effects in Raynaud's phenomenon [22, 23].

Table 1: Summaries of data of four patients with vibration-induced Raynaud's phenomenon due to frequent use of stun gun.

Code	demographic data		History	Exposure to stun guns		Presentation				Treatment		Outcome
	Gender	Age (years)	Smoking	Exposure nature	Exposure (months)	Stress or cold stimulant	Right hand symptoms	left hand symptoms	Dry gangrene	Nifedipine (days)	Losartan (days)	Improved
#1	male	34	Yes	Seller	48	Yes	Moderate	Mild	No	28	-	Yes
#2	female	22	No	User	3	No	Moderate	-	No	60	21	Yes
#3	male	28	Yes	Seller	1	Yes	Moderate	Mild	No	90	-	Yes
#4	female	28	No	User	2	Yes	Severe	Moderate	Yes	18	38	Yes

Although vibration-induced Raynaud's phenomenon is a well-defined clinical entity, it is not very clear how stun gun users may develop this condition. Future research is needed on epidemiology, etiology, and natural history of Raynaud's phenomenon among individuals who use stun guns.

CONCLUSION

Here we reported vibration-induced Raynaud's phenomenon in users of stun guns. Stun gun users, including both law enforcement officials and civilians, should be informed of the potential serious complications of recurrent firing. However, any further conclusion needs further studies.

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Author Contributions

Hafez Ghaheri – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published
Mehrdad Karimi – Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published
Shervin Assari – Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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