

Lightning Injury Caused by a Side Flash

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Abstract A 29-year-old male soldier, who was taking part in a military field training exercise during summer, lost consciousness and fell backwards while sheltering at the foot of a tree that was struck by lightning during a thunderstorm. Upon arrival, his vital signs were stable. He had a linear burn at the right brachium with headache. Electrocardiography, cardiac ultrasound and whole body computed tomography revealed no specific findings. Blood biochemistry revealed rhabdomyolysis. The post-admission course was uneventful. This is a rare report of a patient who received a side flash from a tree during a lightning strike. Service members who routinely train and work outdoors should be vigilant in relation to the dangers of lightning.

Keywords: lightning injury, side flash, headache

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1. Introduction

Lightning can harm an individual through several mechanisms. These include the effect of electric current on/through body tissues, burns due to the conversion of electrical energy to thermal energy, mechanical trauma through various mechanisms (e.g., being thrown by a transmitted shockwave or direct strike from a bolt, flying debris from an object nearby due to shockwave or direct strike, fall secondary to being struck, or muscle contraction). [1] Not all lightning injuries occur in the same manner, the causes of injury are classified as a direct strike, side flash, contact injury, ground current, or current from the ground. [1,2,3] Side flash accounts for one-third of injuries and occurs when the current jumps or "flashes" from a nearby object then follows the path of least resistance to an individual. [1] We herein report a rare case of lightning injury due to a side flash.



Figure 1. The right brachium of the patient (A linear burn was observed (arrow))

2. Case Presentation

A 29-year-old male soldier who was taking part in a military field training exercise during summer, lost consciousness and fell backwards while sheltering at the foot of a tree that was struck by lightning during a thunderstorm. He was 0.5 m away from the tree. He regained consciousness after a few minutes. Initially, he was transported to a local military hospital. As he complained of headache even though he had no objective abnormalities, he was transported to our hospital for further examination. He had no specific past or family history. Upon arrival, his vital signs were as follows: Glasgow Coma Scale, E4V5M6; blood pressure, 126/76 mmHg; pulse rate, 62 beats per minute; and peripheral oxygen saturation on room air, 98%. He had a linear burn at the right brachium and his headache persisted, although he was free of neurological symptoms. The findings of electrocardiography and cardiac ultrasound were normal. Whole body computed tomography revealed no specific findings. The results of a venous blood gas analysis were as follows: pH, 7.307; pCO₂, 40.0 mmHg; pO₂, 49.4 mmHg; HCO₃⁻, 19.4 mmol/L; base excess, -6.0 mmol/L; and lactate, 0.9 mmol/L. The results of blood biochemical analysis were as follows: white blood cells, 7300/mm³; hemoglobin, 12.8 g/dL; platelets, 23.8 x 10⁴/mm³; aspartate aminotransferase, 26 IU/L; alanine aminotransferase, 13 IU/L; total bilirubin, 1.0 mg/dL; total protein, 7.1 g/dL; glucose, 93 mg/dL; blood urea nitrogen, 10.1 mg/dL; creatinine, 0.90 mg/dL; amylase, 55 IU/L; creatine phosphokinase, 531 IU/L; sodium, 140 mEq/L; potassium, 3.7 mEq/L; chloride, 102 mEq/L; c-reactive protein, 0.07 mg/dL; prothrombin time, 11.7 (control; 11.2) sec; activated partial thrombin time, 32.1 (control; 27.0) sec;

fibrinogen, 246 mg/dL; fibrin degradation products, 0.8 µg/mL; and troponin T, <0.010 ng/mL. He was admitted for observation with monitoring. His post-admission course was uneventful. The patient's headache subsided on the next day and he was discharged.

3. Discussion

This is a rare medical case report of a patient who was injured by a side flash from a tree that was struck by lightning. We performed a search of the PubMed database to identify related articles using the following search term: "lightning", and "side splash" or "side flash" or "tree". We also performed a search of the Ichushi database (Japan Centra Revuo Medicine), which collects summaries of Japanese medical articles, using the same search term. We summarized the reports-including the present case-that described cases in which patients were injured by lightning from side flash or while they were under tress (Table 1). [4-11] There were 6 case reports and 2 original reports, which included 39 patients who were predominantly male youths adults. Only 4 patients survived. Fortunately, the present case survived after experiencing a transient loss of consciousness, burn and headache. [12] As lightning injury from "side flash" is not well understood, further studies may can contribute to developing measures to reduce the number of people who suffer from lightning-related injuries. [4]

During thunderstorms, people may seek shelter under isolated trees because they erroneously believe that a tree

offers protection from lightning, or perhaps because their top priority is to escape from rain rather than lightning. [11] However, age and the presence of a tree or open water nearby in the surrounding area were factors that remained significantly associated with lightning-related fatalities in a multivariable model. [13] If there is no suitable space to shelter in an open field, people may take refuge at the nearest safe location with an angle of $>45^\circ$ to the top of the tall object, and at least 2 m from the side of the tall object (Figure 2). [14] Service members who routinely train and work outdoors should be vigilant in relation to the dangers of lightning, especially in field settings during summer months. [13]

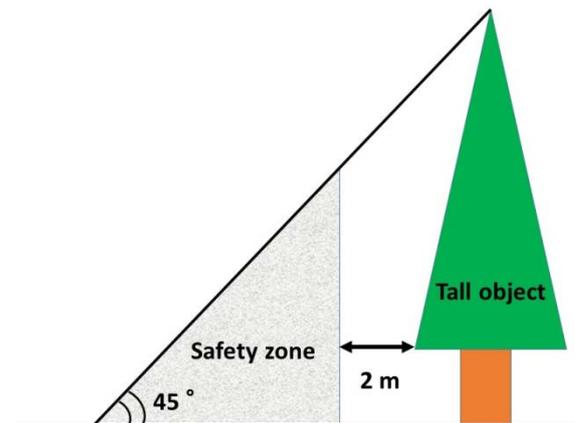


Figure 2. Image of the safety zone

The gray area is thought to be the safety zone.

Table 1. Cases in which patients were injured by lightning from side flash or while they were under tress

No	Reporter	Form	Number of case	Age	Sex	Shade	Character	Outcome
1	Usumoto, 2008	Case	1	66	Male	Tree	feathering burns, cardiac arrest	Died
2	Usumoto, 2008	Case	1	52	Female	Tree	feathering burns, loss of consciousness, nerve injury	Survived
3	Kumar, 2007	Case	1	32	Male	Tree	filigree burn over the left side of the abdomen	Died
4	Alyan, 2006	Case	1	38	Male	Tree	transient electrocardiographic changes	Survived
5	Zack, 1997	Case	1	27	Male	Tree, 1.5 m distant from the tree	thermal damage to the pectoral muscle and cardiac musculature	Died
6	Tandberg, 1990	Case	1	20	Female	Tree	cardiac arrest, destruction of hearing	Survived
7	Cherington, 1990	Case	1	57	Male	Tree	spinal cord and peripheral nerve injury,	Survived
8	Murty, 2009	Original	8	majority between 30 and 39 years old	male to female ratio of 12.5:1	Tree	lightning strike incidence occurred when victims had taken shelter (25.9%) under trees or shades.	Died
9	Duclos, 1990	Original	23	from 5 to 75 years, median of 27.3 years old	Thirteen percent of victims were females.	Tree	Those under a tree were less likely to have been directly hit	Died
10	Present	Case	1	29	Male	Tree, 0.5m distance from the tree	loss of consciousness burn at upper extremity	Survived

4. Conclusion

This is a rare medical case report describing a patient who was injured by a side flash from a tree that was struck by lightning. Service members who routinely train and work outdoors should be vigilant in relation to the dangers of lightning.

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Statement of Competing Interests

We do not have conflict of interest to declare.

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