

**Struck by Lightning: A Case of Nature-Induced Pre-excited Atrial Fibrillation**  
Tiago Luiz Luz Leiria, Leonardo Martins Pires, Marcelo Lapa Kruse and Gustavo Glotz de Lima

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# Images and Case Reports in Arrhythmia and Electrophysiology

## Struck by Lightning

### A Case of Nature-Induced Pre-excited Atrial Fibrillation

Tiago Luiz Luz Leiria, MD, PhD; Leonardo Martins Pires, MD, MSc; Marcelo Lapa Kruse, MD MSc; Gustavo Glotz de Lima, MD, PhD, FACC

A 28-year-old man, with no previous medical history, was brought to the emergency department after being struck by a lightning bolt while working in an open field during a storm. He immediately received bystander cardiopulmonary resuscitation and was conscious at the time of arrival at the hospital. An initial evaluation revealed the presence of an electric burn at the entry site near the right elbow and exit wounds (punctate burns) on both feet (Figure 1A and 1B). Signs of hemodynamic compromise (blood pressure, 90/40 mmHg; heart rate, 160 beats per minute) were also observed. His ECG revealed an irregular wide complex tachycardia with a variable QRS duration for each beat and a forward axis on the horizontal plane. All these features were compatible with pre-excited atrial fibrillation (Figure 2A). Because of the hemodynamic instability of the patient, he was treated by electric cardioversion. A subsequent ECG showed a Wolff–Parkinson–White pattern with a left lateral accessory pathway (Figure 2B). The patient was referred for an electrophysiological study. Due to the initial presentation, radiofrequency ablation was indicated, and this procedure successfully terminated conduction through the accessory pathway.

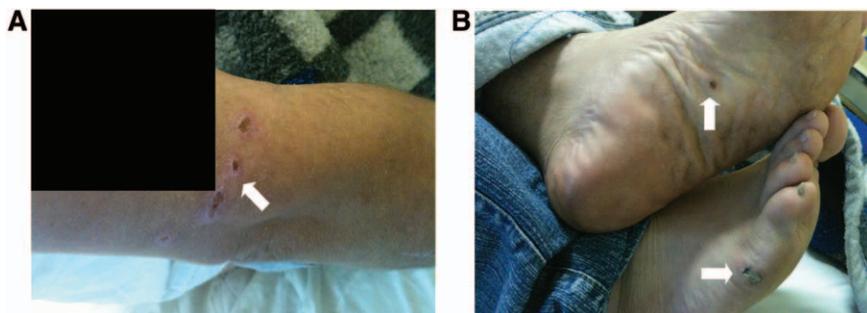
#### Discussion

Lightning strike is a rare but potentially fatal event. The odds of being struck in a given year are estimated to be 1/1 000 000 for Americans.<sup>1</sup> The mortality rate for lightning strikes is

nearly 10%. An estimated 400 lightning injuries occur annually based on data averaged over the last decade.<sup>1</sup> The estimated current of a bolt of lightning is massive, ranging from 30 000 to 110 000 A, although such currents are only applied for 10 to 100 ms<sup>2</sup>. This effect leads to several abnormalities in the different organ systems.

The cardiovascular effects of a lightning strike are variable, ranging from benign electrocardiographic changes to sudden death.<sup>2</sup> Cardiac dysfunctions, including severe biventricular failure and substantial pericardial effusion with tamponade, are mechanical consequences of this event.<sup>3</sup> The direct current of a lightning strike can cause cardiac depolarization and asystole. There are also reports of the occurrence of atrial arrhythmias, specifically atrial fibrillation, in previously healthy patients after lightning strikes,<sup>4</sup> as in the case presented herein.

We could not find any case of pre-excited atrial fibrillation induced by a lightning strike in the medical literature. The probability of these rare events occurring together (having Wolff–Parkinson–White [0.003] plus being hit by lightning [0.00001] plus surviving respiratory arrest [0.1] plus developing pre-excited atrial fibrillation [0.11]) is  $\approx 3.3^{-10}$ . This exceedingly rare combination of factors may have ultimately benefited this particular patient because atrial fibrillation in individuals with Wolff–Parkinson–White is associated with increased mortality, making radiofrequency ablation the treatment of choice.



**Figure 1.** Electrical burns caused by a lightning strike (white arrows). **A**, Entry wound on the right arm in the form of a full-thickness linear burn. **B**, Tip-toe sign: small punctate (<1 cm), full-thickness burns found on the distal toes or the sole of the foot.

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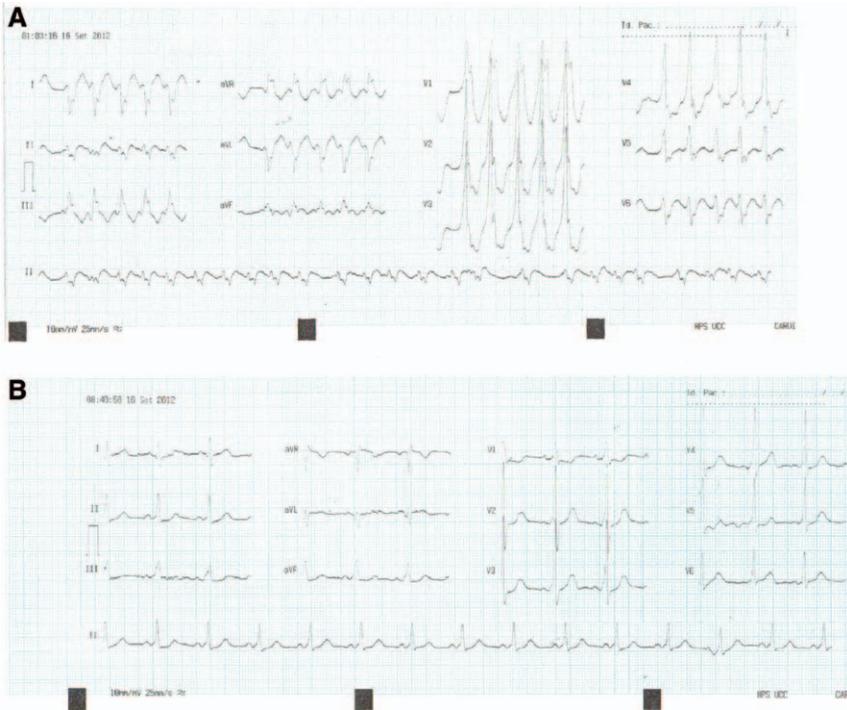
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**Figure 2.** **A**, Twelve-lead ECG showing pre-excited atrial fibrillation. **B**, Twelve-lead ECG taken after electric cardioversion showing sinus rhythm and a Wolff–Parkinson–White pattern because of a left lateral accessory pathway.

**Disclosures**

None.

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KEY WORDS: atrial fibrillation ■ lightning strike ■ Wolff–Parkinson–White syndrome