ANIL AGGRAWAL'S
Internet Journal of Forensic Medicine and Toxicology
The world's first online journal devoted entirely to forensic medicine and toxicology · Published 1 January and 1 July

VOL. 7, NO. 1 · JANUARY – JUNE 2006
Downloaded from www.anilaggrawal.com · ISSN 0972-8074 (Online) · https://www.anilaggrawal.com/ij/vol_007_no_001/papers/paper004.html

Lichtenberg Lightning Strike Figures: Report of an Autopsy Case with Gross and Microscopic Findings

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CITE THIS ARTICLE

Bibb CO, Mellen PF. Lichtenberg Lightning Strike Figures: Report of an Autopsy Case with Gross and Microscopic Findings. *Anil Aggrawal's Internet Journal of Forensic Medicine and Toxicology* [serial online], 2006; Vol. 7, No. 1 (January – June 2006): []. Available from: https://www.anilaggrawal.com/ij/vol_007_no_001/papers/paper004.html

ABSTRACT

We report an autopsy demonstrating gross and microscopic findings of lightning strike injury. Only one prior case with gross and microscopic findings is reported in the literature. The decedent is a 30 year old man found supine under a shattered, burned tree after a thunderstorm, medical history and medications unknown. Gross inspection revealed: soaked and focally tattered clothing; broad, patchy arborescent erythema (Lichtenberg Figures) of the neck and anterior torso consistent with lightning injury; and singed chest hair and minor abrasions of the neck and face. No electrothermal changes were identified on microscopic sections. Follow up skin exam (after autopsy) demonstrated resolution of the Lichtenberg figures at approximately 24 hours. Microscopic sections of the skin show normal histology with very rare perivascular extravasated red blood cells. No electrothermal changes were identified on microscopic sections. Our findings support the accepted theory that arborescent erythema of the skin secondary to lightning injury is a transient phenomenon with a pathogenesis not related to conventional thermal injury, but more analogous to the Lichtenberg figures seen in electrical engineering after which they are named. The exact physiologic mechanism is unknown.

Keywords: Lightning; Electric Injuries; Lichtenberg sign; Dermatology; Forensic Pathology

The Case

A 30 year old man found lying supine under a shattered, burned tree after a thunderstorm, medical history and medications unknown. The clothing and personal effects were soaked. Focally, there were burn marks on the shirt of the decedent.

The autopsy showed broad, patchy arborescent erythema of the neck and anterior torso consistent with lightning injury, with minor abrasions of the neck and face. Hairs on the anterior chest were singed. No internal injuries were identified. No natural disease was identified. Toxicology testing showed that the decedent had been using alcohol and marijuana.

Gross Inspection and Microscopic Evaluation

Gross inspection and microscopic evaluation revealed findings which are best seen in the pictures here.



Figure 1. Initial photograph at time of arrival of decedent to morgue, approximately 5 hours post mortem.



Figure 2. Photograph at beginning of post-mortem examination, approximately 22 hours post-mortem.



Figure 3. Photographs at completion of post mortem examination, approx 24 hours post mortem, demonstrate only trace erythema.



Figure 4. Photographs at completion of post mortem examination, approx 24 hours post mortem, demonstrate only trace erythema

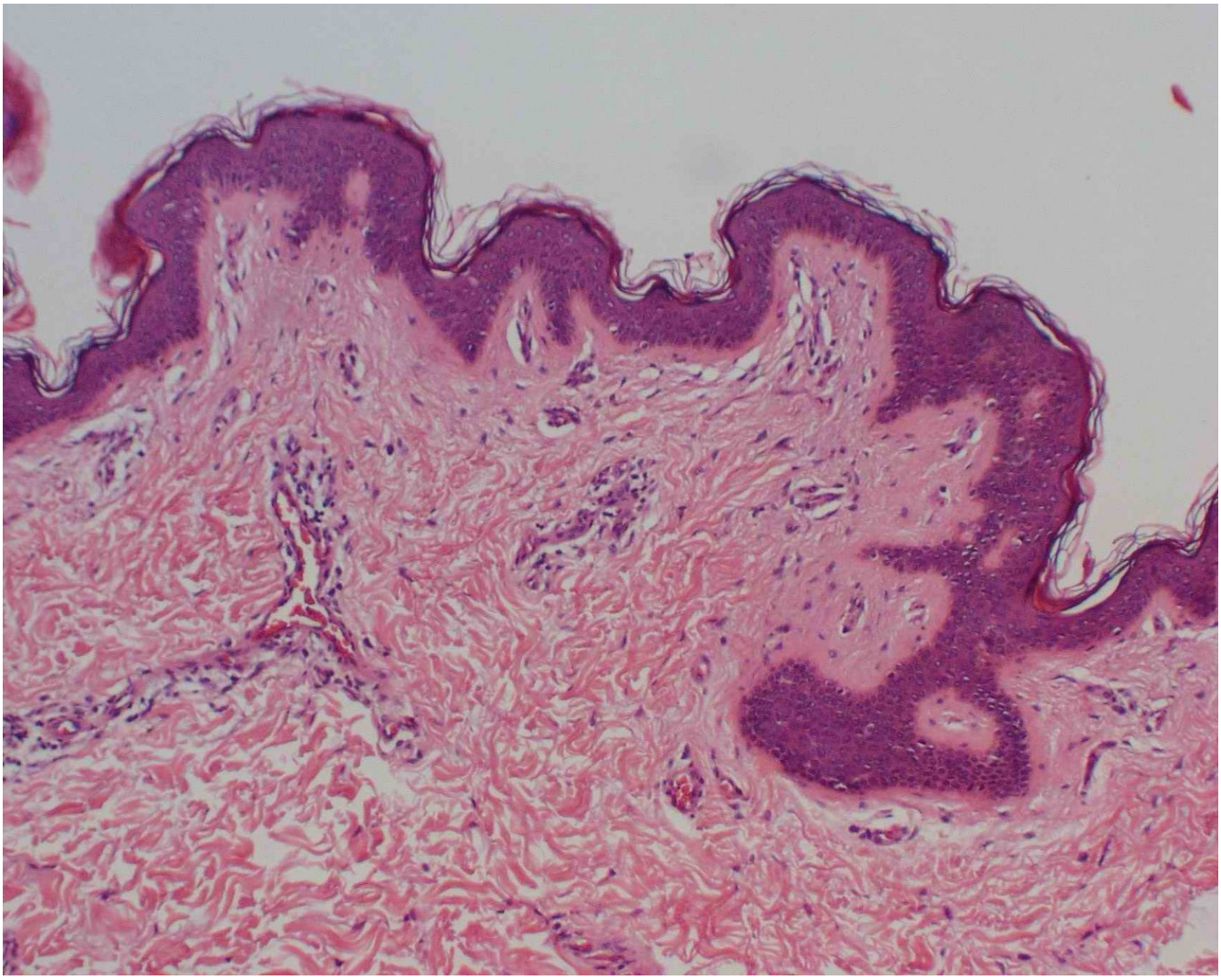

Figure 5. Microscopic sections of skin show normal histology with rare perivascular extravasation of red blood cells.

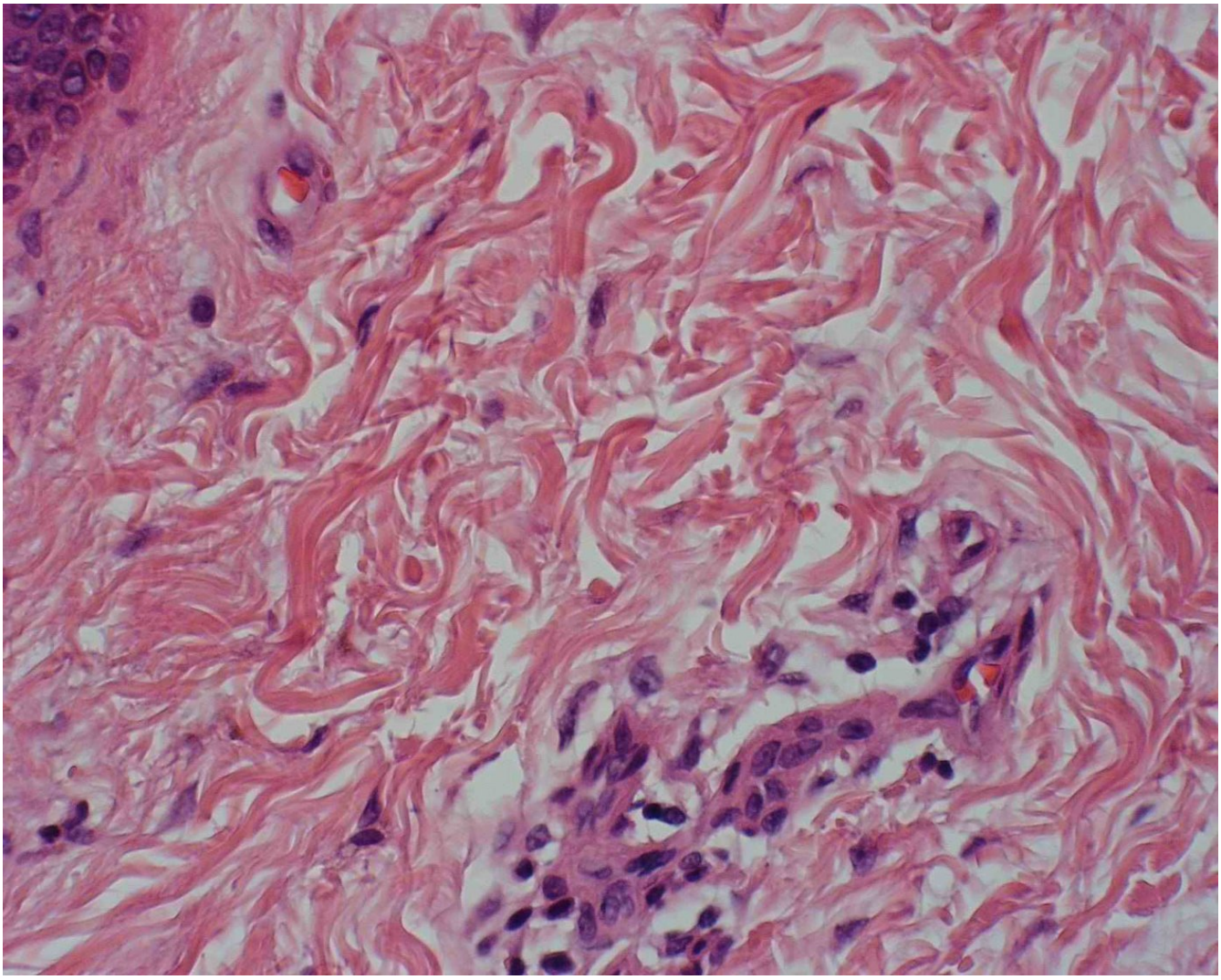

Figure 6. Microscopic sections of skin show normal histology with rare perivascular extravasation of red blood cells.



Figure 7. Lichtenberg Flowers on the sides of the torso.



Figure 8. Lichtenberg Flowers on the sides of the torso.

Discussion

Arborescent erythema of skin due to lightning strike is analogous to Lichtenberg figures. Lichtenberg Figures are branching, tree or fern-like patterns that form as the result of high voltage discharge on, or within, insulating materials[1]. The first Lichtenberg Figures were 2-dimensional patterns formed in dust on the surface of a charged plate in the laboratory of their discoverer, the German physicist Georg Christoph Lichtenberg (1742-1799)[1]. Professor Lichtenberg made this observation in the late 1700's. The basic principles involved in the formation of these electrostatic figures later evolved to become modern xerography[1]. A similar pattern of cutaneous arborescent thermal injury is observed in human beings with lightning injury. This is a phenomenon that appears to persist for approximately 24 hours.

Cutaneous keraunographic marking of the skin, a superficial arborescent erythema, is a rare pattern of injury associated with victims of lightning injury[2]. Though an infrequent finding, it is considered pathognomonic of lightning injury. We present a second documentation of the anatomic and microscopic depiction of this phenomenon.

A previous case report with microscopic sections reveals identical findings of skin with extravasation of red blood cells[3]. No epidermal changes characteristic of electrothermal injuries were identified[3,4]. An iron stain showed no evidence of old hemorrhage. The finding of extravasated red blood cells appears to be the only microscopic correlation with the anatomic finding of arborescent erythema. The etiology of the erythema appears to be a displacement of red blood cells from superficial blood vessels in a pattern analogous to that observed with the distribution of particles in Lichtenberg figures. The reason for the transient nature and exact mechanism is unknown.

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