

LIGHTNING DATA CENTER  
 Minutes  
 February 11, 2005  
 St. Anthony Hospital, Denver  
 www.stanthonyldc.org

Quote of the Month:

“He was so brim full of exultation that he could hardly hold himself when the old lady came back and stood above the wreck discharging lightnings of wrath from over her spectacles.”

Refers to Tom who had just witnessed his half-brother breaking a sugar bowl.

Mark Twain, *The Adventures of Tom Sawyer*

1. Meeting began at 11:30 am and adjourned at 1:40 pm.
2. Members present: Bergschneider, Breed, Cherington, Clark, Collier, Flanders, Gahagan, Glancy, Keen, Langford, McDonough, Mendez, Nibbe, Wachtel, Wells, Yarnell.
3. I brought the following articles from the literature (abstracted in part here):
  - a. Aslan S, Yilmaz S, Karcioğlu. Lightning: an usual cause of cerebellar infarction. *Emerg Med J* 2004;21:750-751.
 

“A 45 year old male farmer struck by lightning. The initial ECG showed signs of inferolateral ischemia. Echocardiography showed decreased motions in the apical and lateral wall of left ventricle. CT of the head displayed a mild cerebral oedema. On the fourth day, the patient was able to walk with support despite a significant ataxia, which led the clinicians to suspect a cerebellar disorder. MRI showed ischemia bilateral cerebellar hemispheres. After one month, dysarthria and hypotonia were found to have resolved, but ataxia did not improve completely.”
  - b. Carrera-Izquierdo E, Moran-Sanchez JD, Carrera-Izquierdo M. et al. Hemorragia intracaneal secundaria a fulguracion por rayo: presentation de un caso. *Rev Neurol* 2004;39:530-532.
 

“ a patient was hit by lightning and then developed an acute bilateral intraparenchymatous hemorrhage in the basal ganglia and the left internal capsule.”
4. Carl Ojala from Eastern Michigan University sent an email with the following information from an article in the September 4, 1902 Alcona County Review (abstracted in part here):

“The government has prepared some statistic showing the fatalities by lightning in the United States annually. During the last year 713 persons were killed by lightning 229 were killed while in the open 214 were killed while seeking shelter in buildings and 57 were killed while standing under trees (this is one of the most dangerous places to which a person can go.) The majority of supposed fatal cases from lightning really are not so, the appearance of death being due to temporary paralysis of the respiratory system. In

such cases prompt and intelligent treatment by a physician usually will result in recovery.”

In response to this article, several members (McDonough, Nibbe, Yarnell) discussed the evolution of CPR in the care of lightning strike patients. CPR, as it is applied today, was introduced in the 1960's. Al Nibbe mentioned that the prognosis for out-of-hospital cardiac arrest cases, although improving recently, remains poor. Phil Yarnell said that, in the past, using AC current to shock a patient with ventricular tachycardia could lead to potentially fatal ventricular fibrillation. Automatic defibrillators are more available today, and can be useful for patients with ventricular fibrillation. Patients with asystole might convert to sinus rhythm with CPR or spontaneously.

5. Bob Glancy, Rich Keen, and Ken Langford told us that there will be a Stormchaser Conference on February 18 to 20, 2005 at the Holiday Inn at I – 70 and Chambers Road. They will be participants. More information can be found at [www.chaserconference.com](http://www.chaserconference.com).
6. Last year, Phil Yarnell told us about a patient who was struck by lightning during a golf tournament. Today, he brought pictures of the tournament that were taken moments before the lightning strike. The pictures show people on the driving range under cloudy skies.
7. Today's speaker: Howard Wachtel, PhD. Howard' PhD Thesis was in Neurophysiology at NYC. His advisor was Professor Eric Kundel, Nobel Prize winner in 2000 for Synaptic Transmission Mechanisms.

Title of Howard's talk: Sub-luminous Lightning Currents Can Be Lethal. His presentation was outstanding. I cannot do justice to his talk in these minutes, but will provide information from my notes taken during the talk.

A. Criteria for diagnosis of lightning caused cardiac arrest:

1. Burns, Lichtenberg figures, ruptured tympanic membranes.
2. Eye witnesses or photographs of lightning
3. Damage to surrounding area (trees, etc.)

B. Points to Ponder

1. How much current required to produce ventricular fibrillation?
2. Would such current produce burns?
3. Would that current match lightning current?

C. Biologic effects of current

- |                             |        |
|-----------------------------|--------|
| 1. Perception, "tingle"     | 1 mA   |
| 2. "Cannot let go" muscles  | 10 mA  |
| 3. Ventricular Fibrillation | 100 mA |

Current density is same for all three. Current density =  $1 \text{ mA/cm}^2$

D. Cell physiology (Nerve, skeletal muscle, cardiac muscle)

1. Resting potential - 90 mV
2. Action potential + 35 mV
3. Cell membrane – electrically excitable. Sodium and potassium ion channels. Sodium more concentrated outside cell; potassium more concentrated inside cell.

4. Membrane is a good dielectric; separated by 2 fluids.
- E. Cardiac cycles
1. “Circus movement” of excitation – cause of ventricular fibrillation
  2. Refractory period 10 to 20 msec occurs after action potential. T wave – 20 to 40 msec. If pulse wave of current arrives at this vulnerable time, it can produce circus movement of ventricular fibrillation.
  3. There are lightning currents that can produce ventricular fibrillation but not enough to cause thermal effects or burns.
- F. Threshold for luminosity depends on background light. Less than 1000 amps might not be visible during bright daylight.
- G. Conclusions:
1. Current (60 Hz) across the torso of 100 amps could produce ventricular fibrillation.
  2. Such current might not be enough for thermal consequences.
  3. Such current could be subluminescent or “invisible.”  
Ken Langford commented that lightning “visibility” = ionized air.
- H. Howard comment on 2 situations where lightning cardiac effects might not be accompanied by burns.
1. Strong current produce magnetic field changes associated with induced currents.
  2. Weak current can produce ventricular fibrillation but no thermal effects.

Following the meeting, Ken Langford sent an email to Ron Holle (with copies to Howard and to me). Ken, as usual, makes us think. He wrote about the electrical flow that occurs under a thunderstorm (more than fair weather flow), but below the threshold to result in lightning. He suggests we explore a new class of phenomena and they be named “Wachtels.” Ken, thanks for your email.

8. These minutes do not represent official positions of LDC or its members. They reflect comments made during the meeting.
9. Next meeting: Friday, March 11, 2005 at 11:30 am in the Main Auditorium of St. Anthony Central Hospital

Respectfully submitted,

Michael Cherington, MD