

LIGHTNING DATA CENTER MINUTES

July 14, 2017
ST. ANTHONY HOSPITAL WEST, LAKEWOOD, CO
www.lightningdatacenter.org

Monthly Quote: “It was like I was holding a lightning bolt in my hand, it was amazing.” “I’m sure I jumped, because I felt a major shock. But after that I was kind of okay and I even continued speaking.” JP Nadeau, commenting on a lightning strike during his speech at his daughter’s wedding. Link: <https://www.theguardian.com/world/2017/jul/11/father-of-the-bride-struck-by-lightning-canada-wedding>

1. Members Present: Clark, Stemple, Langford, Olson, Moore, Nibbe, Wachtel, Yarnell, Elder and Claus. We also had two nurses attend, along with a member of the Nursing Administration; Barbara Sanchez, Mary Sienkiewich and Rene Santos, respectively. Meeting began at 11:50 AM and ended at 1:05 PM.
2. LDC gave two presentations on June 22 in Grand County, Colorado – one for EMS and first responders and the other for the general public. Ken Langford gave the EMS talk. Carl Swanson and Steve Clark gave the public presentation. Feedback from both meetings says they were well-received by the attendees. LDC has been approached about future presentations.
3. In the previous month’s minutes, the case of the girl in Douglas County that had been knocked off the horse was determined to have been an indirect injury from lightning. In this meeting, Dr. Phil Yarnell advised it is still possible the girl could have suffered direct effects from the lightning. He wanted our data base to be updated accordingly.
4. Larry Moore, MD, and Sheryl Olson, RN, presented a talk on the emergency management of a lightning patient in the ER.

Sheryl presented the perspective of a triage nurse who receives patients from ambulances, helicopter flights, or private walk ins. She said statistics indicate 9 out of 10 people struck by lightning survive and many of those are transported to hospitals. Sheryl told us what she does and what she looks for:

- Identify any life-threatening or limb-threatening injuries.
- Look for entrance and exit burns. Burns to the whole body are rare, but do happen. In lightning patients, common types of burns include punctate burns, burns from steam, and burns from synthetic clothing that melted to the skin.
- Assess for injuries that need immediate treatment and/or ongoing evaluation, e.g.: cardiac dysrhythmia. Closely monitor the heart and look for signs of irritable heart, ventricular tachycardia (vtac), etc. Such a heart is not always responsive to lidocaine, and can have breakthrough dysrhythmia.
- Look for trauma from a fall and perform a concussion evaluation.
- Nursing actions taken by a nurse in the ER can include: IV, cardiac monitoring, assessments, neurologic assessment, and checks for auditory and visual changes. A nurse will also try to get the patient’s recollection of events.

Sheryl witnessed a lightning strike to a person who was leaning against a commercial metal dishwasher and had a hard-wired phone to his ear. The lightning traveled through the phone wires, flashed to his head and crossed his body as it passed to the dishwasher. He collapsed to the floor and had no palpable pulse. A precordial thump was given and a pulse returned. He was transported via privately-owned-vehicle to the nearest hospital which was 1 hour away. Upon arrival, the cardiac monitor showed normal sinus rhythm with runs of ventricular tachycardia.

She told us lightning can affect any body function that relies on nervous system conduction, e.g. keraunoparalysis. Lightning can also create ferning, or Lichtenberg figures on patients' bodies.

Sheryl closed her part of the talk saying many injuries caused by lightning can't be visualized. This trauma is caused by something that can't be seen. It is important that time be taken for a thorough assessment and it is important to communicate with the patient and family, providing information and comfort.

Larry opened his segment by stating all lightning is trauma and some forms of trauma are not visible. Since lightning injury is a form of trauma, Larry recommends patients be treated within a trauma department, if possible.

He compared lightning patients to electric shock patients. As compared to lightning survivors, electrical shock survivors tend to have deep electrical burns and more internal injuries. Also, the tendency of renal failure is greater among electrical shock survivors. In lightning survivors, the electric current tends to flow mostly over the skin, rather than through it.

Larry recommends a complete physical exam. Here are some things to look for and keep in mind:

- Many an exam may not see an eardrum injury, but about 50% of lightning-injured patients' eardrums are affected.
- Cataracts may develop relatively soon or present 2-3 months after the injury.
- Look for spinal injuries, e.g.: lower extremity paralysis. Spinal deficiencies may not be recognized right away. What appears to be keraunoparalysis may not be purely from lightning; it could be an actual physical injury to the spine. The entire spine should be evaluated. Keraunoparalysis can vary from case to case.
- Burns may occur from sweat turned to steam, or by clothing heating/catching fire.
- Any ferning is usually transient over a period of as short as a few hours.
- Consider CT scans, spinal CT scans, and plain films of extremities.
- Often the most affected anatomy are the heart, the brain, and peripheral nerves.
- A "stunned heart" (Myocardial stunning) may appear, with onset delayed by up to 24 hours. A stunned heart occurs when the myocardium is not contracting normally. Stunned heart can be seen using ultrasound or echocardiography.
- Possible congestive heart failure.
- Heart injuries tend to be self-limited and resolve.
- Also possible is Takotsubo cardiomyopathy, also called broken-heart syndrome, which is a weakening of the left ventricle that is usually the result of severe stress.

Larry also said need lab evaluations need to be done, such as:

- Check for elevated troponin levels, looking for acute myocardial injury.
- Perform an EKG/ECG.
- Do a renal function test. Dark urine is a clue suggesting renal failure. This is most commonly seen in electric shock patients and relatively uncommon for lightning patients.
- Look for coagulation abnormalities, for example, barotrauma.
- Do an arterial blood gas test (ABG) for pulmonary blood gases.
- ALT and AST tests measure enzymes that your liver releases in response to damage or disease. The liver can be damaged by blunt trauma.

When in the ER, a lightning patient requires a few hours of observation at the minimum.

When a patient is in the ER, at some time, a decision is made on whether to admit a patient or to discharge the patient. A patient should be admitted if they had or show:

- Any electrical abnormality to the heart or lungs.
- Any paralysis. Paralysis often resolves, but it must be observed. Verify the spine.
- Any abnormal bile signs.
- Any abnormal neurologic symptoms.
- Any CPR or defibrillation.
- Any abnormal vital signs.
- Sheryl also added pregnant women should also be admitted due to the possibility of spontaneous abortion. A facility without labor and delivery capability may wish to transfer a pregnant woman to a hospital that has such services. Steve Clark said a pregnant woman in Florida was struck in June. The baby was delivered alive in July but has passed away.

When a patient is discharged, consider what will happen once they go home. Patients require active follow-up. At the very least, a lightning survivor should get an eye exam within the month and also a hearing test and ear evaluation. If and when a patient sees a neurologist, Larry recommends the neurologist should have experience in treating lightning patients.

When a patient is discharged, the family should be educated to recognize if the survivor complains about their health, do not ignore or make light of it. Instead, get help. For example, if the complaint is about deteriorating vision, visit an eye doctor, preferably one that specializes in trauma. In rural areas, ask if there is a physician or mid-level a survivor can talk to. Visits do not always have to be face-to-face. Use technology to your advantage, e.g.: cell phones, Internet, and Skype. Finally, patients can be referred to the LDC for support.

Larry said struck persons often do not understand the severity of the trauma on the day of the event. Instead, they gradually gain insight that this was a major health event. He also said to keep in mind that many neurologists have never have seen a lightning strike patient and that patients are often passed around by providers because they are misunderstood, disbelieved or thought of as crazy. It is important (for patient and doctor) to remember that the struck brain does not function as it used to. Know there may be very long-term sequelae that need management. Finally, most patients have an OK outcome. It is estimated that from roughly 10% to 30% are fatal and some are not reported or are misdiagnosed.

After the presentation, some discussion followed. A few discussion items are presented here.

Larry said lightning has a huge magnetic field caused by current flow. The effects of the magnetic field on human physiology are not well understood. Howard Wachtel said it takes a current of only 10mA @ 60Hz to cause defibrillation in the heart and passive heart probes at 10 uA can actually cause fibrillation. He also said it seems like current enters the body in many cases rather than flowing over the skin. Howard also noted a magnetic field can induce a current to the inner structures even if there is no direct incursion of current.

Larry asked what EMP (Electromagnetic Pulse) does to the brain. Howard said EMP is a radio frequency short duration pulse, vs. an induced current via a magnetic field. Larry wondered if it is semantics which keep us from classifying lightning as EMP and noted regardless of the mechanism, the electromagnetic energy and current of lightning can cause damage to humans. Wikipedia specifically includes lightning as a natural EMP, and states further: "...at higher energy levels a powerful EMP event such as a lightning strike can damage physical objects such as buildings and aircraft structures." Link: https://en.wikipedia.org/wiki/Electromagnetic_pulse

Al Nibbe asked if there are any unique characteristics of lightning caused cataracts? Sheryl recalled a case of a boy who had been struck while playing with metal Tonka trucks had bilateral cataracts, but specific characteristics are uncertain.

Barb Stemple said if she wears a wrist watch, either wind up or battery type, the watch will fail after a short time (in days) and asked if anyone has heard of that. She said many other strike patients she has met report the same anomaly. Steve Clark said Near Death Experiencers (NDErs) have symptoms similar to lightning strike patients, including physical effects on external objects. He cited an article excerpt with anecdotes. From the excerpt, NDErs report greater electromagnetic aftereffects and tend to be ultra-sensitive to their environment.

Barb also reported that after the strike she had stroke-like symptoms on her left side. She could not walk and could not speak. She reported lasting effects on her left side for three months. Sheryl said there can be different grades of paralysis and that keraunoparalysis typically resolves more quickly than three months.

Al Nibbe remembered a case where electrodes showed ferning around their edges when electropaste for EKG was applied within hours of the strike. This was Sheryl's case and it has been documented. Ken asked if the ferning propagated when the paste was applied. Sheryl said she did not monitor the patient continuously, so she was unsure of how the ferning appeared.

Ken pointed out that this is the only known incidence of new ferning which was tangentially rather than directly related to a lightning strike.

We also discussed the unique ferning patterns on a patient who was struck on the Colorado plains. Sheryl had seen this patient and photos of the ferning were taken. Ferning patterns went down one side of the body and stopped at the waistline, only to appear on the opposite side of the body. Ken suggested the presence of sweat caused easy current flow on the "sky side" of the body (away from the ground), but the elastic underwear band caused an interruption of current flow to the dry space below the elastic underwear band. He then said the current might have flowed through the torso (the patient reported subsequent hip problems), with ferning patterns forming on the skin closer to grounded (opposite) side of the body.

This same patient also had an acoustic neuroma. Phil told us of a woman who was struck on a horse and died a year after her strike. She had a benign tumor on the auditory nerve. Larry has seen delayed acoustic neuromas in two cases, years after the strike.

5. Questions, comments, notification of errors, and critiques of these minutes are welcome. Please forward those to Steve Clark at: sclarktoto@gmail.com. Please keep your communications professional and respectful. Communications will be forwarded to the appropriate author(s) of the minutes and addressed accordingly.
6. LDC Disclaimer: These minutes do not represent official positions of the LDC or its members. They simply reflect the comments made at the meeting. Furthermore, the LDC does not implicitly or explicitly recommend or endorse any product or service. Any product or service presented in these minutes is done so for purposes of discussion and analysis. The merit (or lack thereof) is open for the consideration and review by the entire membership.
7. Next meeting: Friday, August 11, 2017, from 11:45 to 1:00 PM at St. Anthony Hospital West. Room: Conference Rooms E & F. Roundtable format.

Respectfully Submitted,
Steven E. Clark, Consulting Meteorologist

Lightning Links

This is a monthly listing of periodicals, websites, and videos about lightning and allied areas from a variety of sources. A headline or description is listed, followed by the link. Please note that some of the links are perishable, which means you'll need to go to the source for the information.

Finley, F., 2017: Douglas County Woman Killed by Lightning Strike Identified. *The Denver Post*. May 7, 2017, Updated May 8, 2017. Link: <http://www.denverpost.com/2017/05/07/lightning-bolt-kills-rider-horse-leaves-teenager-douglas-county/>

Maggert, L., 2017: Staying Alive When Lightning Strikes. *Sky-Hi News*. July 6, 2017. This article references LDC's presentation to the public on June 22. Link: <http://www.skyhinews.com/news/staying-alive-when-lightning-strikes/>

Web Staff., 2017: 2 Years After Being Hit by Lightning, Golden Man Completes Coast-to-Coast Biking Trip. *KDVR.COM*. May 11, 2017. Link: <http://kdvr.com/2017/05/11/2-years-after-being-hit-by-lightning-golden-man-completes-coast-to-coast-biking-trip/>

This gentleman's case was profiled in the August 2015 & September 2015 minutes.

Thomas, G., 2017: Pilot Caught in Nature's Amazing Light Show. *Perthnow.com/au*. June 9, 2017. Link: <http://www.perthnow.com.au/news/pilot-caught-natures-amazing-light-show/news-story/16542f1ef75ecb59711e787f6848c24a>

Boggs, J., 2017: Florida Baby Born to Mother Who Was Struck by Lightning Dies. *WPTV.COM*. July 14, 2017. Link: <http://www.wptv.com/news/state/florida-baby-born-to-mother-who-was-struck-by-lightning-dies>

Dipert, B., 2014: Lightning Strike Becomes EMP Weapon. *EDN Network*. October 14, 2014. Link: <http://www.edn.com/electronics-blogs/brians-brain/4435969/Lightning-strike-becomes-EMP-weapon->