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Specifics of electrical injury

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Learning objectives

- Student will learn the basic effects of electric current on the human body.
- Student will learn the main threatening impacts of the electric current.
- Student will learn basic approach to a person with electrical injury.

Effects of electric current on the human body

- What are the main effects of electric current on the human body?
  1. Excitable
     - Spasms, muscle pain
     - Heart rhythm problems
     - Altered state of consciousness
  2. Thermal
     - Burns
- Main three life-threatening injuries?
  - Cardiac arrest, respiratory arrest
  - Burns
  - Injury due to jerking away or falling

Low voltage < 1000 V

- Alternating current of low voltage distribution network - household current
  - 120 V, 50 Hz (North America,…)
  - 230 V a 50 Hz (Czech Republic, Europe)
- Effects of low voltage current depends also on frequency (frequencies around 100 Hz have highest excitability)
- Excitable effects on human body predominate
  - Spasms, muscle pain
  - Cardiac arrest, arrythmias, VF
  - Confusion, loss of consciousness, retrograde amnesia, neuropathy
  - Respiratory arrest
- In general – electrical injury can results in no injury at all or may results in devastating long-term complications or death

Low voltage < 1000 V

- Thermal effects – burns – usually point of entry, sometimes point of exit, based on these signs the whole-body effects cannot be assessed

Picture 1 – https://zdravi.euro.cz/clanek/sestra/prvni-pomoc-u-pacienta-s-termickym-urazem-453259
Picture 2 - https://www.akutne.cz/index.php?pg=vyukove-materialy--rozhodovaci-algoritmy&tid=105
Picture 3 - https://www.priznaky-projevy.cz/traumatologie/461-uraz-zasazeni-poraneni-elektrickym-proudem-priznaky-projevy-symptomy

High Voltage > 1000 V

- Thermal effects predominate – especially from voltage higher than 500 V
  - 600 V, ss (trams in Brno)
  - 25 kV, 50 Hz (part of the traction train network in CR)
- Burns on the body surface can be discreet, but they may affect deeper inner parts of the body
- There is no need of direct contact – electric arch for different distances (depends on the safety distance of the power line) – usually more than 1 m
- Injuries usually combined with mechanical trauma – falling down

High voltage > 1000 V

Picture 1 - https://www.jcdr.net/article_fulltext.asp?id=3166
Picture 2 - http://vagonari.cz/#collapse1

Lightning injury

- Lightning = an electric discharge between clouds and ground
  - millions V, 20 000 A, short duration (ms)
- Direct strike (usually fatal)
- Indirect strike
  - side splash, contact injury, and ground current (as far as 30 m around lighting strike)
- Due to very short duration lightning injury differs from ”technical electric current injury”
  - Cardiac arrest (reversible), respiratory arrest (usually more prolonged)
  - Altered state of consciousness, retrograde amnesia
  - Burns, spasms
  - Mechanical trauma caused by falling or shock wave
  - Long-term consequences are common – hear or vision damage, …

Lightning injury

- Lichtenberg figures = tree-like lesions, which are pathognomonic for lightning injury = It is caused by dilatated subcutaneous blood vessels with thrombosis. It can heal by scaring or completely disappear

Picture 1 - https://www.nbcnews.com/healthmain/heres-what-lightning-strike-can-do-your-skin-325006
Picture 2 - https://twistedsifter.com/2012/03/lichtenberg-figures-lightning-strike-scars/

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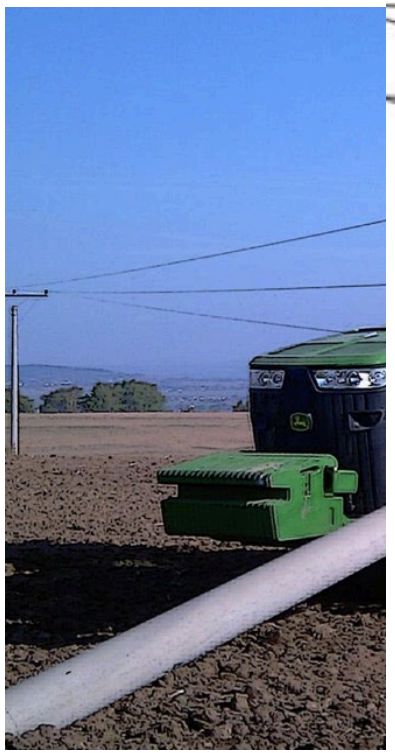
First aid for low voltage injuries

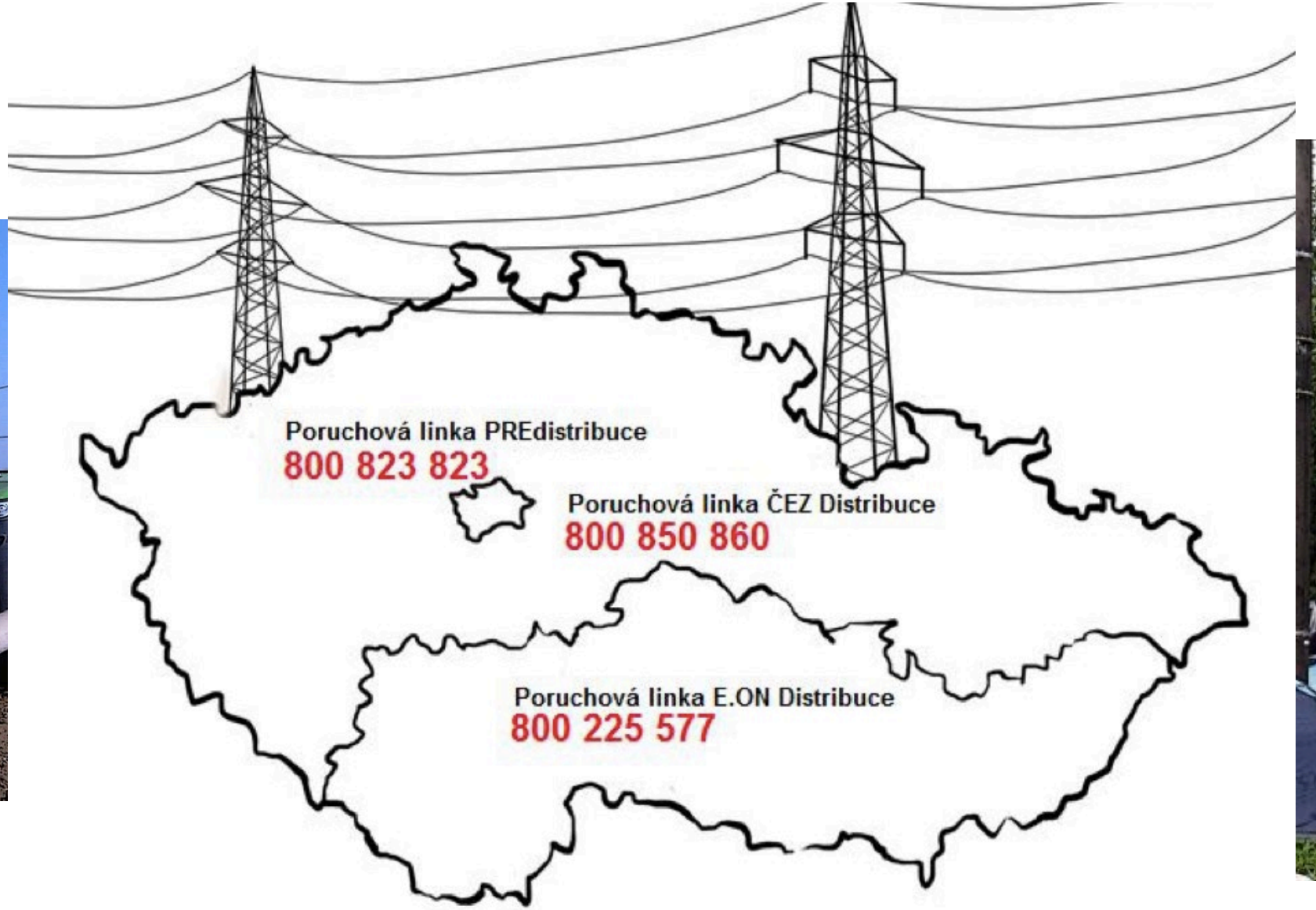
- 2 main aims
  1. Disrupt the contact with current supply
     - SSS ABC – your own safety has priority!
     - Unplug the device or turn off the power – don't touch the injured person if he or she is still in contact with the electrical current
     - If you cannot turn off the power, you can try to separate the victim from the power source using non-conducting objects
     - Try to use non-conductive materials, have dry clothes and hands, Wellington boots or other footwear with rubber sole.
  2. In the case of cardiac arrest perform BLS until the arrival of emergency medical service
- Think of the possibility of an electrical injury – sudden collapse at home or sudden fall
- A person who has been injured by electricity should be always seen by a doctor!

Fist aid for high voltage injuries

- 2 main aims
  1. Disrupt the contact with current supply
     - SSS ABC – you own safety has priority!
     - Call 112 (for CR) - Integrated Rescue System (IRS)
     - Your location, identification of electric power transmission lines - breakdown service of the electrical operator
     - If you are sitting in the car, hit by electric current, without fire or any other danger, stay inside
     - Electric arch – distance of few meters (safety distance varies – depending on the line voltage), ground current (traffic accidents, damages of power lines)
  2. In the case of cardiac arrest perform BLS until the arrival of emergency medical service

- Treatment of burns – topic of Burns is another lesson





Breakdown service operator numbers in CR

Pictures - https://www.csres.cz/Upload/Prevence/rizika-pouzivani-vozidel-a-mechanismu-v-ochrannych-pasmech-elektrickych-vedeni.pdf

Learning outcomes

- Student is able to describe the steps to ensure the safety of the rescuer in the event of electric shock.
- Student is able to describe the effects of electric current on the human body.
- Student is able to describe the principles of first aid in the injured person affected by electric shock.

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