Clinical Information Hotline News

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Ouch! I Just Got Shocked!

The Valleylab Clinical HOTLINE has received a number of calls from surgeons and nurses who have been "shocked or burned" during an electrosurgical procedure. A surgeon may see a hole in his/her glove after the occurrence and believe that the shock was due to a hole in the glove. What the surgeon does not realize is that the concentrated current from the electrosurgical unit might have blown a hole in the glove as it attempted to use the surgeon as a circuit pathway. At best, surgical gloves provide minimal insulation from electrical shocks or burns.

Where does this "concentrated current" come from?

There are two kinds of alternating current that flow during electrosurgery and both have the ability, in certain circumstances, to concentrate and cause injury to the user. First, is the "therapeutic current" which is the intended current used by the surgeon at the surgical site to cut and coagulate tissue. This therapeutic current from a properly functioning electrosurgical unit (ESU) is delivered at such a high frequency (500 kilohertz to 3 megahertz) that it does not cause neuromuscular stimulation; however, this same high frequency current can create pin-point burns that are perceived to be shocks.

The second type of current is "leakage current". This type of current can be low frequency or high frequency. Low frequency leakage is a concern of all medical equipment manufacturers. Small amounts of the 60 cycle wall current can "leak" from patient connections or the metal case of the ESU. Low frequency leakage poses a fibrillation danger to patients and hospital personnel. This is also the type of current that causes shocks, microshocks, and/or neuromuscular stimulation. Valleylab isolated generators carry the designation "CF" (Cardiac Floating) which means that the patient connections have such a low leakage value that direct application to the heart is possible without a fibrillation danger.

The other type of leakage is Radio Frequency (RF), high frequency leakage. This type of leakage can be "transmitted" from all radio frequency electromedical equipment. Small amounts of RF leakage current can escape through all types of cords and connections anywhere there may be a weakness in the electrosurgical circuit. Always be sure your cords and connections are secure. Never use cords or adapters that are damaged. RF leakage current may cause small, localized burns that can feel like shocks.

Why does some current go in an unintended direction? All electrical current will find a path(s) back to its source. An isolated electrosurgical unit (ESU) creates a preferential path for the current through the patient return electrode (PRE) and

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back to the ESU. In a ground referenced generator, the current generally finds the PRE to be the path of least resistance, but it can use anything or anyone that is "grounded" as a path back to ground. Either of these technologies may find a staff member to be a convenient detour back to the pad, but only a ground referenced generator can decide to bypass the patient return electrode completely and detour through a staff member or metal object, to go directly to ground instead. The use of an isolated ESU will decrease but will not eliminate the chances of a radio frequency leakage burn.

Why would the current choose to use a staff member as a circuit pathway? The electrosurgical circuit does not have to be the shortest distance between two points. Several factors come into play, one of which is impedance. The current may find the least impedance (resistance) by having the electrical circuit go from an electrode (pencil); through the patient, then through a surgeon's hand and body; back to the patient and then to the patient return electrode (PRE). It may not appear an easy pathway to us, but electricity is like water running downhill, it might follow multiple paths to its destination.

Why don't shocks and burns happen more often? Electrosurgical current may be flowing through surgeons & nurses more often than is realized. If staff members have good surface contact with the patient and/or instruments, then the current will disperse and no electrosurgical effect will be apparent. It is only on rare occasions that all the conditions are present that will produce a chance for a shock or burn. If a surgeon is barely touching an instrument (ie. "buzzing a hemostat"), or if an anesthesiologist is just slightly touching a patient, then leakage current might concentrate at interfacing points and will be felt as a shock or burn.

What should we do when a shock/burn occurs? Although only a very small percentage of shocks/burns are caused by faulty electrosurgical units, a malfunctioning ESU may allow the emission of low frequency leakage currents that can injure a user. The biomedical engineering department should test any unit that has been involved in a patient or staff injury. Check all your connections and insulated cords and electrodes. Review user technique.

Manufacturers of electrosurgical equipment have made many safety improvements in recent years including isolated generators (significantly reducing patient alternate site burns) and return electrode contact quality monitoring (reducing patient pad site burns). In spite of these new technologies, electrosurgical devices still can pose significant hazards to staff and patients.

What can we do to reduce the occurrence of shocks/burns in the OR?

- Use an isolated generator
- Only use generators that have passed routine biomedical maintenance tests
- Determine that patient return electrode is properly applied (if not a Contact Quality pad)
- NEVER use damaged cords (reusable or single use)
- Activate electrode only if it is touching or in close proximity to target tissue
- If contact with patient is necessary during ES use, use firm grasp
- Use lowest possible therapeutic power settings
- Use safety holster when active electrode is not in use
- Refer to Valleylab's Clinical Information HOTLINE, December 1997, Buzzing the Hemostat, What You Should Know