



## Capacitive-Coupled Patient Return Electrodes

In the early 1980s, Valleylab™ electrosurgical units (ESUs) were tested with capacitive patient return electrodes (PREs). It was concluded through extensive testing that Valleylab™ isolated generators did not function optimally or predictably when used in conjunction with capacitive return electrodes. Because Covidien's goal has always been to deliver the best electrosurgical (ES) tissue effect combined with the safest delivery system, Covidien has consistently recommended against the use of capacitive PREs with Valleylab™ electrosurgical generators.

A return electrode contact quality monitor (RECQM) system was developed in the 1980s to help eliminate pad site injuries due to patient burns resulting from partial or complete PRE detachment. RECQM is now the standard of care.<sup>1</sup>

**RECQM:** A safety feature on many monopolar ESUs, RECQMs are designed to minimize the risk of return-electrode site burns by verifying that there is adequate skin contact between the return electrode and the patient's skin. Dual-foil electrodes should be the only return electrodes that are connected to a RECQM. A single-foil electrode connected to an ESU with RECQM circuitry negates the contact-quality monitor safety feature.<sup>2</sup>

Return electrode injuries are often the result of the following: poor electrode placement, lack of skin prep (e.g., not removing excessive hair from the site), (incorrect) removal of electrodes, skin reactions to adhesives, limited viable skin surface area and high-current, long-activation electrosurgical applications. The prevalence of such injuries resulting from conventional electrosurgery, however, has decreased significantly. This

decrease is due in part to 1) the continuing improvement in electrode adhesives, and 2) the increased use of RECQMs.

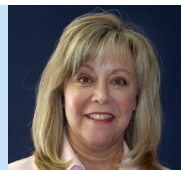
Dual-resistive (conductive) return electrodes such as the Valleylab REM PolyHesive™ II PREs, combined with isolated REM™ electrosurgical generators, provide a predictable electrosurgical current pathway from the time the current leaves the generator, through the electrosurgical instrument, through the patient, to the PRE and back to the generator. In addition to providing a predictable current pathway, the Valleylab REM™ system has monitored the pad-to-patient interface in more than 200 million electrosurgical procedures.

Capacitive-coupled mats may create a less predictable current pathway. A capacitor consists of any two conducting materials separated by an insulator (a non-conductor). The capacitive return mat functions as one conductor of a capacitor, while the patient functions as the other conductor. These two conductors are separated by the covering(s) of the mat, plus the sheath and any linens or positioning devices that are between the capacitive mat and the patient.

Current cannot flow between the two conductors (capacitive mat and patient) because the layers of insulation create high impedance. Although no current flows from one conductor to the other, there is an electrical attraction between the positive and negative charges that gather on the patient and the capacitive mat. The positive side loses electrons while the negative side gains electrons. The larger the area of the conductors and the closer the conductors are to each other, the more charge can be stored on the surfaces.



Jan Fickling  
RN, CNOR  
Clinical Product  
Specialist



Cherie Ryan Loeffler  
BSN, RN, CNOR  
Clinical Product  
Specialist

### Clinical Information Hotline 1-800-255-VLAB (8522) x press 1

Valleylab.ClinicalHotline@covidien.com  
For Hotline News – [www.valleylab.com](http://www.valleylab.com)  
For Accredited Continuing Education – [www.valleylabeducation.org](http://www.valleylabeducation.org)

In order to attempt to reach equilibrium, the polarity of the charges on both conductor surfaces constantly reverse. Although no current actually goes through the capacitor, it acts as though it “conducts” AC current. The polarity reversal occurs hundreds of thousands of times per second, and the charges make a current as they gather on the opposite surface.

It is a common misconception to assume that the current is flowing from the ESU, through the pencil, through the patient, through the capacitive mat and back to the ESU. In reality, the current is flowing in two directions:

- From the ESU, through the pencil, to the patient (in contact with the mat) then reverses back through the pencil, to the ESU.
- From the ESU, through the capacitive return cable, to the capacitive mat (that is in contact with the patient) and back through the capacitive return cable to the ESU.

Because this “current movement” is inefficient, higher power settings are generally required when using capacitive mat technology.

The capacitive mat has the capability of electrically coupling to O.R. tables and to other grounded objects (and people) in the operating room. Once the electrosurgical current leaves the ES instrument and enters the patient, the current pathway may no longer be predictable due to patient variations and position requirements. Although the large size of the capacitive mat decreases the chance of a pad site burn, the chance of an alternate site burn may increase. Covidien makes a concerted effort to design electrosurgical systems that limit capacitance. The capacitive return electrode overrides this engineering design.

### **AORN NURSING GUIDELINES**

Capacitive mats may create nursing issues and additional responsibilities that are not immediately evident. The following are guidelines from the *2004 Mega 2000 Instructions for Use* and nursing considerations from the *2007 AORN Standards, Recommended Practices, and Guidelines*; Recommended Practices for Electrosurgery, Recommended Practice VII: When monopolar electrosurgery is used, a dispersive electrode should be used in a manner that minimizes the potential for injuries.

With advances in technology in return electrode monitor and increased use of laparoscopy, (injury reports) may be changing (from PRE) to other types of injuries (e.g., direct coupling, capacitive coupling). However, burns at the site of the dispersive electrode continue to occur. Preoperative and postoperative assessments allow evaluation of the patient’s skin condition for possible injuries.<sup>4</sup>

### **ALWAYS EVALUATE SKIN, PRE- AND POSTOPERATIVELY**

The patient’s skin should be assessed and documented before and after the use of an ESU.<sup>5</sup> Prior to the use of any PRE, assess all skin that will come into contact with any type of return electrode, and document observations on the patient’s nursing notes. After the procedure, assess all skin that was in contact with the PRE and document in nursing notes.

### **COMPATIBLE DISPERSIVE ELECTRODES**

With all PREs, dispersive electrodes should be compatible with the ESU.<sup>6</sup> Become familiar with the types of generators in use in your O.R. Read all generator and PRE cautions and warnings prior to using a capacitive mat.

Covidien recommends against the use of capacitive pads. These pads do not activate the REM™ Contact Quality Monitoring System, and require the use of higher power settings to achieve the desired surgical effect. This increases the possibility of alternate site burns.<sup>7</sup>

- Warning: Use (capacitive-coupled patient return electrode system) only with isolated generators.<sup>8</sup>
- Warning: Do not use the MEGA 2000™ Reusable Patient Return Electrode system in the HIGH CUT or ENDO CUT modes when using the ERBE ICC 200, 300, or 350 electrosurgical generator. Doing so may result in a greater electrosurgical affect than intended.<sup>9</sup>

### **UNIFORM CONTACT WITH SINGLE-USE DISPERSIVE ELECTRODES**

Use according to the manufacturer’s written instructions for safe operation. Read the single-use dispersive electrode instructions prior to use. Single-use dispersive electrode should maintain uniform body contact and be placed after final patient positioning.<sup>10</sup>

- Ensure that pads are of appropriate size. Also, check conductive gel and date of expiration.
- Electrodes should not be placed over bony prominences, scar tissue, hairy surfaces, distal to tourniquets and pressure points. Scar tissue, bone and hair are high in impedance. Areas of high impedance may cause uneven ES current dispersion.
- Avoid metal prosthesis due to scar tissue.
- Avoid tattoos, many of which contain metallic dyes.

### **LARGE, REUSABLE, CAPACITIVE-COUPLED RETURN ELECTRODES**

Use these systems according to manufacturer’s written instructions for safe operation in conjunction with a compatible ESU.<sup>11</sup> Read the large, reusable, capacitive-coupled return electrode systems complete instructions prior to use. Refer to the generator manufacturer’s operating manual for proper usage of electrosurgical equipment.<sup>12</sup>

Warning: Do not use with pediatric patient  $\leq 11.3$  kg (25 lbs).<sup>13</sup> These electrodes are inappropriate for patients under 25 pounds.<sup>14</sup> A patient injury has been reported when the electrode was used on a smaller patient. When using capacitive-coupled return electrode:

- Ensure adequate contact (weight-bearing area).<sup>15</sup>
- Use minimal materials between pad and patient.
- Thick foam, gel pads and extra linen increase the distance between the patient, and the electrode and should not be used. Distance and barriers between the patient and electrode increase impedance, which can result in an alternate site injury.<sup>16</sup> Complex patient positioning also decreases contact between the skin and the electrode.

- Personnel should verify that no small metal material (e.g., snaps on gowns) is in contact with the patient's skin. Current can concentrate at the site of metal contact. Snaps on patient gowns have resulted in patient injuries when the capacitive-coupled return electrode was used.<sup>17</sup>
- Warning: Do not place the MEGA 2000 assembly directly onto a metal surface.<sup>18</sup>

### KEEP DISPERSIVE ELECTRODES DRY

With all PREs, keep dispersive electrodes dry and protected from seeping or pooling of fluids under the dispersive electrode. Liquids may prevent the electrode from adequately contacting the skin.<sup>19</sup> Conductive fluids may provide an unintended current pathway.

### AVOID CONTACT WITH METAL

With all PREs, there should be no contact between the patient and metal devices that could offer potential alternate return paths for the electrical current (e.g., O.R. beds, stirrups, positioning devices, safety strap buckles). Patient monitoring electrodes (e.g., electrocardiogram, oximetry, fetal) should be placed as far away from the surgical site as possible. Capacitive-coupled return electrodes alter the technology in an isolated ESU, causing the unit to perform similarly to a ground-referenced ESU.<sup>20</sup> Alternate pathway burns have been reported at ECG electrode sites and temperature probe entry sites with ground-referenced electrosurgery units.

### REMOVE PATIENT JEWELRY

When using a capacitive-coupled return electrode all rings, necklaces and body piercings must be removed. With all PREs, the patient's metal jewelry should be removed if it is within the activation range of the active electrode. Metallic jewelry, including that used in body piercing, presents a potential risk of burn from directed current (i.e., active electrode touching it), heat conducted before an electrode cools and leakage current. Eliminating metal near the activation site minimizes this risk.<sup>21</sup> Although there may be other reasons for removal of patient jewelry (e.g., risk of swelling, theft), the risk of an alternative site injury from stray current is negligible. Small metal objects touching the return electrode can concentrate current and result in patient injury. Eliminating contact with metal minimizes this risk.

### MULTIPLE ESUs, FOLLOW MANUFACTURER'S INSTRUCTIONS

When using multiple ESUs simultaneously during a surgical procedure, follow the the applicable instructions from the manufacturer. Compatibility of equipment and proper functioning of corresponding electrode monitoring systems should be verified with the manufacturer. Separate dispersive electrodes should be used for each ESU. Personnel should place the dispersive electrodes as close as possible to their respective surgical sites, and ensure that single-use dispersive electrodes do not overlap.<sup>22</sup>

### WITH HIGH IMPEDANCE, USE TWO DISPERSIVE ELECTRODES

In unique situations when high impedance is reasonably anticipated (e.g., very obese patients) or during prolonged

application of current at high power settings (e.g., ablation) use two dispersive electrodes. Refer to the manufacturer's recommendations for these applications.<sup>23</sup> Follow the ESU and PRE manufacturer's instructions.

### OTHER NURSING CONSIDERATIONS

**Variations in patient size and positioning:** higher power settings may be required. Although counterintuitive, the smaller the mat-to-patient surface area, the greater the chance that the power setting will need to be increased due to weaker capacitive coupling between the patient and the capacitive mat

**Jewelry policy:** AORN recommends all jewelry be removed when using a capacitive mat.<sup>24</sup> Patients must "declare" all jewelry whether it is close to the surgical site or not. No jewelry or other metals should come into contact with a capacitive mat and patient. A written policy should be in place for reference to address this issue.<sup>25</sup> When Valleylab REM™ generators and REM™ patient return electrodes are in use, the O.R. staff can use the Valleylab Clinical Information Hotline Newsletter, Vol. 5 Issue 2, Body Jewelry...to Remove or not Remove, That is the Question, as a guideline to help the staff evaluate whether jewelry can be safely left in place or removed. This newsletter can also be used to develop a patient jewelry protocol.

**Active electrode monitoring system:** If your facility uses an AEM system for laparoscopic procedures, be aware that the single-pad patient electrode versions (NC models) Encision Active Electrode Monitoring (AEM) Systems present a burn hazard when used with capacitively coupled patient return electrodes due to impedance between the patient and the pad.<sup>26</sup> Encision does not recommend the use of capacitive return electrodes with any AEM system.

**Patients with an ICD or IED:** If the patient has a pacemaker, implantable cardioverter defibrillator (ICD) or other implantable electronic device (IED) such as a cochlear implant or a bone growth stimulator, Covidien recommends contacting the IED manufacturer for its cautions and recommendations prior to use.<sup>27</sup>

If Monopolar ES is to be used, Covidien and AORN recommends following standard patient return electrode guidelines.

Place the PRE as close to the surgical site as possible, yet as far from the IED generator and wires as possible. PRE placement should maintain a perpendicular pathway for the current to travel. Make sure the current avoids passing through the IED and or IED electrode array if present.<sup>28,29</sup>

- Implanted sacral nerve stimulators: large, reusable capacitive-coupled return electrode systems should not be used.<sup>30</sup>
- Implantable hearing devices: bipolar is recommended. Do not use monopolar ES in the head and neck area of a patient with a cochlear implant. If monopolar ESU is required, an isolated ESU should be used to decrease the risk of electrosurgical current traveling an alternate pathway to ground.<sup>31</sup>

**Metal objects:** Keep all metal objects (such as gown snaps, EKG pads and cord connections, B/P cuff connections, oximeters, O.R. table parts) away from the capacitive mat and patient. Padding may be used to insulate any metal objects since electrosurgical pathway may be less predictable when a capacitive-coupled mat is in use.

### CAPACITIVE MATS ADD NURSES' RESPONSIBILITIES

The use of capacitive mats may appear to save the perioperative staff time and reduce nursing tasks. But the capacitive mat, used according to instructions and recommendations, may increase the time spent evaluating patients and places additional patient safety responsibility on the perioperative staff. Perioperative staff should read the complete instructions for use prior to placing a patient on the capacitive mat surface.

It is relatively easy to monitor the area around a Valleylab PolyHesive™ II PRE. It may become quite a considerable nursing task to monitor a large capacitive mat under the patient for metal, fluids, leads and cords.

The extra time spent preparing the mat, evaluating patients and monitoring equipment is a costly proposition to the O.R. The capacitive mat cannot be used for all procedures and for all patients, so the O.R. must stock alternative patient return electrodes and evaluate when to use and when not to use the capacitive mat.

Care and cleaning of the MEGA 2000™ Reusable Patient Return Electrode system:

- Following the surgical procedure, inspect the MEGA 2000™ Sheath for damage. If damaged or contaminated with bodily fluids, replace. Replace sheath at least once per day.
- Clean/disinfect the pad/sheath assembly, and cable with any of the following solutions: bleach solution, glutaraldehyde; a-phenylphenol; o-benzyl-p-chlorophenol; or p-tertiary amylphenol.
- Dry the return electrode/sheath prior to next use.
- Do not allow cleaning solutions to come in contact with metal connectors.

### SAFETY PARAMOUNT TO COVIDIEN

Quality, safety and ease of use are paramount to Covidien. Over the past 40 years Covidien has introduced isolated generators that have virtually eliminated alternate site burns; PolyHesive™ Hydrogel, which reduces heat produced in and under return electrodes

for better thermal performance and safer current return; REM™ contact quality monitoring system that has virtually eliminated pad site burns; Instant Response™ technology: Consistent power delivery through all tissue types; TissueFect™ sensing technology: A Valleylab™ control system creating a range of options for desired tissue effect; LigaSure™ tissue fusion: Fuses vessels up to and including 7 mm in size, lymphatics and tissue bundles.

Capacitive-coupled electrodes reduce the efficiency and interfere with the advanced technology of Valleylab™ electrosurgical generators. Valleylab™ products are designed to be used together.

Covidien strongly recommends the use of the Valleylab REM PolyHesive™ patient return electrodes with the Valleylab REM™ system electrosurgery generators. This combination provides the safest, most efficient electrosurgical system available.

Call the Valleylab 24/7 Clinical Hotline whenever you have questions regarding the safe use of Valleylab™ products.

1. Patient return electrode lesions. **Valleylab Clinical Information Hotline News**. September 2000; Vol 5, Issue 3.
2. Operating room risk management, executive summary. ECRI Institute. May 2007; Vol 2: 5.
3. Operating room risk management, executive summary. ECRI Institute. May 2007. Vol 2:3.
4. Standards, Recommended Practices, and Guidelines. AORN; 2007:519.
5. Standards, Recommended Practices, and Guidelines. AORN; 2007:519.
6. Standards, Recommended Practices, and Guidelines. AORN; 2007:519.
7. Valleylab User's Guide Force FX™-C. 1999:3-6.
8. Mega 2000 Reusable Patient Return Electrode System Instructions for Use Rev F. 2004:5-14.
9. Mega 2000 Reusable Patient Return Electrode System Instructions for Use Rev F. 2004:5-14.
10. Standards, Recommended Practices, and Guidelines. AORN; 2007:519.
11. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
12. Mega 2000 Reusable Patient Return Electrode System Instructions for Use Rev F. 2004:5-14.
13. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
14. Mega 2000 Reusable Patient Return Electrode System Instructions for Use Rev F. 2004:5-14.
15. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
16. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
17. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
18. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
19. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
20. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
21. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
22. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
23. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
24. Standards, Recommended Practices, and Guidelines. AORN; 2007:520.
25. Standards, Recommended Practices, and Guidelines. AORN ; 2007:525.
26. ECRI Health Devices Alerts Action Item Accession #: A5282. September, 19, 2003.
27. ForceTriad™ Energy Platform User's Guide. 2007:2-5.
28. Electrosurgical considerations for the patient with an implanted electronic device. **Valleylab Clinical Hotline News**. June 2007; Vol 12, Issue 1.
29. Standards, Recommended Practices, and Guidelines. AORN; 2007:274.
30. Standards, Recommended Practices, and Guidelines. AORN; 2007:284.
31. Standards, Recommended Practices, and Guidelines. AORN; 2007:282.

COVIDIEN, COVIDIEN with Logo and ™ marked brands are trademarks of Covidien AG or its affiliate.  
© 2007 Covidien AG or its affiliate. All rights reserved..

Rev. 2007/10



CLINICAL INFORMATION HOTLINE  
NEWS IS A FREE SERVICE PROVIDED BY  
COVIDIEN FOR THE ADVANCEMENT OF  
PERIOPERATIVE SAFETY.

5920 LONGBOW DRIVE  
BOULDER, CO  
80301

800-255-8522 [MAIN]

WWW.COVIDIEN.COM