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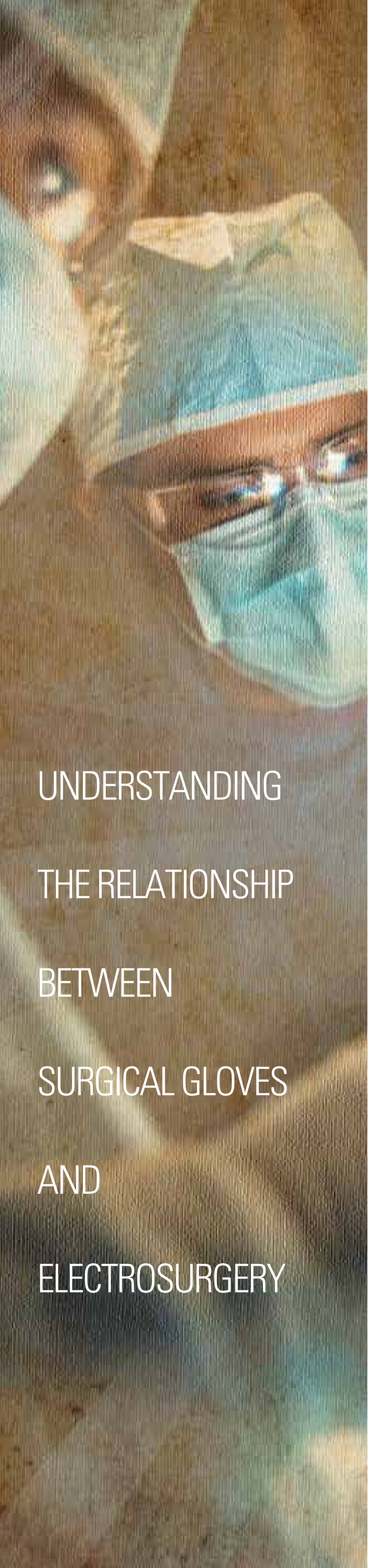
A SELF STUDY GUIDE

SURGICAL GLOVES AND ELECTROSURGERY

Registered Nurses



OVERVIEW

Ansell Healthcare Products LLC has an ongoing commitment to the development of quality products and services for the healthcare industry. This self-study, Clinical Reference Manual: Understanding the Relationship Between Surgical Gloves and Electrosurgery is one in a series of continuing educational services provided by Ansell. This educational module examines basic knowledge of the safety issues associated with electrosurgery in relation to surgical gloves, as well as offering ways to prevent intraoperative electrical shock or bum to surgical personnel during electrosurgery.

PROGRAM OBJECTIVES

Upon completion of this educational activity, the learner should be able to:

1. Define three key terms related to electrosurgery use.
2. Describe the three hazards that may cause electrical shock or bum to surgical personnel during electrosurgery.
3. Describe two hazard prevention measures that may be incorporated to avoid intraoperative shock or burn.

INTENDED AUDIENCE

The information contained in this self-study guidebook is intended for use by healthcare professionals who are responsible for or involved in the following activities related to this topic:

- Educating healthcare personnel.
- Establishing institutional or departmental policies and procedures.
- Decision-making responsibilities for safety and infection prevention products.
- Maintaining regulatory compliance with agencies such as OSHA, ANA and CDC.
- Managing employee health and infection prevention services.

INSTRUCTIONS

Ansell is a Recognized Provider of continuing education by the California Board of Registered Nursing, provider #CEP 15538 and the Australian College of Perioperative Nurses (ACORN). This course has been accredited for 2 (two) contact hours. Obtaining full credit for this offering depends on completion of the self-study materials on-line as directed below.

Approval refers to recognition of educational activities only and does not imply endorsement of any product or company displayed in any form during the educational activity.

To receive contact hours for this program, please go to the "Program Tests" area and complete the post-test. You will receive your certificate via email.

AN 85% PASSING SCORE IS REQUIRED FOR SUCCESSFUL COMPLETION.

Any learner who does not successfully complete the post-test will be notified and given an opportunity to resubmit for certification.

For more information about our educational programs or hand-barrier-related topics, please contact Ansell Healthcare Educational Services by e-mail at edu@ansellhealthcare.com.

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As employees of Ansell Ms. Ouellet, Mrs. Taylor and Ms. Werner have declared an affiliation that could be perceived as posing a potential conflict of interest with development of this self-study module.

This module will include discussion of commercial products referenced in generic terms only.

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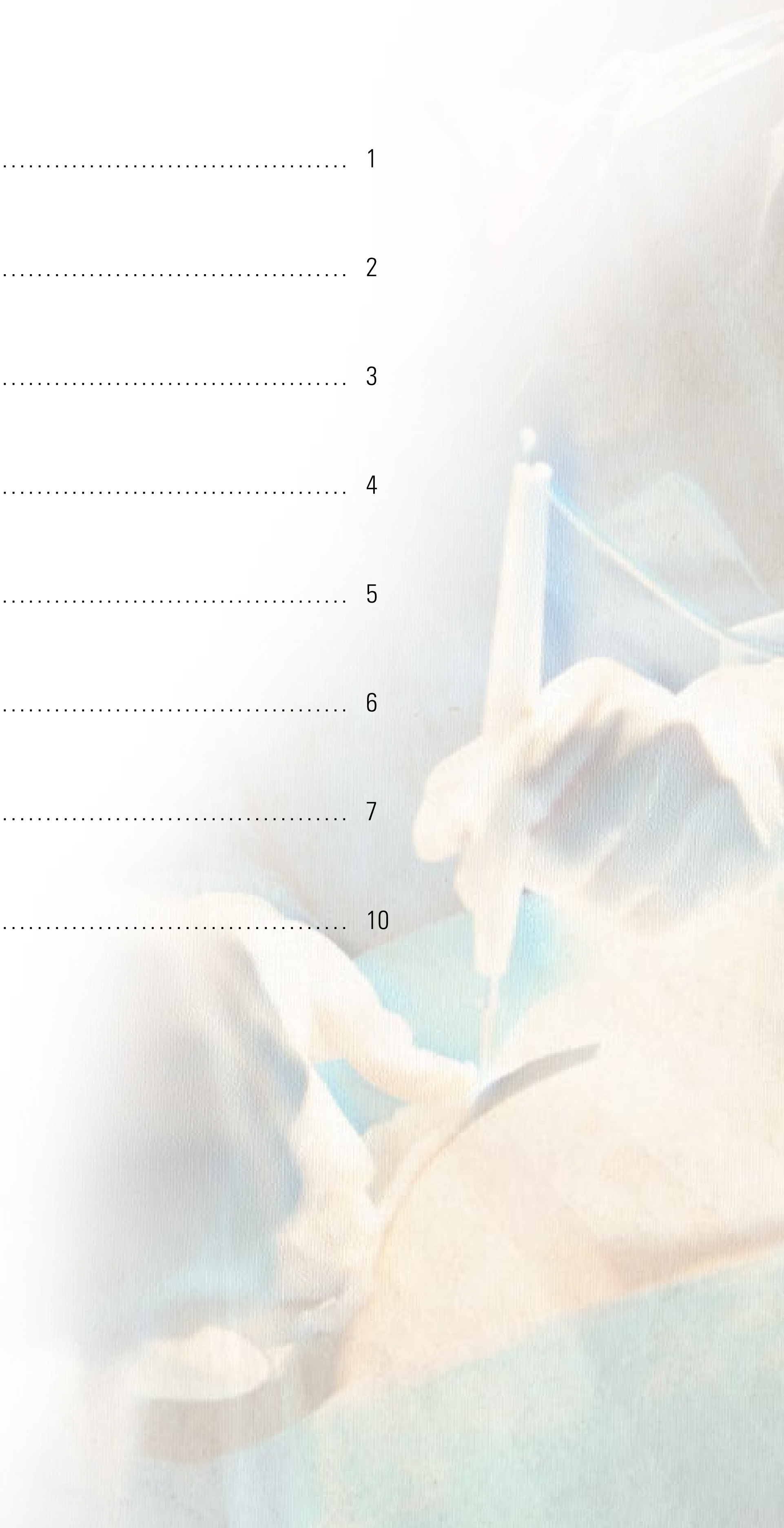

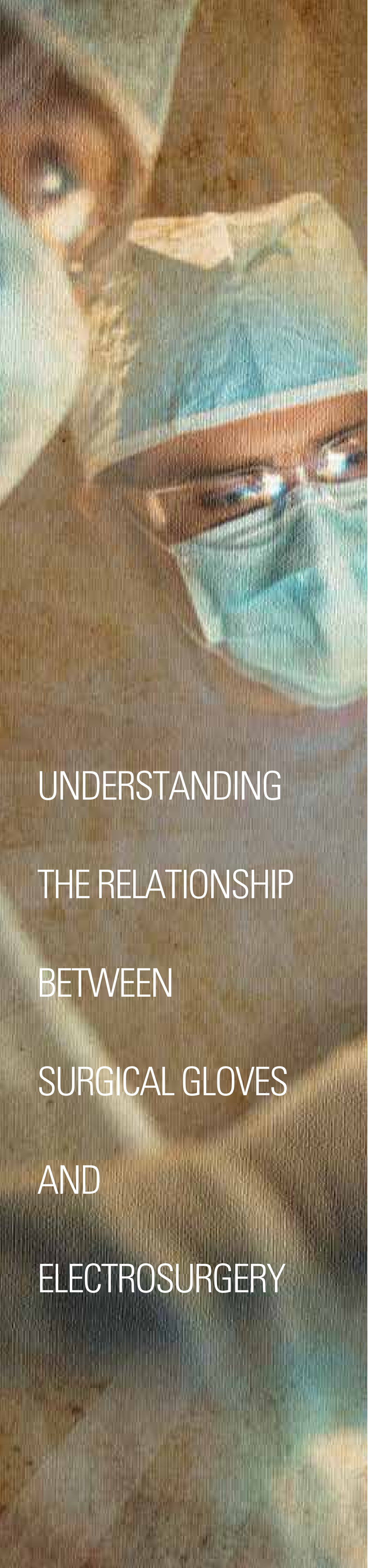

UNDERSTANDING THE RELATIONSHIP BETWEEN SURGICAL GLOVES AND ELECTROSURGERY

TEST YOUR KNOWLEDGE

The following brief quiz will help to develop a starting point for this topic:

1. Electrical current is the movement of electrons past a given point.

   ☐ True ☐ False

2. Electrosurgery is the passage of alternating high-frequency current through biological tissue to create a desired clinical effect on the tissue.

   ☐ True ☐ False

3. Intraoperative shock or burn through the surgical glove is always caused from a preexisting hole in the surgical glove.

   ☐ True ☐ False

4. Conditions that may result in an intra-operative shock or burn to surgical personnel during electrosurgery are inadvertent handling of metal instruments and high-voltage output from the electrosurgery generator.

   ☐ True ☐ False

5. “Hydration” of a latex glove barrier may increase the risk for intra-operative shock or burn to surgical personnel during electrosurgery.

   ☐ True ☐ False

6. Changing gloves periodically during an operative procedure is the only way to prevent intraoperative shock or burn to surgical personnel during electrosurgery.

   ☐ True ☐ False

Answers: 1. True; 2. True; 3. False; 4. True; 5. True; 6. False.

INTRODUCTION

Harvey Cushing, a neurosurgeon, and William T. Bovie, a physicist, worked together to to develop a tool that would stop hemorrhage with electricity. Cushing had tried other methods that were not safe for his patients because he could not control their bleeding. The device that Bovie developed applied high frequency electrical current during Cushing's neurosurgical procedure and it became the instrument that withstood the test of time.[1]

Electrosurgery has been in practice since early in the 20th century as a means to control bleeding. It was a great advancement, as it provided a means to prevent death from hemorrhaging. An inadvertent electrical burn or shock during electrosurgery can be one of the occupational hazards of the operating room. The person experiencing the event usually attributes the incident to a hole in their surgical glove. However, there are several other causes of electrical shocks or burns during electrosurgery.

To gain a broader or more detailed understanding of electrosurgery and the related physiology, the reader should consult a reputable manufacturer of electrosurgical equipment, or refer to the suggested reference material included in this program. This self-study guide will describe basic principles of electrosurgery related to surgical gloves and offer ways to prevent intra-operative electrical shock or burn to surgical personnel during electrosurgery.

1 http://books.google.com/books?id=8r9JmFSW-8cC&pg=PT528&lpg=PT528&dq=Pearce+Cushing+and+Bovie,+1986&source=bl&ots=Ke9OCtAP4b&sig=2dnrh99OGxSarKeINLKVCmcFpbs&hl=en&sa=X&ei=w3BcUpOSA4qtqgGDhIHoDg&ved=0CCsQ6AEwAA#v=onepage&q=Pearce%20Cushing%20and%20Bovie%2C%201986&f=false
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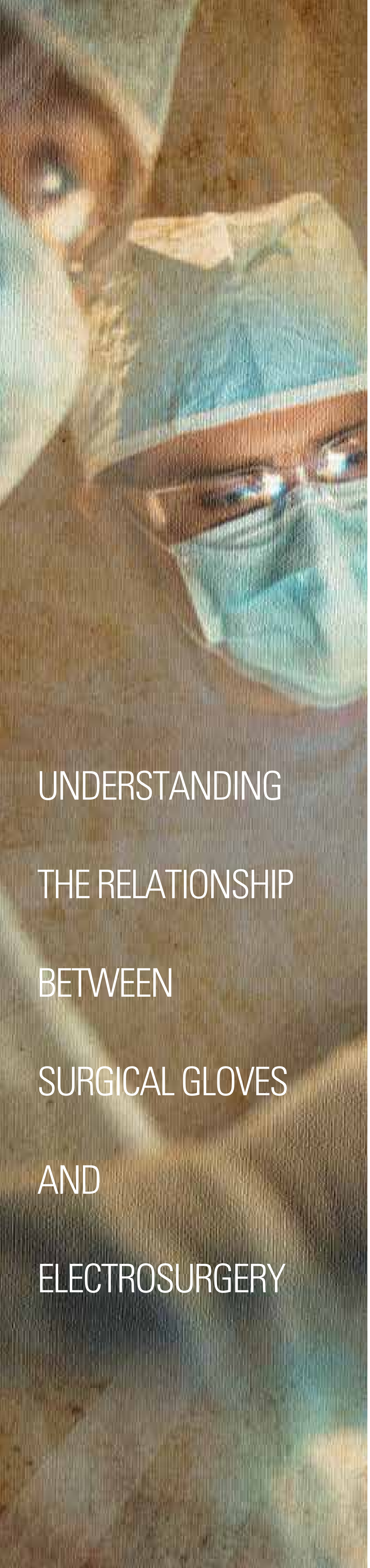


ELECTROSURGERY BASICS

Electrosurgery is the application of electrical (Radio Frequency [RF]) current to biological tissue. An electrosurgical generator supplies the source of electric current, which transfers energy (electrons) to tissue. The term "Bovie," a manufacturer's trademark named after one of the early pioneers, Dr. William T. Bovie, is often used synonymously with the term "Electrosurgery." The terms "electrosurgery" and "electrocautery" are also often used synonymously; however, this is incorrect, and it is important that the two are not confused.

In electrosurgery, the electrical current is applied directly to the tissue and the patient is part of the circuit. Electrocautery, a DC (Direct Current) application, also known as thermal cautery, refers to a process in which a current is passed through a resistant metal wire electrode, generating heat. The heated electrode is then applied to living tissue to achieve hemostasis or varying degrees of tissue destruction.[2] It is important to understand these distinguishable differences, that electrosurgical units are considered AC (alternating current) energy sources and electrocautery units are DC (direct current) sources. An electrosurgery source is quickly identifiable in the OR by the patient return electrode/ dispersive pad applied to the patient.

HOW COMMON IS ELECTROSURGERY?

The use of electrosurgery during an operative procedure is almost as common as wearing gloves. There are various energy sources and methods employed with the use of electrosurgery. RF current is typically used by the surgeon to cut tissue, coagulate tissue to obtain hemostasis (stop bleeding) or fulgarate tissue. An electrosurgery device can deliver heat at a range of 100°C to 1200°C delivered by interchangeable tips such a loop, needle and blade tips. Electrosurgery is a safe and efficient instrument for both invasive and minimally invasive surgical (MIS) procedures if basic safety measures are applied. There have been numerous advances in electrosurgery technology as listed below but the basic principles still apply.

ADVANCES IN ELECTROSURGERY

1925- Ground referenced generators
1968- Solid state generators
1981- Return electrode monitors
1995- Tissue response
1999- Tissue fusion
2006- Tissue sensing

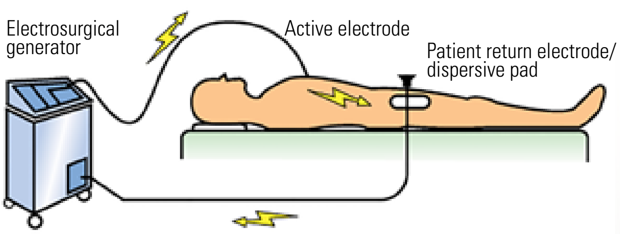
[2] http://emedicine.medscape.com/article/2111163-overview. Accessed 14 Oct 2013.

HOW AN ELECTROSURGICAL UNIT OPERATES

The circuitry of an electrosurgery unit is composed of the generator and active electrode (handheld instrument), the patient, and the patient return electrode/ dispersive pad, which is sometimes referred to as the passive or ground electrode (patient pad or plate). Electrons, or the electrical charge, travel from the generator through the active electrode, through the patient, and return to the generator via the patient return electrode/dispersive pad, completing the electrical circuit (see Diagram 1).

At the point where the current passes through the active electrode, the electrical energy is converted into thermal energy, resulting in high-energy heat. The heat causes disintegration of tissue cells, which may be seen as desiccation (destruction) or hemostasis of the tissue. Of course, the effect upon the tissue depends on a multiplicity of factors, such as the amperage of the electrical current, the size of the active electrode tip, and the time the electrical generator is activated. A final, but very important, point to stress here is to consider an absolute law of electricity, which is: electrical current always follows the path of least resistance. During electrosurgery, if the environment so dictates, the hand of the operating surgeon or assistant may offer the optimal path.

Diagram 1



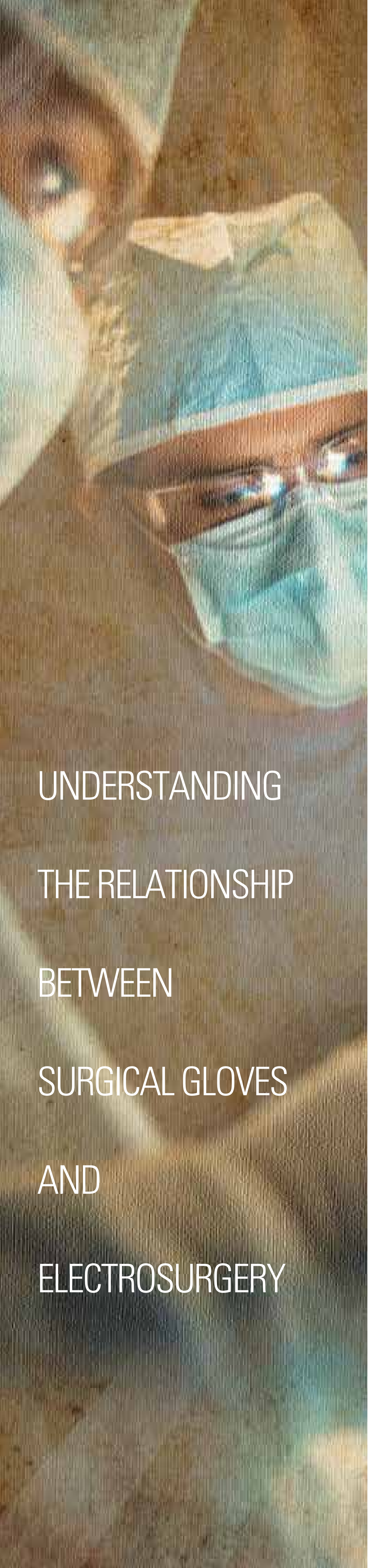
WHAT PROBLEMS EXIST WITH ELECTROSURGERY?

Advances in electrosurgical technology have made it a safer and necessary practice in almost all types of surgical intervention. However, there are idiosyncrasies linked to the modality which warrant astute awareness by all members of the healthcare team involved when electrosurgery is employed. Among the potential concerns for the operative team are interference with video and anesthesia monitoring equipment, patient return electrode/ dispersive pad site burns, and alternate site burns to the patient that may occur if the electrosurgical current is sufficiently concentrated to a site other than the patient return electrode/ dispersive pad. Also, sparks from an electrosurgery unit could provide an ignition source for an intraoperative fire.

Another problem related to the use of electrosurgery is electrical shock or burn to the operating surgeon or assistant through the surgical glove.[3] When this occurs, the clinician often attributes the hazard to a preexisting hole in the glove (i.e., a break in insulation). The clinician simply changes gloves and continues on. While this may be the case, and changing gloves is likely the solution, there are other variables to be considered. It is possible that the hazard did not occur from a preexisting hole in the glove barrier but, in effect, a hole could result from the electrical hazard. The glove barrier may not have had a hole in it at all before the episode occurred. It has been suggested by researchers that the potential for a member of the operative team to receive a shock or burn through the surgical glove—natural rubber or synthetic—may occur three different ways aside from a preexisting hole:

DC Conduction
RF Capacitive Coupling
High-voltage Dielectric Breakdown

[3] Miller JM, et al. Permeability of surgical rubber gloves. Am J Surg. July 1972; 124:57-9.

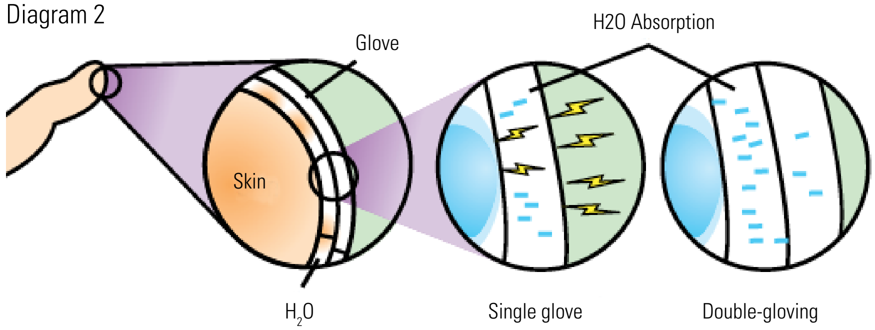


UNDERSTANDING THE RELATIONSHIP BETWEEN SURGICAL GLOVES AND ELECTROSURGERY

DC Conduction

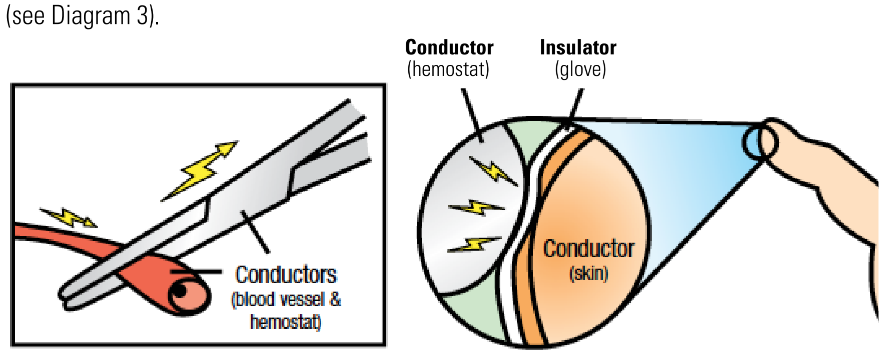
This suggests that the impedance of the glove barrier to the electrical current is low enough to let the current pass through. The impedance or resistance properties of a surgical glove may be reduced as a result of extended wear and exposure to blood and fluids, or from perspiration inside the glove. A "ballooning" phenomenon can typically be seen at the tips of the glove, which suggests that the glove has lost some of its barrier protective property. Another term often used to explain the barrier breakdown effect is "hydration," simply defined as the absorption of water into the glove film. A glove that has become hydrated measures a lower electrical resistance than a non-hydrated glove.[4] A surgical glove that hydrates slowly may offer added protection against the problems associated with electrosurgical shock. Routine re-gloving and double-gloving can prevent these problems as well (see Diagram 2).

Diagram 2



RF Capacitive Coupling

During electrosurgery the operating surgeon's perspiring conductive skin and the metal hemostat applied, for example, to a blood vessel, are considered capacitors (two conductors) separated by an insulator, the glove barrier. When alternating current is applied to the hemostat from the active electrode, it induces electrical charge on the other conductor. The thinner the glove film, the more efficiently current can be induced to surge from one conductor (the hemostat) to the other conductor (the surgeon's hand). This does not imply that electrical shock is imminent in every procedure; certainly, conditions (as described in this manual) dictate. But what is suggested in the literature is that all gloves, intact or otherwise, are capable of transferring large amounts of RF current.[5] Here again, selectively choosing an optimal barrier (e.g., an ultra-thick glove) may prove to be a more effective insulator for the operating surgeon when employing electrosurgery (see Diagram 3).



[4] Ibid.

[5] Miller JM, et al. Permeability of surgical rubber gloves. Am J Surg. July 1972; 124:57-9.

HIGH-VOLTAGE DIELECTRIC BREAKDOWN

This phenomenon results when the glove barrier cannot withstand the effects of the high-energy force from an electrosurgery generator. If the voltage is sufficiently high, it can produce a hole in the glove and a resultant burn. Again, there are contributing variables, such as the amount of time the current is applied or the surgical technique used. Example: It is a very common practice for the surgeon or first assistant to clamp a bleeding vessel and "zap" the bleeder with the active electrode while holding onto the hemostatic instrument. The voltage or force from the generator is exerted onto the entire clamp. The real potential for an electrical hazard is to the person holding the clamp. If the clamp is being held by just the tip of one finger, this allows only a small area for the current to concentrate, increasing the current density to the finger holding the clamp. If all conditions are right, the result is an electrifying "zap."

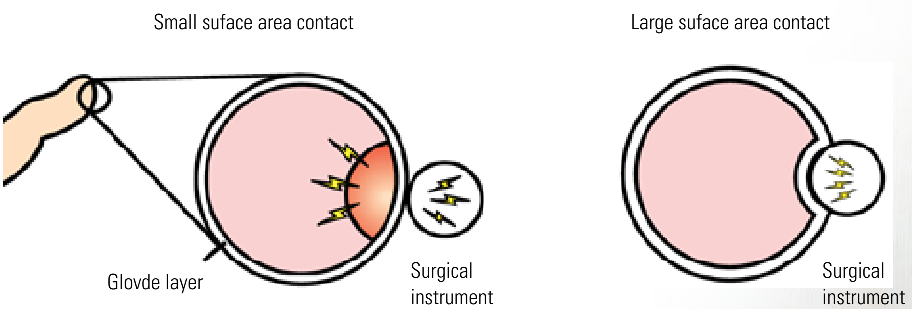
AORN RECOMMENDED PRACTICES

AORN also provides guidance and recommended practices (RP) for use and care of electrosurgical equipment. Proper care of this equipment is a critical part of patient and personal safety. Conformation of setting(s) and using the lowest effective power will help to decrease the potential for arching and capacitive coupling. As always, follow all manufacturer's instructions.

OTHER SAFETY INFORMATION

Electrical equipment and instruments are regulated by the US FDA as class II medical devices and therefore must comply with specific safety standards to ensure the device is safe and effective intended use. The revisions IEC 60601-1 and 60601-2-2 applies essential performance and risk management standards in the US market.

Diagram 4

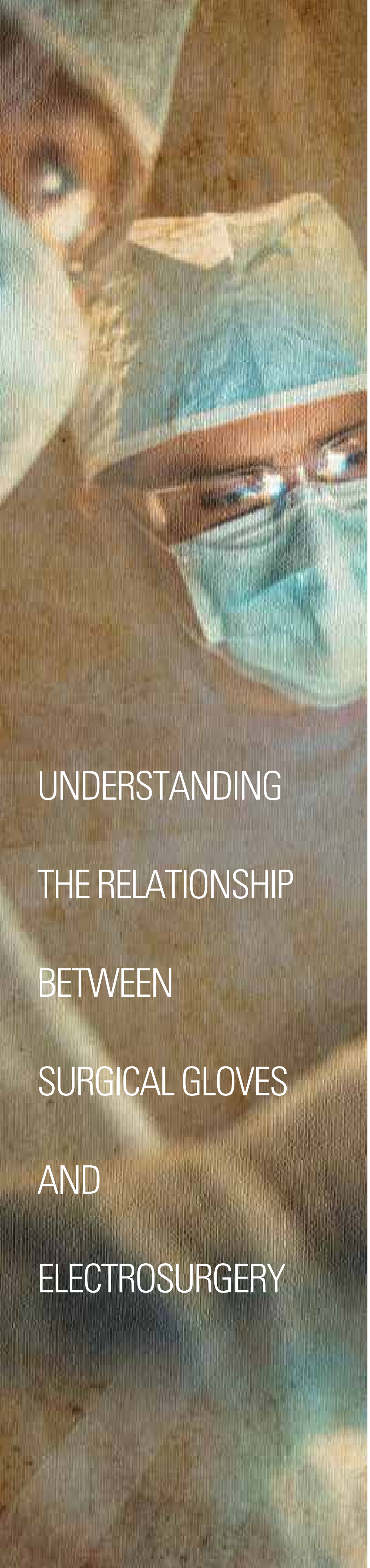


Voltage is focused at one small point, current pushed through glove

Voltage is **not** focused at one small point, burn-through does not occur

Basically, it is the same principle as touching a doorknob with your finger and getting "zapped" after walking across a carpeted room and generating static electricity. A safe method is to keep a firm hold on the hemostat while obtaining hemostasis with the electrosurgery instrument.[6] This ensures a larger area, decreasing the chance for the concentration of current at the site (see Diagram 4).

[6] Tucker RD, Ferguson S. Do surgical gloves protect staff during electrosurgical procedures? Surgery Nov. 1991 ;110(5):892-5.



CONCLUSION

Surgical gloves may be considered a nonconductor due to the insulating properties of rubber and may be considered by some to act as an insulation medium when performing electrosurgery. However, glove barriers are not manufactured for this purpose and, therefore, should not be relied upon to provide "fail-safe" insulation. Understanding how to ensure optimal protection and performance is crucial in healthcare now more than ever, particularly with the overshadowing problems related to bloodborne patho-genic diseases such as hepatitis and AIDS. The instruments and equipment we depend on to deliver quality patient care function the best when we do our best to operate them correctly and effectively.

GLOSSARY OF TERMS

CAPACITIVE COUPLING:
The condition that occurs when alternating (AC) electrical current is transferred from one conductor (an electrode), across intact insulation, into adjacent conductive materials (tissue or skin) or another metal surgical instrument. Capacitance is stored electrical charge.

CIRCUIT:
An important principle of electricity, there must be a complete circuit for electrons to flow.

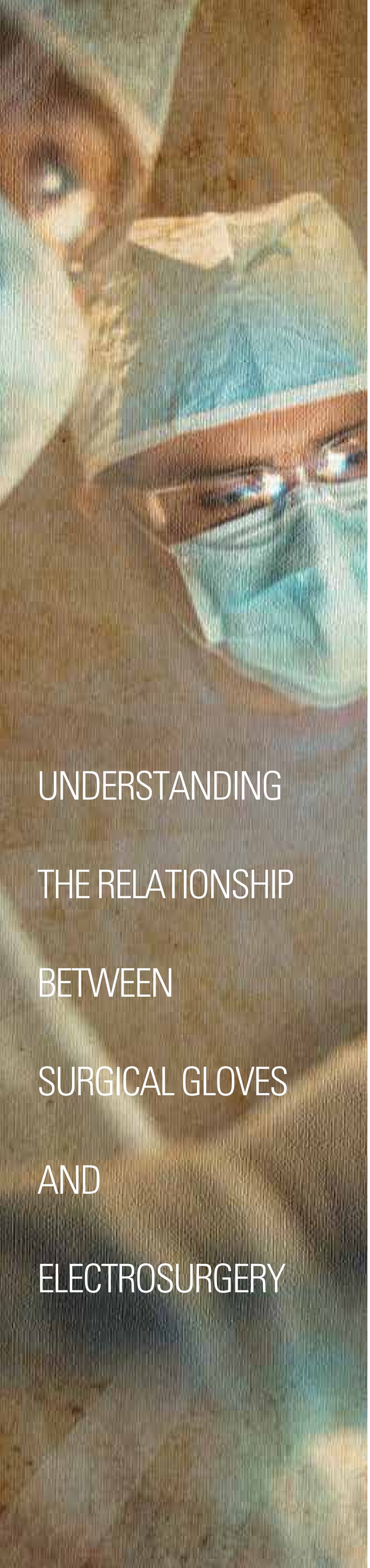
CURRENT:
Refers to the flow of electric charge. The most familiar artificial form of electric current is the flow of conductor electrons in metal wires; i.e., wires within electrical equipment. Electrical current can be alternating current (AC), which means that the direction of electrons alternate or switch, or direct current (DC), in which the flow of electrical current (electrons) is in one direction only.

DIELECTRIC BREAKDOWN:
Breakdown of a nonconductive material (e.g., a rubber glove), which may be caused by high-voltage output from the electrical generator.

ELECTROSURGERY:
The passage of Radio Frequency (RF) or high-frequency electrical current through tissue to create a desired clinical effect on the tissue. RF current is measured in cycles per second.

HEALTHCARE ASSOCIATED INFECTION (HAI):
Serious condition that patients may acquire during hospital stay. Medicare does not reimburse the facility for any of these conditions and patients cannot be billed.

RESISTANCE/IMPEDANCE:
The lack of conductivity or the opposition to the flow of electrical current. The terms are used interchangeably. Resistance/impedance is measured in ohms.



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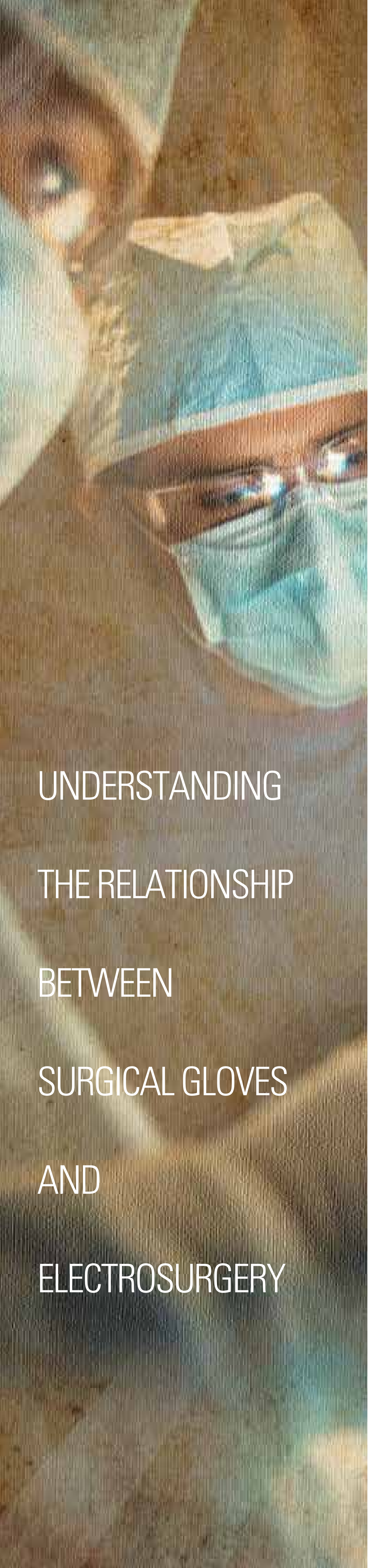
NOTES



POST TEST

CIRCLE THE LETTER THAT CORRESPONDS WITH THE CORRECT ANSWER TO THE FOLLOWING QUESTIONS.

1. Electrosurgery is the application of :

   A) Radio frequency current to connective tissue
   B) Gamma rays to tumors
   C) Electrical current to biological tissue
   D) None of the above

2. The impedance or resistance properties of a surgical glove may be reduced by extended wear and exposure to blood and body fluids or perspiration inside a glove.

   A) True B) False

3. Routine re-gloving and double-gloving can prevent DC Conduction problems.

   A) True B) False

4. Wearing a thicker glove may prove to be a more effective choice to avoid RF Capacitive Coupling dangers.

   A) True B) False

5. Holding a metal instrument with a firm grip during electrosurgery may prevent an intra-operative shock from occurring.

   A) True B) False

6. If the voltage from the electrosurgery generator is sufficiently high enough, it can produce a hole in the surgical glove.

   A) True B) False

7. The potential for a member of the operative team to receive a shock or burn through the surgical glove may occur from:

   A) AC failure, DC conduction, dielectric breakdown
   B) RF capacitive coupling, DC conduction, dielectric breakdown
   C) A and B
   D) None of the above

8. Surgical personnel may avoid intra-operative shock or burn during electrosurgery by:

   A) Re-gloving during surgery, double gloving and wearing ultra-thick gloves
   B) Keeping a firm hold on metal instruments during electrosurgery
   C) Always wearing non-latex surgical gloves
   D) A and B

9. The following pertains to the term "hydration":

   A) May also be characterized as "ballooning" and can typically be seen at the fingertips of the glove
   B) Can be defined as the absorption of water into the glove film
   C) Can be avoided by routine re-gloving or double-gloving
   D) All the above

10. A hole in the surgical glove_______________.

    A) Could result from an electrical hazard
    B) Could never result from an electrical hazard, because the glove is a fail-safe insulator
    C) Is always responsible for an electrical hazard to surgical personnel
    D) None of the above

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