Patient monitoring during moderate sedation administration

**Key words:** moderate sedation, capnography, exhaled carbon dioxide, end-tidal carbon dioxide, pulse oximetry.

**Maintenance requirements for eyewash stations**

**Key words:** eyewash stations, hazardous chemicals.

**Electrosurgery and fire prevention**

**Key words:** fire prevention, electrosurgery handpiece, laparoscopic electrosurgery.

**Preventing alternate site burns from hair accessories during electrosurgery**

**Key words:** electrosurgery, hair weaves, bobby pins, metal, alternate site burn.

**Patient monitoring during moderate sedation administration**

**QUESTION:**
Our chief of anesthesia has recommended that we start monitoring the patient’s exhaled carbon dioxide (CO₂) during all sedation procedures, including those monitored by perioperative nurses. We have been monitoring the patient’s heart rate, electrocardiogram, pulse oximetry, and blood pressure. Should we be monitoring CO₂? Why monitor exhaled CO₂ if we are using pulse oximetry?

**ANSWER:**
Nurses should monitor exhaled CO₂ (ie, end-tidal CO₂ [EtCO₂]) and continuously observe the adequacy of the patient’s ventilation during procedures using moderate sedation.¹ Monitoring the patient’s EtCO₂ in addition to his or her pulse oximetry readings and performing visual assessments completes the cycle of respiratory monitoring of oxygenation and ventilation of patients undergoing sedation.²

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Pulse oximetry is a noninvasive measurement of the percentage of oxygen (O2) in the patient’s red blood cells. Pulse oximetry measures oxygenation (ie, the transport of O2 via the bloodstream to the cells), which is needed for cell metabolism. A change in ventilation, however, may take minutes to detect using pulse oximetry. Pulse oximetry readings also can be affected by patient motion, which can cause artifact and poor perfusion, and some dysrhythmias also may affect the reading.

Carbon dioxide is a product of cellular metabolism and is transported to the lungs to be exhaled.3 Capnography is the noninvasive, continuous, real-time measurement of the patient’s expiratory CO2. Capnography measures the partial pressure of the CO2 the patient is exhaling, provides a numeric value expressed in millimeters of mercury (mmHg), and provides a readout of the exhaled CO2 via a graphic waveform. The normal range of EtCO2 is 35 mmHg to 45 mmHg.3 Measuring EtCO2 levels provides a picture of the patient’s perfusion status, how well his or her blood is moving around the body, how well air is moving in and out of the lungs, and the patient’s airway status. The qualitative clinical signs of ventilation include expansion and contraction of the lungs and auscultation of breath sounds.

Several studies have demonstrated the benefits of adding capnography to standard monitoring during procedures requiring sedation. In a meta-analysis by Waugh et al4 of five selected studies, respiratory depression was 17.6 times more likely to be detected when the patient was monitored by capnography.4 The use of capnography in conjunction with pulse oximetry is essential to detect adverse respiratory events during procedures requiring sedation or analgesia.4

Qadeer et al5 studied 247 patients undergoing endoscopic retrograde cholangiopancreatography and endoscopic ultrasonography under opioid/benzodiazepine sedation. The significant finding of this study was that capnography during procedures requiring sedation significantly reduced hypoxemia, severe hypoxemia, and apnea events by providing early detection and allowing prompt correction of ventilation abnormalities. The researchers concluded that monitoring EtCO2 has the potential to improve patient safety during procedures using sedation.5

Cacho et al2 compared capnography with standard pulse oximetry. They were able to detect respiratory depression 38.6 seconds faster when capnography was used compared with pulse oximetry. The study included 50 patients undergoing colonoscopy. Sixteen of the patients had a total of 29 respiratory events. The researchers compared episodes of apnea or hypoventilation with the occurrence of hypoxemia. They defined apnea as the cessation of respiratory activity for 30 seconds or longer and hypoventilation as an EtCO2 value at least 25% greater than the patient’s baseline value. They defined hypoxemia as a pulse oximetry value of less than 90%. The researchers administered supplemental O2 (ie, 2 L/minute administered through nasal cannulae) during every procedure. In this prospective study, the researchers found that during colonoscopies performed under sedation, respiratory disorders occurred frequently. Clinicians were able to detect more respiratory anomalies by capnography, and they detected them earlier than when using pulse oximetry. Early detection of ventilatory abnormalities by capnography allows clinicians to treat problems before they become clinically significant.2

The American Society of Anesthesiologists (ASA) published an amendment to the “Standards for basic anesthetic monitoring” found in the ASA Standards, Guidelines, and Statements that became effective July 1, 2011; section 3.2.4 of the standard refers to the requirements for monitoring during moderate sedation.1 Monitoring should include “continual observation of qualitative clinical signs and monitoring for the presence of exhaled carbon dioxide.”1 The ASA standards provide minimum requirements for clinical practice. They are regarded as generally accepted principles of patient management. Standards may be modified only under
unusual circumstances (eg, extreme emergencies, unavailability of equipment).\(^1\)

In the “Recommended practices for managing the patient receiving moderate sedation/analgesia,” AORN recommends monitoring of patients’ respiratory rates and adequacy of ventilation during all moderate sedation procedures and monitoring of EtCO\(_2\) when the patient’s ventilations cannot be observed directly.\(^6\) The recommended practices were published before the release of the ASA’s standards for basic anesthetic monitoring.\(^6\) Based on the ASA’s new standard, exhaled CO\(_2\) should be monitored when perioperative RNs administer moderate sedation.\(^1\)

The perioperative RN should be clinically competent and possess the skills to manage the nursing care of the patient receiving moderate sedation/analgesia (eg, advanced cardiac life support, pediatric advanced life support). Competency includes the ability to select, assemble, and be proficient in the use of physiological monitoring equipment (ie, capnography); knowledge of anatomy and physiology; and assessment of the patient’s oxygenation and ventilation before beginning the use of EtCO\(_2\) monitoring equipment.\(^6\) AORN

### Maintenance requirements for eyewash stations

**QUESTION:**
I am the manager of a new freestanding surgery center. On our walk-through inspection, I noticed eyewash stations outside the ORs and in the sterile processing area. In the hospital where I worked previously, members of our maintenance department checked these stations. What are the maintenance requirements for these stations?

**ANSWER:**
The American National Standards Institute (ANSI) develops the standards for the use and performance requirements of eyewash stations.\(^1\)

The ANSI National Standard for Emergency Eyewash and Shower Equipment Z358.1-2009 was originally developed in 1981 and has undergone multiple revisions over the years, with the last revision in 2009.\(^1\) The manufacturer of the eyewash stations also should provide maintenance instructions specific to its units. These instructions should be available to the personnel who will be conducting the maintenance.\(^1\)

Maintenance includes a weekly activation of plumbed units to validate that they are working and that tepid flushing fluid is available. The ANSI has defined tepid water temperature as 60° F to 100° F (16° C to 38° C).\(^1\) Weekly activation of the unit checks the flow and pattern for simultaneous delivery of fluid to both eyes, clears the plumbing supply line of sediment, and lessens...
the risk of microbial contamination of the fluid caused by stagnation. Additional assessments include checking the unit for visible damage, leaks, rust, flow obstruction, contaminate-free spray nozzles, presence of spray nozzle protective caps and tamper-proof seals, and the ability of the unit to run continuously until deactivated. One designated person should perform and document the weekly inspections and maintenance activities.

In addition to the weekly checks, an annual inspection is needed to ensure compliance with the installation requirements outlined in section 5.4 of the ANSI guideline. Eyewash installation requirements include following the manufacturer’s instructions for assembly and fluid-flushing delivery; verifying the ability to access the eyewash station in 10 seconds or less via an obstruction-free pathway; identifying the unit with a highly visible sign placed in a well-lit area; positioning the fluid nozzles 33 inches to 45 inches (83.3 cm to 114.3 cm) from the floor’s surface and 6 inches (15.3 cm) from the wall; connecting the unit to a flushing fluid supply that produces the required spray for a minimum of 15 minutes; preventing unauthorized shutoff; ensuring delivery of tepid fluid determined by a temperature gauge; checking for leaks; ensuring that when the valve is in full open position, both eyes can be washed simultaneously; and installing a flow meter to ensure that the fluid flow is at least 1.5 L/minute.

Employees who may be exposed to hazardous materials should receive training that includes knowledge of the hazardous chemicals present in their workplace (eg, glutaraldehyde, orthophthalaldehyde, ethylene oxide, hydrogen peroxide, peracetic acid, formalin); use of appropriate personal protective equipment, engineering controls, and work practice controls; and the location and operation of the eyewash stations. Safety data sheet written instructions should be available in the language that the employee is able to read.

Electrosurgery and fire prevention

QUESTION:

On a recent safety inspection, we were cited for placing the laparoscopic electrosurgical unit (ESU) handpiece on the drapes covering the patient between uses. The inspector said this was a fire hazard and must be corrected. We do not believe there are holsters long enough to house the handpiece. What does AORN suggest be done to correct this potential fire hazard?

ANSWER:

Surgical drapes should not be exposed to an ignition source. The ESU handpiece is an ignition source, and placing it on the drapes represents a potential fire hazard. For a fire to occur during surgery, three elements are necessary: an
oxidizer, an ignition source, and a fuel source. These are known as the fire triangle. The potential for a surgical fire increases when all three elements are present. The ESU handpiece is one element of the fire triangle (ie, the ignition source), the surgical drapes provide the second element (ie, the fuel source), and oxygen present in room air contributes the third element (ie, the oxidizer).

A potential hazard of laying the ESU handpiece on the drapes is inadvertent activation. The Pennsylvania Patient Safety Authority reported inadvertent handpiece activation as the cause of 56% of all electrosurgical events reviewed by this organization. Inadvertent activation can cause burns to the patient and surgical staff members and can ignite the surgical drapes.

Safety holsters work well to prevent inadvertent activation of the active electrode. Laparoscopic instruments, however, are too long for holsters, and currently there are no laparoscopic ESU handpiece holders available commercially. In addition, the weight of a longer holster attached either vertically or horizontally to the surgical drapes or the Mayo stand cover could potentially jeopardize the sterility of the surgical field. Other methods are needed to secure the handpiece. Protective measures to prevent fire or thermal injury during minimally invasive procedures require the scrub person to

- place the laparoscopic ESU handpiece on the Mayo stand or another place away from the patient when it is not in use,
- disconnect the laparoscopic ESU handpiece from the cord when it is not in use to decrease the risk of unintentional activation, and
- ensure that the user is the only one to activate the hand-held or foot-controlled device.

Local, state, and federal fire safety regulations should be followed when any type of ESU handpiece is used. Active electrodes should not be activated in the presence of flammable agents (eg, antimicrobial skin prep agents, tinctures, collodion, petroleum-based lubricants, aerosol adhesives, uncured methyl methacrylate) until the agents are dry and vapors have dissipated. Opened suture packets containing alcohol should be removed from the sterile field as soon as possible. Caution should be used during the use of an active electrode in the presence of combustible anesthetic gases during surgery on a patient’s head or neck.

For more information or to download the AORN Fire Safety Tool Kit, visit the AORN web site at http://www.aorn.org/Clinical_Practice/ToolKits/Tool_Kits.aspx.

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References
removing the hair accessories because of the cost and time involved to acquire them. Should we insist that they remove them because of the electrosurgical risk?

**ANSWER:**
Ideally, all metal (eg, jewelry, clips, hair pins) should be removed before the patient has surgery to prevent an alternate site burn. An alternate site burn is an injury caused by current from an electrosurgical unit (ESU) device that occurs away from the dispersive electrode site and not in the electrosurgery pathway between the active electrode and the patient return electrode. When using an isolated ESU generator, however, the risk of an alternate site burn from this type of metal in hair is minimal.

Ground referenced generators, introduced during the 1920s, required the current to travel from the active electrode (eg, electrosurgical pencil) through the patient to ground, which ideally was the generator. These units are considered outdated technology and are generally no longer in use. Ground is a common return path for electric current. Electricity, however, takes the path of least resistance, and current may go to any grounded object (eg, metal stirrup, OR bed) and cause an alternate site injury. Alternate site burns are more closely associated with contact between the patient and a grounded conductive object. An isolated generator completes the electrosurgical circuit using the generator, not the ground. The isolated generator recognizes the dispersive electrode as the preferred pathway. If the current cannot return to the generator, it automatically shuts down. Use of an isolated ESU reduces the incidence of alternate site burns.

If the patient is resistant to removing the extensions or hair pins and the patient’s head is not part of the monopolar electrosurgical circuit (Figure 1), the metal extension clips or hair pins could potentially stay in place. The patient should be counseled about the potential hazards of his or her decision, however, and the nurse should document the conversation about the risks and the patient’s decision on the chart.

In addition to the alternate site injury potential, the hair accessories could potentially cause a pressure injury. If the patient’s head is stationary for several hours, the pins, clips, or braided hair could generate enough external

![Figure 1. Monopolar electrosurgery circuit.](image)
pressure to compress the skin and soft tissue between the skull and the surface on which the patient’s head is resting.4,5 This compression of the tissue restricts blood flow to the skin, which results in reduced perfusion and oxygenation of the tissues.4,5 When external pressure on tissue exceeds capillary pressure, the capillary blood flow becomes obstructed. Cellular destruction and irreversible tissue damage may occur if the blood flow is obstructed and circulation is compromised for more than two hours.4,5 If the proposed surgery could last longer than two hours, the removal of the extensions or hair pins should be discussed with the patient, the surgeon, and the anesthesia care provider to determine whether they should be removed.
Clinical Issues

This evaluation is used to determine the extent to which this continuing education program met your learning needs. The evaluation is printed here for your convenience. To receive continuing education credit, you must complete the Learner Evaluation online at http://www.aorn.org/CE. Rate the items as described below.

PURPOSE/GOAL
To educate perioperative nurses about providing safe nursing care throughout the perioperative continuum.

OBJECTIVES
To what extent were the following objectives of this continuing education program achieved?
1. Discuss practices that could jeopardize safety in the perioperative area.
   Low  Low  Low  Low  Low  High
2. Discuss common areas of concern that relate to perioperative best practices.
   Low  Low  Low  Low  Low  High
3. Describe implementation of evidence-based practice in relation to perioperative nursing care.
   Low  Low  Low  Low  Low  High

CONTENT
4. To what extent did this article increase your knowledge of the subject matter?
   Low  Low  Low  Low  Low  High
5. To what extent were your individual objectives met? Low  Low  Low  Low  Low  High

6. Will you be able to use the information from this article in your work setting? 1. Yes 2. No

7. Will you change your practice as a result of reading this article? (If yes, answer question #7A. If no, answer question #7B.)

7A. How will you change your practice? (Select all that apply)
   1. I will provide education to my team regarding why change is needed.
   2. I will work with management to change/implement a policy and procedure.
   3. I will plan an informational meeting with physicians to seek their input and acceptance of the need for change.
   4. I will implement change and evaluate the effect of the change at regular intervals until the change is incorporated as best practice.
   5. Other: __________________________

7B. If you will not change your practice as a result of reading this article, why? (Select all that apply)
   1. The content of the article is not relevant to my practice.
   2. I do not have enough time to teach others about the purpose of the needed change.
   3. I do not have management support to make a change.
   4. Other: __________________________

8. Our accrediting body requires that we verify the time you needed to complete the 1.4 continuing education contact hour (84-minute) program: ___