

13

Ambulatory Monitoring

Learning Outcomes

- 13.1 Identify the purpose and function of ambulatory monitoring.
- 13.2 Explain why ambulatory monitoring is used in addition to the 12-lead ECG.
- 13.3 Summarize the common types of ambulatory monitoring.
- 13.4 Educate the patient about ambulatory monitoring.
- 13.5 Prepare a patient for the application of an ambulatory monitor.
- 13.6 Describe the procedure for applying an ambulatory monitor correctly.
- 13.7 Describe the procedure for removing the ambulatory monitor and reporting the results.

Key Terms

ambulating	palpitations
anomaly	stress ECG
ambulatory monitoring	symptom event monitor
antidysrhythmic	syncope
Holter monitor	telemetry monitoring
loop-memory monitor	
mobile cardiac outpatient	
telemetry (MCOT)	

ambulatory monitoring

The process of recording an ECG tracing for an extended period of time while a patient goes about their daily activities.

ambulate To walk; ambulating is walking.

Holter monitor An instrument that records the electrical activity of the heart during a patient's normal daily activities; also known as an *ambulatory monitor*.

13.1 Ambulatory Monitoring

Ambulatory monitoring is the process of recording an ECG tracing for an extended period of time while a patient goes about their daily activities, including **ambulating**. A typical ambulatory monitor is a small box that is strapped to the patient's waist or shoulder to record an ECG over a set period of time (Figure 13-1). Inside the box is a recording device; the entire device usually weighs less than 1 pound. One common type looks like a small cell phone. Monitors may be a small patch placed on the skin of the chest. Most ambulatory monitors are digital recorders, as seen in Figure 13-2. The first ambulatory monitor was invented by Norman Holter. Although "Holter" actually describes only one of the ambulatory monitors on the market, today the term **Holter monitor** is sometimes applied to any type of ambulatory monitor.

During ambulatory monitoring, the patient typically has three to five leads attached to their chest, depending on the type of monitor used. The patient is free to move around and is encouraged to maintain their normal

Figure 13-1 This ambulatory (Holter) monitor uses three leads and will be attached to the patient's waist during the 24- to 48-hour period while the electrical activity of the heart is being recorded.

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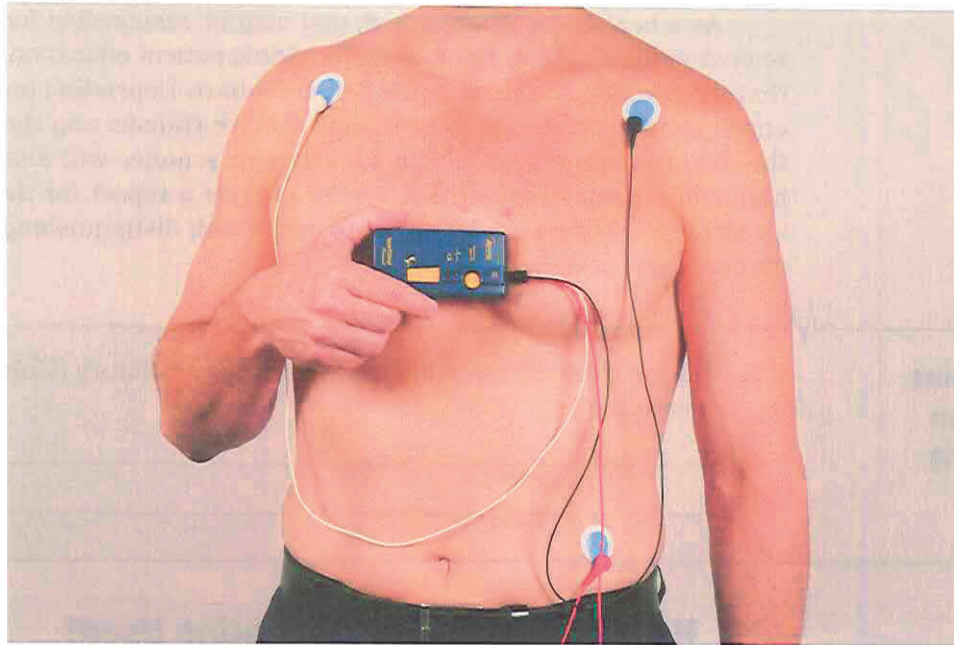
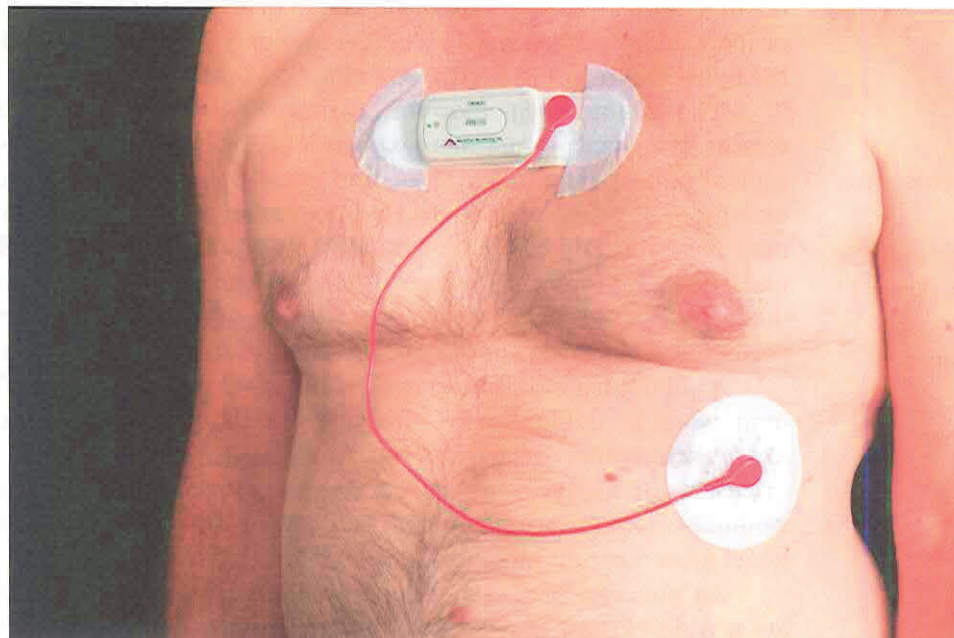


Figure 13-2 Digital ambulatory monitors record the electrical activity of the heart, which is transferred directly to a computer wirelessly.

Norman Pogson/Alamy Stock Photo



daily activities. While the monitor is in place and recording, the patient may be asked to keep a record, called a diary, of all usual and unusual activities. Any symptoms or abnormal sensations such as chest pain, indigestion, or dizziness should be recorded. If symptoms do occur, the patient is asked to monitor the symptoms and what they were doing prior to and during the symptoms.

When the monitoring period is completed, the information from the monitor and diary must be interpreted. A computer is used to print and/or view the ECG tracing from the monitor. A computer may also be used to analyze the tracing.

As a healthcare professional, you may be responsible for applying and removing the ambulatory monitor, providing patient education, and ensuring that the results are placed in the patient's chart. Depending on your place of employment, you may also be responsible for transferring the content from the digital storage device. The computer or scanner will analyze the data, highlighting any irregularities, and/or provide a report for the physician to interpret. Part of your job may be to assist with distinguishing artifact from cardiac dysrhythmias.

Checkpoint Question (LO 13.1)

1. What responsibilities might you have for ambulatory (Holter) monitoring?

13.2 How Is Ambulatory Monitoring Used?

The purpose of ambulatory monitoring is to document the electrical activity in the heart and identify any abnormalities of the heart rhythm. It is also occasionally used in conjunction with a diary in an effort to link physical symptoms with abnormal cardiac rhythms. Abnormal heart rhythms can occur randomly or spontaneously and may be related to sleep, disease, or diet or induced by stress (physical and emotional). Abnormal electrical activity in the heart can result in life-threatening dysrhythmias.

The ambulatory monitor captures abnormal heart rhythms and relates transient symptoms experienced by the patient. For example, a typical patient may be experiencing chest pain, light-headedness, **syncope**, dizziness, or **palpitations**. To find the cause of these symptoms, the patient may have already had a 12-lead ECG and a cardiac **stress ECG** (exercise electrocardiography). However, if the patient did not experience symptoms during these tests, no abnormal rhythms may have been detected. If the patient is still having symptoms, an ambulatory monitor can be used.

Ambulatory monitoring is used for other reasons as well. The physician may want to evaluate the effectiveness of cardiac medications such as **antidysrhythmic** drug therapy. Ambulatory monitoring is also used to evaluate artificial pacemaker function after implantation or if problems arise. Ambulatory monitoring can also help physicians evaluate the function of the heart after a recent myocardial infarction.

As you can see, ambulatory monitoring is an effective tool to evaluate a wide variety of conditions and problems. However, the decision to use ambulatory monitoring does not come without problems. Patient education is essential, as discussed throughout this chapter. The patient must have the ability to understand the process. For example, a patient with dementia may not be a good candidate for ambulatory monitoring. Also, the equipment may fail; for example, a sensor may come off the patient or a lead may stop working during the monitoring process.

syncope Loss of consciousness (fainting).

palpitations Rapid irregular beating of the heart which may or may not be associated with complaints of chest pain.

stress ECG Another name for exercise electrocardiography.

antidysrhythmic Type of medication given to prevent cardiac rhythm abnormalities. Also known as *antiarrhythmic*.

**Checkpoint
Question
(LO 13.2)**

1. Why is a diary a necessary part of Holter monitoring?

13.3 Types of Ambulatory Monitoring

When ambulatory monitoring is necessary, the licensed practitioner will decide which type of monitoring based upon the patient's condition, situation, and location. There are multiple types of ambulatory monitoring.

Holter Monitoring

Holter monitors are the oldest type of ambulatory monitoring device and can be the first choice when a patient has a suspected cardiac abnormality. Holter monitoring provides a complete tracing of the ECG from the time the monitor is applied until it is removed. During the 24 to 48 hours that the monitor is in place, the patient records all daily activities, abnormal experiences, and symptoms in a diary. The Holter monitor provides an ECG tracing at the exact time the patient experiences any symptoms. The physician can interpret the results and evaluate the patient's symptoms based on the ECG tracing. Holter monitoring is noninvasive and a low-cost option, but it is only effective in diagnosing the patient if symptoms occur during the time the monitor is in place.

Other Cardiac Event Recording

Cardiac event recording is used for patients whose symptoms are less frequent or if they have a permanent pacemaker. These monitors may be worn for up to 30 days or even implanted. When the patient experiences an abnormality, recording the preceding and following 5 minutes of the event occurs if the patient presses a button. The monitor has an accurate clock that indicates the time the marker is pressed. The clock is also necessary for the physician to be able to correlate any symptoms the patient may record in the diary with the ECG tracing.

One type of cardiac event recording is known as a **loop-memory monitor**. The memory on this monitor can hold up to 5 minutes of the ECG tracing and is programmed based on the patient's symptoms and complaints. For example, if a patient has a history of syncope (fainting spells), activating the monitor after an episode will lock the previous 5 minutes of ECG tracing into the memory for transmission over the telephone for evaluation. This provides the physician with an ECG tracing of the heart before, during, and after the episode and helps the physician determine the cause of the syncope (Figure 13-3).

Another type of cardiac event monitor is a **symptom event monitor**. A symptom event monitor can be either a handheld device or worn on the wrist. This type of device is used when a patient is experiencing symptoms. It activates when the electrode feet (small metal discs) are pressed onto the

loop-memory monitor

A cardiac monitor that can hold up to 5 minutes of an ECG tracing and can provide the physician with an ECG tracing of the heart before, during, and after an episode or cardiac event.

symptom event monitor

A type of cardiac event monitor that activates when the electrode feet (small metal discs) are pressed onto the patient's chest and records a lead II tracing.

Figure 13-3 The patient presses a button once symptoms begin in order to record all pre- and post-ECG segments.

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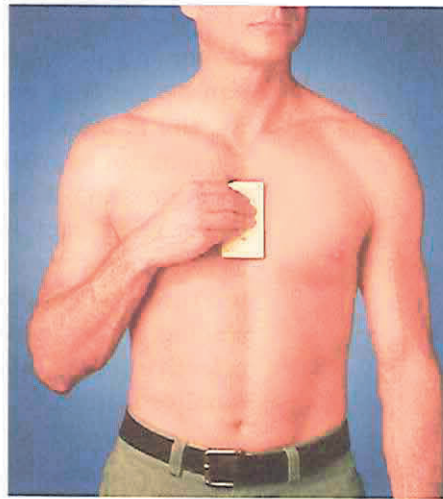


Figure 13-4 The patient activates the small Heart Card monitor by pressing it onto the chest.

A.–B.: Card Guard AG/Life Watch Holding Corp.



A.



B.

patient's chest. The monitor records a lead II tracing (Figure 13-4A and B). The wristwatch type is worn at all times and records a two-directional or bipolar lead I tracing. Postsymptom event monitoring records the heart activity for short periods immediately after the patient experiences symptoms. It is used primarily to document dysrhythmias that last more than a few seconds, such as atrial fibrillation, atrial flutter, and supraventricular tachycardias. Unlike the looping memory monitor; these do not store the ECG before the device is activated.

Safety & Infection Control



Handle Monitors Carefully

Ambulatory monitors are sensitive and can be very expensive. Be careful when handling an ambulatory monitor, and instruct the patient to be careful, as well. Dropping or hitting the machine against something could cause permanent damage.

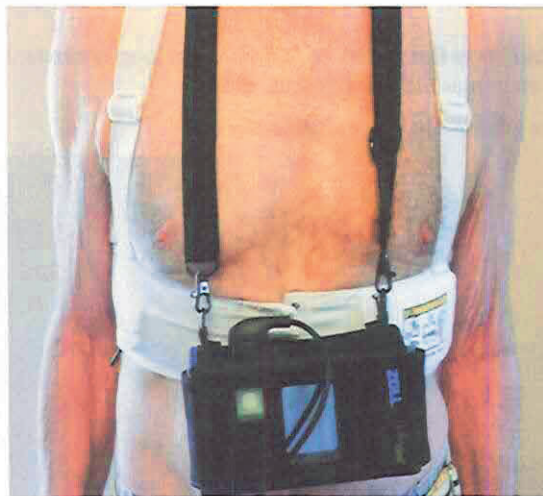
Some cardiac event monitors are voice activated so the patient can speak into the recorder to describe the event. Other monitors have an auto-capture feature in which the device records the information even if the patient is unaware of the activity. Newer models allow for the wireless transmission of the data via the cellular network. These newer devices also have enhanced programming and expanded storage capabilities. Cardiac event monitors store the recorded data, which is ultimately transmitted over the phone, cell tower, or Wi-Fi either to a physician's office or to a central recording station.

Other types of cardiac event monitoring include a wearable or implantable monitor with a defibrillator and a wireless 12-lead ECG. In addition to monitoring the heart and delivering a treatment shock if needed, the data from the monitor is downloaded from the device and can be accessed by the physician at any time (Figure 13-5).

A wireless 12-lead ECG uses a 10-cable device attached in the same manner and locations discussed in the chapter *Performing an ECG*. The difference is that the patient can activate this device at any place at any time and send the data to the physician's office or monitoring facility for immediate interpretation (Figure 13-6).

Figure 13-5 One type of monitor is worn outside of a healthcare facility and even includes a wearable defibrillator.

Total Care Programming, Inc.



Think It Through



Patient Problems

Sometimes during ambulatory monitoring, the electrodes may become loose or disconnected, and the patient will need to know how to handle this situation. Check the policy of the facility where you are employed to give the patient correct instructions. Usually, patients are instructed to press loose electrodes in the center to reapply. However, if the electrode comes off completely, the patient will need to report this and return it to the facility for replacement. Information about how and when to contact the facility should be provided to the patient.

You are working in a monitoring facility and the tracing for one patient is not showing on the LCD screen. What should you do and/or say?

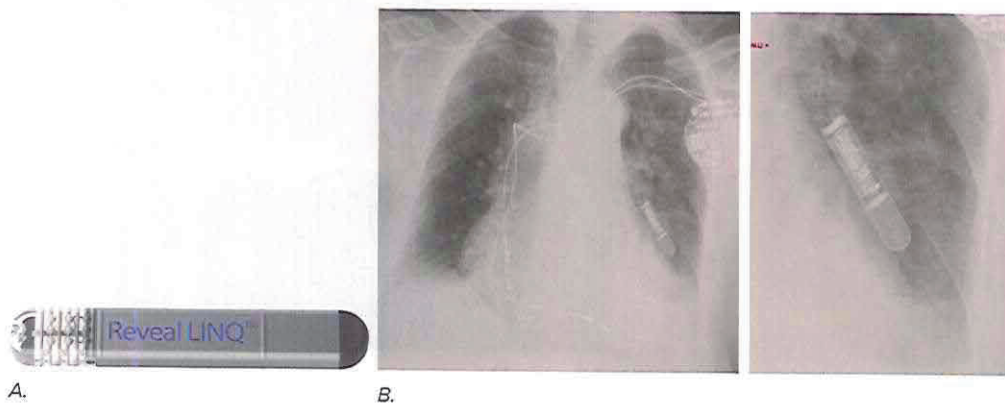
Figure 13-6 A 12-lead wireless cardiac monitor. A 12-lead ECG is produced with this 10-cable monitor.

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Figure 13-7 Insertable Loop Recorder A. One type of loop recorder before insertion. B. X-ray image showing a loop recorder that has been implanted in a patient's chest.

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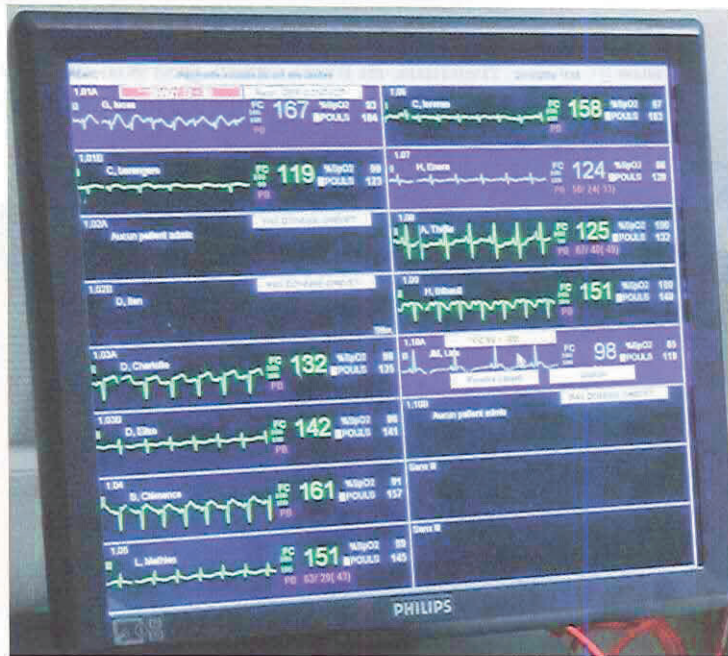


An insertable loop recorder is a type of device for certain cardiac conditions (see Figure 13-7). A single lead and the device are surgically implanted under the skin typically in the left parasternal (upper left chest) region. The recorder can store ECG data automatically in response to a significant bradyarrhythmia or tachyarrhythmia or in response to patient activation. It is particularly useful either when symptoms are infrequent or a lot of ECG data is needed.

Cardiac monitoring is ever-changing due to the rapid advancements in technology. Small monitors for various purposes are found in rings, watches, handheld or placed on the chest. For example, the Food and Drug Administration (FDA) cleared a six-lead personal ECG device. This device detects atrial fibrillation or normal heart rhythm anytime, anywhere. This 6-lead ECG data gives your doctor a more complete view of your heart, and the ability to identify other cardiac arrhythmias.

Figure 13-8 Several patients can be monitored simultaneously at a central patient care station. In this picture of an electronic intensive care unit (eICU), the patients being monitored are in another building or even at home.

BSIP SA/Alamy Stock Photo



Telemetry Monitoring

Telemetry monitoring is real-time monitoring for patients. Real-time monitoring means that someone is viewing the ECG tracing as it occurs. Telemetry is common within a healthcare facility, but mobile cardiac telemetry is also available. Telemetry monitoring is done with a small transmitting device attached to the chest with three or five electrodes. A continuous ECG tracing of the heart is recorded and sent directly to a monitoring station. Telemetry monitors are the only transmitting devices designed to send the electrical signal of the heart to a central location to be evaluated continuously. At this location, single or multiple patients may be monitored at the same time on multiple screens. For patients in a healthcare facility, there is no need for a diary because the patient is observed and monitored at all times (Figure 13-8).

Mobile cardiac outpatient telemetry (MCOT) is common. MCOT devices are small, portable monitors that, when a cardiac **anomaly** is detected, automatically send data. These devices can hold a large amount of data, as much as 96 hours or more, and allow licensed practitioners to capture significant events even when no symptoms are experienced. The sensor detects every heartbeat and relays the information via radiofrequency to the monitoring device (monitor). Abnormal cardiac events are automatically transmitted to a monitoring center using a built-in wireless cellular technology. With these devices, an unlimited number of events can be recorded and transmitted (Figure 13-9). These systems can also allow patients to quickly report any symptoms using a touch screen on the monitor. This information is reviewed by certified monitor technicians and then sent to the doctor via fax or Internet. For life-threatening dysrhythmias, the monitoring center can immediately contact both the patient and the physician.

When telemetry is used in the hospital or on an outpatient basis, a certified technician or licensed professional observes the ECG tracings for

telemetry monitoring

Real-time monitoring in which a small transmitting device attached to the chest with three or five electrodes and sends a continuous ECG tracing of the heart directly to a monitoring station.

mobile cardiac outpatient telemetry (MCOT)

Telemetry that uses a small, portable monitor that automatically sends data when a cardiac anomaly is detected. They can hold up to 96 hours of data as well, allowing licensed practitioners to capture significant events even when no symptoms are experienced.

anomaly Something that deviates from what is standard, normal, or expected.

abnormalities on a computer screen (Figure 13-10). For this type of employment, you must be familiar with various dysrhythmias (irregularities in heart rhythm). In most cases, you will be required to pass a certification examination to work at a telemetry monitoring facility.

Figure 13-9 Very small monitors are used for mobile cardiac outpatient telemetry (MCOT). The ECG tracing collected is stored or transmitted wirelessly to a remote location.

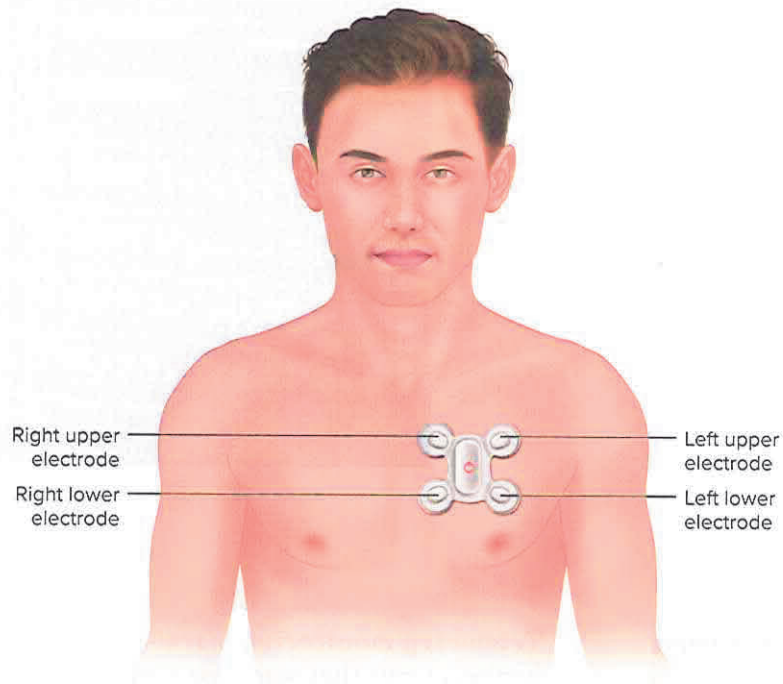


Figure 13-10 Special training is usually required to monitor multiple patients on a single LED display screen like this one.

Bernd Wüstneck/picture alliance via Getty Images



**Checkpoint
Question
(LO 13.3)**

1. What does real-time monitoring mean?

13.4 Educating the Patient

Prior to having a Holter monitor, the patient must be thoroughly instructed on its proper use. Maintaining a diary is vital for accurate interpretation and evaluation of the results of the ECG tracing. The ECG tracing alone is not helpful unless the physician can correlate the results with the activities and symptoms the patient was experiencing during the tracing. Your responsibility is to ensure that the patient understands the monitoring procedure, why it is being done, and what they must do while the monitor is in place.

The Patient Diary

The patient diary must be an accurate record of the events and symptoms that occur while the monitor is in place. Most diaries provide time blocks to mark when activities and symptoms occur, making entry easy for the patient (Figure 13-11). The patient must record *all* activities, including physical and emotional stress and all usual and unusual daily events, such as urinating, bowel movements, sexual activities, walking, emotional upset, eating, and sleeping. You should emphasize the need for an accurate and complete diary. Make sure the patient knows not to change diet or daily activity during Holter or any other type of ambulatory monitoring.

Figure 13-11 Note the sample entries in this Holter monitoring patient diary. The patient should make entries into the diary frequently throughout the Holter monitoring period.

Sample Diary			Patient Instructions	Patient Activity Diary
A portion of a sample diary is shown below. Remember that the more complete your diary, the more valuable it is for your doctor. If in doubt, write it down. Please print clearly so that your doctor or technician will understand your comments.			Carry this diary and a pencil with you at all times and enter your activities, symptoms, and times they occur. Generally you should record: Time of Day: For every entry in the diary. Activities: Routine and strenuous exercise, bowel movements, taking medication, or emotional upsets, such as anger. Symptoms: Chest, neck, arm, or face pain; heart pounding; dizziness; nausea; shortness of breath; or any other—whether or not you feel they are important. If in doubt, write it down. Important: 1. Do not tamper with the recorder, electrodes, or electrode leads. 2. Do not get the recorder wet. 3. Your recorder is equipped with a digital clock display and an event marker button; activate it when symptoms occur.	() hr () 12 hr () 24 hr Patient's Name _____ Patient's Addr. _____ Age: _____ Sex: _____ Phone: _____ Medication: _____ Date of Recording _____ Started: _____ a.m./p.m. Connected By: _____ Ended: _____ a.m./p.m. Disconnected By: _____
TIME	ACTIVITY	SYMPTOM		
11:30 am	walking in hall	dizzy		
1:45 pm	BM			
2:30 pm	exercise class began			
3:45 pm	sitting watching TV	flutter		
11:30 pm	Bed			

Communicate & Connect



Ensuring Patient Understanding

Begin by asking the patient to tell you what they already know about the ambulatory monitoring procedure. Based on the response, you can then explain what they do not know or understand. This is an effective way to ensure that your patient understands the procedure. You should also have the patient repeat the information back to you to demonstrate their understanding.

To ensure that the patient understands the diary recording procedure, have them repeat your instructions back to you. You may want the patient to demonstrate their understanding by placing a sample entry into the diary. Provide the patient with a complete set of instructions with your name and the facility phone number in the event the patient has any questions or problems. If the patient does not understand how to maintain the diary correctly, the monitoring procedure may have to be repeated. This unnecessary time and expense can be avoided by properly instructing the patient.

As previously mentioned, ambulatory monitoring may be done to evaluate the effectiveness of new cardiac medications or the patient's response to discontinuation of cardiac medications. In these circumstances, the physician may change the patient's heart medications prior to the monitoring, either adding a new medication or discontinuing one the patient is currently taking. It is your responsibility to remind the patient of medication changes prescribed by the physician.

Law & Ethics



Scope of Practice

Licensed practitioners are responsible for educating the patient regarding actions, indications, side effects, and precautions of medications. When a question arises regarding this information, refer the patient to a licensed practitioner to avoid practicing outside the scope of your education and training.

Think It Through



Patient Instructions

While you are reviewing the instructions for the diary your patient asks you if they are allowed to do certain things during the monitoring, such as sleep on his stomach or dance at an upcoming dinner party. You should inform them that they are encouraged to participate in normal daily activities during the monitoring, whatever they may be. Because there is a chance that some activities may cause the electrodes to become loose or disconnected, you should check to be sure they know the procedure for correcting this situation. You should also explain that if the electrodes become loose or disconnected, it could interfere with the accuracy of the results.

Your patient wants to know if they can participate in a school's swim meet tomorrow. What should you say?

It is best that the patient wear loose-fitting clothing during the monitoring procedure for comfort and convenience and to reduce artifact. A front buttoning shirt is preferred because you can conveniently access the patient's chest and apply the electrodes. The patient must not tamper with the monitor or disconnect the lead wires or electrodes. While the monitor is in place, they may take only a sponge bath; no shower or tub bath is allowed during the monitoring because the equipment must not get wet. Patients may sleep in any position that does not apply tension on the lead wires or electrodes.

TABLE 13-1 Ambulatory Monitoring Checklist*

Ambulatory Monitoring—Checklist for Patient Education		
Patient Name		
Patient was able to	YES	NO
• Describe ambulatory monitoring.		
• Explain why they are having the test performed.		
• Know the length of time the monitor will be on and when to return the monitor and diary.		
• State where the leads are placed and what they will feel like.		
• Adjust the shoulder strap or waist belt.		
• Wear loose-fitting clothing for comfort and convenience.		
• Operate the event marker.		
• Replace loose electrodes and report loose or removed electrodes.		
• Avoid metal detectors, electric blankets, high-voltage wires, and magnets.		
• State required physical restrictions such as bathing and swimming.		
• For Holter monitoring, log usual and unusual activities and symptoms experienced.		
• Contact the facility when necessary.		
Signature	Date	Initials

*A checklist such as this provides documentation for the medical record of patient instructions for the ambulatory monitoring procedure.

Avoiding magnets, metal detectors, high-voltage areas, and electric blankets is necessary because these devices can interfere with the tracing. Depending upon the monitor type and length, other devices may need to be avoided. Follow the guidelines at your facility. The patient should also know how the monitoring equipment works and be instructed to check that it is working properly during the procedure. Documentation of accurate patient education is necessary and must be included on the patient's chart. You may use a paper or electronic checklist similar to the one found in Table 13-1.

 **Checkpoint
Question
(LO 13.4)**

1. Why should the patient wear loose-fitting clothing during ambulatory monitoring?

13.5 Preparing the Patient

Patients must be prepared for the ambulatory monitoring procedure both emotionally and physically. Many times the patient will be apprehensive. Children may be especially fearful. The first step in reducing the fear is to help them understand the procedure. Take time with the patient to explain each step of the procedure as you perform it. For children, be sure to explain in terms they can understand. Let the patient know it is normal to have some fear and allow the patient to express their feelings. Allow the patient to ask questions, and answer as completely as you can. If you do not know the answer, ask a licensed practitioner or your supervisor.

The patient should understand the challenges presented and the physical requirements of the monitoring procedure. If the patient is male, he may have to have his chest hair clipped in order to place the electrodes. For both males and females, there may be some discomfort such as skin irritation or itching at the electrode site where the device is connected to the skin. You should remind patients that during the procedure they should maintain all regular physical activities.

Communicate & Connect



Pediatric Patients

Pediatric patients require special consideration when you are explaining the ambulatory monitoring procedure. Consider the child's age, and use terms that he or she will understand. To decrease the child's potential anxieties and fears, allow the patient to touch the equipment prior to applying it. Be sure to instruct the parent as well.

Checkpoint Question (LO 13.5)

1. While you are answering questions for a patient, she asks something and you do not know the answer. What would you say?

13.6 Applying an Ambulatory Monitor

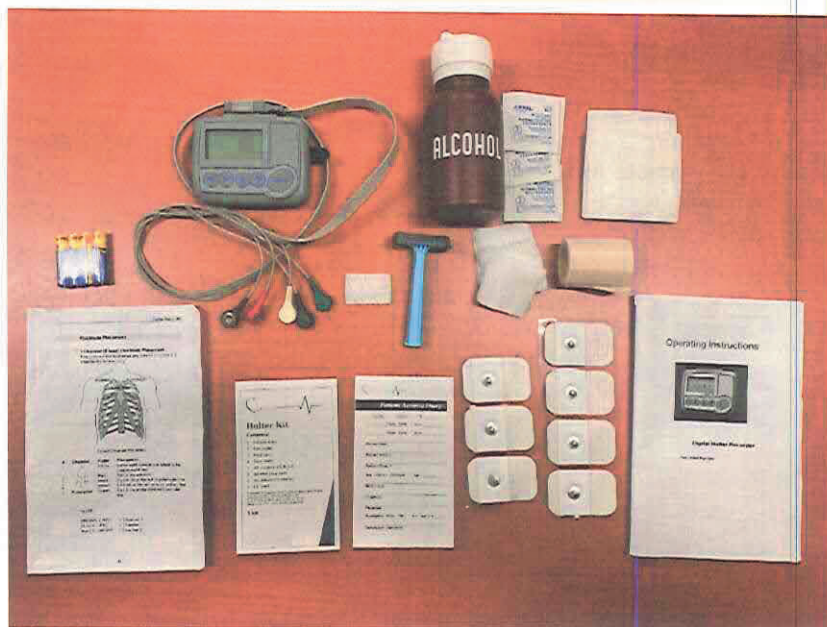
Before the Procedure

Prepare for the procedure by gathering the necessary equipment (Figure 13-12). You will need the following:

- Monitor with holder and shoulder strap or belt
- Newly charged or new batteries and a digital disk if required
- Electrodes (three to five, depending on the type of monitor used)
- Lead wires
- Alcohol and gauze
- Patient diary
- Skin preparation materials (prep pads, benzoin, abrasive cleaner, or skin rasp)
- Shaving equipment

Figure 13-12 Gather all the necessary equipment prior to applying the Holter monitor.

Tom O'Brien



- Tape
- Checklist for patient education
- Manufacturer's directions for specific monitor used
- Pen

Before entering the room to begin the procedure, you should prepare the monitor and review the manufacturer's instructions for the type of monitor you are using. Check to see that the monitor is adequately charged. You will need to insert new batteries to ensure that the monitor will not lose charge during the procedure. Insert a new blank digital disk if required.

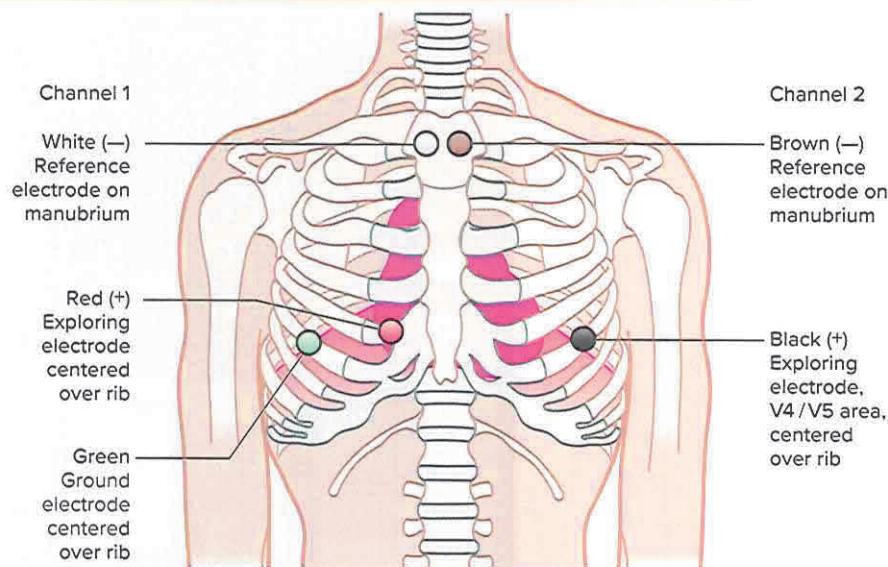
Placing the Electrodes

Have the patient remove their clothing from the waist up so you can position the electrodes. You should provide a drape, especially for female patients. Have the patient sit or lie down in a comfortable position on the bed or examination table. The patient should be relaxed.

Prepare the sites for electrode placement. Rub the site with an alcohol swab and let it dry. If the sites are hairy, dry shave the skin. Wet shaving is not done because soap film will interfere with electrode adhesion. Use the adhesive side of tape to remove any shaved hair remaining. Abrade the skin using a special prep pad, a dry 4 × 4 gauze, a skin rasp, or another type of abrasive cleaner. Abrading the skin consists of rubbing firmly and briskly at each of the sites where the electrodes will be placed so they will adhere to the skin better. Preparation of the electrode sites may vary depending on the type of ambulatory monitoring performed. For telemetry monitoring, it is recommended that the chest hair be *clipped* and not shaved. This prevents itching irritation and keeps the patient from scratching, which can cause artifact on the tracing. Check the manufacturer's instructions and your facility's policy for proper electrode placement.

Place the electrodes on the chest at the proper sites. Electrode placement depends on the number of lead wires, the type of monitor used, and the lead tracing to be produced (e.g., see Figure 13-13). Check the manufacturer's

Figure 13-13 This is one example of five-lead electrode placement for ambulatory monitoring. Lead placement may vary, so check the manufacturer's instructions for the correct placement for the monitor you will be using.



instructions for accurate placement of the electrodes for the monitor you are using. If the lead wires are the “snap-on” type, you should attach the electrodes to the lead wires prior to placing them on the patient to reduce discomfort. Remove the backing from the adhesive, then apply each electrode to its proper position by pressing firmly at the center. Run your finger around the edge of each electrode to ensure firm attachment.

Safety & Infection Control



Elderly Patients

Elderly patients and patients taking certain medications may have very fragile, thin skin. Manipulate the electrodes as little as possible when applying and removing them, and use care to prevent skin damage or pain. You should apply less pressure when abrading the skin and avoid abrasive cleaners when preparing the sites.

Attach the lead wires to the electrodes. Check the wire color and cable identification to ensure proper attachment to the electrode. Arrange the lead wires and cable comfortably on the patient. Tape each of the cables in place using a stress loop to reduce tugging and pulling on the electrodes during movement. Some electrodes include stress loops to reduce artifact (Figure 13-14).

Attach the cable to an electrocardiograph and run a baseline ECG tracing. Make sure the tracing is correct and that the machine is not malfunctioning. Have the patient put on their shirt and run the lead wire between the buttons or out the bottom of the shirt. Attach the cable to the monitor, place it in the carrying case, and attach it comfortably to the patient's waist or shoulder. Double-check the lead wires and electrodes to ensure that there is no tension on them.

Start the monitor and have the patient place the first entry into the diary. Make sure the beginning time is noted in the diary. Review all instructions with the patient, and set the date and time for them to return for removal. Have the patient sign the Patient Responsibility Form, if required by your facility (Figure 13-15). Make sure the patient knows how to get assistance in case problems arise.

Figure 13-14 Individual stress loops take up slack and prevent tension on the lead wires and electrodes during ambulatory monitoring.

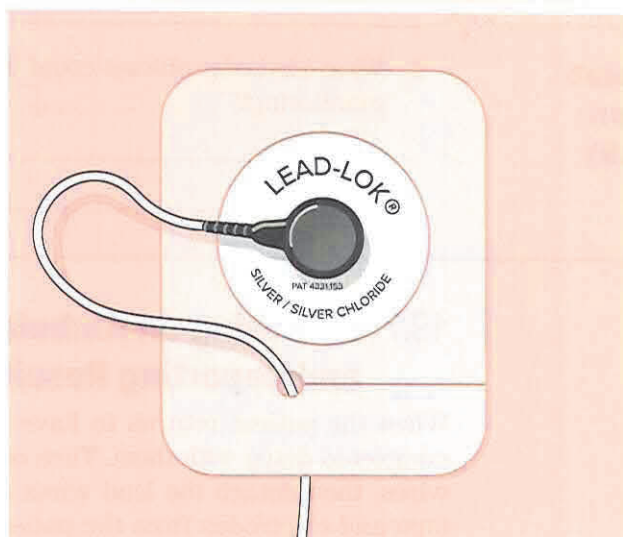


Figure 13-15 Example Patient Responsibility Form.

AMBULATORY MONITOR PATIENT RESPONSIBILITY FORM

I, _____, accept responsibility for and agree to return this monitor to the issuing facility immediately upon completion of my test.

I hereby assume all risk of loss or damage to the monitor during its time in my care.

I understand that I must handle this unit with extreme care as it is a sensitive heart monitoring instrument and must perform properly to provide my physician with the results needed for an accurate assessment.

I understand that the monitor may not get wet as this may damage the monitor.

I understand that if I return the monitor in poor or unstable condition, I will be responsible for the repair cost.

I understand that if I do not return the monitor within three days from the completion of the monitoring period, I will be held responsible to pay directly for replacement.

By signing below, I acknowledge that I have read, understand and agree with the above terms and conditions.

PATIENT NAME (PRINTED)

PHONE NUMBER

ADDRESS

CITY, STATE, ZIP CODE

DATE

PATIENT or GUARANTOR SIGNATURE

DATE

TIME

WITNESS

**Checkpoint
Question
(LO 13.6)**

1. What kind of problems could the patient encounter during monitoring?

13.7 Removing an Ambulatory Monitor and Reporting Results

When the patient returns to have the monitor removed, briefly review the completed diary with them. Turn off the monitor and detach it from the lead wires, then detach the lead wires and cables from the patient. Remove the tape and electrodes from the patient's chest. Clean the skin where the electrodes had been placed. Record the removal procedure on the patient's chart.

**Law &
Ethics**



Document and Label

Carefully document and label the report, diary, and digital disk with all required information as established by the facility protocol.

Once the monitoring is complete, your next responsibility is to see that the results are evaluated and a report is placed in the medical record. In order for the results of the recording to be evaluated, they must be put in the proper format. Each type and brand of ambulatory monitor has a slightly different procedure for preparing the recording for analysis. In some circumstances, you may need to attach the machine to a scanner or computer. The recording will be viewed on an output device such as an LED or LCD monitor or printer. The computer may provide an analysis as well. A physician, usually a cardiologist, must view the recording and the patient diary in order for a final interpretation to be completed. Computer interpretation and evaluation by a cardiologist may occur within your facility, or the digital disk may be sent to an outside laboratory, known as a reference laboratory, for analysis. If the results are sent to a reference laboratory, they are returned to the patient's physician so that the results can be provided to the patient.

**Law &
Ethics**



Ensure Accurate Results

You are assigned to apply a new type of Holter monitor that has a five-lead system. Because you have never used this type of five-lead system before, you should check the manufacturer's instructions prior to placing the electrodes. Ambulatory monitors can vary, and correct placement of the electrodes is essential for accurate results. If you cannot locate the directions or still do not understand the correct placement, you should consult your supervisor.

Accurate results must be provided for correct interpretation of the ECG tracing. Many factors can affect these results, such as improper lead attachment, incomplete patient diary, and failure of the patient to maintain a normal routine. You can reduce the chances of having to repeat the procedure by ensuring proper lead attachment, patient education, and recording of results. The test may need to be repeated if the results are inconclusive.

When the results are sent to an outside lab, it usually takes 7 to 10 days to get the report. The final report must be added to the patient's chart and the physician notified in order to provide the patient with the results of the test. Abnormal results may indicate any of the following:

- Electrical-conduction defects in the heart's rate and rhythm-controlling system
- Rhythm abnormalities, including premature atrial, junctional, or ventricular complexes, and transient dysrhythmias

Think It Through



No Diary

When your patient returns to have his or her monitor removed, you should first ask for the patient diary. If the patient has forgotten to bring the diary, the results of the recording cannot be evaluated.

What do you think you should do if a patient arrives without the diary?

Advise your patient to discuss the results of the ambulatory monitoring with their physician. It is important to note that the ambulatory monitor is only part of the diagnostic process. Results of the ambulatory monitoring will correlate the patient's symptoms with changes on the ECG tracing. Additional tests may be required, depending on the patient's condition. Some examples of additional tests that may be needed include the following:

- Echocardiogram
- Coronary angiogram
- CT (computerized tomography) scan
- MRI (magnetic resonance imaging) scan
- PET (positron emission tomography) scan

Checkpoint Question (LO 13.7)

1. What factors can affect the results of ambulatory monitoring?

Chapter Summary

Learning Outcomes	Summary	Pages
13.1 Identify the purpose and function of ambulatory monitoring.	Ambulatory monitoring records an ECG tracing while the patient goes about their normal daily activities.	304–306
13.2 Explain why ambulatory monitoring is used in addition to the 12-lead ECG.	Unlike an ECG, which evaluates the heart at one point in time, ambulatory monitoring is used to evaluate the heart during an extended period of time when symptoms or problems could occur.	306–307
13.3 Summarize the common types of ambulatory monitoring.	The three main types of ambulatory monitoring are Holter monitoring, cardiac event recording, and telemetry. In Holter monitoring, the patient keeps a diary of usual and unusual events, which the physician then correlates with the tracing. Cardiac event monitoring takes place over a longer period, and the patient presses a button to record the 5 minutes preceding and 5 minutes following the event. Telemetry monitoring is real-time monitoring of the patient.	307–312
13.4 Educate the patient about ambulatory monitoring.	The patient undergoing ambulatory monitoring must be educated about the procedure; its reasons; how long it will last and when to return; the equipment, including marking the tracing during symptoms and electrode problems; the diary; and when and how to contact the medical facility.	313–315
13.5 Prepare a patient for the application of an ambulatory monitor.	A patient must be prepared physically and emotionally before the ambulatory monitoring procedure. Reducing a patient's fear may help improve cooperation during the procedure.	316
13.6 Describe the procedure for applying an ambulatory monitor correctly.	After educating the patient, the equipment must be gathered and prepared, and the electrodes are placed on the patient's chest.	316–320
13.7 Describe the procedure for removing the ambulatory monitor and reporting the results.	Before removing the ambulatory monitor, ask the patient to provide the completed patient diary, then turn off the recording, remove the leads, clean the skin, and report the results. The ambulatory monitor recording must be prepared for review and evaluation. This process is based on the type of equipment used.	320–321

Chapter Review

Ordering

The following is a list of steps for applying an ambulatory monitor. Number the steps in sequential order from 1 to 13. (LO 13.6)

- _____ 1. Prepare the chest for lead placement.
- _____ 2. Identify the patient.
- _____ 3. Remove the patient's clothes from the waist up, and use a drape for female patients.
- _____ 4. Explain the procedure.
- _____ 5. Record the procedure in the patient's chart.
- _____ 6. Attach the lead wires.
- _____ 7. Ensure that the start time is recorded in the patient's diary.
- _____ 8. Start the monitor, and make sure that it is functioning correctly.
- _____ 9. Remove the adhesive backing, and apply the electrodes at the correct sites.
- _____ 10. Place the monitor in its holder, and strap it comfortably to the patient.
- _____ 11. Give the patient the diary, and review the instructions.
- _____ 12. Attach the cable to the monitor.
- _____ 13. Tape the cables in place using stress loops to reduce artifact.

Matching

Match the key terms on the left with their definitions on the right.

- | | |
|---|--|
| _____ 14. Holter monitor (LO 13.1) | a. device that detects cardiac rhythm disturbances and sends data automatically via radiofrequency |
| _____ 15. palpitation (LO 13.2) | b. medication given to prevent dysrhythmias |
| _____ 16. stress ECG (LO 13.1) | c. type of cardiac event recording that provides information before, during, and after a cardiac episode |
| _____ 17. myocardial infarction (LO 13.2) | d. ambulatory monitor used with patient diary |
| _____ 18. syncope (LO 13.2) | e. heart attack |
| _____ 19. ambulatory monitoring (LO 13.1) | f. recording an ECG for an extended period of time while the patient performs daily activities |
| _____ 20. loop-memory monitor (LO 13.3) | g. irregular heartbeat sensation felt by the patient |
| _____ 21. mobile cardiac outpatient telemetry (LO 13.3) | h. exercise electrocardiography |
| _____ 22. antidysrhythmic (LO 13.2) | i. fainting |

Patient Education

You are assigned to teach a patient about ambulatory (Holter) monitoring. From the following list, determine which are correct patient instructions for ambulatory monitoring and which are not. Place a capital **C** beside the correct statements and a capital **I** beside the incorrect statements. For each of the incorrect (**I**) statements, write the correct instructions for the patient. (LO 13.4)

- _____ 23. You should avoid alcohol and caffeine during ambulatory monitoring.
- _____ 24. During ambulatory monitoring, you will need to record your activities and any symptoms in your diary.
- _____ 25. You may take a tub bath as long as you do not let the monitor drop into the water.
- _____ 26. Wear a loose-fitting shirt, preferably one that buttons down the front, and you will be more comfortable during the procedure.
- _____ 27. You should not take your heart medications during the ambulatory monitoring procedure unless instructed to do so by the physician.

Multiple Choice

Circle the correct answer.

28. Your patient will be attached to a cardiac event recorder. How long will he have the monitor in place? (LO 13.3)
- a. 2 to 4 hours
 - b. 24 to 48 hours
 - c. Up to 30 days
 - d. Only during the hospital stay
29. A patient is attached to a real-time telemetry monitor. What does this mean? (LO 13.3)
- a. 12-leads are attached to the chest.
 - b. The patient must be at an inpatient facility.
 - c. The patient is going to send results over the telephone.
 - d. The patient has their ECG tracing being monitored at all times.

30. A patient is having an ambulatory (Holter) monitor attached and asks you how long it will remain in place. Your answer would be (LO 13.4)
- "2 to 4 hours."
 - "24 to 48 hours."
 - "Up to 60 days."
 - "Only during your hospital stay."
31. Your patient asks, "Why am I having this ambulatory monitor attached when I just had an ECG the other day?" What would be your *best* answer? (LO 13.2)
- "Ambulatory monitors record your heart activity in a different way than an ECG does."
 - "Your doctor wants to monitor your heart for longer than an ECG to determine if there are any abnormalities in your heart rhythm."
 - "It is necessary to monitor your heart while you are walking. That is why it is called ambulatory monitoring."
 - "I cannot answer that question. You should speak to your doctor."
32. Which of the following is *not* a common use of the ambulatory monitor? (LO 13.2)
- To monitor the blood pressure
 - To monitor the heart during a typical day
 - To evaluate pacemaker function
 - To correlate symptoms and heart activity

Holter Diary

At 4:20 p.m. today, a 54-year-old male patient, turned in the Holter monitor diary shown below. The monitor was connected yesterday at 8:00 a.m. Looking at the medical record, you see that the patient takes Plavix 75 mg daily and Lipitor 20 mg daily. Disconnect the monitor and turn it over to the physician.

33. Complete your portion of the diary with the information provided above.
34. Did the patient complete his portion of the diary? If not, what is missing?
35. If the diary was not complete, what should you do?

Sample Diary			Patient Instructions	Patient Activity Diary																		
A portion of a sample diary is shown below. Remember that the more complete your diary, the more valuable it is for your doctor. If in doubt, write it down. Please print clearly so that your doctor or technician will understand your comments. <table border="1"> <thead> <tr> <th>TIME</th> <th>ACTIVITY</th> <th>SYMPTOM</th> </tr> </thead> <tbody> <tr> <td>10:35 am</td> <td>walked to mail box</td> <td>chest felt funny</td> </tr> <tr> <td>11:45 pm</td> <td>Took Plavix and Lipitor</td> <td></td> </tr> <tr> <td>1:00 pm</td> <td>walked around block</td> <td>flutter</td> </tr> <tr> <td>6:00 pm</td> <td>sitting watching TV</td> <td></td> </tr> <tr> <td>8:00 pm</td> <td>Bed</td> <td>feeling tired</td> </tr> </tbody> </table>			TIME	ACTIVITY	SYMPTOM	10:35 am	walked to mail box	chest felt funny	11:45 pm	Took Plavix and Lipitor		1:00 pm	walked around block	flutter	6:00 pm	sitting watching TV		8:00 pm	Bed	feeling tired	Carry this diary and a pencil with you at all times and enter your activities, symptoms, and times they occur. Generally you should record: Time of Day: For every entry in the diary. Activities: Routine and strenuous exercise, bowel movements, taking medication, or emotional upsets, such as anger. Symptoms: Chest, neck, arm, or face pain; heart pounding; dizziness; nausea; shortness of breath; or any other—whether or not you feel they are important. If in doubt, write it down. Important: - Do not tamper with the recorder, electrodes, or electrode leads. - Do not get the recorder wet. - Your recorder is equipped with a digital clock display and an event marker button; activate it when symptoms occur.	() hr () 12 hr () 24 hr Patient's Name _____ Patient's Addr. _____ Age: _____ Sex: _____ Phone: _____ Medication: _____ Date of Recording _____ Started: _____ a.m./p.m. Connected By: _____ Ended: _____ a.m./p.m. Disconnected By: _____
TIME	ACTIVITY	SYMPTOM																				
10:35 am	walked to mail box	chest felt funny																				
11:45 pm	Took Plavix and Lipitor																					
1:00 pm	walked around block	flutter																				
6:00 pm	sitting watching TV																					
8:00 pm	Bed	feeling tired																				

Critical Thinking Application *What Should You Do?*

Read the following situations and use critical thinking skills to determine how you would handle each. Write your answer in detail in the space provided.

36. While working in an ambulatory care facility, you are preparing an ambulatory monitor for placement. You are about to insert the batteries when the monitor slips out of your hands. You are by yourself, and no one sees or hears you drop the monitor. What should you do? (LO 13.6)
-
-
37. When a patient returns to have the Holter monitor removed, you check the patient's diary. You notice that many places have been left blank, and the diary does not appear complete. What should you do? (LO 13.7)
-
-
38. A 67-year-old male patient with a pacemaker, has just had a Holter monitor applied. You ask the patient to write the first entry into a diary before they leave. He appears hesitant. You try to encourage the patient and he flatly refuses. What should you do? (LO 13.4)
-
-
39. You are applying an ambulatory monitor to a patient. The patient states that they will be going to court tomorrow before they return to have the monitor removed. Should this be a concern to you or the patient? How would you respond to the statement? Is there a reason why the patient should or should not go to court, and if so, what is it? (LO 13.7)
-
-



connect

Now that you have completed the material in the textbook, go to Connect and complete any chapter activities you have not yet done.

Competency Checklist

PROCEDURES CHECKLIST 13-1

Applying and Removing an Ambulatory (Holter) Monitor

Procedure Steps (<i>Rationale</i>)	Practice		Practice		Performed		Mastered	
	Yes	No	Yes	No	Yes	No	Date	Initials
Preprocedure								
1. Gather supplies and equipment.								
• Prep razor								
• Alcohol								
• Electrodes								
• Gauze pads								
• Skin rasp								
• Tape								
• Holter unit with strap and case								
• Fresh or newly charged batteries								
• Digital disk (SD card)								
• Pen and patient diary								
2. Review patient instructions per facility policy (to ensure accuracy and prevent problems during the testing procedure).								
• Documentation (diary), activities of daily living (ADLs), when symptoms occur.								
• Medications.								
• Physical restrictions such as new activities (should maintain normal routine), bathing, showers, and swimming while wearing the device.								
• How to operate the event marker.								
• How to reapply an electrode if one comes loose or falls off.								
• Must return with the Holter and diary to complete the test.								
• Must wear loose-fitting garments on the upper body to reduce artifact.								

(Continued)

Procedure Steps (<i>Rationale</i>)	Practice		Practice		Performed		Mastered	
	Yes	No	Yes	No	Yes	No	Date	Initials
Procedure (<i>continued</i>)								
Provide facility phone number, copy of instructions, and "point of contact" if the patient has questions, problems, or concerns.								
Provide picture of electrode locations, extra electrodes, and adhesive tape per clinic policy.								
Procedure								
1. Identify the patient and explain the procedure.								
2. Apply the electrodes.								
Using alcohol pads, gently rub and cleanse the patient's skin to obtain a good skin-to-electrode contact (reduces artifact).								
Dry each site completely by rubbing the skin with a gauze pad until it is dry.								
Shave and/or clip any hair in the areas where the electrodes will be attached.								
Wrap tape with adhesive side facing outward from hand, and pat gently to remove any loose hairs remaining on the patient's skin.								
Remove the electrodes from their package and snap onto the patient leads. (This prevents pressure on the patient's chest caused by applying leads to electrodes after they are placed on the chest.)								
Peel the protective backing off the electrodes one at a time as they are placed on the patient.								
3. Place the leads.								
Place the electrodes in the appropriate position. (Follow the physician's preference or manufacturer's instructions.)								
Try to center the electrodes over the ribs by gently setting the gelled center against the skin. (A wrinkled electrode or dispersed gel would cause an inaccurate tracing.)								
If the electrode wrinkles or gel is dispersed, apply a new electrode.								
Form a stress loop for each electrode and tape the cable, loop, and electrode to the skin.								

(Continued)

Procedure Steps (<i>Rationale</i>)	Practice		Practice		Performed		Mastered	
	Yes	No	Yes	No	Yes	No	Date	Initials
Procedure (<i>continued</i>)								
• Leave enough slack between the electrode and the stress loop to allow the patient to move without pulling or stressing the electrodes (prevents inaccurate tracing).								
• Verify that all leads are firmly inserted into the monitor.								
4. Prepare the equipment.								
• Insert the digital disk into the recorder.								
• Insert the appropriate number and size of new batteries into the recorder.								
• Slide and secure the battery cover onto the recorder.								
• Once the batteries have been inserted, avoid removing the digital disk. Some disks may become unusable if this is done.								
• An LED may blink as the recorder performs an initialization sequence and self-diagnostics. This will take approximately 20 seconds.								
5. Start the recording.								
• Place the recorder in the pouch and review the instructions with the patient.								
• Wait for the green LED to stop flashing and stay lit. This indicates that the recorder is collecting ECG data and functioning properly.								
• Note the start time on the enrollment form and patient's diary.								
• Have the patient sign the Patient Responsibility Form, if required.								
• Complete the paperwork.								
Postprocedure								
End the recording.								
• Collect the patient diary—check to ensure that entries were made.								
• Check with the patient to make sure no problems occurred during the recording procedure.								

(Continued)

Procedure Steps (<i>Rationale</i>)	Practice		Practice		Performed		Mastered	
	Yes	No	Yes	No	Yes	No	Date	Initials
Procedure (<i>continued</i>)								
• Report problems to the licensed practitioner per facility policy.								
• Turn off and disconnect the device per manufacturer's instructions.								
• Disconnect the cable from the ambulatory unit.								
• Remove the recorder from the pouch.								
• Carefully remove the electrodes from the patient. (This prevents irritation and tearing of the skin, especially for patients with paper-thin skin.)								
• Clean any residual electrode gel from the patient's skin, and assist the patient as necessary.								
• Remove and discard the batteries.								
• Remove the digital disk from the recorder.								
• Remove excess tape, and clean cables with a nonalcohol adhesive remover.								
• Turn in the recording and diary for analysis per facility policy.								
• Document the completed procedure according to your facility policy.								
• Explain to the patient that results may take 7 to 10 days and when they will be notified of the results.								
Comments: _____								

Signed _____								
Evaluator: _____								
Student: _____								