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Monitoring of patients with cardiovascular disease

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Abstract

Cardiovascular disease accounts for about one-third of deaths worldwide. Not surprisingly, health administrators and insurances are interested in monitoring healthcare performance and outcomes through standardized indicators obtained from reliable data. Hospital-based registries of cardiovascular disease patients are currently considered the reference standard in documenting how patients are treated relative to best practice recommendations outside the ideal world of clinical trials. Monitoring is done by special monitors designed to observe patients' physiological state like heart rate and rhythm, blood pressure, respiration and oxygen saturation and have become a standard device for diagnosis, observation, assessment and treatment in coronary care. Changes in vital signs frequently precede deterioration in a patient's condition and monitors provide valuable information and increase patient safety. Cardiac monitoring is a vital component in the management of the patients with cardiovascular disease. Knowledge of the general condition, location, and extent of a myocardial infarction and effective use of continuous cardiac monitoring will aid the nurse participate in the process of diagnosis and treatment.

Keywords: Monitoring; Cardiovascular disease; Nurse; Acute Myocardial Infarction (AMI); Cardiac Monitoring

1. Introduction

T Emergency cardiac monitoring is continuous monitoring of a patient's cardiac activity to identify conditions that may require emergent intervention. These conditions include certain arrhythmias, ischemia and infarction, as well as abnormal findings that could signal impending decompensation. Additional methods of continuous hemodynamic monitoring in cardiac units include pulse oximetry, end-airway CO2 monitoring, central venous pressure monitoring, and continuous arterial blood pressure monitoring. It should be noted that telemetry is the ability to do cardiac monitoring from a remote location; in practice, this is often a centralized system that might be located at a nursing station where multiple patients can be monitored remotely. [1].

Cardiac monitoring differs from a 12-lead electrocardiogram in that it is performed continuously over a period of time, rather than capturing a single moment in time in a static image. The benefit of this, of course, is to capture transient arrhythmias, ectopic beats, or monitor for changes over time. A disadvantage of cardiac monitoring is that usually only 2 leads are displayed instead of the full 12 leads, which gives a less comprehensive view of the heart and limiting its utility to look for anatomic patterns. For example, on the 12-lead EKG, healthcare professionals typically group the inferior, anterior, and lateral leads when looking for ischemic or infarct patterns. They may be less evident on a monitor with only two leads. In addition, the static EKG allows the doctor to carefully study it for subtle findings, for example, to make measurements of intervals, whereas in real-time monitoring this is very difficult. In practice, both methods are usually used together for many ED patients. Cardiac monitoring is essential for those patients who are at risk for an acute, life-threatening arrhythmia. Indications for cardiac monitoring in the inpatient setting are divided into three classes. Cardiac monitoring is considered indicated in "most, if not all" patients in Class I, which includes 16 subcategories. In Class II, cardiac monitoring "may be beneficial in some patients but is not considered essential for all patients" and has 10 subcategories. Cardiac monitoring is not indicated for Class III. [2].

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2. Material and methods

2.1. Class I Indications

Cardiac monitoring is considered indicated in “most, if not all” class I patients.

- Patients who have been resuscitated from cardiac arrest
- Patients in the early phase of acute coronary syndromes (ST-elevation or non-ST-elevation myocardial infarction (MI), unstable angina/"rule-out" MI)
- Patients with unstable coronary syndromes and newly diagnosed high-risk coronary lesions (for 24 hours)
- Adults or children who have undergone cardiac surgery (minimum of 48 to 72 hours)
- Patients who undergone non-urgent percutaneous coronary intervention with complications
- Patients who have undergone implantation of an automatic defibrillator lead or a pacemaker lead and are considered pacemaker dependent
- Patients with temporary or transcutaneous pacemakers
- Patients with AV block
- Patients with arrhythmias complicating Wolff-Parkinson-White syndrome with rapid anterograde conduction over an accessory pathway
- Patients with long-QT syndrome and associated ventricular arrhythmias
- Patients receiving intra-aortic balloon counter-pulsation
- Patients with acute heart failure/pulmonary edema
- Patients with indications for intensive care
- Patients undergoing diagnostic/therapeutic procedures requiring conscious sedation or anesthesia
- Patients with any other hemodynamically unstable arrhythmia
- Diagnosis of arrhythmias in pediatric patients

2.2. Class II Indications

Cardiac monitoring “may be of benefit in some patients but is not considered essential for all patients.”

- Patients with post-acute MI (24 to 48 hours after admission)
- Patients with chest pain syndromes
- Patients who have undergone uncomplicated, non-urgent percutaneous coronary interventions
- Patients receiving antiarrhythmic medication or requiring adjustment of rate control medication with chronic atrial tachyarrhythmias
- Patients who have an implanted pacemaker lead and are not dependent on it
- Patients who have undergone uncomplicated arrhythmia ablation
- Patients who have undergone routine coronary angiography
- Patients with sub-acute heart failure
- Patients who are being evaluated for syncope
- Patients with do-not-resuscitate orders with arrhythmias that cause discomfort

2.3. Class III

Cardiac monitoring is not indicated.

- Postoperative patients who are at low risk for cardiac arrhythmias (e.g. young patients without cardiac disease undergoing uncomplicated surgical procedures)
- Obstetric patients, unless cardiac disease is present
- Patients with permanent, rate-controlled atrial fibrillation
- Patients undergoing hemodialysis (unless they have a class I or II indication)
- Stable patients with chronic ventricular premature beats.
- [3, 4]

3. Results and discussion

3.1. Nursing care in cardiac monitoring: principles, standards and requirements

Continuous cardiac monitoring allows early identification and treatment of cardiac arrhythmias and, in some circumstances, myocardial ischemia, which requires further investigation. It also supports decisions about safe transfer or discharge following cardiac events or procedures.

Figure 1 depicts the process of assigning cardiac monitoring in case of need.

Cardiac monitoring (for arrhythmia with or without ST-segment monitoring) is a useful diagnostic tool for patients with or without risk of cardiac arrhythmias or acute ischemic changes. It has no therapeutic value unless the clinicians monitoring the patient are experienced in recognizing and managing these abnormalities.

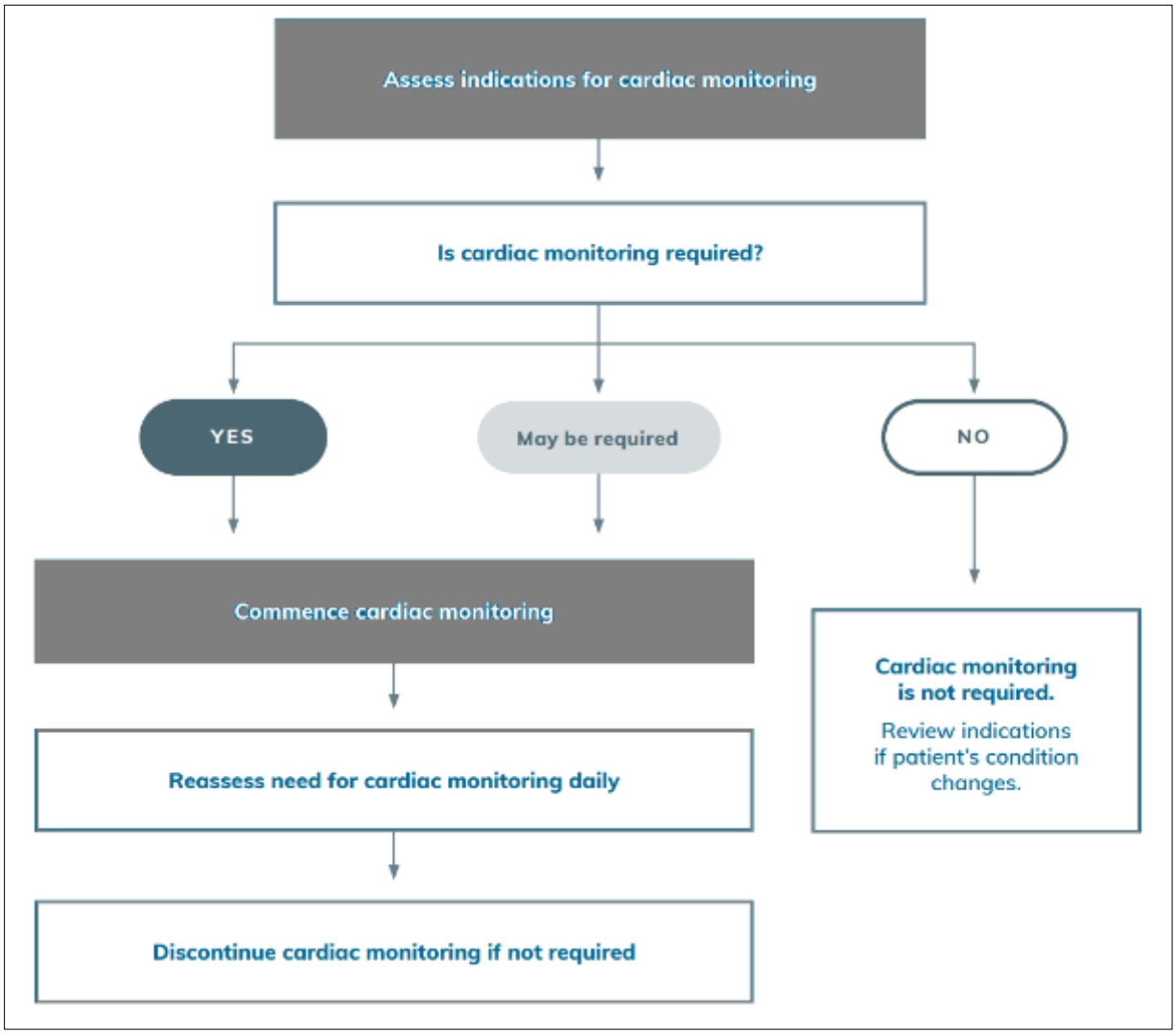

Figure 1 Cardiac monitoring appointment process

There should be a clear documented indication for cardiac monitoring to optimize the use of healthcare resources and reduce identified risks to patient independence and recovery. Cardiac monitoring in low-risk patients does not improve outcomes [5]. Clinical areas designated for the treatment of patients requiring continuous cardiac monitoring should be capable of central monitoring with all cardiac monitors (except those used for transfer) connected to the central monitor. The senior nurse with advanced cardiology skills (Table 1, Group A) may assign a patient to a monitoring category in the absence of medical direction and should document the clinical reasoning for their decision. However, the final responsibility for the risk assessment associated with cardiac monitoring rests with the chief treating medical

officer or the medical officer responsible for the person's cardiac monitoring, who should review the monitoring category within 24 hours.

Table 1 Skill sets and required competencies for staff escort, Group A

Group A (Advanced) escort skill set [9, 10]	Competency requirements (includes basic skill set)
Minimum skill set	
Administration of advanced life support drugs	Holds current, facility-endorsed advanced life support accreditation, that includes administration of intravenous advanced life support drugs
Manual defibrillation	Holds current, facility-endorsed advanced life support accreditation, that includes the use of a manual defibrillator
Patient dependent skill set Elements of advanced escort skill set may be patient dependent. Escort nurse skills should be matched to meet individual patient transport needs.	
Management of a temporary cardiac pacemaker	Holds current, facility-endorsed accreditation for managing a patient with a temporary cardiac pacemaker (transvenous or epicardial electrodes in situ), including troubleshooting pacemaker function
Transcutaneous cardiac pacing	Holds current, facility-endorsed accreditation for initiation and management of transcutaneous cardiac pacing, including troubleshooting pacemaker function
Management of intravenous medications requiring titration	Can demonstrate the requisite knowledge to manage a patient with an infusion of medication requiring titration, e.g. inotropes and nitrates

In the absence of local policy, alarm parameters should be set according to the yellow zone between the flags that triggers a medical review within 30 minutes, except when changed call criteria are documented. When patient parameters exceed an alarm zone, local, context-appropriate protocols developed with multidisciplinary consensus should direct appropriately qualified nurses to adjust alarm limits to reduce inactive alarms and alarm fatigue [6, 7].

All nurses are responsible for responding to and reviewing cardiac monitoring alarms. If there is uncertainty about the cardiac rate that triggered an alarm, this should be communicated to the team leader. Proper skin preparation and good electrode management can reduce inactive alarms and alarm fatigue [8].

Recording and documentation of a patient's rhythm strip (hard copy, or retrieved and entered into the electronic medical record) is expected, along with interpretation and any actions taken:

- on admission
- at least every eight hours
- after a change in rhythm or hemodynamic status.

Documentation must be available to all attending [6].

At the end of the minimum recommended monitoring period, a daily reassessment of clinical indications for continued monitoring is required so that it is discontinued when no longer necessary [6]. For Group A patients, this assessment should be performed by the treating medical team, the medical officer responsible for the patient's cardiac monitoring, or a specific, locally delegated senior nurse with advanced cardiology skills to support complex decision making. For group B patients, the assessment can be carried out by a suitably qualified delegate, for example a clinical nurse consultant, clinical nurse educator, clinical nurse specialist or nurse unit manager.

Patients requiring continuous cardiac monitoring should preferably remain under monitoring at all times. However, if cardiac monitoring must be interrupted (e.g., for showering or examinations), patients should be under direct visual observation by clinical staff with the appropriate skill set (Tables 1 and 2) throughout the period that cardiac monitoring is unavailable. Clinical areas that manage patients must have at least one nurse on duty at all times who meets the competency requirements for the relevant escort skill sets. If a facility is unable to meet the required staffing and

competency, the patient must be transferred to a facility that is able to provide that level of care. During the transfer, cardiac monitoring (or, if not available, direct visual monitoring) should be maintained by a clinician with appropriate escort skill sets. Each local health district must determine the necessary competency assessments for each facility to ensure the appropriate skill mix of staff is available.

Table 2 Skill sets and required competencies for staff escorts, Group B

Group B (Basic) escort skill set	Competency requirements
Basic life support	Holds current, facility-endorsed basic life support accreditation including use of an automated defibrillator [11]
Recognition and management of the deteriorating patient	Successful completion of training in the recognition and management of the deteriorating patient e.g. DETECT
Assessment and management of symptoms of myocardial ischaemia	In this context, the ability to administer supplemental oxygen (if SpO2<93%), nitrates and analgesia (including Schedule 8 medications)
Basic cardiac rhythm interpretation	Can recognise a change in rhythm and escalate accordingly
Management of the infusion pump (if in use) Basic skill set does not apply to infusion of medication requiring titration, e.g. inotropes and nitrates.	Can demonstrate the ability to adjust flow rates if required and troubleshoot pump function

Group A patients are at higher risk of life-threatening arrhythmias and/or increasing myocardial ischemia and require continuous cardiac monitoring or, in extenuating circumstances, continuous direct visual observation until cardiac monitoring ceases. All Group A patients require an escort with the Group A (advanced) escort skill set for transfer. Resuscitation equipment appropriate for the local facility and the distance to be traveled, including a manual or automatic defibrillator, is required for all intra- and inter-facility transfers. ST segment or QTc interval (heart rate-corrected QT interval) monitoring is recommended only when there are clear indications and no contraindications and should be supported by comprehensive training and alarm management. Discontinue ST or QTc monitoring if continuous false alarms cannot be resolved to avoid alarm fatigue. ST-segment monitoring is not useful in patients after routine angiography or no urgent, uncomplicated percutaneous coronary intervention who are fully awake, alert, and able to recognize and/or verbalize symptoms of angina. 12-lead electrocardiograms (ECGs) can be used to monitor QTc intervals every eight hours to every day, depending on patient characteristics and drug therapy. Lead selection for monitoring should be guided by the priority indication for monitoring (arrhythmia and/or ST segment and/or QTc segment monitoring).

At the end of the recommended observation period, group A patients require daily reassessment of clinical indications for continued monitoring and documentation of these indications in the health record [5, 6]. A written medical order is required to continue cardiac monitoring beyond the recommended monitoring period.

3.2. Monitoring in Acute Myocardial Infarction

Myocardial infarction (MI) or acute myocardial infarction (AMI), known as heart attack, is irreversible necrosis of the heart muscle due to prolonged ischemia. This is usually the result of an imbalance in the supply and demand of oxygen, which is most often caused by plaque rupture with thrombus formation in a coronary vessel, resulting in an acute decrease in the blood supply to a part of the myocardium. MI is part of a broader category of disease known as acute coronary syndrome (ACS), resulting from prolonged myocardial ischemia due to reduced blood flow through one of the coronary arteries. The ACS continuum representing ongoing myocardial ischemia or injury, consists of unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI).

Cardiovascular disease, the leading cause of death, usually result from heart damage or complications of MI. Mortality is high when treatment is delayed, and nearly half of sudden deaths due to MI occur before hospitalization, within an hour of symptom onset. The prognosis improves if vigorous treatment is started immediately.

MI can be classified into different types based on pathologic, clinical, and prognostic differences, along with different treatment strategies. MI caused by atherothrombotic coronary artery disease and usually precipitated by atherosclerotic plaque disruption is defined as type 1 MI. The pathophysiological mechanism leading to ischemic myocardial injury in the context of a mismatch between oxygen supply and demand is classified as type 2 MI. Type 3 MI is suspected when the acute myocardial ischemic event is high, even when cardiac biomarkers for MI are missing. This includes patients who present with a typical MI and die before blood can be obtained for cardiac biomarker determination [12, 13].

3.2.1. Nursing care plans and management

The main goals of AMI treatment are to limit myocardial damage, preserve cardiac function, and prevent complications. This is achieved through interventions that restore blood flow in the coronary arteries. To minimize damage, strategies focus on reducing oxygen demand and increasing oxygen delivery through medications, oxygen therapy, and rest. Relief of pain and improvement in ECG results indicate balanced oxygen demand and delivery as well as potential reperfusion. Confirmation of blood flow through an open vessel in the catheterization laboratory provides evidence of successful reperfusion.

The following are the priorities of nursing care for patients with myocardial infarction:

- Management of pain and ischemia.
- Monitoring for potential complications.
- Promotion of adequate tissue perfusion.
- Reducing anxiety.

The assessment that the nurse makes of the condition of patients with AMI is extremely important, since it is she who gives guidelines for possible preventions. Patients with MI commonly have acute and prolonged chest pain, often accompanied by symptoms such as shortness of breath, indigestion, nausea, and anxiety. They may show cool, pale and clammy skin, along with an increased heart and respiratory rate. These signs and symptoms caused by activation of the sympathetic nervous system may be short-lived or permanent. Distinguishing between MI and unstable angina based on symptoms alone can be challenging, leading to the broader term acute coronary syndrome. After a thorough assessment, it is essential to formulate a nursing diagnosis that specifically addresses the problems associated with myocardial infarction (heart attack). This diagnosis reflects your clinical judgment about the patient's health and needs [14].

The primary goals for patients with ACS include pain relief, prevention of myocardial damage, maintenance of respiratory function, adequate tissue perfusion, anxiety reduction, adherence to self-care, and early recognition of complications. Objectives and expected results may include [15]:

- The client will verbalize relief/control of chest pain within the appropriate time frame for administered medications, display reduced tension, a relaxed manner, and ease of movement, and demonstrate the use of relaxation techniques.
- The client will recognize and verbalize feelings, identify causes and contributing factors, verbalize the reduction of anxiety, demonstrate positive problem-solving skills, and identify and use resources appropriately.
- The client will maintain stable hemodynamics (e.g., normal blood pressure, cardiac output) and report reduced dyspnea and angina, while demonstrating improved activity tolerance.

3.2.2. Monitoring of laboratory and diagnostic studies

Cardiac enzymes and biomarkers, including troponin, creatine kinase (CK), and myoglobin, are major diagnostic tools for identifying AMI. These tests detect the release of cellular components into the bloodstream when heart muscle cells are damaged. Analyzing the time courses of these biomarkers allows rapid and accurate diagnosis.

Monitoring of laboratory data such as cardiac enzymes, ABGs and electrolytes. Enzymes monitor the resolution or the infarction extension. Repeat measurement of cardiac enzyme levels at regular intervals during the first 24 hours is a reasonable approach to improve the sensitivity of detecting myocardial necrosis, and the positivity rate may be important for prognosis. The presence of hypoxemia indicates the need for supplemental oxygen. Hypoxemia may result from pulmonary congestion, atelectasis, or ventilatory impairment secondary to complications of MI or excessive sedation or analgesia. Electrolyte imbalances such as hypokalemia or hyperkalemia adversely affect heart rate and contractility [16].

Troponin, a protein that regulates myocardial contraction, is a critical biomarker for detecting myocardial injury. Troponin I and troponin T, which are specific for cardiac muscle, are reliable indicators of myocardial damage. Blood troponin levels rise within hours after AMI and remain elevated for up to 2 weeks. However, it is important to note that troponin levels can also be elevated in conditions such as inflammation, sepsis, heart failure, and respiratory failure.

Creatine kinase (CK) has three isoenzymes: CK-MM (skeletal muscle), CK-MB (cardiac muscle) and CK-BB (brain tissue). CK-MB is specific for the heart and increases when there is cardiac damage. Elevated CK-MB levels are indicative of AMI, with levels beginning to rise within hours and peaking within 24 hours of infarction.

Myoglobin, present in cardiac and skeletal muscle, plays a role in oxygen transport. Its levels begin to rise within 1 to 3 hours and peak within 12 hours of the onset of symptoms. Although myoglobin elevation is not very specific to indicate an acute cardiac event, negative results can help rule out AMI.

4. Conclusion

More than 8 million patients with chest pain and/or angina-equivalent symptoms present to cardiac intensive care units each year. Cardiovascular emergencies account for approximately 10% of all ICU visits, where teams are required to quickly distinguish life-threatening from non-life-threatening conditions and accurately determine which course of treatment will lead to optimal patient outcomes. Cardiac monitoring strategies that include 12-lead electrocardiography (ECG) and night monitors allow professionals to detect arrhythmias, myocardial ischemia, and QT-interval measurements in real time.

Cardiac monitoring is a useful, non-invasive diagnostic tool for monitoring a wide range of patient conditions. To help healthcare professionals determine which patients require monitoring, experts in electro cardiology and cardiac monitoring have developed practice standards for hospital-based ECG monitoring. These practice standards cover all areas of in-hospital cardiac monitoring, including arrhythmia, myocardial ischemia, and QT interval monitoring.

Cardiac ICUs represent a fast-paced, dynamic and chaotic environment that requires rapid and accurate decision-making to differentiate high-acuity patients. The emergency physician's priority is to recognize and stabilize patients with emerging cardiovascular conditions, which include but are not limited to myocardial ischemia/infarction and potentially life-threatening arrhythmias. Cardiac monitoring is one of the most commonly used diagnostic practices in emergency medicine, and emergency nurses are poised to use valuable information revealed in ECG waves for early triage and risk stratification. Future research is needed to promote evidence-based surveillance practices specific to patients with cardiovascular disease.

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