

Appropriate Use of Telemetry Monitoring in Hospitalized Patients

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Abstract Non-intensive telemetry units are overused in hospitalized patients, either inappropriately initiated in low arrhythmia risk patients or continued beyond the recommended duration of monitoring. By far, the largest group of monitored patients is those with chest pain syndromes. The practice guidelines for telemetry monitoring are limited in scope, and chart audits show only moderate adherence by providers; up to 43 % of monitored patients have no indication for monitoring. Review of the available evidence supports the selection of a subset of chest pain patients that have a very low risk of arrhythmias. These low-risk patients have a normal or nonspecific ECG, negative cardiac markers, and, depending on the study, either atypical chest pain characteristics, no recurrent chest pain, or a low Goldman risk score. They are unlikely to benefit from telemetry monitoring in the emergency department or observation unit, during transport between hospital units, and in the inpatient setting.

Keywords Cardiac telemetry monitoring · Arrhythmia · Hospital medicine · Non-intensive telemetry units

Introduction

Non-intensive cardiac telemetry units were originally designed to monitor hospitalized patients at risk for life-threatening dysrhythmias, but did not require the level of care provided by intensive care units. If healthcare

personnel can immediately recognize a life-threatening arrhythmia in an unwitnessed cardiac arrest [1], they may be able to intervene and improve survival [2]. In patients admitted to cardiac intensive care units, continuous cardiac monitoring has been shown to reduce mortality rates following in-hospital cardiac arrest because early detection led to early defibrillation [1]. Its benefit in less acutely ill patients is not as clear. Moreover, most in-hospital cardiac arrests in adults are not preceded by sudden shockable arrhythmias, but rather with respiratory failure, circulatory shock, or both [3]. In 2013, the Society of Hospital Medicine identified continuous cardiac monitoring as one of the top five treatments relevant to their practice that is frequently overused in the hospital setting [4]. Subsequently, the appropriate use of cardiac monitoring has become one of its initiatives of the American Board of Internal Medicine Foundation's *Choosing Wisely*[®] campaign to decrease wasteful healthcare spending [5].

More than simply increasing healthcare costs, the overuse of telemetry also contributes to emergency department (ED) boarding and crowding, as the need for telemetry beds overwhelms a hospital's capacity. Acute chest pain remains one of the primary reasons for ED visits [6], and cardiac-related diagnoses are among the top ten reasons for hospital admissions [7]. These patients are often admitted to a telemetry unit because of their risk of developing a cardiac dysrhythmia. However, telemetry monitoring may also be used for patients with non-cardiac conditions associated with a risk for developing arrhythmias (e.g., pneumonia [8], stroke [9]) or as an inappropriate substitute for nursing care or close observation.

Several unintended clinical consequences of telemetry monitoring have been reported in the literature. Patients have undergone unnecessary diagnostic or therapeutic interventions (e.g., precordial thump, anti-arrhythmic medications,

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internal cardioverter-defibrillator placement) as a result of electrocardiographic artifacts mimicking ventricular tachycardia [10]. Artifacts can also trigger the tachycardia or bradycardia alarms on these hospital units, contributing to “alarm fatigue,” and desensitize staff from patients that have real dysrhythmias [11]. The majority (80 %) of the alarms were found to be false triggers that did not result in a clinical intervention, but significantly interrupted the workflow of the healthcare provider, who would have to go to the bedside to assess the patient and turn off the alarm. In one institution, the alarms were so loud and disruptive to the people working in those units that they were often silenced [12], so the providers had to rely on technicians who were watching the monitors at the central telemetry station to notify them immediately about patient events. However, because the telemetry data are often transmitted wirelessly to the central station, providers have observed delays as long as 5 s between the real-time status of the patient and the information displayed on the monitor [13].

In an effort to establish some consistency among providers, the American Heart Association (AHA) and American College of Cardiology (AHA) published their recommendations for appropriate use of telemetry in hospitalized patients, categorizing them as class I (all patients require telemetry), class II (some may benefit from telemetry), and class III (telemetry not indicated) [14••]. This guideline provides some evidence-based recommendations for cardiac diseases, but has limited details on the duration of monitoring and excludes many non-cardiac conditions. Moreover, since the publication of these guidelines, there have been several studies published by individual hospitals and health systems that have either instituted their own modified version of the guidelines or questioned the utility of continuous monitoring for specific conditions. This review will briefly review the landmark studies as well as some recent data on the utility of monitoring for acute chest pain patients (which represents, by far, the largest group of patients admitted to telemetry units) and then present some practical recommendations for using telemetry in these patients.

The Evidence Question the Utility of Telemetry

The landmark studies of telemetry patients admitted for various conditions showed very little benefit of monitoring. In two analyses of the same patient population over a 5-year period, Estrada et al. [15] showed that telemetry events led to a change in management in 7 % of the monitored patients (i.e., titrating anti-arrhythmic medications, overdrive pacing, defibrillation, intensive care unit admission). Of these, very few patients (0.8 %) had ventricular fibrillation (VF) or ventricular tachycardia (VT). When stratified by the authors using the initial ACC guidelines, patients who were appropriately monitored had

an arrhythmia event rate of 13.5 % (class I) and 40.7 % (class II) [16]. Only 1 % of the study group was inappropriately monitored (class III). In this low-risk group, 12 % of patients had an arrhythmia detected by the monitor, but none of these events required any intervention, and no patients developed VF or VT. In the subset of chest pain patients, telemetry identified a life-threatening arrhythmia in three (0.3 %) patients that prompted intensive care unit transfer. Finally, Schull et al. [17] found no survival benefit of monitoring in almost 9,000 patients to a telemetry unit. During this study, 20 (0.2 %) patients developed in-hospital cardiac arrest, but 44 % of patients did not have a detectable event on telemetry before their arrest. In both study populations, approximately 50 % of the patient admissions to a monitored bed were for chest pain syndromes, thus bringing into question the added benefit of telemetry in these patients.

Since the publication of the updated AHA/ACC guidelines, individual hospitals have performed audits to assess the appropriateness of telemetry use and arrhythmia rates detected by telemetry. In these more recent studies, the percentage of patients without an AHA/ACC indication for monitoring was 18–43 % (up from 1 % in the older studies) [18–23]. Inappropriate monitoring of patients was higher in July than September in one teaching hospital, likely following the learning curve of new interns and residents [19]. Moreover, no patients with a class III indication for monitoring developed a clinically significant arrhythmia that led to a change in management or life-threatening arrhythmia, including two hospitals in which acute chest pain syndrome patients were considered to be in this very low-risk group [20, 23]. These results highlight the overuse of telemetry for patients that may not have a clear indication for monitoring.

Currently, chest pain syndrome patients are routinely monitored during their entire hospital stay, from the ED to a telemetry unit, until symptom resolution, successful reperfusion, and/or acute coronary syndrome (ACS) has been excluded by cardiac markers or functional testing. In this very heterogeneous group of patients with varying risks for developing arrhythmias, providers may be able to select out a very low-risk subgroup that does not require monitoring during their hospital course.

Several risk stratification proposals have been studied specifically to answer this question. Hollander et al. [24] studied a group of 261 ED chest pain patients admitted to a telemetry unit with a normal or nonspecific ECG in which telemetry detected four arrhythmias (supraventricular tachycardia, VT, and bradycardias), none of which resulted in a change in management. When clinical features such as atypical chest pain symptoms or low Goldman risk score [25] and negative cardiac markers are added to the normal or nonspecific ECG, no patients suffered a

life-threatening arrhythmia, cardiac arrest, or death [26–28]. Even in a similar low-risk population where 66 % of the patients were older than 60 years, the telemetry alarms did not influence patient management, and no patient suffered a cardiac death or other major cardiac complication during the hospitalization [29]. Therefore, because these patients have such a low risk of arrhythmias, they are unlikely to benefit from inpatient telemetry monitoring.

The major limitation of these risk stratification studies is they do not specifically assess the safety of admitting low-risk chest pain patients to unmonitored hospital units. To address this limitation, providers in an Australian university hospital studied the safety of their risk stratification admission protocol in which low-risk chest pain patients (pain relief with nitroglycerin or morphine, normal or unchanged ECG, normal cardiac marker results) were admitted to unmonitored hospital beds. In the pilot study, when compared to the monitored group, the unmonitored group had a slightly lower adverse cardiac event rate (7.8 vs. 10 %) and higher mortality rate (2.5 vs. 0.5 %). All eight deaths in the unmonitored group were in patients with pre-existing do-not-resuscitate orders, and only one was from a presumed dysrhythmia for which telemetry may have been beneficial [30]. Of the nonfatal events, 12 patients were diagnosed with ACS and recovered without complications, 4 patients had recurrent pain that required intravenous nitroglycerin treatment and transfer to a monitored bed, and 1 patient developed bradycardia that resolved without intervention. With a larger sample size in the same population, no patient in the unmonitored group had a life-threatening arrhythmia or cardiac arrest. One patient in the monitored group suffered an asystolic cardiac arrest and per protocol would have been allocated to an unmonitored bed. However, the treating physician decided to override the allocation [31].

To introduce some controversy, Cleverley et al. [32] showed significant benefits of telemetry. In this retrospective review of in-hospital cardiac events in a multicenter Canadian study comparing monitored (18 %) and unmonitored patients (82 %), patients on telemetry had significantly higher survival rates (66 % monitored versus 34 % unmonitored, $p = 0.02$) and survival to hospital discharge (30 % monitored versus 6 % unmonitored, $p = 0.01$). The benefit was greatest in the 19 % of patients with VF or VT and in events that occurred at night and in the early morning, regardless of whether the arrest was witnessed. In addition, a prospective study of admissions to 19 telemetry units in Norway showed that 245 (21 %) telemetry events led to a change in management, the majority (60 %) of which were medication changes [33]. In patients without an AHA/ACC indication for monitoring (88 % had a noncardiac admission diagnosis), nearly 50 % had any arrhythmia, and 13 % had life-threatening arrhythmias. While these two large studies support a liberal use of monitoring in both cardiac and non-cardiac patients, they were not designed

to assist the clinician in selecting out the low-risk patients that would not benefit from monitoring.

Related areas of telemetry research assess the utility of monitoring during patient transport, in the ED, and in observation units. Caglar et al. [34] conducted a retrospective study of admitted chest pain patients who were transported to the radiology suite for their chest radiography with a portable telemetry monitor. In more than 3,000 patients, none had a life-threatening arrhythmia detected by telemetry during transport. A similar result was found in a prospective cohort of low-risk chest pain patients (i.e., normal or nonspecific ECG, no high-risk characteristics for ACS [35], pain free, and negative cardiac troponin level) who were transported without a portable telemetry monitor to their inpatient bed [36]. No patient had any adverse event requiring treatment during transport, and no patient died.

The utility of continuous monitoring in low-risk chest pain patients in the ED and in observation units has also been recently investigated. In a study of 997 chest pain patients who were monitored at any time in the ED, the authors developed a clinical decision rule with a sensitivity of 100 % (95 % CI 80–100 %) and specificity of 29 % (95 % CI 25–31 %) for a serious arrhythmia [37]. The incidence of serious arrhythmia in this cohort was 1.7 %. Patients who were pain free at initial assessment and had a normal or nonspecific initial ECG may be safely removed from telemetry because of their very low arrhythmia risk. If the providers had used this decision rule to risk stratify their patients, they would have removed 29 % of their chest pain patients from telemetry. The sensitivity of this rule has a large confidence interval, thus limiting its use. This Ottawa risk stratification rule, however, was subsequently validated in a study of low-risk chest pain patients admitted to an observation unit [38]. Patients who were pain free and had a normal or nonspecific ECG were admitted to a monitored observation unit. Of these 249 patients, no patient suffered a cardiac arrest, or was admitted for or medically treated for a cardiac arrhythmia. One patient with known tachybrady syndrome had 2-s pauses on telemetry and was told to hold β -blocker therapy. Even though these results also seem to support the futility of telemetry in low-risk chest pain patients, more research is needed before this becomes a standard of care.

Systems Changes to Reduce Inappropriate Telemetry Utilization

With the general movement toward providing more cost-effective care and the new initiative not to overuse hospital telemetry, individual institutions can reach these goals in several ways. Most often, the problem of overuse is due to inappropriate initiation of telemetry and continuation beyond the recommended stop date [39]. Electronic ordering systems can be programmed to require physicians to check a patient's indication for telemetry use according

to the AHA/ACC guidelines before telemetry can be ordered for a patient. In addition, the telemetry order can automatically expire after 24 or 48 h, so that if monitoring is still needed, it must be reordered. One institution showed a 16 % increase in compliance with the guidelines after implementation. Patients who did not meet guidelines for monitoring suffered no clinically significant events [40]. In addition, hospitals can create their own policy or guideline that more directly addresses the utilization practices of their physicians and create enforcement teams to round with the treating physicians or perform chart audits to improve compliance. This model increased compliance with the guidelines in one hospital, including proper duration of monitoring, by about 15 % [41]. No deaths or adverse events were associated with the lack of monitoring.

Conclusions

Review of the available evidence supports the selection of low-risk chest pain patients that are unlikely to benefit from in-hospital telemetry monitoring. These patients have a normal or nonspecific ECG, or negative cardiac markers, and have atypical chest pain characteristics, no recurrent chest pain, or a low Goldman risk score. They are unlikely to benefit from telemetry monitoring in the ED or observation unit, during transport between hospital units, and in the inpatient setting. Systems changes to reduce telemetry overuse include implementing electronic ordering systems with indications for monitoring and automatic order expiration, and utilizing enforcement teams to perform periodic chart audits and provide feedback.

Compliance with Ethics Guidelines

Conflict of Interest Esther Chen declares that she has no conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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