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Review Article

Indications, contraindications, and clinical significance of Holter monitoring device

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ABSTRACT

Holter electrocardiogram monitoring devices are mainly indicated to assess the 24-hour heart rate and rhythm, enabling clinicians and physicians to evaluate the underlying disorders, possibly arrhythmias. The clinical significance of these modalities was apparent in different clinical events, including cardiac and non-cardiac ones. Many applications and clinical advantages were reported since the device was first reported, which changed the way how healthcare settings deal with and monitor cardiac rhythm and associated abnormalities. Evidence shows that Holter monitoring devices are useful in the appropriate patient populace and are very efficacious in diagnosing and following cardiac arrhythmias and other different cardiac conditions, which can significantly enhance the prognosis and management of cardiovascular patients. In this context, it has been shown that primary healthcare physicians should always be aware that many patients might be present with asymptomatic cardiac arrhythmias. However, not many studies have adequately assessed them in the non-cardiac population, which calls for conducting more future investigations. In the present literature review study, we aim to discuss the indications, contraindications, and clinical significance of using the Holter monitoring device based on data from the relevant studies in the literature.

Keywords: Management, Cardiac, Mobile electrocardiogram, Holter, Cardiac diseases, Interventional cardiology

INTRODUCTION

A string galvanometer was first reported in 1893 and by Einthoven and was the first cardiogram monitoring device.[1] Norman J. Holter, together with his team, first developed and reported the Holter monitoring device.[1] This ambulatory electrocardiographic system can diagnose and follow-up various cardiovascular conditions and enhance healthcare outcomes. The Holter device is mainly based on galvanometer principles, designated to perform

an electrocardiogram for patients during their daily activities. In this context, many approaches have been reported to enhance the quality of these modalities to obtain better outcomes.[2]

Many applications and clinical advantages were reported since the device was first reported, which changed the way how healthcare settings deal with and monitor cardiac rhythm and associated abnormalities.[3] In addition, many indications have been reported for using the Holter device in cardiac settings, which have been associated with many favorable outcomes and reduced risk of mortality and morbidity. Besides, some studies reported that the device could be used in other non-cardiac settings.[2] Therefore, in the present literature review study, we aim to discuss the indications, contraindications, and clinical significance of using the Holter monitoring device based on data from the relevant studies in the literature.

METHODS

This literature review is based on an extensive literature search in Medline, Cochrane, and EMBASE databases which was performed on 27 December 2021 using the medical subject headings (MeSH) or a combination of all possible related terms, according to the database. To avoid missing potential studies, a further manual search for papers was done through Google Scholar while the reference lists of the initially included papers. Papers discussing indications, contraindications, and clinical significance of holter monitoring device were screened for useful information. No limitations were posed on date, language, age of participants, or publication type.

DISCUSSION

Indications and clinical significance

Evidence shows that Holter monitoring devices are useful in the appropriate patient populace and are very efficacious in diagnosing and following cardiac arrhythmias and other different cardiac conditions, which can significantly enhance the prognosis and management of cardiovascular patients. In this context, it has been shown that primary healthcare physicians should always be aware that many patients might be present with asymptomatic cardiac arrhythmias. Accordingly, a high index of suspicion is needed to establish the best prognosis and enhance the quality of care for patients at high risk of developing conditions.[4] With the early diagnosis of cardiovascular events by adequate monitoring of the high-risk population, it has been concluded that the quality of care of these patients has significantly enhanced secondary to the ability to enhance the interventional approaches and pharmacological treatment administration, which is associated with a major reduction in related morbidity and mortality rates. This has been attributed to the effective use and utilization of Holter monitoring devices in the early and prompt management and interventions of patients with arrhythmias and other cardiovascular events.[2,5,6]

Studies indicate no apparent recommendations among the different studies in the literature that might help identify patients who might benefit from conducting ambulatory electrocardiogram monitoring or Holter monitoring. However, it should be noted that many indications have been reported in the current recommendations and essential practice guidelines, which will be discussed in the current section. For instance, it has been shown that these devices can be used to predict and judge the risk of sudden cardiac mortality and evaluate the prognosis of the affected patients. Moreover, evidence shows that they are usually used to evaluate the functions of different implantable cardiac devices, including pacemakers.[7] In addition, these devices can also monitor the safety and efficacy of different non-pharmacological and pharmacological therapeutic approaches and detect the proarrhythmic responses among high-risk patients on antiarrhythmic medications. Besides, they might be used to detect the transient episodes of myocardial ischemic and cardiac arrhythmias and be strongly indicated for patients with neurological conditions when suspecting transient atrial flutter or fibrillation.[8] Studies also indicate that these devices can be furtherly used to detect near and total syncope events and the underlying cause and predict the association between abnormal heart rhythms and palpitations. Therefore, the main determinant of using the 12 lead or two to three Holter electrocardiography (ECG) monitoring devices is based on the indications and the intended aims of installing Holter monitoring. For instance, it has been shown that the two-to-three lead approach can be used to monitor heart rhythm and rate. On the other hand, it is usually recommended to use a twelve-lead Holter ECG to evaluate the underlying etiology of tachycardia or dysrhythmias (premature beats).[9-11]

The frequency of symptoms and clinical signs can also determine which monitor should be selected. For instance, it has been shown that to establish a proper diagnosis, a routine twelve-lead electrocardiogram can be used for patients presenting with continuous symptoms. For patients presenting with intermittent symptoms, it has been reported that most cardiologists prefer to use the Holter monitoring device. On the other hand, studies indicate that when patients present with rare symptoms, it is usually recommended to use longer duration-based devices, including an event monitor or an Implantable loop recorder (ILR).[12] Among the different studies in the literature, it has also been reported that the Holter monitor device can be effectively used in establishing a proper diagnosis of many conditions. For instance, it has been demonstrated that the diagnosis of a left anterior and posterior fascicular block, left and right bundle branch block, atrioventricular block, and dominant atrioventricular accessory pathways can be adequately established by a twelve-lead Holter monitor. Moreover, these devices can also accurately diagnose ventricular premature complexes, supraventricular premature complexes, long QT syndrome, polymorphic and monomorphic ventricular tachycardia, atrial fibrillation, atrial flutter, ventricular tachycardia, and supraventricular tachycardia.[13] In another context, it has

been suggested that patients with cryptogenic strokes should be monitored by an intracardiac monitoring device based on the current European guidelines.[14,15]

Studies show that the utilization of Holter monitoring devices has remarkably increased over the past decades, particularly for detecting occult atrial fibrillation as a potential etiology associated with cryptogenic stroke development. Moreover, it has been suggested that choosing the most appropriate secondary intervention is essential in these events. For instance, it has been recommended that using anticoagulants is always preferred over antiplatelets when conducting interventions against atrial fibrillation-induced stroke. Therefore, it has been recommended that preventing recurrent strokes be established with the aid of the Holter monitoring devices. This can be achieved by adequately diagnosing occult atrial fibrillation to strat anticoagulation therapy as early as possible and enhancing the prognostic and interventional outcomes.[16] Moreover, it has been shown that using the Holter monitoring devices can be associated with favorable outcomes for patients presenting with symptoms potentially suggestive of transient second or third-degree heart blocks and presumed arrhythmic events associated with left ventricular systolic dysfunction.[17] No apparent complications have been reported for using Holter monitoring devices as they are usually held in a pocket close to the patient's chest within the patient's vest pocket or by using a neck sling. However, the long-term use of the device might induce some cutaneous irritation because of the surface electrodes. Besides, this can cumulatively lead to skin ulceration. However, these events are only theoretical and were not reported among the different studies in the literature as the device and electrodes are usually removed before they can cause these events.

After heart failure and acute myocardial infarction, it has been evidenced that patients usually suffer from a remarkable reduction in heart rate variability. Furthermore, based on the outcomes of 24-hour electrocardiogram monitoring, many previous investigations have reported that the survivors from these cardiac events usually exhibit an interesting association. Additionally, abnormal heart rate variability parameters are strongly associated with the different morbidities and relevant complications (including death) among these patients. Therefore, the frequency and time-domain measures of heart rate variability studies have been the parameters of interest for stratifying the risk of these events in these studies. For instance, a previous investigation by Kleiger et al concluded that the risk of all-cause mortality was significantly increased and predictable by the reduction in the 24-hour monitored standard deviation of NN intervals (SDNN) intervals.[18] Furthermore, another study by Makikallio et al also concluded that among patients with decreased ejection fraction, reduced physiological complexity of heart rate variability was remarkably associated with increased risk of mortality in these patients.[19] Another study by Makikallio et al also aimed to assess the different factors and parameters monitored by the Holter-based risk indices among post-infarction patients associated with the increased risk of non-sudden and sudden cardiac death.[20] The authors reported that many parameters were significantly associated, including fractal heart rate variability index, heart rate turbulence, spectral measures of heart rate variability, and SDNN.

Among the previous studies that included patients with heart failure, it has been demonstrated that reduced heart rate variability parameters were significantly correlated with the severity of associated conditions and complications, neurohormonal activation, and increased cardiovascular disease risk. Moreover, previous studies also reported that heart rate variation parameters could provide remarkable prognostic information when the administration of beta-blockers was not recommended for patients with heart failure.[21,22] Findings from the GISSI-HF trial also indicate the remarkable association and clinical significance of heart rate variability parameters in predicting different outcomes in patients with heart failure.[23] Another previous study also reported that a long-term Holter monitoring electrocardiogram could be used to assess the risk of complications and subsequent adverse events among hypertensive patients.[24] In another context, many previous studies also assessed the efficacy and clinical significance of the device and its ability to predict different clinical outcomes in non-cardiac patients. It has been previously reported that among patients with type 2 diabetes mellitus, neurodegenerative disorders, obstructive sleep apnea, and hypertension, the combined ST-segment elevation and heart rate variability monitored by Holter electrocardiogram devices are significant predictors for the clinical outcomes and associated parameters in these patients.[25] In addition, a previous investigation reported that the diagnosis of obstructive sleep apnea could be significantly established by using heart rate variability parameters with estimated favorable sensitivity and specificity rates.[26] In another context, it should be noted that not many previous studies assessed the association between the significance of Holter monitoring devices and the symptoms and manifestations of neurodegenerative diseases. In this context, a previous comparative study concluded a significant difference in long-term time-domain indices of heart rate variability among patients with multiple system atrophy and healthy control patients.[27] However, another study reported that the different domains of heart rate variability monitored by Holter devices are not significantly correlated with the onset and different stages of Parkinson's disease. This indicates the need to conduct future relevant investigations.[28,29]

Contraindications

Although many indications for using mobile electrocardiogram devices have been listed among the various relevant studies in the literature, it should be noted that some contraindications were also reported for these modalities. For instance, it has been shown that these modalities should not be used when indicated that they can

potentially postpone hospitalization, an urgent treatment, or another diagnostic approach.[30] In this context, evidence indicates that these modalities should not be conducted in the initial routine investigations for patients presenting with angina. On the other hand, it would be more appropriate to use a stress test in these events. Moreover, it has been further shown that monitoring electrocardiogram devices are not favorable in patients presenting with high-risk factors and syncope when urgent inpatient management is usually recommended.[31] Moreover, studies also indicate that these approaches should not be conducted for patients presenting with palpitation, episodic dizziness, near-syncope, and syncope. Other clinical manifestations were concomitantly observed by laboratory studies, physical examination, and medical history of these patients.

Based on the American college of cardiology/American heart association guidelines, using ambulatory cardiograms is not recommended for conducting an interventional analysis of variability in heart rhythm or aiming to detect arrhythmias in patients with no clinical manifestations or symptoms of arrhythmias, aiming at assessing the associated risk. This has been furtherly indicated even when patients previously presented with different cardiovascular conditions, like valvular heart diseases and left ventricular hypertrophy. Another contraindication for using mobile monitoring electrocardiogram devices is when patients refuse to undergo additional treatment when arrhythmia has been conducted. Finally, these devices should not be used as a routine screening approach for asymptomatic patients.[32]

CONCLUSION

Holter electrocardiogram monitoring devices are mainly indicated to assess the 24-hour heart rate and rhythm, enabling clinicians and physicians to evaluate the underlying disorders, possibly arrhythmias. The clinical significance of these modalities was apparent in different clinical events, including cardiac and non-cardiac ones. However, not many studies have adequately assessed them in the non-cardiac population, which calls for conducting more future investigations.

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