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Review Article

Holter monitoring: Understanding its indications, contraindications, and clinical relevance

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ABSTRACT

Holter electrocardiogram monitoring devices play a crucial role in assessing 24-hour heart rate and rhythm, aiding clinicians in evaluating underlying disorders, including arrhythmias. These devices have demonstrated significant clinical importance across various events, both cardiac and non-cardiac, since their inception. They've revolutionized how healthcare settings monitor cardiac rhythm and associated abnormalities, offering numerous applications and clinical benefits. Evidence underscores their efficacy in diagnosing and monitoring cardiac arrhythmias and other cardiovascular conditions, thereby improving patient prognosis and management.

It's noteworthy that primary healthcare physicians should remain vigilant as many patients may harbor asymptomatic cardiac arrhythmias. However, there's a scarcity of studies adequately assessing these arrhythmias in non-cardiac populations, emphasizing the need for further investigation. Through this literature review, we aim to explore the indications, contraindications, and clinical significance of utilizing Holter monitoring devices, drawing insights from relevant studies in the field.

1. Introduction

The advent of the string galvanometer, pioneered by Einthoven in 1893, marked a significant milestone as the first cardiogram monitoring device.[1] Following this breakthrough, Norman J. Holter and his team developed the Holter monitoring device, introducing an ambulatory electrocardiographic system. This innovation revolutionized cardiovascular care by enabling the diagnosis and continuous monitoring of various cardiac conditions, thereby improving healthcare outcomes. Utilizing galvanometer principles, the Holter device conducts electrocardiograms on patients during their daily activities. Over time, numerous approaches have been explored to enhance the quality of these modalities, aiming to achieve superior outcomes.[2]

Since its inception, the Holter monitoring device has sparked numerous applications and clinical advantages, fundamentally altering the approach of healthcare settings toward cardiac rhythm monitoring and associated abnormalities. Moreover, its utilization in cardiac settings has been linked to favourable outcomes, including reduced mortality and morbidity risks.[3] Additionally, emerging evidence suggests its potential utility in non-cardiac settings. Consequently, our literature review aims to delve into the indications, contraindications, and clinical significance of employing the Holter monitoring device, drawing insights from pertinent studies in the field.[2]

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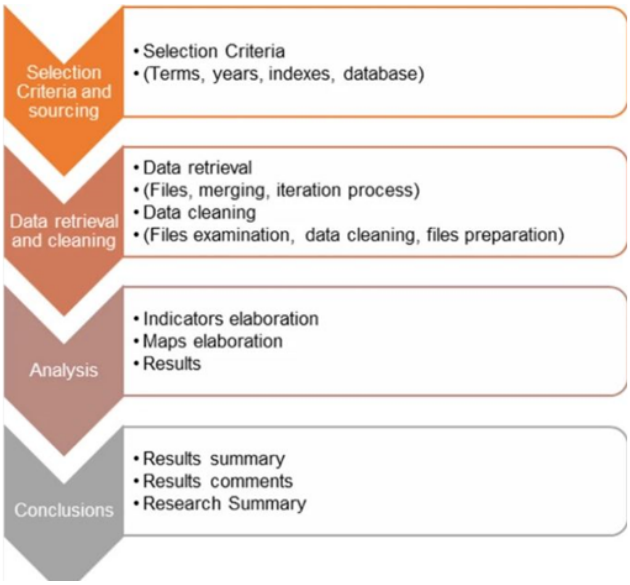
2. Methods



For this literature review, a comprehensive search was conducted across Medline, Cochrane, and EMBASE databases on April (1- 15), 2024. Medical subject headings (MeSH) and relevant terms were utilized to ensure inclusivity. To minimize the risk of overlooking relevant studies, additional manual searches were conducted using Google Scholar and by reviewing the reference lists of initially selected papers. Papers addressing the indications, contraindications, and clinical significance of the Holter monitoring device were meticulously screened for pertinent information. No restrictions were imposed regarding publication date, language, participant age, or publication type, ensuring a thorough examination of the available literature.

2.1. Inclusion criteria

Peer-reviewed articles on Holter monitoring's clinical applications, outcomes, and limitations. Research focusing on cardiac arrhythmias, risk stratification, or therapy monitoring. Global studies in English or with accessible translations.

2.2. Exclusion criteria

Editorials, opinion pieces, or non-research articles. Studies unrelated to Holter monitoring or focused on alternative devices without comparison. Non-English articles without translations and duplicate publications. This ensures a comprehensive and focused bibliometric analysis of relevant, high-quality literature.

3. Discussion

3.1. Indication and clinical significance

Evidence underscores the utility of Holter monitoring devices in appropriate patient populations, demonstrating high efficacy in diagnosing and monitoring cardiac arrhythmias and various cardiovascular conditions. This capability significantly improves the prognosis and management of cardiovascular patients. Primary healthcare physicians must remain vigilant, as many patients may present with asymptomatic cardiac arrhythmias. Thus, maintaining a high index of suspicion is crucial for optimal patient care, especially for those at high risk.[4]

Early diagnosis of cardiovascular events through adequate monitoring of high-risk populations leads to a substantial enhancement in patient care. This improvement is attributed to the ability to implement timely interventional approaches and pharmacological treatments, resulting in a significant reduction in morbidity and mortality rates. The effective utilization of Holter monitoring devices plays a pivotal role in facilitating early and prompt management and interventions for patients with arrhythmias and other cardiovascular events.[2,5,6]

Studies suggest a lack of clear recommendations across the literature regarding the identification of patients who might benefit from ambulatory electrocardiogram monitoring or Holter monitoring. However, it's important to note that current recommendations and essential practice guidelines outline various indications, which will be discussed in this section. For example, these devices can predict and assess the risk of sudden cardiac mortality and evaluate patient prognosis. Additionally, evidence indicates their utility in assessing the functionality of different implantable cardiac devices, such as pacemakers.[7]

Moreover, these devices play a crucial role in monitoring the safety and effectiveness of both non-pharmacological and pharmacological therapeutic interventions. They can detect proarrhythmic responses in high-risk patients undergoing antiarrhythmic medication regimens. Additionally, they are instrumental in identifying transient episodes of myocardial ischemia and cardiac arrhythmias, particularly in patients with neurological conditions suspected of transient atrial flutter or fibrillation.[8]

Studies also highlight their utility in detecting near and total syncope events, identifying underlying causes, and predicting the association between abnormal heart rhythms and palpitations. The choice between using a 12-lead or two to three-lead Holter electrocardiography (ECG) monitoring device depends on the specific indications and intended objectives of the monitoring. For instance, the two-to-three-lead approach is suitable for monitoring heart rhythm and rate, while a twelve-lead Holter ECG is typically recommended for evaluating the underlying etiology of tachycardia or dysrhythmias, such as premature beats.[9–11]

The choice of monitor is also influenced by the frequency of symptoms and clinical signs. For patients experiencing continuous symptoms, a routine twelve-lead electrocardiogram is typically sufficient to establish a proper diagnosis. However, for those with intermittent symptoms, cardiologists often prefer the use of a Holter monitoring device. Conversely, when patients present with rare symptoms, longer duration-based devices such as event monitors or Implantable loop recorders (ILRs) are usually recommended.[12]

Several studies in the literature highlight the effective use of Holter monitor devices in establishing accurate diagnoses for various conditions. For example, a twelve-lead Holter monitor can adequately diagnose left anterior and posterior fascicular blocks, left and right bundle branch blocks, atrioventricular blocks, and dominant atrioventricular accessory pathways. Additionally, these devices 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]

According to current European guidelines, patients with cryptogenic strokes are recommended to undergo monitoring with an intracardiac monitoring device. The utilization of Holter monitoring devices has significantly surged in recent decades, especially for detecting occult atrial fibrillation as a potential cause linked to the development of cryptogenic stroke.[14,15] Furthermore, selecting the most suitable secondary intervention is crucial in these cases. For example, it is recommended to prioritize anticoagulants over antiplatelets when intervening against strokes induced by atrial fibrillation.

Thus, it is recommended to employ Holter monitoring devices in preventing recurrent strokes. This involves accurately diagnosing occult atrial fibrillation to initiate anticoagulation therapy promptly, thereby improving prognostic and interventional outcomes.[16] Additionally, utilizing Holter monitoring devices has been associated with favourable outcomes for patients exhibiting symptoms suggestive of transient second or third-degree heart blocks and presumed arrhythmic events linked to left ventricular systolic dysfunction.[17]

No significant complications have been reported with the use of Holter monitoring devices. Typically, these devices are securely positioned in a pocket close to the patient's chest, either within their vest pocket or with the assistance of a neck sling. However, prolonged use of the device may potentially cause cutaneous irritation due to the surface electrodes, which could, in rare instances, lead to skin ulceration. It's important to note that such events are theoretical and have not been reported in the literature, as the device and electrodes are typically removed before they can cause any adverse effects.[18]

Following heart failure and acute myocardial infarction, patients commonly experience a notable reduction in heart rate variability. Previous investigations based on outcomes from 24-hour electrocardiogram monitoring have revealed an intriguing association among survivors of these cardiac events. Abnormal heart rate variability parameters are strongly linked to various morbidities and relevant complications, including death, in these patients. Therefore, frequency and time-domain measures of heart rate variability have been of particular interest in stratifying the risk of these events.[19]

For example, a study by Kleiger et al. found that the reduction in the 24-hour monitored standard deviation of NN intervals (SDNN) significantly increased the risk of all-cause mortality. Additionally, research by Makikallio et al. concluded that reduced physiological complexity of heart rate variability was markedly associated with an elevated risk of mortality among patients with decreased ejection fraction.

Another study conducted by Makikallio et al. aimed to evaluate various factors and parameters monitored by Holter-based risk indices among post-infarction patients, particularly those associated with an increased risk of non-sudden and sudden cardiac death.[20] The authors found significant associations among several parameters, including the fractal heart rate variability index, heart rate turbulence, spectral measures of heart rate variability, and SDNN.

Previous studies involving patients with heart failure have shown that reduced heart rate variability parameters are significantly correlated with the severity of associated conditions and complications, neurohormonal activation, and increased risk of cardiovascular disease. Additionally, these studies have indicated that heart rate variation parameters can offer valuable prognostic information, especially in cases where the administration of beta-blockers is not recommended for patients with heart failure.[21,22]

Results from the GISSI-HF trial underscore the notable association and clinical importance of heart rate variability parameters in predicting various outcomes in patients with heart failure. Another study highlighted the utility of long-term Holter monitoring electrocardiograms in assessing the risk of complications and subsequent adverse events among hypertensive patients.[23] Furthermore, several previous studies have evaluated the effectiveness and clinical significance of Holter monitoring devices in predicting diverse clinical outcomes in non-cardiac patients.[24] Previous reports have indicated that among patients with type 2 diabetes mellitus, neurodegenerative disorders, obstructive sleep apnea, and hypertension, the combined assessment of ST-segment elevation and heart rate variability monitored by Holter electrocardiogram devices serves as a significant predictor for clinical outcomes and

associated parameters in these individuals.[25] Furthermore, an earlier investigation demonstrated that the diagnosis of obstructive sleep apnea could be significantly established through the use of heart rate variability parameters, with estimated favourable sensitivity and specificity rates.[26] In a different context, it's important to note that there haven't been many previous studies examining the association between Holter monitoring devices and the symptoms and manifestations of neurodegenerative diseases. A prior comparative study found a significant difference in long-term time-domain indices of heart rate variability between patients with multiple system atrophy and healthy control subjects.[27] However, another study reported that the various domains of heart rate variability monitored by Holter devices are not significantly correlated with the onset and different stages of Parkinson's disease. This underscores the necessity for conducting future relevant investigations in this area.[28,29]

3.2. Contraindications

While numerous indications for using mobile electrocardiogram devices have been documented in the literature, it's important to acknowledge that certain contraindications have also been reported for these modalities. For instance, evidence suggests that these devices should not be utilized if there is a risk of delaying hospitalization, urgent treatment, or another diagnostic approach.[30] Additionally, it is not recommended to use these modalities as part of initial routine investigations for patients presenting with angina. Alternatively, a stress test would be more suitable in these scenarios. Furthermore, it has been demonstrated that monitoring electrocardiogram devices are not advisable for patients presenting with high-risk factors and syncope, as urgent inpatient management is typically warranted.[31] Studies also suggest that these approaches should be avoided for patients presenting with palpitations, episodic dizziness, near-syncope, and syncope. Instead, it is recommended to consider other diagnostic modalities alongside laboratory studies, physical examination, and medical history evaluation for these patients. According to the American College of Cardiology/American Heart Association guidelines, the use of ambulatory cardiograms is not recommended for conducting interventional analysis of heart rhythm variability or detecting arrhythmias in patients who exhibit no clinical manifestations or symptoms of arrhythmias, even if they have previously presented with cardiovascular conditions such as valvular heart diseases and left ventricular hypertrophy. Another contraindication for using mobile monitoring electrocardiogram devices is when patients decline further treatment after arrhythmia detection. Additionally, these devices should not be employed as a routine screening approach for asymptomatic patients.[32]

4. Limitations

Holter monitoring has limitations in its application and research. Studies on its effectiveness in non-cardiac populations and long-term outcomes remain limited. The absence of universal guidelines for patient selection creates inconsistencies in its use. Rarely, prolonged use can lead to skin irritation or ulceration, though these effects are not commonly reported. Additionally, there is a need for further exploration of contraindications, particularly in high-risk cases, where alternative diagnostic methods may be more appropriate.

4.1. Outcomes

Despite these limitations, Holter monitoring demonstrates significant clinical value. It improves diagnostic accuracy for arrhythmias, ischemic events, and transient conditions, aiding in risk stratification and reducing morbidity and mortality rates. It is instrumental in therapy monitoring, ensuring the safety and efficacy of pharmacological and non-pharmacological treatments. Holter monitoring has also shown utility in stroke prevention by diagnosing occult atrial fibrillation, enabling timely anticoagulant therapy. Furthermore, its applications extend to non-cardiac settings, such as detecting sleep apnea and assessing autonomic dysfunction, with minimal complications reported. These outcomes highlight its critical role in advancing patient care and clinical outcomes.

5. Conclusion

Holter electrocardiogram monitoring devices are primarily used to assess the 24-hour heart rate and rhythm, allowing clinicians to evaluate underlying disorders, potentially including arrhythmias. While their clinical significance has been evident in various clinical events, both cardiac and non-cardiac, there has been a lack of adequate studies assessing their efficacy in non-cardiac populations. This underscores the need for further investigations in this area.

6. Source of Funding

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7. Conflict of Interest

None declared.

References

1. Holter NJ, Generelli JA. Remote recording of physiological data by radio. *Rocky Mt Med J*. 1949;46(9):747–51.
2. Maria BD, Vecchia L, Porta A, Rovere MTL. Autonomic dysfunction and heart rate variability with Holter monitoring: a diagnostic look at autonomic regulation. *Herzschrittmacherther Elektrophysiol*. 2021;32(3):315–9.
3. Pevnick JM, Birkeland K, Zimmer R, Elad Y, Kedan I. Wearable technology for cardiology: An update and framework for the future.

Trends Cardiovasc Med. 2018;28(2):144–50.
4. Gibson CM, Ciaglo LN, Southard MC, Takao S, Harrigan C, Lewis J, et al. Diagnostic and prognostic value of ambulatory ECG (Holter) monitoring in patients with coronary heart disease: a review. *J Thromb Thrombolysis*. 2007;23(2):135–45.
5. Son PT, Reda A, Viet DC, Quynh NXT, Hung DT, Tung TH, et al. Exchange transfusion in the management of critical pertussis in young infants: a case series. *Vox Sang*. 2021;116(9):976–82.
6. Pham TS, Reda A, Nguyen T, Ng SJ, Huan VT, Viet DC, et al. Blood exchange transfusion in viral hepatitis in a small infant: a case report. *Transfus Apher Sci*. 2020;59(6):102907. doi:10.1016/j.transci.2020.102907.
7. Galli A, Ambrosini F, Lombardi F. Holter Monitoring and Loop Recorders: From Research to Clinical Practice. *Arrhythm Electrophysiol Rev*. 2016;5(2):136–43.
8. Giada F, Bartoletti A. Value of Ambulatory Electrocardiographic Monitoring in Syncope. *Cardiol Clin*. 2015;33(3):361–6.
9. Wimmer NJ, Scirica BM, Stone PH. The clinical significance of continuous ECG (ambulatory ECG or Holter) monitoring of the ST-segment to evaluate ischemia: a review. *Prog Cardiovasc Dis*. 2013;56(2):195–202.
10. Nguyen TM, Huan VT, Reda A, Morsy S, Giang HTN, Tri V, et al. Clinical features and outcomes of neonatal dengue at the Children's Hospital 1, Ho Chi Minh, Vietnam. *J Clin Virol*. 2021;138:104758. doi:10.1016/j.jcv.2021.104758.
11. Thieu H, Dat BB, Nam NH, Reda A, Duc NT, Alshareef A, et al. Antibiotic resistance of Helicobacter pylori infection in a children's hospital in Vietnam: prevalence and associated factors. *Minerva Med*. 2020;111(5):498–501.
12. Diemberger I, Gardini B, Martignani C, Ziacchi M, Corzani A, Biffi M, et al. Holter ECG for pacemaker/defibrillator carriers: what is its role in the era of remote monitoring? *Heart*. 2015;101(16):1272–8.
13. Wang R, Blackburn G, Desai M. Accuracy of Wrist-Worn Heart Rate Monitors. *JAMA Cardiol*. 2017;2(1):104–6.
14. El-Qushayri AE, Dahy A, Reda A, Mahmoud MA, Mageed SA, Kamel AMA, et al. A closer look at the high burden of psychiatric disorders among healthcare workers in Egypt during the COVID-19 pandemic. *Epidemiol Health*. 2021;43:2021045. doi:10.4178/epih.e2021045.
15. El-Qushayri AE, Ghozy S, Reda A, Kamel AMA, Abbas AS, Dmytriw AA, et al. The impact of Parkinson's disease on manifestations and outcomes of Covid-19 patients: A systematic review and meta-analysis. *Rev Med Virol*. 2021;32(2):e2278. doi:10.1002/rmv.2278.
16. Albers GW, Bernstein RA, Brachmann J, Camm J, Easton JD, Fromm P, et al. Heart Rhythm Monitoring Strategies for CryptogenicStroke: 2015 Diagnostics and Monitoring Stroke Focus Group Report. *J Am Heart Assoc*. 2016;5(3):2944. doi:10.1161/JAHA.115.002944.
17. Dibas M, Doheim MF, Ghozy S, Ros MH, El-Helw GO, Reda A, et al. Incidence and survival rates and trends of skull Base chondrosarcoma: A Population-Based study. *Clin Neurol Neurosurg*. 2020;198:106153. doi:10.1016/j.clineuro.2020.106153.
18. Kleiger RE, Miller JP, Bigger-Jr JT, Moss AJ, R E Kleiger, J P Miller, J T Bigger Jr, A J Moss. Decreased heart rate variability and its association with increased mortality after acute myocardial infarction. *Am J Cardiol*. 1987;59(4):256–62.
19. Mäkikallio TH, Høiber S, Køber L, Torp-Pedersen C, Peng CK, Goldberger AL, et al. Fractal analysis of heart rate dynamics as a predictor of mortality in patients with depressed left ventricular function after acute myocardial infarction. TRACE Investigators. TRAndolapril Cardiac Evaluation. *Am J Cardiol*. 1999;83(6):836–9.
20. Mäkikallio TH, Barthel P, Schneider R, Bauer A, Tapanainen JM, Tulppo MP, et al. Prediction of sudden cardiac death after acute myocardial infarction: role of Holter monitoring in the modern treatment era. *Eur Heart J*. 2005;26(8):762–9.
21. Galinier M, Pathak A, Fourcade J, Androdias C, Curnier D, Varnous S, et al. Depressed low frequency power of heart rate variability as an independent predictor of sudden death in chronic heart failure. *Eur Heart J*. 2000;21(6):475–82.
22. Nolan J, Batin PD, Andrews R. Prospective study of heart rate variability and mortality in chronic heart failure: results of the United Kingdom heart failure evaluation and assessment of risk trial (UK-heart). *Circulation*. 1998;98(15):1510–6.
23. Rovere MTL, Pinna GD, Maestri R, Barlera S, Bernardinangeli M, Veniani M, et al. Autonomic markers and cardiovascular and arrhythmic events in heart failure patients: still a place in prognostication? Data from the GISSI-HF trial. *Eur J Heart Fail*. 2012;14(12):1410–9.
24. Guzzetti S, Dassi S, Pecis M, Casati R, Masu AM, Longoni P, et al. Altered pattern of circadian neural control of heart period in mild hypertension. *J Hypertens*. 1991;9(9):831–8.
25. Bosone D, Fogari R, Ramusino MC, Ghiotto N, Guaschino E, Zoppi A, et al. Ambulatory 24-h ECG monitoring and cardiovascular autonomic assessment for the screening of silent myocardial ischemia in elderly type 2 diabetic hypertensive patients. *Heart Vessels*. 2017;32(5):507–13.
26. Roche F, Pichot V, Sforza E, Court-Fortune I, Duverney D, Costes F, et al. Predicting sleep apnoea syndrome from heart period: a time-frequency wavelet analysis. *Eur Respir J*. 2003;22(6):937–42.
27. Kiyono K, Hayano J, Kwak S, Watanabe E, Yamamoto Y. Non-gaussianity of low frequency heart rate variability and sympathetic activation: lack of increases in multiple system atrophy and Parkinson disease. *Front Physiol*. 2012;3:34. doi:10.3389/fphys.2012.00034.
28. Kim JS, Lee SH, Oh YS, Park JW, An JY, Park SK, et al. Cardiovascular Autonomic Dysfunction in Mild and Advanced Parkinson's Disease. *J Mov Disord*. 2016;9(2):97–103.
29. Jain S, Ton TG, Perera S, Zheng Y, Stein PK, Thacker E, et al. Cardiovascular physiology in premotor Parkinson's disease: a neuroepidemiologic study. *Mov Disord*. 2012;27(8):988–95.
30. Brandes A, Bethge KP. Long term electrocardiography (Holter monitoring). *Herzschrittmacherther Elektrophysiol*. 2008;19(3):107–29.
31. Steinberg JS, Varma N, Cygankiewicz I, Aziz P, Balsam P, Baranchuk A, et al. 2017 ISHNE-HRS expert consensus statement on ambulatory ECG and external cardiac monitoring/telemetry. *Ann Noninvasive Electrocardiol*. 2017;22(3):12447. doi:10.1111/anec.12447.
32. Biersteker TE, Schalij MJ, Treskes RW. Impact of Mobile Health Devices for the Detection of Atrial Fibrillation: Systematic Review. *JMIR Mhealth Uhealth*. 2021;9(4):26161. doi:10.2196/26161.

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