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Retrospective Cohort Study

Utility of short-term telemetry heart rhythm monitoring and CHA₂DS₂-VASc stratification in patients presenting with suspected cerebrovascular accident

Tanzim Bhuiya, Sherif Roman, Taner Aydin, Bhakti Patel, Roman Zeltser, Amgad N Makaryus

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Abstract

BACKGROUND

Inpatient telemetry heart rhythm monitoring overuse has been linked to higher healthcare costs.

AIM

To evaluate if CHA₂DS₂-VASc score could be used to indicate if a patient admitted with possible cerebrovascular accident (CVA) or transient ischemic attack (TIA) requires inpatient telemetry monitoring.

METHODS

A total of 257 patients presenting with CVA or TIA and placed on telemetry monitoring were analyzed retrospectively. We investigated the utility of telemetry monitoring to diagnose atrial fibrillation/flutter and the CHA₂DS₂-VASc scoring tool to stratify the risk of having CVA/TIA in these patients.

RESULTS

In our study population, 63 (24.5%) of the patients with CVA/TIA and telemetry monitoring were determined to have no ischemic neurologic event. Of the 194 (75.5) patients that had a confirmed CVA/TIA, only 6 (2.3%) had an arrhythmia detected during their inpatient telemetry monitoring period. Individuals with a

confirmed CVA/TIA had a statistically significant higher CHA₂DS₂-VASc score compared to individuals without an ischemic event (3.59 *vs* 2.61, *P* < 0.001).

CONCLUSION

Given the low percentage of inpatient arrhythmias identified, further research should focus on discretionary use of inpatient telemetry on higher risk patients to diagnose the arrhythmias commonly leading to CVA/TIA. A prospective study assessing event rate of CVA/TIA in patients with higher CHA₂DS₂-VASc score should be performed to validate the CHA₂DS₂-VASc score as a possible risk stratifying tool for patients at risk for CVA/TIA.

Key Words: Telemetry monitoring; CHA₂DS₂-VASc score; Arrhythmia; Atrial fibrillation

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Core Tip: Inpatient telemetry monitoring can be a costly resource in hospitals. Inappropriate use of this clinical tool only increases burgeoning healthcare costs both to the patient and the hospital. Atrial fibrillation is a risk factor for stroke which is why telemetry is indicated for 24-48 h after a cerebrovascular accident. However, telemetry for all patients for this short period of time can be non-diagnostic. Our study shows telemetry can be better utilized in patients with higher risk factors for atrial fibrillation as seen with higher CHA₂DS₂-VASc scores, and this stratification of telemetry monitoring may allow appropriate allocation and use for patients in whom benefit will be derived.

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INTRODUCTION

Non-intensive-care inpatient telemetry monitoring is a widely used observation tool in cardiovascular medicine. The use of non-intensive-care telemetry is widely utilized in the setting of suspected cerebrovascular accident (CVA) or transient ischemic attack (TIA)[1]. One of the most common causes of CVA/TIA is atrial fibrillation (AFib). The 2018 stroke guidelines states that cardiac monitoring is recommended for atrial fibrillation as part of in-hospital secondary prevention. Cardiac monitoring should be performed for at least the first 24 h[2]. Telemetry monitoring is utilized in these cases to assess whether undiagnosed atrial fibrillation was the cause of their ischemic event. Past studies have demonstrated that the use of telemetry inpatient post-stroke to assess for the presence of these arrhythmias may contribute to an increased healthcare cost burden[3,4].

The overutilization of telemetry monitoring has been a frequent discussion regarding our nation's ever-increasing healthcare costs. The American Board of Internal Medicine's 2013 Choosing Wisely campaign emphasized avoiding inappropriate continuous use of telemetry monitoring in an attempt to decrease the cost of care and number of false positive errors which could negatively impact patient care [5]. In 2004, the American Heart Association (AHA) first issued a statement on telemetry monitoring indications in intensive care settings[3]. Since then, updated recommendations in 2017 have been published by the AHA in order to address the overuse of arrhythmia monitoring as well as other issues. The AHA recommends monitoring arrhythmias for 24-48 h after a stroke[6]. Dhillon *et al*[7] formulated inclusion and exclusion guidelines for which patients should need telemetry monitoring outside of the intensive care unit in an effort to decrease costs from overuse. The efficacy of these guidelines was tested in a retrospective study of 562 patients and found that no patient that was not indicated for telemetry had a clinically significant arrhythmia. This suggests that it is possible to narrow the indications for which patients should be on telemetry monitoring.

As atrial fibrillation is a common etiology of CVA/TIA, CHA₂DS₂-VASc is a clinical scoring tool used to evaluate the one-year risk of having a thromboembolic event in a non-anticoagulated patient with nonvalvular atrial fibrillation[8,9]. This clinical scoring tool uses age, sex, congestive heart failure, hypertension, thromboembolism history, vascular disease, and diabetes as risk factors, and assigns points to each risk factor. If the total score is greater than or equal to 2 points, current literature states that an oral anticoagulation strategy should be employed to reduce the annual risk of stroke[10]. In our study, we sought to evaluate if CHA₂DS₂-VASc scoring could be used to risk stratify patients with a possible diagnosis of CVA or TIA into telemetry monitoring indicated *vs* nonindicated group.

MATERIALS AND METHODS

A retrospective cohort study was performed at a tertiary-care safety-net community hospital between January 2014 and December 2016 with a total of 257 consecutive patients admitted with suspected CVA or TIA. Criteria for patient inclusion in the study was an admission diagnosis of CVA or TIA, lack of pre-existing atrial fibrillation, and admission with telemetry monitoring employed. Telemetry monitoring was performed for at least 24 h, consistent with current standards of care. CVA or TIA was confirmed *via* current diagnostic guidelines (including patient evaluation by the neurology consulting service and/or non-invasive brain imaging studies). The CHA₂DS₂-VASc score was calculated for each patient. Independent variable *t*-tests were performed using SPSS Statistics, version 16.0, when comparing patients with and without a final diagnosis of CVA or TIA.

RESULTS

The demographics of our study population can be seen in Table 1 and includes age, ethnicity, sex, body mass index, smoking, and history of dyslipidemia. Of the 257 patients included in our study, 75.5% (*n* = 194) patients had a confirmed ischemic event (CVA or TIA). Of these patients, only 2.3% (*n* = 6) were found to have atrial fibrillation or atrial flutter during their inpatient telemetry monitoring.

The mean and median CHA₂DS₂-VASc scores were found to be significantly different between patients that did and did not have a confirmed CVA/TIA (Table 2). The mean CHA₂DS₂-VASc score was higher in the group with confirmed CVA/TIA than in the group without an ischemic event (3.59 *vs* 2.61, *P* < 0.001). The median score was also found to be higher, with median score of 4 in patients with CVA/TIA compared to median score of 2 in patients without an event (*P* < 0.001).

DISCUSSION

Atrial fibrillation affects over 5 million people in the United States and increases the risk of stroke by 5-fold compared to the rest of the population[10,11]. The initial presentation of atrial fibrillation can be asymptomatic or subclinical[12]. The economic burden of people with previously unknown and asymptomatic atrial fibrillation is estimated to be over 3 billion dollars[13,14]. Of those with atrial fibrillation, female sex is an established risk factor for stroke, cognitive dysfunction, and dementia[15-17]. Patients diagnosed with atrial fibrillation with a concerning CHA₂DS₂-VASc score should be treated with anticoagulation therapy to avoid major adverse cardiac and cerebrovascular events (MACCE). The AFIRE trial showed a temporal association between major bleeding and MACCE events, demonstrating the importance of optimal antithrombotic therapy and managing bleeding risk in patients with atrial fibrillation and stable coronary artery disease[18]. Direct oral anticoagulants are shown to be at least as efficacious and safe as warfarin among patients with non-valvular atrial fibrillation[19]. DOACs are shown to have lower MACE rates *vs* warfarin[20].

The CHA₂DS₂-VASc scoring tool has been validated to estimate the patient's stroke risk with atrial fibrillation[21,22]. Limited research has been done to demonstrate its utility in predicting the risk of ischemic stroke in patients without atrial fibrillation. Our findings show that there is a statistically significant increase in the CHA₂DS₂-VASc score for patients with a confirmed ischemic event (3.59 *vs* 2.61, *P* < 0.001). Patients with ischemic events had their CHA₂DS₂-VASc score clustered on the higher end of the scores. Similarly, those patients without an ischemic event had their scores clustered towards the lower end of the score.

Of the 75.5% (*n* = 193) of patients that had a confirmed CVA/TIA, only 2.3% (*n* = 6) of these were found to have newly diagnosed atrial fibrillation. In a 2016 meta-analysis, Demeestere *et al*[23], detected atrial fibrillation in only 2.2% of patients with large-vessel CVA, and 2.4% of patients with small-vessel CVA. Moreover, a 2016 meta-analysis by Korompoki *et al*[24], found that atrial fibrillation was detected in 4% of patients post-TIA. These detection rates increased over time with an increased duration of monitoring. A meta-analysis of 32 studies showed the atrial fibrillation detection after CVA/TIA was better detected with more prolonged periods of monitoring compared to standard telemetry[25]. A study conducted by Simova *et al*[1] showed ECG telemonitoring after cryptogenic stroke or TIA only resulted in detection of AF in 10 of 36 patients (27%). The therapeutic implication of this finding suggests the benefit of routine prolonged ECG monitoring in this group as opposed to short-duration (24-48 h) inpatient telemetry.

The yield of telemetry use in this patient population is low, despite atrial fibrillation being a common cause of CVA/TIA. This presents a possible area in which we can safely reduce the amount of telemetry monitoring to only 24 h while inpatient or even possibly forgo monitoring completely in very low risk patients. Given the burden atrial fibrillation has on the general population, novel methods of screening are available and can be more cost effective[26]. Employment of wearable wireless continuous electrocardiographic (EKG) patches allows for one-to-two-week telemetry monitoring compared to the traditional 24-48-h Holter monitoring. This patient friendly approach can transmit telemetry recordings

Table 1 Demographics of the study population, *n* (%)

| Variable | Confirmed CVA/TIA (<i>n</i> = 194) | Absent CVA/TIA (<i>n</i> = 63) |
|------------------|-------------------------------------|---------------------------------|
| Mean age (yr) | 67.54 | 58.54 |
| <i>Ethnicity</i> | | |
| White | 105 (54.12) | 32 (50.79) |
| Black | 70 (36.08) | 22 (34.92) |
| Other | 19 (9.80) | 9 (14.29) |
| <i>Gender</i> | | |
| Men | 93 (47.94) | 24 (38.10) |
| Women | 101 (52.06) | 39 (61.90) |
| Mean BMI | 27.36 | 29.10 |
| Dyslipidemia | 108 (55.70) | 22 (34.90) |
| Smoking | 54 (27.83) | 14 (22.20) |

CVA: Cerebrovascular accident; BMI: Body mass index; TIA: Transient ischemic attack.

Table 2 CHA₂DS₂-Vasc scores of patients with confirmed cerebrovascular accident /transient ischemic attack vs absent cerebrovascular accident /transient ischemic attack, *n* (%)

| CHA ₂ DS ₂ -Vasc | Confirmed CVA/TIA (<i>n</i> = 194) | Absent CVA/TIA (<i>n</i> = 63) |
|--|-------------------------------------|---------------------------------|
| 0 | 11 (5.70) | 4 (6.35) |
| 1 | 26 (13.40) | 19 (30.16) |
| 2 | 24 (12.37) | 10 (15.87) |
| 3 | 29 (14.95) | 15 (23.81) |
| 4 | 42 (21.65) | 4 (6.35) |
| 5 | 26 (13.40) | 4 (6.35) |
| 6 | 20 (10.31) | 4 (6.35) |
| 7 | 11 (5.67) | 3 (4.76) |
| 8 | 5 (2.55) | 0 (0.00) |
| Mean | 3.59 | 2.61 ^a |
| Median | 4 | 2 ^a |

^a*P* value < 0.001 on Mann-Whitney *U* Test. CVA: Cerebrovascular accident; TIA: Transient ischemic attack.

to health care providers for real time detection of cardiac events[27]. Studies have shown that the adhesive patch monitors detect more events than the conventional Holter monitor[28]. Recent developments have shown that wearables, such as smart watches, are an effective method of screening for atrial fibrillation in the general population. The Apple Heart Study used the Apple Watch in concurrent use with the current standard of diagnosing paroxysmal arrhythmias, the EKG patch, and showed that the positive predictive value of the tachograms was 0.71 (95%CI: 0.76-0.92)[29]. In addition to smart watches, portable single lead EKGs and phone applications can also be used to record palpitation events[26]. The Kardia Band designed by AliveCor mimics lead I and was designed to be used as an accessory for the Apple Watch. It was able to correctly detect atrial fibrillation with a sensitivity of 93% (95%CI: 86%-99%) and an 84% specificity (95%CI: 73%-95%)[30]. The Cardio Rhythm app for the iPhone uses the phone's camera to act as a light sensor in order to obtain heart rate measurements. The app is not used for continuous rhythm monitoring but can be used for sporadic heart rate checks or during symptoms of palpitations. It was able to detect atrial fibrillation with a sensitivity of 92.9% (95%CI: 77%-99%) and a specificity of 97.7% (95%CI: 97%-99%)[31]. Significant gaps of knowledge remain regarding the optimal length and yield of long-term inpatient monitoring beyond the recommended 24-h inpatient telemetry monitoring[32]. Future research should be done to evaluate

the percentage of detected atrial fibrillation in patients with confirmed ischemic events with outpatient cardiac rhythm monitoring of different lengths of time.

A total of 24.5% ($n = 63$) of patients in this study that were placed on telemetry monitoring for suspected CVA/TIA did not have a confirmed ischemic event per neurology evaluation. Given that the use of telemetry requires additional staff and hospital resources, increased cost burden, and is a limited resource in hospitals, efforts should be made to limit its use. Our findings suggest that the CHA₂DS₂-VASc score may be a valuable scoring tool to help risk stratify patients at risk for CVA/TIA and could thereby reduce the need of inpatient telemetry monitoring in patients suspected to have a CVA/TIA that have a low CHA₂DS₂-VASc score. Our study was limited by the small sample size of the study group. Additional studies with a larger sample size would allow for more statistical analysis of the utility of CHA₂DS₂-VASc in predicting CVA/TIA. Risk stratifications of patients can help reduce the use of unnecessary telemetry monitoring, especially in resource-limited hospitals.

CONCLUSION

Inpatient telemetry monitoring can be a costly resource in hospitals. Inappropriate use of this clinical tool only increases burgeoning healthcare costs both to the patient and the hospital. Atrial fibrillation is a risk factor for stroke which is why telemetry is indicated for 24-48 h after a CVA. However, telemetry for all patients for this short period of time can be superfluous and costly. Our study shows telemetry can be better utilized in patients with higher risk factors for atrial fibrillation as seen with higher CHA₂DS₂-VASc scores, and this stratification of use of telemetry monitoring will allow appropriate allocation and use for patients in whom benefit will be derived.

ARTICLE HIGHLIGHTS

Research background

Non-intensive-care inpatient telemetry monitoring is a widely used observation tool in cardiovascular medicine.

Research motivation

Inpatient telemetry heart rhythm monitoring overuse has been linked to higher healthcare costs.

Research objectives

Our study aimed to evaluate if CHA₂DS₂-VASc score could be used to indicate if a patient admitted with possible cerebrovascular accident (CVA) or transient ischemic attack (TIA) requires inpatient telemetry monitoring.

Research methods

A retrospective cohort study was performed at a tertiary-care safety-net community hospital between January 2014 and December 2016 with a total of 257 consecutive patients admitted with suspected CVA or TIA. Telemetry monitoring was performed for at least 24 h, consistent with current standards of care. CVA or TIA was confirmed *via* current diagnostic guidelines (including patient evaluation by the neurology consulting service and/or non-invasive brain imaging studies). The CHA₂DS₂-VASc score was calculated for each patient. Independent variable *t*-tests were performed using SPSS Statistics, version 16.0, when comparing patients with and without a final diagnosis of CVA or TIA.

Research results

Individuals with a confirmed CVA/TIA had a statistically significant higher CHA₂DS₂-VASc score compared to individuals without an ischemic event (3.59 *vs* 2.61, $P < 0.001$).

Research conclusions

Given the low percentage of inpatient arrhythmias identified, further research should focus on discretionary use of inpatient telemetry on higher risk patients to diagnose the arrhythmias commonly leading to CVA/TIA.

Research perspectives

A prospective study assessing event rate of CVA/TIA in patients with higher CHA₂DS₂-VASc score should be performed to validate the CHA₂DS₂-VASc score as a possible risk stratifying tool for patients at risk for CVA/TIA.

FOOTNOTES

Author contributions: Aydin T, Zeltser R, Makaryus AN performed the research; Bhuiya T and Zeltser R performed the statistical analyses in the paper; Zeltser R and Makaryus AN designed the research and contributed to the analysis; Bhuiya T, Roman S, Aydin T, Patel B, Makaryus AN, wrote the paper; Zeltser R, and Makaryus AN supervised the report.

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