ORIGINAL ARTICLE

Retrospective application of the HEAR score on patients evacuated for chest pain: Assessing the utility of point-of-care troponin

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Introduction: The HEART scoring system codifies the clinical gestalt used by physicians with 0–2 points assigned to 5 criteria (history, electrocardiography, age, risk factors and troponin). This scoring provides a prognostic tool that assists in disposition planning. The use of a truncated HEART score, minus the troponin data (HEAR score), was used for patients presenting with chest pain at one of four outpost nursing stations served by La Ronge Health Centre in northern Saskatchewan. These nursing stations have no onsite physician and no ability to obtain any troponin data. This study set out to determine if there was any utility in conducting point-of-care (PoC) troponins in these nursing outposts.

Materials and Methods: A retrospective analysis was conducted using the La Ronge regional electronic medical record by searching for all patients for whom an outpost nurse had called a physician regarding chest pain symptoms between 01 January 2011 and 31 December 2016. The HEAR and HEART score were then calculated for each individual presentation of patients with chest pain that met inclusion and exclusion criteria.

Results: By calculating both the patient's HEART score before evacuation from the outposts and after (i.e. with the troponin data), we were able to determine that, in 89.4% of cases (110/123 events), patients would require evacuation regardless of the troponin values due to a HEART score ≥4. In 10.6% (13/124 events) of cases, the patients who were evacuated had a HEART score ≤3, and in only one case did the troponin data increase this score.

Conclusions: The majority of patients would continue to be evacuated regardless of the result of their PoC troponin due to an already elevated HEAR score. PoC troponin is unlikely to reduce the rate of evacuation of patients with chest pain from the nursing stations served by the La Ronge Health Centre.

Keywords: Heart disease, HEART score, rural medicine, troponin

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Résumé

Introduction: Le système de pointage HEART codifie la gestalt clinique utilisée par les médecins avec 0–2 points attribués à 5 critères (anamnèse, ECG, âge, facteurs de risque, troponine). Ce pointage est un outil pronostique qui aide à planifier les soins aux patients. Un score HEART tronqué, c'est-à-dire moins les données de troponine (score HEAR), a été utilisé chez les patients qui se présentaient pour douleur thoracique à 1 des 4 avant-postes de soins infirmiers servis par le centre *La Ronge Health Centre* au nord de la Saskatchewan. Il n'y a pas de médecin sur place à ces postes de soins infirmiers, et il est impossible d'obtenir des données sur la troponine. Cette étude voulait déterminer si le dosage ciblé de troponine est utile dans ces avant-postes de soins infirmiers.

Méthodes: Une analyse rétrospective a été réalisée à l'aide du dossier médical électronique de la région de La Ronge après une recherche de tous les patients pour lesquels un avant-poste de soins infirmiers avait appelé un médecin pour des symptômes de douleur thoracique entre le 1er Janvier 2011 et le 31 Décembre 2016. Les scores HEAR et HEART ont alors été calculés pour chaque cas de douleur thoracique qui répondait aux critères d'inclusion et d'exclusion.

Résultats: En calculant le score HEART (c.-à-d. avec les données sur la troponine) avant et après l'évacuation du patient de l'avant-poste, nous avons pu déterminer que dans 89,4% des cas (110/123 événements), les patients devraient être évacués sans égard aux valeurs de troponine en raison d'un score HEART ≤3 et la troponine a augmenté ce score dans un seul cas.

Conclusions: La majorité des patients continueraient d'être évacués, peu importe les résultats de troponine ciblée en raison d'un score HEAR déjà élevé. La troponine ciblée ne réduirait probablement pas le taux d'évacuation des patients pour douleur thoracique des postes de soins infirmiers servis par le centre *La Ronge Health Centre*.

Mots-clés: Maladie cardiaque, médecine rurale, score HEART, troponine

INTRODUCTION

Cardiovascular disease is the second leading cause of death in Canada, and chest pain is a common chief complaint in patients presenting with acute coronary syndromes (ACS) such as ST-elevation myocardial infarction (STEMI) and non-STEMI (NSTEMI).[1] Given the potentially disastrous consequences of missing a major adverse cardiac event (MACE), resulting in death, STEMI, or NSTEMI in patients presenting to the emergency department with chest pain, almost half are admitted for further workup.[2] However, <15% of these patients are ultimately diagnosed with a life-threatening cardiac event, resulting in significant unnecessary costs to the healthcare system.[3,4] The development of several risk-stratification tools allowing for early, safe discharge in patients presenting to the emergency department with chest pain has been the subject of significant research activity over the past 2 decades, potentially offering a method to reduce the costs associated with unnecessary investigations and long hospital stays for patients at low risk for MACE.[5-7]

The HEART score (history, electrocardiography [ECG], age, risk factors and troponin) codifies a physician's gestalt for a patient's risk of MACE and identifies patients presenting with chest pain as low, moderate and high risk for MACE within 30 days of presentation; 0–2 points are assigned to 5 criteria, and patient disposition planning and further investigations can be guided by the HEART pathway.[8-10]

Importantly, up to 30% of patients presenting with chest pain are deemed low risk for MACE (HEART score <4, 1.7% risk of MACE within 30 days).[8,10] This has important implications in rural sites, where access to specialist services and intensive care can be extremely costly.[11,12]

In remote locations in Canada, patients are often serviced by nursing outposts with no onsite physician and no ability to obtain troponin data. This clinical dilemma suggests a potential role for the use of point-of-care (PoC) troponin testing to risk-stratify patients using a prehospital HEART score, potentially reducing the rate of costly evacuations. PoC troponin testing has emerged as a method for reducing test turnaround time, reducing emergency department length of stays and allowing for early identification of patients at high risk of MACE.[13-20] Although not yet formally

validated in the pre-hospital setting, the use of the HEART score and PoC troponin testing have been proposed as a possible method of risk-stratifying patients with chest pain even before arrival in the emergency department.[18,19]

In northern Saskatchewan, where the population density is 0.1 person/km^2, the La Ronge Health Centre services four outpost nursing stations, ranging from 80 to 466 km away by road.[21] These clinics have access to ECG but no laboratory services; when patients contact these nursing stations with chest pain, the attending nurse contacts a physician in La Ronge for further guidance, and the patient's risk for MACE must be stratified without the use of troponin. A pre-hospital risk stratification tool that safely rules out MACE in patients presenting to these nursing outposts could significantly reduce the costs associated with evacuating low-risk patients and transporting them to La Ronge. Our study sought to determine if there is any role for PoC troponin testing at nursing outposts serviced by our health centre, by truncating the HEART score (HEAR).

MATERIALS AND METHODS

Study design

A retrospective analysis was conducted using the La Ronge clinic's electronic medical records by searching for all patients for whom an outpost nurse had called a physician regarding symptoms of ACS between 01 January 2011 and 31 December 2016. All patients whose concern generated a phone consult to the La Ronge Health Centre and had a diagnosis of myocardial infarction, chest pain, other chronic ischemic heart disease, angina pectoris or if the diagnosis was left blank were included. Exclusion criteria included patients under 18-year-old, an obvious non-cardiac cause of chest pain (trauma, cancer and abscess), patients who were never evacuated and all charts lacking sufficient data to calculate a HEART score (history of presenting illness, ECG, age of patient, description of risk factors, or troponin result). The HEAR and HEART score were then calculated for each individual presentation of chest pain that met the inclusion and exclusion criteria. HEAR scores were calculated before evacuation, and HEART scores were calculated using troponin data obtained after the patients were evacuated to La Ronge. The four nursing outposts included in the study were Pinehouse, Southend, Wollaston and Stanley Mission.

A master list of all patient provincial health services numbers was generated in order to assign unique study IDs for the purpose of data entry and tracking. Each patient's chart was individually reviewed to assess the number of times they generated a phone call from an outpost nurse that was related to symptoms of ACS. Many patients had more than 1 event; these were all treated as distinct data points.

A detailed comparison was performed of the HEAR and HEART scores, with the following three outcomes.

1. HEAR Score ≤3 which was recalculated with troponin level to result in a HEART score of ≤3 (The addition of the troponin did not significantly change the score)
2. HEAR Score ≤3 recalculated with troponin level to result in a HEART score of ≥4 (The addition of the troponin was significant in raising the score above cutoff)
3. HEAR Score ≥ 4-(Hence no added value of a PoC troponin, as patient already meets criteria for evacuation).

All research was conducted in accordance with our university's biomedical research ethics board. Access to patient health information was granted by our local Medical Services, and the local Population Health Unit was an informed party.

RESULTS

The initial chart review identified 302 patients with 400 unique events. One hundred and twenty-three of these met inclusion criteria, and 110 (89.4%) had a HEAR score of 4 or more. Thirteen of these events (10.6%), each representing a different patient, had a HEAR score of <4 and adding a troponin to generate a HEART score increased the score to 4 or more in one case (0.8%) [Figure 1]. Seven events had an elevated troponin, causing the HEAR and HEART scores to differ; six of these were unique patients with a HEAR score of 6 or greater. Seventeen patients generated numerous evacuations for the same complaint over the study period with limited findings on each occasion.

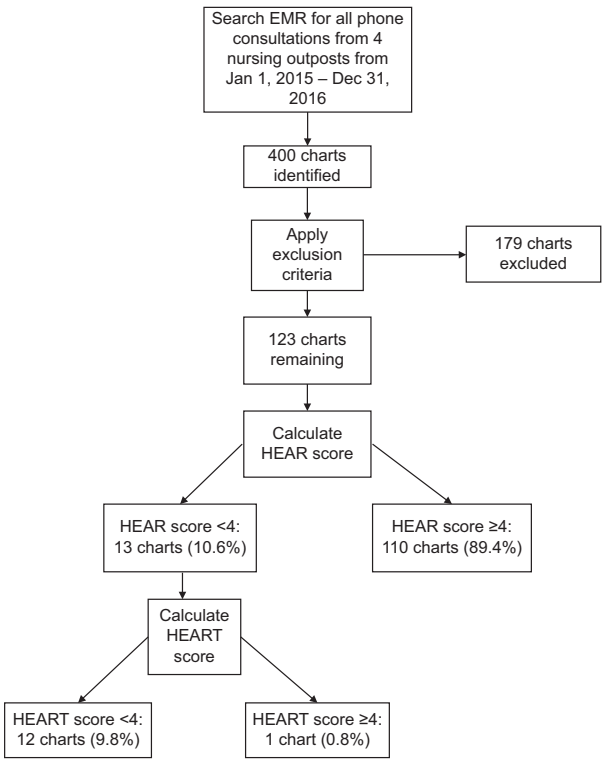

Figure 1: Results flow chart. Patients were excluded if they were less than 18 years old, were not evacuated from the outpost, had no troponin study performed, had no ECG on file, or if risk factor and demographic information was not available from the chart review

Based on our proposed decision-making model, in 89.4% of cases (110/123 events), patients would require evacuation regardless of the troponin values due to a HEAR score ≥4. In 10.6% of cases (13/123), the patients who were evacuated had a HEAR score ≤3, and in only 1 case did the troponin data increase this score (0.8% of cases). The relative contribution of each component of the HEART score for each patient included is presented in Table 1. All patients received at least 1 point for history, based on the inclusion criteria of patients presenting with chest pain concerning for ACS. The greatest contributors to the HEAR scores were history and risk factors; ECG changes contributed the least to HEAR scores [Table 1].

DISCUSSION

In this study, we used a HEAR score (a truncated HEART score which excluded the troponin) to mimic the clinical context in which evacuation decisions are made by physicians in our centre. In northern Saskatchewan, most patients present with chest pain to outpost nursing stations that have no access to troponin data and no on-site

Table 1: HEART score points assigned for each of 113 patients evacuated to LaRonge after presenting with chest pain to one of four nursing outpost stations in northern Saskatchewan

	History	ECG	Age	Risk Factors	Troponin
0 points assigned	0	86	6	3	116
1 points assigned	43	529	71	30	3
2 points assigned	80	8	46	90	4

physician. However, the nurses at these outposts are able to obtain a history and obtain an ECG, and this information is faxed to the La Ronge Health Centre to be read by the physician on call. We found that most patients presenting to four remote nursing outposts with chest pain suspicious for ACS would continue to be evacuated for further investigations and management regardless of their troponin result due to an already elevated HEAR score [Table 1].

Overall, our findings suggest that over the course of 5 years, only 12 of 123 patients could have potentially avoided evacuation with PoC troponin testing, and the addition of troponin to the HEAR score of these patients would have changed the management in only one individual.

While PoC troponin tests have gained popularity in recent decades, there is little evidence to suggest they result in improved clinical outcomes compared to traditional laboratory testing.[22,23] In addition, PoC testing is less sensitive and has a lower negative predictive value than high-sensitivity troponin testing, reducing its utility in ruling out ACSs.[24,25] In rural locations in Canada, there are also significant costs associated with PoC testing including costs associated with maintaining the equipment, training staff to use the equipment and maintaining quality standards.[22] These results lend further support to our results suggesting PoC troponin testing is unlikely to improve diagnostic accuracy and reduce the costs associated with the investigation of patients with chest pain.

Our results are in keeping with several recent studies assessing the utility of a modified HEART score, in which troponin is excluded, to risk-stratify patients presenting with undifferentiated chest pain. In a planned secondary analysis of the HEART pathway implementation study, Smith *et al.*[13] assessed the 30-day risk of MACEs in patients presenting

with chest pain based on their HEAR score only; their findings suggest that patients with a HEAR score of <2 are at very low risk for MACE, with only 0.9% of these patients suffering a MACE at 30 days. Moreover, the addition of troponin to the HEAR score re-classified only 2 of 447 patients with a HEAR score <2.[13] Similarly, in a retrospective analysis of patients with chest pain transported to hospital by emergency medical services, Stopyra *et al*.[26] found that a pre-hospital HEAR score had a 94.3% negative predictive value for MACE at 30 days, suggesting a modified HEAR score may be useful even in the pre-hospital setting.

In contrast to our results, in a prospective study comparing the risk of MACE in patients classified as low-risk based on a pre-hospital HEART score calculated using PoC troponin compared to HEAR score alone, van Dongen *et al*.[27] noted significantly fewer MACEs in patients stratified using HEART versus HEAR (3% vs. 7%). However, this could be due to the higher baseline prevalence of MACE and the inclusion of unstable angina in their definition of MACE. The conflicting results of our study, and the studies of Smith *et al.*[13] and Stopyra *et al.*[26] compared to van Dongen *et al.*,[27] highlight the need for prospective validation of a HEAR score pathway, especially in rural locations.

Limitations

Limitations of this study include the small sample size, single geographic location and retrospective design. During the study period, many physicians used exclusively paper records or no records at all, meaning most events recorded occurred after 2013 with the arrival of an electronic medical record. Moreover, the lack of a standard work process for encoding or billing may have left records or events outside the research parameters for this study. In addition, given the retrospective design of the study, it is possible the patients included were biased towards patients with high-risk chest pain, as sicker-appearing patients would presumably have been more likely to generate a phone call from a nurse to the health centre based on gestalt. However, in our experience, nursing stations tend to err on the side of caution in patients with chest pain, contacting the supervising physician for most cases of chest pain unless there is an obvious non-cardiac cause (i.e. chest trauma).

CONCLUSIONS

Overall, our results suggest that a truncated HEART score (i.e. HEAR score), in which the troponin measurement is excluded, may be a useful method of risk-stratifying patients with chest pain presenting to remote nursing stations with no access to laboratory data. These results have important implications for providing safe, quality care to patients in rural and remote locations, as evacuation is associated with significant financial and safety risks. Future research should focus on prospectively validating the use of a HEAR score in rural locations.

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Conflicts of interest: There are no conflicts of interest.

REFERENCES

1. Statistics Canada. Leading Causes of Death, Total Population; 2017. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310039401. [Last accessed on 2021 Jan 18].
2. Weinstock MB, Weingart S, Orth F, VanFossen D, Kaide C, Anderson J, *et al*. Risk for clinically relevant adverse cardiac events in patients with chest pain at hospital admission. JAMA Intern Med 2015;175:1207-12.
3. Hoorweg BB, Willemsen RT, Cleef LE, Boogaerts T, Buntinx F, Glatz JF, *et al*. Frequency of chest pain in primary care, diagnostic tests performed and final diagnoses. Heart 2017;103:1727-32.
4. Foy AJ, Liu G, Davidson WR Jr., Sciamanna C, Leslie DL. Comparative effectiveness of diagnostic testing strategies in emergency department patients with chest pain: An analysis of downstream testing, interventions, and outcomes. JAMA Intern Med 2015;175:428-36.
5. Ryan RJ, Lindsell CJ, Hollander JE, O'Neil B, Jackson R, Schreiber D, *et al*. A multicenter randomized controlled trial comparing central laboratory and point-of-care cardiac marker testing strategies: The disposition impacted by serial point of care markers in acute coronary syndromes (DISPO-ACS) trial. Ann Emerg Med 2009;53:321-8.
6. Huis In 't Veld MA, Cullen L, Mahler SA, Backus BE, Dezman ZD, Mattu A. The fast and the furious: Low-risk chest pain and the rapid rule-out protocol. West J Emerg Med 2017;18:474-8.
7. Gibbs J, deFilippi C, Peacock F, Mahler S, Nowak R,

Christenson R, *et al.* The utility of risk scores when evaluating for acute myocardial infarction using high-sensitivity cardiac troponin I. Am Heart J 2020;227:1-8.
8. Backus BE, Six AJ, Kelder JC, Bosschaert MA, Mast EG, Mosterd A, *et al.* A prospective validation of the HEART score for chest pain patients at the emergency department. Int J Cardiol 2013;168:2153-8.
9. Mahler SA, Riley RF, Hiestand BC, Russell GB, Hoekstra JW, Lefebvre CW, *et al.* The HEART pathway randomized trial: Identifying emergency department patients with acute chest pain for early discharge. Circ Cardiovasc Qual Outcomes 2015;8:195-203.
10. Six AJ, Backus BE, Kelder JC. Chest pain in the emergency room: Value of the HEART score. Neth Heart J 2008;16:191-6.
11. Spaeth BA, Kaambwa B, Shephard MD, Omond R. Economic evaluation of point-of-care testing in the remote primary health care setting of Australia's northern territory. Clinicoecon Outcomes Res 2018;10:269-77.
12. Kuehner ZC, Dmitriew MD, Wu LK, Shearing AD. The impact of the HEART score on the prevalence of cardiac testing and patient outcomes in a rural emergency department. Can J Rural Med 2020;25:105-11.
13. Smith LM, Ashburn NP, Snavely AC, Stopyra JP, Lenoir KM, Wells BJ, *et al.* Identification of very low-risk acute chest pain patients without troponin testing. Emerg Med J 2020;37:690-5.
14. Pickering JW, Young JM, George PM, Watson AS, Aldous SJ, Troughton RW, *et al.* Validity of a novel point-of-care troponin assay for single-test rule-out of acute myocardial infarction. JAMA Cardiol 2018;3:1108-12.
15. Sörensen NA, Neumann JT, Ojeda F, Giannitsis E, Spanuth E, Blankenberg S, *et al.* Diagnostic evaluation of a high-sensitivity troponin I point-of-care assay. Clin Chem 2019;65:1592-601.
16. Wilke P, Masuch A, Fahron O, Zylla S, Leipold T, Petersmann A. Diagnostic performance of point-of-care and central laboratory cardiac troponin assays in an emergency department. PLoS One 2017;12:e0188706.
17. Suzuki K, Komukai K, Nakata K, Kang R, Oi Y, Muto E, *et al.* The usefulness and limitations of point-of-care cardiac troponin measurement in the emergency department. Intern Med 2018;57:1673-80.
18. Rasmussen MB, Stengaard C, Sørensen JT, Riddervold IS, Hansen TM, Giebner M, *et al.* Predictive value of routine point-of-care cardiac troponin T measurement for prehospital diagnosis and risk-stratification in patients with suspected acute myocardial infarction. Eur Heart J Acute Cardiovasc Care 2019;8:299-308.
19. Schols AM, Stakenborg JP, Dinant GJ, Willemsen RT, Cals JW. Point-of-care testing in primary care patients with acute cardiopulmonary symptoms: A systematic review. Fam Pract 2018;35:4-12.
20. van Dongen DN, Fokkert MJ, Tolsma RT, van der Sluis A, Slingerland RJ, Badings EA, *et al.* Accuracy of pre-hospital HEART score risk classification using point of care versus high sensitive troponin in suspected NSTE-ACS. Am J Emerg Med 2020;38:1616-20.
21. Statistics Canada. Division No. 18, CDR [Census Division], Saskatchewan and Saskatchewan [Province] (Table). Census Profile. 2016 Census. Statistics Canada Catalogue No. 98-316-X2016001. Ottawa; Released November 29, 2017. Available from: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=FED&Code1=35078&Geo2=PR&Code2=35&SearchText=Ottawa--Vanier&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=35078&TABID=1&type=0. [Last accessed on 2021 Jan 18].
22. Ho C, Cimon K, Weeks L, Mierzwinski-Urban M, Dunfield L, Soril L, *et al.* Point-of-care troponin testing in patients with symptoms suggestive of acute coronary syndrome: Recommendations. Ottawa: CADTH; 2016 Mar. (CADTH optimal use report; 5(1c).
23. Florkowski C, Don-Wauchope A, Gimenez N, Rodriguez-Capote K, Wils J, Zemlin A. Point-of-care testing (POCT) and evidence-based laboratory medicine (EBLM) – Does it leverage any advantage in clinical decision making? Crit Rev Clin Lab Sci 2017;54:471-94.
24. Nilsson S, Andersson A, Janzon M, Karlsson JE, Levin LÅ. Cost consequences of point-of-care troponin T testing in a Swedish primary health care setting. Scand J Prim Health Care 2014;32:241-7.
25. Alghamdi AA, Body R. Best evidence topic reports: Prehospital cardiac troponin testing to "rule out" acute coronary syndromes using point of care assays. Emerg Med J 2018;35:572-4.
26. Stopyra JP, Harper WS, Higgins TJ, Prokesova JV, Winslow JE, Nelson RD, *et al.* Prehospital modified HEART score predictive of 30-day adverse cardiac events. Prehosp Disaster Med 2018;33:58-62.
27. van Dongen DN, Fokkert MJ, Tolsma RT, Badings EA, van der Sluis A, Slingerland RJ, *et al.* Value of prehospital troponin assessment in suspected non-ST-elevation acute coronary syndrome. Am J Cardiol 2018;122:1610-6.