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Cardiac troponin I use for diagnosing acute myocardial infarction in a small rural emergency department

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Objective: To audit the use of cardiac troponin I (cTnI) testing in a small rural emergency department (ED) in Newfoundland.

Methods: Data on administration and results of cTnI tests were collected during the ED visit. Other data relating to demographic factors, and other test results and the discharge outcome were collected by chart review.

Results: In the study period, 197 (2.1%) of 9238 ED registrations were for chest pain, and 10 of them had a discharge diagnosis of acute myocardial infarction (AMI). Cardiac troponin I testing was ordered for 50 patients, of whom 5 had an AMI, and the test was found to be positive in 2 of these. Troponin I tests were negative in all 45 patients who did not have an AMI diagnosis. Of the 50 cTnI tests, 42 were ordered within 4 hours to 7 days of symptom onset and 37 were ordered within the 6-hour to 7-day range.

Conclusions: In this low-prevalence setting, the cTnI test worked well if used within the appropriate time frame. The test proved useful in ruling out AMI but did not appear to provide significant additional information to that obtained from the electrocardiogram and clinical examination in confirming the diagnosis of AMI.

Objectif : Vérifier l'utilisation de la troponine I cardiaque (TnIc) dans un petit service d'urgence rural de Terre-Neuve.

Méthodes : On a recueilli des données sur l'administration et les résultats des tests à la TnIc pendant la visite effectuée au service d'urgence. Les autres données sur les aspects démographiques et d'autres résultats de tests, ainsi que sur le résultat du congé, proviennent d'une étude des dossiers.

Résultats : Au cours de la période d'étude, 197 (2,1 %) des 9238 patients inscrits à l'urgence se sont plaints de douleur à la poitrine et, au moment du congé, on avait diagnostiqué un infarctus aigu du myocarde (IAM) chez 10 d'entre eux. Le test à la troponine I cardiaque a été prescrit pour 50 patients, dont cinq avaient subi un IAM. Le test a donné des résultats positifs dans deux de ces cas. Les tests à la troponine I ont donné un résultat négatif chez les 45 patients chez lesquels on n'a pas diagnostiqué d'IAM. Sur les 50 tests à la TnIc, 42 ont été prescrits dans les quatre heures à sept jours suivant l'apparition des symptômes et 37, dans les six heures à sept jours.

Conclusions : Dans ce contexte de faible prévalence, le test à la TnIc a donné de bons résultats lorsqu'on l'a utilisé dans le délai approprié. Il s'est révélé utile pour exclure l'IAM, mais il n'a pas semblé produire plus de renseignements supplémentaires que ceux que fournissent l'électrocardiogramme et l'examen clinique pour confirmer le diagnostic d'IAM.

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Introduction

Ruling out acute coronary syndromes is often a challenge for emergency department (ED) physicians. Diagnostic strategies are based on clinical symptoms, electrocardiographic changes and serial creatine kinase/creatine kinase-MB measures. The current "gold standard" for the diagnosis of acute myocardial infarction (AMI), namely the electrocardiogram (ECG), is not without its problems, as 50% of all patients complaining of chest pains suggestive of AMI have a nondiagnostic ECG.1 Furthermore, only 15% of patients presenting with chest pains actually have an AMI.2 The cardiac enzyme tests that are currently used become reliably accurate in 1 to 6 hours after an AMI3 but are not cardiac specific, and in many small rural sites, like ours, the laboratory does not do these tests. An accurate point-of-care test that quickly detects myocardial damage would be most useful in such a setting.

Troponins are proteins found in cardiac and skeletal muscle. Cardiac troponin I (cTnI) is a sensitive biochemical marker of high cardiac specificity because of its unique expression in myocardial tissue. It is released 4 to 6 hours after myocardial damage; readings return to normal after 6 to 7 days.4 The sensitivity of the rapid cTnI test for myocardial damage has been reported to be 96% or greater, with specificities of 83% or greater when the test is given 6 to 12 hours after onset of symptoms.5–8

Although the use of rapid cTnI testing in the ED has been widely reported, the studies were either large controlled trials or studies of patients in large urban EDs.

The purpose of this study was to audit the use of the cTnI test in a small rural ED:

- to assess if the test was useful in either ruling out or ruling in AMI compared to ECG, clinical examination and medical history; and
- to assess if the test was being used appropriately, based on the time from onset of symptoms.

Methods

Setting

The study was carried out in a small community health centre in rural Newfoundland. In addition to 5 permanent physicians, family practice residents and short-term locums work in the ED.

Subjects

Fifty consecutive patients presented to the ED during 1999 who underwent cTnI testing. Use of the test was always at the discretion of the attending physician.

The test

The Spectral Diagnostics Cardiac STATusTM (Spectral Diagnostics, Toronto) test was used. This test uses whole blood, plasma or serum and consists of a colour-labelled antibody and a different biotenylated capture antibody forming a sandwich complex with cTnI adhering to streptavidin in a signal zone. Enrichment of colour-labelled antibodies binding to cTnI (discriminator 0.10 ng/mL) results in a colour line within 15 minutes. This is a qualitative test, which is either positive or negative.

Other data

The date, time of the cTnI test and test result were recorded during the emergency visit. Other data, including sex, age, history of myocardial infarction, symptoms, ischemic changes noted on the ECG, result of clinical examination, arrival time, time of symptom onset and final diagnosis, were collected later using a chart audit. The total number of ED registrations during the study period, the total number of patients presenting to the ED with chest pain and the total number of myocardial infarctions were determined from the medical database.

Results

During the study period 197 (2%) of 9238 people presenting to the ED had a complaint of chest pain. Ten (5%) of the 197 had a discharge diagnosis of AMI. Five AMIs were diagnosed without the use of the cTnI test because the physician felt able to make a clear diagnosis without the aid of the test; these patients were not part of the cTnl sample.

The cTnI test was ordered for 50 (29 males) of the 197 people. Their average age was 63.3 years, and 58% had a history of heart disease. Twenty-nine had a primary complaint of chest pain. Of 5 patients who were diagnosed with myocardial infarction (Fig. 1), 3 had chest pain as a primary complaint; the others had chest pain, but complained primarily of "shortness of breath" and "flu." The final diagnosis for the 50 patients is shown in Table 1.

Of the 5 patients having a diagnosis of AMI in the cTnI-tested group, the ECG showed obvious ischemic changes in 4 patients. Cardiac troponin I was positive in only 2 of these 5 patients (Fig. 1). In the fifth patient, whose diagnosis was initially unclear, the cTnI test was negative. Thus, for the 5 AMI cases in the cTnI-tested group sensitivity was 40% (Table 2a and Table 3) and the positive predictive value was 100% (i.e., there were no false-positives among tested patients).

In the 45 cTnI-tested patients who did not have a diagnosis of AMI, the cTnI was negative (specificity 100%). The negative predictive value of the test was 93.8% (Tables 2a and 3). In one instance where the ECG was questionable the negative test supported the ruling out of an AMI.

If 4 hours to 7 days from onset of symptoms is used as an appropriate time frame for test use, the cTnI test was used appropriately with respect to time in 42 of 50 cases. On the basis of this time frame, sensitivity is now 50% and specificity and positive predictive value remain at 100%, while negative predictive value increases to 95% (Table 2b and Table 3).

In the 5 patients with a diagnosis of AMI the cTnI test was done at 1.5 hours in 1 patient (and was negative), between 4 to 6 hours in 2 patients (negative in both instances) and after 6 hours in 2 patients (both positive).

If a 6-hour to 7-day time frame is used, the total number of appropriate cTnI tests becomes 37. Sensitivity, specificity, and positive and negative prediction values are now all at 100% (Table 2c and Table 3).

Discussion

The proportion of patients with chest pain in this sample who were subsequently found to have an AMI (5%) was lower than the proportion typically seen in larger hospitals.2 Five of these 10 underwent cTnI testing. Only 2 out of the 50 cTnI tests that were ordered were positive, but as AMI can occur without classic chest pain the frequency of use in this study is arguably appropriate.

There appeared to be a fairly high rate of inappropriate use related to the timing of the cTnI test, as 8 tests (16%) were carried out in less than 4 hours, and 13 tests (26%) in less than 6 hours after the onset of symptoms. Proper training about the time restrictions of the test is important if the test is to be used appropriately.

Even with our small sample, a difference was seen in the effectiveness of the test as the time from the onset of symptoms increased. When blood was drawn within 4 hours of symptom onset test sensitivity was low (50%). If a 6-hour cutoff was used sensitivity doubled to 100%; the longer time resulted in the elimination of false-negative tests. Specificity remained constant at 100% at all cutoff times. This is comparable to the results of other studies.5–9

A negative cTnI test did help rule out AMI in 1 patient when the ECG appeared to indicate AMI and in the 45 patients who were discharged with other diagnoses.

Limitations of the study

The study was largely a retrospective chart audit and carries with it all of the limitations and problems of such a study. There were no set criteria for interpretation of the ECG by physicians, for ordering of cTnI tests or for criteria to determine a discharge diagnois of AMI. These were left to the discretion of the attending physician. As the study was a snapshot of activity over 1 year in a low prevalence setting, numbers are small and the validity of statistical analysis may be limited.

Recommendations for clinical practice

The physicians involved in the study believed the test was of use in making the decision about which patients it was safe to discharge home and which to detain in the ED. Overall, however, cTnI, as used by the doctors in this clinic, did not provide additional diagnostic information over and above clinical examination and the ECG. It was not useful in ruling in AMI because the test was never positive when clinical examination or the ECG did not show evidence of myocardial infarction. We recommend that if cTnI is to be used in the ED, physicians must be trained in appropriate use of the test. Physicians should, as far as possible, determine precisely the time of onset of chest pain or other indicative symptoms and wait at least 6 hours before drawing blood

from the patient to perform the test. Physicians should be aware that early testing adversely affects the performance of the test.

Competing interests: None declared.

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