

# Presenting characteristics of patients undergoing cardiac troponin measurements in the emergency department

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## ABSTRACT

**Introduction:** Not all patients with suspected acute coronary syndrome (ACS) receiving cardiac troponin (cTn) testing present to the emergency department (ED) with cardiac chest pain. Since elderly patients (age  $\geq 70$ ) have increased morbidity and mortality associated with ACS, complaints other than cardiac chest pain may justify cTn testing. Our primary objective was to characterize the population of ED patients who receive cTn testing. The secondary objective was to determine if elderly patients underwent cTn testing for different presenting complaints than their younger counterparts.

**Methods:** We created an electronic database including Canadian Emergency Department Information Systems (CEDIS) presenting complaints, age, sex, disposition, and Canadian Triage Acuity Scale (CTAS) score, for patients who received cTn testing in three Canadian EDs during 2011. We analyzed the data for patient characteristics and sorted by age ( $< 70$  and  $\geq 70$ ) for further analysis.

**Results:** In the 15,824 included patients, the average age was 66 (51%  $< 70$ ; 51% female). The most common presenting complaints were cardiac chest pain ( $n = 3,267$ ) and shortness of breath ( $n = 2,266$ ). The elderly underwent cTn testing for significantly ( $p < 0.0001$ ) different complaints than their younger counterparts. They more commonly presented with generalized weakness ( $n = 898$ ), whereas younger patients more frequently had abdominal pain ( $n = 576$ ).

**Conclusions:** Cardiac chest pain and shortness of breath are presenting complaints in one-third of patients undergoing ED cTn testing. The majority of patients undergoing cTn testing did not have typical ACS symptoms. Half of all cTn testing in the ED is on the elderly, who present with different complaints than their younger counterparts.

## RÉSUMÉ

**Introduction:** Les patients souffrant d'un syndrome coronarien aigu (SCA) présumé et soumis à un dosage de la

troponine cardiaque (TC) ne présentent pas tous une douleur thoracique cardiaque au service des urgences (SU). Comme les personnes âgées (âge  $\geq 70$  ans) connaissent une morbidité et une mortalité accrues, associées au SCA, la présence de symptômes différents de la douleur thoracique cardiaque peut justifier le dosage de la TC. L'étude avait pour objectif principal de caractériser la population soumise au dosage de la TC au SU. L'objectif secondaire visait à déterminer si les personnes âgées étaient soumises au dosage de la TC pour des motifs de consultation différents de ceux notés chez leurs homologues plus jeunes.

**Méthode:** Nous avons constitué une base de données comprenant les motifs de consultation selon les systèmes canadiens d'information des urgences, l'âge, le sexe, les suites à donner, et les résultats sur l'Échelle canadienne de triage et de gravité et concernant des patients soumis au dosage de la TC dans trois SU, au Canada, en 2011. Il y a eu analyse des données sur les caractéristiques des patients, puis répartition selon l'âge ( $< 70$  ans et  $\geq 70$ ) en vue d'une analyse approfondie.

**Résultats:** L'âge moyen, parmi les 15,824 patients retenus, était de 66 ans ( $< 70$  ans: 51%; femmes: 51%). Les motifs de consultation les plus fréquents étaient une douleur thoracique cardiaque ( $n = 3,267$ ) et l'essoufflement ( $n = 2,266$ ). Les personnes âgées ont été soumises à un dosage de la TC pour des motifs de consultation sensiblement différents ( $p < 0.0001$ ) de ceux notés chez leurs homologues plus jeunes. Le premier groupe présentait davantage une faiblesse généralisée ( $n = 898$ ), tandis que le second présentait plus souvent une douleur abdominale ( $n = 576$ ).

**Conclusions:** La douleur thoracique cardiaque et l'essoufflement sont les motifs de consultation qui justifient un dosage de la TC, au SU, chez un tiers des patients concernés. La majorité des patients soumis au dosage de la TC ne présentent pas les symptômes caractéristiques du SCA. La moitié des dosages de la TC effectués au SU l'est chez des personnes âgées, qui consultent pour des motifs différents de ceux observés chez leurs homologues plus jeunes.

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Acute coronary syndrome (ACS) represents a spectrum of myocardial ischemia ranging from ST elevation myocardial infarction (STEMI) to non-STEMI (NSTEMI) and unstable angina (UA). NSTEMI and UA are typically associated with myocardial ischemia but are distinguished by the former also having myocardial necrosis as defined by elevated cardiac troponin (cTn). They are often clinically indistinguishable because of the similarity in symptoms and transient or nonspecific electrocardiographic (ECG) findings of ischemia at presentation. Patients with suspected ACS classically present to the emergency department (ED) with chest pain but can also present with other primary complaints, thereby adding to the diagnostic challenge.

cTn is a biomarker of myocardial injury. In 2000, the European Society of Cardiology and the American College of Cardiology (ESC/ACC) jointly redefined myocardial necrosis to incorporate cTn assays as a diagnostic determinant.<sup>1</sup> In 2007, the ESC/ACC/American Heart Association (AHA) updated the definition of myocardial infarction (MI) and advocated a “rise and/or fall” of cTn over a 6- to 9-hour time period using the 99th percentile in a reference population as the cutoff for classifying an acute and evolving MI.<sup>2</sup> The definition of MI was again updated in 2012 and remains that, in patients with suspected MI but without ECG STEMI criteria, the cTn level is the discriminating criterion between NSTEMI and UA.<sup>3</sup> Both NSTEMI and UA represent cardiac ischemia and risk of death and warrant hospital admission and treatment.<sup>4</sup>

Although cTn testing can be used to rule in or rule out MI, confirming ACS is more difficult because of the absence of positive test findings associated with UA.<sup>1</sup> It has been proposed that ACS can be ruled out in low-risk patients with a cTn concentration within the reference interval and a normal stress test done in the ED, or within 72 hours of discharge.<sup>5</sup> Clinical decision rules have been created for this purpose.<sup>6,7</sup> In the presence of ACS symptoms, an elevated cTn concentration can confirm the diagnosis of ACS.

Because not all patients with ACS present with the typical ACS symptom of chest pain, cTn measurements are likely conducted on patients presenting with symptoms other than those of ACS. Our *MEDLINE* literature search using the key terms “troponin,”

“acute coronary syndrome/ACS,” “cardiac markers,” “risk stratification,” “demographics/demography,” and “characteristics” revealed no previously published studies describing the population of patients undergoing cTn testing in the ED. The primary objective of this study was to characterize the population of all ED patients in a single city who undergo cTn testing. We hypothesized that since older patients ( $\geq 70$  years of age) have a higher prevalence of coronary artery disease, a higher morbidity and mortality associated with ACS,<sup>8</sup> and more atypical presentations,<sup>9</sup> they may have cTn ordered more frequently for different presenting complaints than their younger counterparts.

## **METHODS**

After receiving research ethics board approval, we created an encrypted and password-protected electronic database hosted on a secure server. The database contained the descriptive data for each patient who underwent cTn testing at any of three EDs in a Canadian city with two separate hospital systems during the entire 2011 calendar year. We recorded patient age, sex, disposition from the ED, Canadian Emergency Department Triage and Acuity Scale (CTAS)<sup>10</sup> score, and the Canadian Emergency Department Information Systems (CEDIS, v1.1.1) presenting complaint, a standardized list of presenting patient complaints to Canadian EDs.<sup>11</sup> The CTAS score is a standardized method of recording a patient’s acuity and timely need to receive medical care.<sup>10</sup> For those patients visiting an ED more than once in 2011, we included only the first ED visit in the final database and deleted incomplete or missing records.

Using IBM *SPSS Statistics* software version 20 (IBM, Armonk, NY), we summarized the demographic data and measured the frequency of CEDIS complaints of all patients who underwent cTn testing. We then compared the frequency of cTn testing for each of the 10 most common overall presenting complaints between the two age groups using chi-square analysis and 0.05 as the level of significance.

## **RESULTS**

After deletion of 220 incomplete records, 15,824 index ED visits in 2011 for cTn testing remained. The average age of patients undergoing cTn testing was 66 years (SD 17.8 years), of whom 51% were  $< 70$  years

old and 51% were female (Table 1). The most common CTAS score was CTAS 3 or “urgent,” which represented 47% of patient visits. Over half of all visits resulted in a hospital admission (57%). Overall, the most common CEDIS complaints were cardiac chest pain ( $n = 3,280$ ), shortness of breath ( $n = 2,275$ ), and generalized weakness ( $n = 1,225$ ) (Table 2, Figure 1). There was a significant difference in presenting complaints between the two age groups for which cTn testing was ordered (see Figure 1). In the  $< 70$  age group, the most common CEDIS complaints were cardiac chest pain ( $n = 2,082$ ), shortness of breath ( $n = 866$ ), abdominal pain ( $n = 576$ ), and noncardiac chest pain ( $n = 510$ ), whereas in the  $\geq 70$  age group, they were shortness of breath ( $n = 1,400$ ), cardiac chest pain ( $n = 1,185$ ), generalized weakness ( $n = 898$ ), and abdominal pain ( $n = 415$ ) (see Figure 1).

**DISCUSSION**

The results of this study illustrated that the majority of patients undergoing cTn testing had a CEDIS presenting complaint other than cardiac chest pain. This presenting complaint was seen even less frequently in the elderly population, who represent half of all ED patients receiving cTn testing. The results confirmed our hypothesis that elderly ED patients (age  $\geq 70$ ) receive cTn testing for different presenting complaints than their younger counterparts. Generalized weakness differentiated the elderly as

**Table 1. Patient demographics**

|                         | <i>n</i> (%) |
|-------------------------|--------------|
| Number of patients      | 15,824       |
| Average age, yr         | 66.56        |
| Male                    | 7,746 (49)   |
| Female                  | 8,078 (51)   |
| Patients age $< 70$     | 7,991        |
| Patients age $\geq 70$  | 7,833        |
| Disposition             |              |
| Admitted                | 9,045        |
| Home                    | 6,327        |
| Other (death, transfer) | 452          |
| CTAS                    |              |
| 1 (resuscitation)       | 1,352        |
| 2 (emergent)            | 6,448        |
| 3 (urgent)              | 7,463        |
| 4 (less urgent)         | 535          |
| 5 (not urgent)          | 26           |

CTAS = Canadian Triage and Acuity Scale.

**Table 2. CEDIS complaints listed (0.8% frequency or greater)**

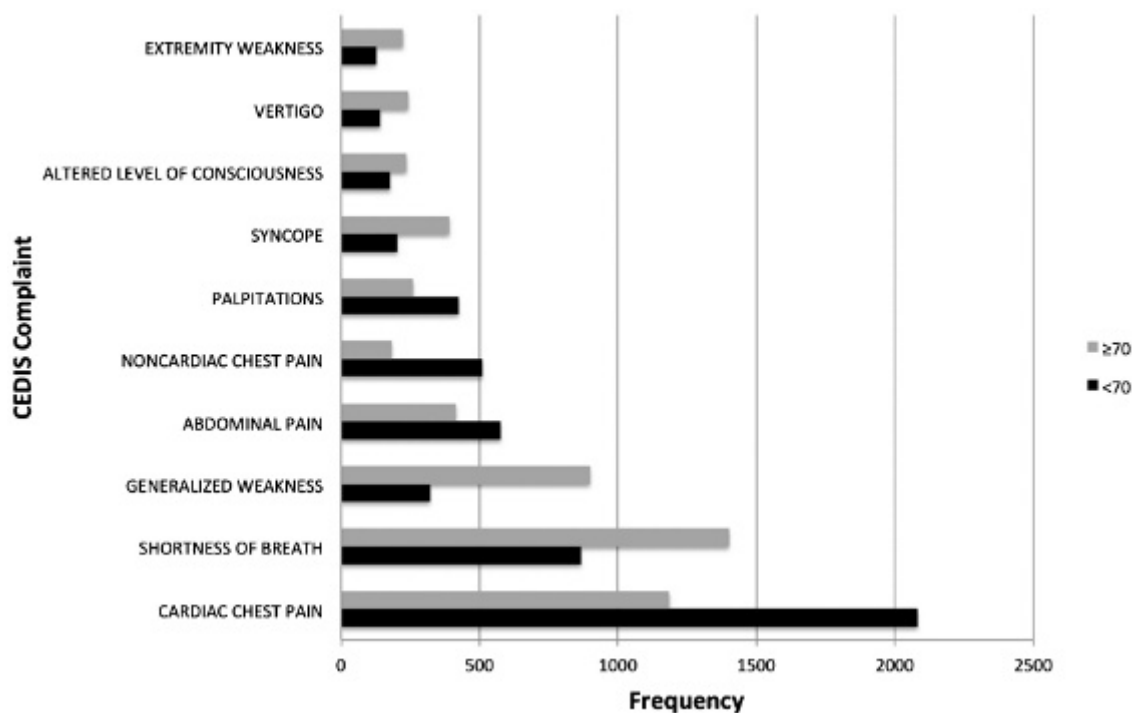
| CEDIS complaint                          | Frequency | %    |
|--|-----------|------|
| Cardiac chest pain                       | 3,267     | 20.6 |
| Shortness of breath                      | 2,266     | 14.3 |
| Generalized weakness                     | 1,218     | 7.7  |
| Abdominal pain                           | 991       | 6.3  |
| Noncardiac chest pain                    | 692       | 4.4  |
| Palpitations                             | 684       | 4.3  |
| Syncope                                  | 594       | 3.8  |
| Altered level of consciousness           | 413       | 2.6  |
| Vertigo                                  | 383       | 2.4  |
| Extremity weakness                       | 350       | 2.2  |
| Head injury                              | 344       | 2.2  |
| Vomiting and/or nausea                   | 331       | 2.1  |
| Confusion                                | 298       | 1.9  |
| Major blunt trauma                       | 262       | 1.7  |
| Fever                                    | 248       | 1.6  |
| Lower extremity pain                     | 219       | 1.4  |
| Lower extremity injury                   | 195       | 1.2  |
| Hypertension                             | 176       | 1.1  |
| Seizure                                  | 175       | 1.1  |
| Back pain                                | 157       | 1.0  |
| Blood in stool                           | 136       | 0.9  |
| Minor complaints not otherwise specified | 128       | 0.8  |
| Headache                                 | 127       | 0.8  |
| Upper extremity pain                     | 127       | 0.8  |

CEDIS = Canadian Emergency Department Information Systems.

approximately 75% of patients who received cTn testing for generalized weakness were elderly.

The presenting complaint of each patient is a CEDIS categorization of what the triage nurse believed to be a patient’s chief presenting complaint. Even though many patients undergoing cTn testing have a CEDIS presenting complaint other than cardiac chest pain, this does not preclude the presence of chest pain along with the patients’ listed CEDIS complaint. The high proportion of patients in this study with a presenting complaint other than cardiac chest pain increases the likelihood that many did not have any chest pain at all.

These findings raise some interesting questions. Do patients without ACS symptoms have a similar proportion of elevated cTn levels? Are patients without any ACS symptoms or ischemic ECG changes managed differently? As high sensitivity cTn assays are introduced to more EDs and more patients are found with elevated cTn levels, these and other questions about the diagnostic utility of cTn testing in the ED will become more pertinent.



**Figure 1.** Ten most common overall Canadian Emergency Department Information Systems (CEDIS) complaints versus age. \* $\chi^2$   $p$  value < 0.05.

### LIMITATIONS

The results of this study may have been limited by the arbitrary cutoff of 70 years of age for the elderly and could have yielded different results with a different cutoff value. The ACS literature has not standardized an age cutoff for the “elderly” patient. Previous literature used 65 years as the cutoff,<sup>12</sup> whereas newer population-based data may be trending toward increasing the cutoff to 75 or 80 years of age in line with the aging population.<sup>13</sup> Present population-based studies<sup>14,15</sup> and chest pain diagnostic studies<sup>16</sup> have demonstrated significant differences in concentrations of cTn measured by high-sensitivity assays between the young and elderly. Those > 70 years have higher cTn concentrations. This study used 70 years of age as a cutoff as a compromise among previous literature, new trends, and the aging population. Although the CEDIS complaint represents the triage nurse’s impression of the primary presenting complaint of a patient, it does not take into account the many other complaints a patient may have, which may be due to the same pathology as their main complaint. The study data were collected from three EDs of two hospital systems in a single Canadian city, and medical practice may be similar among these emergency physicians despite

their different hospital affiliations and not represent available ordering patterns. It is highly unlikely that all of the patients and emergency physicians are significantly different in presentation and practice, respectively, than their counterparts in other Canadian cities. These findings need to be validated in other settings.

### CONCLUSIONS

cTn testing is an important component in the workup for suspected ACS. Cardiac chest pain and shortness of breath are typical ACS complaints<sup>1</sup> and the most common presenting complaints of patients undergoing cTn testing in the ED. They only represent one-third of all presenting complaints, which means that a majority of cTn testing is on patients with atypical ACS symptoms. Half of all cTn testing in the ED is on the elderly, who present with significantly different chief complaints than their younger counterparts.

**Competing interests:** None declared.

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