Does mode of arrival to the emergency department influence door-to-electrocardiogram or door-to-troponin times?

ABSTRACT:

Background: The morbidity and mortality of acute myocardial infarction (AMI) is dependent upon time to diagnosis and treatment. Delays to early diagnosis in the emergency department (ED) can have important clinical impact. We sought to determine whether ED patients with chest pain who arrived by self-transport to a Hamilton emergency department experienced a significant delay in door-to-electrocardiogram (DTE) and door-to-troponin (DTT) times compared to patients with chest pain that arrived by emergency medical services (EMS).

Methods: We randomly selected 1,000 charts from the over 13,000 visits with “cardiac chest pain” as the chief complaint at two EDs in the city of Hamilton in 2013. We divided these patients into two groups: those arriving by EMS and those arriving by self-transport. We then compared these two groups with respect to mean sex, age, DTE and DTT times.

Results: The self-transport group had a significantly longer door-to-troponin time (mean 4260 seconds) than the group that arrived via EMS (mean 3000 seconds) (p<0.001) and both groups had comparable DTE times. The nationally recommended benchmark was met for DTT time for the group that arrived via EMS, but not for the self-transport group. Recommended benchmarks for DTE times were not met, regardless of mode of arrival.

Conclusion: There was a significant difference in mean DTT times between patients who arrived to the ED via self-transport, versus patients who arrived via EMS. This study also revealed that the two EDs studied were not meeting the recommended benchmark times of ten minute DTE time.

INTRODUCTION

Acute myocardial infarction (AMI) contributes significantly to adult morbidity and mortality. Both increase with delays to definitive treatment such as percutaneous coronary intervention (PCI) and thrombolysis. The catch-phrase “time is muscle” expresses the impact of expediency upon limiting myocardial injury, and benchmarks for door-to-balloon (PCI) and door-to-needle time (thrombolysis) have been set at 90 and 30 minutes respectively. Diagnosis of AMI is an independent precursor to definitive treatment and, in patients with ischemic cardiac symptoms, can be made with electrocardiographic (ECG) findings alone. Door-to-ECG time (DTE) has become a benchmark for assessing quality of emergency department (ED) care for patients who present with chest pain as prolonged DTE times are associated with increased adverse outcomes in AMI patients. To that end, the American Heart Association (AHA) and the American College of Cardiology (ACC) recommend a DTE time of less than ten minutes. Similarly, in patients with ischemic cardiac symptoms, cardiac troponin (cTn) levels alone can be diagnostic for unstable...
angina/non ST-elevation myocardial infarction\textsuperscript{14,16}. The AHA and ACC both recommend an initial door-to-troponin (DTT) results time of 30-60 minutes or less\textsuperscript{14}. Just as the door-to-balloon and door-to-needle times are dependent upon the DTE and DTT results time\textsuperscript{17}, the latter might also be affected by precursor variables. The door-to-needle or door-to-balloon time has been shown to be significantly shorter for AMI patients arriving by emergency medical services (EMS) than those arriving by self-transport\textsuperscript{18,19}. Hence, mode of arrival to the ED has the potential to affect DTT and DTE times. Because the 50-60% of patients with chest pain arriving via EMS do not necessarily undergo the same ED entry processes as those arriving via self-transport, they are less likely to experience DTE delays\textsuperscript{20,21}. It is not known whether mode of transportation affects DTT similarly. Therefore, the primary objective of this study is to determine if patients presenting to the ED with cardiac chest pain experience differences in DTE and DTT times depending on mode of arrival.

METHODS

Data Collection

After receiving approval from the research ethics board, we created a password protected, encrypted database of all ED visits in the 2013 calendar year to two EDs in a Canadian city (Hamilton, ON). Our inclusion criteria were: adults ($\geq 18$ years old) and presenting with a Canadian Emergency Department Information Systems (CEDIS) standardized presenting complaint of chest pain with cardiac features. We then used a computer-generated random number generator to select 1000 charts for review. Two trained data abstractors independently conducted the chart reviews and data collection using a protocol and procedure manual in the same session. An initial sample batch of 100 chart reviews was checked for consistency by a third researcher to ensure compliance and agreement but was not included in the study collection of 1000 charts.

From the 1000 charts, researchers manually collected descriptive data for each subject: ED site, age, mode of arrival, DTE time, DTT time, sex, and Canadian Triage Acuity Scale (CTAS) score. The DTE and DTT times used the time of patient registration (triage) as the ‘door’ time as this was the time of first contact with the hospital and was recorded electronically. It was therefore taken as a consistent and accurate record of arrival time\textsuperscript{22}. The DTE time was the time recorded on the patients’ first ECG, and the DTT time used was the sample collection time recorded by nursing staff.

Data Analysis

We compared the two groups, arrival by EMS and arrival by self-transport, with respect to mean sex, age, DTE and DTT times. We compared the proportion of males and females using the Chi Square Test. We tested age, DTE time and DTT time for normality by the Shapiro-Wilk Test and assessed the differences in median rank of age, DTE and DTT times between groups with the Mann Whitney U Test. We conducted all analyses using SPSS (SPSS Inc. Version 18, Chicago, IL).

Table 1.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Self-Transport</th>
<th>EMS</th>
<th>Difference in Medians</th>
<th>95% Confidence Interval</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>58</td>
<td>65</td>
<td>7</td>
<td>3.86, 10.14</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 2.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Self-Transport</th>
<th>EMS</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>345 (53.2%)</td>
<td>176 (50.0%)</td>
<td>0.327</td>
</tr>
<tr>
<td>Female</td>
<td>303 (46.8%)</td>
<td>176 (50.0%)</td>
<td></td>
</tr>
</tbody>
</table>

Note: $\chi^2 = 0.96, df = 1$.

Table 3.

<table>
<thead>
<tr>
<th>Median Door To Troponin Draw and ECG Completion Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Transport</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Door to Troponin Time (DTT)</td>
</tr>
<tr>
<td>Door to ECG Time (DTE)</td>
</tr>
</tbody>
</table>
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RESULTS

Of the 1000 patients included in the study, 648 arrived by self-transport and 352 of arrived via EMS. On average, the self-transport group was significantly younger (58.8 years versus 65.1 years; p<0.001) but the two groups were not significantly different in terms of sex (Tables 1 and 2). The self-transport group had a significantly longer median DTT time of 4260 seconds (71 minutes) than the group that arrived via EMS of 3000 seconds (50 minutes) (p<0.001), and the two groups had comparable DTE times (Table 3).

DISCUSSION

Minimizing door-to-ECG and door-to-troponin times is integral to decreasing the time it takes for patients with AMI to reach myocardium-saving interventions such as PCI. Importantly, this study revealed that the door-to-troponin collection time took significantly longer for patients who arrived by self-transport to the ED than for patients who arrived by EMS. Our study was not designed to determine if this 21-minute difference in DTT was clinical significant, and future studies should address this question. Although there was no significant difference in DTE times between the two modes of arrival, both were more than double the ten-minute DTE benchmark. These findings demonstrate that room for improvement exists in our two EDs to not only reduce DTT time for self-transport patients, but to reduce DTE and DTT times for all patients, regardless of mode of arrival. Since previous studies have shown that patients who arrive by EMS do not have a significantly higher rate of AMI compared with patients arriving via self-transport, equal urgency and consideration must be given to patients with chest pain, regardless of method of arrival.

Evidence shows that simple, directed changes in the ED can change DTE and DTT times and ultimately, door-to-balloon or door-to-needle times. Other centres have shown that removing the registration and triage processes for chest pain presenters was shown to help increase the number of patients who met door to ECG benchmark times of less than ten minutes from 16% to 62% and subsequently increased the number of patients who met the door to balloon time goal of 90 minutes. Similarly, moving an ECG machine and dedicated ECG technician to the walk-in triage area has reduced both DTE and door to balloon times. A physician in triage has also been shown to reduce door-to-troponin times. The same can be done for cTn draws, with the same ECG technician being responsible for drawing a cTn and sending it to the lab immediately. Along with this measure, a chief-complaint based “cardiac focused” triage system can be initiated. In this system, patients who have chest pain bypass regular registration and triage, and go straight to a separate area, where an ECG and cTn blood draw are conducted immediately. This could be helpful for self-transport patients to minimize time spent triaging and registering patients that may not always be an issue for an EMS patient.

An important first step in reducing the disparity in DTT times between EMS and self-transport patients would be identifying reasons why EMS patients had a shorter door to cTn time than self-transport patients. Possibilities include the fact that patients arriving by EMS might be seen in a separate, less busy triage area than self-transport patients, making it easier for cTn to be drawn right away; or because they have EMS personnel to advocate on their behalf and relay the seriousness of their condition. The data collected in this study can be used by our two Hamilton EDs to examine their assessment protocols for patients presenting with chest pain with cardiac features.

Limitations in this study include those inherent in any medical record review study. All efforts were made to minimize those weaknesses, such as audits of data collection to ensure inter-rater reliability. The charts used for data collection were chosen from a large pool, and selection was completely random. However, since charts were reviewed and data entered manually, the potential for human error exists. Data abstractors were also not blinded to the outcome of the study. In this study, although benchmarks for DTT time refer to the time it takes to obtain results, DTT time was measured in terms of “collection time” rather than “result time”, since the authors did not have access to reliably recorded data that indicated when results of cTns were viewed. Additionally, we did not measure door-to-intervention time or record any patient outcomes - we believe that the examination of these metrics would be an excellent next step for future studies.

CONCLUSION

Patients who arrived at the ED via EMS had significantly lower door-to-troponin times than patients who arrived via self-transport. The two Hamilton EDs assessed in this study did not meet the recommended benchmark of ten-minute DTE time. These results can be used by these EDs to examine their approach to patients with chest pain and consider the implementation of strategies to reduce these times.

References

7. Cervellin, G. Chest pain and highly-sensitive troponin testing. The perspective


