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Risk of revisits to the emergency department in admitted versus discharged patients with chest pain but without myocardial infarction in relation to high-sensitivity cardiac troponin T levels

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ABSTRACT

Background: Recent studies have indicated that it may be safe to discharge chest pain patients with an initial high-sensitivity cardiac troponin T (hs-cTnT) level of <5 ng/L from the emergency department (ED) without further evaluation. We sought to assess the effects of discharge from the ED versus admission to hospital on downstream resource utilisation in low-risk chest pain patients.
Methods: We included all patients who sought medical attention for chest pain during 2 years at the Karolinska University Hospital and who had no myocardial infarction (MI). Adjusted hazard ratios (HRs) were calculated for revisits to the ED, revisits leading to hospitalisation, coronary angiography, or revascularisation during follow-up for admitted compared with discharged patients.
Results: 13,046 patients were included, of whom 7694 (59%) had at least one revisit to the ED during a mean of 516 days' follow-up. Admitted patients with hs-cTnT levels of <5 ng/L were 12% more likely to return to the ED during follow-up (HR 1.12, 95% confidence interval (CI) 1.04 to 1.20), and 24% more likely to return to the ED within 30 days (HR 1.24, CI 1.05 to 1.46) than patients who were discharged. The risk of revisit leading to hospitalisation was almost doubled, and the likelihood of undergoing coronary angiography or revascularisation was three-fold in admitted compared with discharged patients.
Conclusions: Increased risks of revisit to the ED, hospitalisation, coronary angiography, and revascularisation were observed when patients with chest pain and hs-cTnT levels of <5 ng/L were admitted instead of discharged home.

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1. Introduction

Each year, 15–20 million people in Europe and the United States seek medical attention because of chest pain, making it the second most common reason for visits to the emergency department (ED) [1,2]. Chest pain may be a symptom of an acute coronary syndrome, but only 15–20% of patients admitted for chest pain are ultimately diagnosed with myocardial infarction (MI) [3]. Uncertainty regarding symptoms and outcome in patients with a principal complaint of chest pain may contribute to overcrowding of EDs and lead to unnecessary hospital stays.

The recent introduction of high-sensitivity cardiac troponin assays has allowed the detection of much lower concentrations of troponins in the blood compared with previous generations of troponin assays [4,5]. Furthermore, high-sensitivity cardiac troponins are detectable in the blood several hours before older generations of troponins, which enables an earlier decision of whether to admit or discharge patients with chest pain [5].

Recent studies have found that an initial high-sensitivity cardiac troponin T (hs-cTnT) level of <5 ng/L in combination with a normal electrocardiogram (ECG) may rule out MI in the ED with nearly 100% accuracy [6–9]. These findings indicate that the discharge of these patients home without any further in-hospital evaluation may be safe. Undergoing investigations such as exercise tests or echocardiographies during a hospital stay may reassure patients and convince them that they are healthy. On the contrary, investigations performed in healthy individuals may increase their anxiety, which may predispose them for revisits to the ED and increase ED overcrowding and resource utilisation [10–12].

The aim with this study was to investigate if patients with chest pain and an initial undetectable hs-cTnT level in the ED had an increased risk of revisits to the ED if they were admitted to the hospital instead of being discharged home, and if the number of coronary angiographies,

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and coronary revascularisations during follow-up were increased accordingly.

2. Methods

2.1. Study population

The ED at Karolinska University Hospital in Stockholm, Sweden has a yearly census of approximately 150,000 adult patients at two sites. The ED has a local database, which includes information on reasons for visit, date and time of the visit, duration of stay and a number of other variables for each patient. In addition, each patient has a unique national personal identity number in the database. We included all patients over 25 years of age who came to the ED with a principal complaint of chest pain, and who had at least one hs-cTnT test result from December 10, 2010 (when the hs-cTnT assay was introduced) to December 31, 2012 in the hospital's laboratory database. We excluded all patients with a MI associated with the index visit. During the study period there was a local guideline for all six emergency hospitals in greater Stockholm area on how to assess patients with suspected acute coronary syndromes. These guidelines did not recommend the use of any specific risk-assessment tool, but solely relied on medical history, ECG, and troponin levels. Patients with chest pain and an ECG without signs of ischemia and no troponin elevation were regarded as low risk patients.

2.2. Study design

Patients were identified from the hospital's local database, and laboratory data were used to determine which of those patients had at least one hs-cTnT test analyzed while in the ED. Patient data were then sent to and processed by the National Board of Health and Welfare, and data were added from the Swedish National Patient Register [13], which contains information about all hospital stays in Sweden. The Swedish National Patient Register also includes information about surgery and interventions such as coronary angiography, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG). Information about current medications was collected from the Swedish Prescribed Drug Register [14]. The dataset was then anonymised and returned to the investigators.

Hs-cTnT was analyzed using the Elecsys 2010 system (Roche Diagnostics GmbH, Mannheim, Germany), which has a limit of detection of 5 ng/L and a limit of blank of 3 ng/L. The 99th percentile cutoff point is 14 ng/L, and the coefficient of variation is <10% at 13 ng/L [5].

The study complied with the guidelines of the Declaration of Helsinki, and was approved by the regional ethics committee in Stockholm, Sweden.

2.3. Outcome and follow-up

The primary outcome was a revisit to the ED, regardless of cause. The secondary outcomes were a revisit to the ED within 30, 90, 180, and 365 days; a revisit to the ED leading to hospital stay; > 1 revisit to the ED; coronary angiography; and revascularisation, defined as PCI or CABG, during follow-up. Follow-up started at the time of discharge from the ED, or for patients who were admitted to hospital at the time of discharge. Information about revisits to the ED was collected from the hospital's local database, and information on hospital stay, coronary angiography, and revascularisation was collected from national registers. Follow-up ended June 30, 2014 for revisits and December 31, 2012 for hospital stays, coronary angiography, and revascularisation.

2.4. Statistical analyses

Patients were stratified by a status of admitted or discharged and according to three groups of hs-cTnT levels: <5, 5–14, and >14 ng/L. Within each of these six strata, absolute risk and incidence rate per 1000 person-years with 95% confidence intervals (CI) were calculated for the primary and secondary outcomes. Furthermore, Cox proportional hazard models were used to estimate the hazard ratio (HR) and 95% CI for the potential relationship between admitted versus discharged patients and the primary and secondary outcome stratified by three groups of hs-cTnT levels: < 5, 5–14, and >14 ng/L. This estimation was conducted for three different models: 1) crude; 2) adjusted for age and sex; and 3) adjusted for age, sex, estimated glomerular filtration rate (eGFR), diabetes, prior MI, prior stroke, chronic obstructive pulmonary disease, heart failure, and revascularisation. Age, and eGFR were used as continuous variables in the models. In subgroup analyses patients were further stratified into those with or without comorbidities, defined as prior MI, prior stroke, chronic obstructive pulmonary disease, heart failure, and revascularisation. Subgroup analyses were adjusted for age and sex. The proportional hazard assumption was met.

There were 122 (0.9%) patients who had missing information on eGFR and who were excluded from the Cox proportional regression models.

Data management and calculations were performed using the World Programming System, version 3.0 (World Programming Ltd., Romsey, Hampshire, UK). Cox proportional hazards models were calculated using R, version 3.0.2 (R Foundation for Statistical Computing, Vienna, Austria).

3. Results

3.1. Patient characteristics

Among patients with a first hs-cTnT level of <5 ng/L, there were 42/8185 (0.51%) (0.33% with, and 0.18% without ischemic changes on ECG, respectively) MIs associated with the index visit. In patients with hs-cTnT levels between 5 and 14 ng/L, and >14 ng/L, there were 96/2979 (3.2%), and 676/1882 (36%) MIs, respectively, associated with the index visit. These patients were excluded from further analyses.

In total, 13,046 patients were included, of whom 4528 (34%) were admitted. 1825 (40%) of admitted patients had a first hs-cTnT level <5 ng/L. Patients with hs-cTnT levels of 5–14 ng/L, and >14 ng/L, contributed equally to admissions (29%, and 31%, respectively). Patients with higher levels of hs-cTnT were more likely to be admitted than patients with lower levels. Patients with hs-cTnT levels of <5 ng/L (undetectable) who were admitted were older, predominantly men, and were more likely to have diabetes, prior stroke, MI, heart failure, or revascularisation than patients with undetectable hs-cTnT who were discharged from the ED (Table 1).

3.2. Risk of revisits

Of in total 13,046 patients, 7694 (59%) patients had at least one revisit to the ED during a mean follow-up of 516 days (Table 2). The median time to the first revisit was 167 days (interquartile range, 43–396 days). After adjustment for confounders, the likelihood of revisit in patients with hs-cTnT levels of <5 ng/L was increased by 12% (HR 1.12, 95% CI 1.04–1.20) in those admitted versus discharged from the ED (Table 2). In patients with hs-cTnT levels of >14 ng/L, there was a trend toward a decreased likelihood of revisit by 11% (HR 0.89, 95% CI 0.79–1.00) if admitted. The unadjusted risk of revisits was increased in patients with hs-cTnT levels of ≤14 ng/L, and decreased for patients with hs-cTnT levels of >14 ng/L throughout the follow-up period (Fig. 1).

A total of 1631 (13%) revisits to the ED occurred within 30 days. After adjustment for confounders, the results revealed a 24% increased risk (HR 1.24, 95% CI 1.05–1.46) of revisit to the ED within 30 days in patients with hs-cTnT levels of <5 ng/L that were admitted compared with those who were discharged from the ED at the initial visit. The association between being admitted to the hospital and revisits to the ED was similarly increased at 90 days, 180 days, and 365 days of follow-up (Table 1, Supplemental material).

In 7057 patients with a first hs-cTnT level <5 ng/L, who had no history of prior hospital stay for MI, stroke, heart failure, chronic obstructive pulmonary disease, or revascularisation or prevalent diabetes (comorbidities), admissions were associated with an increased risk of revisits to the ED at 30 days, 90 days, 180 days, and 365 days (Table 2, Supplemental material). Point estimates indicated a similar association at 90 days, 180 days, and 365 days, in 1051 patients with comorbidities and a first hs-cTnT <5 ng/L, but confidence intervals were wide and non-significant. In total 1,358/1,825 (74 %) of admitted patients with a first hs-cTnT level <5 ng/L had no prior comorbidities. The corresponding figure among patients with a first hs-cTnT level <5 ng/l who were discharged was 5,699/6,360 (90%).

In total, 2330 (18%) patients had a return visit to the ED that led to a hospital stay during follow-up (Table 3, Supplemental material). The likelihood of revisit leading to hospital stay was almost doubled (HR 1.84, 95% CI 1.59–2.12) in patients with hs-cTnT levels of <5 ng/L who were admitted versus discharged at the first visit (Table 3, Supplemental material). No association was found between admission at the first visit and revisit leading to hospital stay in patients with hs-cTnT levels of >14 ng/L. The five most common discharge diagnoses at readmission were in almost all cases related to cardiac disease at each troponin level (Table 4, Supplemental material). The risk of >1 revisit to the ED was increased by 22% in patients with hs-cTnT levels of <5 ng/L who were

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