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Original Article

Role of high-sensitivity cardiac troponin in the early accurate diagnosis of peri-operative acute myocardial infarction

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Abstract: Background: Clinical assessment of myocardial ischemia risk and early rapid and accurate diagnosis of acute myocardial infarction (AMI) are lacking. Methods: Surgical patients with coronary heart disease (CHD) or its risk factors were recruited. According to the perioperative chest pain, severe myocardial ischemia related changes in ECG, and vital signs, blood samples were collected at different time points for the detection of hs-cTnT and cTnT. Results: The hs-cTnT area under receiver operating curve (AUC) of all patients with postoperative chest pain or severe myocardial ischemia within 3 h and 6 h was 0.902 and 0.941, respectively, diagnostic accuracy for AMI was 86.3% and 92.6%, respectively, sensitivity was 89.1% and 93.8%, respectively, and specificity was 83.5% and 92.5%, respectively. The cTnT AUC within 3 h and 6 h was 0.623 and 0.820, respectively, diagnostic accuracy for AMI was 38.5% and 85.0%, respectively, sensitivity was 32.6% and 81.0%, respectively, and specificity was 37.8% and 83.8%, respectively. Postoperative incidence of AMI in patients with CHD was significantly higher than in other patients. At 3 h and 6 h after chest pain, hs-cTnT concentration higher than 99th percentile of healthy controls was observed in 77.4% and 89.6% of high risk patients, respectively, and >20% change in plasma hs-cTnT was found in 51.2% and 82.5% of high risk patients, respectively. Conclusion: Patients with high risk had higher hs-cTnT than other groups. Continuous peri-operative detection of hs-cTnT is able to assess the risk for myocardial ischemic injury and help the early accurate diagnosis of AMI. It is especially important for patients with clinically invisible chest pain.

Keywords: Troponin, acute myocardial infarction

Introduction

Acute myocardial infarction (AMI) is a major cause of perioperative death in patients with concomitant heart disease undergoing non-cardiac surgery [1]. Substantial advances have been achieved in non-cardiac surgery, which improves the quality of life of patients, but has perioperative complications in approximately 30% of patients and may cause death in 50% of patients due to myocardial ischemic injury complicated by AMI [1-5]. Therefore, the AMI should be more rapidly and accurately diagnosed, which is very important to reduce the incidence of adverse cardiovascular events and the timely and targeted evidence-based medical treatment [6-8].

Nowadays, 12-lead electrocardiogram (ECG) and cardiac troponin (cTn) are major parameters used in the diagnosis and clinical assessment of AMI [6-9]. In most patients with ST-elevation AMI, the clinical assessment and ECG may confirm the diagnosis of AMI and thus revascularization may be initiated within minutes. However, ST-elevation AMI is found in only about 5% of consecutive patients presenting with acute chest pain [10]. Therefore, in the vast majority of patients, considerable uncertainty is left after the clinical assessment and initial ECG examination. In addition, ST-segment deviation is often affected by other conditions, such as acute pericarditis, left ventricular hypertrophy, and conduction block [6-8, 11]. Therefore, ECG alone is often insufficient to diagnose AMI. cTn is an important biochemical marker for myocardial damage with high sensitivity and specificity and may serve as a useful biological indicator in the clinical diagnosis of

acute coronary syndrome (ACS) [8, 12]. However, within the initial few hours of chest pain, the blood cTn concentration remains at a low level and therefore has a poor sensitivity; until six hours after myocardial ischemia, blood cTn significantly rises. Therefore, it will delay the diagnosis of AMI, significantly increasing the risk for serious complications [8, 13].

To overcome these limitations, the forth generation of this technique is developed for the detection of high-sensitivity cardiac troponin T (hs-cTnT) that has the 10% coefficient of variation no higher than 10% and is lower than the 99th percentile of that in healthy controls [14-20]. Clinical studies on patients with chest pain in the department of emergency have shown that hs-cTnT can significantly improve the sensitivity and specificity of AMI diagnosis [19, 20]. Apple et al. [8, 21] also demonstrated hs-cTnT had a higher sensitivity than previous indicators and could further enhance the accuracy of the diagnosis of AMI and therefore improve the diagnostic sensitivity and specificity, even in patients early after the onset of chest pain. We hypothesized that hs-cTnT may be used for early, rapid and accurate diagnosis of AMI in patients even in the absence of obvious chest pain and other symptoms in the peri-operative period. This study was to investigate whether hs-cTnT can be used for the early, rapid and accurate diagnosis of AMI, and the sensitivity and specificity of hs-cTnT in the diagnosis of AMI and the incidence of AMI in non-cardiac surgery patients with heart disease in the peri-operative period were also explored.

Materials and methods

Ethics

The study was approved by the Ethics Committee of the Fourth People's Hospital of Wuxi City and was carried out from March 2013 to August 2015.

Objectives

The primary objective of this study was to examine the role of hs-cTnT in the prediction of risk for myocardial ischemic injury through comparing chest pain patients with different risks.

Participants

Institutional approval was obtained from the Ethics Committee of the Fourth People's Hospital of Wuxi City and all the patients provided informed consent before study. Considering that the incidence of myocardial ischemia was 26% in the high risk patients (α=0.05, β=0.2) [14, 22], the number of patients required for each group was 80. Eligible patients were at least 18 years old, had American Society of Anesthesiologists (ASA) class I-IV, had no history of allergy to anesthetics and received non-cardiac elective surgery under general anesthesia in our hospital. A total of 343 patients were recruited between March 2013 and August 2015.

Evaluation

According to the guideline of New York Heart Academy (NYHA) on heart function classification, patients with a history of AMI within a week or recent myocardial infarction (one week to a month) or risk factors associated with myocardial ischemia (MI), decompensated heart failure (NYNA stage IV), new onset of ventricular tachycardia, severe aortic stenosis (mean pressure gradient greater than 40 mmHg, aortic valve area less than 1.0 cm^2 or presence of significant clinical symptoms), and severe mitral stenosis (chronic progressive exertional dyspnea, fatigue, syncope, or heart failure) were excluded from this study.

Grouping

Patients with different heart diseases or different related cardiovascular risk factors have distinct incidences of AMI and other serious cardiovascular events. Therefore, patients studied were allocated to three different groups according to cardiac risk determined on the basis of 2014 AHA/ACC Guideline for the Management of Patients With Non-ST-Elevation Acute Coronary Syndromes and 2014 ACC/AHA Guideline for Peri-operative Cardiovascular Evaluation and Management of Patients Undergoing non-cardiac Surgery [9]. High risk group (Group H) consisted of 85 patients with a history of coronary artery disease, including 19 patients with a history of unstable angina, 15 patients in the recovery period of AMI (within 6 months), 8 patients with 3° degree atrioventricular block, 20 patients with atrial fibrillation (resting heart rate >100 beats/min), and 23 patients with symptomatic bradycardia. Moderate risk group (Group M) consisted of 87 patients with high-risk factors of AMI, including 21 diabetic melli-

Table 1. Basic line information of all groups

Characteristics	Group H	Group M	Group L	Group C
Age (age)	62±8	63±9	65±9	62±8
Gender (Male/Female)	54/31	57/30	52/33	55/31
BMI (Kg/m^2)	23.5±4.7	23.8±3.9	23.3±3.7	22.9±4.1
Heart function (I/II/III/IV)	0/16/65/4	0/34/53/0	0/73/12/0	76/10/0/0
ASA grade (I/II/III/IV)	0/16/65/4	0/34/53/0	0/73/12/0	76/10/0/0
Anesthetic time (min)	189±35	193±39	182±37	183±32
Operation time (min)	165±22	168±24	163±23	160±20
Blood loss (ml)	315±32	325±36	320±29	318±33
Transfusion volume (ml)	2025±256	2080±269	2100±272	2056±270

Notes: High risk group (Group H); Moderate risk group (Group M); Low risk group (Group L); The control group (Group C).

tus patients, 19 patients with atrial fibrillation (resting heart rate <100 beats/min), 10 patients with 2 degree atrioventricular block, and 37 patients with premature systole. Low risk group (Group L) consisted of 85 patients having risk factors of AMI, including 50 patients with abnormal electrocardiogram (cardiac hypertrophy, bundle branch block and ST-T changes) and 35 patients with severe hypertension. In addition, the control group (Group C) consisted of 86 apparently healthy subjects: according to the requirements in the Clinical and Laboratory Standards Institute (CLSI), liver and kidney function, findings from routine blood test, blood pressure, blood glucose and plasma albumin were within the normal ranges; there was no obvious history of smoking or drinking; ECGs were normal, and there was no history of blood transfusion and surgery within six months.

Anesthesia

Isotonic liquid (10 ml/kg/h; <500 ml) was infused before anesthesia induction. Anesthesia was induced with etomidate (2.0~3.0 mg/kg), midazolam (0.1 mg/kg), fentanyl citrate (5-8 μg/kg) and cisatracurium besylate (0.2~0.25 mg/kg). After intubation, anesthesia was maintained with propofol (4-5 mg/kg/h), sevoflurane (0.8-1.5 minimum alveolar concentration), cisatracurium besylate (3-4 μg/kg/min) and remifentanil (0.1-0.2 μg/kg/min). Isotonic liquid, plasma and blood were administered to maintain blood volume according to patients' weight and blood loss during surgery. If bleeding was uncontrolled and mean arterial pressure (MAP) was very low, aramine (50 μg/min) was infused till MAP was maintained at 70 mmHg. The bispectral index (BIS) was maintained at between 40 and 60 for all the patients. Caleium Dibulyryl Cyclic Adenosine Monophate Injection (40 mg/d) was given continuously to improve myocardial ischemia from 1 day before surgery to 7 days after surgery in three risk groups, and normal saline of the same volume was administered in control group.

Observations

During the peri-operative period, measurements of ECG, continuous invasive arterial blood pressure, central venous pressure, respiration; pulse oximetry (SPO_2), body temperature, and urine output were done in all the patients. Blood was sampled at 0 h, 3 h, and 6 h for the hs-cTnT and cTnT detection.

Sample collection

3-ml blood was collected at 0 h, 3 h, and 6 h after chest pain, coagulated at room temperature for 10-20 min, and centrifuged for 20 min at 2000-3000 rmp/min. Serum was collected and stored at -80°C for further detections.

Reagent and instrument

cTnT kit, hs-cTnT kit, and cobase 601 automated immunoassay analyzer were used. According to the manufacturer instructions, hs-cTnT ≥0.014 μg/L and cTnT ≥0.030 μg/L are indicative of AMI secondary to ischemic myocardial injury. The hs-cTnT detection limit is 0.002 μg/L, the 99th percentile of hs-cTnT in apparently healthy subjects is ≤0.014 μg/L, and CV% ≤10 is 0.013 μg/L; 99th percentile of cTnT in apparently healthy subjects is <0.010 μg/L, and CV% ≤10% is 0.030 μg/L.

Diagnostic criteria for AMI

AMI was diagnosed according to the third universal definition of myocardial infarction developed by ESC/ACC/AHA/WHF in 2016. AMI was diagnosed according to the International Diagnostic Criteria for acute myocardial ischemia developed by ESC/ACC in 2016. AMI was defined when there was evidence of myocardial necrosis in a clinical setting. Under these con-

Table 2. Plasma hs-cTnT (μg/L) and con-cTnT (μg/L) concentrations at 0 h, 3 h and 6 h after chest pain

Group	0 h		3 h		6 h	
	hs-cTnT	con-cTnT	hs-cTnT	con-cTnT	hs-cTnT	con-cTnT
Group H	0.012 (0.009-0.015)	0.1 (0.06-0.18)	0.058 (0.011-0.124)	0.25 (0.13-0.52)	0.127 (0.012-0.326)	0.62 (0.38-0.95)
Group M	0.009 (0.007-0.012)	0.09 (0.05-0.14)	0.012 (0.007-0.015)	0.18 (0.11-0.36)	0.013 (0.007-0.016)	0.42 (0.27-0.58)
Group L	0.010 (0.008-0.013)	0.09 (0.04-0.12)	0.017 (0.009-0.014)	0.13 (0.07-0.24)	0.015 (0.010-0.018)	0.26 (0.15-0.37)
Group C	0.004 (0.002-0.005)	0.06 (0.02-0.09)	0.004 (0.002-0.006)	0.12 (0.05-0.18)	0.004 (0.002-0.005)	0.13 (0.05-0.26)

Notes: High risk group (Group H); Moderate risk group (Group M); Low risk group (Group L); The control group (Group C).

Table 3. hs-cTnT higher than 99th percentile of hs-cTnT in apparently healthy subjects and >20% change in plasma hs-cTnT by at 3 h and 6 h after chest pain

Group	Higher than 99th percentile of hs-cTnT in apparently healthy subjects at 3 h	>20% change in plasma hs-cTnT	Higher than 99th percentile of hs-cTnT in apparently healthy subjects at 6 h	>20% change in plasma hs-cTnT
Group H	77.4	51.2	89.6	82.5
Group M	7.3	2.1	9.4	5.6
Group L	8.2	4.5	14.6	8.3
Group C	0	0	0	0

Notes: High risk group (Group H); Moderate risk group (Group M); Low risk group (Group L); The control group (Group C).

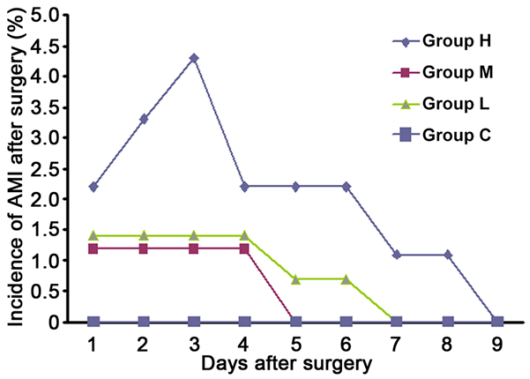

Figure 1. The incidence of AMI in four groups at different time points during the perioperative period. High risk group (Group H); Moderate risk group (Group M); Low risk group (Group L); The control group (Group C).

ditions, any one of following criteria was indicative of the diagnosis of MI [23].

The final diagnosis was made by an independent clinical cardiologist and an anesthesiologist according to the clinical medical history, physical examination, ECG, cTnT, and clinical signs (coronary angiography if necessary) during the perioperative period. Any disagreement was resolved by consulting another cardiologist.

Generally, the clinical diagnosis of AMI was based on the hs-cTnT above the 99th percentile of apparently healthy subjects (0.014 μg/L) and the CV% of ≤10% (0.013 μg/L) (that is, hs-cTnT ≥0.014 μg/L), which is according to the instruction of Roche hs-cTnT Kit. In order to improve the sensitivity and specificity of early AMI diagnosis, hs-cTnT of different cut points was used for the diagnosis of AMI: (A) hs-cTnT ≥0.014 μg/L at 0 h after chest pain or severe new MI changes; (B) hs-cTnT ≥0.014 μg/L at 3 h after chest pain or severe new MI changes; (C) hs-cTnT ≥0.014 μg/L at 6 h after chest pain or severe new MI changes; (D) was >20% change in hs-cTnT concentration at 3 h after chest pain or sever new MI changes; (E) >30% change in hs-cTnT concentration at 3 h after chest pain or severe new MI changes; (F) >20% change in hs-cTnT concentration at 6 h after chest pain or severe new MI changes; (G) >30% change in hs-cTnT concentration at 6 h after chest pain or sever new MI changes.

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences for Windows, version 11.0 (SPSS, Inc., Chicago, IL). Measurement data were treated by Shapiro-Wilk test and homogeneity of variance test. Data with normal distribution are expressed as mean ± standard deviation (SD), and intergroup comparisons were performed using Student's t test. Data with abnormal distribution are expressed as median or interquartile range, and intergroup comparisons were performed using Mann-Whitney U test. Categorical variables were compared using the chi-square test or

Table 4. Diagnostic characteristics of hs-cTnT and con-cTnT for AMI at 3 h after chest pain in all patients (%)

Parameter	AUC (95% confidence interval)	Sensitivity	Specificity	Accuracy	Positive predictive value	Negative predictive value
hs-cTnT	0.915 (0.835-0.967)	89.1	83.5	86.3	76.7	84.5
con-cTnT	0.643 (0.528-0.672)	32.6	37.8	38.5	36.2	38.5

Notes: Cutoff value: hs-cTnT ≥0.014 μg/L; con-cTnT ≥0.030 μg/L.

Table 5. Diagnosis characteristics of hs-cTnT and con-cTnT for AMI at 6 h after chest pain in all patients (%)

Parameter	AUC (95% confidence interval)	Sensitivity	Specificity	Accuracy	Positive predictive value	Negative predictive value
hs-cTnT	0.972 (0.893-0.988)	93.8	92.5	92.6	86.3	93.4
con-cTnT	0.821 (0.738-0.902)	81.0	83.8	85.0	73.0	91.2

Notes: Cutoff value: hs-cTnT ≥0.014 μg/L; con-cTnT ≥0.030 μg/L.

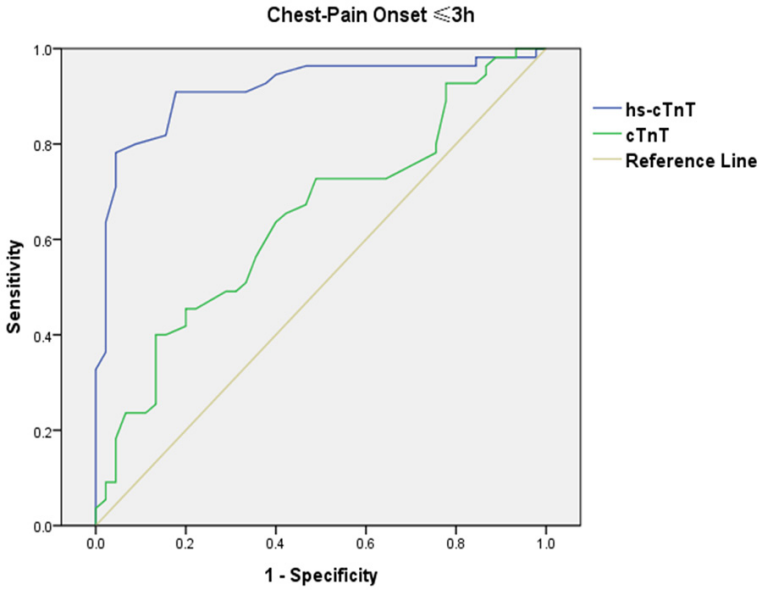

Figure 2. ROC of hs-cTnT and cTnT at 3 h after chest pain or sever new myocardial ischemia changes. Significant difference was observed between hs-cTnT and cTnT (P<0.01). The AUC, sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were 0.915, 89.1%, 83.5%, 86.3%, 76.7%, and 84.5% for hs-cTnT. The AUC, sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were 0.643, 32.6%, 37.8%, 38.5%, 36.2%, and 38.5% for con-cTnT.

Fisher's exact test. A value of $P<0.05$ was considered statistically significant.

Results

In total 343 patients were recruited into present study, and all the patients completed this study. None withdrew from the study. All the basic line information of objectives in four groups is shown in **Table 1**. None developed chest pain during the preoperative period; however, only 8 patients complained chest dull pain a few days after surgery.

1) The plasma concentrations of hs-cTnT and cTnT after chest pain in four groups are shown in **Table 2**.

2) Over 20% change in hs-cTnT concentration at 3 h and 6 h after chest pain or severe new MI changes is shown in **Table 3**.

3) The incidence of AMI in four groups at different time points during the perioperative period is shown in **Figure 1**.

4) The diagnostic characteristics of hs-cTnT and cTnT in relation to AMI at 3 h and 6 h after chest pain or severe new MI changes were compared (**Tables 4**, **5**). In addition, the AUC of hs-cTnT and cTnT at 3 h and 6 h after chest pain or severe new MI changes showed statistically significant differences between hs-cTnT and cTnT (P<0.01, **Figure 2**; P<0.05, **Figure 3**).

5) Clinical application of AMI diagnosing principles was conducted in this study. The different principles were used for the peri-operative AMI

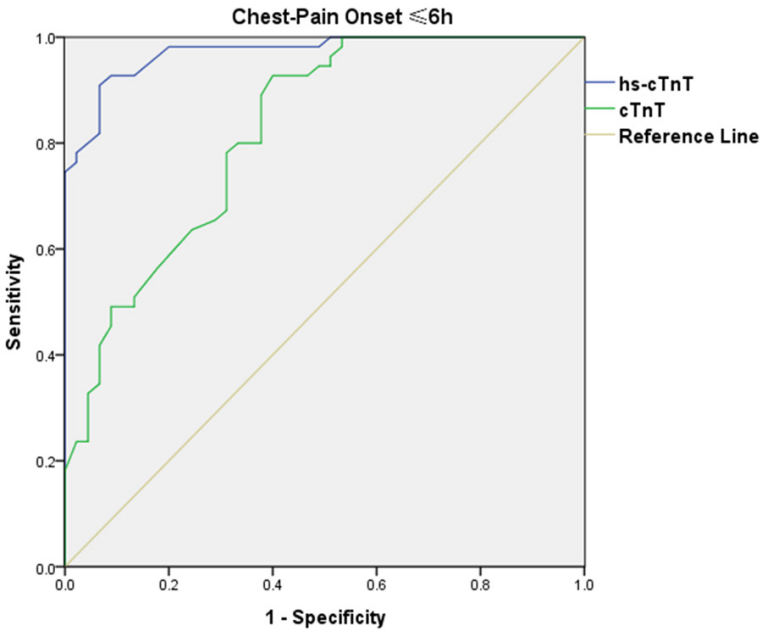

Figure 3. ROC of hs-cTnT and cTnT at 6 h after chest pain or sever new myocardial ischemia changes. Significant difference was observed between hs-cTnT and cTnT (P<0.05. The AUC, sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were 0.972, 93.8%, 92.5%, 92.6%, 86.3%, and 93.4% for hs-cTnT. The AUC, sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were 0.821, 81.0%, 83.8%, 85.0%, 73.0%, and 91.2% for con-cTnT.

Table 6. Role of different rules in the diagnosis of AMI (%)

Combined mode	Sensitivity	Specificity	Accuracy	Positive predictive value	Negative predictive value
A	86.5	87.9	83.2	74.1	82.2
B	89.1	83.8	86.3	76.7	84.5
C	93.8	92.5	92.6	86.3	93.4
A&D or B&D	92.6	90.2	93.5	83.7	87.2
A&E or B&E	94.2	95.6	95.2	89.0	92.7
A&F or C&F	97.5	97.5	98.6	92.8	93.4
A&G or C&G	98.7	99.3	99.2	94.6	95.3

Notes: A: 0 h after postoperative chest pain or myocardial ischemia, hs-cTnT greater than 99th percentile (0.014 μg/L) of apparently healthy subjects; B: 3 h after postoperative chest pain or myocardial ischemia, hs-cTnT greater than 99th percentile of healthy subjects; C: 6 h after postoperative chest pain or myocardial ischemia, hs-cTnT greater than 99th percentile of healthy subjects; D: within 3 h after postoperative chest pain or myocardial ischemia, >20% hs-cTnT change; E: 3 h within postoperative chest pain or myocardial ischemia, >30% hs-cTnT change; F: within 6 h after postoperative chest pain or myocardial ischemia, >20% hs-cTnT change; G: within 6 h after postoperative chest pain or myocardial ischemia, >30% hs-cTnT change. cutoff value: hs-cTnT ≥0.014 μg/L; con-cTnT ≥0.030 μg/L.

diagnosis in patients with cardiovascular diseases and the diagnostic features are shown in **Table 6**.

Discussion

Clinical studies have shown that hs-cTnT has higher sensitivity and specificity for the diagnosis of AMI than traditional methods [16-18, 21, 24, 25]. However, concerns remain in to the clinical application of hs-cTnT. Most previous studies primarily focus on emergency patients with chest pain. In this study, 343 hospitalized patients with different heart disease and risk factors who received surgery were recruited. Our results showed that that hs-cTnT could help early prediction of ACS and early diagnosis of AMI during the perioperative period.

Our results also showed that hs-cTnT had high sensitivity in the diagnosis of myocardial ischemic injury of different severities. For patients with a history of coronary artery disease (CHD), 3.8%, 77.4% and 89.6% of patients had plasma hs-cTnT concentration above the 99th percentile of that in apparently healthy subjects at 0 h, 3 h and 6 h after chest pain or severe MI, respectively (**Table 2**) and, 82.5% and 51.2% of patients had >20% change in hs-cTnT plasma concentration within 3 h and 6 h (**Table 3**), respectively, which were much higher than in moderate risk group and low risk group. It is indicated that the probability and severity of postoperative MI were higher in patients with a history of CHD. These results indicated that within 9 days, 17.6% of patients with a history of CHD experienced AMI, while only 5.7% of non-AMI heart disease patients and 2.3% of AMI-related high-risk patients experienced AMI (**Figure 2**).

Studies on ACS patients showed that hs-cTnT above the 99th percentile of apparently healthy subjects may significantly increase the risk for future cardiovascular events [26], and hs-cTnT is able to predict myocardial infarction after one year and improve diagnostic ability [27]. A study on 4513 ACS patients without ST-segment elevation found that patients with hs-cTnT higher than the 99th percentile of apparently healthy subjects suffered myocardial infarction and the risk of death within 30 days was three times higher than that in healthy patients [28]. Although the subjects and methods used differed from those in previous studies, the results were consistent among them, indicating that plasma hs-cTnT concentration can reflect myocardial injury of ischemic heart disease and predict the risk of AMI.

Moreover, our results showed that hs-cTnT helped the early peri-operative diagnosis of AMI in patients with severe MI. Three hours after chest pain or severe MI, the plasma hs-cTnT concentration was significantly higher than the 99th percentile of apparently healthy subjects. In addition, the AUC of hs-cTnT reached 0.902 (**Figure 2**), but that was only 0.623 for cTnT (**Figure 2**). Six hours after chest pain, the AUC of hs-cTnT was 0.941 (**Figure 3**) and that for cTnT was 0.820 (**Figure 3**), indicating that hs-cTnT achieved early and accurate diagnosis of AMI. Studies on emergency patients with chest pain demonstrated that hs-cTnT was capable of helping accurate AMI diagnosis at 3 h after chest pain [19, 20]. Different from many other studies, our study recruited patients after surgery. When AMI occurred, only eight patients developed chest pain. Most patients were still unable to describe symptoms clearly due to the mechanical ventilation in ICU, and thus relevant information could not be obtained. However, severe or new MI, or characteristics of AMI shown in continuous electrocardiography or significant changes in vital signs are risk signals and provide us direction in the treatment which differ from the usual treatment of emergency patients with chest pain as the major complaint.

Our results suggest that patients with cardiovascular disease have a high risk for AMI within a week after surgery. Comprehensive analysis of clinical vital signs, continuous ECG changes, and timely detection of plasma hs-cTnT concentration has important clinical significance for the early detection of perioperative AMI (**Tables 2**, **3**).

Dynamic detection of hs-cTnT improves the positive and negative predictive values. The positive and negative predictive values of hs-cTnT were 76.7% and 84.5%, respectively at 3 h and 86.3% and 93.4%, respectively at 6 h after surgery (**Table 4**). Early short term and repeated blood sampling can not only improve diagnostic sensitivity, accuracy and specificity, but increase negative predictive value for ACS, providing a basis for timely, early, and evidence-based treatment [7, 27, 29, 30]. When mild myocardial injury occurs, hs-cTnT concentration is at a low level; one test is not enough to confirm the diagnosis. Prior studies have indicated that repeated testing can improve the positive and negative predictive values of hs-cTnT for ACS, thereby reflecting the degree of myocardial ischemic injury [31].

The application of clinical diagnosis rules also significantly improved hs-cTnT specificity and accuracy of AMI diagnosis. At 3 and 6 h after chest pain, >20% or 30% change in plasma hs-cTnT concentration significantly increased the diagnostic capacities (**Table 5**). For patients with unstable angina, higher hs-cTnT concentration was present. A single hs-cTnT test cannot reflect real condition, but the fold change in hs-cTnT concentration may help the accurate diagnosis (**Table 5**). Other studies have demonstrated that dynamic detection of hs-cTnT (twice over a short time period; change of ≥20% or 30%) may also improve the diagnostic accuracy of AMI and negative predictive value [32].

However, there were some limitations in our study. First, only plasma hs-cTnT concentration, post-operative AMI and other cardiovascular events in the perioperative period were examined, and long-term outcome was not evaluated. Second, the influence of kidney function on plasma hs-cTnT concentration was not evaluated. Third, reagents from different manufacturers may also affect the detection of hs-cTnT, but reagent from a single manufacturer was used in our study.

In conclusion, perioperative dynamic hs-cTnT detection is helpful for the assessment of risk for myocardial ischemic injury and for the early accurate diagnosis of AMI. Especially, for patients with clinically latent chest pain, this provides an important scientific basis for the early accurate diagnosis and treatment of MI. However, to assess the risk of AMI development, it

is still needed to rule out other potential factors which contribute to AMI occurrence.

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Disclosure of conflict of interest

None.

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