Prognostic prediction of troponins in cardiac myxoma: case study with literature review

Previsão de prognóstico de troponinas em mixoma cardíaco: estudo de caso e revisão da literatura

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Abstract

Objective: It was supposed that troponins in cardiac myxoma patients might be in a same fashion as in the conditions without myocardial injury. In order to verify this hypothesis, troponins in cardiac myxoma patients were discussed by presenting a comprehensive retrieval of the literature with incorporating the information of a recent patient.

Methods: Postoperative detections of troponin I, creatine kinase isoenzyme MB (CK-MB) and N-terminal pro-B-type natriuretic peptide revealed elevated troponin I and CK-MB and normal N-terminal pro-B-type natriuretic peptide. Postoperative troponin I and CK-MB shared a same trend, reaching a peak value at postoperative hour 2, gradually decreased on postoperative day 1, and reached a plateau on postoperative days 7 and 13. A significant correlation could be noted between the postoperative values of the two indicators (\(Y=0.0714X + 0.6425\), \(r^2=0.9111\), \(r=0.9545\), \(P=0.0116\)). No significant linear correlation between troponin I and N-terminal pro-B-type natriuretic peptide were found. Literature review of troponins in cardiac myxoma patients revealed the uncomplicated patients had a normal or only slightly elevated troponin before open heart surgery. However, the complicated patients (with cerebral or cardiac events) showed a normal preoperative troponin in 3 (23.1%) and an elevated troponin in 10 (76.9%) patients (\(\chi^2=7.54\), \(P=0.0169\), Fisher’s exact test). The overall quantitative result of troponin I was 2.45±2.53 μg/L, and that of troponin T was 3.10±4.29 mg/L, respectively.

Conclusion: Troponins are not necessarily elevated in patients with a cardiac myxoma without coronary syndrome. By contrast, patients with a cardiac myxoma with an elevated troponin may herald the presence of an associated coronary event. An old cerebral infarct does not necessarily cause an elevation of troponin or B-type natriuretic peptide, or new neurological events, but might lead to a delayed awakening.

Descriptors: Brain. Myxoma. Natriuretic Peptides. Troponin.

Resumo

Objetivo: Supunha-se que troponinas em pacientes com mixoma cardíaco poderiam estar em uma mesma forma que naqueles sem lesão miocárdica. Para verificar essa hipótese, as troponinas em pacientes com mixoma cardíaco foram discutidas, em uma revisão abrangente da literatura com a incorporação das informações de um paciente recente.

Métodos: Deteções pós-operatórias de troponina I, creatina quinase isoenzima MB (CK-MB) e peptídeo natriurético tipo B N-terminal revelaram troponina I e CK-MB elevadas e pró-peptídeo natriurético tipo B N-terminal normais. Troponina I e CK-MB no pós-operatório tiveram a mesma tendência, chegando a
INTRODUCTION

Troponins are a type of contractile protein produced in cardiac and skeletal muscles. They are composed of troponin subunits I, C and T, with the former two subunits being highly sensitive and specific for myocardial damage, especially implicated in the diagnosis of acute coronary syndrome\(^1\). Dynamics of troponins have been sufficiently described as to start to increase a few hours after myocardial ischemic damage, reach a plateau after 10-15 hours, and recover gradually to the baseline level\(^5\). Elevations of troponins T and I were also found in patients without myocardial injury. These situations included severe renal dysfunction\(^3\), acute neurological events (with a peak troponin I value of 3.43±3.22 μg/L)\(^4\), hepatic cirrhosis and portal hypertension\(^3\), stroke, pulmonary embolism and sepsis\(^6\).

Troponins were sporadically reported in cardiac myxoma patients. However, these results were actually anecdotal without being taken into a through investigation. It was supposed that troponins in cardiac myxoma patients might be in a same fashion as in the conditions without myocardial injury. In order to verify this hypothesis, a patient with cardiac myxoma, whose clinical and histopathological aspects have been reported elsewhere\(^7,8\), is to be presented in terms of her serum troponin studies along with creatine kinase isoenzyme MB (CK-MB) and N-terminal pro-B-type natriuretic peptide (NT-proBNP) by incorporating the results based on a comprehensive retrieval of the literature.

CLINICAL OBSERVATIONS

Six months prior to current admission, a 51-year-old female had abrupt loss of vision and consciousness. She was in a state of cardiogenic shock, which was revealed to be a result of multiple cerebral infarcts with a diagnosis of “top of the basilar” syndrome due to a left atrial myxoma. Later, she also developed multiple segmental embolism of her lower extremities involving the bilateral anterior tibial, bilateral posterior tibial, right popliteal and bilateral dorsal arteries. Left atrial myxoma resection was performed under cardiopulmonary bypass. During the operation, the myxoma was found to be originated from the free wall of the left atrium. The myxoma was resected en bloc, and the iatrogenic atrial free wall defect was repaired with an autologous pericardial patch. She had a delayed awakening until postoperative hour (POH) 13.5 without any new neurological sequela. She had an uneventful postoperative course and was discharged home on postoperative day (POD) 19. Histopathology of the resected myxoma showed a glandular cardiac myxoma.

On admission, her C-reaction protein was 41.66 (normal range, 0-10) mg/L, hypersensitive C-reaction protein was >5 (normal range, 0-1) mg/L, and CK-MB 7.6 (normal range, 0-40) U/L. Her condition was gradually stable after prolonged treatment. She was recently referred to this hospital for surgical treatment of left atrial myxoma. After admission, the diagnosis of left atrial myxoma was confirmed by echocardiography and chest computed tomography. Her preoperative troponin I and NT-proBNP values were normal.

Postoperative detections revealed elevated troponin I and CK-MB and normal NT-proBNP (Table 1). Troponin I values were moderately elevated at POH 2 and POD 1. Postoperative CK-MB showed a same trend with cardiac troponin I, which reached a peak value at POH 2 (POD 0.08), gradually decreased on POH 24 (POD 1), and reached a plateau on PODs 7 and 13. The only difference between the two indicators was CK-MB recovered to normal values since POD 7, whereas troponin I did not, but
were 0.43 μg/L and 0.32 μg/L at PODs 7 and 13 (Figure 1). A significant correlation could be noted between the postoperative values of the two indicators (\(Y=0.0714X + 0.6425\), \(r^2=0.9111\), \(r=0.9545\), \(P=0.0116\)) (Figure 2). Random NT-proBNP values were 243 and 448 pg/mL at POH 2 and on POD 7. No significant linear correlation between troponin I and NT-proBNP were found (\(Y=-0.0251X + 11.2760\), \(r^2=0.2846\), \(r=-0.5335\), \(P=0.6418\)) (Figure 3).

### Table 1. Determinations of serum cardiac biomarkers.

| Biomarker                                | Normal range | Preoperation | Postoperative day |
|------------------------------------------|--------------|--------------|-------------------|
| Troponin I (μg/L)                        | 0-0.1        | 0            | 9.47 3.74 0.43 0.32 |
| CK-MB (U/L)                              | 0-40         | 7.6          | 126 15 1 1        |
| N-terminal pro-B-type natriuretic peptide (pg/mL) | 0-900        | 261          | 243 -- 448 --    |

**Fig. 1** - A similar changing trend of troponin I and creatine kinase isoenzyme MB. CK-MB=creatine kinase isoenzyme MB.

**Fig. 2** - Linear correlation between troponin I and creatine kinase isoenzyme MB. CK-MB=creatine kinase isoenzyme MB.

**Fig. 3** - Linear correlation between troponin I and N-terminal pro-B-type natriuretic peptide (NT-proBNP). NT-proBNP=N-terminal pro-B-type natriuretic peptide.

**DISCUSSION**

Troponin I is a popularly recognized sensitive biomarker in the diagnosis of postoperative myocardial damage and perioperative myocardial infarction[9]. Clinical observations revealed that troponin I, CK and CK-MB values peaked between POHs 6 and 18, troponin T between POHs 18 and 42, and myoglobin at the surgical closure. The values of all markers were higher in patients undergoing coronary surgery compared to those undergoing valve surgery[10]. Yuan et al.[11] discovered significant elevated serum troponin I during the early days after the onset or surgical repair of myocardial rupture, and they advocated the troponin I was valuable in judging the prognosis of the patients with myocardial injury. Troponin I (as well as NT-BNP) can be helpful in the evaluation of the functions of the vital organs including heart.
subjected to perioperative drug use, such as oral prophylactic metoprolol$^{[12]}$ and high-dose aprotinin$^{[13]}$.

Troponin levels in cardiac myxoma were reported in 18 sporadic patients$^{[14-31]}$, totally 19 patients including the present one (Table 2). Of them, 12 (63.2%) were troponin I and 7 (36.8%) were troponin T. Six (31.6%) patients were uncomplicated, and 13 (68.4%) were complicated ($\chi^2=5.16$, $P=0.0502$, Fisher’s exact test). Of the complicated patients, acute myocardial infarction developed in 10 (76.9%) patients, and ventricular fibrillation arrest, pulmonary embolism, and ischemic stroke developed in 1 (7.7%) patient, each ($\chi^2=21.17$, $P=0.0001$, Fisher’s exact test). The uncomplicated patients had a normal or only slightly elevated troponin before open heart surgery. However, the complicated patients showed a normal preoperative troponin in 3 (23.1%) and an elevated troponin in 10 (76.9%) patients ($\chi^2=7.54$, $P=0.0169$, Fisher’s exact test). The overall quantitative result of preoperative troponin I was 2.45±2.53 (range, 0.0189-5.91; median, 1.47) μg/L ($n=7$), and that of troponin T was 3.10±4.29 (range, 0.31-9.37; median, 1.36) mg/L ($n=4$), respectively. The troponin I was somewhat higher than the baseline value of coronary artery disease patients (1.0±6 μg/L)$^{[9]}$ or the baseline value of the patients with coronary and/or valvular disorders (0.16±0.05 μg/L)$^{[10]}$ reported in the literature.

Table 2. Preoperative troponin levels in the patients with a cardiac myxoma.

| Year | Author                  | Age (year) | Sex | Location of cardiac myxoma | Complication                                                                 | Troponin I (μg/l) | Troponin T (mg/L) |
|------|-------------------------|------------|-----|----------------------------|---------------------------------------------------------------------------|-------------------|-------------------|
| 1.   | Gurlertop et al. $^{[14]}$ | 90         | f   | Left ventricular outflow tract myxoma | A history of anterior myocardial infarction (2 years ago)                   | 0.071             | Positive          |
| 2.   | Demir et al. $^{[15]}$  | 55         | f   | Left atrial myxoma          | Myocardial infarction                                                      | 4.5               | Positive          |
| 3.   | Balami et al. $^{[16]}$ | 82         | f   | Left atrial myxoma          | Transient ischemic attack and acute coronary syndrome                      | 0.31              | Negative          |
| 4.   | Özdögru et al. $^{[17]}$| 38         | m   | Left atrial myxoma          | Acute unheralded neurological compromise, acute pulmonary edema, severe impairment of left ventricular function, total occlusion of abdominal aorta | 9.37              | Slightly increased |
| 5.   | Yadav et al. $^{[18]}$  | 62         | f   | Left atrial myxoma          | Ventricular fibrillation arrest                                            | 4.5               | Positive          |
| 6.   | Dalzell et al. $^{[19]}$| 59         | m   | Left atrial myxoma, recurrent| Ischemic stroke (middle cerebral artery and posterior inferior cerebellar artery) | 9.37              | Slightly increased |
| 7.   | Alboaimi et al. $^{[20]}$| 70         | m   | Left atrial myxoma          | Systemic embolization (acute posterior circulation territory ischemia) and myocardial infarction | 4.8               | Positive          |
| 8.   | Shimada et al. $^{[21]}$| 68         | f   | Left atrial myxoma          | Ventricular fibrillation arrest                                            | 0.2               | Normal            |
| 9.   | Agarwal et al. $^{[22]}$| 22         | f   | Left atrial myxoma          | Critical stenosis of several coronary arteries                             | 1.47              | Very high         |
| 10.  | Vogel et al. $^{[23]}$  | 43         | f   | Left atrial myxoma          | Non-ST elevation acute myocardial infarction                              | 0.0189            | Normal            |
| 11.  | Weiss et al. $^{[24]}$  | 14         | m   | Calcified right atrial myxoma| Myocardial infarction                                                      | 5.91              | Very high         |
| 12.  | Marta et al. $^{[25]}$  | 57         | f   | Left atrial myxoma          | Pulmonary embolism                                                         | 0.38              | Normal            |
| 13.  | Stepień et al. $^{[26]}$| 75         | m   | Left atrial myxoma          | Critical stenosis of several coronary arteries                             | 1.47              | Very high         |
| 14.  | Haffner et al. $^{[27]}$| 58         | f   | Left atrial myxoma          | Pulmonary embolism                                                         | 0.38              | Normal            |
| 15.  | Jung et al. $^{[28]}$   | 76         | f   | Right atrial myxoma         | Myocardial infarction                                                      | 1.47              | Normal            |
| 16.  | Lazaros et al. $^{[29]}$| 35         | f   | Left atrial myxoma          | Myocardial infarction                                                      | 1.47              | Normal            |
| 17.  | Leo et al. $^{[30]}$    | 58         | f   | Left atrial myxoma          | Ischemic stroke (middle cerebral artery and posterior inferior cerebellar artery) | 0.38              | Normal            |
| 18.  | Sadeghpour et al. $^{[31]}$| 73       | f   | Left atrial myxoma          | Acute ST segment elevation, inferolateral myocardial infarction, multiple emboli | 0                 | Normal            |

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The functional atrophic valve obstruction and embolic phenomena predisposing to myocardial infarction in the presence of a cardiac myxoma might be the explanations of the remarkable rise of the baseline troponin values. It was proposed that troponin I levels measured on POD 1 may predict short-, medium- and long-term mortality. Troponin I levels of alive patients was 2.01 (range, 1.01-3.65) and 4.26 (range, 2.18-8.37) μg/L at POH 2 and on POD 1, while those of the deceased were 3.63 (range, 1.62-8.26) and 11.85 (range, 5.59-23.96) μg/L, respectively. In a patient with a cardiac myxoma and associated coronary artery stenosis, his troponin I was 3.56 μg/L on POD 13. The present patient with old cerebral infarct had an uneventful recovery after the resection of cardiac myxoma. She had compatible troponin I values in the early postoperative period to the maximal value of the survived surgical patients as reported by Croal et al. In addition, this patient had significantly decreased troponin I values on PODs 7 and 13, much lower than those of the patient reported by Stepien’s et al. This could be interpreted by the associated coronary artery disease in the latter patient.

Comparative studies between troponins and CK-MB have already been stated some decades ago. There were little differences among troponins I and T, and CK-MB after cardiac operation to diagnose myocardial damage. However, troponins have a more prolonged release than CK-MB when the patient is subjected to myocardial damage; it is therefore more sensitive than CK-MB in indicating myocardial necrosis. A troponin I concentration <15 μg/L within PODs 1-2 was highly suggestive of the absence of perioperative myocardial necrosis. The dynamic changes of troponin I and CK-MB in the present patient were quite identical. The incidental finding was a peak value at POH 2 and a gradual decrease on POD 1, contrary to a delayed peak appearing on POD 1 as reported by Croal et al. The disconformity warranted further investigations.

NT-proBNP is a pre-propeptide synthetized in the cardiomyocytes. When it is secreted, it splits into two parts: a physiologically active brain natriuretic peptide (BNP) and biologically inactive NT-proBNP. Both can be significantly elevated when the patient is with an acute or congestive heart failure. The normal range of BNP was <200 pg/mL. Increased BNP values were discovered to be related to acute cerebrovascular events. BNP >140 pg/mL could be helpful in distinguishing cardiogenic from non-cardiogenic embolism. Clinical observations revealed BNP values were loosely correlated with New York Heart Association (NYHA) functional class. In the patients undergoing cardiac surgery including one patient with atrial myxoma, BNP was 62.8±68.1 pg/mL. Patients with congestive heart failure had a mean BNP concentration of 1076±138 pg/mL, while the non-congestive heart failure patients had a mean BNP concentration of 38±4 pg/mL. Links between BNP and cardiac myxoma have rarely been discussed. Factors associated with high BNP levels other than congestive heart failure were age, gender, renal failure, lung disease and myocardial infarction; meanwhile, atrial myxoma was determined as a factor accounting for low BNP levels with congestive heart failure. Plasma BNP level in 17 consecutive adult patients (including one patient with a left atrial myxoma) during the perioperative period were detected. Plasma BNP remained unchanged until 12, 24 and 48 hours after the termination of cardiopulmonary bypass, which were 149.5±43.0 pg/mL, 175.2±93.6 pg/mL and 146.2±59.4 pg/mL, respectively. In a patient with right heart enlargement and severe pulmonary hypertension free of congestive heart failure, her BNP was 5,613.4 pg/mL. A 53-year-old man with a large left atrial myxoma presented with biventricular heart failure. His BNP was as high as 4,800 pg/mL. Lack of elevations of BNP has been reported in the event of acute congestive heart failure or with ventricular infow obstruction (hypertrophic obstructive cardiomyopathy, mitral stenosis, or atrial myxoma).

Top of the basilar artery refers to a 2-cm territory surrounding the five-forked junction at the top of the basilar artery formed by 2 posterior cerebral arteries, 2 superior cerebellar arteries and the top of basilar artery. Cerebral infarction involving the rostral brainstem and cerebral hemisphere that are supplied by the distal basilar artery causes a clinical syndrome, known as rostral brainstem infarction or “top of the basilar” syndrome, characterized by visual, oculomotor, and behavioral abnormalities, often with insignificant motor dysfunction. “Top of the basilar” syndrome occurs when the top of the basilar artery is subjected to thromboembolic occlusions, and results in bilateral thalamic ischemia due to occlusion of perforator vessels. Transient ischemic attack and stroke can present in 80% of patients with a cardiac myxoma. Unexplained transient ischemic attack, cerebral infarction and syncope are common neurologic manifestations. Clinical observations demonstrated that the patients with preoperative cerebral infarct took longer time to awaken than those without (6.5±5.0 hours vs. 4.6±2.9 hours, P<0.05). The incidence of confusion and cerebral infarction after operation in the preoperative infarct patients was higher than those without. The anesthetic awareness in the present patient was 13.5 hours, even longer than reported. This phenomenon implicated that an old cerebral infarct may interfere anesthetic awareness, but not necessarily complicated with new postoperative sequelae. The normal postoperative BNP values of the present patient offered a strong support to this argument.

CONCLUSION

Troponins are not necessarily elevated in patients with a cardiac myxoma without coronary syndrome. By contrast, cardiac myxoma patients with an elevated troponin may herald the presence of an associated coronary event. An old...
cerebral infarct does not necessarily cause an elevation of troponin or BNP, or new neurological events, but might lead to a delayed awakening.

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