Does percutaneous nephrolithotomy cause elevated cardiac troponins?

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Original Article

Abstract

BACKGROUND: Percutaneous nephrolithotomy is the treatment of choice in large and staghorn renal stones, and myocardial infarction is one the possible complications during and after the surgery. We investigated if renal and skeletal muscle injury, caused by percutaneous nephrolithotomy, can cause elevation in cardiac troponins (cTn).

METHODS: This study was conducted on otherwise healthy patients with renal stone undergoing percutaneous nephrolithotomy. A baseline 12-lead electrocardiogram, echocardiography, and cTn assessment confirmed no cardiac pathology in any patients. Cardiac troponins T (cTnT) and I (cTnI), and also creatine kinase (CK) were assessed before and after surgery.

RESULTS: A total of 55 patients (69.1% males, mean age: 40.5 ± 13.8 year) were included. Serum creatinine level ranged from 0.7 to 1.3 mg/dl (mean = 1.03 ± 0.17). The level of CK was significantly increased by 469.5 ± 201.4 U/l ($P < 0.001$), and no positive cTnT or cTnI was observed after surgery.

CONCLUSION: The results of the present study showed that renal cell injury, caused by percutaneous nephrolithotomy, is not associated with elevated cardiac troponins. These findings show that increasing troponins in patients undergoing percutaneous nephrolithotomy indicate a cardiovascular pathology.

Keywords: Percutaneous Nephrolithotomy, Coronary Artery Disease, Acute Coronary Syndrome, Cardiac Markers, Troponin

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Introduction

Percutaneous nephrolithotomy (PCNL) is the treatment of choice for renal staghorn stones.[1]

Postoperative myocardial insult is a common surgical morbidity and mortality. Up to 40% of all coronary artery disease patients undergoing major non-cardiac operations develop post-surgical silent myocardial ischemia (MI), and between 2–4% experience myocardial damage or cardiac death.[2,3] Cardiovascular disease in patients scheduled for PCNL is common (23%).[4] Accordingly, it is expected that patients encounter cardiac symptoms after surgery. We had a similar case in our clinic; PCNL was performed on a 62-year old diabetic man in our department, and 3 hours after the surgery the patient developed dyspnea. Electrocardiography and symptoms were unremarkable, but a three-fold increase in troponin was observed. We doubted whether renal and skeletal muscle trauma caused by PCNL could have increased serum troponin. The aim of this study was to investigate the diagnostic accuracy of cardiac troponin in patients undergoing PCNL.

Previously, diagnosis of acute MI relied upon the combination of symptoms, electrocardiographic (ECG) abnormalities, and elevations in serum

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cardiac enzymes. Since symptoms and ECG abnormalities may be nonspecific or absent after surgery, diagnosis of MI has been increasingly dependent on the evaluation of cardiac enzymes.[1] End stage renal disease (ESRD), old age, diabetes mellitus (DM), and some non-cardiac surgeries can complicate the clinical presentation of acute coronary syndrome (ACS).[2,3] A large number of these patients have significant coronary artery diseases despite being asymptomatic or manifesting with atypical symptoms. Thus, the accurate interpretation of serum concentrations of cardiac enzymes is extremely important in these patients.[1,3,5]

When available, cardiac troponins (cTn), including troponin T (cTnT) and troponin I (cTnI), are the markers of choice for early evaluation of patients suspicious for ACS. The skeletal muscle and cardiac isoforms of troponin T and troponin I are distinct and skeletal muscle isoforms are not detected by the currently used monoclonal antibody-based assays.[1] Although cTnI and cTnT are specific markers for myocardial damage and MI, there are some other conditions, including renal failure and chronic kidney disease, accompanied with elevation of these enzymes in the absence of detectable myocardial damage or MI.[6] Several studies reported sporadic or persistently increased level of cardiac troponins (> 0.1 ng/ml) among 20% to 53% of patients with ESRD, with cTnT being more frequently elevated in patients on dialysis than cTnI.[3]

The underlying mechanisms of the elevated cTn in ESRD patients are not clear and studies have controversial results. Previous studies have proposed that increased cTnT in asymptomatic patients with ESRD indicates a subclinical myocardial necrosis/injury caused by ischemia due to coronary artery disease (CAD), cardiac hypertrophy, and fluctuations in blood volume.[1,2] Abnormalities of troponin catabolism and clearance caused by renal failure or dialysis are also suggested to have a role in increased levels of troponins in ESRD patients.[3,7] Some studies suggested that cardiac enzymes in serum of ESRD patients without evidence of ischemic heart disease are originated from the skeletal muscle and not from the heart.[8,9] Other studies also found elevated expression of cTnT in examined biopsy specimens from the skeletal muscle of dialysis patients, likely associated with uremic-induced skeletal myopathy.[10,11] PCNL is a unique surgery with known parenchyma damage. Extensive search of literature did not reveal any related articles.

It seems that the effect of renal surgeries and specifically PCNL on cardiac troponins has not been previously studied.

We carried out this study in order to investigate whether renal injury, induced by PCNL, can cause elevation in cardiac troponins.

Materials and Methods

Patients and settings

This study was conducted on 55 consecutive patients with renal stone referring to Alzahra University Hospital for PCNL between February 2011 and February 2012. All patients were interviewed and examined by a cardiologist for symptoms, signs, and history of cardiovascular disease. A 12-lead ECG and echocardiography were done before the operation and patients with any abnormalities were not included in the study. Those with history, risk factors (DM, hypertension, hyperlipidemia, and smoking), or symptoms of any cardiovascular diseases and those with renal dysfunction (serum Cr > 1.5) were not included. The study was approved by the Ethical Committee of Isfahan University of Medical Sciences and an informed consent was obtained from each patient.

Percutaneous nephrolithotomy

The surgical procedure is summarized as follows: After general anesthesia, a 5 or 6 Fr ureteral catheter was inserted and fixed to a Foley catheter. The patient was then turned to a prone position with special care for the pressure points. The desired calyx was punctured under fluoroscopic guidance and a guide wire was inserted. Tract dilation was performed by Amplatz dilators in a one-shot manner. After Amplatz sheath insertion, nephroscopy was performed and stones were fragmented by a pneumatic lithotripter (Litho Crack, Sp. Swiss-Germany) and removed. Normal saline (0.9% NaCl) was used for continuous irrigation. In the case of residual stones more than 2 cm in diameter that could not be accessed by the first tract, a second access was established.

Residual stones less than 2 cm in diameter were scheduled for shock wave lithotripsy (SWL). Foley and ureteral catheter were removed 24 hours after the operation. Nephrostomy tube was clamped 48 hours after operation and was removed after 24 hours if no leak, pain, or fever was present. Demographic, perioperative data such as age, sex, stone burden, laterality, co-morbid diseases, stone opacity, operation time, number and site of accesses, and complications during and after surgery were recorded by the surgeon. Patients with

excessive bleeding or hypotension during the operation were excluded from the study. Patients were kept hydrated during the operation and postoperative pain was controlled by narcotics. No non-steroidal anti-inflammatory drugs were used. Ceftriaxone was prescribed before the operation and continued until discharge.

Assessments

The serum levels of cTnT and cTnI were assessed before and 6 hours after surgery in automated immunoanalysis system (VIDAS® Troponin I Ultra, BioMérieux SA, Marcy l'Etoile, France). This system uses the enzyme-linked fluorescence assay (ELFA) principle, combining the enzyme linked immunosorbent assay (ELISA) method with a final fluorescent reading. CK was also assessed as a marker of renal injury before and 6 hours after lithotripsy using automated analyzer (Greiner Diagnostic GmbH, Bahlingen, Germany).

Statistical analysis

Data were analyzed using SPSS for Windows (version 16.0; SPSS Inc., Chicago, IL, USA). Categorical data were reported as frequencies and percentages. Continuous data were reported as mean and standard deviation (SD). Comparison of quantitative data before and after lithotripsy was done using the paired t-test. A P value of less than 0.05 was considered as significant.

Results

A total of 55 patients (69.1% males, mean a ge = 40.5 ± 13.8 years) were studied. The mean operating time and mean hospital stay were 116 ± 24 minutes and 3.93 ± 1.47 days, respectively. Moreover, 7 patients (12.7%) required second access tract. Auxiliary procedures were performed in 5 patients (9%). In addition, 50 patients were completely stone free leading to a stone-free rate of 90%. Complication occurred in 17 (31%) patients; fever in 13 (23.6%) patients, transfusion in 3 (5.4%) patients, and delayed hematuria in 1 (1.8%) patient.

Serum creatinine level ranged from 0.7 to 1.3 mg/dl (mean = 1.03 ± 0.17). Data regarding cTnT, cTnI, and CK are presented in table 1. The level of CK was significantly increased by 469.5 ± 201.4 U/L after surgery (P < 0.001). No positive cTnT or cTnI was observed after PCNL.

Discussion

This observational study demonstrates that none of the patients undergoing PCNL developed elevated cardiac enzymes after the operation. It confirms that renal and skeletal muscle injury induced by percutaneous nephrolithotomy, which was documented by elevation in CK level, is not associated with elevation in cTnT or cTnI.

Troponin is a cardio-specific enzyme, now universally used as the standard marker for detection of cardiac ischemia. It rises 4 to 6 hours after the myocardial injury and remains elevated for up to 10 days.[12] It is also well-accepted as a marker of non-ischemic cardiac muscle injury such as myocardial trauma. However, it is falsely elevated in medical conditions, other than acute coronary syndrome, which occasionally makes the clinical use of this biomarker challenging.[13]

The value of troponin in patients with conditions such as dialysis or renal transplant has already been studied.[3,14-16]. However, there is no report so far on the clinical application of cardiac enzymes in patient undergoing PCNL.

Data regarding the serum levels of cardiac troponins in patients undergoing other urological procedures, such as renal transplant and extracorporeal shock wave lithotripsy (ESWL), exist. Bozbas et al. showed that cardiac troponin I should be the biomarker of choice in renal transplant patients as it remains unchanged during the procedure.[17] In a survey by Greenstein et al. on 32 patients undergoing SWL for kidney stones, the results provide confirmatory evidence of previous researches. No myocardial damage was detected and troponin is advised as a suitable tool in the evaluation of patients complaining of chest pain after SWL.[18] In another report, lithotripsy induced arrhythmias were shown not to be associated with myocardial damages and the serum troponin levels did not increase.[19]

Table 1. Cardiac troponins and creatine kinase before and after the lithotripsy

	Before	After	P*
CK, U/l	112.2 ± 47.0	581.7 ± 235.1	< 0.001
cTnT > 0.1 µg/l	0	0	-
cTnI > 0.1 µg/l	0	0	-

Data are presented as mean ± standard deviation

* P value

CK: Creatine kinase; cTnT: Cardiac troponins T; cTnI: Cardiac troponins I

Shroff et al. retrospectively studied 376 consecutive renal and renal/pancreas transplant recipients for a period of one year. They investigated cardiac events during the hospital stay and within 1 year after renal transplantation. Interestingly enough, all patients with a cardiac event during their hospital stay had abnormal cTnI in the immediate postoperative period.[14]

Thus, negative cTnI immediately following transplantation had a high negative predictive value in distinguishing patients likely to develop in-hospital postoperative MI. They also found that the occurrence of at least one abnormal postoperative cTnI level immediately following renal transplantation was associated with increased rates of coronary revascularization at 1 year.[14]

Hypotensive episode is proved to be associated with increased infarction rates in patients undergoing surgeries. Therefore, in patients with perioperative bleeding risk factors, cardiac events should be monitored more closely. Although severe bleeding leading hypovolemic shock is reported to have an occurrence rate of less than 3% of patients; however, troponin measurement might have a more diagnostic value in patients with hemorrhage risk factors undergoing PCNL.[20,21]

PCNL is accepted as a relatively safe procedure for removal of kidney stones.[22] Mohta et al. monitored hemodynamic, electrolyte, and metabolic changes before, during, and after the irrigation in PCNL patients. They found no significant alterations in the aforementioned variables such as heart rate, systolic and diastolic blood pressure, arterial blood gases, and electrolytes.[23] Likewise, we found PCNL to be a safe procedure with regard to alterations in cardiac muscle injury-related markers. Shen et al. showed that PCNL induces less inflammatory systemic response than open surgery. They examined the immunological markers of tissue damage, such as CRP and IL-6, and found that the tissue damage markers in PCNL group were significantly less than the open surgery group.[22] On the other hand, in our study, the troponin levels have been measured both before and after the surgery in order to better monitor the level changes. However, patients with medical conditions such as renal impairment, diabetes, and hypertension have not been included in the study; therefore, the role of cardiac enzymes in patients with these medical conditions undergoing PCNL should be examined by future studies. In order to define the value and cost-effectiveness of routine post-PCNL measurement of cardiac troponins, trials with large sample sizes are required to identify the incidence of cardiac events in these patients.

Another point of our study was that we only monitored the troponin level once after the urologic procedures, we did not examine the long term cardiac events in the patients; hence, prospective evaluations with longer follow up period are needed to define the accuracy of cardiac enzymes in PCNL patients in diagnosis of late cardiac events.

Conclusion

The results of the present study showed that renal cell injury, modeled by percutaneous nephrolithotomy, is not associated with elevated cardiac troponins. Thus, in postoperative chest discomfort, troponins could be a valuable marker of myocardial infarction. An elevated post PCNL cardiac enzyme is highly sensitive for a cardiac event and requires prompt attention.

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Conflict of Interests

Authors have no conflict of interests.

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