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Kardiyak Tamponad Gelişen ya da Masif Perikardiyal Effüzyonu Olan Hastalarda Akut Böbrek Yetmezliği

Acute Renal Failure in Patients with Massive Pericardial Effusion or Cardiac Tamponade

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ÖZ

GİRİŞ ve AMAÇ: *Akut böbrek yetmezliği (ABY) yoğun bakım ünitelerinde özellikle kritik hastalarda sık karşılaşılan bir durumdur. Akut böbrek yetmezliği prevalansı 3-25% arasında değişmektedir. Koroner yoğun bakım ünitelerindeki (KYBÜ) hastalarda gelişen ABY ile ilgili literatürde yeterli very bulunmamaktadır. Özelllikle massif perikardiyal effüzyon ve kardiyak tamponad bulunan hastalardaki ABY gelişimi için prediktörler bilinmemektedir. Bu çalışmadaki amaç bu hasta grubunda ABY prevalansını ve prediktörlerini belirlemektir.*

YÖNTEM ve GEREÇLER: *Ekim 2014 ile Ocak 2016 arasında KYBÜ'ne 4829 hasta interne edilmiştir. Bu hastalardan 81'inde (1.67%) internasyon süresince masif perikardiyal effüzyon ya da kardiyak tamponad gelişmiştir. Bütün hasta verilerine KYBÜ elektronik veri sisteminden retrospektif olarak ulaşılmıştır. Hastalar ABY prevalansı ve prediktörleri açısından değerlendirilmişlerdir. Hastalar ABY gelişip gelişmediğine gore iki gruba ayrlmışlardır.*

BULGULAR: *Akut böbrek yetmezliği 23 (28.4%) hastada görülmüştür. ABY görülen hastalar daha yaşlı olmakla beraber bu hastalarda kronik böbrek yetmezliği ve konjestif kalp yetmezliği öyküsü daha sık bulunmuştur. Ayrıca bu hastaların arteryel kan basınçları daha düşük saptanmıştır. İki hasta grubunun sol ventrikül ejeksiyon fraksiyonları benzerdir. Bazal kreatinin ve kan üre nitrojen değerleri ABY gelişen hastalarda daha yüksektir. Lojistik regresyon analizinde hipertansiyon öyküsü ve bazal kretainin değeri ABY gelişimini predikte eden parametreler olarak saptanmıştır. Hastane içi mortalite iki hasta grubunda da benzer saptanmıştır.*

TARTIŞMA ve SONUÇ: *Masif perikardiyal effüzyon veya kardiyak tamponad KYBÜ hastalarında önemli bir ABY nedenidir. Hipertansiyon öyküsü ve bazal kreatinin değerleri ABY gelişimini predikte eden parametrelerdir.*

Anahtar Kelimeler: *perikardiyal effüzyon, kardiyak tamponad, akut böbrek yetmezliği*

ABSTRACT

INTRODUCTION: *Acute kidney injury (AKI) is an important complication in intensive care unit especially in critically ill patients. Prevalence of AKI is ranged from 3 to 25% in different intensive care unit series. Knowledge about incidence of AKI in intensive cardiac care units (ICCU) is limited especially in patients with massive pericardial effusion and cardiac tamponad (PEoT). Our aim was to clarify the prevalence and predictors of AKI in these patients.*

METHODS: *Between October 2014-January 2016, 4,829 patients were hospitalized in our ICCU. Eigthy one of these patients (%1.67) were diagnosed with PEoT during their hospitalization. All patients' relevant data gathered retrospectively from hospital ICCU database. Patients were evaluated for AKI, its prevalence and predictors. Patients were divided into two groups according to development of AKI.*

RESULTS: *Acute kidney injury was seen in 23 (%28.4) patients. Patients with AKI were significantly older, had higher chronic renal disease and congestive heart failure history and lower hypertension history. Left ventricular systolic functions were similar in both patient groups. Baseline serum creatinine and blood urea nitrogen (BUN) levels were higher in patients with AKI. Logistic regression analysis revealed that hypertension history and creatinine levels on admission were only predictors of AKI in these patients. In-hospital mortality was similar in both groups.*

DISCUSSION and CONCLUSION: *Massive pericardial effusion or cardiac tamponade is an important cause of AKI especially in patients with hypertension history and high creatinine levels on admission in ICCU.*

Keywords: *pericardial effusion, cardiac tamponade, acute kidney ınjury*

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INTRODUCTION

Accumulation of excessive fluid in the pericardial space occurs due to several distinct etiologies. Many of these effusions are related to idiopathic pericarditis with small transudates (1). Pericardial effusion (PE) also comes forward in patients with chronic renal failure, malignancy, infection, collagen vascular disease and congestive heart failure. Larger pericardial effusions are generally related to specific diagnosis and may require appropriate treatment.

Pericardial effusion is usually asymptomatic, but also has a wide range of clinical spectrum from dyspnea to fatal tamponade (2). In patients with PEoT cardiac filling compromised in diastole, especially during inspiration, further compromises left ventricular filling and results in decreased cardiac output (3). In the follow up period, patients with PEoT may encounter systemic complications secondary to reduced cardiac output, hypotension and systemic hypoperfusion (4).

Acute kidney injury is a common encountered entity in the course of the cardiology patients. AKI is detected <1% in general society, 2-7% in hospital, 5-30% in intensive care units. Despite that, AKI is accepted as a relatively common entity, there is no uniform definition for AKI, and relatively few data regarding its prevalence in hospitalized patients are available (5). However, there is no data according to the AKI incidence in patients with PEoT. Conversely, PEoT can alone result in acute renal failure. The aim of the present study is to evaluate the development and predictors of AKI in PEoT patients .

METHODS

Eighty-one patients who were hospitalized to ICCU with a diagnosis of cardiac tamponade/massive pericardial effusion in October 2014-January 2016 were included in the study. All patients' data retrieved from our hospital Database program retrospectively. The study is approved by the institutional ethical committee. Patients were diagnosed with massive pericardial effusion if they had >20 mm effusion in pericardial space during diastole (6). Cardiac tamponade was diagnosed with TTE according criteria as follows: Right atrium and ventricle diastolic compression and collapse, >30% inspiratory decrease in mitral inflow, >50% inspiratory increase in tricuspid inflow, systolic anterior motion of the mitral valve, swinging heart image in addition to pericardial effusion >20 mm (7). The inclusion criteria was as follows: age≥18 years, PEoT demonstrated by transthoracic echocardiography (TTE), first diagnosis with pericardial effusion, not treated with non-steroidal anti-inflammatory drugs or other nephrotoxic agents recently, not having active systemic infectious disease.

The clinical, hemodynamic and laboratory data were collected as admission and then on daily basis. The treatment regimen of PEoT patients during the hospitalization period was confirmed from hospital recordings. All of them received anti-inflamatory drug (ibuprofen retard 800 mg bid) independent from the effusion etiology and 1cc/kg/h isotonic infusion during the ICCU hospitalization period.

Acute kidney injury diagnosis is optimized by using acute kidney injury network (AKIN) criteria which is as follows: an >0,3mg/dl increase in serum basal creatinine level in 48 hours or a 50% increase in basal serum creatinine or <0,5 ml/kg/h oliguria in more than 6 hours. Patients' daily blood urea nitrogen (BUN), creatinine values measured in the ICCU.

All patients evaluated with transthoracic echocardiography for the diagnosis of the PEoT on admission and before discharge. Left ventricular ejection fraction calculated with biplane model according to the American Society of Echocardiography guidelines before discharge (8).

Statistical analysis

Data will be analyzed with Statistical Package for Social Sciences (SPSS) version 20.0 for Windows (IBM, Armonk, New York). Continuous variables will be defined as mean± standard deviation if distributed normally and as median (interquartile range) if distributed abnormally. Normality of distribution will be assessed using Kolmogorov-Smirnov test. Categorical variables will be presented as number and percentages. Mann-Whitney U test, Kruskal-Wallis, independent samples T test will be used for comparison of two

groups and one-sided variance analysis (ANOVA) will be used for comparison of more than 2 groups. The Chi-squared test will be used for qualitative data. A multivariate logistic regression analysis will be performed for determination of independent predictors of AKI. Statistical significance will be accepted as p<0.05.

RESULTS

The study population was consisted of 81 consecutive patients (mean age 62.9±18.6 years, 46.9% males) who were diagnosed as PEoT. Only 9 patients (11.1%) were hypotensive during admission and pericardiocentesis was performed in 38 patients (46.9%) during cardiac intensive care hospitalization. Nineteen patients (23.5%) underwent surgery due to inadequate pericardiocentesis window, recurrent PEoT and additional cause to perform surgery. Mean creatinine level on admission was 1.43±1.36 mg/dl. There were 11 patients (13.6%) with a history of chronic renal failure and none of them was receiving hemodialysis before hospitalization. AKI defined in 23 patients (28.4%). All patients divided into two groups according to AKI diagnosis during hospitalization period. The baseline characteristics of the study groups are shown in **Table-1.**

Table 1. Demographic and baseline characteristics of patients with PEoT

	AKI(+) (n=27)	AKI (-) (n=56)	p value
Age (years)	71.7±11.8	59.4±19.7	0.006
Male, n(%)	12 (52.2%)	26 (44.8%)	0.62
Female, n(%)	11 (47.8%)	32 (55.2%)	
HT, n(%)	16 (69.6%)	20 (34.5%)	0.006
DM, n(%)	8 (34.8%)	10 (17.2%)	0.13
Smoking, n(%)	4 (17.4%)	10 (17.2%)	1.00
COPD, n(%)	1 (4.3%)	3 (5.2%)	1.00
Chronic renal disease, n(%)	9 (39.1%)	2 (3.4%)	<0.01
CHF, n(%)	5 (21.7%)	3 (5.2%)	0.03
Previous coronary revascularization	1 (4.3%)	3 (5.2%)	1.00

CHF, *Congestive Heart Failure;* ***COPD,*** *Chronic Obstructive Pulmonary Disease;* ***DM,*** *Diabetes Mellitus;* ***HT,*** *Hypertension*

Demographic and clinical parameters were similar between study groups. Patients who experienced AKI are found to be older (p=0.006). Diabetes mellitus disease was similar between two groups whereas hypertension was more frequent in patients with AKI(-). Congestive heart failure history was more prevalent in patients with AKI (+). Chronic renal failure was also significantly higher in patients with AKI (+). Blood pressure on admission was similar in both groups. Left ventricular ejection fraction of these patients was assessed before discharge and was similar between two groups. (p=0.76) **(Table-2).** Mortality was not different between the groups (8.7% vs 11.7%, p=1.0).

Table 2: Clinical Characteristics on Admission

	AKI(+) (n=27)	AKI (-) (n=56)	p value
Hemodynamics			
Normotensive	19 (82.6%)	51 (87.9%)	0.07
Hypotensive	2 (8.7%)	7 (12.1%)	
Hypertensive	2 (8.7%)	0	
BUN (mg/dl)	37.9±21.0	23.4±17.9	0.003
Creatinine (mg/dl)	2.42±2.07	1.03±0.61	<0.01
Hemoglobin (mg/dl)	11.2±1.4	11.6±1.8	0.286
Potassium (mEq/L)	4.31±0.76	4.33±0.58	0.970
CRP (mg/dl)	6.35±5.92	7.97±6.72	0.349
LVEF (%)	56.6±7.9	57.2±8.4	0.791
Treatment method			
Pericardiocentesis	9 (23.7%)	29 (76.3%)	
Surgery	8 (40.0%)	12 (60.0%)	0.401
Medical	6 (26.1%)	17 (73.9%)	

BUN, *Blood Urea Nitrogen;* ***CRP,*** *C-reactive protein;* ***LVEF,*** *Left Ventricular Ejection Fraction*

Univariate analysis revealed that age, history of hypertension, diabetes mellitus, chronic renal failure, congestive heart failure, and blood urea nitrogen and creatinine on admission were predictors of AKI in PEoT patients **(Table 3).**

Table 3. Univariate analysis for AKI in patients with PEoT

	OR	95%CI	p value
Age	1.044	1.010-1.078	0.01
Hypertension	4.343	1.535-12.289	0.006
Diabetes Mellitus	2.560	0.856-7.657	0.093
Chronic renal failure	0.056	0.011-0.286	<0.01
CHF	5.093	1.106-23.450	0.037
BUN	1.036	1.010-1.062	0.006
Creatinine	3.607	1.704-7.633	0.001

BUN, *Blood urea nitrate,* ***CHF,*** *congestive heart failure*

On the other hand in multivariate logistic regression analyses creatinine on admission and hypertension history were found to be independent predictors of AKI in PEoT patients (Table-4).

Table 4. Logistic regression analysis for AKI in patients with PEoT

	OR	95%CI	p value
Creatinine	3.001	1.449-6.214	0.003
Hypertension	4.723	1.309-17.041	0.018
CHF	4.286	0.779-23.589	0.094

CHF, *congestive heart failure*

DISCUSSION

Our study is first data to reveal predictors of AKI in PEoT patients with or without hemodynamic compromise. We demonstrated that prior hypertension and initial creatinine levels are independent predictors of AKI in patients with PEoT.

Acute kidney injury is one of the most frequent complications in patients following up in intensive care units (9). The approach to AKI starts with accurate diagnosis and etiology research. Acute kidney injury occurs 55-60% prerenally. The prerenal causes of AKI are intravascular volume depletion (hemorrhage, increased loss from gastrointestinal system or skin, depletion to 3rd space), decrease in ejection fraction of ventricles (myocardial infarction, pulmonary embolism), systemic vasodilatation (sepsis, cirrhosis, anaphylaxis), renal vasoconstriction (sepsis), drugs that effect auto-regulation and deteriorate glomerular filtration rate (e.g. non-steroidal anti-inflammatory drugs) (10). Our study groups were similar according to drug usage; NSAIDs were started in our intensive care unit. Left ventricular ejection fraction was normal among the groups. We expected to see more hemodynamically deteriorated patients in AKI + group. Whereas admission hemodynamic states of the patients in AKI (+) group was not statistically significant compared to AKI (–) group. The pathophysiology of AKI in PEoT patients is combination of prerenal, renal and postrenal reasons. Renal reserve at cellular level also plays an important role to predict AKI in PEoT patients. Our explanation for hypertension to be an independent factor of AKI development due to its chronic damage to nephrons when combined with PEoT. In our study population the low cardiac output was not predominant factor for AKI development as left ventricular ejection fraction was preserved and hemodynamics on admission was not different between the groups. Thus we can speculate that, in this specific population renal venous congestion secondary to increased peripheral venous pressure could play an important role for AKI development.

The overall incidence of AKI in intensive care patients ranges from 20% to 50% with lower incidence in elective surgical patients and higher incidence in sepsis patients (10). Moreover in coronary care units %28.7 (43/150) of coronary care patients had AKI of varying severity and %80 of these patients was hospitalized with myocardial infarction (11). In our study, all the patients are hospitalized in ICCU with diagnosis of PEoT. 27.7% (23/83) patients suffered from AKI. The AKI prevalence in PEoT patients is similar to intensive care patients. Serum creatinine is generally used to calculate glomerular filtration rate. Moreover, creatinine is found to have many prognostic effects in coronary care patients. In acute coronary syndrome patients, daily serum creatinine value and its change pattern are found to be strong predictors of in-hospital-mortality (12). Preoperative creatinine level is found to be strongest predictor of renal failure requiring hemofiltration after cardiac surgery (13). In our study similar to investigations above initial serum creatinine level was found as an independent predictor factor AKI in PEoT patients.

There is lack of standardized criteria accepted all over the world in terms of AKI. The RIFLE (risk, injury, failure, loss of kidney function, end stage kidney disease), AKIN (acute kidney injury network) and KDIGO (kidney disease improving global outcomes) have been consecutively offered to define acute renal failure in critical ill patients (14). AKIN criteria were used in our study in order to define AKI. AKIN was proposed to refine the RIFLE criteria in 2007 (15). AKIN is one of the most accepted criteria being used universally. Acute kidney injury can be the only finding during the PE disease process. Pericardial effusion appears with a wide spectrum of symptoms in routine

clinical practice. Slowly developing PEs are usually asymptomatic. Sinus tachycardia and hypotension are signs of hemodynamic compromise (16). The rate of fluid accumulation influences the clinical status of the patients. Acute renal failure due to acute cardiac tamponade was reported in the literature (17). Even PE alone without tamponade may present with AKI alone. Gluck et al first reported anuric AKI secondary to PE without tamponade in the literature (18).

Transthoracic echocardiography is the gold standard and most effective technique for the diagnosis of PEoT patients independent from etiology (19). This method is also used in our study as well (20,21). We collected massive PE and tamponade patients retrospectively by using TTE.

STUDY LIMITATIONS

Our study has several limitations. First of all, our study is a retrospective study with a relatively small sample size. Secondly it was a single-center study. Third, as our study's data was collected retrospectively, thus we could not reach the detailed TTE of the patients through the treatment process. Because the etiologies of PE were different in our study population, the response and recovery of the PE varied. The remitted PE patients are less prone to develop AKI during their hospitalization. Although creatinine levels were used in our study to evaluate patients glomerular filtration rate may also be used to evaluate renal functions.

CONCLUSION

Initial serum creatinine levels at admission and hypertension are independent risk factors for AKI in PEoT patients. The results may be explained by decreased renal nephron reserve and increased renal venous congestion leading to decreased glomerular filtration rate in these patients. In addition PEoT may also evoke prerenal AKI by deteriorating cardiac output. Since AKI is a highly prevalent complication in patients with the diagnosis of PEoT in ICCU, prespecifying high risk patients and implementation of specific treatment efforts has a great importance in ICCU practice.

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