Patients With Complex Ventricular Arrhythmias During Hemodialysis Suffer From Unstable Blood Pressure

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Abstract

Purpose: To clarify characteristics of the routine examinations among the patients who show complex ventricular arrhythmias (CVA) during hemodialysis.

Methods: Holter monitoring was performed in 18 chronic hemodialysis patients (12 male/ 6 female, mean 60.6 years old). Between the groups of patients with or without CVA during hemodialysis, various parameters including the patient's background and clinical examinations routinely investigated.

Results: The background of the patients and clinical investigation revealed no significant difference between CVA+ and CVA- patients. Both minimum systolic and diastolic blood pressure revealed difference between CVA+ and CVA- patients (98.7±10.3 vs. 135.5±5.4mmHg; P<0.01). Moreover, mean (maximum systolic blood pressure-minimum systolic blood pressure) of CVA+ patients was significantly higher than that of CVA- patients (42±8 vs 18±6 mmHg; P<0.05).
Conclusion: The patients with CVA during hemodialysis have instability of blood pressure, which suggests their reduced arterial compliance, ventricular hypertrophy and low coronary perfusion.

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INTRODUCTION

Ventricular arrhythmia is a serious problem of hemodialysis patients. Clinicians engaged in hemodialysis are afraid of severe ventricular arrhythmias such as ventricular tachycardia and fibrillation during hemodialysis because it is difficult and dangerous to perform the cardiac resuscitation in a hemodialysis unit. Hemodialysis patients have several disorders of serum ion balance, anemia, and water retention, favoring arrhythmias. Hemodialysis patients administered with digitalis have increased risk of arrhythmia [1]. Age, duration of hemodialysis, and acetate dialysis also have close relation with occurrence of arrhythmias among hemodialysis patients [2,3,4]. A high calcium phosphate product predialysis may be correlated with increased incidence of ventricular arrhythmias [5]. Left ventricular hypertrophy (LVH) leads to ventricular arrhythmias and it is an independent risk factor for cardiac disease in dialysis patients[6]. Hypertension, a well known risk factor for CVA in patients with essential hypertension, is applied to hemodialysis patients [7]. Patients undergoing maintenance hemodialysis are periodically examined about their hematological and biochemical status, electrocardiogram, and chest X-ray. Blood pressure is frequently monitored during hemodialysis. The purpose of the present study is to know the characteristics among patients with CVA during maintenance hemodialysis in their background and routine clinical investigation.

PATIENTS AND METHODS

PATIENTS

We enrolled 18 endstage renal failure patients (12 men/ 6 women) undergoing maintenance hemodialysis in Kitaibaraki General Hospital. Informed consent was obtained in each case. Their ages ranged from 48 to 80 years (mean 60.6). They had undergone hemodialysis for a period ranging from 2 to 255 months (mean 54.3). The etiologies for chronic renal failure were as follows: chronic glomerulonephritis (n=10), diabetic nephropathy (n=7), undetermined (n=1). Twelve patients had been treated with antihypertensive drugs, one patient with digitalis, and one

with antiarrhythmic agent.

HEMODIALYSIS

Hemodialysis was performed using standard techniques with a Gambro polyamide dialyser (Gambro Inc., Tokyo, Japan). The dialysate (Kindary AF2, Fuso Pharmaceuticals Inc., Tokyo, Japan) contained: calcium 3mEq/L, potassium 2mEq/L, sodium 140mEq/L, and carbonic hydrate 30mEq/L as buffer.

EVALUATION OF PARAMETERS

Chest X-ray and resting electrocardiogram were recorded in the morning before hemodialysis. Blood samples for hematological and biological status were drawn before and after hemodialysis. The tape recorders (SM-30, Fukuda Denshi, Tokyo, Japan) were used for Holter monitoring and recordings were analyzed with SCM 280 analyzer (Fukuda Denshi, Tokyo, Japan). Ventricular arrhythmia was defined in accordance with the classification of Lown and Wolf: multiform ventricular premature beats (grade ?), couplets (grade ?a), runs (grade ?b), and R on T (grade V)[8]. Blood pressure was monitored at 15 minutes interval using mercury sphygmomanometers by well-trained staffs of our hemodialysis unit. Between the group of CVA+ and CVA- patients, we compared the following parameters: age, duration of hemodialysis, presence of diabetes, mean amount of ultrafiltration (?BW), maximum systolic and diastolic blood pressure (Max. sBP, Max. dBP, respectively), minimum systolic and diastolic blood pressure (Min. sBP, Min. dBP, respectively), mean Max. sBP-Min. sBP??sBP?, mean Max. dBP-Min. dBP(?dBP), hematocrit, serum level of creatinine, blood urea nitrogen (BUN), serum potassium, serum calcium phosphorus product (Ca×iP), serum magnesium, serum ?2-microglobulin, serum high sensitive parathyroid hormone (HS-PTH), serum human atrial natriuretic polypeptide (HANP), QTc of resting electrocardiogram, and cardio-thoracic ratio on chest X-ray.

STATISTICAL ANALYSIS

Statistical analysis was performed using Student's unpaired t test. If necessary, ?2 test was adopted. Results were expressed as mean ±standard error (SE) when appropriate. A value of $P<0.05$ was considered significant.

RESULTS

All patients accomplished this study. Six of 18 patients showed CVA during hemodialysis. CVA+ group consisted of one diabetic and 5 non-diabetic patients, whereas 6 diabetic and 6 non-diabetic patients were in CVA- group. The number of the CVA+ patients who belonged to the Lown's classification ?a was 1 and ? was 5.

No differences were apparent between CVA+ and CVA- patients in respect to age, duration of hemodialysis, ?BW, hematocrit, serum creatinine, BUN, serum potassium, serum calcium, serum phosphorus, serum magnesium, serum ?2-microglobulin, serum HS-PTH, serum HANP, QTc of resting electrocardiogram, and cardio-thoracic ratio on chest X-ray. Ca×iP did not show significant difference, either. Max. sBP and Max. dBP showed no difference between both groups. Min. sBP level of CVA+ patients was lower than CVA- patients (98.7±10.3 vs 135.5±5.4mmHg; $P<0.05$). Therefore, ?sBP level was significantly higher in CVA+ patients compared to CVA- patients (41.7±8.2 vs 18.2±6.4mmHg; $P<0.05$). Moreover, Min. dBP level of CVA+ patients was lower than CVA- patients(59.3±4.4 vs 72.0±3.3mmHg; $P<0.05$) (Table 1).

Figure 1

Table 1: Compared multiple parameters between CVA+ and CVA- patients.

	CVA+ (n=6)	**CVA-** (n=12)	P value
Diabetes	1	6	P>0.05
Age(year)	64.8±4.9	58.5±2.1	0.18
Duration of hemodialysis(month)	86.3±35.4	41.3±8.5	0.17
QTc(second)	0.443±0.018	0.443±0.009	0.99
Cardio-thoracic ratio(%)	51.8±1.4	52.7±1.2	0.65
Max. sBP(mmHg)	148.7±4.7	153.3±4.5	0.53
Max. dBP(mmHg)	83.3±5.8	83.2±2.9	0.98
Min. sBP(mmHg)	98.7±10.3	135.5±5.4	<0.01**
Min. dBP(mmHg)	59.3±4.4	72.0±3.3	0.02*
□sBP(mmHg)	41.7±8.2	18.2±6.4	0.04*
□dBP(mmHg)	24.0±5.2	12.0±4.2	0.1*
amount of ultrafiltration(Kg)	2.1±0.5	2.3±0.3	0.76
Hematocrit(%)	29.1±1.0	28.1±0.7	0.44
Creatinine(mg/dl)	11.4±0.8	12.2±0.5	0.38
Blood urea nitrogen(mg/dl)	68.0±4.2	76.0±5.8	0.37
Sodium(mmol/l)	138.0±1.0	137.6±0.5	0.43
Potassium(mmol/l)	4.4±0.2	4.5±0.1	0.79
Calcium(mg/dl)	9.6±0.3	9.0±0.3	0.17
Phosphorus(mg/dl)	6.5±0.4	5.9±0.3	0.32
Ca×iP	62.5±4.4	53.5±3.5	0.15
Magnesium(mmol/l)	2.5±0.1	2.6±0.1	0.61
High sensitive PTH(pg/ml)	7962±3644	10610±2922	0.59
b2-microglobulin	35.2±3.7	34.0±2.7	0.78
hANP(pg/ml)	51.8±1.4	52.7±1.2	0.65

DISCUSSION

CVA was shown in 6 of 18 hemodialysis patients during

routine dialysis. Kyriakidis et al. stated that hemodialysis had no influence on type or frequency of arrhythmias, however their patients were much younger than ours (41 years old)[9]. Our patients were 60.6 years old and this population reflects the characteristics of Japanese hemodialysis patients[10]. Arrhythmias are very frequent in the elderly during dialysis because metastatic calcification, amyloid filtration, coronary heart disease, cardiac hypertrophy, and hypertension are more severe than younger patients[11].

An adequate blood pressure control with less than 5% of the patients is achieved even with long-treatment-time dialysis[12]. Hypotension during hemodialysis is common in elderly, occurring in 20 to 30% of patients, and is multifocal origin[13, 14]. In this study, we found ?sBP level during hemodialysis of CVA+ patients was higher than that of CVA- patients. It is suggested that they keep high blood pressure when they are free from hemodialysis, but they cannot sustain pressure level during hemodialysis. The level of ?Bw between CVA+ and CVA- patients was not significantly different so their ultrafiltration rate was considered to be equal. This fact suggests that patients with CVA during hemodialysis have reduced arterial compliance. Peripheral vascular changes including a reduced venous and arterial compliance have been already found among hemodialysis patients [15]. Arterial compliance affects pulse pressure amplitude by an increased velocity of pressure wave through the stiffened arterial system, resulting in a change on the timing and incidence of reflected waves [18]. This effect is one of the contributors by which a decreased arterial compliance develops LVH [16]. LVH is a major risk factor for ventricular arrhythmias and cardiac diseases [6].

We also found that CVA+ patients had significant lower level of Min. dBP than CVA- patients. Angina-like symptoms are often found among hemodialysis patients when their blood pressure falls greatly during hemodialysis. Especially, aged patients with coronary insufficiency are more prone to occurring of angina during hemodialysis and this may be aggravated by LVH [17]. The aortic-left ventricular diastolic blood pressure and the time spent in a diastole are the major determinant of coronary blood flow[18]. It is suggested that coronary blood flow is decreased by the factors decreasing aortic-left ventricular diastolic pressure. Reflex tachycardia that develops in response to fall in blood pressure would occurs at the time of hemodialysis related hypotension.

In non-uremic subjects, alterations of arterial elastic properties are influenced by the control of blood pressure and aging [19, 20]. Stiffening of arterial vessels is caused by structural changes of the vascular walls as atherosclerosis, medial and intimal thickening, accumulation of collagen fibers, deposition of calcium, and degeneration of elastic lamina [21]. Intimal thickening and medial calcification are frequently seen in hemodialysis patients. Diffuse myocardial calcification has been documented in patients with chronic renal failure [22].

CONCLUSION

Chronic hemodialysis patients who show CVA during hemodialysis have instability of blood pressure. It suggests their reduced arterial compliance and left ventricular hypertrophy. Furthermore, their greater fall of diastolic pressure may influence coronary perfusion. These factors are determinants of occurring ventricular arrhythmias. Continuous or frequent blood pressure and elecrocardiogram monitoring during hemodialysis benefits high-risk patients for CVA.

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