

Low Postdialytic Calcium would Deteriorate All Cause and Cardiovascular Mortality in the Patients with Maintenance Dialysis.

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OBJECTIVES

- Predialytic electrolytes, sodium, potassium, calcium and phosphorus, have been reported as the prognostic factors for dialysis patients in many literature¹⁾⁻⁶⁾. Whereas it is not clarified whether postdialytic electrolytes affect their prognosis.
- In this study, we investigated the relationship between postdialytic electrolytes and mortality for dialysis patients in our prospective dialysis cohort.

METHODS

- A total of 376 patients (226 males and 150 females) in our dialysis database enrolled in the study.
- The prognostic factors for all-cause and cardiovascular mortality were extracted from 45 background factors (shown in Table 1), including time-averaged postdialytic sodium (Na), potassium (K), calcium (Ca) and phosphorus (P), using Cox regression model.
- Continuous variables in extracted factors were evaluated their predictive accuracy and their cut-off values were determined by ROC analysis.

Table 1. Profile of eligible patients

Age	(year)	68.0	±	6.7
Gender	(M : F)	226	:	150
Vintage of dialysis	(year)	4.4	±	3.2
Comorbidity				
Diabetes	(n)	144		
Intradialytic hypotension	(n)	121		
Coronary heart disease	(n)	74		
CHF	(n)	42		
Stroke	(n)	31		
PAD	(n)	42		
Predialysis SBP	(mmHg)	143.2	±	10.4
Predialysis DBP	(mmHg)	72.7	±	6.1
Predialysis laboratory data				
BUN	(mg/dL)	60.7	±	5.3
Kt/V		0.96	±	0.10
Albumin	(g/dL)	3.56	±	0.19
Uric acid	(mg/dL)	7.08	±	0.56
Hb	(g/dL)	10.18	±	0.32
CRP	(mg/dL)	1.00	±	0.68
Sodium	(mEq/L)	138.8	±	1.3
Potassium	(mEq/L)	4.90	±	0.27
Ca	(mg/dL)	8.56	±	0.25
P	(mg/dL)	5.23	±	0.44
ALP	(IU/L)	310.9	±	89.9
Intact PTH	(pg/mL)	230.3	±	107.4
TC	(mg/dL)	158.6	±	17.0
Blood glucose	(mg/dL)	126.0	±	20.1
HCV positive	(n)	18		
Postdialysis laboratory data				
Sodium	(mEq/L)	141.9	±	0.7
Potassium	(mEq/L)	3.60	±	0.12
Ca	(mg/dL)	9.03	±	0.28
P	(mg/dL)	2.53	±	0.21
AF	(n)	31		
ST-T change in resting ECG	(n)	133		
Medication				
ACEI	(n)	35		
ARB	(n)	235		
CCB	(n)	291		
Beta blocker	(n)	147		
Statins	(n)	49		
CaCO3	(n)	227		
Sevelamer	(n)	104		
Oral VD3	(n)	227		
Intravenous VD3	(n)	112		
Aspirin	(n)	119		
ADP-antagonist	(n)	52		
Warfarin	(n)	27		
Weekly dose of Epoetin	(U/W)	7329.3	±	2270.4
Follow up period	(year)	5.1	±	1.6

CHF, congestive heart disease; CVD, cerebrovascular disease; PAD, peripheral artery disease; SBP, systolic blood pressure; DBP, diastolic blood pressure; BUN, blood urea nitrogen; Alb, albumin; Hb, hemoglobin; Ca, calcium; P, phosphorus; ALP, alkaline phosphatase; TC, total cholesterol; AF, atrial fibrillation; AsAC score, ascending aorta calcification score; ACEI, angiotensin converting enzyme inhibitor; ARB, angiotensin II receptor blocker; CCB, calcium channel blocker; VD3, Vitamin D3

RESULTS

Table 2. Cause of death

Cardiovascular death	91
CHF	28
Acute coronary syndrome	6
Cardiac sudden death	30
Cerebral infarction	10
Cerebral hemorrhage	6
Aortic and peripheral artery disease	11
Death of other cause	58
Infection	36
Malignancy	5
Hepatic failure	5
Others	12
Total	149

CHF, congestive heart failure

Table 3. Prognostic Factor for All Cause Death

	Exp(B)	95%CI	p value
Age (per +1year old)	1.041	1.022-1.059	<0.001
CRP (per +1mg/dL)	1.490	1.330-1.670	<0.001
Predialytic Na (per +1mEq/L)	0.781	0.712-0.857	<0.001
AF	2.781	1.642-4.710	<0.001
Use of CaCO3	0.646	0.450-0.927	0.018
Use of H1RA	0.489	0.302-0.791	0.004
Postdialytic Na (per +1mEq/L)	1.256	1.054-1.496	0.011
Postdialytic Ca (per +1mg/dL)	0.026	0.129-0.328	<0.001

95%CI, 95% confidential interval; CRP, c-reactive protein; AF, atrial fibrillation; H1RA, H1 receptor antagonist

Table 4. Prognostic Factor for Cardiovascular Death

	Exp(B)	95%CI	p value
Age (per +1year old)	1.043	1.020-1.067	<0.001
CRP (per +1mg/dL)	1.370	1.164-1.613	<0.001
Predialytic Na (per +1mEq/L)	0.825	0.755-0.901	<0.001
Predialytic Ca (per +1mg/dL)	2.300	1.245-4.247	0.008
AF	3.244	1.710-6.156	<0.001
HCV positive	0.208	0.060-0.719	0.013
Use of CCB	0.540	0.342-0.855	0.008
Use of H1RA	0.360	0.191-0.677	0.002
Postdialytic Ca (per +1mg/dL)	0.118	0.056-0.248	<0.001

CRP, c-reactive protein; AF, atrial fibrillation; CCB, Calcium Channel Blocker; H1RA, H1 receptor antagonist

Table 5. Cut-Off Value and AUC on Each Prognostic Factor

	All Cause Death				Cardiovascular Death			
	Cut-off value	Sensitivity	Specificity	AUC	Cut-off value	Sensitivity	Specificity	AUC
Age	64.2	0.853	0.511	0.733	64.2	0.868	0.441	0.674
CRP	0.548	0.713	0.727	0.765	0.569	0.692	0.654	0.676
Predialytic Na	140.9	0.893	0.260	0.655	140.3	0.846	0.339	0.643
Predialytic Ca					8.81	0.725	0.318	0.546
Postdialytic Na	143.6	0.960	0.070	0.626				
Postdialytic Ca	9.22	0.880	0.529	0.799	9.24	0.846	0.427	0.706

AUC, area under curve; CRP, c-reactive protein

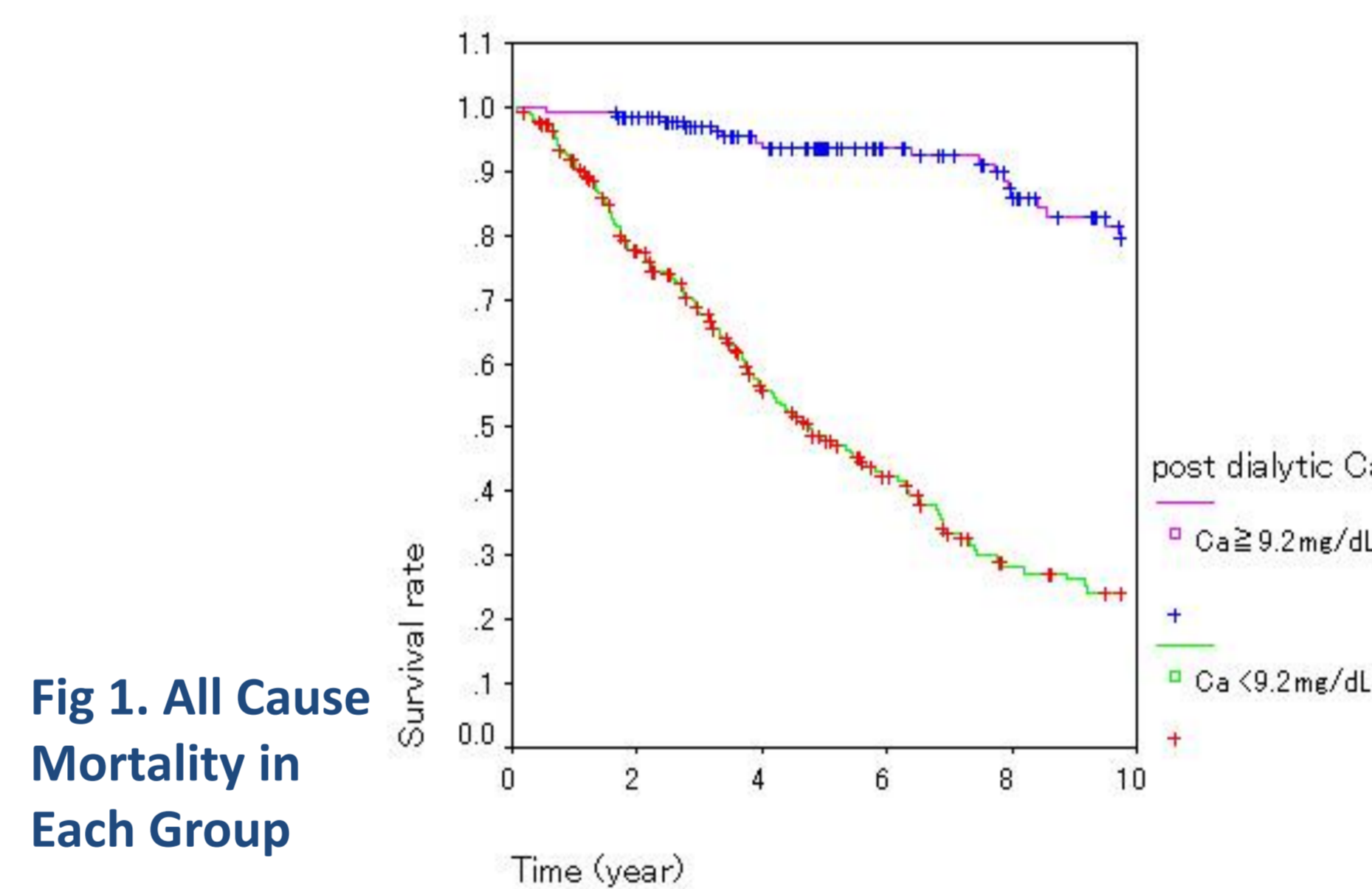


Fig 1. All Cause Mortality in Each Group

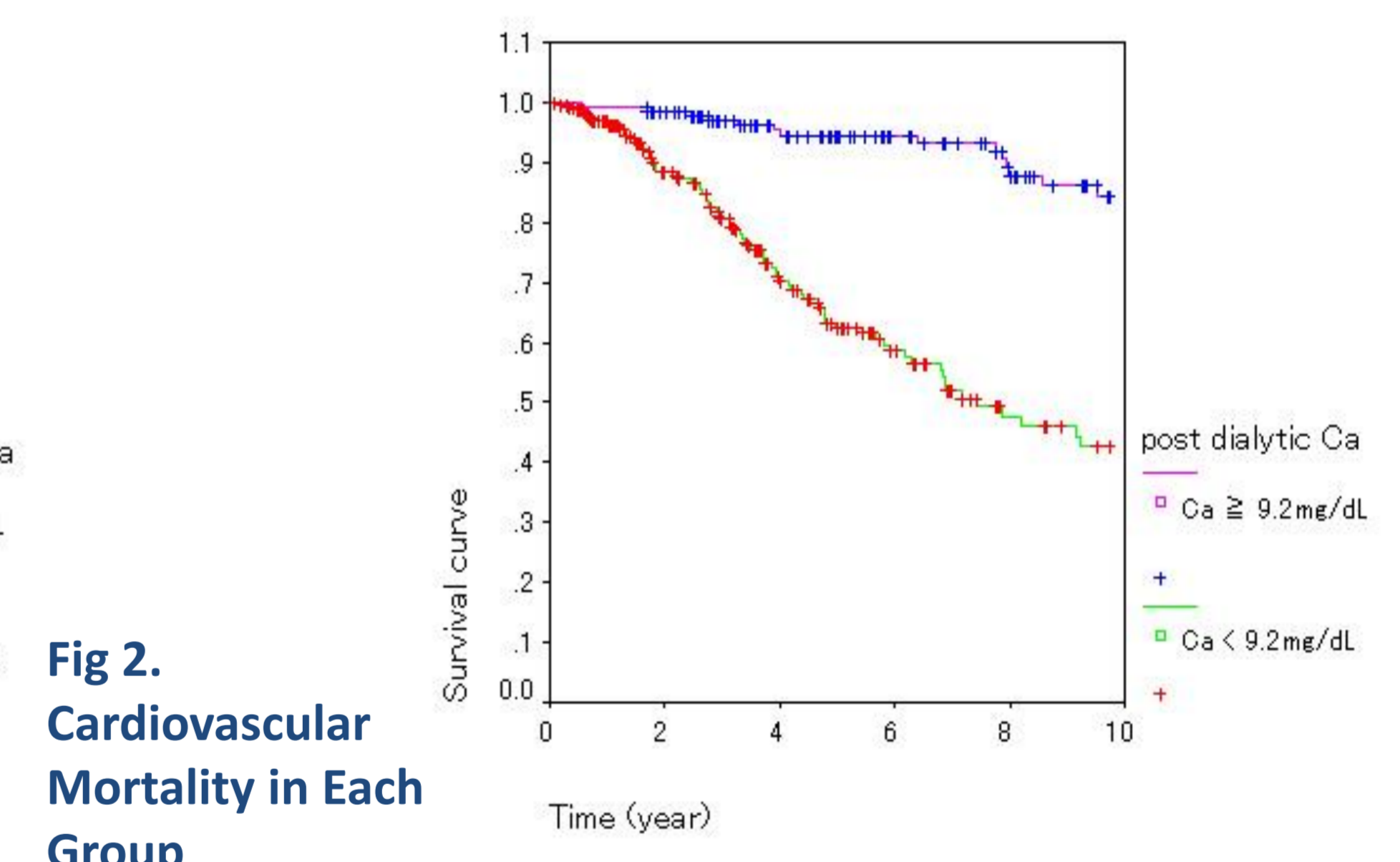


Fig 2. Cardiovascular Mortality in Each Group

SUMMURIES and DISCUSSIONS

- As the prognostic factors for all-cause death (ACD), age, CRP, comorbidity of atrial fibrillation (AF), predialytic Na, postdialytic Na and Ca were extracted from multivariate analysis and the hazard ratios (HR) were 1.041, 1.490, 2.781, 0.781, 1.256 and 0.206, respectively (table 3).
- As the prognostic factors for Cardiovascular death (CVD), age, CRP, comorbidity of AF, predialytic Na, predialytic Ca and postdialytic Ca were extracted and HR were 1.043, 1.370, 3.244, 0.825, 2.300 and 0.118, respectively (table 4).
- AUC of postdialytic Ca was the largest on each end point, indicating most superior predictive value among all extracted factors. The cut-off values on postdialytic Ca for ACD and CVD were both 9.2mg/dL (table 5).
- At the moment there is no report on relationship between postdialytic Ca and mortality in dialysis patients, while several reports showed intradialytic and postdialytic hypotension occurred by intradialytic low ionized Ca^{7),8)}. Moreover, 2 times increase of cardiac sudden death with low Ca dialysate was reported⁹⁾.
- In this study, negative correlation of postdialytic Ca with intradialytic hypotension was clarified (shown in table 6), suggesting that hemodynamic changes would be one of the mechanism on high mortality in patients with postdialytic relative hypocalcemia.

Table 6. Factors associated with Intradialytic Hypotension

	Exp(B)	95%CI	p value
CHF	2.291	1.070-4.905	0.033
Predialytic SBP (per +1mmHg)	0.976	0.963-0.989	<0.001
Albumin (per +1g/dL)	0.286	0.121-0.676	0.004
Predialytic Serum Phosphorus (per +1mg/dL)	1.567	1.116-2.200	0.009
ST-T change in resting ECG	2.427	1.444-4.077	<0.001
Use of ARB	0.560	0.331-0.946	0.030
Use of Sevelamer	2.472	1.398-4.372	0.002
Postdialytic Serum Calcium (per +1mg/dL)	0.383	0.129-0.328	<0.001

CHF, congestive heart failure; SBP, systolic blood pressure; ECG, electrocardiogram; ARB, angiotensin II receptor blocker

CONCLUSIONS

- This study indicated that dialysis patients with less than 9.2 mg/dL of postdialytic Ca showed poor prognosis for both ACD and CVD.
- Prospective multicenter study must be needed in the future.

- REFERENCES**
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CONFLICT of INTERESTS

: None