# A DECREASE OF THE ANKLE-BRACHIAL PRESSURE INDEX (ABI) IS THE IMPORTANT RISK FACTORS FOR MORTALITY IN LONG-TERM DIALYSIS PATIENTS

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## OBJECTIVES

Peripheral artery disease (PAD) is a regular complication of hemodialysis patients [1, 2] and is associated with poor outcomes[2-7]. Clinically, the ankle-brachial blood pressure index (ABI) is highly correlated with PAD of the lower extremities[8], and ABI is an independent predictor of all-cause mortality in hemodialysis patients [4-7].

A recent study also revealed that not only the value of the ABI itself, but also the rate of the reduction in the ABI was a risk factor for cardiovascular mortality[9].

In the present study, we investigated the effect of changes in the ABI on mortality and the factors that predict changes in the ABI in hemodialysis patients.

## METHODS

A total of 61 consecutive patients receiving maintenance hemodialysis who successfully underwent ABI examinations in both 2005 and 2011 were retrospectively enrolled in this study. All patients were not treated by interventional or surgical repair for PAD during 2005 and 2011.

The blood pressure was measured after the patients had rested in a supine position for at least 5 min. Patients who failed to measure ABI of either side of legs were excluded from the study. The change in the ABI (2011 measurement versus 2005 measurement) was estimated. ⊿ABI was defined and estimated as the following formula.

**⊿ ABI=ABI in 2011 – ABI in 2005**

We set the baseline at 2011 and investigated the patient outcomes. The clinical endpoints were defined as cardiovascular disease (CVD) events and death from any cause. The smaller values for either ABI or ⊿ABI among the two values of both legs were adopted and incorporated into the analysis. The data were expressed as the means ± S.D or median (quartile) (interquartile range: IQR).

Cox proportional hazards model was used to examine predictors of overall outcomes. A simple regression analysis was used to examine the relationship between two continuous variables.

Cox proportional hazards analysis of the covariates for predicting mortality (univariate analysis)

| Parameters (n=61) | Hazard Ratio (95% CI) | P value |
|---|---|---|
| **ABI (per 0.1)*** | 0.43 (0.25 to 0.64) | <0.0001 |
| **ΔABI (per 0.1)*** | 0.62 (0.49 to 0.79) | <0.001 |
| Age (per 1 year) | 1.06 (1.00 to 1.13) | 0.048 |
| Gender (M) | 0.77 (0.34 to 1.64) | 0.493 |
| Duration of HD (per 1 year) | 1.00 (0.91 to 1.09) | 0.969 |
| Albumin (per 1 g/dL) | 0.12 (0.02 to 0.82) | 0.032 |
| Creatinine (per 1 mg/dL) | 0.49 (0.32 to 0.71) | <0.001 |
| Uric acid (per 1 mg/dL) | 0.42 (0.20 to 0.80) | 0.008 |
| Corrected Calcium (per 1 mg/dL) | 1.14 (0.42 to 2.81) | 0.789 |
| Phosphate (per 1 mg/dL) | 0.26 (0.09 to 0.65) | 0.002 |
| Ca x P (per 1 (mg/dL)2) | 0.98 (0.92 to 1.03) | 0.446 |
| Total-Cholesterol (per 1 mg/dL) | 1.00 (0.98 to 1.02) | 0.919 |
| Triglyceride (per 1 mg/dL) | 1.00 (0.98 to 1.02) | 0.916 |
| c-reactive protein (per 1 mg/dL) | 1.04 (0.29 to 1.75) | 0.912 |
| Hemoglobin (per 1 g/dL) | 0.60 (0.25 to 1.44) | 0.25 |
| Hypertension (Y) | 2.15 (0.89 to 9.36) | 0.095 |
| Diabetes mellitus(Y) | 0.95 (0.22 to 2.29) | 0.918 |

Cox proportional hazards analysis of the covariates for predicting composite endpoints including cardiovascular events and mortality (univariate analysis)

| Parameters (n=61) | Hazard Ratio (95% CI) | P value |
|---|---|---|
| **ABI (per 0.1)*** | 0.65 (0.50 to 0.86) | 0.025 |
| **ΔABI (per 0.1)*** | 0.73 (0.61 to 0.90) | 0.005 |
| Age (per 1 year) | 1.04 (1.00 to 1.09) | 0.044 |
| Gender (M) | 1.25 (0.73 to 2.25) | 0.419 |
| Duration of HD (per 1 year) | 1.03 (0.97 to 1.09) | 0.357 |
| Albumin (per 1 g/dL) | 0.16 (0.05 to 0.64) | 0.011 |
| Creatinine (per 1 mg/dL) | 0.67 (0.52 to 0.86) | 0.001 |
| Uric acid (per 1 mg/dL) | 0.80 (0.51 to 1.21) | 0.294 |
| Corrected Calcium (per 1 mg/dL) | 1.68 (0.74 to 3.64) | 0.211 |
| Phosphate (per 1 mg/dL) | 0.60 (0.34 to 0.96) | 0.033 |
| Ca x P (per 1 (mg/dL)2) | 0.96 (0.91 to 1.01) | 0.084 |
| Total-Cholesterol (per 1 mg/dL) | 0.99 (0.97 to 1.00) | 0.141 |
| Triglyceride (per 1 mg/dL) | 1.01 (1.00 to 1.02) | 0.153 |
| c-reactive protein (per 1 mg/dL) | 1.44 (0.84 to 2.05) | 0.154 |
| Hemoglobin (per 1 g/dL) | 0.52 (0.27 to 0.98) | 0.042 |
| Hypertension (Y) | 1.40 (0.81 to 2.67) | 0.239 |
| Diabetes mellitus(Y) | 0.62 ( 0.15 to 1.40) | 0.299 |

The relationship between the change of ABI (2005 to 2011) and other clinical parameters of 2005.

| | r | P value |
|---|---|---|
| Age (year) | -0.1968 | 0.030 |
| Duration of HD (year) | 0.0762 | 0.404 |
| Albumin (g/dL) | 0.0490 | 0.592 |
| Creatinine (mg/dL) | 0.2079 | 0.022 |
| Corrected Calcium (mg/dL) | 0.0783 | 0.391 |
| Phosphate (mg/dL) | -0.0371 | 0.685 |
| Ca x P $(mg/dL)^2$ | 0.0542 | 0.553 |
| Total-Cholesterol (mg/dL) | -0.1385 | 0.128 |
| Triglyceride (mg/dL) | -0.0002 | 0.998 |
| c-reactive protein (mg/dL) | 0.1233 | 0.176 |
| Hemoglobin (g/dL) | -0.0134 | 0.884 |

HD: hemodialysis, Ca: calcium, P: phosphate,
ABI: ankle-brachial blood pressure index,
*ABI and ⊿ABI: smaller values among both legs
⊿ABI=ABI in 2011 – ABI in 2005
ESKD: end-stage kidney disease Mean ± SD, Median (interquartile range: IQR)

Background characteristics of the study participants

| | All patients (n= 61) |
|---|---|
| Age (year) | 57.2 ± 13.2 |
| Gender (M/F) | 33 / 28 |
| Duration of HD (year) | 19.8 (11.1 – 28.1) |
| Albumin (g/dL) | 3.7 ± 0.3 |
| Creatinine (mg/dL) | 11.8 ± 2.3 |
| Uric acid (mg/dL) | 7.7 ± 1.4 |
| Corrected Calcium (mg/dL) | 9.4 ± 0.8 |
| Phosphate (mg/dL) | 5.4 ± 1.4 |
| Ca x P (mg/dL)2 | 50.6 ± 12.2 |
| Total-Cholesterol (mg/dL) | 159 ± 36 |
| Triglyceride (mg/dL) | 102 ± 41 |
| c-reactive protein (mg/dL) | 0.07 (0.05 – 0.16) |
| Hemoglobin (g/dL) | 10.7 ± 0.8 |
| Primary Cause of ESKD, n (%) | |
| Chronic glomerulonephritis | 43 (70.5) |
| Diabetic Nephropathy | 5 (8.2) |
| Polycystic kidney disease | 3 (4.9) |
| Chronic pyelonephritis | 1 (1.7) |
| Post transplantation | 8 (13.1) |
| Unknown and others | 1 (1.7) |
| Complication, n (%) | |
| Hypertension | 36 (59.0) |
| Diabetes mellitus | 9 (14.8) |

## RESULTS

The mean follow-up period was 3.1 ± 0.7 years. During the follow-up period, 7 deaths were recorded. The causes of death were infection in 5 cases, cerebrovascular disease in one case, and unknown in one case. In the Cox proportional hazard analysis, predictive variables for mortality included ABI (0.43 [0.25–0.64]; [per 0.1 increase]), and the change of ABI (0.62 [0.49–0.79]; [per 0.1 increase]).

Patient age was negatively correlated and the serum creatinine level was positively correlated with the change in the ABI (P = 0.030 and 0.022, respectively).

## CONCLUSIONS

We confirmed that not only the value of the ABI itself, but also the change in the ABI was a risk factor for mortality among hemodialysis patients. Careful attention should be given to changes in the ABI as well as the value of the ABI itself. The change in the ABI was negatively correlated with age and was positively correlated with the serum creatinine level. Careful observation of the ABI is needed for old patients and patients with a low serum creatinine level.

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