# Prediction of Hemodialysis Vascular Access Failure Using Data From Segmental Bioimpedance Analysis

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## BACKGROUNDS

◆ Hemodialysis (HD) vascular access dysfunction is a major cause of morbidity and hospitalization in patients with end-stage renal disease (ESRD) on HD. Although most patients on HD undergo surveillance monitoring for vascular access such as measurement of access flow, the results have been variable and inconsistent.

◆ Bioimpedance analysis (BIA) has been widely used for the assessment of body water volume and nutritional status in patients with ESRD.

## PURPOSE

◆ The purpose of this study was to investigate whether segmental BIA can properly identifies regional fluid changes of limbs of ESRD patients on HD and it can be used to predict HD vascular access failure.

## SUBJECTS & METHODS

◆ ***Patient group***

- 87 ESRD on HD
- Age: 63.5 ± 14.4 years
- 48 male, 39 female
- HD duration: 55.6 ± 50.2 months

Body composition measurements of post-dialysis patients were carried out by segmental BIA, using eight tractile electrodes according to the manufacturer's instructions (InBody 2.0, Biospace Co. Ltd, Seoul, Korea). The difference of water volume between upper limbs was calculated from water volume of upper limb with vascular access for HD minus that of the opposite upper limb. Demographical, clinical and laboratory data at the time of the measurement of body composition were recorded. The primary outcome was primary unassisted vascular access patency within 3 months.

## RESULTS

**Table 1. Baseline characteristics of patients according to the difference of water volume between upper limbs**

| Characteristics | Lowest tertile (<7.9%, n=29) | Middle tertile (7.9~13.3%, n=29) | Highest tertile (>13.3%, n=29) | *P*-value |
|---|---|---|---|---|
| Age, years | 59.4 ± 16.0 | 68.1 ± 13.3 | 63.0 ± 12.9 | 0.069 |
| Male, *n* (%) | 19 (66) | 16 (55) | 13 (45) | 0.285 |
| Body mass index, kg/m$^2$ | 23.4 ± 3.8 | 23.1 ± 2.6 | 22.6 ± 4.2 | 0.674 |
| Duration of hemodialysis, months | 46.8 ± 39.2 | 59.0 ± 46.1 | 61.0 ± 62.9 | 0.513 |
| Hypertension, n (%) | 27 (93) | 26 (90) | 26 (90) | 0.871 |
| Diabetes mellitus, n (%) | 16 (55) | 11 (38) | 16 (55) | 0.371 |
| Coronary artery disease, n (%) | 8 (28) | 8 (28) | 4 (14) | 0.354 |
| Arteriovenous fistula, n (%) | 26 (90) | 24 (83) | 22 (76) | 0.380 |
| Single pool Kt/V | 1.58 ± 0.25 | 1.47 ± 0.18 | 1.62 ± 0.30 | 0.172 |
| ACEIs or ARBs, n (%) | 15 (52) | 11 (38) | 18 (62) | 0.182 |
| Beta-blockers, n (%) | 12 (41) | 10 (35) | 16 (55) | 0.270 |
| Calcium channel blockers, n (%) | 15 (52) | 13 (45) | 16 (55) | 0.725 |
| Vasodilators, n (%) | 2 (7) | 5 (17) | 4 (14) | 0.483 |
| Statin, n (%) | 10 (35) | 17 (59) | 11 (38) | 0.134 |
| Anti-platelet agents, n (%) | 20 (69) | 22 (76) | 13 (45) | 0.058 |
| Hemoglobin, g/dL | 10.9 ± 1.0 | 10.5 ± 0.6 | 10.3 ± 1.4 | 0.076 |
| Serum albumin, g/dL | 3.6 ± 0.4 | 3.7 ± 0.3 | 3.6 ± 0.3 | 0.713 |
| Calcium-phosphorus product, mg$^2$/dL$^2$ | 48.7 ± 17.6 | 42.7 ± 13.6 | 44.0 ± 19.8 | 0.374 |
| LDL-cholesterol, mg/dL | 77.3 ± 25.3 | 73.9 ± 24.3 | 84.9 ± 31.4 | 0.306 |
| Ferritin, ng/ml median (interquartile range) | 139.0 (74.6~261.6) | 142.7 (75.8~257.4) | 154.5 (115.2~273.4) | 0.453 |

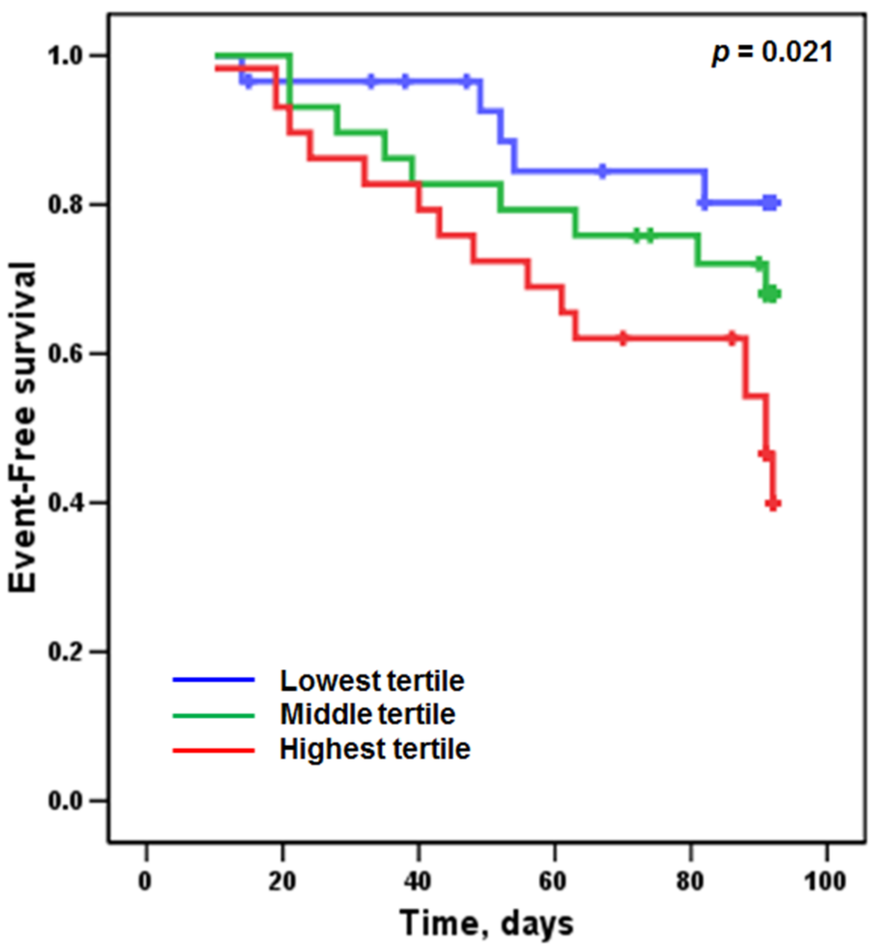
**ACEI = angiotensin converting enzyme inhibitor; ARB = angiotensin II receptor blocker**
**LDL = low density lipoprotein**

**Table 2. Predictors for hemodialysis vascular assess failure**

| | Univariate | | Multivariate | |
|---|---|---|---|---|
| Covariate | HR (95% CI) | P-value | HR (95% CI) | P-value |
| Age, per year | 1.042 (1.009–1.076) | 0.013 | 1.035 (0.992–1.080) | 0.112 |
| Gender, male/female | 0.883 (0.431–1.809) | 0.733 | 1.478 (0.570–3.832) | 0.421 |
| Body mass index, per kg/m$^2$ | 0.948 (0.858–1.048) | 0.295 | | |
| Hemodialysis duration* | 1.001 (0.994–1.007) | 0.847 | | |
| Hypertension | 0.829 (0.251–2.735) | 0.758 | | |
| Diabetes mellitus | 1.258 (0.613–2.578) | 0.532 | 0.536 (0.190–1.517) | 0.240 |
| Coronary artery disease | 2.365 (1.121–4.989) | 0.024 | 2.927 (1.037–8.261) | 0.042 |
| AVF vs. AVG | 0.265 (0.125–0.562) | 0.001 | 0.251 (0.098–0.644) | 0.004 |
| ACEIs or ARBs | 0.832 (0.406–1.705) | 0.615 | | |
| Beta-blockers | 1.380 (0.674–2.825) | 0.379 | | |
| Calcium channel blockers | 0.741 (0.360–1.526) | 0.416 | | |
| Statins | 1.980 (0.960–4.082) | 0.064 | 2.368 (0.839–6.685) | 0.103 |
| Anti-Platelet agents | 1.092 (0.520–2.295) | 0.816 | | |
| Single-pool Kt/V, per 1 | 1.748 (0.277–11.024) | 0.552 | | |
| Hemoglobin, per g/dl | 1.017 (0.721–1.433) | 0.924 | | |
| Serum albumin, per g/dl | 1.240 (0.359–4.284) | 0.734 | | |
| LDL cholesterol, per mg/dl | 1.002 (0.988–1.016) | 0.775 | | |
| HDL cholesterol, per mg/dl | 0.989 (0.961–1.018) | 0.473 | | |
| Triglyceride, per mg/dl* | 1.460 (0.784–2.717) | 0.233 | 2.136 (0.814–5.604) | 0.123 |
| Total calcium, per mg/dl | 0.809 (0.537–1.218) | 0.309 | | |
| Phosphate, per mg/dl | 1.109 (0.920–1.337) | 0.278 | 1.068 (0.841–1.356) | 0.589 |
| Parathyroid hormone, per pg/ml* | 0.881 (0.630–1.232) | 0.460 | | |
| Ferritin, per ng/ml* | 1.834 (0.973–3.456) | 0.061 | 1.818 (0.930–3.557) | 0.081 |
| Difference of water volume between upper limbs | | | | |
| Lowest tertile | reference | | | |
| Middle tertile | 1.739 (0.583–5.191) | 0.321 | 1.115 (0.355–3.500) | 0.852 |
| Highest tertile | 3.501 (1.282–9.562) | 0.014 | 3.284 (1.151–9.364) | 0.026 |

***Indicate log values.**
**ACEI = angiotensin converting enzyme inhibitor; ARB = angiotensin II receptor blocker; LDL = low density lipoprotein; AVF = arteriovenous fistula; AVG = arteriovenous graft; CI = confidence interval; HDL = high-density lipoprotein; HR = Hazard ratio; LDL = low-density lipoprotein**

**Figure 1. Kaplan-Meier analysis for hemodialysis vascular access survival according to the difference of water volume between upper limbs**




## SUMMARY

◆ Segmental BIA may be used as a tool that predict vascular access failure in the patients with ESRD on HD through calculating the difference of water volume between upper limbs.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