

Usefulness of Bioelectrical Impedance Analysis to Measure Calcium Channel Blockers-Related Edema

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Background/Aims: Dihydropyridine calcium channel blockers (CCBs) are one of the most common antihypertensive agents; however, are often associated with peripheral edema, a cause for poor drug adherence. This study aimed to objectively evaluate CCBs-related peripheral edema using Bioelectrical Impedance Analysis (BIA) which can measure the edema as the ratio of extracellular water to total body water. **Methods:** A total of 46 patients with mild to moderate hypertension were randomly administered either Manidipine (20 mg/day; n=20) or Amlodipine (10 mg/day; n=26) for 8 weeks (Figure 1). All patients have undergone Direct Segmental Multi-frequency Bioelectrical Impedance Analysis (DSM-BIA) at the screening visit and at the end of the treatment. Blood pressure and adverse events during the study were collected. **Results:** Blood pressure reductions after 8-week treatment were significant in both groups, but there were no significant between-group differences (Table 1). In comparison to the Manidipine group, the incidence of peripheral edema was higher in the Amlodipine group during the 1st 4-week (10.0% vs. 11.5%, p=1.0) and the 2nd 4-week (5.6% vs. 27.3%, p=0.105)(Table 2). The changes in leg edema score during the treatment with Manidipine or Amlodipine were not significantly different between two groups (right leg: (1.938 ± 2.720) × 10⁻³ vs. (2.071 ± 4.233) × 10⁻³, p=0.828; left leg: (3.875 ± 3.948) × 10⁻³ vs. (1.786 ± 5.041) × 10⁻³, p=0.326)(Table 3). Comparing the changes of edema score over the course of the study according to edema development, changes was consistently higher in edema (+) group than in edema (-) group, although the results were not statistically significant (Table 4). **Conclusions:** This study suggests the usefulness of BIA measurements as an objective tool to estimate CCBs-related fluid retention and edema. However, the results were not statistically significant. Larger study is needed to confirm robust results.

Figure 1 Flow Diagram of Study Patients

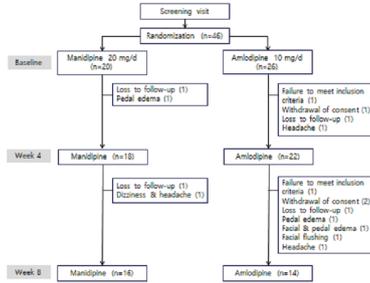


Table 1. Blood pressure parameters at baseline and end of treatment (Week 8) with manidipine or amlodipine

	Manidipine (n=16)	Amlodipine (n=16)	p
Systolic BP (mmHg)			
Baseline	161 ± 7.5	168.9 ± 16.6	
Study end	136.6 ± 12.4	128.8 ± 9.4	
p	0.002	0.001	
Delta	-24.8 ± 12.6	-39.9 ± 18.3	0.134
Diastolic BP (mmHg)			
Baseline	95.2 ± 9.6	99.8 ± 8.9	
Study end	84.9 ± 9.2	86.6 ± 9.6	
p	0.002	0.002	
Delta	-10.3 ± 9.9	-13.2 ± 10.0	0.212
24-hr urine (mmHg)			
Baseline	80.5 ± 16.9	78.3 ± 11.6	
Study end	84.8 ± 18.4	79.4 ± 7.9	
p	0.076	0.168	
Delta	4.3 ± 13.7	-1.2 ± 5.4	0.058

Table 2. Adverse events (AE) during 8-week treatment with manidipine or amlodipine

	Manidipine (n=20)	Amlodipine (n=26)	p
Edema	2 (10.0%)	3 (11.5%)	1.0
Head	2 (10.0%)	1 (3.8%)	0.872
Leg	0	1 (3.8%)	1.0
Face & leg	0	1 (3.8%)	1.0
Facial flushing	0	3 (11.5%)	0.246
Headache	2 (10.0%)	2 (7.7%)	1.0
Dizziness	2 (10.0%)	1 (3.8%)	0.572
Abstention	1 (5.0%)	0	0.298
Dropout	1 (5.0%)	0	0.298

Table 3. Edema score difference between study end and baseline according to study group

	Manidipine (n=16)	Amlodipine (n=16)	p
Edema score (ECV/TBW)			
Whole body	(2.645 ± 2.677) × 10 ⁻³	(3.460 ± 3.268) × 10 ⁻³	0.593
Right arm	(3.000 ± 2.871) × 10 ⁻³	(3.480 ± 2.288) × 10 ⁻³	0.797
Left arm	(3.408 ± 2.869) × 10 ⁻³	(2.422 ± 2.228) × 10 ⁻³	0.059
Trunk	(2.000 ± 2.330) × 10 ⁻³	(3.800 ± 2.295) × 10 ⁻³	0.583
Right leg	(3.992 ± 2.721) × 10 ⁻³	(2.071 ± 4.233) × 10 ⁻³	0.020
Left leg	(3.875 ± 3.948) × 10 ⁻³	(1.786 ± 5.041) × 10 ⁻³	0.326
Edema score (ECV/TBW)			
Whole body	(3.875 ± 2.094) × 10 ⁻³	(4.929 ± 1.970) × 10 ⁻³	0.698
Right arm	(3.976 ± 2.872) × 10 ⁻³	(3.143 ± 2.107) × 10 ⁻³	0.100
Left arm	(3.378 ± 2.833) × 10 ⁻³	(2.837 ± 2.168) × 10 ⁻³	0.220
Trunk	(2.187 ± 2.813) × 10 ⁻³	(3.429 ± 1.788) × 10 ⁻³	0.388
Right leg	(3.762 ± 2.783) × 10 ⁻³	(1.971 ± 4.662) × 10 ⁻³	0.047
Left leg	(3.562 ± 3.949) × 10 ⁻³	(1.887 ± 4.468) × 10 ⁻³	0.061

Table 4. Edema score difference between study end and baseline according to edema development

	Edema (-) (n=7)	Edema (+) (n=20)	p
Edema score (ECV/TBW)			
Whole body	(2.537 ± 3.000) × 10 ⁻³	(2.178 ± 3.066) × 10 ⁻³	0.965
Right arm	(3.429 ± 2.171) × 10 ⁻³	(3.058 ± 2.768) × 10 ⁻³	0.620
Left arm	(3.429 ± 2.919) × 10 ⁻³	(3.761 ± 2.268) × 10 ⁻³	0.289
Trunk	(3.000 ± 2.708) × 10 ⁻³	(3.577 ± 2.286) × 10 ⁻³	0.181
Right leg	(4.000 ± 4.183) × 10 ⁻³	(3.423 ± 3.712) × 10 ⁻³	0.120
Left leg	(3.286 ± 4.132) × 10 ⁻³	(3.423 ± 4.963) × 10 ⁻³	0.181
Edema score (ECV/TBW)			
Whole body	(4.429 ± 28.328) × 10 ⁻³	(3.615 ± 2.174) × 10 ⁻³	0.517
Right arm	(2.143 ± 2.988) × 10 ⁻³	(2.923 ± 2.768) × 10 ⁻³	0.296
Left arm	(3.286 ± 3.488) × 10 ⁻³	(3.684 ± 2.468) × 10 ⁻³	0.371
Trunk	(2.714 ± 2.038) × 10 ⁻³	(3.882 ± 2.268) × 10 ⁻³	0.277
Right leg	(3.429 ± 3.762) × 10 ⁻³	(3.615 ± 3.268) × 10 ⁻³	0.426
Left leg	(2.286 ± 3.147) × 10 ⁻³	(2.263 ± 4.468) × 10 ⁻³	0.043

ECV: extracellular water; TBW: total body water; ECV: extracellular fluid; TBW: total body fluid