

BIOELECTRICAL IMPEDANCE ANALYSIS FOR DETECTION SUBCLINICAL HYPERTENSIVE IN CAPD PATIENTS

SAPD HASTALARINDA SUBKLİNİK HİPERVOLEMİNİN TESBIT EDİLMESİNDE BİYOELEKTRİK İMPEDANS ANALİZİ

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SUMMARY

Introduction. The absence of clinical clue of volume excess does not exclude of hypervolemia. The aim of study was to evaluate the value of bioelectrical impedance analysis (BIA) for detection subclinical hypervolemia in peritoneal dialysis (PD) patients.

Patients and Methods Twenty six PD patients (F:13, M:13; mean age: 43,88±2,92) in stable clinical condition and at least six months on PD participated in the study. None of the patients had any clinical sign of hypervolemia. Vena cava inferior diameter (VCD) and BIA measurements were performed simultaneously after drainage of peritoneal fluid...

Results Seven of 26 patients have VCD higher than 11mm/m² and 12 patients have more TBW than upper limit of expected range. All of the patients with high VCD also have high TBW. The patients with high VCD have significantly higher TBW than the patients with normal VCD (67,257±1, 263% vs. 58,232±1, 907% of body weights, p<0.01).

Conclusion TBW measurement with BIA is very sensitive and easy test for detection of hypervolemia in PD patients. But minor excess of TBW should be confirmed with other methods such as VCD measurement.

Key words: Dry weight, Bioelectrical impedance, Hypervolemia, Hypertension

ÖZET

Volum fazlalığının klinik ipuçlarının olmaması hipervolemiyi dışlamaz. Bu çalışmanın amacı periton diyalizi (PD) hastalarındaki subklinik hipervoleminin saptanmasında biyoelektrik impedans analizinin (BİA) önemini değerlendirmesidir.

Hastalar ve metodlar

Bu çalışmaya en az altı aydır periton diyaliz (PD) yapılan ve klinik durumu stabil 26 PD hastası dahil edilmiştir (E: 13, K : 13 , ortalama yaş: 43.88 ± 2.92) Hastaların hiçbirinde hipervoleminin klinik bulgusu yoktu. Vena cava inferior çapı (VCD) ve BİA ölçümü peritoneal sıvı drenajından sonra eş zamanlı olarak yapıldı.

Sonuçlar

26 hastanın yedisinde VCD 11 mm/m²' den yüksek bulundu ve 12 hastanın total vücut suyu (TBW) beklenen aralığın üst sınırından daha yüksekti. VCD'si yüksek olan tüm hastaların TBW'si de yüksekti. Yüksek VCD'si olan hastaların TBW'si , normal VCD'si olan hastaların TBW'sine göre anlamlı derecede yüksekti.

(vücut ağırlığının %67.257±1.263 ve % 58.232±1.907, p<0.01)

Tartışma

PD hastalarındaki hipervoleminin araştırılmasında BİA ile TBW ölçümü çok duyarlı ve kolay bir testtir. Ancak TBW' deki minör artışlar VCD ölçümü gibi diğer metodlarla doğrulanmalıdır.

Anahtar Kelimeler: kuru ağırlık, biyoelektrik impedans, hipervolemi, hipertansiyon

Introduction

Volume expansion is perhaps the major factor in development of hypertension in dialysis patients. The absence of clinical clues of volume overload does not exclude of hypervolemia. Volume expansion, hypertension and left ventricular hypertrophy are more common and more severe in CAPD patients [1, 2]. Therefore determination and treatment of subclinical hypervolemia might have particular importance for CAPD patients.

Vena cava inferior diameter (VCD) measurement by ultrasound provides an estimation of dry weight in dialysis patients [3, 4]. Bioelectrical impedance analysis (BIA) is an accurate method for total body water (TBW) estimation in healthy people [5]. TBW measurement with BIA is also very well correlated with TBW obtained using deuterium dilution technique in chronic dialysis patients [6]. BIA has been used for establishment of optimum dry weight of hemodialysis patients [7, 8]. The aim of study was to evaluate the value of BIA for detection subclinical hypervolemia in CAPD patients.

Patients and methods

Twenty six CAPD patients (Female: 13, Male: 13; mean age: 43,88±2,92) in stable clinical condition and at least 6 months on PD participated in the study. The cause of end stage renal failure was variable: diabetes mellitus (7), hypertensive nephrosclerosis (13), chronic glomerulonephritis (5) and AA type amyloidosis (1). None of the patients had any clinical sign of hypervolemia such as ankle and sacral edema or pleural effusion.. All patients gave informed consent to participation according to the ethical principles for human investigations as outlined in the 2nd Declaration of Helsinki.

VCD and BIA measurements were performed simultaneously after drainage of peritoneal fluid. VCD was measured with ultrasound in the supine position after 10 minutes of rest at the level just below the diaphragm in hepatic segment during expiration. All VCD measurements were performed by the same radiologist. The range between 8mm/m² and 11,5mm/m² was accepted normal [3,4].

BIA were performed with the patients in the supine position using two leads on the nondominant hand and two leads on the ipsilateral foot (tetrapolar placement). The patient were rested in the supine position for 10 minutes and the measurements were performed with their arms parallel but separate to the trunk, and their legs apart far enough so the thighs were not touching. BIA resistance measurements were obtained using Bodystat 1500 bioimpedance analyzer (Bodystat Ltd, Douglas, UK). TBW was calculated from equations described by Kushner and Schoeller [5]. Expected TBW was also calculated for each patient by Watson formula (W). The range between the numbers calculated as W plus 3% of the body weight

and W minus 3% of the body weight was accepted normal TBW for the patient.

Results were expressed as mean values±SEM. Comparisons between two groups were performed by non-paired Student's t-test. Receiver operating characteristics curve (ROC) method was used to determinate sensitivity and specificity of TBW measured by BIA compared to VCD. Statistical analysis were done using SPSS 10.0 for windows.

Results

Seven of 26 patients have VCD higher than 11,5mm/m² and 12 patients have more TBW than upper limit of expected range. All of the patients with high VCD also have high TBW. But 7 of the 12 patients with high TBW have high VCD and the other 5 patients have normal VCD. The patients with high VCD have significantly higher TBW than the patients with normal VCD (67,257±1,263% vs 58,232±1,907% of body weights, p<0,01). Also the patients with increased TBW have higher VCD than the patients with normal TBW (10,178±0,320 mm/m² vs 8,586±0,561 mm/m², p<0,05). Sensitivity and specificity of TBW measurement with BIA for detection of hypervolemia compared to VCD were calculated as 100% and 71,4% respectively by ROC analysis. Twenty two (84,5%) of the patients used antihypertensive drug and no correlations was found between VCD and TBW on one hand and blood pressure on the other hand.

Discussion

Fluid balance is an integral component of CAPD treatment to prevent overhydration which has been demonstrated to have significant effects on long-term cardiovascular complications [1,2]. The degree of extracellular volume expansion is not always sufficient to induce edema. Thus the absence of edema does not exclude hypervolemia. The data of this pilot study show that TBW measurement with BIA is well correlated with VCD measurement with ultrasound which has been accepted as one of the most reliable methods for assesment of dry weight [3, 4]. According to our study results BIA is very sensitive method to detect hypervolemia without clinical sign in CAPD patients.

Although numerous attempts have been made to assess "dry weight" more accurately including plasma atrial natriuretic peptid concentration, blood volume measurement with dilution technique, measurement of VCD, BIA is most practical one of these methods [10]. BIA can be performed by a nurse noninvasively and within a few seconds. BIA machine is also easily carried to patients' home for using during home visit of peritoneal dialysis nurse. Our findings also show that TBW measurement with BIA has acceptable specificity

for diagnosis of subclinical volume overload. But confirmation with one of the other methods may be necessary in case of minor volume excess to avoid underhydration..

The most possible explanation of the lack of the correlation between blood pressures and volume parameters is that the most of the patients had been treated with antihypertensive drugs to achieve target blood pressure.

In conclusion the results of the pilot study suggested that TBW measurement with BIA is useful clinical tool for early detection of hypervolemia in CAPD patients. However the results should be supported by further clinical studies with large cases number.

KAYNAKLAR

- 1) Enia G, Mallamaci F, Benedetto FA, et al. Long-term CAPD patients are volume expanded and display more severe left ventricular hypertrophy than hemodialysis patients. *Nephrol Dial Transplant* 2001;16: 1459-1464.
- 2) Plum J, Schoenicke G, Kleophas W, et al. Comparison of body fluid distribution between chronic haemodialysis and peritoneal dialysis patients as assessed by biophysical and biochemical methods. *Nephrol Dial Transplant* 2001; 16: 2378-2385.
- 3) Leunissen KML, Kouw P, Kooman JP, et al. New techniques to determine fluid status in hemodialysis patients. *Kidney Int* 1993; 43 (Supp 41): 50-56.
- 4) Mandelbaum A, Ritz E. Vena cava diameter measurement for estimation of dry weight in hemodialysis patients. *Nephrol Dial Transplant* 1996; 11 (Supp 2): 24-27.
- 5) Kushner RF, Schoeller DA. Estimation of total body water by bioelectrical impedance analysis. *Am J Nutr* 1986;44:417-424.
- 6) Cooper BA, Aslani A, Ryan M, et al. Comparing different methods of assessing body composition in end-stage renal failure. *Kidney Int* 2000; 58: 408-416.
- 7) Fisch BJ, Spiegel DM 1996. Assessment of excess fluid distribution in chronic hemodialysis patients using bioelectrical impedance spectroscopy. *Kidney Int* 1996; 49: 1105-1109.
- 8) Spiegel DM, Bashir K, Fisch B. Bioimpedance resistance ratios for the evaluation of dry weight in hemodialysis. *Clinical Nephrol* 2000; 53: 108-114.
- 9) Watson PE, Watson ID, Batt RD. Total body water volumes for adult males and females estimated from single anthropometric measurements. *Am J Clin Nutr* 1980;33:27-39.
- 10) Jaeger JQ, Mehta RL. Assessment of dry weight in hemodialysis patients: an overview. *J Am Soc Nephrol* 1999; 10: 392-403.