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Research Article

The Assessment of Volume Status with Body Composition Monitor in Cancer Patients

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Abstract

Objectives: Intravenous (IV) fluid therapy is often needed in patients with the malignant disease during IV chemotherapy. The aim of our study is to evaluate the volume status of cancer patients treated with IV chemotherapy and standard fluid therapy by using body composition monitor (BCM) measurements.

Methods: Thirty chemotherapy cycles of the 30 cancer patients were evaluated. Patients had solid tumors (10.7%) and lymphoproliferative disease (89.3%). Biochemical and hematological parameters and fluid status by using BCM were measured on the 1st and fifth days of chemotherapy cycles.

Results: Hypovolemia or hypervolemia were found both at baseline and 5. day during IV fluid and chemotherapy in cancer patients (1.057±1.68 and 0.78±1.63 $p>0.05$ respectively). Also according to baseline, serum levels of Na, K, Ca, and body weight were decreased ($p<0.04$ for all), and CRP increased ($p<0.02$) on the 5th day.

Conclusion: BCM measurements for fluid status revealed hypo/hypervolemia both at baseline and the 5. Day during chemotherapy. Interestingly at 5.day serum CRP level increased and serum levels of Na, K, Ca decreased. So that technical assessment of volume status during IV chemotherapy and fluid therapy may reduce the risk of fluid and electrolyte disorders and inflammation.

Keywords: Body composition monitoring, intravenous fluid therapy, malignancy patients

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In patients with malignancy, volume disorders, electrolyte imbalances, kidney failure, pulmonary edema, and heart failure, are seen frequently, especially during IV fluid infusion and chemotherapy. Technical assessment of volume status may be useful in cancer patients with altered muscle/adipose tissue mass and fluid distribution. Fluid excess may develop due to the high risk of malnutrition in cancer patients, but it is difficult to detect as seen generally in older patients.[1] Bioelectrical impedance analysis (BIA) has been established as a valuable tool in the evaluation of body composition and nutritional status in many patients' conditions, including cancer patients. In patients with chronic kidney disease stage V Dialysis, malnutrition, or malign disease using bioelectrical impedance analysis, nutrition, and hydration status can be evaluated non-invasive. BIA can be used as a routine method in the clinical setting for the assessment and management of body fluids.[2] Bioelectrical impedance vector analysis allows non-invasive evaluation of soft tissue hydration and mass through pattern analysis of vec-

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Table 1. Comparison of fluid status (BCM) and body weight, biochemical parameters on days 0 (1) and 5 (2)

Parameters	Baseline (1.) day	5. day	p
SBP	112.5±2.03	116.1±2.08	0.134
DBP	69.6±8.4	68.9±6.8	0.678
BCM(fluid), lt	1.057±1.68	0.78±1.63	0.386
Body Weight, kg	73.2±13.1	73.4±13.2	0.612
BUN, mg/dl	**13.3±5.6**	**16.9±6.5**	**0.001**
Creatinine, mg/dl	0.712±0.242	0.656±0.255	0.168
Na, mmol/l	**137.9±4.1**	**136.1±4.3**	**0.018**
K, mmol/l	**4.24±0.93**	**3.89±0.99**	**0.001**
Ca, mg/dl	**8.96±0.67**	**8.71±0.59**	**0.042**
Albumin, gr/dl	3.44±0.48	3.39±0.48	0.336
Phosphorus, mg/dl	3.69±0.78	3.38±1.04	0.127
Wbc, µl	5943±430	5723±563	0.708
Hgb, gr/dl	11.3±0.36	11.3±0.34	0.636
Hct, %	32.9±6.06	32.3±5.37	0.219
Plt, µl	269.250±23215	238.892±25.466	0.066
CRP, mg/dl	**6.99±1.84**	**12.84±2.96**	**0.027**

BCM: Body composition monitor; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; BUN: Blood urea nitrogenous; Na: Sodium; potassium; Ca: Calcium; Wbc: White blood cell; Hgb: Hemoglobin; Hct: Hematocrit; Plt: Platelets; CRP: C reactive protein.

tor plots as height, normalized resistance, and reactance measurements.[3] In peritoneal dialysis patients and cancer patients, BIA has been used to detect, monitor, and control hydration and nutrition status.[4,5] It is possible to show the distribution of fluid in the body with body composition monitor (BCM), which is a more objective and non-invasive method. The aim of our study was to evaluate electrolytes changes and the volume status of cancer patients by using BCM measurements during IV chemotherapy and standart fluid therapy.

Methods

In this prospective study, 30 chemotherapy cycles were evaluated. The body water status using BCM and serum electrolytes were assessed in the 1st and fifth days of IV chemotherapy. Patient characteristics included in the study were age older than 18 years of age, without limb amputation or a cardiac pacemaker. Informed consent was taken from all patients. In the follow-up period, 30 chemotherapy cycles of the 30 patient were recorded. IV chemotherapy and fluid therapy, and other interventions were planned and performed by the primary physician. Primary physicians were blinded about the results of BCM measurements. Changes in physical examination findings and also laboratory tests including WBC, Hb, Hct, Plt, glucose, BUN, creatinine, Na, K, AST, ALT, albumin, bilirubin, Ca, P, CRP were recorded daily in the follow-up period. Fresenius BCM instrument was used to assess fluid status. The measurements were performed according to the recommendations in the technical manual of the tool by the same doctor who had previously educated how to use the tool. For BCM measurements firstly; age, gender, height, body weight of the patient were recorded into BCM device. Four electrodes connected to the BCM device were taped to wrist and ankle of the patient in supine position. Volume status accepted as difference between measured body weight and dry body weight according to BCM and negative value as hypovolemia and positive value as overvolemia.

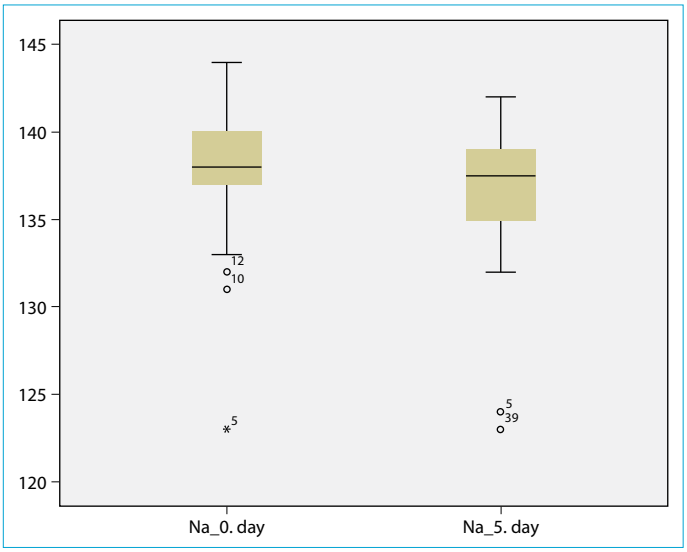

Figure 1. Comparison of serum sodium on days 0 (1) and 5 (2).

Statistical Analysis

IBM SPSS 21 (Chicago, IL, USA) was used as a statistical method. The data were summarized as counts and percentages for categorical variables and mean and standard deviation or median and range for numerical variables. Shapiro-Wilk test was used to determine whether the variables are suitable for normal distribution. Comparison of demographic and laboratory data on the 1st day and 5th day was made with the Repeated Measures Anova test. Differences were considered statistically significant if p-value is less than 0.05.

Results

The mean age was 49.1±17.9 (22-78). Patients had solid tumors (10.7%) and lymphoproliferative disease (89.3%). The value of blood pressure, body weight and volume status according to BCM and laboratory tests have been summarized in Table 1 and Figures 1–5. None of the patients developed clinically overt organ failure such as hepatic, renal, or cardiac. There were significant differences

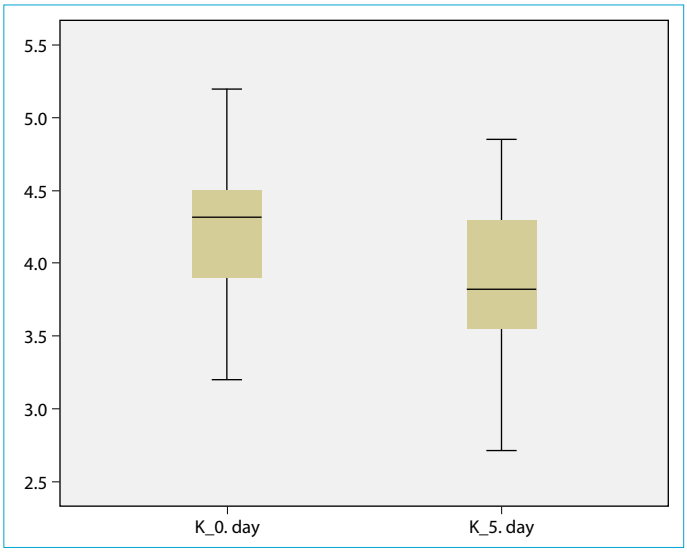

Figure 2. Comparison of serum potassium on days 0 (1) and 5 (2).

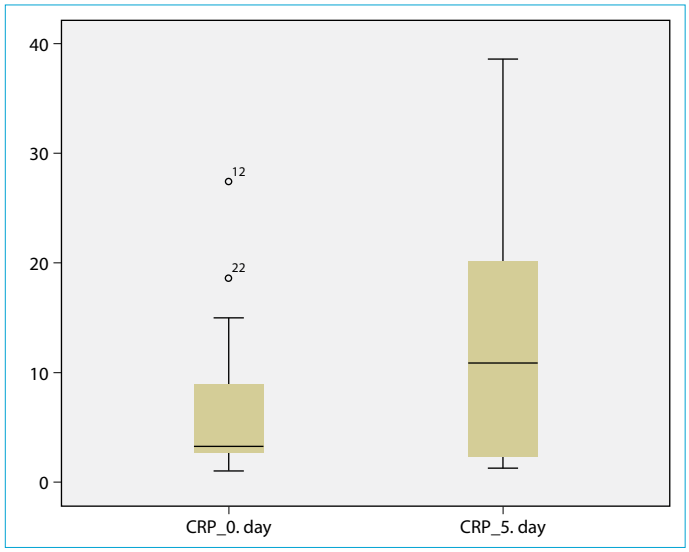

Figure 4. Comparison of serum CRP on days 0 (1) and 5 (2).

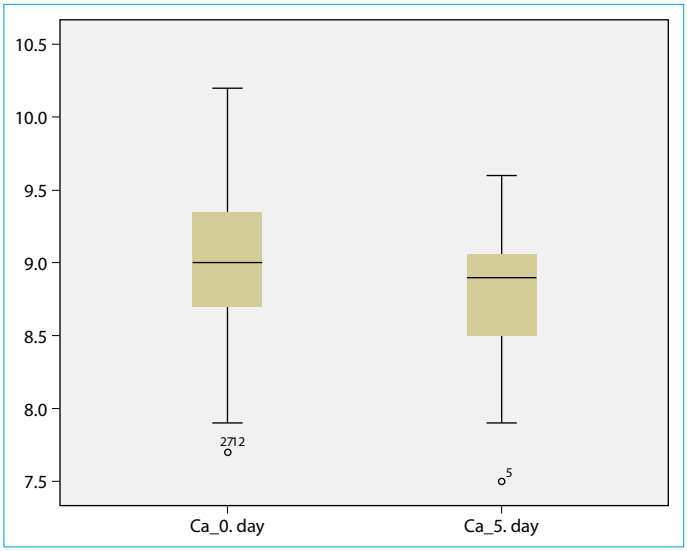

Figure 3. Comparison of serum calcium on days 0 (1) and 5 (2).

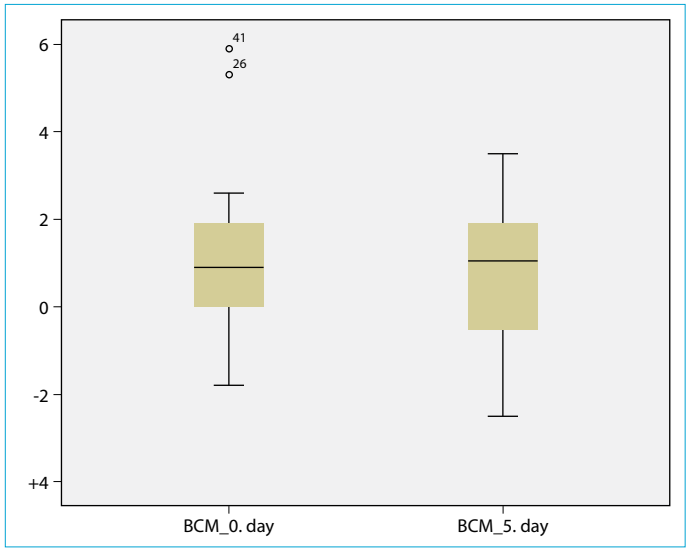

Figure 5. Comparison of fluid status (BCM) on days 0 (1) and 5 (2).

between baseline and 5. day some parameters such as serum levels of BUN (0.001), Na (0.018), K (0.001) and Ca (0.042), and body weight (0.035) were decreased, and CRP (0.027) increased. Hypovolemia or overvolemia determined at baseline continued to 5. day of the IV chemotherapy and fluid fluid therapy. Mean value of fluid status were 1.057±1.68 L (range: -1.8 L and +5.9 l L) and 0.78±1.63 L (range: -2.5 L and +3.5 L) respectively p>0.05. Body weight of the patients also did not change at 5. day comparing to baseline (73.2±13.1 kg and 73.4±13.2 kg respectively p=0.386). The value of CRP1 was correlated with CRP2 value (r: 0.590, p: 0.016). CRP1 and CRP2 were not correlated with Na, K, BCM measurements and body weight on day 1, and 5. Body weights and BCM measurements in 1. and 5. days were correlated with each other (r: 0.990 p<0.003, r: 0.506 p<0.006 respectively).

Discussion

In our study, we aimed to compare body fluid status by using BCM and electrolyte imbalance arising during standard fluid infusion and IV chemotherapy. Because oral intake is limited in cases with cancer due to lack of appetite, nausea and drugs such as antibiotics, analgesics, and chemotherapeutics etc. In our study comparing to baseline value in 5. day body weight and the levels of Na, K, Ca decreased CRP levels increased. In clinical practice, fluid and electrolyte disturbances secondary to accompanying conditions, such as syndrome of inappropriate antidiuretic hormone, renal dysfunction, heart failure, tumor lysis syndrome, malnutrition in cancer patients, are commonly seen and can cause increased mortality and morbidity. There are some reports that it may be difficult to achieve normovolemia,

especially during standard IV fluid replacement therapy.[1,6] The technical assessment of volume status most commonly has been evaluated in dialysis patients.[6-10] BCM was used to detect dry weight in patients in the chronic dialysis program. Chronic volume overload in hemodialysis patients has been found to be associated with left ventricular hypertrophy and increased cardiovascular complications.[6,7] Also it has been reported that BCM measurements were a prognostic factor or indicator of volume overload in patients with the malignant disease.[11,12] Karnofsky performance status and modified Glasgow prognostic score have been found to be improved after three months of treatment in patients with advanced stage cancer receiving parenteral nutrition at home. In this study BCM measurements have been found to be increased in fat mass and a decrease in total body fluid, and a decrease in extracellular fluid.[12] In other stıdy changes in muscle mass and adipose tissue and total body fluid during radiotherapy have been evaluated by BCM in the follow-up period. In patients with head and neck cancer who underwent radiotherapy, total body fluid and muscle mass decreased significantly in the fourth week. In patients who received radiotherapy due to lung and breast cancer, the fat mass has been found to be decreased at weeks 2 and 4. In patients with abdominal and pelvic cancer, total body weight and muscle mass have been found to be decreased within two weeks.[13] Technical assessment of volume status during intraoperative fluid application has been evaluated in 71 patients who underwent surgery. Routine fluid administration has been found to cause an extracellular fluid increase in BCM measurements.[14] In severe polytrauma patients, fluid management with bioimpedance spectroscopy was found to be a useful tool.[15] In our study, fluid status with BCM measurements in cancer patients receiving chemotherapy showed a parallel with hydration status and weight measurements. In BCM measurements, we detected volume changes, including hypovolemia and/or hypervolemia at the beginning and also during followup. Interestingly, there were both fluid deficiency and also fluid overload without changing blood pressure and pulse, and this status continued up to 5 days in the follow-up period. Clinically overt renal and hepatic dysfunction did not develop in our patients. Although there was no correlation between CRP and serum Na levels we found an increase in CRP and a decrease in serum Na on day 5 compared to baseline. Also there was no difference in BCM fluid measurements, it may be said that a significant increase in CRP2 on day 5 and a significant decrease in Na2, fluid accumulation may cause inflammation and Na decrease or vise versa. Theoretically, it can be questioned that the association between fluid excess and inflammation and indirectly increase in CRP. However, we did not find any correlation between body fluid according to BCM measurements and CRP measurements. Also there were correlation between baseline and 5. day for body weight, BCM, serum levels of CRP, Na, K each other.

In our study there may be limitations as the sample was small, cancer subtypes are not homogeneous, and chemotherapy agents given are not mentioned.

In conclusion: BCM measurements revealed excess fluid or deficiency both at baseline and 5. day of infusion therapy in patients with malignant disease. Initial hypokalemia did not improve despite standard potassium replacement during infusion therapy. Increased CRP accompanied a decrease in serum sodium level. As a result, technical assessment of body water of patients with malignancy during the follow-up period and intravenous chemotherapy and fluid therapy may improve the management of patients and reduce the risks of sodium disorder and CRP increase.

Disclosures

Ethics Committee Approval: Cukurova University Medical Faculty Clinical Research Ethics Committee date 02.06.2017 Number 65/16.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – Sa.P., S.P.; Design – Sa.P., S.P.; Supervision – S.P.; Materials – H.O., S.P.; Data collection and/or processing – H.O., B.K., C.E.; Literature search – S.P., B.K.; Writing – S.P., B.K.; Critical review – Sa.P., S.P.

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