EFFECT OF HYDATID DISEASE ON BODY COMPOSITION AS ASSESSED BY BIOELECTRICAL IMPEDANCE ANALYSIS

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ABSTRACT

Objective: *Hydatid disease (HD), which is common in children in developing countries, causes many health problems. However, no study has yet investigated the effect of HD on body composition. We thus compared results of bioelectrical impedance analysis (BIA) of healthy children and children with HD.*

Material and Method: *BIA recordings were prospectively obtained from 30 children with HD and 29 healthy controls. We assessed body composition, basal metabolic rate, body mass index (BMI), phase angle, fat-free mass, body fat index (BFI), lean body mass (LBM), total body water (TBW), amount of extracellular water (ECW), capacitance, resistance, reactance, extracellular mass (ECM), and ECM:BCM ratio.*

Results: *We found no significant between-group difference in mean age or gender ($p>0.05$). The phase angle, body capacitance, lean body mass, and extracellular mass were no significant difference between the groups ($p>0.05$). The extracellular water level was higher and BMI was lower in the patients than controls ($p<0.005$).*

Conclusion: *HD impacted body structures, and BIA utility in children with HD deserves further investigation.*

Keywords: *Bioelectrical-impedance analysis, children, hydatid disease.* **Nobel Med 2018; 14(3): 25-30**

HİDATİK HASTALIĞININ VÜCUT KOMPOZİSYONU ÜZERİNDEKİ ETKİSİNİN BİYOELEKTRİK-EMPEDANS ANALİZİ İLE DEĞERLENDİRİLMESİ

ÖZET

Amaç: Hidatik hastalığı (HD), gelişmekte olan ülkelerin çocuklarda sık görülüp, pek çok sağlık sorununa neden olmaktadır. Ancak, HD'nin vücut kompozisyonu üzerindeki etkisini araştıran bir çalışma henüz bulunmamaktadır. Bundan dolayı, sağlıklı çocukların ve HD'li çocukların biyoelektrik impedans analizi (BIA) sonuçlarını karşılaştırdık.

Materyal ve Metot: Bu çalışmada, HD'li 30 çocuk ve 29 sağlıklı kontrol ile BIA kayıtları prospektif olarak çalışmaya alındı. Vücut kompozisyonu, bazal metabolizma hızı, vücut kütle indeksi (BMI), faz açısı, yağsız kütle, vücut yağ indeksi (BFI), yağsız vücut kütlesi (LBM), toplam vücut suyu (TBW), ekstrasellüler su miktarı (ECW), kapasitans, direnç, reaktans, ekstrasellüler kütle (ECM) ve ECM: BCM oranı faktörleri değerlendirildi.

Bulgular: Bu çalışmada yaş ve cinsiyet açısında gruplar arasında anlamlı fark bulunamadı (p>0,05). Faz açısı, vücut kapasitansı, yağsız vücut kütlesi ve hücre dışı kütle açısında gruplar arasında anlamlı fark yoktu (p>0,05). Hastalarda kontrol grubuna göre ekstrasellüler sıvı daha yüksek ve BMI daha düşüktü (p<0,005).

Sonuç: HD, çocukların vücut yapılarını etkilemekte olup BIA'nın HD'li çocuklarda kullanımı için daha fazla çalışma gerekmektedir.

Anahtar kelimeler: Biyoelektrik-impedans analizi, çocuklar, hidatik hastalığı. **Nobel Med 2018; 14(3): 25-30**

INTRODUCTION

Hydatid disease (HD) is a serious parasitic infection caused by ingestion of the eggs of Echinococcus tapeworms.[1,2] The real prevalence of HD is unknown, but it has been reported to affect 1 in every 10,000 children.[1,2] Those in developing countries are more vulnerable because of poor environmental, socioeconomic, sanitary, and hygienic conditions.[1] Poor functioning of the immune system may increase the incidence of HD in children.[1,3-5] HD compromises nutritional status, growth, and development. Both the genetic characterization of Echinococcus strains and vaccination strategies have improved over time.[2] Body composition parameters may aid in HD diagnosis and treatment, and allow us to better understand both nutrition and the mechanisms of disease. An enlarging visceral mass causing nonspecific symptoms or allergic manifestations means that a child requires medical attention. Bioelectrical impedance analysis (BIA) measures the electrical properties of biological tissues.[6] Tumoral tissues often exhibit lower bioimpedance than healthy tissues do, and body composition may therefore yield useful clinical data on HD.

BIA is often used to directly estimate body composition and nutritional status, particularly in critically ill patients, those with HIV, patients on hemodialysis, and malnourished children.[4,6,7] Biological tissues impede the passage of electric current.[8] Depending on the source of electricity, it is possible to distinguish two main types of response when electric current provokes ionic activity within cells. Signal analysis yields useful information on electrochemical processes in target tissues, allowing physiopathological changes to be constantly monitored.[8] BIA data are dependent on the ionic environment around the cells of tissues. BIA has been widely used, as it is non-invasive, painless, practical, safe, inexpensive, easy, and repeatable.[9] BIA supports both clinical research and routine evaluation of patients with various conditions.[6] Our purpose in the present study was to assess body composition as measured by BIA in patients with HD to determine whether physiological changes were evident.

MATERIAL AND METHOD

This case-control study involving 30 consecutive pediatric patients with HD and 29 healthy controls admitted to the pediatric surgery department was performed from September 2012 to December 2014. The study was collaboration between a pediatric surgery department and a department of biophysics. The patients were diagnosed with HD by ultrasonography, ELISA tests, and/or computed tomography. We recorded age, gender, and BIA data.

The study was carried out in accordance with the Helsinki Declaration as revised in 1989 and approved by the local human institutional review committee at Harran University (report no: B.30.2 HRU.0.20.05.00.903.05/161). The parents of each participating child gave their informed written consent for participation in the study, and each gave oral consent to participation prior to the tests.

BIA was performed using a Biodynamic 450 instrument (Biodynamics Corp; Seattle, WA, USA) after a 3-h fast (including liquids). The same

physician analyzed data of all subjects. Children lay on their backs on an examination table. Standard tetrapolar electrodes were used; two were placed on each of the left and right wrists, and the other two on the right ankle. The device was then turned on. We recorded total weight (TW) and height, and then commenced measurement. Body composition measurement (BCM), body fat index (BFI), lean body mass (LBM), total body water (TBW), phase angle, amount of extracellular water (ECW), capacitance, resistance, reactance, extracellular mass (ECM), ECM:BCM ratio, body mass index (BMI), and basal metabolic rate (BMR), were recorded.

Statistical analysis was performed using SPSS for Windows ver. 16.0 (SPSS®; Chicago, IL, USA). Continuous variables are expressed as means±standard deviations (SDs). The chi-squared and Independent samples t-test were used for between-group compressions. Pearson's correlations were calculated. A two-tailed *p*-value<0.05 was considered to reflect statistical significance.

RESULTS

We studied children with HD admitted to our pediatric surgery department and healthy control children. We enrolled 29 healthy controls and 30 patients. Neither age nor gender differed significantly between the groups. The ECW level, BMI, weight, and height were significantly lower in patients than controls (all *p*-values<0.05) (Table). The phase angle, body capacitance, resistance, reactance, BCM, lean body mass, the TBW/LBW and TBW/TW ratios of patients were all lower than those of healthy controls (all *p*-values>0.05) (Figure 1,2). However, the fat mass, ECM/BCM ratio, BMR, and ECW level were higher in patients than in healthy controls (all *p*-values>0.05) (Figure 3,4). There were no significantly differences. BCM was highly correlated with fat mass.

DISCUSSION

HD patients may carry asymptomatic cysts for years; many studies have explored HD mechanisms and outcomes.[2,3,10] We performed BIA on healthy children and children with HD. To the best of our knowledge, this has not been done before. We defined BIA parameters affected by HD. Our goal was to identify BIA values that might allow early diagnosis of suggestive small lesions prior to initiation of medical treatment As timely diagnosis is important, we used real-time BIA to evaluate and validate the electrical properties of HD. BIA data may aid in HD management and follow-up. Further prospective studies are required.

Table. Demographic and data of the cases

	Patients (n=30)	Controls (n=29)	*p*
Age (years)	11.6±1.49	10.9±0.85	>0.05
Gender (M/F)	18/12	16/13	>0.05
BMI (kg/m^2)	15.43±2.24	19.1±2.49	<0.05
ECW	8.86±2.60	7.27±2.60	<0.05
Fat mass	4.64±0.53	4.02±0.52	>0.05
Body capacitance	470.63±18.559	491.13±20.9	>0.05
Phase	5.51±0.71	5.59±0.86	>0.05

BMI: Body mass index, **ECW:** amount of extracellular water

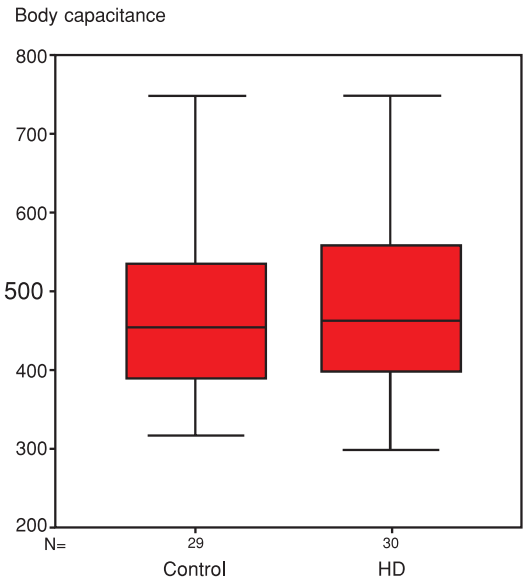

Figure 1. The results of evaluation between patient and control group body capacitance
HD: Hydatid disease

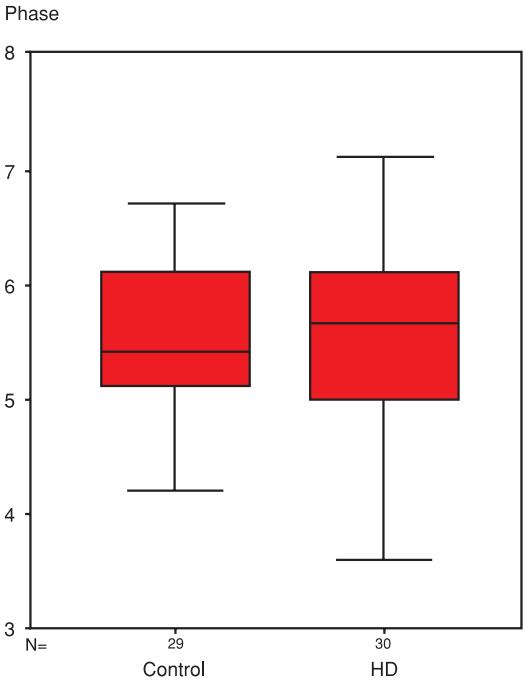

Figure 2. The results of evaluation between patient and control group phase angel
HD: Hydatid disease

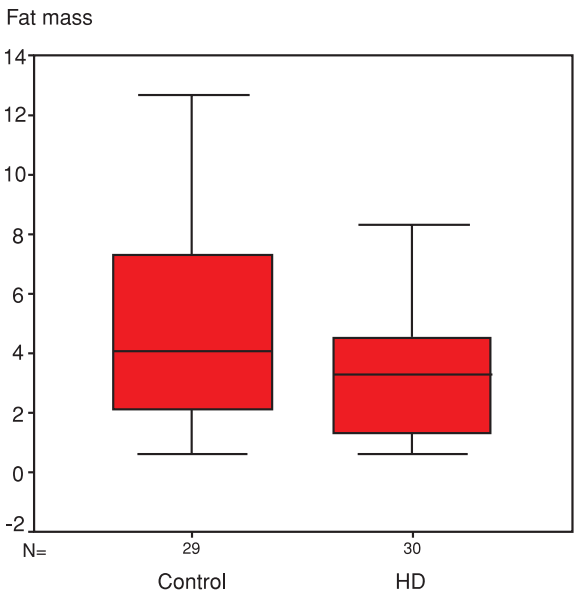

Figure 3. The results evaluation between patient and control group fat mass
HD: Hydatid disease

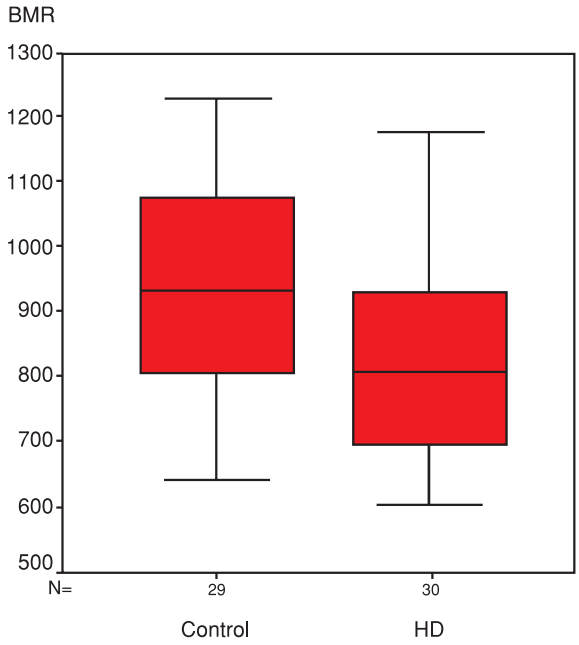

Figure 4. The results of evaluation between patient and control group basal metabolic rate
HD: Hydatid disease, **BMR:** Basal metabolic rate

An Echinococcus infestation commences when eggs ingested by humans become lodged in various organs. The host surrounds the primary cyst with a tough fibrous capsule.[11] The outcomes of HD differ; some patients may experience spontaneous cures. Advanced disease may be cured either medically or via surgical intervention.[3]

Most infections occur in developing countries where malnutrition is common, as nutritional deficits significantly impact patients.[1] The relatively poorly developed immune system of children increases their susceptibility to pathophysiological disturbances associated with infection. Additionally, environmental hygiene is poor in undeveloped countries.[4] Parasitic infections may interfere with nutritional status, which should therefore be assessed in patients with HD.

Malnutrition has a major impact on the human immune system and on the inflammatory responses that are strongly associated with HD development.[3,12] BIA has been validated for assessment of body composition and nutritional status.[1,13] The growth impairment associated with HD may increase the risk of infection and delay in wound healing.[12] Drugs to which HD is susceptible and resistant remain poorly understood. Host immunological and genetic factors play crucial roles in the development and progression of fluid-filled cysts, mainly in the liver and/or lung.[3,10] Disease staging, progression, and prognosis after treatment appear to be strongly influenced by cytokine and antibody profiles. Recent evidence has suggested important roles for dendritic and T-regulatory cells in immunomodulation.[3]

BIA yields useful information about electrochemical processes in target tissues.[8] We found that patient weight, height, and BMI were lower than those of controls, although BIA revealed no significant between-group difference. Future prospective studies on HD patients may yield more information. BIA is useful for nutritional assessment of body cell mass in children.[12] Loss of weight and height are common in patients with chronic disease. However, BMI alone does not reflect body composition or nutritional status; data on PA, ECM, BCM, and fat-free mass are also required.[5,13,14,] Nutritional monitoring is an important feature of certain treatments.[5]

The fat-free mass and phase angle were somewhat lower in patients than in controls, but the differences were not significant. Phase angle and fat-free mass are affected by cell membrane functionality; they reflect the earliest changes in nutritional patterns and the probable survival rate.[13,14] The phase angle detects body changes associated with undernutrition more sensitively than do other parameters.[12] Therefore, the phase angle may be the best tool for evaluating clinical outcomes and monitoring disease progression and nutritional status.[12] We found no significant difference in phase angle between patients and controls.

BIA also evaluates body resistance and reactance, which reflect changes in body composition. Resistance is related to the level of tissue water, and reactance is a resistive effect produced by tissue

interfaces and cell membranes.[4] The BMR was also somewhat higher in patients than in controls, but the difference was not significant. An elevated BMR may reflect malnutrition and weight loss. Certain BIA parameters serve as measures of cell membrane capacitance, which is determined by the extracellular fluid level. Poor cell integrity or necrosis.[8] BCM, which includes all metabolizing cells, is reduced in those suffering from malnutrition. ECM reflects extracellular water retention or loss.[5] The fat-free mass, which incorporates BCM and ECM, declines in individuals with chronic disease. The phase angle, one of the best indicators of cell membrane function, is reduced in people with poor nutritional status. High TBW values indicate water retention, and low values, dehydration. TBW is strongly related to fat-free mass in healthy individuals.[10]

BIA parameters were somewhat higher in patients than in controls, but no difference was significant. Further large prospective studies on HD patients followed up until they are cured may yield more informative data.

Body mass is divided into two parts: fat mass and fat-free mass. BCM, which reflects the metabolically active component of fat-free mass, is the single best predictor of nutritional status.[11] BCM is lower in undeveloped countries, particularly in unhealthy children. However, we found no significant difference between patients and controls.

We used BIA to assess HD, but no difference was evident between patients and controls. Further investigations are necessary. We seek to establish a standard BIA protocol for periodic monitoring of HD patients.

Our study has several limitations. First, the group size was small. Second, patients were not followed up until they were cured. Third, patients and controls differed significantly in terms of weight and height, which affected the BIA results.

CONCLUSION

BIA may be useful for monitoring HD. We seek to improve the diagnostic tools available to clinicians. BIA is reliable, inexpensive, and non-invasive. BIA may find a novel application in the routine monitoring of nutritional progress and treatment in HD patients. Further research is required.

*The authors declare that there are no conflicts of interest.

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