

Volume 2

2013

# InBody

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# Body Fat Percentage as a Marker of New-Onset Diabetes Mellitus After Kidney Transplantation

K. Tokodai, N. Amada, H. Kikuchi, I. Haga, T. Takayama, and A. Nakamura

Transplantation proceedings (Vol. 45, No. 4, pp. 1544-1547).

## ABSTRACT

### Background

New-onset diabetes after transplantation (NODAT) is a serious metabolic complication that can follow kidney transplantation. Several risk factors, including obesity, have been related to NODAT development. Obesity is defined as an excessive accumulation of body fat, and body fat percentage (BF%) has been commonly measured by different techniques, including bioelectrical impedance analysis. However, the correlation between an increase in BF% and the development of NODAT during outpatient follow-up has not yet been explored. We aimed to elucidate the association between BF% changes and the development of NODAT.

### Methods

We performed a retrospective study involving 45 patients without diabetes who underwent kidney transplantation in our hospital between March 2008 and December 2010. We compared the BF% and demographic variables of patients who did and did not develop NODAT during follow-up.

### Results

Four patients (8.9%) developed NODAT during a mean follow-up period of 30.3 months. The post-transplantation increase in BF% was much higher in NODAT patients than the NODAT patients. Univariate analysis indicated that the rate of increase in BF% was a risk factor for NODAT (hazard ratio [HR], 1.08 [1.02–1.18]; P .005).

### Conclusions

A large increase in BF% may be a risk factor for NODAT. These findings underline the importance of routine BF% measurements in medical practice.

# Impact of pretransplant nutritional status in patients undergoing liver transplantation

Kaido, T., Mori, A., Oike, F., Mizumoto, M., Ogura, Y., Hata, K., ... & Uemoto, S

Hepato-gastroenterology, 57(104), 1489-1492.

## ABSTRACT

### Background

Protein-energy malnutrition is common in patients with end-stage liver disease requiring liver transplantation and is a risk factor for posttransplant morbidity including sepsis. We therefore investigated the relationship between preoperative nutritional status and postoperative clinical course, and the risk factors for postoperative sepsis in patients undergoing living donor liver transplantation (LDLT), focusing on nutritional parameters. **METHODOLOGY:** We preoperatively measured body cell mass (BCM) using a body composition analyzer and various nutritional parameters including prealbumin, branched-chain amino acids (BCAA)/tyrosine ratio, and zinc in 50 consecutive recipients undergoing LDLT between February 2008 and February 2009. Risk factors for post-transplant sepsis were analyzed.

### Methods

We preoperatively measured body cell mass (BCM) using a body composition analyzer and various nutritional parameters including prealbumin, branched-chain amino acids (BCAA)/tyrosine ratio, and zinc in 50 consecutive recipients undergoing LDLT between February 2008 and February 2009. Risk factors for post-transplant sepsis were analyzed.

### Results

The incidence of postoperative severe infection and in-hospital death was significantly higher in patients with preoperative low BCM than in patients with normal or high BCM. Multivariate predictors of posttransplant sepsis included preoperative low BCM ( $p = 0.016$ ), absence of preoperative supplementation with BCAA-enriched nutrient mixture ( $p = 0.028$ ), and a Model for End-stage Liver Disease score of 20 or above ( $p = 0.040$ ).

### Conclusions

Preoperative BCM level was closely related to the postoperative clinical course in patients undergoing LDLT. Pretransplant nutritional status and supplementation with BCAA-enriched nutrient mixture have potent impacts on the incidence of postoperative sepsis.

# **Impact of Sarcopenia on Survival in Patients Undergoing Living Donor Liver Transplantation**

T. Kaido, K. Ogawa, Y. Fujimoto, Y. Ogura, K. Hata, T. Ito, K. Tomiyama, S. Yagi, A. Mori and S. Uemoto

American Journal of Transplantation, Pages 1-8 (2013).

## **ABSTRACT**

Skeletal muscle depletion, referred to as sarcopenia, predicts morbidity and mortality in patients undergoing digestive surgery. However, the impact on liver transplantation is unclear. The present study investigated the impact of sarcopenia on patients undergoing living donor liver transplantation (LDLT). Sarcopenia was assessed by a body composition analyzer in 124 adult patients undergoing LDLT between February 2008 and April 2012. The correlation of sarcopenia with other patient factors and the impact of sarcopenia on survival after LDLT were analyzed. The median ratio of preoperative skeletal muscle mass was 92% (range, 67–130%) of the standard mass. Preoperative skeletal muscle mass was significantly correlated with the branched-chain amino acids to tyrosine ratio ( $r = 0.254$ ,  $p = 0.005$ ) and body cell mass ( $r = 0.636$ ,  $p < 0.001$ ). The overall survival rate in patients with low skeletal muscle mass was significantly lower than in patients with normal/high skeletal muscle mass ( $p < 0.001$ ). Perioperative nutritional therapy significantly increased overall survival in patients with low skeletal muscle mass ( $p = 0.009$ ). Multivariate analysis showed that low skeletal muscle mass was an independent risk factor for death after transplantation. In conclusion, sarcopenia was closely involved with posttransplant mortality in patients undergoing LDLT. Perioperative nutritional therapy significantly improved overall survival in patients with sarcopenia.



# Postoperative changes in body composition after gastrectomy

Kiyama, T., Mizutani, T., Okuda, T., Fujita, I., Tokunaga, A., Tajiri, T., & Barbul, A.

Journal of gastrointestinal surgery, 9(3), 313-319.

## ABSTRACT

Nutritional status is one of the most important clinical determinants of outcome after gastrectomy. The aim of this study was to compare changes in the body composition of patients undergoing laparoscopy-assisted gastrectomy (LAG), distal gastrectomy (DG), or total gastrectomy (TG). Total body protein and fat mass were measured by performing a multifrequency bioelectrical impedance analysis using an inBody II machine (Biospace, Tokyo, Japan) in 108 patients (72 men, 36 women) who had undergone LAG ( $n = 24$ ), DG ( $n = 39$ ), or TG ( $n = 45$ ). Changes between the preoperative data and results obtained on postoperative day 14 and 6 months after surgery were then evaluated. The mean preoperative body weight of the subjects was  $57.6 \pm 10.7$  kg, the mean body mass index was  $22.5 \pm 3.4$  kg/m<sup>2</sup>, and the mean fat % was  $24\% \pm 7\%$ . In the immediate postoperative period (14 days), the body weight loss in the LAG group was significantly lower than in the DG and TG groups ( $2.5 \pm 0.9$  kg vs.  $3.5 \pm 1.8$  kg and  $4.0 \pm 1.9$  kg, respectively;  $P < 0.0001$ ). The body composition studies demonstrated a loss of total body protein rather than fat mass. Six months after surgery, body weight was not significantly different from preoperative values in the LAG and DG groups ( $-1.2 \pm 3.8$  kg and  $-1.8 \pm 4.7$  kg, respectively), but had decreased by  $8.9 \pm 4.9$  kg in the TG group ( $P = 0.0003$ ). A body composition analysis revealed a loss of fat mass in the DG and TG groups. The patients who underwent gastrectomy lost body protein mass during the early postoperative period. The type and extent of surgery has an effect on long-term body mass and composition. Bioelectric impedance analysis can be used to assess body composition and may be useful for nutritional assessment in patients who have undergone gastrectomy.

# **Pre-and perioperative factors affecting infection after living donor liver transplantation.**

Kaido, T., Mori, A., Oike, F., Mizumoto, M., Ogura, Y., Hata, K., ... & Uemoto, S

Nutrition, 28(11), 1104-1108.

## **ABSTRACT**

### **Objective**

Infectious complications, including sepsis, that often occur after liver transplantation (LT) comprise the most frequent causes of in-hospital death. This study investigated the predictors of post-transplantation infectious complications to establish a strategy with which to improve short-term outcomes after LT.

### **Methods**

We used univariate and multivariate analyses to assess pre- and perioperative risk factors for post-transplantation infectious complications in 100 consecutive patients who underwent living donor LT from February 2008 through February 2010 at our institute.

### **Results**

Multivariate analysis showed that low preoperative body cell mass and the absence of preoperative supplementation with branched-chain amino acids were of prognostic significance for post-transplantation sepsis. In addition, Child–Pugh classification C and massive operative blood loss were independent risk factors for post-transplantation bacteremia, and preoperative low body cell mass was an independent risk factor for in-hospital death from infection.

### **Conclusion**

Pretransplantation nutritional intervention and decreases in operative blood loss would help prevent post-transplantation infectious complications from developing during living donor LT. Branched-chain amino acid supplementation before LT affects the occurrence of infectious complications.

# Changes in N-Terminal Pro-Brain Natriuretic Peptide Correlate with Fluid Volume Changes Assessed by Bioimpedance in Peritoneal Dialysis Patients.

Andrew Davenport

American Journal of Nephrology, 31:371-376.

## ABSTRACT

### Background/Aims

Both brain natriuretic peptide (BNP) and volume overload are reported to be powerful predictors of survival for peritoneal dialysis patients. The usefulness of single BNP determinations in helping determine volume status in peritoneal dialysis patients remains controversial, so we reviewed serial BNP and multifrequency bioimpedance measurements to determine whether changes in BNP reflected changes in volume status.

### Methods

Prospective measurements of fluid volume by multifrequency bioimpedance and serum N-terminal pro-BNP (NTproBNP) were conducted in stable adult peritoneal dialysis outpatients attending for routine assessments of peritoneal dialysis adequacy and transport status.

### Results

A total of 189 serial measurements were made in 92 patients, and NTproBNP increased from a median of 162.5 pmol/l (interquartile range 82–385.4) to 195 pmol/l (interquartile range 101.9–348.6;  $p < 0.05$ ). Changes in NTproBNP correlated with changes in extracellular water (ECW), total body water (TBW) and ECW/TBW ( $r = 0.38, 0.31$  and  $0.45$ , respectively; all  $p < 0.0001$ ). Patients were divided into quartiles depending upon NTproBNP changes; those with the greatest fall in NTproBNP had significant falls in ECW ( $p < 0.001$ ), TBW ( $p = 0.001$ ) and ECW/TBW ( $p < 0.001$ ) compared to the quartile with the greatest increase in NTproBNP, who also had an increase in systolic blood pressure from  $133.5 \pm 22.7$  to  $142.7 \pm 28.8$  mm Hg ( $p = 0.0078$ ), whereas it fell in the quartile with the greatest fall in NTproBNP ( $143.8 \pm 24.6$  vs.  $136.5 \pm 18.7$  mm Hg).

### Conclusion

Serial measurements of NTproBNP correlated with changes in volume assessments made by multifrequency bioimpedance in peritoneal dialysis outpatients. As multifrequency bioimpedance measures total ECW, rather than effective plasma volume, serial NTproBNP determinations may prove an adjunct to the clinical assessment of volume status in peritoneal dialysis patients.

# Edema index established by a segmental multifrequency bioelectrical impedance analysis provides prognostic value in acute heart failure

Min-Hui Liu, Chao-Hung Wang, Yu-Yen Huang, Tao-Hsin Tung, Chii-Ming Lee, Ning-I Yang, Ping-Chang Liu, Wen-Jin Cherng

Journal of cardiovascular medicine, 13:299-306.

## ABSTRACT

### Objectives

A segmental multifrequency bioelectrical impedance analysis (SMBIA) is a noninvasive and reproducible modality for estimating the fluid state. The aim of this study was to test whether the SMBIA-derived edema index provides prognostic value in patients hospitalized due to acute heart failure (AHF).

### Methods

To estimate the 6-month prognostic value of the predischage edema index in patients hospitalized due to AHF, 112 patients were consecutively enrolled. Both predischage edema index and B-type natriuretic peptide (BNP) were measured. Outcome follow-up focused on heart failure-related and all-cause re-hospitalizations and all events.

### Results

On the basis of a cutoff value of edema index of 0.390, patients were separated into two groups: edema index more than 0.390 (nU44) and edema index of 0.390 or less (nU68). Compared with patients with edema index 0.390 or less, those with edema index of more than 0.390 were older, had lower blood albumin and hemoglobin levels, and had higher predischage BNP levels, functional class, incidence of diabetes mellitus, valvular cause, and diuretic use. Although edema indexes were correlated with BNP levels (rU0.47, P<0.0001), a mismatch was noted in 33 (29%) patients. Univariate and multivariate analysis showed that an edema index of more than 0.390 predicted a higher incidence of heart failure-related re-hospitalization [odds ratio (OR)U4.14, confidence interval (CI)U1.05–15.28, PU0.04] and all events (ORU3.97, CIU1.4–11.25, PU0.01). The edema index provided a prognostic value superior to that of BNP. Reducing the edema index in high risk patients resulted in fewer heart failure-related rehospitalizations (ORU0.81, CIU0.77–0.84, P<0.001) and all events (ORU0.8, CIU0.76–0.85, P<0.001).

### Conclusion

Edema index provides 6-month prognostic values in patients hospitalized due to AHF. Reducing the edema index in high-risk patients results in better outcomes.

# The relationship between various measures of obesity and arterial stiffness in morbidly obese patients

Nordstrand, N., Gjevestad, E., Dinh, K. N., Hofsø, D., Røislien, J., Saltvedt, E., ... & Hjelmæsæth, J.

BMC cardiovascular disorders, 11(1), 7.

## ABSTRACT

### Objectives

Obesity is associated with increased risk of cardiovascular disease. Arterial stiffness assessed by carotid femoral pulse wave velocity (PWV) is an independent predictor of cardiovascular morbidity and mortality. We aimed to investigate how various measures of body composition affect arterial stiffness.

### Methods

This is an analysis of cross-sectional baseline data from a controlled clinical trial addressing changes in arterial stiffness after either surgery or lifestyle intervention in a population of morbidly obese patients. High-fidelity applanation tonometry (Millar®, Sphygmocor®) was used to measure pulse wave velocity (PWV). Carotid femoral PWV is a direct measure of arterial stiffness and is considered to be the gold standard method. The Inbody 720 Body Composition Analyzer was used for bioelectrical impedance analysis (BIA). Spearman's correlation, independent samples t-test, chi-square tests, Fisher's exact test and multiple linear regression analyses were used as statistical methods.

### Results

A total of 133 patients (79 women), with a mean (SD) age of 43 (11) years were included in the study. Men had a significantly higher prevalence of obesity related comorbidities and significantly higher PWV, 9.1 (2.0) m/s vs. 8.1 (1.8) m/s,  $p = 0.003$ , than women. In the female group, PWV was positively correlated with WC, WHtR, BMI and visceral fat area. In the male group, PWV was negatively correlated with BMI. Multiple linear regression analysis showed that increasing BMI, WC, WHtR, visceral fat area and fat mass were independently associated with higher PWV in women, but not in men, after adjustment for age, hypertension and type 2 diabetes.

### Conclusion

Most measures of general and abdominal obesity were predictors of arterial stiffness in female morbidly obese patients.

# Edema Index-Guided Disease Management Improves 6-Month Outcomes of Patients With Acute Heart Failure

Liu, M. H., Wang, C. H., Huang, Y. Y., Tung, T. H., Lee, C. M., Yang, N. I., ... & Cherng, W. J.

International Heart Journal, 53(1), 11-17.

## ABSTRACT

The efficacy of heart failure (HF) management programs is compromised by the challenge of early identification of patients at imminent risk. Segmental multifrequency bioelectrical impedance analysis can generate an “edema index” (EI) as a surrogate for the body fluid status. In this study, we tested whether integration of EI-guided management improved the 6-month outcomes of HF patients under multidisciplinary care. In total, 159 patients with acute HF were randomized into control, case management (CM), and EI-guided CM (EI) groups ( $n = 53$  in each group). In the EI group, a management algorithm was designed based on the measured EI. The analyzed endpoints included HF-related and all cause-related events during the 6-month follow-up period. In the 6 months, there were 11 (6.9%) deaths, 19 (11.9%) HF-related rehospitalizations, and 45 (28.3%) all-cause-related rehospitalizations. Compared to the control (26.4%) and CM groups (15.1%), the EI group had a lower rate of HF-related death and rehospitalization (3.8%,  $P = 0.004$ ). Multivariate analysis revealed that EI-guided management was an independent predictor of a lower HF-related event rate (hazard ratio = 0.15, 95%CI = 0.03~0.66,  $P = 0.012$ ). Patients with a higher pre-discharge EI were older, had lower blood albumin and hemoglobin levels, and had a higher functional class and incidences of diabetes mellitus and chronic kidney disease. An increase in the pre-discharge EI by 0.001 increased the HF-related event rate by 6% ( $P = 0.002$ ). Use of EI-guided management lowered this risk ( $P = 0.03$ ). In conclusion, an EI-based HF management program demonstrated an event-lowering effect superior to traditional nurse-led multidisciplinary care in 6 months after an acute HF episode.

# **Body cell mass is a useful parameter for assessing malnutrition and severity of disease in non-ascitic cirrhotic patients with hepatocellular carcinoma or esophageal varices.**

Kawaguchi, T., Taniguchi, E., Itou, M., Ibi, R., Okada, T., Mutou, M., ... & Sata, M.

International journal of molecular medicine, 22(5), 589-594.

## **ABSTRACT**

Body cell mass (BCM) is a nutritional parameter, however, changes in BCM in patients with non-ascitic liver cirrhosis (LC) in comparison to patients with other malnutritional diseases remains unclear. We investigated the difference in BCM between patients with LC and malnourished gastrointestinal disease controls (M.CON), and examined the relationship between BCM and the severity of LC. Results demonstrated that serum nutritional parameters were not significantly different between the LC (n=56) and M.CON groups (n=25), whereas BCM%BW was significantly lower in the LC group than in the M.CON group ( $50.9 \pm 4.6$  vs.  $54.4 \pm 7.1\%$ ,  $P=0.018$ ). Furthermore, BCM%BW negatively correlated with the model for end-stage liver disease (MELD) score ( $P=0.04$ ). In conclusion, BCM showed a significant decrease and a negative correlation with the MELD score in the LC group. BCM may be a useful parameter for assessing malnutrition and severity of LC.

# **Oxidized albumin is associated with water retention and severity of disease in patients with chronic liver diseases**

Sakata, M., Kawaguchi, T., Taniguchi, E., Nakayama, A., Ishizaki, S., Sonaka, I., ... & Sata, M.

e-SPEN, the European e-Journal of Clinical Nutrition and Metabolism, 5(6), e247-e253.

## **ABSTRACT**

### **Background & aims**

Serum albumin exists in oxidized and reduced forms. Although oxidation of albumin affects some functions of albumin, the involvement of oxidized albumin in disease progression and water retention in patients with chronic liver disease remains unclear. The aim of this study was to determine whether there is an association between oxidized albumin and water retention in patients with chronic liver disease.

### **Methods**

Seventy-nine patients with chronic viral liver diseases and 31 cirrhotic patients with hypoalbuminemia were enrolled. The oxidized albumin percentage was determined by high-performance liquid chromatography. Water retention was assessed by the extra cellular fluid/total body fluid ratio (ECF/TBF) using a bioelectrical impedance analyzer.

### **Results**

The oxidized albumin percentage was significantly increased according to disease progression (chronic hepatitis;  $28.3 \pm 1.1$ , Child A;  $33.5 \pm 1.2$ , Child B and C;  $37.8 \pm 1.3$ ,  $P < 0.05$ ). Moreover, the ECF/TBF showed a significant positive correlation with the oxidized albumin percentage ( $P = 0.010$ ,  $R^2 = 0.161$ ), but no correlation with serum albumin levels. A low proportion of oxidized albumin was an independent predictor of reduction in body weight (OR 10.6, 95%CI 1.304–86.307,  $P = 0.0272$ ).

### **Conclusions**

Oxidized albumin was related to disease progression and water retention in patients with chronic liver disease.



# **Estimating survival in patients with cancer receiving palliative care: Is analysis of body composition using bioimpedance helpful?**

Crawford, G. B., Robinson, J. A., Hunt, R. W., Piller, N. B., & Esterman, A.

Journal of palliative medicine, 12(11), 1009-1014

## **ABSTRACT**

### **Background**

This research investigated whether bioimpedance spectroscopy (BIS) has the potential to improve prognostication in an outpatient clinic for patients with cancer receiving palliative care.

### **Methods**

Survival time, and BIS measures of basal metabolic rate and 11 body composition parameters (extracellular fluid [ECF], intracellular fluid [ICF], ratio of ECF to ICF, fluid in trunk and each arm and leg, protein mass, mineral mass, and percent body fat) were recorded for 84 oncology patients.

### **Results**

None of the BIS measures showed a linear association with survival time. However, threshold values associated with short survival were identified for basal metabolic rate and 6 of the body composition measures related to fluid (ECF, ratio of ECF to ICF, fluid in right and left arms, and right and left legs). In addition, almost all patients who died within 6 weeks of assessment reached the threshold values for ECF and/or ECF:ICF ratio.

### **Conclusion**

Results confirm that elevated metabolic rate and accumulation of body fluid are indicators of a poor prognosis in patients with cancer receiving palliative care. Because BIS is simple for clinicians to use, is noninvasive, and allows early detection of these parameters, it has the potential to improve prognostication.

# Value of the extracellular water ratio for assessment of cirrhotic patients with and without ascites

Hara, N., Iwasa, M., Iwata, K., Miyachi, H., Tanaka, H., Takeo, M., ... & Takei, Y.

Hepatology Research, 39(11), 1072-1079.

## ABSTRACT

### Aims

Ascites, which often complicates liver cirrhosis, is reported to be a factor that worsens the outcome. The aims of this study were to quantify body water compartment changes in cirrhotic patients, with and without ascites, and to elucidate the value of body water analysis for predicting the development of ascites.

### Methods

A total of 109 cirrhotic patients, with and without ascites, and 65 controls were studied. Intra- and extracellular water (ECW) in the whole body and in the arm, leg and trunk were measured using the recently developed 8-electrodes multiple-frequency bioelectrical impedance analyzer. Furthermore, patients without ascites were followed to an episode of ascites or death.

### Results

Patients with liver cirrhosis had significantly higher ECW ratios than controls. ECW ratios were increased in cirrhotic patients with moderate and severe disease. The ECW ratio of the trunk showed highly significant changes in cirrhotic patients with ascites. The ECW ratio correlated with age, serum albumin, and prothrombin time. A relative expansion of ECW and low albumin were predictive of further episodes of ascites (log-rank 6.94,  $P < 0.01$ ). In multivariate analysis, the ECW ratio was independently associated with the development of ascites.

### Conclusion

Liver cirrhosis was characterized by a redistribution of body water. The ECW ratio is a reliable tool for quantification of redistribution of body water and can predict the development of ascites.

# **Restriction of calorie and iron intake results in reduction of visceral fat and serum alanine aminotransferase and ferritin levels in patients with chronic liver disease**

Iwasa, M., Hara, N., Iwata, K., Ishidome, M., Sugimoto, R., Tanaka, H., ... & Takei, Y.

Hepatology Research, 40(12), 1188-1194.

## **ABSTRACT**

### **Aim**

To clarify the impact of visceral fat on chronic liver diseases such as non-alcoholic fatty liver disease (NAFLD) and hepatitis C, we investigated the effects of lifestyle modifications on the amount of visceral fat, liver biochemistry and serum ferritin levels in patients with liver disease.

### **Methods**

Eighty-two patients (NAFLD, n = 37; hepatitis C, n = 45) were advised to adopt lifestyle modifications, including dietary changes and exercise, and these were maintained for 6 months. Bodyweight, percentage of body fat, visceral fat area (VFA) and serum alanine aminotransferase (ALT) and ferritin were measured before and after intervention.

### **Results**

In NAFLD, the mean VFA of 134.5 cm<sup>2</sup> was significantly reduced to 125.3 cm<sup>2</sup> after 6 months (P < 0.001). ALT levels improved significantly between the values measured before and after intervention (P = 0.039). The VFA prior to intervention was 100 cm<sup>2</sup> in hepatitis C patients and it was reduced significantly after 6 months to 95.6 cm<sup>2</sup> (P < 0.001). ALT levels also improved significantly in the hepatitis C patients (P < 0.001). The serum ferritin levels also reduced in these patients. Improvements in serum ALT and ferritin levels correlated with the amount of visceral fat reduction in both groups (P = 0.046, P = 0.008, respectively).

### **Conclusion**

These findings demonstrate that restriction of calorie and iron intake results in reduction of visceral fat, liver enzymes and ferritin in patients with chronic liver disease. Visceral fat may be a central target for future interventions, not only in NAFLD but also in hepatitis C.

# The impact of nutritional supplementation on quality of life in patients infected with hepatitis C virus

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Journal of Human Nutrition and Dietetics, 26 (Suppl. 1), 7–15

## ABSTRACT

### Background

The present study aimed to evaluate the impact of animal and vegetable protein supplementation on health-related quality of life (HRQL) in patients with hepatitis C virus (HCV) and to investigate clinical and nutritional variables related to quality of life in these patients.

### Methods

One hundred and forty patients infected with HCV were randomly assigned to one of two groups: the Soy Group (SG;  $n = 72$ ), where patients received a soy supplement diet and the Casein Group (CG;  $n = 68$ ), where patients received casein as a supplement. Anthropometric, biochemical and clinical assessments were performed in all patients, and the Short-Form Health Survey was applied at baseline and 12 weeks after study initiation.

### Results

Before supplementation, poor HRQL scores were associated with female sex ( $P = 0.004$ ) and advanced fibrosis (F3/F4;  $P = 0.04$ ). Reduced HRQL scores were correlated with age ( $r = 0.263$ ;  $P = 0.002$ ), serum albumin levels ( $r = 0.245$ ;  $P = 0.004$ ), lean mass ( $r = 0.301$ ;  $P < 0.0001$ ) and body fat percentage ( $r = 0.262$ ;  $P = 0.002$ ). After 12 weeks of intervention, patients in both supplementation groups showed significantly increased HRQL scores, with no difference being observed between the SG and the CG.

### Conclusions

Nutritional therapy with either soybean or casein supplementation improved quality of life in patients infected with HCV. Quality of life was influenced by anthropometric, biochemical, clinical and sociodemographic factors in patients with HCV before nutritional supplementation.

# Comparison between serum free triiodothyronine levels and body fluid distribution in hemodialysis patients

Saito, O., Saito, T., Ueno, K., Shiraishi, T., Kikuchi, T., Yamamoto, H., ... & Kusano, E.

Clinical and experimental nephrology, 16(6), 952-958.

## ABSTRACT

### Aim

Low free triiodothyronine (fT3) has been associated with the presence of malnutrition–inflammation syndrome in patients with end-stage renal disease (ESRD) and decreased overall survival in ESRD. Since thyroid hormone has a particular effect on body fluid status, we hypothesized that hemodialysis patients with low-T3 syndrome might have interstitial edema. In this study, we examined the relationship between levels of thyroid hormone and body composition parameters in Japanese hemodialysis patients.

### Methods

The subjects were 52 patients on maintenance hemodialysis. Serum levels of thyroid hormone and atrial natriuretic peptide (hANP) were measured. Body composition parameters were measured using a bioimpedance body composition analyzer.

### Results

Serum fT3 had positive correlations with body mass index (BMI), body fat mass (BFM), total body water (TBW) and intracellular water (ICW), and negative correlations with the ratio of extracellular water to total body water (ECW/TBW) and hANP. There were no correlations between serum fT4 and any body composition parameter. The 49 patients with data at baseline and after 1 year were divided into groups with increased (n = 33) and decreased (n = 16) fT3 after 1 year. DBMI and DBFM were significantly lower and DTBW, DICW, DECW and DECW/TBW (changes over 1 year from baseline) were significantly higher in patients with decreased fT3 compared to those with increased fT3. There was no significant difference in DhANP or Dcardiothoracic ratio between the two groups.

### Conclusion

These results show that a decrease in fT3 might be associated with emaciation and interstitial edema in Japanese hemodialysis patients.

# Does Diabetes Mellitus Predispose to Increased Fluid Overload in Peritoneal Dialysis Patients?

Davenport, A., & Willicombe, M. K

Nephron Clinical Practice, 114(1), c60-c66.

## ABSTRACT

### Background

Diabetic peritoneal dialysis patients have been reported to have faster peritoneal solute transport and may be at risk of reduced ultrafiltration volumes, leading to fluid overload.

### Methods

We audited multi-frequency bioimpedance data from 198 consecutive peritoneal dialysis patients (141 nondiabetics and 57 diabetics).

### Results

Diabetic patients had increased body mass index (males  $27 \pm 4$  vs.  $26 \pm 4$ ; females  $28 \pm 5$  vs.  $25 \pm 4$ ;  $p < 0.01$  for both), waist to hip ratio (males  $0.94 \pm 0.07$  vs.  $0.94 \pm 0.04$ ; females  $0.99 \pm 0.9$  vs.  $0.94 \pm 0.09$ ;  $p < 0.01$  for both) and body fat (males  $31 \pm 8$  vs.  $26 \pm 11\%$ ,  $p < 0.05$ ; females  $40 \pm 8$  vs.  $33 \pm 10\%$ ,  $p < 0.01$ ) compared to nondiabetic patients. D4/P creatinine was greater for the female diabetic patients than the nondiabetic patients ( $0.75 \pm 0.1$  vs.  $0.69 \pm 0.1$ ;  $p = 0.044$ ); otherwise, the peritoneal equilibrium test (PET) results did not differ. Extracellular water (ECW) adjusted for height was similar in diabetic and nondiabetic patients, but the ratio of ECW to total body water (TBW) was greater for diabetics (males  $0.40 \pm 0.01$  vs.  $0.39 \pm 0.01$ ; females  $0.39 \pm 0.01$  vs.  $0.38 \pm 0.01$ ;  $p < 0.05$  for both).

### Conclusions

Diabetic and nondiabetic patients had similar PET results, 24-hour net peritoneal ultrafiltration and blood pressure control. The ratio of ECW to TBW was greater in diabetic patients, and although this could be due to a loss of intracellular water, as albumin and C-reactive protein did not differ, it suggests that diabetic peritoneal dialysis patients have an expanded extracellular volume.

# Extracellular volume expansion in peritoneal dialysis patients

Fan, S., Sayed, R. H., & Davenport, A.

International journal of artificial organs, 35(5), 338-345.

## ABSTRACT

### Introduction

Cardiovascular mortality remains high among peritoneal dialysis (PD) patients. Several small studies have suggested that PD patients are volume expanded, and as such this could be a cardiovascular risk factor. We therefore wished to investigate factors which could lead to extracellular water (ECW) expansion.

### Methods

Retrospective cross-sectional audit of 600 prevalent, adult PD patients attending two tertiary university PD centers, with corresponding assessments of PD adequacy, transport status, and multifrequency bioimpedance measurements of extracellular water to total body water (ECW/TBW).

### Results

600 PD patients, median age 57.5 (46.9-67.9) years, 54% male, 31% diabetic, 47.6% Caucasoid, median PD vintage 16 (3.7-38) months, (64% prescribed icodextrin, 34% hypertonic glucose dialysates, and 74% antihypertensive medications). Mean ECW 15.1±0.2 L, ICW 20±0.2 L, ECW/TBW ratio 0.437±0.007. On multivariate analysis %ECW/TBW was associated with age ( $F=13.1$   $\beta=0.045$   $p=0.000$ ), number of antihypertensive medications ( $F=10.3$   $\beta=0.43$   $p=0.001$ ), log CRP ( $F=12.9$   $\beta=1.3$   $p=0.000$ ), and negatively with serum albumin ( $F=25$   $\beta=-0.22$   $p=0.000$ ), and residual renal function (urine volume mL  $F=9.96$   $\beta=-0.001$   $p=0.002$ ) (weekly Kt/Vurine  $F=8.82$   $\beta=-2.05$ ,  $p=0.003$ ).

### Conclusions

Overhydration as assessed by ECW/TBW is prevalent in adult PD patients, and is associated with loss of residual renal function, inflammation, malnutrition and hypertension – as assessed by antihypertensive medications. As this was a retrospective cross-sectional audit, whether loss of residual renal function, inflammation, and protein energy wasting lead to volume expansion remains to be determined in prospective longitudinal studies.

# Association of plasma adiponectin levels with cellular hydration state measured using bioelectrical impedance analysis in patients with COPD

Yoshikawa, T., & Kanazawa, H.

International Journal of Chronic Obstructive Pulmonary Disease, 7, 515.

## ABSTRACT

### Background

It is widely recognized that chronic obstructive pulmonary disease (COPD) includes a variety of extra pulmonary complications and comorbidities. Recently, adiponectin was shown to regulate cellular metabolism in humans. Cellular hydration state is affected by a variety of hormonal factors and regulates cellular metabolic state. Therefore, this study was designed to determine whether adiponectin is a possible factor involved in cellular hydration state in COPD.

### Methods

Thirty patients with COPD and 41 age-matched controls participated in the study. Plasma levels of total and high molecular weight (HMW) adiponectin were measured and anthropometry and pulmonary function tests were conducted. Intracellular water (ICW), extracellular water (ECW), and ECW/ICW ratio, which are parameters of cellular hydration state, were measured using bioelectrical impedance analysis.

### Results

Higher levels of total and HMW adiponectin in plasma were found in patients with COPD compared with levels in controls. A significant inverse correlation was observed between body mass index and plasma levels of total and HMW adiponectin in the control group. However, this significant correlation was not observed in patients with COPD. The plasma levels of total and HMW adiponectin were also not significantly correlated with any pulmonary function parameters in patients with COPD. Regarding the state of cellular hydration, the plasma levels of total adiponectin were inversely correlated with the ECW/ICW ratio and positively with ICW values in patients with COPD. Moreover, closer correlations were found between these parameters and plasma HMW adiponectin levels.

### Conclusion

The results of the present study suggest a novel association of the plasma adiponectin with cellular hydration state in patients with COPD. Accordingly, lower adiponectin levels may result in cellular shrinkage, leading to metabolic malfunction at a cellular level. Thus, our findings provide new insights regarding the preventive roles of adiponectin in the progression of comorbidities in COPD.



# Excessive visceral fat accumulation in advanced chronic obstructive pulmonary disease

Furutate, R., Ishii, T., Wakabayashi, R., Motegi, T., Yamada, K., Gemma, A., & Kida, K.

International journal of chronic obstructive pulmonary disease, 6, 423.

## ABSTRACT

### Background

Previous studies have suggested links between chronic obstructive pulmonary disease (COPD), cardiovascular disease, and abdominal obesity. Although abdominal visceral fat is thought to be associated with cardiovascular risk factors, the degree of visceral fat accumulation in patients with COPD has not been directly studied. The aim of this study was to investigate the abdominal visceral fat accumulation and the association between visceral fat and the severity and changes in emphysema in COPD patients.

### Methods

We performed clinical and laboratory tests, including pulmonary function, dyspnea score, and the six-minute walking test in COPD patients (n = 101) and control, which included subjects with a smoking history but without airflow obstruction (n = 62). We used computed tomography to evaluate the abdominal visceral fat area (VFA), subcutaneous fat area (SFA), and the extent of emphysema.

### Results

The COPD group had a larger VFA than the control group. The prevalence of non-obese subjects with an increased VFA was greater in the Global Initiative for Chronic Obstructive Lung Disease Stages III and IV than in the other stages of COPD. The extent of emphysema was inversely correlated with waist circumference and SFA. However, VFA did not decrease with the severity of emphysema. VFA was positively correlated with the degree of dyspnea.

### Conclusion

COPD patients have excessive visceral fat, which is retained in patients with more advanced stages of COPD or severe emphysema despite the absence of obesity.

# **Accuracy of direct segmental multi-frequency bioimpedance analysis in the assessment of total body and segmental body composition in middle-aged adult population**

Ling, C. H., de Craen, A. J., Slagboom, P. E., Gunn, D. A., Stokkel, M. P., Westendorp, R. G., & Maier, A. B

Clinical Nutrition, 30(5), 610-615.

## **ABSTRACT**

### **Background & aims**

Body composition measurement is a valuable tool for assessing nutritional status and physical fitness in a variety of clinical settings. Although bioimpedance analysis (BIA) can easily assess body composition, its accuracy remains unclear. We examined the accuracy of direct segmental multi-frequency BIA technique (DSM-BIA) in assessing different body composition parameters, using dual energy X-ray absorptiometry (DEXA) as a reference standard.

### **Methods**

A total of 484 middle-aged participants from the Leiden Longevity Study were recruited. Agreements between DSM-BIA and DEXA for total and segmental body composition quantification were assessed using intraclass correlation coefficients and Bland–Altman plots.

### **Results**

Excellent agreements were observed between both techniques in whole body lean mass (ICC female = 0.95, ICC men = 0.96), fat mass (ICC female = 0.97, ICC male = 0.93) and percentage body fat (ICC female = 0.93, ICC male = 0.88) measurements. Similarly, Bland–Altman plots revealed narrow limits of agreements with small biases noted for the whole body lean mass quantification but relatively wider limits for fat mass and percentage body fat quantifications. In segmental lean muscle mass quantification, excellent agreements between methods were demonstrated for the upper limbs (ICC female  $\geq$ 0.91, ICC men  $\geq$ 0.87) and lower limbs (ICC female  $\geq$ 0.83, ICC male  $\geq$ 0.85), with good agreements shown for the trunk measurements (ICC female = 0.73, ICC male = 0.70).

### **Conclusions**

DSM-BIA is a valid tool for the assessments of total body and segmental body composition in the general middle-aged population, particularly for the quantification of body lean mass.

# **Body composition measurements determined by air displacement plethysmography and eight polar bioelectrical impedance analysis are equivalent in African American college students**

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HealthMED, 6(6), 1902-1905.

## **ABSTRACT**

The 143 subjects, aged 17–39 years, visited the participating Human Performance & Leisure Studies laboratory at North Carolina A&T State University, Greensboro, NC, United States, between June 1, 2011 and December 31, 2011.

Measurements of body composition, including fat mass (FM), fat free mass (FFM), and % body fat were determined using BOD POD (Life Measurement Inc., California, USA) and an eightpolar BIA (Inbody-720, Biospace, Seoul, Korea). The relationships between body composition measurements taken using BOD POD and eight-polar BIA were assessed using Pearson's  $r$  correlation.

Results showed that body composition measurements taken using the BOD POD and the eightpolar BIA correlated significantly with respect to FFM (male,  $r=0.911$ ,  $p<0.001$ ; female,  $r=0.918$ ,  $p<0.001$ ); FM (male,  $r=0.938$ ,  $p<0.001$ ; female:  $r=0.931$ ,  $p<0.001$ ); and % body fat (male,  $r=0.871$ ,  $p<0.001$ ; female,  $r=0.717$ ,  $p<0.001$ ).

*The authors* concluded that measurements taken using BODPOD and eight-polar BIA were similar in African American students. These methods are useful for field tests requiring body composition measurements and can be used interchangeably in the field.

# Body water distribution in severe obesity and its assessment from eight-polar bioelectrical impedance analysis

Sartorio, A., Malavolti, M., Agosti, F., Marinone, P. G., Caiti, O., Battistini, N., & Bedogni

European Journal of Clinical Nutrition, 59(2), 155-160.

## ABSTRACT

### Objective

To measure body water distribution and to evaluate the accuracy of eight-polar bioelectrical impedance analysis (BIA) for the assessment of total body water (TBW) and extracellular water (ECW) in severe obesity.

### Subjects

In all, 75 women aged 18–66 y, 25 with body mass index (BMI) between 19.1 and 29.9 kg/m<sup>2</sup> (ie not obese), 25 with BMI between 30.0 and 39.9 kg/m<sup>2</sup> (ie class I and II obese), and 25 with BMI between 40.0 and 48.2 kg/m<sup>2</sup> (ie class III obese).

### Methods

TBW and ECW were measured by <sup>2</sup>H<sub>2</sub>O and Br dilution. Body resistance (R) was obtained by summing the resistances of arms, trunk and legs as measured by eight-polar BIA (InBody 3.0, Biospace, Seoul, Korea). The resistance index at a frequency of x kHz (RI<sub>x</sub>) was calculated as height<sup>2</sup>/R<sub>x</sub>.

### Results

ECW : TBW was similar in women with class III (463%, means.d.) and class I–II obesity (453%) but higher than in nonobese women (393%,  $P < 0.05$ ). In a random subsample of 37 subjects, RI<sub>500</sub> explained 82% of TBW variance ( $P < 0.0001$ ) and cross-validation of the obtained algorithm in the remaining 38 subjects gave a percent root mean square error (RMSE%) of 5% and a pure error (PE) of 2.1 l. In the same subjects, RI<sub>5</sub> explained 87% of ECW variance ( $P < 0.0001$ ) and cross-validation of the obtained algorithm gave a RMSE% of 8% and a PE of 1.4 l. The contribution of weight and BMI to the prediction of TBW and ECW was nil or negligible on practical grounds.

### Conclusions

ECW : TBW is similar in women with class I–II and class III obesity up to BMI values of 48.2 kg/m<sup>2</sup>. Eight-polar BIA offers accurate estimates of TBW and ECW in women with a wide range of BMI (19.1–48.2 kg/m<sup>2</sup>) without the need of population-specific formulae.

# Comparison of multifrequency bioelectrical impedance analysis and dual-energy X-ray absorptiometry assessments in outpatient hemodialysis patients

Fürstenberg, A., & Davenport, A.

American Journal of Kidney Diseases, 57(1), 123-129.

## ABSTRACT

### Background

Malnutrition is common in hemodialysis patients and closely related to increased morbidity and mortality. As such, simple, reliable, and easily available methods of determining nutritional status and recognition of short-term changes in body composition are desirable for routine clinical practice.

### Setting & Participants

53 stable adult hemodialysis patients attending for thrice-weekly outpatient hemodialysis in a university tertiary hospital dialysis center.

### Index Test

Comparison of dual-energy x-ray absorptiometry (DEXA) and multifrequency bioelectrical impedance analysis (BIA) using a tetrapolar 8-point tactile electrode system as 2 index tests of body composition.

### Results

Assessment of whole-body composition showed that lean body mass measured using the 2 techniques correlated highly, with good method agreement shown using a Bland-Altman plot ( $r = 0.92$ ;  $P < 0.001$ ; bias, +1 g [95% CI, -1,173 to 1,175]), as did fat mass ( $r = 0.93$ ;  $P < 0.001$ ; bias, -157 g [95% CI, -1,251 to 937]). Similarly, segmental analysis of lean body mass showed strong correlations between lean body mass of the trunk and right and left legs with small bias ( $r = 0.85, 0.89,$  and  $0.86,$  respectively;  $P < 0.001$ ; Bland-Altman bias, -859, +364, and +552 g, respectively), but weaker correlations for lean body mass for the right and left arm ( $r = 0.69$  and  $0.75,$  respectively;  $P < 0.001$ ; Bland-Altman bias, -240 and +12 g, respectively). Bone mineral content derived using multifrequency BIA overestimated that measured using DEXA ( $r = 0.77$ ;  $P < 0.001$ ; bias, +530 g [95% CI, 422-638]).

### Conclusions

Compared with DEXA, multifrequency BIA appears to be a robust tool for measuring and monitoring total-body fat and lean body mass in hemodialysis patients; however, there is less agreement in bone mineral content assessment between the 2 methods.

# **Cross-calibration of multi-frequency bioelectrical impedance analysis with eight-point tactile electrodes and dual-energy X-ray absorptiometry for assessment of body composition in healthy children aged 6–18 years**

Lim, J. S., Hwang, J. S., Lee, J. A., Kim, D. H., Park, K. D., Jeong, J. S., & Cheon, G. J.

Pediatrics International, 51(2), 263-268.

## **ABSTRACT**

### **Background**

In diagnosis and treatment of obesity, body composition analysis including percent body fat (%BF) is useful in the clinical setting. Because bioelectrical impedance analysis (BIA) could be used quickly, easily and was non-invasive in clinical setting, the purpose of the present study was to evaluate the usefulness of multi-frequency BIA with eight-point tactile electrodes (MF-BIA8; InBody 720, Biospace) compared with dual-energy X-ray absorptiometry (DXA) in healthy children and adolescents.

### **Methods**

A total of 166 children and adolescents under 18 (male, n = 86; female, n = 80) were recruited. Height, weight, body mass index (BMI) and Tanner stage were measured for each subject. The body composition such as fat-free mass (FFM), fat mass (FM), and %BF was measured on BIA and DXA and compared.

### **Results**

On linear regression analysis,  $DXA\ FFM = 1.006(BIA\ FFM) + 0.554$ ,  $R^2 = 0.99$  and the standard error of the estimate (SEE) was 1.16 kg;  $DXA\ FM = 0.971(BIA\ FM) - 0.596$ ,  $R^2 = 0.93$ ; SEE, 1.34 kg; and  $DXA\ \%BF = 0.940(BIA\ \%BF) - 1.026$ ,  $R^2 = 0.858$ ; SEE, 3.03%. Limit of agreement in FFM, FM, and %BF was  $0.7 \pm 2.3$  kg,  $-0.9 \pm 2.9$  kg and  $-2.2 \pm 6.1\%$ , respectively.

### **Conclusions**

Although the %BF was not interchangeable with DXA, MF-BIA8 (InBody 720; Biospace) could be used to measure body composition of children and adolescents in the clinical field because of its high precision.