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Nutritional status and intrarenal arterial stiffness in cardiorenal syndrome: a pilot study

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Abstract. – OBJECTIVE: Cardio-Renal Syndrome (CRS) is a condition, which is more frequently observed in clinical practice. The aim of this study is to explore nutritional status and intrarenal arterial stiffness in patients affected by CRS.

PATIENTS AND METHODS: 14 consecutive CRS patients, screened for anthropometry, biochemistry, nutritional and metabolic status underwent renal Doppler ultrasound and whole-body bioimpedance spectroscopy (BIS).

RESULTS: We found a positive correlation between phase angle (PA) and CKD-EPI and MDRD (*p*=0.011 and *p*=0.007), and between body mass index and renal resistive index (RRI) (*p*=0.002). Finally, we found a negative correlation between fat-free mass and RRI (*p*=0.024).

CONCLUSIONS: Body composition assessment may improve the care of patients with chronic kidney disease (CKD). Also, BIS may help identify changes in hydration status in CKD patients resulting as a significant predictor of mortality.

Key Words:
Cardiorenal syndrome, Renal resistive index, Bioimpedance spectroscopy, Cachexia, Malnutrition.

Introduction

Cardio-Renal Syndrome (CRS) describes a cardiac and renal dysfunction, where the acute or chronic failure of one of the two organs determines acute or chronic insufficiency of the other organ[1]. CRS is a condition that is more frequently observed in the clinical practice and the identification of predisposing trigger factors, such as infectious diseases, particularly in older adults, plays a key role in reducing morbidity and mortality[2]. Malnutrition and cachexia frequently develop in patients with heart failure or kidney failure. Cachexia is clinically characterized by involuntary weight loss, anorexia, reduced food intake, and muscle wasting[3]. Recently cachexia has been proposed as a possible mechanism defining cardio-renal cachexia syndromes (CRCS)[4]. CRCS can contribute to the worsening of cardiac and kidney functions and negatively influences clinical outcome.

By exploring nutritional status in CRS patients and its relationship with intrarenal arterial stiffness, we aimed to assess whether anthropometric parameters correlate with renal resistive index (RRI) in CRS hospitalized patients.

Patients and Methods

Adult patients admitted to our Department during five consecutive months and meeting the diagnosis of CRS were considered for inclusion in the study. The diagnosis of CRS was based on the criteria set in the ADQI Consensus Conference 2008[1]. Patients unable to give informed consent, with cancer, gastrointestinal obstruction or dysphagia were excluded. At the moment of diagnosis, patients underwent renal Doppler ultrasound, echocardiography and whole-body bioimpedance spectroscopy (BIS).

Renal Doppler ultrasound (RDU) was performed using a Toshiba Aplio Ultrasound System SSA-790 (Tokyo, Japan) equipped with convex 3.5-MHz probe. RRI was calculated as (peak systolic frequency shift-minimum diastolic frequency shift)/peak systolic frequency shift. All the ultrasound examinations were performed by the same-blinded physician in order to reduce variability in the assessment management of the study. The average of three measurements for each Doppler parameter of arcuate and interlobar arteries in both kidneys was calculated. RRI > 0.7 were considered pathologic[5].

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Echocardiography was performed with an ultrasound Toshiba Ultrasound System (Tokyo, Japan) equipped with a convex 2.5-3.5 MHz probe.

Patients' anthropometry [weight, height, body mass index (BMI), hand-grip (HG) strength] and biochemistry were collected from charts and recorded. Also, patients were screened for malnutrition by using the validated tool NRS-2002[6].

Whole-body BIS was performed using an Impedimed multifrequency device (Impedimed IMP SFB7, San Diego, CA, USA). All the subjects were in the supine position with four gel-type electrodes, two voltages and two current, pasted on the right foot and wrist. Two pairs of electrodes were placed: on the hand to foot for injecting current with a frequency from 4 kHz to 1 MHz, and on the wrist to ankle for measuring voltage. Data derived from these measurements included resistance, reactance, phase angle (PA) and impedance.

Data were collected and processed using SPSS version 20 for Macintosh (SPSS Inc., Chicago, IL, USA). Correlations were used to assess the bivariate associations between variables, using Pearson correlation. Data are presented as median (range). A $p<0.05$ was considered statistically significant.

Results

During the study period, 14 patients were considered for inclusion in the study: eight presented an acute disorder and six manifested baseline characteristics typical of a chronic disease. Out of fourteen patients, 11 were males (78.6%) and 3 females (21.4%). The median age of the sample was 77.5 years (37-92). In most of the patients the reason for hospitalization was dyspnea. An abrupt increase of blood pressure, anemia, chest pain, fever of unknown origin, loss of consciousness and acute kidney injury were other remarkable causes. The baseline demographic, anthropometric and clinical characteristics are shown in Table I. In particular, we found a positive correlation between PA and renal function, as expressed by estimated glomerular filtrate rate (eGFR) evaluated by CKD-EPI and MDRD (p=0.011 and p=0.007 respectively). Moreover, we found a positive correlation between BMI and RRI (p=0.002) and a negative correlation between fat-free mass (%) and RRI (p=0.024) (Figure 1).

Discussion

Our study shows that in CRS patients, RRI correlates positively with BMI and negatively with fat-free mass. In patients with metabolic syndrome, it is well known that intra-renal resistances are elevated at an early stage and associated with a dysregulated production of fat-derived hormones and cytokines[7]. Furthermore, we found that eGFR showed a positive correlation with PA.

PA is a bedside reliable tool for nutritional assessment based on conductivity properties of body tissues representing an indicator of cell membrane integrity and a prognostic indicator

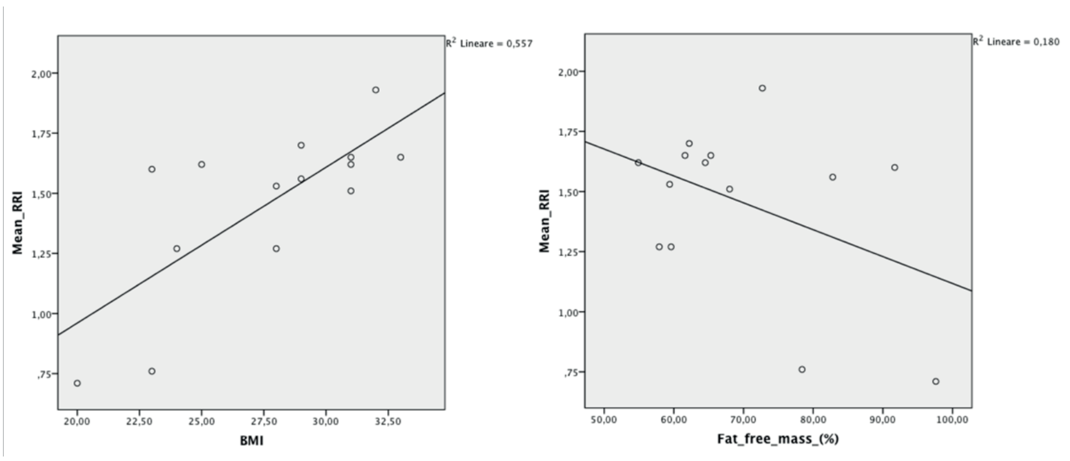

Figure 1. Correlation between mean RRI and BMI and between RRI and Fat Free Mass (%).

Table I. Demographic, anthropometric and clinical characteristics in patients affected by CRS.

	Median value	Max	Min
Creatinine (mg/dl)	1.55	7.8	1.1
eGFR CKD-EPI (ml/min/1.73 m^2)	40	66	7
eGFR MDRD (ml/min/1.73 m^2)	43	69	8
Azotemia (mg/dl)	57.2	308.0	35.0
Hemoglobin (g/dl)	11	16.5	8.1
Uric acid (mg/dl)	7.6	11.6	4.7
Albumin (mg/dl)	3.1	4	1.6
PCR (ng/ml)	50850	208800	500
BMI (kg/m^2)	28.5	33.1	20.2
BSA (m^2)	1.9	2.3	1.7
NRS 2002	2	4	1
HG right (kg)	18	33	9
HG left (kg)	18	33	4
Phase angle	5.8	8.6	3.3
Fat free mass (kg)	55.4	68.6	35.7
Fat free mass (%)	64.9	97.6	54.9
EF (%)	50	60	40
Cardiac mass	215.9	339.6	114
Cardiac mass/BSA	117.5	172.4	49.78
RRI	0.79	0.96	0.63

in many clinical situations[8]. These data, when comprehensively evaluated, seem to point at a protective role of improved nutritional status in determining renal function. This is in agreement with previous studies in different clinical settings, highlighting the close relationship between preserved muscle mass and favorable outcome[9]. Additionally, it may be helpful to intervene in the early CRS by drugs that act on outcome at multiple levels (heart, kidney, vessels)[10]. In particular, the divergent correlations of RRI with BMI and fat-free mass suggest that sarcopenic obesity, i.e., concurrent large fat mass and low muscle mass, may negatively influence outcome also in CRS patients. Therefore, considering the role of specialized nutrition therapy to ameliorate nutritional status, body composition assessment has the potential to improve the care of CKD patients. Furthermore, BIS may help to identify changes in hydration status in CKD patients not fully appreciated by clinical or biochemical assessment resulting as a significant predictor of mortality in these patients.

Conclusions

Our study strongly encourages the initiation of larger trials to assess the RRI and BIS in course of CRS to help monitoring therapy.

Ethical Statement

The study protocol was designed according to the criteria set in the Declaration of Helsinki and was approved by the Ethics Committee at our institution.

Conflict of Interest

The authors declare no conflicts of interest.

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