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Original article

Concordance of the new ESPEN criteria with low phase angle in defining early stages of malnutrition in cardiac surgery

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SUMMARY

Background & aims: The aim of this study was to evaluate the incidence of malnutrition (MN) in cardiac surgery patients by implementing the new ESPEN diagnostic criteria and to determine whether these criteria are concordant with the bioelectrical impedance analysis (BIA) provided phase angle (PA) in predicting early stages of malnutrition.

Methods: A prospective study was conducted in a tertiary hospital. The nutritional state of the cardiac surgery patients was evaluated one day prior to cardiac surgery using the malnutrition screening tools NRS-2002, MUST and SF-MNA, and bioelectrical impedance analysis. Patients at risk of malnutrition were further studied in accordance with the ESPEN malnutrition diagnostic criteria. A BIA provided PA value of less than the 15th percentile of the age and gender group was set as a theoretical marker of early malnutrition. ROC AUC (receiver operating characteristic area under curve) analysis and other parameters were calculated to determine the concordance between the new ESPEN malnutrition diagnostic criteria and a low PA.

Results: The study comprised 549 enrolled cardiac surgery patients. MN or risk of MN in accordance with at least one nutritional status assessment tool was diagnosed in 372 (67.75%) patients. MN, according to the new ESPEN malnutrition diagnostic criteria, was only diagnosed in 31 (5.6%) patients. Low PA was detected in 124 patients (22.6%), providing a higher MN rate. The ROC analysis and other concordance parameters showed that the new ESPEN diagnostic criteria (AUC 0.560, $p = 0.042$) were not concordant with a low PA.

Conclusion: Fewer patients are classified as malnourished by the new ESPEN definition as those identified by the BIA provided PA. Incorporation of the BIA provided PA into the new ESPEN definition may aid to diagnose the early stages of MN in the field of cardiac surgery.

Abbreviations: PA, phase angle; BIA, bioelectrical impedance analysis; Low PA, low phase angle; FFMI, fat free mass index; Euroscore II, European system for cardiac operative risk evaluation II; IQR, interquartile range; OR, odds ratio; CI, confidence interval; BMI, body mass index; CABG, coronary artery bypass grafting; LVEF, ejection fraction of the left ventricle; ESPEN, European Society of Clinical Nutrition and Metabolism; CPB, cardiopulmonary bypass; ROC, receiver operating characteristic; AUC, area under the curve; NYHA, New York heart association functional classification.

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1. Background

Malnutrition in cardiac surgery is a well-established condition [1,2]. The range of malnutrition is substantial and varies from 13% to 50%, depending on the diagnostic tool used [3–7]. Current research on cardiac surgery patient nutrition focuses on the evaluation of risk and the effects of malnutrition on clinical outcomes [8,9]. Therefore, it is of the utmost importance to select the most accurate and sensitive malnutrition diagnostic tool [10].

There are many ways to diagnose malnutrition in hospitalised patients [11]. The options range from anthropometric measurements, such as skin-fold thickness and body mass index, to scanning of radioactive potassium isotopes, amounting to 44 different diagnostic tools described over 25 years of nutritional diagnostics [12]. However, not all of these methods are applicable in cardiac surgery patients. Furthermore, due to various physiological alterations in cardiac failure, it would be misleading to use some of these methods in this particular setting [13,14]. Hence, one of the most commonly described methods is bioelectrical impedance analysis (BIA). The analysis is based on the different electrical conduction of tissues, providing the therapist with the volume of fluids, fat mass and fat free mass [15]. Currently, the preferred and most novel application of BIA is the appliance of raw measurements of impedance. These measurements are mathematically compounded into the value of the phase angle [16]. The BIA derived phase angle value is associated with malnutrition in various clinical fields, strongly related to the disease outcome, particularly in cardiac surgery [17–19]. Furthermore, the value of the phase angle is further determined by the inflammatory, physical [20–22], and psychosocial state of the patients, and is commonly lower during chronic conditions, or in elderly patients [23–26]. This demonstrates that these changes are found because of nutritional rearrangements and therefore disturbed synthesis in the cell. Thus, a phase angle was selected as a marker of early malnutrition, following the definition of malnutrition proposed by ESPEN: “A state resulting from lack of uptake or intake of nutrition leading to altered body composition (decreased fat free mass and body cell mass) leading to diminished physical and mental function and impaired clinical outcome from disease” [27].

The half century long debates on malnutrition diagnostics have been summarised in the ESPEN consensus statement on diagnostic criteria for malnutrition [11]. The statement was produced by implementing the results of a survey by the most renowned experts in the malnutrition field. It recommended to use the nutritional risk screening questionnaires to detect the risk of malnutrition, and bioelectrical impedance provided FFMI to define the malnutrition in the overall unhealthy population. However, there might be some limitations in the proposed model of diagnostics in the cardiac surgery field due to the aforementioned physiological alterations. The cumulative effect of excess fluid in congestive heart failure, the subtle alterations occurring in the membranes of the malnourished cells, and the nutrition related social state of the patient might not be promptly reflected by the changes in FFMI or by the answers to the questionnaires. These doubts were supported in a recent statement by Soeters P. and colleagues, who provided insight into possible shortcomings of the new criteria due to a lack of evaluation of inflammation and a negative nutrient balance leading to changes in body composition, function and outcome [28]. Furthermore, Rojer A. and colleagues have shown that the rate of malnutrition using these new criteria ranges from 0 to 14%, suggesting an extremely low incidence, not reported in previous research [10].

Therefore, the aim of this study was to evaluate the incidence of malnutrition in cardiac surgery patients by implementing the new ESPEN diagnostic criteria and to determine whether these criteria are concordant with the BIA provided phase angle (PA) in predicting early stages of malnutrition.

2. Materials and methods

2.1. Study samples and design

This was a retrospective study of prospectively gathered data, which took place in Vilnius University Santariskiu Clinics between March 2013 and March 2014. This study was approved by the research ethics committee of Vilnius University, and informed consent was obtained from the patients.

During this period, all eligible cardiac surgery patients in the clinic were offered an opportunity to participate in the study. The selection criteria were elective cardiac surgery, age of more than 18 years, consciousness, cooperation and ability to provide a written informed consent. Patients with implanted defibrillators, major amputations or patients who could not provide information on weight loss were excluded.

All patients underwent a standard preoperative screening, and the following data were recorded: demographic data, comorbidities, laboratory and instrumental analyses in accordance with the standard protocol of examinations conducted at the cardiac surgery clinic for patients scheduled for cardiac surgery.

2.2. ESPEN malnutrition diagnostic criteria

The nutritional state of the patients was evaluated the day before surgery. Nutrition evaluation was composed of a malnutrition risk assessment and malnutrition diagnostics. The malnutrition risk assessment was carried out using three malnutrition screening tools recommended by the European Society of Clinical Nutrition and Metabolism (ESPEN): The Nutritional Risk Screening 2002 (NRS-2002), Malnutrition Universal Screening Tool (MUST) and the Short Form-Mini Nutritional Assessment (MNA-SF). The patients who were at risk of malnutrition were further studied in accordance to the new ESPEN malnutrition diagnostic criteria:

1) body mass index (BMI) < 18.5 kg/m^2, or
2) unintentional weight loss >5% of their body weight with reduced BMI (<20 kg/m^2 in subjects younger than 70 years or <22 kg/m^2 in subjects older than 70 years).

Participants were also grouped in two FFMI categories – below 15 kg/m^2 for women and below 17 kg/m^2 for men – providing a simplified version of malnutrition diagnostics. The relevant anthropometric was gathered by ESPEN recommendations with proper and certified medical tools and devices.

2.3. BIA derived and standardised phase angle as a reference method

The reference method of malnutrition diagnostics was acquired from parameters of bioelectrical impedance analysis (BIA). This user-friendly method is a non-invasive way to analyse the patients' nutritional status and body composition at the bedside. BIA was performed with an InBody S10 (Seoul, South Korea) device in a supine position according to the ESPEN guidelines on BIA application: with height and weight measured in the clinic, voided bladder, no physical activity before measurement, correctly prepared skin, abducted limbs, no electrical interferences and according to all other manufacturer and ESPEN recommendations [29]. A standardised phase angle (PA) derived from raw parameters of BIA was used to differentiate malnourished patients from well-nourished patients. The standardisation of the PA was carried

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