Organizational, Clinical and Social Aspects of Age-Related Sarcopenia Diagnostics in Patients with Obesity

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Abstract.
Sarcopenia is one of the key geriatric syndromes, the presence of which is associated with an extremely poor prognosis as to life expectancy and quality of life. The significance of sarcopenia as a prognostic factor is vividly reflected in the ILSIRENTE study in which the patients aged 80-85 years (364 patients in total at the baseline) were observed during 7 years. Within this period of time, 67.4% of the observed patients from the sarcopenia group and 21.8% from the non-sarcopenia group died (p<0.001). The relative risk of death in the sarcopenia group was significantly (2.32 times) higher even after excluding the age, sex, education, active daily life (ADL), body mass index (BMI), apical hypertrophy (AH), chronic heart failure (CHF), chronic obstructive pulmonary disease (COPD), number of chronic diseases and TNF-alpha levels from the analysis. This article examines the organizational aspects of early diagnostics of this syndrome.
Keywords: organization, clinical and statistical aspects, elderly age, sarcopenia, obesity.

INTRODUCTION

In various questionnaires dedicated to the identification of sarcopenia, senile asthenia and malnutrition syndrome there are questions about the weight loss for a particular time interval, implying that a decrease in the "total" body mass leads to a decrease in the mass of skeletal muscles. However, obesity greatly complicates the diagnostics of sarcopenia and the approach to managing such patients. The excessive accumulation of adipose tissue does not allow considering the body mass as a direct equivalent to the mass of skeletal muscles. Moreover, on the one hand, in case of patients with obesity a doctor invariably tries to reduce the body mass in order to reduce the health risks; on the other hand, the increase in the total body mass among such patients may conceal a decrease in the mass of skeletal muscles [1-5; 14]. This necessitates the analysis of approaches to the diagnostics of sarcopenia in patients with obesity.

METHODS.

We have performed a systematic review of publications over the past five years using the PUBMED database and the publication archive of European Geriatric Medicine dedicated to organizational, clinical and social aspects of age-related sarcopenia diagnostics in patients with obesity.

RESULTS.

The term of sarcopenia for the first time was used by Rosenberg to designate the age-dependent loss of muscle mass. Since the age of 50 years old, people experience a decrease in muscle mass by 1-2% per year [6]. At the same time, the muscular strength reduces by 1.5% per year.

Thereafter, the rate of muscle strength decrease rises up to 3% among people above 60 years old. The data of three large population studies conducted in Denmark show that the decrease in muscle strength and the age of a person show an almost linear dependence at the age of 50-85 years old, after which the curve goes to a horizontal plateau.

In addition to the age-dependent decrease in muscle mass there is an increase in the mass of adipose tissue. Such rearrangements in the ratio of muscle and fat mass may turn out to be invisible due to preservation of unchanged total body mass. The minimal muscle mass in combination with an increase of body mass (due to the above-described rearrangement and growth of adipose tissue) is a phenomenon of sarcopenic obesity. The prevalence of sarcopenic obesity among people above 80 years old is about 30% for men and 10% for women. Most of researchers agree that the prognosis for sarcopenic obesity is at least no better than in case of "pure sarcopenia" [7-9].

In the development of sarcopenia, the most important role belongs to the malnutrition syndrome [10] which most often occurs against the background of age-related anorexia due to the effect of early primary saturation caused by a decreased ability of the stomach to stretch, an increase in cholecystokinin level in response to fat intake and an increase in leptin level. 15% of people over 60 years old consume less than 75% of the recommended amount of daily protein [11]. In addition, masticatory system disorders and exhausting chronic diseases also contribute to the development of malnutrition syndrome. Among the disorders that take on enormous importance in the pathogenesis of sarcopenia, an important role belongs to the deficiency of vitamin D3 which takes part in the

regulation of metabolic processes in the musculoskeletal system.

According to the criteria of the European Working Group on "Sarcopenia among senior citizens" issue, we need three components to diagnose sarcopenia: evidence of muscle mass decrease in combination with the confirmation of muscle weakness or low muscular functional ability.

The stage of sarcopenia development reflects the severity of the health condition. The European Working Group on Sarcopenia in Older People (EWGSOP) has identified three stages of sarcopenia development:

I – Presarcopenia stage which is characterized by a decrease in muscle mass without reducing its strength and function;

II – Sarcopenia stage which is characterized by a decrease in skeletal muscle mass, its strength or function;

III –severe form of sarcopenia which is characterized by a decrease in all three parameters: muscle mass, its strength and function [12].

In our review, we will briefly examine the methods of evaluating the muscle strength and function, as they practically do not depend on the presence/absence of obesity, and we'll examine in details different approaches to the definition of the muscle mass used in modern clinical practice.

Definition of muscle strength. Despite the abundance of different techniques and methods on evaluating the muscle strength (tests are used to evaluate the leg muscles, the abdominal press muscles and etc.), the most common in both clinical studies and routine medical practice is the measurement of muscle strength with a dynamometer. The measurement of muscle strength with a dynamometer is the golden standard that clearly correlates with a patient's life expectancy [13]. This measurement is cheap, does not take much time and is easy to reproduce during the dynamic observation of the patient [9, 11]. Among the common protocols for its evaluation, we prefer the Southampton protocol [13].

The Southampton protocol used to measure the muscle strength of adults [13]:

– Seat the examined person on a standard chair with legs, backrest and armrests with the fixed wrists. Use one and the same chair for each measurement.

– Ask the examined person to place his/her hands on the armrests with fixed wrists in a relaxed (neutral) position with thumbs up.

– Show the patient how the Jamar dynamometer works, explaining that the closer the device is, the more results you'll get.

– Start with the right hand. Put the patient's hand in position in which the patient could enclasp the handle of the dynamometer as follows: the thumb is located on one side of the equipment and the 4 remaining fingers – on the other side. The patient should enclasp the instrument in the most comfortable way and position. Change the position of the handle if necessary.

– The researcher must hold the base of the dynamometer with his palm, while the examined person holds the dynamometer. The object of such study is to keep the weight of the dynamometer (to compensate the effect of gravity on the maximum muscle strength), but in a way not to restrict the movement of the hand of the patient.

– As soon as the numerical value of the strength stops to increase, the participant should stop compressing the dynamometer.

– The obtained value of muscular strength is rounded to an integer in kilograms and recorded in the research results form.

– Similarly, measure the strength of the left hand of the examined person.

– Make two more measurements with each hand, alternating sides to get 3 measurements for each hand.

– The best result from six dimensions of hand strength is used in statistical studies.

– Also note the dominant hand: right, left, "two-handed" (people who can write equally well with both hands).

The most recognized dynamometer in the international practice is the JAMAR dynamometer (in the original article – Equipment: Model J00105 JAMAR Hydraulic Hand Dynamometer) [16]. In our practice we use the Russian hand dynamometer "DK-100-e".

Determining muscular function. We will not consider the endless variants of ways to determine the muscular function but we will examine the most recognized and practical test – the 5-meter walk test.

Numerous studies reveal a pathogenetic connection of reduced mobility according to the data of a 5-meter walk test and risk factors for cardiovascular diseases: inflammatory markers, homocysteine concentration in blood, decrease in HDL level, diabetes, smoking and abdominal obesity. J. Dumurgier *et al.* in his work observed 3208 patients aged 65 years and older. When studying the results of a 5-meter walk test, he determined a prognostic role regarding mortality. All patients were divided into three subgroups according to the test results. The subgroup with the lowest walking pace was characterized by a highly significant increase in the mortality risk from all death-causing diseases by 1.64 ($p = 0.004$).

Below, we provide the algorithm of 5-meter walk test from the Society of Thoracic Surgeons which examines it as a routine examination before a possible cardiological surgery.

The procedure of a 5-meter walk test
(STS National Database News, 2011) [16].

Bring the patient to a flat ground without any obstacles with clearly marked 0 and 5 m points. The patient should stand onto the starting point so that his toes lightly touch the starting line marked with "0 m". Give the patient instructions "to walk in a walking pace which is comfortable for him and pass beyond the finish mark" (the patient should not slow down his walking pace before the mark of 5 m). Each study shall begin with the word "Start". Start the stopwatch immediately after the first crossing of the mark "0". Stop the stopwatch immediately after the first step beyond a mark of 5 m. Repeat the test 3 times with sufficient intervals for rest between measurements. Count the time in seconds, determine the average time of 3

attempts and calculate the walking pace in m/s (5 m is divided by the average time of passing the distance). The patient may use some supporting devices (crutch, etc.) or help of a guide. If the patient is tied to intravenous infusion, you can carry out a test with a perfusor or temporary stop the infusion but only if it does not pose a risk to the patient. The speed less than 0.8 m/s is unsatisfactory and is considered as a criterion for reducing the muscle function [16].

Determining muscle mass. Speaking about the definition of muscle mass, we should first of all mention those parameters that are amenable to study. There is no single indicator of muscle mass which can identify sarcopenia. Various indicators most commonly used for this purpose are presented below:

1. musculoskeletal mass;
2. musculoskeletal mass index:
   a) by weight in Janssen *et al*. – skeletal mass/total mass × 100;
   b) by height in Cruz-Jentfort *et al*. – skeletal mass/height^2;
3. lean (fat-free) body mass.
4. The appendicular mass of the skeletal musculature is the sum of the muscular mass of the upper and lower limbs. The lean body mass also includes parenchymal organs. When evaluating the lean mass of the limbs, the skeletal muscle, skin, ligaments and vascular system are evaluated as well.
5. lean/ appendicular mass indexes (LMI/AMI)
   LMI = lean mass of upper and lower limbs (kg/height (m^2)).

The muscle mass indexes are also used for any particular areas of the body – hands, legs, etc. [16].

Sarcopenia is diagnosed with a decrease in LMI by two standard deviations (SD) comparing with practically healthy young people according to the gender. The criterion of low muscle mass is the values of the skeletal muscle mass index of 6.75 kg/m^2 or the appendicular mass index of 4.36 kg/m^2 for women and 8.67 or 5.54 kg/m^2 for men.

The studies of cadaveric material confirm the role of MRT or CT techniques as unconditionally golden standards for measuring muscle mass that reach the highest level of correlation with a true muscle mass (r = 0.99 for both methods). At the same time, these methods are practically used neither in clinical practice nor in large epidemiological studies (12). This is due to their high cost and radiation load (for CT).

Speaking about the methods of radiodiagnosis, two-photon (dual-energy) x-ray absorptiometry becomes a reasonable alternative for determining fat and fat-free tissue both in clinical studies and in practice. With insignificant irradiation, the technical error in measuring the percentage of fat mass and appendicular mass of skeletal muscles with DRA is ± 1.5% and ± 3.0%, respectively. In general, the differences in the informative value of DRA, CT and MRT are less than 5% [15].

However, it should be acknowledged that DRA, as well as MRI and CT, is also expensive and inaccessible in a real clinical situation. The possible alternatives are the study of bioelectrical impedance and anthropometric measurements.

Bioimpedance analysis of body composition is a diagnostic method that allows estimating absolute and relative values of body composition parameters on the basis of measured values of the electrical resistance of a human body and anthropometric data. This method, for a long time used in sports medicine, nowadays gradually enters into clinical medicine. In the foreign publications, the accuracy and reliability of bioimpedance evaluations of body composition are shown in comparison with the reference methods. In 2004-2009 in the State Research Institute of Nutrition of the Russian Academy of Medical Science, the verification of fat mass evaluation obtained by the domestic bioimpedance analyzer ABC-01 Medass was carried out. The DRA data were used as a reference. A high correlation was found between the values of signs r = 0.94 for fat body mass. Thus, bioimpedance analysis of body composition is able to replace more expensive and lengthy studies.

Presently, there are various anthropometric measurements proposed for characterization of muscle mass [15]. In our opinion, one of the most practical approaches to the definition of muscle mass is the technique demonstrated in the ILSIRENTE study. The authors of the work have selected the MAMC (mid-arm muscle circumference) index as a muscular mass verifier. For this purpose, the arm circumference was preliminary determined at the middle of the distance from the shoulder to the bend of elbow and the thickness of musculocutaneous fold of triceps.

The MAMC calculation was performed using the standard formula:

MAMC, cm = arm circumference – 3.14 × thickness of the musculocutaneous fold of the triceps. For the low muscle mass, we took values less than 21.1 for men and less than 19.2 cm for women. The obtained values correlated with both muscle mass and patients' life expectancy. The principal difference of this approach from other anthropometric measurements is the subtraction of the musculoskeletal fold of the triceps, which should level the inaccuracy of other anthropometric measurements that can be successfully used for patients with sarcopenia (measurement of the shoulder circumference, measurement of the shin circumference) but can hardly be considered as a method of choice for patients with sarcopenia and obesity [16].

DISCUSSION.

Despite certain difficulties, the modern medicine has a quite wide range of clinical and instrumental methods to diagnose sarcopenia among patients with obesity. The last one seems to be extremely important, since following the described above proper methodological approaches, it is possible to identify underestimated risks and properly evaluate the changes in such simple and common indicators as waist circumference and BMI in this group of patients.

CONCLUSION.

The performed review of the literature and data on the methods of diagnosing the age-related sarcopenia shows us the multivariate diagnostic approaches in this group of patients which necessitates the unification and further improvement of methods for sarcopenia diagnostics.

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