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SELECTED PROBLEMS WITH DIAGNOSTICS OF SARCOPENIA IN LONG-TERM-CARE FACILITIES FOR THE ELDERLY

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SUMMARY

As the current population gets older, we are learning that some of the diseases and conditions which were formerly perceived as a natural part of the ageing process are actually preventable and curable. Sarcopenia is one of these; it is currently one of the most challenging problems of clinical gerontology. Sarcopenia is a geriatric syndrome that presents as gradual muscle mass loss and decreases in physical performance. It is one of the important factors of frailty. Its treatment is as any other treatment highly dependent on the correct diagnostics. Nevertheless, it seems that latest guidelines for sarcopenia diagnostics considerably neglect real conditions in a number of medical facilities for the elderly, despite the vast increase in the number of studies on its prevalence and the options of sarcopenia treatment carried out in recent years. In this mini review, we shall discuss various diagnostic methods and the possibilities of their real use in clinical practice for the institutionalized elderly.

Keywords: aging, muscular atrophy, diagnostic techniques, sarcopenia, institutionalized elderly

INTRODUCTION

Ageing is accompanied by multiple changes in the human body and the loss of muscle mass is one of them. During ageing, muscle mass is partially replaced by adipose tissue. Muscle functions decrease together with the loss of muscle mass and physical functioning declines, too. At the end of the twentieth century Rosenberg (1989) proposed the term sarcopenia to describe the age-related decline of muscle mass and muscle functions. Although more than twenty years have passed since that time, a lot of the questions associated with this phenomenon are yet to be resolved. Sarcopenia is a very complex process

influenced by a lot of factors which contribute to skeletal muscle mass loss and muscle function disorders (Muscaritoli et al., 2010). A wide range of diagnostic methods have been recommended for diagnosing sarcopenia but few of them are actually useful in real practice for the elderly over 80. Currently, there are three basic areas, which can be used in the diagnosing sarcopenia; these are a measurement of muscle mass, muscle strength and physical performance (Cruz-Jentoft et al., 2010). In this mini review, we shall discuss the possibilities of using non-invasive measurement techniques for sarcopenia diagnostics in nursing homes, in homes for the elderly or facilities with special care.

MEASUREMENT OF MUSCLE MASS

The European Working Group on Sarcopenia in Older People (EWGSOP) proposes the dual energy X-ray absorptiometry (DXA) for measurement of body composition (Cruz-Jentoft, Baeyens, Bauer, Boirie, Cederholm, Landi, Martin, Michel, Rolland, Schneider, Topinkova, Vandewoude and Zamboni, 2010). DXA is the most preferred method and gold standard (Bouchard et al., 2009; Bunout et al., 2011; Di Monaco et al., 2011; Fielding et al., 2011; Hairi et al., 2010; Chen et al., 2007; Kim et al., 2009; Lee et al., 2007). This method is very exact to assess appendicular muscle mass (Burton and Sumukadas, 2010). Acquisition and operation of the whole body DXA with special software are comparable with the computed tomography (CT) and magnetic resonance imaging (MRI) and definitely less expensive than them but still greatly exceed the budgets in many facilities. Moreover, DXA has a lot of limitations and contraindications that prevent its use for the elderly e.g., changes in body hydration incurred as a result of kidney damage or heart failure can affect the accuracy of the estimate (Bunout, de la Maza, Barrera, Leiva and Hirsch, 2011), DXA accuracy decreases with increasing patient weight (Evans et al., 2010), DXA is unsuitable for examining patients unable to lie calmly during the twenty-minute examination; this may be a problem for patients with Parkinson's and Alzheimer's diseases (Bauer et al., 2008). Areas with implanted metallic material cannot be assessed by DXA either (Lee, Auyeung, Kwok, Lau, Leung and Woo, 2007). In addition, DXA does not provide any information about the quality of muscles, patients are exposed to low doses of radiation and the limited resolution between water, bone tissue and lean tissue mass can also lead to poor results of measurement (Pahor et al., 2009).

The bioelectrical impedance analysis (BIA) is another method of measuring body composition which is recommended by EWGSOP for clinical measurement as an alternative method (Cruz-Jentoft, Baeyens, Bauer, Boirie, Cederholm, Landi, Martin, Michel, Rolland, Schneider, Topinkova, Vandewoude and Zamboni, 2010). But the use of BIA has also a lot of limitations, e.g. a measurement is inaccurate at patients with an acute disease, liver disease, cardiac or renal dysfunction, endocrine disorders (diabetes mellitus, hypo- or hyper-thyroidism), at patients who take certain medication affecting a body composition (steroids, diphenylhydantoin and heparin), patients with implanted metallic material and patients with diseases which can disturb the balance of electrolytes, e.g. due to edema (Chumlea and Baumgartner, 1989; Janssen et al., 2000; Landi et al., 2012). Patients with cardiac pacemakers and limb amputations have completely contraindicated BIA measurement (Hedayati and Dittmar, 2010; Chien et al., 2008). The principle of BIA is to measure

body impedance against alternating electrical flow because electrical impedance of body is inversely proportional to the amount of body water. For this reason, the measurement results are strongly influenced by a hydration state of the tested patients, which may be a source of inaccuracy at the elderly (Janssen, Heymsfield, Baumgartner and Ross, 2000). BIA also cannot provide any information about the quality of muscles and in comparison with CT, MRI and DXA is much less accurate (Jelen et al., 2008; Pahor, Manini and Cesari, 2009). Most patients living in nursing homes and facilities with special care suffer from some of the above mentioned diseases so the use of DXA and BIA is very limited in practice (Bauer, Kaiser and Sieber, 2008; Gallagher and DeLege, 2011; Landi, Liperoti, Fusco, Mastropaolo, Quattrociochi, Proia, Russo, Bernabei and Onder, 2012).

The third of the recommended EWGSOP resources is anthropometry. This is a whole range of methods that are inexpensive and widely used in practice. Waist or calf circumference can be used as an alternative diagnostic tool (Chien et al., 2010; Rolland et al., 2003; Sanada et al., 2010), because they are positively related to the muscle mass for both sexes Hedayati and Dittmar (2010). Midarm muscle circumference (MAMC = midarm circumference – $3.14 \times$ triceps skinfold thickness) also seems to be a useful tool for assessing sarcopenia in the elderly as a simple, fast, inexpensive and non-invasive method (Landi et al., 2010). The triceps and subscapular skinfold thicknesses could be useful indicators of subcutaneous adipose tissue but their use is highly controversial for the elderly (Chumlea and Baumgartner, 1989) because there occurs the age-related fat redistribution in a human body (Hughes et al., 2004). Height and weight body measurement could also be the useful indicator of sarcopenia e.g. body mass index (BMI) values below 22 are prognostically unfavourable for the elderly (Allison et al., 1997) and malnutrition (BMI < 21 kg/m²) is associated with an increased risk of sarcopenia (Landi, Liperoti, Fusco, Mastropaolo, Quattrociochi, Proia, Russo, Bernabei and Onder, 2012).

Unfortunately, anthropometric measurements cannot give any information about the quality of muscle and nutritional status with co-morbid diseases can easily distort their results (Pahor, Manini and Cesari, 2009). In addition, measurements for the elderly are a special problem. Standard anthropometric measurements are done standing but a lot of elderly people have a problem to maintain the upright body posture and some of them depend on a wheelchair or are bedridden due to an injury or disease. Moreover, to diagnose sarcopenia depending on the physical composition, the norms for a given population group are required. Variability and average value found within the reference population may fundamentally influence evaluation of a patient. Reference populations can vary ethnically. Even within the U.S. reference population is usually expressed as Caucasian and African American or Hispanic, which differ substantially (Miller et al., 2009; Steffen et al., 2002). The reference values between the U.S., Asian, European or Japanese populations are different. They may differ also within Europe; e.g. northern European and southern European populations (Janssen, Heymsfield, Baumgartner and Ross, 2000). The reference values have not been established in many countries because large epidemiological studies needed for their calculation have not been conducted yet. The survey data are usually compared with reference values from adjacent states (Hedayati and Dittmar, 2010) which may also affect the evaluation of the patients measured. Precisely for the reasons mentioned above, also the algorithm suggested by EWGSOP for identifying subjects with sarcopenia (Cruz-Jentoft, Baeyens, Bauer, Boirie, Cederholm, Landi, Martin,

Michel, Rolland, Schneider, Topinkova, Vandewoude and Zamboni, 2010) does not have to be useful for treatment of sarcopenia because it is very dependent on subjects' body composition.

MEASUREMENT OF MUSCLE STRENGTH

As muscle strength has been proved an important indicator of sarcopenia at the elderly (Berger and Doherty, 2010) and muscle strength measurement can be a very effective indicator of changes in the muscle for the use in clinical practice (Hairi, Cumming, Naganathan, Handelsman, Le Couteur, Creasey, Waite, Seibel and Sambrook, 2010) muscle strength measuring is another area on which diagnosing sarcopenia is focused. EWGSOP recommends a diagnostic tool to detect sarcopenia for the use in clinical practice, hand-grip strength < 30 kg for men and < 20 kg for women, which is classified as decreased muscle strength (Cruz-Jentoft, Baeyens, Bauer, Boirie, Cederholm, Landi, Martin, Michel, Rolland, Schneider, Topinkova, Vandewoude and Zamboni, 2010). Nevertheless, the use of this may also be limited for the elderly. Reasons for excluding handgrip strength are recent or current wrist or hand pain/surgery to the upper extremity within the three months prior to the measurement (Hairi, Cumming, Naganathan, Handelsman, Le Couteur, Creasey, Waite, Seibel and Sambrook, 2010). Moreover, the strength of upper extremities is not the main limitation for sarcopenic patients. The reduced force of lower extremities is much greater problem for mobility and self-sufficiency of the elderly than the upper extremities strength.

MEASURING PHYSICAL PERFORMANCE

The last area is measuring physical performance. To measure physical performance, EWGSOP recommends the Short Physical Performance Battery (SPPB) or similar tests, the gait speed res. the geriatric get-up-and-go test (Cruz-Jentoft, Baeyens, Bauer, Boirie, Cederholm, Landi, Martin, Michel, Rolland, Schneider, Topinkova, Vandewoude and Zamboni, 2010). Recommended methods for measuring physical performance focus largely on the function of the lower extremities. The lower extremities are crucial to execute daily physical activities (Buford et al., 2010) and functional limitations of a lower extremity may predict development of disability reflecting the symptoms of a chronic disease, injury and overall decline in physical performance (Guralnik et al., 1995). SPPB consists of three sub items, the balance test, usual gait speed and chair stand test (Cruz-Jentoft, Baeyens, Bauer, Boirie, Cederholm, Landi, Martin, Michel, Rolland, Schneider, Topinkova, Vandewoude and Zamboni, 2010). According to SPPB, elderly people with poor results have significantly less muscle mass than their contemporaries without functional limitations (Buford et al., 2012; Castillo et al., 2003; Clark et al., 2011; Marzetti et al., 2012). Moreover, only some sub items of the SPPB may be used as a sufficiently effective tool to detect sarcopenia. Landi, Liperoti, Fusco, Mastropaolo, Quattrociochi, Proia, Russo, Bernabei and Onder (2012) used the four-meter walking test to evaluate physical performance; participants with sarcopenia were significantly slower comparing

to residents without sarcopenia. Assessing usual walking speed over 4 meters long may be a fast, safe, inexpensive and highly reliable diagnostic tool for practical use (Abellan van Kan et al., 2009). Some other tests measuring levels of physical performance have also been used in sarcopenia research e.g. the Berg balance scale (Berg et al., 1992) or timed up & go test (TUG) (Podsiadlo and Richardson, 1991). These are mostly modifications of one of the above mentioned tests and their accuracy is comparable.

The use of speed walking or getting up from a chair, however accurate this measurement may seem, has also a lot of limitations for the elderly. Patient's cooperation is essential for these measurements. Therefore, acquiring clinically useful results may be hard with patients suffering from multimorbidity, functional impairment, cognitive impairment or depression due to unwillingness to cooperate. For example, Landi, Liperoti, Fusco, Mastropaolo, Quattrocioni, Proia, Russo, Bernabei and Onder (2012) stated in their study that only 2.5% of participants were able to perform the walking test by speed > 0.8 m/s recommended by EWGSOP (Cruz-Jentoft, Baeyens, Bauer, Boirie, Cederholm, Landi, Martin, Michel, Rolland, Schneider, Topinkova, Vandewoude and Zamboni, 2010). However, the walking speed and chair stands did not demonstrate any association with muscle mass in the study on numbers of community-dwelling older Chinese men and women (Lee, Auyeung, Kwok, Lau, Leung and Woo, 2007).

OTHER DIAGNOSTIC POSSIBILITIES

Diagnosing sarcopenia in nursing homes and facilities with special care has many drawbacks and although a number of studies have been carried out in recent years, there is no universally applicable diagnostic method recommended yet. Besides, methods used in research are usually very expensive and they have a number of limitations and thus are not particularly useful in practice. Practical use needs a method suitable for the given conditions. With regard to the fact that funding for these facilities is usually limited, the result should be, if possible, a compromise between the price of the diagnostic tool and its accuracy. Taking this fact into account, the following equations seem to be a viable option for body composition analysis as they are independent on expensive measurement technology.

With regard to the limitations mentioned above Woods et al. (2011) made an interesting finding in their study. They evaluated muscle strength on the basis of objective methods to determine the maximum isometric strength of the ankle dorsiflexors, knee extensors, and hip abductors and on both legs using a hand held dynamometer. Using the results of their study the authors consider hip strength as a more important indicator of sarcopenia than body composition. Their study included participants with a history of cancer, diabetes, high blood pressure, heart disease, rheumatic fever, lung disease, kidney disease, thyroid disease, stroke, arthritis, and back pain. Spink et al. (2010) confirmed that the hand-held dynamometer is a reliable tool for measuring foot and ankle strength at the elderly. In addition, hand-held dynamometry is considered justified for investigating limitations in mobility for the elderly (Bohannon, 2009; Bohannon, 2012; Schaubert and Bohannon, 2005). It thus seems that muscle testing by hand held dynamometer is an interesting method of diagnosing sarcopenia in nursing homes and facilities with special

care. However, its use in diagnosing sarcopenia has to be verified by further research. Surprisingly, manual muscle testing is completely neglected in the research of sarcopenia, although the use of this measuring method offers a wide range of possibilities for the research into applied kinesiology (Conable and Rosner, 2011). Although their work was done by a lot of experienced physiotherapists using these diagnostic methods to diagnose neuromusculoskeletal dysfunction (Schmitt and Cuthbert, 2008), we can only speculate about the use of manual muscle testing in diagnosing sarcopenia because these measurement techniques have not been documented yet.

CONCLUSION

Sarcopenia is currently a growing health problem that needs to be resolved as soon as possible. However, although this topic has recently been the subject of great attention, it seems that the issues regarding diagnostic methods applicable in real practice have not been investigated enough so far. A large part of the diagnostic methods cannot be used in specialized medical facilities such as a nursing home. Therefore the lack of reliable diagnostic methods for sarcopenia identification may complicate effective treatment of this disease in facilities where patients are endangered with sarcopenia is on daily basis. Future research should thus focus primarily on creating and verifying methods that can be realistically used for sarcopenia diagnostics in facilities such as nursing homes, facilities with special care and similar specialized geriatric workplaces.

ACKNOWLEDGMENTS

This research project was supported by VZ MSM 0021620864 – Active Lifestyle in Bio-Social Context as a part of the subtask called the Influence of Physical Activity Levels of Selected Risk Factors of Metabolic Syndrome and by Specific Academic Research SVV 2013-267603 and the grant NT11325 of the Ministry of Health of the Czech Republic and project P038.

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VYBRANÉ PROBLÉMY S DIAGNOSTIKOU SARCOPENIA V ÚSTAVECH DLOUHODOBÉ PÉČE PRO SENIORY

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SOUHRN

Protože současná populace stárne, stávají se některé nemoci, které byly dříve vnímány jako přirozená součást procesu stárnutí, významnou výzvou pro vědeckou společnost. Sarcopenia je jednou z těchto nemocí. V současné době je sarkopenie jedním z nejnáročnějších problémů klinické gerontologie. Sarcopenia je geriatrický syndrom, který se projevuje postupnou ztrátou svalové hmoty, silové schopnosti a snížením fyzické výkonnosti. Je to jeden z důležitých faktorů stařecké křehkosti. Její léčba je tak jako jakákoliv jiná léčba vysoce závislá na správné diagnostice. Přesto se zdá, že poslední pokyny pro diagnostiku sarkopenie výrazně zanedbávají skutečné podmínky v řadě zdravotnických zařízení pro seniory a to navzdory obrovskému zvýšení počtu studií zabývajících se prevalencí a možnostmi léčby sarcopenie, které byly provedené v posledních letech. V této mini recenzi budeme diskutovat o různých diagnostických metodách a možnostech jejich skutečného použití v klinické praxi při léčbě sarkopenií ohrožených institucionalizovaných seniorů.

Klíčová slova: stárnutí, svalová atrofie, diagnostické metody, sarcopenie, institucionalizovaní senioři

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