Journal of Frailty, Sarcopenia and Falls

Review Article

Sarcopenic Dysphagia. A Narrative Review

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Abstract

Sarcopenic dysphagia is described as difficulty swallowing due to generalized sarcopenia of skeletal muscles and thus swallowing muscles. It is a recently recognized condition. It draws attention due to its important complications.The risk factors of dysphagia include age, history of clinical disease, and physical frailty, including reduced activities of daily living. It is a common syndrome among the elderly and demands multidisciplinary therapeutic interventions, including nutritional support and rehabilitation programs, which are non-invasive but effective methods, mandatory for the best outcome. The prevention, assessment, and intervention methods for sarcopenic dysphagia are very important. Recent studies demonstrate that new concepts in rehabilitation and nutritional support render promising results.

Keywords: Sarcopenia, Sarcopenic dysphagia, Nutrition, Rehabilitation

Introduction

Within the past few years the skeletal muscle problems that elderly populations suffer from, have increased dramatically making their lives difficult. Sarcopenia is a disease causing problems affecting skeletal muscles and strength or performance. This disease deteriorates the quality of life. Sarcopenia can be either primary or secondary. Primary is when age is the major cause of the problem while in cases where other causes exist it is thought as secondary. The latter type of sarcopenia is related to activities, diseases and nutrition. Activity related sarcopenia can be caused by bed rest, sedentary lifestyle, deconditioning or zero gravity conditions. As far as disease related sarcopenia is concerned, it is connected to inflammatory disease, malignancy, endocrine disease or advanced organ failure i.e., heart, lung, liver, kidney and brain. Last but not least is the nutrition related sarcopenia that occurs when there is inadequate dietary intake of energy and protein, malabsorption, gastrointestinal problems or medication that result in anorexia[1].

The guidelines, regarding the definition, diagnosis and treatment of sarcopenia, which are published by The European Working Group on Sarcopenia in Older People and the International Working Group on Sarcopenia are very close to their approach[1,2].

For the diagnosis of sarcopenia two out of three criteria need to be documented. These are low muscle mass and either low muscle strength or low physical performance. The reason for using only two criteria lies within the fact that strength and mass are not connected with a linear relationship. Moreover, there are more factors influencing muscle strength other than muscle mass[1].

Sarcopenia usually occurs in hospitalized patients. In these cases, aging, long-term hospital stay and the generalized medical condition of the patients seem to have a crucial effect on the food intake and absorption.

Dysphagia is a term derived from Greek words, *dys* meaning worsening and *phago* meaning eating. In fact, it includes any difficulties in forming and moving saliva, medicine, and food bolus of any consistency from the oral cavity to the stomach, successfully and safely[3]. It is related to organic or structural diseases. There are many causes, which are implicated in dysphagia, but among them, three conditions, namely stroke, Parkinson's disease and dementia are responsible for about 75% of incidents[4].

The authors have no conflict of interest.

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Edited by: *Yannis Dionyssiotis*

Accepted *29 January 2018*

For the diagnosis, usually is conducted video fluoroscopy (VFSS) and it is critical that related symptoms be associated with the act of swallowing of a liquid, semi-solid or solid bolus. Actually, it includes retention, penetration, and aspiration. Sometimes, there are patients with a silent aspiration without cough, which is the most severe condition of impaired safety of swallowing. The induced mechanical obstruction of airflow into the lungs leads to asphyxia.

According to recent studies, the weakening of skeletal muscle mass may be connected to dysphagia. Disorders in skeletal muscle movement might be the result of various diseases, namely neuromuscular disease, stroke and head and neck carcinoma. Such disorders are, also, common causes of dysphagia. The function of swallowing is the result of the coordination of head and neck muscles, thus, it can be affected in case of a weakening of these muscles. Therefore, the connection between this syndrome and skeletal muscle disorders is not very clear[5].

Recent studies suggest a strong correlation between these conditions, associating the development of sarcopenia as a cause for development of dysphagia[5-7].

Sarcopenia may be responsible for a number of physical functional disorders such as dysphagia. On the other hand, the reverse relationship is also possible i.e., dysphagia can also lead to sarcopenia through malnutrition. Although there are suspicions of a correlation between deglutition disorders and degenerative muscle mass loss, the exact association between these two these syndromes is not fully understood[5].

A literature search was conducted by the 2nd author (S.P.) during October 2017, accessing the Pub Med and Google Scholar databases. All abstracts were examined regardless of relevance to the aim of this review and the selection was done accordingly. Articles, written in other languages, apart from English, were excluded. The purpose of this review article is to investigate the association between sarcopenia and dysphagia.

Sarcopenia in the elderly and relation with dysphagia

The prevalence of dysphagia among people over the age of 65 ranges from 15% in the community dwelling elderly, to 68% in nursing home residents[8]. Elderly sarcopenic patients have a poor physical activity, resulting in less swallowing opportunities and a difficulty maintaining a high quality of life. A generalized loss of skeletal muscle mass and skeletal muscle strength, also affects the muscles of head and neck. In this way, eating and deglutition movements are also affected[9]. The same patient group often faces the problem of decreased tongue pressure, chewing and swallowing function. Closure of the upper esophageal sphincter, which becomes less sufficient as sarcopenia progresses, is another important step of the swallowing process which is affected by muscle strength loss.

Loss of teeth and poor oral hygiene, which are very common among elderly, contribute to the development of dysphagia, decreasing the efficiency of chewing, resulting in poor bolus formation, which is finally difficult to be transported to the pharynx and swallowed[10]. Another factor which leads to the same condition is decreased saliva production, also common in the elderly[11].

Other risk factors, which increase the prevalence of dysphagia, are poly pharmacy, psychiatric disorders, social isolation and alcohol abuse. Actually, stroke is known to be frequent reason for dysphagia, as it is commonly found among diseases, causing directly skeletal muscle mass loss or skeletal muscle movement dysfunction. This fact highlights the direct impact of muscle mass or muscle strength reduction on the normal and effective swallowing function[12].

Presbyphagia refers to age-related anatomical, physiological, psychological and functional changes in the swallowing mechanism in the elderly; involves natural diminishment of functional reserve, increased duration of eating, decreased elevation of the larynx, xerostomy, muscular atrophy, and in general, inefficient function of swallowing.

This phenomenon is prevalent in elderly patients with neurological and neurodegenerative disease, who are more at risk mainly due to sarcopenia, causing impaired efficacy of swallowing. Presbyphagia differentiates from dysphagia[13].

The relationship between dysphagia and sarcopenia in older patients is clear especially in those with musculoskeletal diseases. In these cases, sarcopenia appears to be a major reason for dysphagia[5,6,14].

Pathophysiology of sarcopenic dysphagia

Sarcopenia is characterized by a decrease in the circumference of distinct types of muscle fibers, each and every one of them, showing expression of distinct myosin variants. “Type 2” fiber circumference is usually found decreased, during sarcopenia and only an imperceptible reduction or no decrease in “type 1” fiber circumference is observed, while it is usual to find denervated “type 2” fibers to be converted to “type 1” fibers[2].

In most cases, muscle fibers are replaced with fat, fibrosis is increased and these symptoms coexist with changes in general muscle metabolism, oxidative stress, and degeneration of the neuromuscular junction. Satellite cells, these small mononuclear skeletal muscle precursor cells, which are found in the muscle fiber and reside in a quiescent state, are normally activated and begin the process of skeletal muscle repair and regeneration in response to the stress of heavy muscle use such as with weight-bearing activities or through traumatic events such as injury. Satellite cells also undergo important aging-related changes[15]. Ageing induces reduction of satellite cell content, especially in the type-2 skeletal muscle fibers[16]. Many scientists support the idea that sarcopenia is partly caused by a malfunctioning satellite cell activation[17]. Changes in general muscle metabolism are previously mentioned as one of the factors, which contribute to sarcopenia. In fact, extreme muscle loss is usually related to both decreased anabolic signals (e.g. growth

hormone, testosterone) and increased catabolic signals (e.g. inflammatory cytokines)[17].

Oxidative stress is also considered as an important factor of sarcopenia. Ageing leads to extensive increase of oxidized proteins in skeletal muscle, which ends up in a buildup of lipofuscin and cross-linked proteins, which are conventionally removed via the proteolysis system. These proteins are gathered in the skeletal muscle tissue, but in a dysfunctional way. Thus, it leads to an accumulation of non-contractile material. This mechanism explains the severe decrease of muscle strength, in parallel with muscle mass in sarcopenia[18].

Some scientific groups have advocated, from the standpoint of evolutionary theory, that gradual loss of skeletal muscle and strength, with age, is related to the fact that the selection of the genes which control skeletal function regulation was undertaken in Late Paleolithic environment, where there was severe exercise and muscle strain was part of the daily routine. Modern lifestyle is more sedentary and less active; these genetic traits can be useful and remain functional nowadays[4].

Other scientists concede with validated and reliable epidemiological data, that health and disease in some way are related with the developmental origins[10]. They support the idea that growth and development is associated with early environmental influences and these may affect the later human health[11,12]. In particular, low birth weight, seems to be interwoven with reduced muscle mass and strength in adult life and in this way with sarcopenia too[5,6,14].

When unassociated with swallowing, the sensation of fullness in the upper esophagus suggests globus hystericus, which is distinct from dysphagia[19]. Globus hystericus is often a sign of a functional disorder, but it may also represent an abnormality of the pharyngeal or upper esophageal musculature[20]. Because of dysphagia, elderly patients face often nutritional deficiencies with associated weight loss, increased risk of falling, poor healing and increased susceptibility to other illnesses associated with weakness. Additionally, due to malfunctioned swallowing, patients show depressive symptoms and poor quality of life.

Unlike many symptoms, such as chest pain or gastrointestinal bleeding, which may be associated with esophageal disease, dysphagia specifically ascribes the problem to the esophagus. Causes of dysphagia basically fall into two groups: obstructive lesions and motor disorders[21]. A more specific classification categorizes the cause of dysphagia according to location: pre-esophageal or oropharyngeal dysphagia, esophageal or transport dysphagia, post esophageal or esophago- gastric dysphagia, and para-esophageal or extrinsic dysphagia. Although useful for classification, there is overlap among these categories[20].

Sarcopenic dysphagia is described as difficulty in swallowing due to sarcopenia of generalized skeletal muscles and thus swallowing muscles[22]. Swallowing muscle mass decrease becomes evident in the genio-hyoid muscle and tongue, due to senescence. Elderly people, with both sarcopenia and dysphagia may demonstrate symptoms, not only disease-related dysphagia but also sarcopenic dysphagia. In contrast with the well-defined diagnostic criteria for sarcopenia, including the cutoff value of muscle mass and physical function or muscle strength, the diagnostic criteria for sarcopenic dysphagia have not yet been standardized[1,23].

The risk factors include age, history of clinical disease, and physical frailty, including reduced activities of daily living. Older inpatients are at higher risk of sarcopenic dysphagia. The prevention, assessment, and intervention for sarcopenic dysphagia are important, especially in this age group[24].

Clinical presentation

As signs and symptoms of sarcopenic dysphagia usually develop very slowly, in the typical sense, diagnosis is quite difficult. The common problem is that the condition, which is recognized as sarcopenic dysphagia, is underestimated and underdiagnosed as a cause of symptoms in the elderly. The main clinical presentation is possible through the recording of complications, which can be categorized into two main types: a) choking and tracheobronchial aspiration due to loss of deglutition safety and b) dehydration and malnutrition due to loss of deglutition efficacy.

The condition of tracheobronchial aspiration can lead to aspiration pneumonia which occurs in up to 50% of the nursing home residents, suffering from dysphagia, during the first year living in thenursing home. The overwhelming majority of them, approximating 45% die[25]. The syndrome of sarcopenic dysphagia is an important factor of recurrent aspiration pneumonia and the generalized loss of skeletal muscle. This condition usually results in absence of cough and development of so-called silent aspiration pneumonia[13]. Because of sarcopenic dysphagia, malnutrition also leads to weight loss, which consequently results to further development of sarcopenia. The general clinical condition leads to poor quality of life and poor physical function, increased incidence of falls, prolonged hospital stay and high rates of morbidity and mortality[26].

In patients with esophageal dysphagia, the physical examination is generally unremarkable and the clinical presentation gives a sense of asymptomatic condition. Patient's skin sometimes shows some features of connective tissue disorders, such as scleroderma and CREST syndrome (Calcinosis, Raynaud's phenomenon, Esophageal dysmotility, Sclerodactyly and Telangiectasia)[27].

Diagnostic evaluation of sarcopenic dysphagia

Diagnosis of sarcopenic dysphagia requires appropriate clinical judgment by a geriatrician and a gastroenterologist[1].

The diagnostic evaluation of sarcopenic dysphagia is summarized in four main steps, including history recording, physical examination, laboratory evaluation and diagnostic imaging. Barium swallow study, endoscopy (frequently obviate the need for barium radiology) and esophageal

manometry are employed to diagnose esophageal dysphagia. If the results of esophageal motility studies are proven to be atypical or equivocal, then a barium swallow can be very useful[28-30].

Esophageal manometry is the technique of choice, if the endoscopic findings are normal or the patient's history suggests a dysmotility disorder, to confirm the diagnosis. High-resolution manometry is simple; it could provide a precise picture of esophageal pressure pattern, extract ignorereadily interpretable image than traditional manometry[31,32]. Computed axial tomography (CT) to measure swallowing muscle mass has also been described. Important clinical information, such as pre-existing conditions, comorbidities and history of weight loss must be recorded. There is a reliable graded water-swallowing test (GWST) for the evaluation of dysphagia. GWST includes swallowing of 2, 3, and 5 ml of water and assessing the patients swallowing ability, regarding effectiveness and safety[31]. Another classification tool of this syndrome is the Food Intake Level Scale, ranging from 1 to 10. Different stages of severe dysphagia and inability for oral feeding are graded with 1 up to 3. Levels from 4 to 6 refer to very poor capability for oral feeding or alternative feeding methods. Levels from 7 to 10 correspond to unassisted oral feeding and normal food intake[33].

Evaluation of swallowing can be achieved by endoscopy, using flexible endoscope, as it allows observing the swallowing process, providing information about swallowing dysfunction[34]. Flexible endoscopic evaluation of swallowing (FEES) can distinguish uni- or bilateral swallowing pathology[35].The method of choice for the estimation of dysphagia is video fluoroscopic swallow study (VFSS) or videofluoroscopy[8]. The use of video fluoroscopic swallow study (VFSS) provides objective information on bolus transport, safest consistency of the bolus, and optimal head position and maneuvers that may facilitate and individualize the act of swallowing[8]. Most dysphagia related dysfunctions, namely loss of pharyngeal constriction, lack of epiglottic inversion, premature bolus loss and most importantly aspiration, can easily be observed with this method. The usual practice, which provides an excellent and detailed way to study dysphagia, includes lateral plane images to be acquired, while the patient swallows 5 to 20 ml boluses of hydro soluble contrast of three consistencies, liquid, nectar and pudding. In this way, exact deglutition dysfunction can be detected, safety and efficiency of deglutition can be evaluated and severity can be categorized. So, selection and reassessment of treatment options are allowed. The classification of patients' condition, obtained by this method, includes four main categories, indicating the extent of swallowing insufficiency and aspiration danger and it also suggests the therapeutic treatment needed. The first category refers to patients with safe and efficient swallowing who can achieve free oral intake. In the second category one can finds patients with minor symptoms who need simple therapeutic interventions, regarding increase of bolus consistency and decrease of bolus volume. The third category characterizes patients with severe symptoms who need extended therapeutic interventions including rehabilitation and nutritional support and finally the fourth category includes those with severe danger of aspiration and ineffective deglutition, which require percutaneous endoscopic gastrostomy, to avoid malnutrition and respiratory aspiration. An important danger is hidden because, many patients, due to skeletal muscle loss, are unable to cough and remain asymptomatic. So, there is no sign of physical distress or choking and this situation is described as silent aspiration. It is often left undiagnosed and untreated.

Nutritional assessment

Sarcopenic dysphagia is associated with malnutrition. Patients who suffer from this syndrome take on reduced quantities proteins, vitamins or minerals and therefore, suffer from significant weight loss. Weight and height measurements are obligatory in nutritional evaluation, as in this way, calculation of body mass index (BMI) is obtained. However, a low BMI alone should not be used in screening nutritional evaluation, because it does not take into account the patient's nutrition. A questionnaire like, Mini Nutritional Assessment Short Form (MNA-SF), is a very useful tool, describing the nutritional status of older patients[36] as well as in the identification of those who are in danger of early-stage malnutrition and provides information for establishing a nutritional intervention plan. In addition, it can be used diachronically, allowing comparisons and helping in the evaluation of the effect of any treatment applied[36].

Functional evaluation

For the evaluation of the patients' activity there is a test which includes observation at the hospital, on a scale ranging from bedridden to unassisted walking. The Barthel Index with scores from 0 to 100 is used to measure the patient's ability to successfully carry out daily life activities[37].

Dynamometers can be used, to measure hand grip strength, in kilograms, placing the patient in both sitting and standing position. The highest measurement should be noted, as it is an indicator of muscle strength, evaluating the physical function.

The gait speed is also a clear measurement which indicates the decline of muscle strength and performance. The threshold of 0.8 m/s is considered as minimum of normal gait speed, as the cutoff values indicate a pathological gait speed less than this[38].

Mid upper arm and calf circumference measurements allow for the estimation of skeletal muscle mass. There is also a skeletal muscle index for the same reason. This index, called SMI, is calculated as appendicular rmuscle mass. It is divided by height squared. Appendicular muscle

mass is obtained from bioelectrical impedance analysis, which measures body composition.

Abdominal CT can also be used to measure skeletal muscle mass, reclaiming anatomical measurements. This method is quite reliable and easily performed to assess sarcopenia, characterized by loss of muscle strength and muscle mass. Tongue muscles mass and function are a key observation for the evaluation of sarcopenic dysphagia, as decreased tongue pressure and poor swallowing function are related to this syndrome. Functional swallowing requires more than twenty muscles of the head and neck, working together harmonically. Tongue plays an important role as a swallowing muscle. Decrease in tongue thickness is an important finding directly connected with swallowing insufficiency. It can be evaluated, employing ultrasonography, or by measuring the maximum tongue pressure with special instruments[39].

Treatment

A multidisciplinary care plan is necessary, in order to, prevent, treat or recover from sarcopenic dysphagia. This strategy consists of physical rehabilitation, dysphagia rehabilitation and nutritional support. Cooperation with patients, their family or their caregivers is required for an excellent outcome[40].

Physical rehabilitation, activity modification

Reduction of bed rest time and lying down along with increased activity should be the most important directions to patients. Encouragement for starting simple tasks like sitting up in bed and walking, and specific exercise programs should be prescribed by physical therapist. There are specifically designed programs, to improve swallowing muscles strength and coordination, such as McNeill Dysphagia Therapy Program (MDTP)[41].

Lack of physical activity contributes to pre-existing sarcopenia, so early mobilization and physical activity is very important for every therapeutic intervention. When the patients' capability for exercise is not satisfactory, resistance training should be started under supervision. Muscle mass and muscle strength increase is the goal of each intervention. One of the most important public health challenges, includes the public education and the identification of cost-effective interventions that improve the health status and prevent disability in old age[42].

Nutritional support

Poor nutritional status is a main characteristic of sarcopenic dysphagia. Regardless of the cause of sarcopenic dysphagia, increase of muscle mass should be of crucial importance, so nutritional support plays a major role in any therapeutic intervention. Recent studies have proven that protein and amino acid dietary supplementation can be helpful in the improvement of muscle mass[43]. This kind of diet could be beneficial for the elderly to gain and maintain lean body mass and improve health parameters[44].

Vitamin D is also of key importance, in muscle functions and muscle strength, according to many scientific studies. Every attempt for nutritional support should include Vitamin D supplementation. Generally speaking, diet modification is often necessary to deal with every patient's specific condition[45].

Texture modification of food should be included to improve safety and efficiency of oral eating. At the early stages of therapy, patients require a soft diet, which is easy to chew and swallow or even totally liquid diet to provide the nutritional support needed, in order to avoid dehydration and malnutrition. Later change to a more solid consistency diet, as the treatment progresses, is also obligatory.

Patients' swallowing ability must be considered. Patients who are unable to perform safe and efficient oral eating should be fed by nasogastric tube. In more severe cases, percutaneous endoscopic gastrostomy placement is needed. These methods are considered as low risk interventions, substituting oral feeding in patients with advanced dysphagia and minimizing the danger of malnutrition, choking and aspiration. Patients should be also encouraged to quit smoking[46].

Malnutrition is a risk factor for the development of secondary sarcopenia and sarcopenic dysphagia, so the improvement of nourishment is very important. The earlier nutritional support starts, the better outcome is possible[13].

Sarcopenic dysphagia rehabilitation

Sarcopenic dysphagia rehabilitation requires interventions specifically focusing on re-establishing effective and efficient swallowing. Highly trained health professionals, must be selected for performing a number of specific interventions. Oral care should also be performed. Periodontal disease, if it exists, must be treated, as it often results in loss of teeth. In order to substitute any teeth loss, with the prospective of re-establishing an efficient chewing function, the use of well-fitting artificial dentures is needed[47].

Lingual resistance exercises have to be performed by speech pathologists. Head and neck muscles exercise, postural adjustment and swallowing exercises have to be directed by physiotherapists. Combined treatment requires collaboration with nurses, in cases of patients who cannot perform unassisted eating or use alternative eating methods. In any case, dietitians design the interventions needed for patients' nutritional support[48].

In some cases, a social worker could be helpful providing information and educating the patient, and their relatives or caregivers, regarding the condition, as well as the therapeutic plan, focusing on encouraging and empowering patients to make informed decisions[22].

Pharmacological treatment

Pharmacological treatment is mostly selected and applied in cases with disease-related sarcopenia in order

to heal the underlying conditions, namely inflammatory disease, malignancy, endocrine disease, and often advanced organ failure[49]. Pharmaceutical therapies of sarcopenic dysphagia may advance in the future, as sarcopenia draws attention and our findings and understanding of the disease gradually increases.

Conclusion

Sarcopenic dysphagia is a recently recognized condition. It draws attention due to its important complications.It is a common syndrome affecting the elderly and demands a combination of diagnostic methods and the cooperation of an interdisciplinary team for its definite diagnosis. Multidisciplinary therapeutic interventions, including nutritional support and rehabilitation programs, which are non-invasive but effective methods, are mandatory for the best outcome.

According to epidemiology data, increased life expectancy and population aging are expected to result in higher prevalence of age-related syndromes, such as sarcopenic dysphagia, in the near future. This situation demands the development of systematic diagnosis and efficient treatment protocols.

New findings will enhance the knowledge about this condition, helping us develop more effective prevention plans. Recent studies demonstrate that new concepts in rehabilitation and nutritional support give promising results on its treatment.

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