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MUSTAFA KEMAL KILIÇ

FATİH SÜMER

ZEKERİYA ÜLGER

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Nutritional issues in dementia patients

Mustafa Kemal KILIÇ*, Fatih SÜMER, Zekeriya ÜLGER
Department of Internal Medicine, Division of Geriatric Medicine, Faculty of Medicine, Gazi University, Ankara, Turkey

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Abstract: Dementia is an inevitable disease of aging, leading not only to diminished cognitive ability but also behavioral changes, malnutrition, pressure sores, and infections. Acknowledging common problems and their solutions is essential for any health service worker who deals with demented geriatric patients.

Key words: Alzheimer disease, dementia, malnutrition, vitamin deficiency

1. Introduction

Dementia is defined as a progressive decline in cognitive functions that interacts with activities of daily living, causing dependency while performing tasks such as bathing, eating, and ambulation. Reversible conditions such as hypothyroidism, vitamin B12 deficiency, intracranial lesions, normal pressure hydrocephalus, subdural hematoma, and drugs can result in symptoms resembling dementia and resolve after appropriate medical or surgical therapy. However, the leading cause of dementia is Alzheimer disease and current medications can only slow its progression. Advanced age, female sex, low level of education, and genetic factors increase the risk of cognitive impairment. In addition, metabolic and vascular risk factors like smoking, diabetes, hyperlipidemia, hypertension, and obesity play roles in the development of dementia. As a result of more common vaccination programs and better sanitation, expected survival at birth has increased worldwide over the last 5 decades. Therefore, the aging population became a major problem of western countries due to its burden on health care services devoted to older patients. More and more patients with dementia are admitted to hospitals for complications like infections, pressure sores, and feeding problems. Malnutrition is important and should be prevented; otherwise, susceptibility to infection, development of pressure sores, and immobilization due to sarcopenia will ensue. Demented patients are prone to malnutrition owing to many different conditions such as edentulism, dysphagia, and financial and social restrictions. Their caregivers are also at risk of malnutrition (1). This review will focus on common nutritional problems of patients with dementia and their management.

2. Common problems

2.1. Oral health

Edentulism, poorly fitting dentures, and alterations in the sense of taste and smell of the foods by aging can lead to malnutrition by decreasing solid food intake (2). Thus, optimization of oral health is mandatory to maintain adequate nutrition. In addition, cognitive impairment itself can threaten oral health (3). Gil-Montoya et al. reported that the Oral Health Impact Profile (OHIP), a 14-item questionnaire, was able to detect malnutrition presence and risk effectively in geriatric patients. Malnutrition/risk was 3.43-fold more prevalent in patients with OHIP-reported problems than in those who did not report any problems (4). Several studies reported an association between oral health and malnutrition. Furuta et al., in their study conducted among 286 dementia patients receiving home-care services, reported that cognitive impairment, denture wearing, and number of teeth affected nutritional status by interacting with swallowing function, leading to malnutrition and restriction in activities of daily living (5). Dion et al. indicated the importance of regular dental examination in order to prevent malnutrition in a study performed among 1094 geriatric institutionalized patients (6).

2.2. Dysphagia

Dysphagia, defined as difficulty in swallowing, is a late clinical finding of patients with frontotemporal dementia, while patients with Alzheimer disease, esophagus diseases, neurologic disorders, and cerebrovascular accidents may present with it initially. Various methods to confirm dysphagia and aspiration are available, such as bed-side sipping tests and fluoroscopic imaging. It is a major risk

* Correspondence: mustafakemalkilic@mynet.com

factor for aspiration pneumonia and consequent mortality. In a previous study, geriatric patients with pneumonia who were found to suffer from dysphagia had a higher 1-year mortality rate compared to patients without dysphagia (55.4% vs. 26.7%, P = 0.001). It was also reported to be causative of malnutrition (7). In a Dutch study including 8119 care-home residents, subjective dysphagia was reported in 9% of participants and particularly in 10.9% of residents with dementia. Malnutrition was reported to be associated with subjective dysphagia (OR: 1.58, 95%: CI 1.31–1.90, P < 0.001) (8). A systematic review encompassing the medical literature between 1990 and 2011 about oropharyngeal dysphagia reported its prevalence as 13%–57% and also concluded that preventive measures, medications, and percutaneous endoscopic gastrostomy placement were not proven to be beneficial (9). In another review focusing on dysphagia in the elderly, intensive swallowing rehabilitation was recommended as a useful measure to decrease malnutrition and aspiration pneumonia incidence (10). A multicenter study conducted in Belgium assessed the prevalence of malnutrition and associated factors in 2329 geriatric patients. Dysphagia resulted in a 4.92-fold increased risk of malnutrition, as the leading cause among other patient characteristics (11).

2.3. Vitamin B12 and folate deficiencies

Patients with dementia have a tendency for macro- and micronutrient deficiencies. Deficiencies of certain micronutrients are suspected to be responsible in the pathogenesis of dementia and vice versa. Vitamin B12 is an important molecule in terms of mental functionality. It is well known that prevalence of vitamin B12 deficiency increases with age. Insufficient oral intake is suggested to be responsible; however, its impact on deficiency is controversial. Thus, it is hard to infer that vitamin B12 is deficient in demented patients due to malnutrition. The most common mechanism suggested to explain vitamin B12 deficiency in the elderly is atrophic gastritis and consequent malabsorption. In addition, drugs can impair absorption of vitamin B12. Defects in transportation of vitamin B12 are being evaluated (12). Vitamin B12 deficiency, as an etiologic agent in dementia, was investigated in several autopsy and intervention studies. Inada et al. reported that histopathologic examination of brains of patients with dementia revealed tissue deficiency of vitamin B12 and consequent demyelination, neuronal loss, and atrophy (13). Many trials were conducted to find out the relationship between vitamin B12 and cognitive impairment; however, the precise mechanism still waits to be found (14–19). Subclinical deficiency of vitamin B12 and cognitive impairment incidence is also under investigation (20–22). Hyperhomocysteinemia was considered to be a major vascular risk factor in recent trials and is secondary to folate deficiency. Folate deficiency has the potential to impair cognition via different pathways including mitochondrial dysfunction and consequent oxidative stress, loss of calcium regulation, neuronal and synaptic impairment, and β-amyloid and hyperphosphorylated tau accumulation. The effect of hyperhomocysteinemia on development of dementia was indicated in an animal model. A folate-deficient diet resulted in hyperhomocysteinemia, which in turn caused β-amyloid accumulation in the plasma and brains of young and older mice, respectively (23). Therefore, supplementing folate and B12 to maintain their levels over the low/normal threshold (>14 nmol/L for folate and >220 pmol/L for B12) is reasonable (24). Although results of numerous trials are inconclusive, some observations need to be mentioned. Hyperhomocysteinemia and folate deficiency are related to dementia and Alzheimer disease; however, that is not true for vitamin B12 deficiency. Hyperhomocysteinemia and folate deficiency negatively affect information processing and memory function, respectively; however, reversal of the biochemical alteration ameliorates clinical status. Vitamin B12 deficiency markers such as methylmalonic acid elevation are related to both of the aforementioned problems. Circulating vitamin B12 decrease is a sign for accelerated global cognitive decline. Overtreatment of folate deficiency results in deterioration of memory function, information processing, and global cognition (25).

2.4. Vitamin D deficiency

Vitamin D is a steroid hormone that is acquired from food as ergocalciferol (D_2) and cholecalciferol (D_3). It is synthesized in the skin with the aid of ultraviolet radiation and hepatic and renal activation by hydroxylation ensues. Miscellaneous health problems are reported to be related to its deficiency, such as sepsis, cardiovascular and metabolic problems, and neoplastic disorders. Recommended daily intake ascends with age, because physiologic decrease of its synthesis and indoor living contribute to deficiency. Dementia involves multiple risk factors of vitamin D deficiency, such as advanced age, diminished oral intake, and insufficient sunlight exposure due to institutionalization. Daily intake of at least 800 IU is appropriate for the healthy geriatric population, and up to 4000 IU/day is tolerable (26). A recent metaanalysis that included 6 studies of Alzheimer disease and 5 studies of Parkinson disease revealed that these 2 common problems of older people render them vulnerable to vitamin D

deficiency as compared to healthy age-matched individuals (27). From a different point of view, deficiency of vitamin D is reported to be causative of Alzheimer disease. Micro-RNA, toll-like receptors, vascular endothelial growth factor, angiogenin, advanced glycation end products, major histocompatibility complex class II, vitamin D receptor, apolipoprotein E, liver X receptor, SpI promoter gene, and the poly (ADP-ribose) polymerase-I gene are proteins associated with Alzheimer disease pathology. Furthermore, calcium sensing receptor, amyloid β, interleukin-10, matrix metalloproteinases, heme oxygenase-1, reduced NADP, L-type voltage-sensitive calcium channels, nerve growth factor, prostaglandins, cyclooxygenase 2, reactive oxygen species, and nitric oxide synthase are mediators of vitamin D-driven Alzheimer disease development (28,29). Even before diagnosis of manifest Alzheimer disease, vitamin D was shown to be associated with mild cognitive impairment (MCI) in a French study comparing 95 participants with MCI and normal cognitive function. In that study, the odds ratio of the lowest quartile of vitamin D status for the presence of MCI was 25.46 and patients with MCI had lower mean vitamin D concentrations (30). In another cross-sectional study including 159 patients with a mean age of 85 years, vitamin D deficiency was associated with increased falls and impaired cognitive function; however, muscle strength and balance was preserved. The authors concluded that vitamin D deficiency resulted in cognitive decline, which in turn increased falls, but due to the design of the study it was impossible to conclude a causal relationship (31).

2.5. Micronutrient deficiencies

Micronutrients are essential minerals and vitamins of utmost importance to maintain vital reactions. They are also reported to play a role in Alzheimer disease physiopathology. Cardiovascular disease and cancer are associated with their deficiency, as well (32). In a large metaanalysis covering 80 eligible trials about micronutrients, low levels of vitamin B12, A, E, and C and folate were found to be associated with Alzheimer disease. On the other hand, plasma copper and iron levels were not different between Alzheimer disease patients and healthy controls. It was concluded that insufficient utilization of these molecules was followed by protein and energy malnutrition, which is a classical problem of apparent dementia. Therefore, nutritional interventions may have the potential to prevent progression of dementia long before irreversible cognitive deficit develops (33). Though the current literature is inconclusive for making definite recommendations on the ideal micronutrient composition of regular diets, consumption of fish, vegetable oils, nonstarchy vegetables, and fruits with low glycemic indexes is recommended to reduce the risk of dementia and other nutrition-associated health conditions. Even popular diets like the Mediterranean diet and dietary approaches to stop hypertension lack enough evidence to become guideline recommendations in terms of slowing cognitive performance loss (34).

Common nutritional problems, their clinical manifestations, their relationships with dementia severity, and recommendations to overcome them are summarized in Table 1.

2.6. Interventions to improve nutritional status

Oral nutritional supplements (ONSs) are drinks that contain the needed macro- and micronutrients. They are indicated in the case of malnutrition or malnutrition risk due to various disorders (35). A recent metaanalysis depicting their efficacy reported that they were efficient in providing enough energy, and slight weight gain ensued. Some of those studies showed that Mini Mental

Table 1. Common nutritional problems, their manifestations, their relationships with dementia severity, and recommendations.

Common problems	Dementia severity	Manifestation	Recommendations
Oral health problems	Any stage	Impaired swallowing function due to edentulism or poor oral hygiene	Dentures, dental implants, tooth brushing, regular dentist visits
Dysphagia	Moderate to advanced dementia	Aspiration pneumonia	Intensive swallowing rehabilitation
Vitamin B12 and folate deficiencies	Any stage	Impaired cognitive ability, paresthesias, falls, rarely anemia	Replacement to ensure levels over low/normal thresholds (>14 nmol/L for folate and >220 pmol/L for B12)
Vitamin D deficiency	Any stage	Falls, common bone pain, muscle weakness	Daily intake of 800 IU vitamin D
Micronutrient deficiencies	Advanced dementia	Associated with a huge range of different conditions such as cardiovascular problems, cancer, and dementia	Consumption of fish, vegetable oils, nonstarchy vegetables, and fruits with low glycemic indexes

State Examination scores improved after ONS usage; however, their effectiveness is still debated. The most expected problem of insufficient adherence to drinks was reported to be significant in only 1 of 12 studies (36). Even the serving method can matter. Allen et al. analyzed 45 older patients with cognitive impairment and reported that the consumption of ONSs increased if they were served in a glass rather than by a straw inserted directly into the container (37). Administration of nutrients via a tube inserted into the stomach is an alternative to ONSs and can easily be emplaced by the guide of endoscopy. Percutaneous endoscopic gastrostomy (PEG) placement is a common procedure of increasing popularity, particularly in Alzheimer disease patients (38). However, it is not beneficial to use PEG in patients with end-stage cancer or other end-stage diseases and advanced dementia. Early intervention to improve nutritional status is preferred to terminal palliative intervention. PEG usage is expected to prevent malnutrition and aspiration in patients with dementia; however, trials showed that none of these endpoints were met (39). The last resort is parenteral nutrition for patients who are unable to be fed via the enteral route or whose enteral nutrition does not meet protein and energy goals. Except for terminal dementia, administration of parenteral nutrition is a valuable method. Its role in patients with advanced dementia is unclear (40). Behavioral therapy was shown to be effective for better nutrition; nevertheless, scarcity of trained staff limits its availability (41). Pros and cons of interventions to prevent and treat malnutrition are summarized in Table 2.

3. Conclusions

In this review, individualized patient care is emphasized. As contributors of malnutrition in a patient with dementia, optimizing oral health and managing dysphagia is important. Fortifying the macro- and micronutrients via the optimal route is a major challenge in demented elderly patients due to the complexity of the disease itself and conflicting ethical issues about end-of-life management. However, it seems a rational approach to prefer ONSs over other options due to their ease of administration and relatively lower rate of complications in order to maintain adequate caloric intake. In addition, many dementia patients are bedridden or live indoors, deprived of sunlight; for this reason, they have a tendency to develop sarcopenia and osteomalacia. Most ONSs contain the recommended daily intake of micronutrients and vitamin D. Despite the great variation in practice among different countries, tube feeding is not recommended in patients with advanced dementia as it is not proven to be more beneficial than hand feeding. Therefore, tube feeding should be limited to early-stage dementia patients who suffer from dysphagia and consequent aspiration pneumonia. Parenteral nutrition may be useful for patients with certain conditions in which we need to by-pass the gastrointestinal tract. Nevertheless, it should be reserved as a last resort because of its burdensome complications.

Table 2. Pros and cons of interventions to prevent and treat malnutrition.

Methods	Pros	Cons
Oral nutritional supplements	Low cost Physiological Maintains the satisfaction of tasting	Adherence to drinks is low in long-term administration May cause diarrhea
Tube feeding	Aspiration risk is expected to decrease in cases of dysphagia Physiological A safe way to administer enough caloric intake An easy route of nutrition for the caregiver, bypassing the need for hand feeding	Needs a procedure to apply May cause diarrhea Aspiration/malnutrition incidence is not proven to be as low as expected Blockage of tube and entry-site skin reactions are possible problems leading to recurrent hospitalization Displacement of tube is common in delirious patients, leading to usage of physical and chemical restraints
Parenteral nutrition	Effective way of nutritional supplementation	Expensive Hard to apply in community-dwelling patients Possible biochemical abnormalities Risk of hypervolemia Nonphysiological, threatens enteral mucosal integrity and increases the risk of bacterial translocation
Behavioral therapy	Low cost No adverse effects	Limited availability due to lack of enough trained staff

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