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REVIEW ARTICLE

Epidemiology, diagnosis, and assessment of diabetes mellitus in the elderly population: a purposive review

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Abstract

The elderly population with diabetes mellitus is rapidly growing worldwide and has become a major social burden with significant impact on health and economics. This social category requires considerations that are not traditionally associated with diabetes mellitus management. Several epidemiological studies have shown that the prevalence of diabetes mellitus increases with advancing age. According to the recent International Diabetes Federation (IDF) published data, the number of people with diabetes mellitus among those 65 and over has reached 136 million (19.3%) with more frequent diabetes mellitus complications and co-morbidities compared to the young counterparts. Cardiovascular complications are the leading cause of death and the quality of life is strongly impacted by geriatric syndromes such as poor vision, dementia and functional dependence. The elderly diabetic population is classified into three categories; the robust, the fragile and the patient at the end of life. In practical terms, they can also be classified into two categories: the autonomous patients and the dependent patients, requiring support and assistance.

Keywords: diabetes mellitus, elderly, epidemiology, geriatric syndromes, geriatric evaluation.

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1 Diabetes mellitus

Several studies have shown that the prevalence of diabetes mellitus increases with advancing age [1-5]. The elderly and/or those with multiple co-morbidities have often been excluded from randomized controlled trials of treatments for diabetes and its associated conditions [6]. The management of this chronic disease in the elderly suffers from a great insufficiency, especially in countries where the specialty of geriatrics is not taught and where structures dedicated to this age group are non-existent. The aim of the current purposive review article is to provide, on the one hand, an update on the epidemiology of diabetes mellitus in the elderly, on the other hand, to shed the light on the specificities of this pathology in the elderly people in terms of diagnosis, of diabetes evaluation considering macro- and microangiopathic complications. As well as the evaluation of the elderly person as a whole with an emphasis on the geriatric evaluation being an essential prerequisite for the management of the elderly diabetic patients by looking for geriatric syndromes. The geriatric assessment will classify the elderly as robust (healthy), fragile, and at the end of their life and the treatment objectives will be according to this categorization [7]. The search strategy was developed using the following keywords: "Elderly", "Diabetes Mellitus", Epidemiology", Geriatric assessment", "Geriatric syndrome". To retrieve relevant articles to the research question of this review, databases of PubMed/Medline, Scopus, were searched in English and French with no time restriction. The grey literature was also searched (Google, Google Scholar).

2 Diabetes mellitus epidemiology in the elderly

According to the International Diabetes Federation (IDF), the diabetes mellitus pandemic is dramatically arising worldwide. In 2019, the number of diabetes mellitus patients reached 463 million and will be 578 million in 2030 and 700 million in 2045 [8]. Several epidemiological studies have shown that the prevalence of diabetes mellitus increases with advancing age. According to the IDF, the number of diabetic people among those 65 and over has reached 136 million (19.3%). The projections are more alarming since they will be 195.2 million and 276.2 million respectively in 2030 and 2045 [8].

As summarized in Table 1, the prevalence of diabetes mellitus in the elderly by continent is as follows: In Europe 20.1%, in North America 27%, in Middle East and North Africa (MENA) 24.2%, in Central and South America 22.7%, in western pacific 18.9%, in Africa 8.4% and in Southeast Asia: 13.6% [9]. In the United States, a third of people aged 65 and over are diabetic and half suffer from prediabetes [10]. In our region (North Africa), two prevalence studies were carried out, one in Tunisia which found a prevalence of 27.4% [11] and the other in Algeria and which found 26.7% in subjects aged 65 and over [12]. What should be noted is that the prevalence of diabetes mellitus decreases after the age of 75, this is explained by the high mortality linked to diabetes mellitus but also to the weight loss after 75 years which decreases the incidence of diabetes mellitus [13].

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Table 1: Diabetes mellitus prevalence in people older than 65 years by IDF Region in 2017, 2019, 2030 and 2045, ranked by 2019 prevalence estimates [2]

Rank	IDF Region	2017		2019		2030		2045	
		Prevalence (%)	Number of people with diabetes (millions)	Prevalence (%)	Number of people with diabetes (millions)	Prevalence (%)	Number of people with diabetes (millions)	Prevalence (%)	Number of people with diabetes (millions)
	World	18.8 (15.4–23.4) [i]	122.8 (100.2–152.3)	19.3 (15.3–24.2)	135.6 (107.6–170.6)	19.6 (15.5–24.8)	195.2 (154.7–247.1)	19.6 (15.2–25.4)	276.2 (214.8–358.9)
1	NAC	26.3 (23.4–29.4)	17.7 (15.7–19.7)	27.0 (22.2–32.6)	19.2 (15.7–23.1)	27.3 (22.4–33.0)	26. 9 (22.0–32.5)	27.5 (21.9–33.9)	34.0 (27.1–42.0)
2	MENA	20.4 (12.6–29.0)	6.5 (4.0–9.3)	24.2 (13.2–34.0)	8.4 (4.6–11.8)	24.7 (13.7–34.6)	13.7 (7.6–19.2)	25.2 (13.9–35.6)	25.2 (13.9–35.6)
3	SACA	19.0 (15.1–24.4)	7.9 (6.3–10.2)	22.7 (18.3–29.3)	10.3 (8.3–13.2)	23.1 (18.7–29.7)	15.7 (12.7–20.2)	23.1 (18.5–30.1)	24.0 (19.2–31.2)
4	EUR	19.4 (14.9–25.0)	28.5 (21.9–36.7)	20.1 (15.3–25.8)	31.0 (23.5–39.8)	20.2 (15.2–26.1)	38.8 (29.2–50.0)	20.5 (15.2–26.8)	46.3 (34.5–60.8)
5	WP	20.0 (17.8–23.0)	48.1 (42.7–55.2)	18.9 (16.7–22.1)	50.3 (44.4–58.9)	19.6 (17.2–23.1)	75.4 (66.4–89.1)	19.8 (17.3–23.9)	107.3 (93.5–129.6)
6	SEA	13.5 (9.5–18.6)	12.5 (8.7–17.1)	13.6 (10.1–18.6)	13.6 (10.1–18.6)	13.9 (10.3–19.1)	20.5 (15.3–28.2)	14.0 (10.4–19.7)	32.2 (24.0–45.1)
7	AFR	5.2 (2.8–12.8)	1.6 (0.9–4.0)	8.4 (3.0–15.5)	2.8 (1.0–5.1)	8.7 (3.1–16.2)	4.2 (1.5–7.8)	8.4 (3.1–16.8)	7.3 (2.7–14.6)

IDF: International Diabetes Federation; AFR: Africa; EUR: Europe; MENA: Middle East and North Africa; NAC: North America and Caribbean; SACA: South and Central America; SEA: South-East Asia; WP: Western Pacific.

i: 95% confidence intervals are reported in brackets.

3 Diagnosis of diabetes mellitus in the elderly and circumstances of discovery

The diagnostic criteria for diabetes mellitus in the elderly are identical as in the young population. Glycated hemoglobin (HbA1c) is also a parameter used for the diagnosis of diabetes mellitus, but it is often distorted by comorbidities, in particular anemia in the elderly [14]. The most frequent circumstances of discovery are a fortuitous diagnosis either during a check-up routine, either on the occasion of a cardiovascular complication, an infection (most often urinary) or a lesion of the foot [15].

In emergencies, diabetes mellitus can be revealed mainly by a hyperosmolar coma or precoma where the elderly subject do not feel thirsty. This complication is encountered during the hot seasons, in the event of diarrhea, vomiting, fever or medication (diuretics or laxatives), or when taking corticosteroids [16].

A distinction must be considered between recent diabetes mellitus occurring at an advanced age and aged diabetes, this distinction is crucial since the clinical data are not identical. Diabetes mellitus occurring at an advanced age requires the use of insulin less often, it presents less microvascular complications, in particular less diabetic retinopathy, however there is no difference in the prevalence of neuropathy or other complications mainly the cardiovascular ones [17].

In most cases, aged type 2 diabetes mellitus (T2DM) does not constitute a major issue of classification, this type of diabetes mellitus requires insulin therapy after a certain period of development, the distinction then between insulin-treated T2DM and type 1 diabetes mellitus is important to take into consideration [17].

T2DM is generally asymptomatic, so the seniority cannot be specified, and the search for complications that have gone unnoticed must be systematic, in particular, by performing an ophthalmological examination (fundus) in search of retinopathy, which can inform us about the duration of diabetes mellitus [18].

Diabetes mellitus poses a real concern of diagnosis and classification when transient hyperglycemia must be eliminated, at this age, during stress (cardiovascular complication, inflammation, hyperthyroidism) [19]. Pancreatic disease should also be diagnosed.

4 Assessment of the elderly diabetic

4.1 Search for microangiopathic complications

Diabetic retinopathy should be sought systematically by performing a fundus. Retinopathy is considered as the fourth cause of poor vision in the elderly [20]. However, diabetic nephropathy is sought by performing an ACR (Albumin-to-creatinine ratio) on a fresh urine sample. This nephropathy may be of diabetes mellitus, vascular origin, or secondary to other etiologies [21]. The assessment of glomerular filtration rate (GFR) must use the Modification of Diet in Renal Disease (MDRD) formula or the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula [22].

4.2 Search for macroangiopathic complications

The practice of an electrocardiogram (ECG) is systematic in the search of a cardiac complication such as cardiac ischemia or an unnoticed myocardial infarction or further abnormalities, such as left ventricular hypertrophy (LVH), atrial fibrillation (AF), etc. [23].

Peripheral arterial disease is sought by using a pocket vascular Doppler. The Ankle Brachial Index (ABI) is calculated while keeping in mind that it is often faulted by the arterial stiffness being frequent in the elderly and therefore it is often necessary to supplement by a vascular echo Doppler, even an angiography of the arteries of the lower limbs [24].

The search for a plaque or carotid artery stenosis is also recommended by the practice of an echo Doppler of the supra aortic trunks [23].

Finally, the search for heart failure must be part of the assessment of the elderly diabetes mellitus patients because of its high prevalence and its seriousness. It is frequently a heart failure with preserved ejection fraction and an echocardiography should be performed in the event of any symptom leading to heart failure such as dyspnea, cough on exertion, an abnormality on the ECG [25].

4.3 Diabetic neuropathy (DN)

DN is frequent in the elderly but it is always necessary to look for further cause of neuropathy such as vitamin B12 deficiencies, especially in patients on metformin. Painful neuropathy is diagnosed using *Douleur Neuropathique en 4 Questions* (DN4), one of the questionnaires that can be useful in diagnosing neuropathic pain. The painful neuropathy affects quality of life and must be treated [25].

4.4 Diabetic foot

Foot lesions are particularly frequent in the elderly due to the presence of several risk factors such as peripheral neuropathy, foot deformities, arterial disease of the lower limbs, vision disorders, balance disorders, and reduced mobility. The risk of amputation increases with age. The prevention of foot ulcerations is based on the estimation of the podiatry risk, on the implementation of preventive measures and on therapeutic education. It is essential to avoid bad footwear, barefoot walking, exposure to heat sources (hammam, radiator), henna, dry feet after ablutions or a bath [26].

Obliterating arterial disease of the lower limbs is a major cause of amputation; their prevention is based on the correction of cardiovascular risk factors by insisting on smoking cessation [27].

The treatment of foot ulcers is based on ulcer area off-loading, being crucial for the healing of plantar ulcers, including also debridement of the wounds, and treatment of infection and ischemia [26].

4.5 Geriatric assessment

The overall geriatric assessment is at the heart of all care decisions and will identify the different geriatric syndromes, and determine the functional, clinical and social profile of the elderly [28, 29].

4.5.1 Social assessment

It would be primordial to determine the lifestyle of the elderly population, their marital status, living alone or with their family, the type of accommodation, the presence of a caregiver or not, income, health insurance, their autonomy for activities of daily living. All these would help to identify the needs of the elderly and possibly provide the necessary home assistance and support [26].

4.5.2 Cognitive disorders

Diabetes mellitus accelerates cognitive decline in the elderly, several studies showed that diabetics have impaired cognitive functions compared to the non-diabetic population [30-33]. Studies have also shown that the risk of vascular dementia and dementia Alzheimer's is multiplied by 1.5 to 2.5 [34, 35].

The mechanisms of cognitive decline are not elucidated and would be explained by the reduction of extracellular glucose in the hippocampus that limits the memorization process. Another explanation would be the prolonged and repeated hypoglycemia in patients on hypoglycemic agents or insulin-therapy [28, 29].

Cognitive decline has a negative impact on the management of diabetes mellitus and therefore diabetes mellitus patients no longer recognize hypoglycemia. This could aggravate cognitive decline. As a consequence, patients cannot or no longer want to self-monitor, and reaching glycemic objectives is difficult. Therefore, an early diagnosis and management of cognitive and diabetes mellitus impairment should help prevent or at least delay the progression of a Mild Cognitive Impairment (MCI) to severe dementia [36].

The involvement of healthcare professionals as well as the family and primary caregiver plays a crucial role in improving the adherence and persistence of the diabetic patient to the treatment [37].

Hypoglycemia must be avoided, for this it would be better to provide drugs with a low risk of hypoglycemia, to avoid the use of HbA1c as the unique measure of glycemic monitoring. Capillary blood glucose levels or even better the continuous glucose monitoring (CGM) are more accurate. A simplified diagram and patient education when possible and/or that of caregivers and family is imperative [36-38].

To assess cognition, several tests are available, three are particularly useful and rapid to perform, the Mini-Mental State Examination (MMSE), the Montreal Cognitive Assessment (MoCA) and the Mini-Cog [39].

Elderly diabetic patients with cognitive impairment are generally not included in therapeutic education and disease self-management programs. This situation can lead to the institutionalization of the patient or to total care by the caregivers [40].

4.5.3 Thymic disorders

Diabetes mellitus increases the risk of developing or recurring depression, similarly, a history of depression increases the risk of developing diabetes mellitus [41]. In elderly diabetics, the presence of undiagnosed, untreated or insufficiently treated depression negatively impacts the management of diabetes mellitus, as consequence, patients show low adherence to the treatment [42].

The coexistence of depression and diabetes mellitus can accelerate cognitive decline, hence the importance of treatment for both depression and diabetes mellitus. Depression is often masked and it is necessary to know how to look for signs such as sleep disturbances, changes in appetite, asthenia, reduced motivation and a lack of interest in participating in care. Several treatment approaches are available, pharmaceutical, psychotherapeutic, behavioral, lifestyle interventions, and combination therapies. The elderly may feel desperate in the face of prescribed treatments [43].

Symptoms of depression in the elderly are unfortunately often attributed to natural aging, bereavement, illness or dementia, thus delaying diagnosis and the initiation of beneficial treatment [44]. In the elderly diabetes mellitus population, depressive symptoms may be mistaken for symptoms due to diabetes mellitus or other illnesses. Many of the symptoms of depression such as asthenia, loss of appetite and trouble sleeping are also found in diabetes mellitus. It can therefore be difficult to differentiate symptoms related to diabetes mellitus from those associated to depression [45]. The majority of older people with clinically significant depressive symptoms do not meet the standard diagnostic criteria for major depression [46, 47]. Furthermore, these patients have a high risk of developing major depression afterwards and may also develop suicidal thoughts [48-50]. Depressed patients with diabetes mellitus are at greater risk of developing chronic depression or making less complete recovery [51].

Depression is frequent, difficult to diagnose, it must be mentioned in the face of a wide variety of symptoms. The treatment of depression has a favorable impact on adherence to diabetes mellitus treatment and therefore allows for better glycemic control [36].

4.5.4 Functional profile

Functional disability refers to the presence of "limitation in the performance of socially defined roles and tasks in a socio-cultural environment due to physical impairment" [52]. Frailty and sarcopenia are two risk factors for the development of disability. Frailty being a clinical entity, is characterized by a decrease in reserve and resistance to stressors (unsuitability to stress) resulting from the physiological decline of numerous systems [53]. Sarcopenia is an important cause of frailty in the elderly. It is defined as a decrease in muscle mass associated with a decrease in muscle function (strength or performance) [54]. People with diabetes mellitus present a high risk of developing sarcopenia. Sarcopenia is thought to be an intermediate stage in the development of frailty and disability in elderly people with diabetes mellitus [55].

It is important to identify the risk factors, especially when they are modifiable, for the development of sarcopenia in elderly people with diabetes mellitus. Several studies have shown that elderly people with diabetes mellitus have an increased risk of functional disability, and show more impairment in simple and complex activities of daily living than people without diabetes

mellitus [56, 57]. Moreover, they also have a higher risk of falls and fractures [58].

According to Wong et al., diabetes mellitus increases the risk of loss of mobility by 1.5, the risk of instrumental daily living disability (IADL) by 1.6, and the risk of disability in activities of daily living (ADL) by 1.8 [57].

There are several causes of disability in adults with diabetes mellitus, such as visual impairment, cardiovascular morbidity, peripheral neuropathy and kidney failure. The frailty of the elderly is most often sought by two tools, the Fried criteria and the Rockwood criteria [53, 59].

The two most widely used tools to assess functional disability are activities of daily living (ADL) [60], and IADL [61].

4.5.5 Risk of falling

Falls are a leading cause of fractures in the elderly population [62], affecting a third of adults 65 years and over in the United States [63]. Falls are associated with the risk of fractures and hospitalization. Diabetes mellitus is associated with a high risk of recurrent falls and fractures in people with or without pre-existing functional disability; this risk is particularly high in diabetics after a long period of development.

According to some studies, the risk factors are female sex, reduced mobility, postural hypotension, high body mass index (BMI) and poor diabetes mellitus control, but not hypoglycemia [64-66]. In contrast, a systematic review and a meta-analysis revealed that older people with diabetes mellitus have a higher risk of falls compared to non-diabetics. The same authors found that hypoglycemia is a risk factor for falls, especially in patients treated with insulin and peripheral neuropathy and retinopathy, induced by poor blood sugar control, can also increase the risk of falls [67]. Other risk factors, associated with diabetes mellitus, include visual impairment, peripheral neuropathy, foot deformities (including previous amputation), and polypharmacy [68].

Despite the fact that bone density is high in type 2 diabetics due to obesity, there is an increase in fractures in this population [69]. In the Study of Osteoporotic Fractures, diabetic women had a high risk of hip fracture, proximal humerus, but no vertebral fractures, after adjusting for age, BMI, bone density, and other factors [70]. The Health ABC Study also found an increased risk of fractures in diabetic patients (relative risk 1.64) after adjusting for bone mineral density and other fracture risk factors [71]. Two simple and widely used tools to diagnose the risk of falls are the get up and go and the monopodal support [72, 73].

4.5.6 Malnutrition

Protein-energy malnutrition results from an imbalance between the body's intake and needs. This imbalance leads to tissue loss, especially muscle loss, which has deleterious consequences [74]. According to the Haute Autorité de Santé (HAS) or French National Authority for Health, the prevalence of protein-energy malnutrition is 4 to 10% of elderly people living at home, 15 to 38% of those living in retirement homes and 30 to 70% of those who are hospitalized [74]. In the 2007 HAS recommendations [75], the diagnosis of undernutrition in a person aged 70 or over is based on the presence of one or more of the following criteria.

To diagnose undernutrition at least one phenotypic criterion should be present with no etiologic criterion [76].

a. **Undernutrition criteria:**
   - Body weight loss: ≥ 5% in 1 month, or ≥ 10% in 6 months;
   - BMI <21 kg/m^2;
   - Albuminemia <35 g / L
   - Global mini nutritional assessment (MNA)<17

b. **Severe undernutrition:**
   - Body weight loss: ≥ 10% in 1 month or ≥ 15% in 6 months
   - BMI <18 kg/m^2
   - Albuminemia <30 g / L

The factors favoring undernutrition in the elderly diabetic are: retinopathy, vision disorders, reduced mobility, swallowing disorders, intestinal absorption disorders, financial resources, depression and loneliness, cognition, decreased intestinal motility, frequent hospitalizations. Undernutrition is associated with risks of infection, falls, functional disability, sarcopenia, frailty, delayed wound healing, prolonged hospital stays, cognitive impairment, depression and mortality [76].

Malnutrition screening tools

The diagnosis and management of undernutrition must be systematic to preserve the quality of life, autonomy and survival in the elderly. The five main criteria for diagnosing undernutrition are: body weight loss, low BMI, reduced muscle mass, decreased food intake or absorption, and coexistence of disease and / or inflammation [75].

The MNA is the best validated and most widely used nutritional assessment tool [77-79]. A score comprised between 17 and 23 is considered at risk of undernutrition and a score of less than 17 is in favor of protein-energy undernutrition. The major advantage of this test is that it does not require any laboratory testing. A short version of the MNA has been developed and validated [80].

Determining BMI in the elderly is often difficult, and therefore a new revised version of the Mini Nutritional Assessment Short-Form (MNA-SF) has been developed, showing that calf circumference can replace BMI [81]. When the MNA identifies people at risk of undernutrition, they are often identified as fragile because the different items of the MNA-SF explore the components of frailty such as body weight loss, low food intake and muscle strength (mobility and girth calf) [82-84].

Nutrition Management and Intervention

It is essential to consider that the elderly with diabetes mellitus constitute a diverse population with various care needs requiring individualized management and dietary treatment and therefore should be involved in this management. To minimize the incidence of frailty and mortality in elderly people, sufficient energy intake is recommended. The European Society of Clinical Nutrition and Metabolism guidelines on clinical nutrition and

hydration in geriatrics recommend an energy intake of approximately 30 kcal/kg body weight/day, based on the nutritional status, physical activity level, disease status, and tolerance [85]. According to some authors, decreased energy intake in older patients with diabetes mellitus might lead to a lower BMI, cognitive impairment, and higher prevalence of sarcopenia, which might be associated with an increased risk for frailty and mortality [86, 87].

According to the 2019 Japan Diabetes Society guidelines, the total energy intake requirement in older adults should be calculated using age-dependent target body weight (kg)= (22–25 kg/m^2 × height [m]^2) multiplied by coefficients of physical activity [88].

An appropriate protein intake could reduce the incidence of frailty or mortality in older individuals. A minimum of protein intake of 1.2–1.5 g/kg body weight/day is recommended by the European Society of Clinical Nutrition and Metabolism guidelines for older subjects with acute or chronic illness [89]. Together with sufficient vitamin D intake can ameliorate cognitive function, reduce risks of sarcopenia [90, 91] and might play a protective role in Alzheimer's disease [92]. Concerning fatty acids, consumption of polyunsaturated fatty acids (PUFA) and ω-3 fatty acids was associated with lower risk of mortality in diabetes mellitus patients aged over50 years [93] and reduced cognitive decline [94]. The authors of the Nurses' Health Study conducted on 1,486 female participants aged ≥70 years, with diabetes mellitus type 2 showed that higher intakes of saturated and trans fat and lower polyunsaturated to saturated fat ratio, were each highly associated with worse cognitive decline [95].

The Mediterranean diet (MD) being widely considered as a healthy diet, is rich in vegetables, fish, and olive oil and known to reduce the risk of cardiovascular events [96]. Meta-analysis of observational studies showed that high adherence to the MD with higher intake of vegetables, fruits, and whole grains was associated with lower risk of frailty and functional disability in the elderly population [97, 98].

4.5.7 Pain

Pain, in the elderly, is frequent. According to an American study, 52.8% of people aged 65 and over suffer from pain. In diabetes mellitus elderly population, pain reaches 61.5% [99] and is dominated by pain of rheumatic and of neuropathic origin.

- **Rheumatic origin:** concerns joint stiffness syndrome, Dupuytren's disease, tenosynovitis, carpal tunnel syndrome, shoulder capsulitis / periarthritis, osteoarthritis [100, 101].
- **Neuropathic origin:** the prevalence of neuropathic pain, in people with diabetes mellitus, is difficult to estimate because definitions, populations studied, and methodologies vary across studies.

Pain regardless of its etiology has a negative impact on the quality of life [102]. A Finnish study showed that the pain in elderly people with diabetes mellitus was neither more frequent nor more intense than in non-diabetics. The pain is due to depression and other comorbidities more than to diabetes mellitus [103]. It is imperative to assess and treat pain to improve quality of life.

4.5.8 Vision disturbances

Diabetes mellitus increases the risk of poor vision and blindness in elderly people with diabetes mellitus compared to the healthy population by a factor of 1.5 according to Sinclair *et al.* [104]. Diabetic retinopathy represents the fourth leading cause of blindness in elderly diabetes mellitus patients after age-related macular degeneration (AMD), cataracts and glaucoma. Unlike the population under 60, in whom diabetes mellitus is the leading cause of blindness [105], vision disturbances in the elderly are associated with functional disability and poor quality of life.

Most older people relate poor vision to a physiological process of aging and therefore do not seek medical attention, even though many conditions require effective treatment [106]. In patients with diabetic retinopathy, the main cause of poor vision is macular edema and not proliferative diabetic retinopathy [107]. Poor vision worsens other geriatric syndromes such as falls, inability to function, undernutrition, depression and cognitive impairment. Therefore, a complete eye exam is required in any elderly diabetic to determine the cause of poor vision and to suggest adequate treatment.

4.5.9 Hearing problems

Aging is the most frequent cause of sensorineural hearing loss in adults. Deafness seriously affects the quality of life of patients who no longer communicate, resulting in social isolation leading to an increased risk of depression, anxiety and cognitive impairment [108]. More than 35% of people over 60 and 50% of those over 70 have difficulty in activities of daily living due to hearing loss [109]. A study that included 37,773 subjects, conducted from 2009 to 2012 aimed to assess the presence of hearing disorders according to age, to the presence of hypertension and/or diabetes mellitus, showed that aging and diabetes mellitus were correlated with hearing loss ($p<0.05$). There was no statistically significant association between hearing loss and hypertension after adjusting for age and diabetes mellitus [110].

4.5.10 Polypharmacy

The use of multiple drugs, often termed polypharmacy is commonly defined as using from 5 to 10 prescription drugs. Among seniors living at home in the United States, 57% of women and 59% of men report using 5 or more medications, and almost 20% report taking 10 or more medications [111].

Older people with diabetes mellitus are more likely to take multiple medications than those without diabetes mellitus [112].

Polypharmacy is associated with increased risks of drug nonadherence [113], drug interactions [114] and adverse events [115]. The presence of polypharmacy is also associated with cascading prescriptions, in which adverse drug events are interpreted as new pathologies, leading to the prescription of new drugs to treat these pathologies [116].

4.5.11 Urinary incontinence

Urinary incontinence (UI) is frequent in the elderly and is associated with significant morbidity and mortality. Diabetes

mellitus is a potent risk factor for UI, increasing both the prevalence and severity of UI. [117, 118]. UI dramatically decreases quality of life, increasing the risk of social isolation, depression, falls, fractures, hospitalization and mortality [119-122]. UI is little sought after by caregivers, yet studies show that its presence affects the prognosis. The UI diagnosis is based on questioning the patient or family, and its management involves several therapies.

5 Conclusion

Studies and epidemiological projections conclude that with a significant increase in the prevalence of diabetes mellitus in the elderly, it will undoubtedly constitute a major public health concern.

Diabetes mellitus management in the elderly is based on:

- a clinical assessment with eliminating transient hyperglycemia and distinguish aged type 2 diabetes mellitus patients with insulin treatment from type 1 diabetes ones, know how to look for secondary diabetes, mainly pancreatitis;
- diabetes assessment with looking for macroangiopathic, microangiopathic, neuropathic complications, and podiatry evaluation;
- and a global geriatric assessment with an emphasis on the cognitive and functional status of the elderly individuals.

At the end of this evaluation, the treatment goals will be defined according to the recommendations of the ADA (American Diabetes Association).

Older adults who are otherwise healthy with less coexisting chronic diseases and preserved cognitive function and functional status should present lower glycemic goals (such as HbA1c, 7.5% [58 mmol / mol]), while those presenting multiple coexisting chronic diseases, cognitive impairment, or functional dependence should have less-stringent glycemic goals (such as HbA1c, 8.0–8.5% [64–69 mmol / mol]) [123].

For some older adults, blood glucose targets car reasonably be relaxed as part of individualized care. However, hyperglycemia leading to symptoms or risk of developing acute hyperglycemia complications should be avoided in overall patients [123].

Abbreviations

- ABI: Ankle Brachial Index
- ADA (American Diabetes Association)
- ADL: activities of daily living
- AF: Atrial fibrillation
- AMD: age-related macular degeneration
- BMI: body mass index
- CGM: continuous glucose monitoring
- CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration)
- DN : Diabetic neuropathy
- DN4 : *Douleur Neuropathique en 4 Questions*
- HAS : *Haute Autorité de Santé*
- HbA1c: Glycated hemoglobin
- IADL: instrumental activities of daily living
- IDF: International Diabetes Federation
- LVH: left ventricular hypertrophy
- MD: Mediterranean diet
- MDRD (Modification of Diet in Renal Disease)
- MENA: Middle East and North Africa
- MMSE: mental state examination
- MNA: mini nutritional assessment
- MNA-SF: mini nutritional assessment short-form)
- MoCA: Montreal Cognitive Assessment
- T2DM: Type 2 diabetes mellitus
- UI: Urinary incontinence

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