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Review Article

Diabetes in old age, a review

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Abstract

The elderly population is usually defined as those at least 60 or 65 years of age. In tandem with the rest of the world, Iran has seen a dramatic increase in this age group in recent decades. It is estimated that the percentage of men and women over 65 years old in 2020 will be 9.4% and 9.1%, respectively. The old are liable to suffer from coincidental diseases; decisions as to the most appropriate treatment modality should, therefore, be made on an individual basis in harmony with the physical and mental status of the patients as well as possible drug interactions. Diabetes, together with its complications such as hypoglycemia, is one of the most prevalent chronic diseases and its prevalence rises considerably by aging. Educating patients and their families empowers them to maintain their independence in the management and treatment of their medical condition. In addition, regular ophthalmologic, cardiovascular, and other laboratory examinations can reduce treatment costs and burdens and confers a better overall quality of life. Given the increase in the aged population around the globe and in Iran and the relative paucity of data on diabetes in this age group, it seems advisable that more attention be paid to raising awareness of the problems of diabetes in this age group.

Keywords: Diabetes, Elderly, Education

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Introduction

The elderly are the symbols and a treasure trove of a country's customs and traditions. The cultural-religious context of our country, Iran, demands special reverence for the aged, not least during debilitating diseases.

Diabetes deteriorates lifespan by imposing damages on multiple vital organs [1]. In 1997, it was estimated that 124 million people were afflicted with this metabolic disorder worldwide, the majority (97%) of them had type2 diabetes [2]. Unfortunately, it estimates that the number of diabetics in the adult population (aged ≥ 20 years old) to have risen to 300 million by the year 2025 [3]. In the Eastern Mediterranean Region (EMRO), which includes such countries as Saudi Arabia, Islamic Republics of Iran, Kuwait and Iraq, the prevalence of diabetes amongst the adult population was 14.5% in the year 2003 [4]; simultaneously, the prevalence of the diabetic population in Iran stayed at 5% [5]. Currently, it is estimated that there are 22 million diabetic patients out of total 290 million adult populations in the EMRO; the feature seems to elevate to 300 million by the year 2025 [4].

The elderly comprise a portion of the general population that are at least 60 or 65 years of age according to different definitions [6]. In the next fifty years, the elderly may account for 2 billion people in the world [7]. The rapid population growth in the developing world by comparison with developed countries means that the former has much less time to devise suitable programs for the prevention of diabetes [7].

Diabetes and its consequent complications place a very heavy burden on health care systems. Abolhasani et al. revealed that the burden of diabetes and its complications in term of the Disability-Adjusted of Life Years (DALYs) was 306,440 years in Iran in 2001 [8].

In short, diabetes mellitus is a common disorder in the elderly population and imposes a great burden on individuals and health care systems. The present study sought primarily to probe into diabetes in old age using such keywords as type2 diabetes mellitus, elderly, diabetes complications, and treatment of diabetes.

Epidemiology

Age is one of the variables influencing the prevalence of diabetes and Impaired Glucose Tolerance (IGT) [1]. For instance, in those 45 – 55 years of age in the USA, diabetes is four times more common than in the ones in the 20 – 44 aged. [1] Currently, at least 20% of people aged over 65 years old are estimated to be suffering from diabetes [9], and the figure amounts to 50% in some races such as Hispanics [10]. On the other hand, the world's elderly population is on the increase [11]. Different epidemiological studies have reported varying diabetes prevalence in the elderly, with the reasons cited being different in terms of not only the dates of the studies but also the diagnostic criteria and the racial groups recruited into the studies [12]. A study, conducted between 1993 and 2001 on old people (≥ 67 years), evaluated the prevalence and incidence of diabetes mellitus in four racial groups and reported that Asians had the highest prevalence. In that study, the prevalence of diabetes raised alongside aging and reached its peak amongst those in the 75-79 aged before it started to drop [13]. It should be noted, however, that the highest prevalence of diabetes mellitus tends to occur in the oldest age groups in the majority of the world's populations [2].

Until 1979, fasting blood glucose ≥140 mg/dl was the standard diagnosis of diabetes. In 1997, this standard was lowered to 126 mg/dl, which accounts for the lower epidemics having been reported in published epidemiological data since then. In the Japan 2002 Survey, a total of 7.4 million people were suspected to suffer from diabetes, 2.26 million of them being in the age bracket of 60 and 2.51 million being

at least 70 years old [14]. The annual rate of diabetes appearance amongst individuals over 65 years old in the 1994-1995 time period in the USA was about 23% before it soared to 62% in 2003-2004 [15, 16]. The total prevalence of diabetes in adult groups (≥ 20 years) in Iran in 2001 was reprted at 4.67% (1.6 million patients). In the same year, the rate of diabetes in those aged between 60 and 69 years and those aged over 70 years was 15.49% and 14.07%, respectively. The average rate of diabetes in the elderly population (≥65 years old) was 14%, with the prevalence in women being higher than that in men in all age groups [5]. In the Tehran Lipid and Glucose Study (TLGS) between 1999 and 2001, 1799 persons from a total number of 15005 participants were 60 years old or higher. In this population based study, the prevalence of diabetes and IGT was 26.2% and 20.8% in the women and men, respectively [17]. In a study conducted on 1694 elderly persons over 60 years of age in the Iranian city of Isfahan in the year 2004, 17.4% suffered from diabetes and there was a significant difference in terms of diet between the diabetics and non-diabetics [18].

The time period between the years 1980 and 2003 life expectancy in Iran increase from 55 years to 68 years in men and to 70 years in women; this change is a testament to the further aging of the population and also the increase in non-communicable diseases such as diabetes mellitus in Iran [19]. A population based survey in the year 1986 showed that old people accounted for 3.03% of the entire Iranian population. This figure rose to 4.32% in 1996 and 5.18% in 2006 [20]. In the Shieber et al. study in 1995, men and women over 65 years of age accounted for 6% and 5.7% of the total study population, respectively. The authors predicted that by 2020, those percentages would have risen to 9.4 and 9.1% in men and women, respectively [21].

Of the factors contributing to a higher prevalence of diabetes in old age are the presence of other chronic diseases, higher "hope for life", [22] lower activity level, higher prevalence of obesity due to development of technology and westernized diet, availability of healthy and therapeutic facilities, and more efficient laboratory evaluations of high blood sugar. In both genders, the prevalence of obesity in middle age makes the person susceptible to diabetes [14, 22].

A major health issue, diabetes has adverse effects on the quality of life and life span [4]. The fact that diabetes worsens with advancing age means that it creates even more problems in elderly people [23].

Senile diabetes pathophysiology and etiology

Insulin resistance and IGT are more prevalent in the aged than in young people, and the former are more susceptible to have type2 diabetes. Some reasons for lower sensitivity to insulin in the elderly are: adiposity, changing in fat distribution, decrease in free fat mass, abnormal muscle content, bad food habits, and lack of physical activity. Insulin resistance and defects in insulin secretion in response to glucose are the main contributing factors for IGT or diabetes in old obese and old slim persons, respectively. Also, autoimmune changes like antibody against islet cells as well as insulin deficiency may also be responsible [24, 25].

Type2 diabetes is divided into two categories according to the time of appearance: one that starts from middle age and has the most prevalence (55.28%) and another that commences after 65 years of age with a 44.72% prevalence rate. In rare cases, a continuation of juvenile diabetes (type I) is also seen in old age [26]. The etiopathology of diabetes in the elderly is complex and multi-factorial and it can happen due to a lower function of the islets of Langerhans because of partial vein damage to the pancreas or ramification of general atherosclerosis process [27].

Diagnosis of diabetes in the elderly

Natural differences in the physiology of the body are the corollaries to aging and exert a direct bearing upon the signs and symptoms of diabetes and are likely to cause problems in the diagnosis or treatment of diabetes. As a consequence, diabetes does not tend to present with gross hyperglycemia in elderly individuals. Moreover, at least 50% of elderly persons are oblivious to their diabetes [11]. The reasons, albeit not very clear, may be attributable to the unawareness of health care providers about the criteria for diagnosis of diabetes, absence of classic signs of diabetes, or the increase in the urinary extraction limit of glucose secondary to aging [11]. For instance, polydipsia in the elderly caused by a decline in thirst perception is less common than that in other age groups, rendering dehydration more prevalent. Hyperglycemia in these people can be accompanied with such symptoms as dizziness and incontinence. In old people, autonomic alerting signs set off by a decrease in glucagon and epinephrine, moreover the secretion of growth hormones in response to hypoglycemia decreases. Conversely, sometimes the epinephrine response increases and may induce severe hypoglycemia [25]. It is, therefore, advisable that blood tests be included in routine medical assessments of the aged.

Standard laboratory criteria for the diagnosis of diabetes in old people are similar to those in other age groups: blood glucose <100 mg/dl is normal and >126 mg/dl is indicative of diabetes. Blood glucose of 100-126 mg/dl is not regarded as diabetes, but it is called IGT and an individual with that amount of blood glucose is usually susceptible to some diabetic complications, especially, cardiovascular diseases. After the age of 50; for each decade that passes, fasting blood sugar and 2-hour postprandial blood sugar in the GTT (Glucose Tolerance Test) are liable to increase by 1.08 and 9 mg/dl, respectively [24].

Diabetes complications in the elderly

Geriatric syndromes

Cognitive disorders, depression, chronic pains, polypharmacy, injuries from falling, and difficulties in urination are some of the geriatric symptoms [28]. The risk of these syndromes in diabetics is higher than those in non-diabetics [29]. Depression and psychosocial stressors are more common in diabetics than in non–diabetic groups [30, 31]. A cross-sectional study recruited 2522 old men and women between 70 and 79 years old for an investigation into the relationship between diabetes and depression and found that the probability of depression symptoms was 23.5% and 19% in the diabetics and non-diabetics, respectively, and the rates of relapsing were 8.8% against 4.3%. The highest relation between diabetes and relapse of depressive symptoms was for the most part observed in the patients with weak blood sugar control [32]. Depression is one of the salient contributors to movement disability [33]. On account of the fact that diabetics are at higher risk of suffering from major depression, necessitates screening measures at the beginning of the diagnosis (i.e. first 3 months) or whenever it appeared a change in the patients' clinical conditions [28]. Cognitive problems and dementia are more prevalent in elderly diabetics than non-diabetics [34]. In an examination of cognitive disorders, in a case-control study in Tehran, with 160 type2 diabetics and non-diabetics recruitment, the average values in Mini Mental Status Examination (MMSE) in the case group were less than those of the control group and a significant reverse correlation between these values, age, and duration of diabetes was reported. This report showed that old diabetics had some degrees of cognitive problems, which worsened with advancing age [35].

Functional disability is defined as difficulty in performing activities of daily living and social activities [33]. Diabetes can aggravate the disability and delay the

patients' recovery, as a consequence, leads to a higher prevalence of disability. This relation magnifies with the appearance of diabetes complications in the eye and diabetic foot, related conditions like obesity and depression or high blood pressure, and such social issues as lower education levels and lower income [29]. Not only will all these factors bring about higher rates of hospitalization and stays at nursing homes, but they will also increase need for care and the burden of diabetes in this age-group [29, 36].

Cardiovascular diseases

Both diabetes and aging tend to exacerbate cardiovascular diseases with symptoms ranging from completely silent and without any sign to obviously overt diseases [37]. Without considering the influence of age on diabetes, the most common outcome of type2 diabetes is emerging fatal and non-fatal vascular complications such as cardiovascular diseases and peripheral vascular or cerebrovascular conditions [38, 39]. In a study conducted over an eleven-year period, death due to diabetes in the old people with recent diagnosis was 9.2% higher than that in the non-diabetics. Also, 91.8% of the diabetic patients had more micro and macro vascular complications compared to 72% of the non-diabetics, and the diabetics were at higher risk of lower limb complications [40].

The metabolic syndrome is a disorder that is normally accompanied with central obesity, hypertension, and abnormal glucose tolerance test and lipid profile test results. This syndrome is a precursor to such serious diseases as cardiovascular diseases and diabetes. In one study carried out no 12600 persons in Iran, the incidence of the metabolic syndrome in the urban and rural populations was 25.4% and 21.7%, respectively. Additionally, the highest incidence (68.9%) was found amongst those over 60 years old in the rural areas of Isfahan, Iran [41].

The rate of heart failure in diabetic patients with respect to age as a major risk factor has been reported to be twice as the rate in non-diabetics [42]. The rate of heart failure in diabetics is also believed to be related to the quality of blood sugar control in as much as for each percentage increase in HbA1c[1], the risk of heart failure will increase by 15% [43]. According to the ACCORD[2] study, the mortality rate in the diabetics with HbA1c>6.5% tends to increase, especially in the elderly with prior history of cardiovascular diseases [44].

In a prospective study aimed at examining random cases with heart failure, the rates of having heart failure in a four-year period for men and women (≥65 years old) were 15% and 18%, respectively. Twenty years later and with the same people and time period, the respective percentages increased to 22% and 24% [45].

The treatment of hypertension and dyslipidemia in elderly groups can reduce the morbidity and mortality of cardiovascular diseases [46]. The goal is to control blood pressure at ≤ 130/80 mmHg, LDL[3] at <100 mg/dl, and total cholesterol / HDL[4] ratio at < 4 in elderly groups [50]. In individuals with a history of cardiovascular diseases, it is usually recommended that LDL be reduced to levels lower than 70mg/dl [47].

Hypoglycemia

Hypoglycemia is a severe and prevalent consequence in the treatment of diabetes in old people and is defined as the Whipple triad, i.e. presence of clinical symptoms resulting from a drop in the blood sugar level followed by a decrease in the blood sugar level (less than 50 mg/dl) and symptoms fading after the blood sugar level returns to the normal mode [48]. Warning symptoms are dizziness or changing level of consciousness, pallor, sweating,

1 -Clycosylated Hemoglobin A1C
2 -Action to Control Cardiovascular Risk in Diabetes
3 -Low Density Lipoprotein
4 -High Density Lipoprotein

difficulty concentration, irritability, and paresthesia around the lips, low body temperature, nightmares, and insomnia. Ramifications of hypoglycemia in old people are more severe due to weaker physical strength and macrovascular diseases. On the other hand, after hypoglycemia, patients are at higher risk for macrovascular incidents like myocardial infarction and brain stroke. The occurrence of several and sudden hypoglycemia attacks in old people triggers dizziness, weakness, temporary unconsciousness and fall, undermining the patient's confidence and sense of independence. Accordingly, a desirable blood sugar level in old people is set at higher levels than that in the young [49].

Unawareness of hypoglycemia is widespread. Approximately, one fourth of insulin-administered patients may experience hypoglycemia without any alerting sign. Hypoglycemia is likely to be followed by changes in the brain blood circulation; that may not distinctly manifest itself in old patients because of hard vessels and nervous system disorders. An increase in the duration of diabetes concurs with rise in the probability of unawareness of emerging hypoglycemia [49].

Diabetic foot

According to a reported study in Iran in the year 2001 [8], the incidence diabetic foot in those over 20 years old was 3%. Another study looked into the rate of lower limb amputations and hospital stays due to diabetic foot in 281 patients hospitalized in Imam Khomeini Hospital and Dr Shariati Hospital, two educational hospitals in Tehran, between 1979 and 2001 and following findigs reported: the amputation rate dropped from 40% in 1995 to 14% in 2001 and the average hospital stay was 4 weeks [50].

Like young people, old patients are not spared from diabetic ulcers. Some of the principal causes of this symptom are sensory neuropathy [51], foot deformities, peripheral arterial diseases, sight weakness, low activity, or presence of other diseases. The risk of other major amputations (proximal amputations to the foot heel) [52] due to aging and increase in visual loss may intensify as well. Moreover, sight weakness leads to not daily foot checking by old patients [53]. For prevention of diabetic foot ulcers, an identification of high risk people, avoiding wearing unsuitable shoes, and not walking with barefoot are usually suggested. Peripheral vascular disease is one of the important leading factors for amputations which can be prevented by carefully long-term blood sugar and dyslipidemia control, treatment of hypertension, and smoking cessation [54-56]. It is recommended that diabetic foot be managed by a multidisciplinary team approach encompasssing general practitioners, nurses, endocrinologists, vascular surgeons, orthopedists, and physiatrists [57- 59].

Visual problems

Visual impairments tend to increase amongst the old to the extent that one out of three elderly persons suffers from some form of impairment [60]. the most severe visual impairments are age–related macular degeneration, cataract, glaucoma, and diabetic retinopathy [61]. After age-dependent degeneration in the macula, cataract, and glaucoma, diabetes is the fourth common cause of blindness in the eltherly and the first in the West and in people under 60 years of age [62]. Diabetic retinopathy is distinct with micro vascular injuries in the retina [63], with its prevalence in Asia reported from 10.5% in India to 35% in Taiwan [64].

There are only a few epidemiological studies in the existing literature on diabetic retinopathy in the aged. In Afkhami et al. study of 590 patients with type2 diabetes referring to the Yazd Diabetes Clinic, a city in centre of Iran, 39.3% of the study population suffered from diabetic retinopathy and age, body mass index, glucose level, and HbA1c were amongst the majority of

risk factors for diabetes-related visual impairments [65].

Diabetic retinopathy is evident in 15% of diabetics over 70 years old at the time of diagnosis [66]. The prevalence of diabetic retinopathy is highly dependent upon the duration of diabetes. In a study of people over 65 years of age with an average diabetes background of 15 years, while the prevalence of diabetic retinopathy was 43%, the prevalence observed in 23% of people in the same group but with a shorter history [67].

Increase in age, diabetes duration, and the intensity of retinopathy (less important) are the main risk factors for developing cataract. In diabetics, the clinical appearances of cataract are not specific to diabetics [62]. Although aging is the main factor for appearance of glaucoma, no relation between diabetes and glaucoma has been mentioned in numerous studies [62, 68]. Old diabetics who have recently been diagnosed, must be underwent ophthalmologic examination [28, 62]. Old diabetics who are at higher risk of suffering eye disease (e.g. having eye symptoms, retinopathy, glaucoma and cataract in the first examination or during the last two years, HbA1C ≥8%, type1 diabetes, and blood pressure ≥ 140/80 mmHg) must be examined annually by an ophthalmologist [28,62]. For low-risk people (e.g. recent diabetes diagnosis, with no diabetic retinopathy, controlled blood sugar, and no diabetes adverse effects) examining at least once every two years is suggested [28, 62]. Regular visual assessments can assist elderly persons in maintaining their life activities and self–sufficiency [61].

Like younger diabetics, regularly control of plasma sugar and blood pressure in order to decrease in incidence and progress to diabetic retinopathy is crucial and HbA1c must be kept at an acceptable level. Needless to say, the probability of hypoglycemia and blood pressure drop must not be neglected in the aged, hence the advisability to treat everyone individually [62].

Diabetic nephropathy

This complication is characterized as microalbuminuria ≥ 30 mg/day. If albuminuria amounts to ≥ 300 mg/24h, it is referred to as clinical nephropathy or obvious albuminuria [69]. Diabetic nephropathy has no prominent symptoms until advanced stages of the disease. This condition is aggravated when accompanied with such problems as anemia or cardiac failure. The detection of proteinuria and diabetic nephropathy necessitates routine screening [70-72].

For the majority of elderly persons, the presence of macrovascular diseases, apart from nephropathy, is a great problem. The clinician needs to take heed of the patients' age and serum creatinine when evaluating the patients' albuminuria. The general approach to diabetic nephropathy in the elderly is similar to that in young diabetics and includes controlling blood pressure, blood sugar, and lipid profiles, administering angiotensin-converting enzyme inhibitor drugs, and periodically assessing serum creatinine and urine albumin. It is recommended that precautions be taken when treating patients with high levels of serum creatinine. For example, the use of metformin is generally contraindicated and the use of glibenclamide should be closely monitored because of the tendency of the drug to cause prolonged hypoglycemia [70].

In one study in Iran, 123 diabetics with respect to macroalbuminuria were evaluated, accordingly, 20.3% of the patients had microalbuminuria, 61.1% normoalbuminuria, and 10.6% macroalbuminuria. There was a significant statistical difference between the mean age of those with microalbuminuria (58.8 years) and those with normoalbuminuria (50.3 years), and the renal function in the patients with type2 diabetes progressively deteriorated with

advancing age and the duration of diabetes [73].

Oral and teeth diseases

Oral and teeth diseases are regarded as one of the frequent consequences of diabetes. These diseases are more severe and prevalent in diabetics than in the healthy population. Diabetics are more susceptible to some clinical manifestations of oral diseases like candidiasis, which weakened the control of blood sugar. Appearance of xerostomia due to an increase in glucose levels in oral secretions and dysfunction of local immune mechanisms, is usually observed [74]. In an examination of diabetes-related causes of oral symptoms in 116 diabetics, the most common symptoms were gingivitis (96%), periodontitis (90%), and mouth dryness (67%). Although there was no statistically significant relationship between diabetes-related causes of mouth symptoms and blood glucose control, the patients with good blood glucose control had a lower incidence of the foregoing diseases [75].

Sexual dysfunction

Sexual dysfunction is seen in both types of diabetes (types 1 and 2). In elderly women, diabetes alongside with menopause, can causes vaginal dryness, low resistance to normal vaginal flora infections, and high susceptibility for fungal infections [76, 77]. Erectile dysfunction (impotency) is the most common sexual dysfunction in diabetic men regardless of age, and its prevalence increases with advancing age [78]. It has been reported that the prevalence of erectile dysfunction in male diabetics is 35-75%, which rises to 55-95% after 60 years old. Etiology of erectile dysfunction is multifactorial, and neuropathy, vascular insufficiency, and failure to control of blood sugar are some of frequent risk factors [76].

Mofid et al. study of 700 diabetic men between 20 and 69 years of age in Tehran [79] reported that 246 (35%) persons suffered from erectile dysfunction according to the International Index of Erectile Function (IIEF) and this figure rose to 43% in those over 60 years old. Erectile dysfunction is more frequently observed with advancing the duration of diabetes and unfavorable blood glucose control.

Treatment of diabetes in the aged

The principles of the treatment of diabetes in the elderly are similar to those in the young; the difference lies in the changes taking place in insulin pharmaco-kinetics, also, its absorption, metabolism, and clearance are liable to changes. Furthermore, alongside diseases, onset of diabetes, presence or absence of microvascular and macrovascular complications, and varying physical and emotional problems of old people are all reasons justifying to make the best decision on drug regimens on an individual basis [25, 80].

Most of the diabetic patients are suffering from accompanied diseases and up to 70% have more than two comorbid conditions [81, 82]. Moreover, regular evaluation, management, and follow-up of complications such as hypertension, obesity, dyslipidemia, and cardiovascular diseases are similar as those in youth [83]. Nonetheless, clinicians must be cognizant of the dominant features of the disease for choosing appropriate treatment modalities.

Self-care is one of the most important aspects of diabetes management. Patients should adopt a healthy life style as regards diet and physical activities and have sufficient knowledge about the disease and its management; thus, the significance of education as an important factor in blood glucose control is unfolded [84]. Diabetic patients and their families or caregivers should be equipped with the knowledge on the symptoms, diagnosis and management of hyper and hypoglycemia. Education in this regard includes knowing the causing

factors, early warning signs and symptoms, prevention, diagnosis and control of the symptoms, treatment modalities, use of the glucometer, and appropriate scheduling for seeking professional help [28]. Usually, patients who have been diagnosed at middle-age are more familiar with appropriate management of diabetes than those of the elderly who have recently been diagnosed.

The management of diabetes in old age based on three fundaments: nutritional changes, physical activity, and medications if the desired blood sugar level can not be achieved.

Eating three regular meals in addition to at least two snacks between meals reduces the risk of a drop in the blood glucose level. It is, therefore, important that patients be educated for healthy lifestyle and regular physical activities alongside with routine medication [27]. The elderly diabetics should regularly receive consultations about dieting and weight reduction [28, 85]. The consumption of vitamin C, vitamin E, and minerals (zinc, magnesium, and complements) may improve blood glucose control in selected groups of elderly diabetics [86-89]. Several investigations have demonstrated that physical activity can significantly promote control of blood glucose as well as lipids in elderly diabetics [90-92]. Needless to say, the intensity of physical activity should correspond to the health and physical condition of the patient [93]. Vigorous exercise is not usually recommended for elderly diabetics because of the possibility of cardiovascular complications [94].

Primary or secondary failure of taking oral hypoglycemic agents is conceivable in elderly diabetics who have diagnosed during middle-ages. In addition, oral agents are not markedly efficacious in senile diabetes when administering early in the course of treatment; moreover, their efficacy tend to decrease over the time. Indeed, no desirable response can be observed with oral hypoglycemic agents in most elderly diabetics and majority end up using insulin as the last available therapeutic choice. Different treatment modaliyies have various effects on the quality of life. Occasionally, insulin prescription may improve as quality of life [27]. In one study, the patients under treatment with insulin had less satisfaction in life and worse general condition than did those receiving medical-nutritional treatments. This difference, however, was not significant when taking into account the duration of diabetes [94]. In some patients, insulin treatment hastens need for institutionalization [29]. Another study, however, reported more satisfaction and improvement in the general condition of diabetics between 39 and 81 years old after 7 months of insulin therapy [95].

The optimal levels of plasma glucose vary in the elderly because of possible accompanied diseases, drug interactions, and occurrence of some unpredictable conditions. Accordingly, the goal in the management of diabetes in the elderly is to maintain an appropriate level of blood sugar without increase in the risk of hypoglycemia. For effectively management of diabetes in the elderly, a multidisciplinary approach is warranted; moreover, endeavors must target efficiently lifestyle changes. Several studies have shown that the foregoing approach can markedly improve blood glucose control, enhance effectiveness of treatments, and improve the quality of life in elderly patients [96, 97]. For monitoring the long-term control of blood sugar in old patients, HbA1c assessment at least every six months is recommended [98]; the goal is to attain HbA1c of 6.5 to 7.5% in the elderly with no coincident diseases and 7.5 to 8.5% in ones who suffering from accompanied conditions. A desirable fasting blood sugar level is 90-126 mg/dl [27].

It is worthy of note, however, that the costs of hospitalization for elder diabetics estimated 60% higher than those for non-

diabetics [99]. Table 1 presents a list of oral hypoglycemic agents for the treatment of type2 diabetes [63, 100], and Table 2 introduces various products of insulin which are frequently used in Iran [100]. Given the significantly increase in the aged population around the world and in Iran and the importance of maintaining the dignity of this age group, it is judicious to separately notice their problems.

Taken together, it seems advisable that more attention be paid to raising awareness of the problems of diabetes in this age group.

Table 1. Oral hypoglycemic agents for type 2 diabetes mellitus

	Sulfonylureas (generation2: Glybenclamide*)	**Meglitinides (Repaglinide*)**	**Biguanides (Metformin*)**	**Thiazolidinediones (Pioglitazone*)**	**Alpha-glucosidase inhibitors (Acarbose*)**
Mechanism	Stimulate insulin release from beta cells of pancreas	Stimulate insulin release from beta cells of pancreas	↓hepatic neoglucogenesis, ↑ insulin uptake in peripheral muscles	Enhance sensitivity to insulin in liver & muscle	Reversible inhibition of glucosidase in intestinal tract
Decrease in HbA1C (%)	1-2	1-2	1-2	1-2	0.5-1
Decrease in FBS (mg/dl)	50-60	60	40-80	60-70	30
Intake time	Before meal	Before meal	By meal or after meal	Before meal	Before meal
Daily recommended dosage (mg) *	5-20	1-16	500-3000	15-45	25-300
Side effects	Hypoglycemia	Hypoglycemia	GI‡ effects, Lactic acid	Hepatotoxicity, anemia, Fluid retention	GI ‡ effects (Diarrhea, Bloating)
Contraindications	Cr †>2 mg/dl, Liver disease	Renal Failure	Renal dysfunction, Liver disease, CHF ¶ (Class 4)	Liver failure, CHF¶	Severe renal disease, Chronic intestinal disease, Liver disease

* The given dose is just for the sample of each group, † Creatinine , ‡ Gastrointestinal, ¶ Congestive heart failure

Table 2. The most available products of insulin in Iran

	Onset time†	**Peak time†**	**Duration time†**
Short acting (Regular)	0.5	2-3	4-6
Intermediate acting (NPH*)	1.5	4-8	10-18

* NPH: Neutral Protamine Hagedorn, † All times recorded based on hours

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