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Vascular neurocognitive disorders and the vascular risk factors

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Review

Vascular neurocognitive disorders and the vascular risk factors

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Abstract

Dementias are clinical neurodegenerative diseases characterized by permanent and progressive transformation of cognitive functions such as memory, learning capacity, attention, thinking, language, passing judgments, calculation or orientation. Dementias represent a relatively frequent pathology, encountered at about 10% of the population of 65-year olds and 20% of the population of 80-year olds.

This review presents the main etiological forms of dementia, which include Alzheimer form of dementia, vascular dementia, dementia associated with alpha-synucleionopathies, and mixed forms. Regarding vascular dementia, the risk factors are similar to those for an ischemic or hemorrhagic cerebrovascular accident: arterial hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, age, alcohol consumption, cerebral atherosclerosis/ arteriosclerosis.

Several studies show that efficient management of the vascular risk factors can prevent the expression and/ or progression of dementia. Thus, lifestyle changes such as stress reduction, regular physical exercise, decreasing dietary fat, multivitamin supplementation, adequate control of blood pressure and serum cholesterol, and social integration and mental stimulation in the elderly population are important factors in preventing or limiting the symptoms of dementia, a disease with significant individual, social, and economic implications.

Keywords: dementia, neurodegenerative disease, atherosclerosis, Alzheimer`s disease, cognitive decline

Highlights:

- ✓ Dementia is a neurocognitive disorder with multiple and severe (individual, social, and economic) implications.
- ✓ Lifestyle changes implying stress reduction, regular physical exercise, decreasing dietary fat, social integration and mental stimulation in the elderly population are important factors in preventing or limiting the symptoms of dementia

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Introduction

Neuro-cognitive disorders (NCD) are neurodegenerative diseases characterized clinically by persistent and progressive impairment of cognitive functions (1). These impairments are usually inherited, with etiology and pathogeny currently documented, but they are not considered developmental disorders (2).

According to the American Psychiatric Association and The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM5), the term dementia was replaced with the notion of major neurocognitive disorder (NCD), defining thus a broad spectrum of cognitive and functional disorders that form the basis for diagnostic criteria. Nevertheless, for certain etiological subtypes, the term of dementia is standard (2). Thus, according to the current international agreement, for the confirmation of a major neurocognitive disorder, the cognitive deficiency and the main clinical SDR (source data review) must be characterized by a significant decline in performance compared to a previous level in one or more cognitive fields such as: memory, learning, complex attention, executive function, perceptual-motor skills related to language skills, or social knowledge. The cognitive deficiency must interfere with daily activities, and the health care provider might request evidence of minimum assistance for daily routines (e.g., invoices, payment, testimonials from relatives, etc.). At the same time, the cognitive deficiency must not be associated with a psychological disorder, such as a major depression or schizophrenia. (3).

This paper presents the main etiological forms of dementia, focusing discussion especially on vascular neurocognitive disorder and the vascular risk factors implicated (diabetes mellitus, age and arterial hypertension, the metabolic syndrome, smoking and alcohol consumption), as a premise to further understand and develop therapeutic and prophylactic guidance related to this severe disease.

Discussion

DSM5 defines the incipient stage of dementia when the cognitive disorder is less severe as a minor neurocognitive disorder. Several diagnostic criteria are also formulated for this incipient stage. The subtypes of minor or major NCD are: NCD due to Alzheimer's disease, vascular NCD, NCD with Lewy bodies, NCD due to Parkinson's disease, frontotemporal NCD, NCD due to traumatic brain injury, NCD due to HIV infection, substance/ medication-induced NCD, NCD due to Huntington's disease, NCD due to prion disease, NCD due to another medical condition, NCD due to multiple etiologies, and unspecified NCD (1, 2).

Regarding their global prevalence, dementias, a term almost super-imposable with major NCD, represent 1-2% of the population of 65 and older, and 30% by age 85 (3). Estimations of the prevalence of minor NCD for the older patients range between 2-10% at the age 65 and 5-25% at the age 85 (2). The most common etiological factors are represented by: Alzheimer disease (60%–80%), dementia with Lewy bodies, Parkinson disease with dementia (10%–20%), frontotemporal dementia (5%–10%), cerebrovascular disease (10%– 20%) (4).

Vascular neurocognitive disorder is the result of reduced cerebral blood flow that can either produce an ischemic stroke, with different strategic localizations at the cerebral level (such as the angular gyrus, the temporal lobe, the frontal lobe, the thalamus, the caudate nucleus, the hippocampus), or result in modifications such as the hyaline and fibrosis of the small vessels with the appearance of infarcts at the level of the cerebral white matter (clinically silent or accompanied by neurological non-specific signs). These injuries of the white matter generate interruptions of the cortical and subcortical circuits, with the deterioration of complex attention, information processing speed, and executive skills and abilities, resulting in a neurocognitive disorder (5-7). At the same time, there are also the so-called cortical– subcortical border zone infarcts, the result of hypoperfusion from atherosclerosis, as well as extended episodes of arterial hypotension that can be accompanied by NCD. Consequently, neurocognitive disorders having as etiology the cerebrovascular diseases actually represent a vast group of manifestations from the cognitive vascular sphere. They are characterized by two subcategories: medium or major NCD (7).

The major vascular NCD represents the second most frequent cause of NCD, second only to Alzheimer disease. In the USA, the prevalence of vascular dementia is 0,2% for those between 65-70 years, and more than 16% for those over 80. In the first three months after a stroke, about 20-30% of the patients are diagnosed with dementia. Regarding patients with neurological pathology, the prevalence of vascular dementia increases from 13% at age 70 to 44,6% at age 90, compared to the Alzheimer disease (23,6%-51%), and to vascular dementia associated with the Alzheimer disease (2% - 46,4%). The prevalence is higher for men and Afro-Americans, compared to Caucasians and East Asians (2, 3).

The revised NINDS-AIRENS criteria (National Institute of Neurological Disorders and Stroke-Association Internationale pour la Recherche et

l'Enseignement en Neurosciences) or Hachinskiu ischemic scale (8, 9) have been unanimously accepted and used by neurologists for diagnosing vascular dementia. Initially, dementia related to the vascular traumas or injuries was labeled arteriosclerotic dementia, then multi infarct dementia, post-stroke dementia, and vascular dementia; the term currently used is vascular cognitive disorder (7). A correct diagnosis typically requires a fairly complicated algorithm. The DSM5 diagnostic criteria elaborated by the American Psychiatric Association are also formulated.

The main types of the vascular neurocognitive disorder are as follows (10):

1. Cortical vascular dementia or multi infarct dementia, (Multi-infarct Dementia), characterized by the presence of infarcts in the cortical and subcortical regions of the cerebral arteries and clinically by the existence of motor deficits, unilateral sensitivity disorders, and the gross occurrence of cognitive decline and aphasia.
2. Subcortical vascular dementia or the dementia of small bloood vessels, (Subcortical Ischemic Vascular Dementia or Bisswanger's Disease), a condition of cerebral insufficiency and Bisswanger's disease, clinically characterized by pure motor deficits, signs of bulbar palsy, dysarthria emotional lability, or deficits of executive functions.
3. Cortical and subcortical vascular dementia, (Mixed Dementia) with mixed components.
4. Strategic infarction dementia involving the strategical spheres of the brain such as the thalamus, hippocampus, fronto-cingulate cortex, temporal lobe-median area, and basal portion of the brain (1, 7-9).
5. Other types of vascular dementia are: vasculits, cerebral amyloid angiopathy (CAA), and hereditary disease such as CADASIL (Cerebral Autosomal Dominant Arteriopathy with Subcortical Infarcts And Leukoencefalopathy).

The last type is an hereditary affectation with autosomal transmission (mutations of the Notch3 gene from the 19 chromosome that codifies a dominant transmembrane receptor that is to be found in the vascular flat muscle and at the level of the pericytes, in the case of the adults) that is rarely encountered. It is clinically associated with: progressive dementia, mood disorders, migraine with aura, and recurrent subcortical cerebral infarctions (10, 11). The cerebral amyloid angiopathy (CAA) affects persons over 65, and shows an increased incidence for those 80-90 years old.

Other types of vascular neurocognitive disorder are (7):

1. Post-ischemic encephalopathy that is divided into 3 subentities:
   - the cortical laminar necrosis, localized in the areas of arterial border associated with the diffuse deterioration of white matter;
   - multiple post-ischemic injuries that have as a substratum the hypotension and enlargement of the vascular wall with the reduction of the cerebral blood flow and the generation of minor cortical and subcortical infarctions;
   - hippocampal sclerosis characterized at the neuropathological level by neuronal loss and gliosis, noticed in patients over 85 years olds who were not previously affected by the Alzheimer's dementia, but with pathological antecedents of cardiac insufficiency and cerebral hypoperfusion.
2. Hemorrhagic dementia. Cerebral bleedings do not regularly cause dementias. However, there may be a connection between cerebral bleedings and NCD, depending on its localization and/or dimension, or in the case of cortical and subcortical hemorrhages, whether the patient had arterial hypertension antecedents. According to several hypotheses, several mechanisms might explain the appearance and development of certain neurocognitive disorders for patients affected by a stroke, such as (5, 6, 12):
   - the cerebral injuries determined by an ischemic or hemorrhagic stroke, involving neurological deficits (motor deficits, sensitivity, language or sight disorders, etc.) can result in perturbations of superior nervous functions, having as clinical expression minor or major neurocognitive disorders;
   - after an ischemic or hemorrhagic stroke, the neurocognitive disorder may actually be a continuation of a preexistent state, such as the Alzheimer dementia, not made known by the patient, or not diagnosed before the cerebrovascular event;
   - the recidivated ischemic stroke can lead to the development of the neurocognitive disorders; as is well known, multiple ischemic attacks can favor the development of certain cognitive disorders characterized by a rapid progressive model (multi infarction dementia).

These hypotheses are supported by the fact that an ischemic stroke is associated with two physio-pathological mechanisms:

1. Arterial enlargement with the consecutive narrowing of the lumen, modifications resulting from factors such as arterial hypertension, certain diseases, dyslipidemia, or genetic factors. These modifications are represented by deposits of fibrinoid, the hypertrophy of the flat musculature, and other elements of conjunctive tissue present in the arterial wall, a phenomenon called fibrinoid degeneration and lipohyalinosis (11).
2. Obstruction of the origins of penetrating arteries by parent large intracranial artery intimal plaques. It has

been noticed that these modifications of the cerebral large blood vessels are much more important for the determination of a stroke than the intrinsic injury of the small blood vessels. Thus, the decrease in the blood flow in the cerebral small arteries or their obstruction is generated either by the existence of the atheroma plaque, that can be situated at the level of the large cerebral blood vessels, or by the existence of the microatheromas that can be found precisely on the place of origin of the small arteries. The atheroma plaque initially takes shape by the enlargement of the main blood vessels followed by the deposition of the lipids in the blood, the accumulation of lipid laden macrophages, cholesterol crystals and the deposition of calcium at the level of the main blood vessels.

This process is accompanied by a local inflammatory reaction that includes lymphocytes and macrophages, with the loss of the elasticity specific to the arterial wall, the narrowing and then the occlusion of the arterial lumen. The atheroma plaque can break and injure the distal cerebral arteries (11). The described atherosclerotic mechanism can combine with the thrombotic one, and this steno-occlusive mechanism of the small blood vessels is favored by: the increased resistance of the blood vessels to the blood flow, the denatured vascular self-adjustment, the modifications of the hematoencephalic barrier, the modifications of the vascular endothelium, and the dilation of the perivascular spaces (10). Thus, both minor ischemic lesions, (lacunar strokes) with a diameter ranging between 1-15 mm and anomalies at the cerebral white matter take place at the level of the brain, due to the demyelination of the myelin sheath and consequently of the axons and deterioration of the oligodendrocytes, but without the development of profound infarctions or cystic necrosis (10, 11).

The most frequent localizations of the lacunar strokes are: the putamen, the pallidum, thalamus, caudate nucleus, the internal boll and the corona radiata, the cerebral trunk, and the cerebellar white matter. The association between these minor strokes and modification of the white matter represent the Bisswanger disease (7, 11). The large number of lacunae associated with the injuries of white matter determines interruptions of the prefrontal-subcortical, thalamo-cortical, striato-cortical circuits, as well as deterioration of the limbic system, structures that play specific roles in cognition, memory, and behaviour, thus being responsible for the development of the neurocognitive disorders (7, 11). However, it seems that the accumulation of b–amyloid and of the neurofibrillary tangles, specific to the Alzheimer disease, can facilitate and accelerate the development of the cerebral ischemic lesions and then of the neurocognitive disorders (10). It is well known that the cholinergic system plays a role in the adjustment of the cerebral blood flow. Its dysfunction can lead to the reduction of blood flow and thus to the development of the cerebral hypoperfusion, representing a risk factor for the production of the cognitive decline.

- Significant hemodynamic stenosis of the large cerebral blood vessels affected by atherosclerosis or arteriopathy that affects the small cerebral vessels, reducing the cerebral blood flow, without the induction of cerebral lesions leads to the development of a cognitive deterioration syndrome; this mechanism is not sufficiently investigated (3). We also note, in the context of the injury of the cerebral microcirculation, the existence of the incomplete ischemia and of the selective tissue necrosis that are clinically characterized by the cognitive decline (13, 14).
- Structural alterations of the small cerebral blood vessels, such as arteriosclerosis, lipohyalinosis, cerebral amyloid angiopathy CAA, CADASIL, etc., that can determine the lacunar strokes or modifications of the typical cerebral white matter seem to be responsible for the development of certain cognitive disorders similar to those related to subcortical vascular dementia (15-17). At the level of the small blood vessels, apart from the fibrinoid degeneration and lipohyalinosis, there is also the possibility of accumulation of a granular material that can infiltrate from the main blood vessels to the tunica adventitia of the arterial wall. This aspect is specific to the hereditary diseases such as CADASIL. Anatomopathological studies have also revealed the presence of glycoproteins at the level of the arterial wall, whereas the muscle fibres present in the medium tunic are hypertrophied, deteriorated, and the vascular endothelium can be absent or replaced with the cholagen (11). Devoid of the muscle layer, the vascular wall in the CAA becomes thicker due to a hyaline, acellular material, while the presence of A-beta peptide in persons diagnosed with arterial hypertension increases the brain's vulnerability to the ischemic lesions. It has been demonstrated that the CAA rarely causes spontaneous cerebral hemorrhages (7).

There are pathogenic mechanisms that explain the development of vascular neurocognitive disorders, namely (7): the sedimentation of the amyloid at the brain's level, the existence of the subdiagnosed Alzheimer disease, with a series of studies showing that it can coexist with the vascular risk factors. Thus, Alzheimer disease associated with the cerebrovascular disease has been accepted as a diagnosis (1), the phenomenon of growing old, atherosclerosis, the arterial hypertension.

These pathogenic links bring about the cerebrovascular disease and dementia, relying on an inflammatory-type mechanism and the oxidative stress at the vascular level, mediated by b-amyloid and NADPH, (Nicotinamide adenine dinucleotide phosphate) – OXIDASE, the enzyme that represents in its turn a permanent source of oxidative stress at the vascular level. The cerebrovascular alterations associated with changes in the hematoencephalic barrier increase the brain's vulnerability to the hypoxic-ischemic mechanisms, generating changes to the structure and functions of the neurons, accelerating thus the development of the neurocognitive disorders. Due to their amyloidogenic role, the following etiopathogenic factors apoE4, Ɛ2 and Ɛ3 can determine microvascular modifications, clinically characteri-zed by neurocognitive disorders: the atrial fibrillation that via microembolic complications induces various cognitive declines and neurological deficits, as a result of the microinfarcts in different areas of the brain. Inflammation may have a role in the inducement of these mechanisms (7).

Due to the etiopathogenic relation, the cerebrovascular disease – neurocognitive disorders have a multifactorial etiology, the risk factors involved in its development being divided as follows (1, 5, 9):

- vascular: arterial hypertension, dyslipidemia, smoking, generalized atherosclerosis, other heart diseases, (myocardial infarction, atrial fibrillation), smoking;
- demographic: age, education;
- genetic
- factors related to the stroke, (localization of the lesions, the type of stroke, the type of the cerebral lesions);
- the presence of certain factors that can lead to chronic cerebral hypoperfusion and ischemic events, (heart arrhythmias, heart diseases, or the congestive heart failure, etc).

Diabetes Mellitus

Diabetes mellitus (DM) represents a major risk factor for myocardial infarction, thromboses, and cerebrovascular disease—ischemic or hemorrhagic stroke, associated with mild or major vascular neurocognitive disorders (18). The risk of developing dementia doubles in patients diagnosed with DM who follow antidiabetes oral drugs or Insulin treatments compared to those without DM (19-21). Patients younger than 65 diagnosed with diabetes mellitus are at higher the risk of vascular dementia than older ones. The risk is directly proportional to the duration of the disease, and it may appear concomitantly with certain complications of the diabetes, such as the peripheral arterial disease (22-24). Various cognitive disorders can be encountered at the level of mild or low values of glycemia (prediabetes) (25). Jaffe and collaborators have shown in a 4-year prospective study that older women with low blood sugar levels have lower scores on cognitive evaluation tests than the women with normal values (18). The second type of DM (type II) has been associated with an increased risk of neurocognitive disorder. This risk increases with the increase in the number of repeated episodes of hypoglycemia (18). Imagistic investigations such as the cranial computed tomography (CT) scan or magnetic resonance imaging have emphasized the presence of cortical atrophy and a cortical or subcortical stroke, as well as several ischemic subcortical modifications, or leukoaraiosis in such patients. This association is not surprising, considering the fact that DM increases the risk of developing a stroke or lacunar infarcts (25, 26). The association between DM type 2 and arterial hypertension increases the risk of developing cerebrovascular diseases. The risk decreases together with the decrease in the values of arterial tension (18).

The age and the arterial hypertension

It is well known that advanced age (individuals over 60) is associated with both high blood pressure and cerebrovascular disease, which in turn can lead to the development of neurocognitive disorders (27). Knowing that the risk of ischemic and hemorrhagic stroke accident increases with aging leads to the conclusion that age represents an important factor in the development of vascular dementia. Furthermore, older patients may develop cerebral amyloid angiopathy (CAA) that can cause multiple cerebral infarcts, lobar hemorrhages or microhemorrhages, and subsequent cognitive decline. Thus, although dementia may occur at any age, older patients are more predisposed (18). This conclusion is consistent with epidemiological data: 2% of the population aged from 65 to 70 are diagnosed with dementia, 5% from 70 to 80 suffer from dementia, and 20% over 80 and 33% over 90 are diagnosed with clinical signs of dementia (28, 29).

Blood pressure values over 160/95 mmHg represent a major risk for the development of a vascular dementia (23, 24). Cranial CT scans on hypertensive patients have revealed a cortical atrophy or leukoaraiosis at the level of the hippocampus (30, 31). High blood pressure that is not treated or therapeutically controlled generates dysfunctions of the cerebral vessels by modifications of the vascular endothelium, of the flat muscle cells from this level, and of the hematoencephalic barrier, as well as extensive lesions at the level of the cerebral white matter that can be associated with the cognitive decline (18, 32).

With endothelial modifications such as lipohyalinosis (also called the fibrinoid necrosis), a hypertrophic remodeling and the eutrophication of the cerebral arteries generate arterial thickening, narrowing of the vascular lumen, stenosis, or arterial occlusion, as well as the reduction or absence of blood flow in a certain cerebral area, thus altering the brain's capacity to adapt to an insufficient energy contribution, induced by the reduced or absent blood flow. The mechanisms associated with cerebral atherosclerosis in patients diagnosed with arterial hypertension result in cerebral ischemic lesions with different localizations and neurocognitive disorders (33, 34). The increase in the pressure of impulse which stands as a marker of arterial rigidity has been associated with cognitive decline and especially with modifications of linguistic skills and abilities (18). Studies or clinical trials developed thus far align with the fact that vascular dementia is less frequent for hypertensive patients treated with hypotensors than in untreated patients (35).

The metabolic syndrome

Metabolic syndrome is defined by the presence of at several cardiovascular risk factors: obesity, arterial hypertension, dyslipidemia (high TG values and low values of HDL cholesterol) and DM. Metabolic syndrome is associated with an increased risk of developing vascular neurocognitive disorders (18), especially for patients aged 70 or older (18, 36, 37). At the same time, for some male patients with metabolic syndrome older than 75, the cognitive decline is slightly delayed, explained by a simple neuroprotective effect of the metabolic syndrome (38). For middle-aged individuals, hypercholesterolemia is associated with an increased risk of dementia, whereas for older persons, it is associated with a low risk of developing dementia. Prospective statistical studies have shown that treatment with statins for dyslipidemia does not influence the development of neurocognitive disorders (18).

Certain studies outline the fact that the patients over 60 with high levels of triglycerides and obesity have a high risk of developing short term memory disorders and even dementia (28, 39). Persons with a very high body mass index (BMI) are also more predisposed to developing dementia throughout their life (28, 40). The BMI effect modifies with aging (33). Studies on middle-aged or older populations have shown causal relationships among cerebrovascular disease, neurocognitive disorder, and vascular risk factors such as: hypertension (41), dyslipidemia (42), DM (43), associated with behavioral factors such as obesity and the lack of physical activities (44).

Smoking

Clinical studies have found that nicotine can stimulate good functioning of certain neurotransmitters involved in the generation of the different types of dementia and especially of the Alzheimer disease, but this relationship may be valid only in the short run. In the long run, nicotine can modify the vascular wall, modifying at the same time the chemical composition of nutritive substances in the blood essential for good functioning of brain.

Statistical studies in the USA on populations over 65 years of smokers and alcohol consumers have identified smoking as an important risk factor for stroke and a potential risk factor for cognitive decline (45). A Chinese study on a large number of smokers and alcohol consumers has demonstrated that smoking is associated with a greater risk of developing a vascular neurocognitive disorder. Smoking results in a pronounced progression of the cerebral vascular lesions as well as deterioration of the executive function a decade later (46). Thus, smoking is a risk factor for both vascular dementia and Alzheimer disease, the smokers being twice more likely to develop a certain type of dementia (28, 29, 40).

Alcohol

Small quantities of alcohol may protect older individuals against dementia and Alzheimer disease. Based on several studies, 14 units of alcohol for women and a maximum 21 units for men per week are not considered excessive (a unit represents a small glass of wine or one single measure of alcoholic drinks). The American Heart Association stipulates moderate alcohol consumption as 1-2 portions of alcohol/day for men and one portion/day for women (340g of beer, 113g of wine or 40g of alcoholic drinks); exceeding these doses increases the risk of stroke and favors other cardiovascular risk factors such the arterial hypertension and obesity. Thus, moderate quantities of alcohol do not eliminate the risk of developing dementia, but they can play an important role in its reduction (28, 29, 40). According to several large studies of chronic alcohol consumers, excess alcohol is associated with the cognitive decline of dementia (40).

The USA study on groups over 65 years demonstrated that moderate alcohol consumption represents a protective factor only on the vascular endothelium, especially for 80 years olds (45). Excessive alcohol consumption has neurotoxic effects on the central nervous system, thus bringing about dementia (45). The Chinese study on a large number of smokers and alcohol consumers has shown that a daily quantity of alcohol (beer, wine, hard liquor) is associated with a

higher risk of vascular neurocognitive disorder than for those who do not consume alcohol. The combination of smoking and alcohol consumption leads to a higher risk of developing a vascular NCD than moderate, daily alcohol consumption or smoking (46). The triad, arterial hypertension- smoking – DM, leads to the appearance and development of vascular dementia (46). Although the effects of alcohol consumption and smoking on cognitive function have been confirmed through numerous studies, their mechanism of action is yet unclear (46). It has been noticed that male patients, alcohol consumers, and carriers of the apolipoprotein E, (ApoE) or more precisely E4 allele, who manifested moderate cognitive disorders had rapidly-developed dementia (46-48).

Conclusions

The dominant pathology in vascular neurocognitive disorder is cerebrovascular disease, the cognitive decline being associated with clinical neurological signs characteristic of cerebral lesions that can be focal, multifocal, diffuse, or in diverse combinations.

The risk factors involved in the generation of a vascular neurocognitive disorder are similar to those for an ischemic or hemorrhagic cerebrovascular accident: arterial hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, age, alcohol consumption, cerebral atherosclerosis, or arteriosclerosis. For this reason, efficient management of the vascular risk factors can prevent cognitive decline and dementia.

Vascular neurocognitive disorder represents a heterogenous group of manifestations associated with the various types of cerebrovascular lesions, manifestations that progress through different stages during their evolution, up to the final phase of vascular neurocognitive disorder. The disorder is actually a memory disorder exacerbated by aphasia, apraxia, agnosia, and deterioration of executive functions, which then interfere with the patient's daily activities. Criteria for the correct and complete diagnosis of vascular neurocognitive disorder have been updated, with the diagnosis algorithm involving both the NINDS-AIRENS criteria and those in DSM5.

Understanding the interrelation among vascular risk factors, cerebrovascular disease, and the vascular neurocognitive disorder represents an ongoing challenge and an important step with respect to the diagnosis and treatment of the various types of cognitive disorders. Patients with cognitive disorders and especially those with vascular neurocognitive disorders are characterized by a higher degree of disability, a lower life quality, and a shorter life expectancy. Furthermore, the costs for their treatment and supervision under special conditions are high.

Conflicts of interest

There are no conflicts of interest.

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