

MULTIDISCIPLINARY APPROACH TO NEUROPSYCHOLOGICAL DISORDERS IN WOMEN WITH METABOLIC SYNDROME

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Abstract

Background. *Metabolic syndrome (MetS) is a multifactorial disorder characterized by abdominal obesity, insulin resistance, impaired glucose metabolism, dyslipidemia and arterial hypertension. In addition to cardiovascular and metabolic complications, increasing evidence indicates that MetS may be associated with cognitive impairment, anxiety, depression, sleep disturbances and reduced quality of life. These neuropsychological manifestations may negatively influence treatment adherence and lifestyle modification. Therefore, their early detection and comprehensive management are clinically important.*

Keywords: *metabolic syndrome, women, neuropsychological disorders, cognitive impairment, anxiety, depression, multidisciplinary approach, rehabilitation, quality of life.*

Objective. To develop a multidisciplinary approach for the early detection, assessment and management of neuropsychological disorders in women with metabolic syndrome.

Materials and Methods. A prospective comparative study is planned among women with MetS receiving outpatient or inpatient care and an age-matched control group without MetS. Clinical-neurological, biochemical and neuropsychological assessments will be performed. Cognitive functions will be evaluated using the Montreal Cognitive Assessment (MoCA) and Addenbrooke's Cognitive Examination III (ACE-III). Anxiety and depressive symptoms will be assessed using HADS and DASS-21. Health-related quality of life will be evaluated using EQ-5D. Biochemical assessment will include glucose, glycated hemoglobin, lipid profile, insulin, homocysteine and C-reactive protein. Based on the expected clinical findings, a multidisciplinary management and rehabilitation algorithm will be developed.

Expected Results. The proposed approach is expected to facilitate early identification of cognitive and affective disorders, improve risk stratification and support individualized management. The algorithm will integrate neurological, metabolic, psychological, nutritional and rehabilitation interventions.

Conclusion. Neuropsychological disorders should be considered an important component of the clinical phenotype of MetS in women. A multidisciplinary approach

may improve early diagnosis, treatment adherence and quality of life and may contribute to prevention of long-term functional impairment.

Introduction

Metabolic syndrome is currently regarded as one of the major medical and public health problems worldwide. It is characterized by a combination of abdominal obesity, insulin resistance, impaired glucose metabolism, dyslipidemia and elevated blood pressure. The coexistence of these abnormalities significantly increases the risk of cardiovascular disease and type 2 diabetes mellitus.

The clinical consequences of MetS, however, are not limited to cardiovascular and endocrine systems. Growing evidence suggests that metabolic abnormalities may also affect the central nervous system and contribute to cognitive and psychological disorders. A systematic review demonstrated an association between MetS and cognitive dysfunction across several cognitive domains, although the strength of these associations varies between studies.

Several mechanisms may explain the relationship between metabolic abnormalities and neuropsychological dysfunction. Insulin resistance can influence neuronal insulin signaling and brain energy metabolism. Dyslipidemia and arterial hypertension may contribute to endothelial dysfunction and cerebral microvascular changes. Chronic low-grade inflammation and oxidative stress may further impair neuronal function. In addition, obesity and metabolic disturbances are frequently associated with poor sleep, which may independently affect cognitive performance and emotional well-being.

Women represent an important population for studying these associations. Hormonal changes, particularly during the menopausal transition, may interact with obesity, insulin resistance, inflammation and psychological stress. Recent evidence suggests that insulin resistance and inflammatory factors may be associated with cognitive impairment in middle-aged and older women.

Neuropsychological disorders in MetS are clinically relevant because they may create a negative feedback cycle. Cognitive impairment can reduce the patient's ability to follow complex treatment recommendations, while depression and anxiety may decrease motivation for physical activity and dietary modification. Reduced adherence may subsequently worsen metabolic control.

Therefore, the management of women with MetS should not focus exclusively on glucose, lipid and blood pressure control. Identification and correction of neuropsychological disorders should also be incorporated into comprehensive care.

A multidisciplinary approach is particularly appropriate because the clinical manifestations of MetS involve several interconnected domains. Neurologists, endocrinologists, cardiologists, psychologists, nutrition specialists and rehabilitation professionals may each contribute to different components of patient care.

Aim of the study

The aim of the study is to develop a multidisciplinary approach for the early detection, comprehensive assessment, management and rehabilitation of neuropsychological disorders in women with metabolic syndrome.

Objectives

The study will address the following objectives:

1. To assess the clinical and neuropsychological characteristics of women with metabolic syndrome.
2. To identify cognitive, anxiety, depressive and stress-related disorders using standardized neuropsychological instruments.
3. To evaluate the relationship between neuropsychological disorders and metabolic abnormalities.
4. To assess the influence of neuropsychological disorders on health-related quality of life.
5. To identify major clinical and behavioral risk factors associated with neuropsychological impairment.
6. To develop a multidisciplinary algorithm for early detection, management and rehabilitation of neuropsychological disorders in women with MetS.

Materials and methods

Study design and participants

A prospective comparative clinical study is planned at the Tashkent State Medical University, Termez Branch.

More than 100 women with metabolic syndrome will be examined in outpatient and inpatient settings. A control group consisting of age-matched women without metabolic syndrome will also be included.

The final sample size should be confirmed by an appropriate statistical power calculation before recruitment.

Clinical assessment

The clinical assessment will include:

- age;
- body mass index;
- waist circumference;
- arterial blood pressure;
- duration of MetS;
- presence of diabetes or prediabetes;
- cardiovascular comorbidities;
- medication use;
- physical activity;
- sleep-related complaints;
- lifestyle factors.

A standard clinical-neurological examination will be performed.

Biochemical assessment

The following laboratory parameters will be evaluated:

- fasting glucose;
- glycated hemoglobin;
- total cholesterol;
- LDL cholesterol;
- HDL cholesterol;
- triglycerides;
- insulin;
- homocysteine;
- C-reactive protein.

Where appropriate, insulin resistance may be estimated using HOMA-IR.

Neuropsychological assessment

Cognitive function will be assessed using the **Montreal Cognitive Assessment (MoCA)** and **Addenbrooke's Cognitive Examination III (ACE-III)**.

MoCA provides a brief assessment of several cognitive domains, whereas ACE-III allows more detailed assessment of attention, memory, verbal fluency, language and visuospatial abilities.

Anxiety and depressive symptoms will be assessed using the **Hospital Anxiety and Depression Scale (HADS)**.

The **Depression Anxiety Stress Scale-21 (DASS-21)** will provide additional assessment of depression, anxiety and stress.

Health-related quality of life will be assessed using **EQ-5D**.

MULTIDISCIPLINARY MANAGEMENT MODEL

The proposed multidisciplinary model is based on the principle that neuropsychological disorders in MetS are multifactorial and require simultaneous management of metabolic, neurological, psychological and lifestyle-related factors.

The proposed team includes:

- neurologist;
- endocrinologist;
- cardiologist or internist;
- clinical psychologist/neuropsychologist;
- nutrition specialist;
- rehabilitation specialist.

Role of the neurologist

The neurologist will conduct neurological assessment, identify cognitive impairment, evaluate neurological risk factors and determine the need for additional investigations.

The neurologist will also participate in monitoring the dynamics of cognitive functioning.

Role of the endocrinologist

The endocrinologist will focus on:

- glucose regulation;
- insulin resistance;
- obesity;
- dyslipidemia;
- metabolic risk reduction.

Improved metabolic control may reduce several biological mechanisms potentially contributing to neuropsychological dysfunction.

Role of the cardiologist

Cardiovascular risk assessment is important because hypertension, dyslipidemia and vascular dysfunction may contribute to cerebral injury and cognitive impairment.

The cardiologist will therefore participate in blood pressure control, cardiovascular risk assessment and prevention of cerebrovascular complications.

Role of the psychologist

Psychological assessment is essential for identifying depression, anxiety and stress-related symptoms.

Psychological intervention may include counseling, behavioral strategies, stress management and cognitive rehabilitation when indicated.

Role of the nutrition specialist

Individualized dietary intervention should consider the patient's metabolic profile, body weight, dietary habits, cultural characteristics and ability to maintain long-term lifestyle changes.

Role of the rehabilitation specialist

Rehabilitation should focus on maintaining physical activity, improving functional capacity and supporting cognitive and psychological recovery.

Physical activity may provide benefits for metabolic control, cardiovascular health, mood and cognitive functioning.

Proposed clinical algorithm

Based on the available evidence and the objectives of the planned study, the following six-stage algorithm is proposed.

Stage 1. Identification of patients with metabolic syndrome

Women diagnosed with MetS undergo clinical and metabolic assessment.

Stage 2. Neuropsychological screening

Patients are screened for:

- memory complaints;
- concentration difficulties;
- fatigue;
- anxiety;
- depressive symptoms;
- sleep disturbances.

MoCA is used as the initial cognitive screening tool.

Stage 3. Detailed assessment

If cognitive impairment is suspected, ACE-III is performed.

HADS and DASS-21 are used to assess emotional disorders.

EQ-5D evaluates the impact of these disorders on quality of life.

Stage 4. Risk stratification

Patients are classified according to the dominant clinical phenotype:

Low-risk phenotype:

No significant cognitive or emotional impairment.

Cognitive phenotype:

Predominant cognitive difficulties.

Affective phenotype:

Predominant anxiety or depressive symptoms.

Mixed phenotype:

Cognitive and affective disorders coexist.

High-risk multidomain phenotype:

Cognitive, emotional, metabolic and quality-of-life impairments occur simultaneously.

Stage 5. Individualized multidisciplinary intervention

The intervention is selected according to the patient's phenotype and metabolic risk.

It may include:

- metabolic correction;
- dietary intervention;
- physical activity;
- psychological support;
- cognitive rehabilitation;
- sleep management;
- cardiovascular risk reduction.

Stage 6. Follow-up

Patients undergo repeated clinical, metabolic and neuropsychological assessment.

Treatment is adjusted according to changes in:

- cognitive function;
- anxiety and depression;
- metabolic parameters;
- physical activity;
- quality of life.

Expected results

Because the proposed research is prospective and has not yet been completed, numerical clinical results cannot be reported at this stage.

It is expected that the study will identify clinically significant associations between metabolic abnormalities and neuropsychological manifestations in women with MetS.

Particular attention will be paid to the relationship between:

- insulin resistance and cognitive function;
- dyslipidemia and cognitive performance;
- inflammatory activity and neuropsychological symptoms;
- obesity and quality of life;
- anxiety/depression and treatment adherence;
- sleep disturbances and cognitive functioning.

The study is also expected to demonstrate that patients with combined cognitive and affective disorders may have a greater reduction in quality of life than patients without neuropsychological impairment. The resulting clinical data will be used to validate and refine the proposed multidisciplinary algorithm.

Discussion

The relationship between MetS and cognitive dysfunction is biologically plausible and supported by a growing body of evidence. Metabolic abnormalities may affect the brain through vascular, inflammatory, endocrine and oxidative mechanisms. A systematic review of MetS and cognition reported associations across several cognitive domains, but also emphasized substantial heterogeneity between studies. This heterogeneity supports the need for individualized assessment. A patient with predominant insulin resistance may have a different neuropsychological profile from a patient whose major metabolic abnormalities are hypertension and dyslipidemia. Therefore, management should address individual risk factors rather than relying solely on the diagnosis of MetS. Psychological symptoms are also important. Anxiety and depression may worsen subjective cognitive complaints and reduce motivation to maintain healthy behaviors. If these disorders remain undiagnosed, metabolic treatment may be less effective because the patient may have difficulty adhering to lifestyle recommendations.

Sleep is another important component. Poor sleep has been associated with MetS and may contribute independently to impaired attention, memory and emotional regulation.

The multidisciplinary approach proposed in this study is therefore based on the concept that metabolic and neuropsychological disorders should be managed as interconnected clinical problems. The potential inclusion of genetic assessment, particularly analysis of LDLR-related characteristics, may provide an additional dimension for future personalized risk stratification. Experimental evidence suggests that LDLR dysfunction may be related to altered brain metabolism and cognitive impairment, although further human research is necessary before such genetic information can be routinely applied in clinical practice.

The main expected advantage of the proposed algorithm is early identification. Neuropsychological disorders can remain unnoticed when patients are evaluated only

for metabolic parameters. Incorporating a brief cognitive and psychological screening into routine MetS care may therefore facilitate earlier intervention.

Practical significance

The proposed multidisciplinary algorithm may be applied at different levels of healthcare. At the primary care level, women with MetS can be screened for cognitive and emotional symptoms. At the specialist level, patients with abnormal screening results can undergo detailed neuropsychological assessment. At the rehabilitation level, individualized programs can be developed.

The algorithm may contribute to:

- earlier detection of neuropsychological disorders;
- individualized treatment;
- improved adherence;
- better lifestyle modification;
- improved quality of life;
- prevention of functional decline.

Importantly, the algorithm does not require all patients to undergo the same intensive evaluation. A stepwise approach allows detailed investigations to be concentrated on patients with positive screening results.

Conclusion

Neuropsychological disorders should be regarded as an important component of the clinical burden of metabolic syndrome in women. Cognitive impairment, anxiety, depression, sleep disturbances and reduced quality of life may interact with metabolic abnormalities and negatively influence treatment adherence and long-term outcomes.

The proposed multidisciplinary approach integrates neurological, metabolic, psychological, nutritional and rehabilitation components. The six-stage algorithm — identification, screening, detailed assessment, risk stratification, individualized intervention and follow-up — provides a practical framework for comprehensive patient management.

The prospective study planned at Tashkent State Medical University, Termez Branch, will allow this algorithm to be evaluated using clinical, biochemical and neuropsychological data.

The implementation of an evidence-based multidisciplinary model may contribute to earlier diagnosis, improved quality of life, better adherence to treatment and prevention of long-term functional impairment in women with metabolic syndrome.

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