v. 4, n. 96, 2024

International Journal of Health Science

Acceptance date: 30/10/2024

MYOCARDIAL REVASCULARIZATION IN PATIENTS WITH METABOLIC SYNDROME

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Abstract: Introduction: Metabolic Syndrome (MS) is characterized by a set of interconnected metabolic alterations associated with an increased risk of cardiovascular disease and type 2 diabetes. These factors include hypertension, central obesity, dyslipidemia and glucose metabolism disorders, constituting a serious public health challenge. Metabolic syndrome increases the risk of cardiovascular disease and stroke 2-fold, as well as increasing the risk of all-cause mortality by 1.5-fold. **Objective:** This study aims to analyze the correlation between Metabolic Syndrome and the increased risk of cardiovascular disease. **Methodology:** The review was conducted in databases such as PubMed and Scopus, with inclusion criteria of clinical studies and systematic reviews. Data was extracted and analyzed to compare the effectiveness of different types of nerve blocks. **Results and Discussion:** Metabolic Syndrome (MS) is strongly associated with a significant increase in the risk of cardiovascular disease (CVD), stroke and mortality. People with MetS are twice as likely to develop CVD and stroke, and have a 1.5 times greater risk of death from any cause. Factors such as hypertension, central obesity, dyslipidemia and alterations in glucose metabolism are key components of this condition. Thus, MetS represents a major threat to global public health due to its complications. **Conclusion:** Metabolic Syndrome (MS) is linked to a high risk of cardiovascular disease, type 2 diabetes and surgical complications such as infections and thrombosis. Inflammatory and metabolic factors increase the chance of atherosclerosis, heart attacks and strokes. Preventive approaches and personalized therapies are essential to minimize complications and improve clinical outcomes.

Keywords: Myocardial Revascularization; Metabolic Syndrome; Coronary Artery Disease; Cardiovascular Surgical Procedures.

INTRODUCTION

Metabolic Syndrome (MS) represents a set of interconnected and complex metabolic alterations and is the subject of extensive global research due to its harmful consequences for health and its strong correlation with the development of cardiovascular diseases and type 2 diabetes. This condition encompasses a combination of factors, including hypertension, central obesity, dyslipidemia and glucose metabolism disorders, reflecting a significant public health risk (OLIVEIRA et al., 2020).

Patients with Metabolic Syndrome (MS) are at substantially increased risk, being up to four times more likely to die from coronary artery disease and up to three times more vulnerable to mortality from any cause. In addition, these individuals are significantly more likely to suffer coronary events and, when such events occur, they tend to experience a more severe clinical evolution. This includes a greater extent of tissue damage in the areas affected by acute myocardial infarction (AMI) and frequent left ventricular dysfunction, which further worsens the cardiovascular prognosis (LAKKA, 2002).

Coronary artery bypass grafting (CABG) is a surgical procedure designed to restore blood flow to the heart by reconstructing the coronary arteries. This is done using the internal thoracic artery (or mammary artery) or the radial artery. The intervention is indicated in cases of cardiovascular disease, such as Coronary Artery Disease (CAD), when drug treatment is not feasible or has proved ineffective. Risk factors for CAD include family history, poor diet, sedentary lifestyle, obesity, excessive alcohol consumption and smoking. In addition to CAD, CABG is also indicated for other conditions, such as atherosclerosis, extensive myocardial ischemia, functional and/or structural abnormalities of the coronary arteries, coronary thrombosis, coronary vasospasm and refractory anginal pain that does not respond to conventional treatment. The main aim of the surgery is to re-establish blood flow in the obstructed areas, as the reduced supply of oxygen and nutrients can damage the heart tissue. In addition, CABG helps to protect the body against more serious complications, such as acute myocardial infarction (AMI), which is characterized by necrosis of the heart tissue (DAVIERWALA *et al.*, 2020).

Metabolic syndrome is associated with a 2-fold increase in the risk of cardiovascular disease (CVD), CVD mortality and stroke, as well as a 1.5-fold increase in the risk of all-cause mortality. Thus, patients with metabolic syndrome have a higher risk of cardiovascular outcomes compared to overall mortality, although they are at high risk for both when compared to individuals without the syndrome. Metabolic syndrome also increases the risk of myocardial infarction (MI) approximately 2-fold. One reason for this association is that insulin resistance can progress to hyperinsulinemia and hyperglycemia, leading to peripheral vasoconstriction and sodium retention. In addition, hepatic production of very low density lipoproteins (VLDL) increases, resulting in hypertriglyceridemia, low levels of HDL cholesterol, high levels of apolipoprotein B, an increase in small particle LDL cholesterol and, consequently, a greater risk of atherosclerosis. As a result of these lipid imbalances, individuals with metabolic syndrome often have a pro-thrombotic and pro-inflammatory state (MOTTILLO et al., 2010).

METHODOLOGY

LITERATURE SELECTION

The bibliographic research was conducted in renowned electronic databases such as PubMed, Scopus, Web of Science, Cochrane Library and Google Scholar. These sources were chosen because of their comprehensiveness and relevance to medical and clinical studies. To ensure a comprehensive search, specific terms were used, including "Myocardial Revascularization, Metabolic Syndrome, Coronary Artery Disease, Cardiovascular Surgical Procedures" Combinations of keywords and Boolean operators helped to refine the results.

The inclusion criteria were: clinical studies, systematic reviews, meta-analyses and observational studies investigating the use of nerve blocks in the management of trigeminal neuralgia; publications in English and Portuguese; and articles published in the last 20 years. Studies of articles unavailable in full text, isolated case reports and non-peer-reviewed studies were excluded.

DATA COLLECTION

The initial selection of the titles and abstracts of the articles identified was carried out by two independent reviewers. Potentially relevant articles were assessed in full text. Discrepancies between reviewers were resolved by consensus or by a third reviewer. Data was extracted using a standardized form which included information on authors, year of publication, type of study, study population, study objectives and study results.

DATA ANALYSIS

The extracted data was presented in tables to facilitate comparison between the studies. The quality of the included studies was assessed using appropriate tools, such as the Cochrane risk of bias tool for clinical trials and the STROBE checklist for observational studies. High-quality studies were prioritized in the synthesis of results. In addition, areas with a lack of evidence or conflicting results were identified, suggesting directions for future research.

RESULTS AND DISCUSSION

INTRODUCTION TO METABOLIC SYNDROME AND CARDIOVASCULAR DISEASE

According to the criteria established by the International Diabetes Foundation, metabolic syndrome (MS) is diagnosed when the patient has abdominal obesity, defined by waist circumference measurement (equal to or greater than 84 cm for women and equal to or greater than 88 cm for men), together with the presence of at least two of the following factors: Hypertension: systolic blood pressure equal to or greater than 120 mmHg and/or diastolic blood pressure equal to or greater than 85 mmHg; Hyperglycemia: fasting blood glucose levels equal to or greater than 100 mg/dl; Hypertriglyceridemia: blood triglyceride levels equal to or greater than 150 mg/dl; Hypoalphalipoproteinemia: low HDL-cholesterol levels, being less than 40 mg/dl for women and less than 50 mg/dl for men (MANNUCCI et al., 2007).

From this perspective, it is essential to highlight the strong correlation between metabolic syndrome (MS) and the development of cardiovascular diseases (CVDs). The largest meta-analysis ever carried out on the subject, involving almost one million patients, revealed that MetS is associated with a twofold

increased risk of developing cardiovascular diseases, myocardial infarction and stroke, as well as a similar increase in the risk of mortality from CVDs. In addition, MetS patients had a 1.5 times greater risk of all-cause mortality. These data reinforce the importance of recognizing and treating MetS-related risk factors early, with the aim of preventing serious cardiovascular outcomes and reducing overall mortality (CATHARINA et al., 2018).

PATHOPHYSIOLOGY OF METABOLIC SYNDROME AND ITS CARDIOVASCULAR IMPACT

Metabolic syndrome has been widely recognized as a pro-thrombotic state, characterized by the elevation of various inflammatory and thrombogenic markers, such as increased levels of C-reactive protein, interleukin-6 (IL-6) and plasminogen activator inhibitor (PAI-1). These markers are closely related to an increased risk of developing cardiovascular disease and type 2 diabetes, reinforcing the role of chronic inflammation and metabolic dysfunction in worsening these conditions. However, although adipokines and other inflammatory mediators contribute to increased cardiovascular risk, they explain only a modest portion of the association between metabolic syndrome and cardiovascular disease mortality. This suggests that MS involves a complex interaction of factors that amplify cardiovascular risk and progression to more serious outcomes, making multifactorial management of this condition essential (GUEMBE et al., 2020).

Insulin resistance plays a crucial role in endothelial dysfunction, which is considered an important precursor to cardiovascular events. This resistance decreases the bioavailability of nitric oxide (NO), a key molecule for vasodilation, leading to vasoconstriction and increased oxidative stress. In turn, dyslipidemia, characterized by an increase in triglyceride levels and a decrease in HDL, results in the oxidation of LDL, which accumulates in the vascular endothelium. The interaction between these oxidized lipoproteins and endothelial cells triggers a local inflammatory response, aggravating endothelial dysfunction and accelerating the progression of atherosclerosis (GRUNDY, 2005).

Patients with metabolic syndrome are at high risk of accelerated atherosclerosis, the result of the interaction between dyslipidemia, chronic inflammation, hypertension and insulin resistance. The oxidation of LDL and the migration of monocytes to the subendothelium lead to the formation of foam cells, which are essential for the development of atherosclerotic plaques. In addition, hypertension intensifies endothelial damage, facilitating the infiltration of inflammatory cells and the deposition of collagen. Increased levels of inflammatory cytokines, such as TNF-α and IL-6, also aggravate the pro-inflammatory state, contributing to atherosclerotic plaque rupture and subsequent thrombotic events (HANSSON, 2005).

Metabolic syndrome is related to a chronic state of pro-inflammation, mediated by adipokines originating in adipose tissue, such as leptin and resistin, and by a decrease in adiponectin, a substance with anti-inflammatory properties. These elements increase the production of inflammatory cytokines such as IL-6 and TNF-α, which favor insulin resistance and endothelial dysfunction. In addition, there is an increase in the expression of endothelial adhesion molecules, which facilitate the adhesion of monocytes and lymphocytes to the endothelium. The pro-thrombotic state is, in turn, aggravated by high levels of plasminogen activator inhibitor-1 (PAI-1) and fibrinogen, which increase the propensity for clot formation, increasing the risk of thrombotic events, such as acute myocardial infarction (ROSSI et al., 2021).

INDICATIONS FOR MYOCARDIAL REVASCULARIZATION IN PATIENTS WITH METABOLIC SYNDROME

Myocardial revascularization in patients with metabolic syndrome (MS) is recommended in cases of significant impairment of the coronary circulation, especially in patients with extensive, multivessel coronary artery disease (CAD), or when drug therapy alone is not effective in controlling symptoms. Individuals with MS have an increased risk of accelerated progression of atherosclerosis, a higher incidence of cardiovascular complications and mortality, justifying an earlier surgical approach. In addition, the presence of insulin resistance, dyslipidemia and chronic inflammation increases susceptibility to ischemic events, such as acute myocardial infarction, making revascularization a relevant therapeutic strategy (VIRANI et al., 2023).

Myocardial revascularization, whether by percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery (CABG), is indicated mainly in patients with stable coronary artery disease (CAD) who have symptoms of angina refractory to clinical treatment, ischemia documented in stress tests or evidence of ventricular dysfunction. Specific indications include lesions in the left main coronary artery, three-vessel disease with left ventricular dysfunction (ejection fraction <50%) and critical stenoses causing significant ischemia. In patients with metabolic syndrome, CABG is often preferred due to the complexity of coronary lesions and the higher risk of adverse events, such as restenosis and progression of atherosclerosis (MATES et al., 2019).

Patients with metabolic syndrome and multivessel coronary artery disease (CAD), especially with involvement of the left main coronary artery or three-vessel disease, are often considered for coronary artery bypass grafting (CABG). Additional criteria include left ventricular dysfunction (ejection fraction <50%) and angina refractory to clinical treatment or percutaneous coronary intervention (PCI). The choice of CABG also takes into account factors such as inadequate blood glucose control, hypertension and severe dyslipidemia, which increase the risk of cardiovascular complications. In these cases, CABG is preferred, as patients with metabolic syndrome undergoing PCI have a higher risk of thrombotic complications and restenosis (BODEN et al., 2007).

SURGICAL CHALLENGES AND SPECIFIC CONSIDERATIONS

Metabolic syndrome (MS), characterized by a set of risk factors such as abdominal obesity, hypertension and changes in glucose and lipid levels, represents a considerable challenge for surgical interventions. The chronic inflammation present in MS impairs tissue healing capacity, while endothelial dysfunction and insulin resistance increase susceptibility to thromboembolic and infectious complications. In addition, the exacerbated inflammatory response and insulin resistance prolong post-operative recovery time. The scientific literature shows that the presence of MS is associated with a significantly higher risk of cardiovascular events, including mortality. Given this scenario, it is essential that health professionals adopt specific pre- and post-operative management strategies for these patients, in order to minimize risks and optimize surgical results (JANSSON, 2007).

Patients with metabolic syndrome (MS) are more susceptible to complications during and after surgery. Central obesity, chronic inflammation and endothelial dysfunction, characteristic of MetS, compromise pulmonary and cardiac function, making anesthetic management more difficult and increasing the risk of respiratory and cardiovascular compli-

cations. Hypertension and dyslipidemia contribute to poor healing, increasing the risk of wound dehiscence. In addition, insulin resistance and coagulation disorders associated with MS increase the risk of thromboembolic events. Although gastric bypass has been shown to be effective in treating obesity and controlling diabetes in MetS patients, the presence of advanced comorbidities can make the procedure more difficult and increase the risk of vascular and thrombotic complications (POTENZA et al., 2008).

Patients with metabolic syndrome (MS) are at high risk of postoperative complications. Immune dysfunction associated with insulin resistance and chronic inflammation makes these patients more susceptible to infections. In addition, MS promotes a procoagulant state, increasing the chance of thromboembolic events such as deep vein thrombosis (DVT) and pulmonary embolism. Hypertension and dyslipidemia, often present in MetS, increase the risk of cardiovascular events, such as myocardial infarction, especially in patients undergoing surgical procedures. Studies show that bariatric surgery, by promoting weight loss and improving metabolic control, can significantly reduce these risks, improving the postoperative prognosis of these patients (HIREMATH et al., 2016).

CONCLUSION

Metabolic syndrome (MS) is emerging as one of the greatest challenges for contemporary public health and clinical practice, given its close link to cardiovascular disease, type 2 diabetes and other chronic complications. The complex interaction of metabolic, inflammatory and hormonal factors in MS culminates in a pro-inflammatory and pro-thrombotic state, substantially increasing the risk of cardiovascular events and overall mortality. Solid evidence corroborates that individuals with MS are significantly more prone to the accelerated development of atherosclerosis, acute myocardial infarction and stroke, reinforcing the urgency of early and effective interventions.

In the surgical context, the presence of MS intensifies the complexity of procedures, increasing the risk of complications such as infections, thrombosis and healing failures. The chronic inflammation and endothelial dysfunction inherent in MS prolong recovery time and increase mortality, especially in patients with multivessel coronary artery disease.

Given this scenario, the implementation of multifactorial preventive and therapeutic approaches becomes imperative in order to control the metabolic and inflammatory risk factors characteristic of MetS. The combination of early treatment, personalized surgical strategies and rigorous post-operative follow-up can significantly reduce the complications associated with metabolic syndrome, optimizing clinical outcomes and patients' quality of life.

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