DOBUTAMINE IN THE MANAGEMENT OF DECOMPENSATED HEART FAILURE: EVIDENCE AND CLINICAL IMPLICATIONS FROM A LITERATURE REVIEW

DOBUTAMINA NO MANEJO DA INSUFICIÊNCIA CARDÍACA DESCOMPENSADA: EVIDÊNCIAS E IMPLICAÇÕES CLÍNICAS A PARTIR DE UMA REVISÃO DA LITERATURA

DOBUTAMINA EN EL MANEJO DE LA INSUFICIENCIA CARDÍACA DESCOMPENSADA: EVIDENCIAS E IMPLICACIONES CLÍNICAS A PARTIR DE UNA REVISIÓN DE LA LITERATURA

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ABSTRACT

Decompensated heart failure represents a clinical condition with high morbidity and mortality, often associated with reduced cardiac output and tissue hypoperfusion, requiring rapid therapeutic interventions to achieve hemodynamic stabilization. In this context, the use of inotropic agents such as dobutamine plays an important role in the management of patients with cardiovascular instability. This study aims to analyze, through a literature review, the main hemodynamic effects of dobutamine in the treatment of decompensated heart failure, as well as to discuss its clinical indications, therapeutic benefits, and potential limitations. To this end, a bibliographic review was conducted using the PubMed, SciELO, and LILACS databases, considering publications between 2013 and 2024, resulting in the final selection of 13 studies addressing the use of dobutamine in the management of heart failure. The findings indicate that dobutamine significantly improves myocardial contractility and increases cardiac output, contributing to hemodynamic stabilization in patients with acute heart failure. However, the literature also highlights potential limitations associated with prolonged use, including the risk of arrhythmias and increased myocardial oxygen consumption. It can be concluded that dobutamine remains an important therapeutic option in the management of decompensated heart failure, particularly in situations requiring rapid hemodynamic intervention, and its use should be carefully monitored and clinically indicated.

Keywords: Heart Failure. Dobutamine. Inotropic Agents. Hemodynamics. Decompensated Heart Failure.

RESUMO

A insuficiência cardíaca descompensada representa uma condição clínica de elevada morbimortalidade, frequentemente associada à redução do débito cardíaco e à hipoperfusão

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tecidual, exigindo intervenções terapêuticas rápidas para estabilização hemodinâmica. Nesse contexto, a utilização de agentes inotrópicos, como a dobutamina, tem papel relevante no manejo de pacientes em estado de instabilidade cardiovascular. Objetiva-se analisar, por meio de uma revisão da literatura científica, os principais efeitos hemodinâmicos da dobutamina no tratamento da insuficiência cardíaca descompensada, bem como discutir suas indicações clínicas, benefícios terapêuticos e limitações. Para tanto, procede-se à realização de uma revisão bibliográfica nas bases de dados PubMed, SciELO e LILACS, considerando publicações entre os anos de 2013 e 2024, com a seleção final de 13 estudos que abordam o uso da dobutamina no manejo da insuficiência cardíaca. Desse modo, observa-se que a dobutamina apresenta efeitos significativos na melhora da contratilidade miocárdica e no aumento do débito cardíaco, contribuindo para a estabilização hemodinâmica em pacientes com insuficiência cardíaca aguda. Entretanto, a literatura também aponta possíveis limitações relacionadas ao uso prolongado do fármaco, incluindo risco de arritmias e aumento do consumo de oxigênio pelo miocárdio. Conclui-se que a dobutamina permanece como importante opção terapêutica no manejo da insuficiência cardíaca descompensada, sobretudo em cenários que exigem rápida intervenção hemodinâmica, devendo seu uso ser realizado de forma criteriosa e com monitorização clínica adequada.

Palavras-chave: Insuficiência Cardíaca. Dobutamina. Inotrópicos. Hemodinâmica. Insuficiência Cardíaca Descompensada.

RESUMEN

La insuficiencia cardíaca descompensada representa una condición clínica de elevada morbimortalidad, frecuentemente asociada a la reducción del gasto cardíaco y a la hipoperfusión tisular, lo que exige intervenciones terapéuticas rápidas para lograr la estabilización hemodinámica. En este contexto, el uso de agentes inotrópicos, como la dobutamina, desempeña un papel importante en el manejo de pacientes con inestabilidad cardiovascular. El presente estudio tiene como objetivo analizar, a través de una revisión de la literatura científica, los principales efectos hemodinámicos de la dobutamina en el tratamiento de la insuficiencia cardíaca descompensada, así como discutir sus indicaciones clínicas, beneficios terapéuticos y posibles limitaciones. Para ello, se realizó una revisión bibliográfica en las bases de datos PubMed, SciELO y LILACS, considerando publicaciones entre los años 2013 y 2024, con la selección final de 13 estudios que abordan el uso de la dobutamina en el manejo de la insuficiencia cardíaca. Los resultados indican que la dobutamina presenta efectos significativos en la mejora de la contractilidad miocárdica y en el aumento del gasto cardíaco, contribuyendo a la estabilización hemodinámica en pacientes con insuficiencia cardíaca aguda. Sin embargo, la literatura también señala posibles limitaciones asociadas al uso prolongado del fármaco, incluyendo el riesgo de arritmias y el aumento del consumo de oxígeno por el miocardio. Se concluye que la dobutamina continúa siendo una opción terapéutica importante en el manejo de la insuficiencia cardíaca descompensada, especialmente en escenarios que requieren una rápida intervención hemodinámica, debiendo su uso realizarse de forma cuidadosa y con adecuada monitorización clínica.

Palabras clave: Insuficiencia Cardíaca. Dobutamina. Agentes Inotrópicos. Hemodinámica. Insuficiencia Cardíaca Descompensada.

1 INTRODUCTION

Heart failure represents one of the leading causes of morbidity and mortality worldwide, making it an important public health problem (McDonagh et al., 2021; Marcondes-Braga et al., 2021). Characterized by the inability of the heart to maintain an adequate cardiac output to meet the body's metabolic demands, this condition is often associated with a high rate of hospitalizations, worsening quality of life, and increased mortality, especially in patients who progress to acute decompensation (Bistola et al., 2019).

In episodes of decompensated heart failure, many patients present clinical signs of low cardiac output and tissue hypoperfusion, a situation that requires rapid therapeutic interventions with the aim of reestablishing hemodynamic stability. In this context, inotropic agents play an important role in clinical management, since they act by increasing myocardial contractility and, consequently, cardiac output, contributing to the improvement of systemic perfusion and cardiovascular function (Tariq; Aronow, 2015).

Among the drugs available for this type of intervention, dobutamine stands out as one of the most widely used inotropes in clinical practice, especially in hospital environments and intensive care units. Its mechanism of action is predominantly based on the stimulation of myocardial β1-adrenergic receptors, promoting an increase in ventricular contraction force and improvement in cardiac performance (Passos et al., 2012). However, despite its beneficial hemodynamic effects, the use of dobutamine may also be associated with adverse effects, such as increased heart rate, increased myocardial oxygen consumption, and a higher risk of arrhythmias, especially when used for prolonged periods (Bonatto, 2022).

In view of this scenario, it is observed that, although dobutamine is widely used in the management of decompensated heart failure, there are still discussions in the literature about its real clinical benefits, its therapeutic limitations, and the potential risks associated with its use. Thus, there is a need to gather and critically analyze the available evidence on the use of this inotropic agent, seeking to understand its role in the treatment of acute heart failure more broadly.

In this sense, the present study aims to analyze, through a review of the scientific literature, the main hemodynamic effects of dobutamine in the management of decompensated heart failure, as well as to discuss its clinical indications, therapeutic benefits, and possible limitations described in the available studies.

2 THEORETICAL FRAMEWORK

According to McDonagh et al. (2021), heart failure is a clinical syndrome characterized by the appearance of cardinal signs and symptoms, such as dyspnea, asthenia, and edema,

resulting from structural and/or functional changes in the heart. These changes can result in increased intracardiac pressures and/or reduced cardiac output, compromising the heart's ability to adequately meet the body's metabolic demands. In addition, according to Cabral and Campos (2023, v.6, p. 13145-13146), several classifications have been created for this syndrome, including the classification by hemodynamic profiles, based on the evaluation of volume and peripheral perfusion, with patients being categorized as: A – hot and dry; B – hot and humid; C – cold and humid; and D – cold and dry.

In addition to this classification based on hemodynamic profiles, patients with heart failure can also be categorized according to left ventricular ejection fraction values. Thus, Marcondes-Braga et al. (2021) distribute patients into three categories: heart failure with reduced ejection fraction (LVEF ≤ 40%), preserved (LVEF ≥ 50%), or slightly reduced (LVEF between 41% and 49%). The determination of ejection fraction can be performed by different imaging methods, such as transthoracic echocardiography, cardiac magnetic resonance imaging, and cardiac catheterization ventriculography (McDonagh et al., 2021).

Another relevant factor to be pointed out concerns the pathophysiology of heart failure, which results from the combination of hemodynamic changes with compensatory mechanisms triggered by the reduction of cardiac output (Cabral; Campos, 2021). Among these adaptations, the activation of the sympathetic nervous system and the renin-angiotensin-aldosterone system stand out, which initially contribute to the maintenance of tissue perfusion, however, when maintained chronically, favor cardiac remodeling and disease progression (Marcondes-Braga et al., 2021).

In the context of the evolution of the disease, decompensated heart failure is defined as the acute or subacute deterioration of the signs and symptoms of heart failure, which may occur in previously diagnosed patients or represent the first clinical manifestation of the disease (SOCESP, 2021). In this context, there is an exacerbation of pulmonary congestion, which can progress to systemic congestion, associated with the inability of the cardiovascular system to adequately meet the metabolic demands of the body due to insufficient cardiac output. As a consequence, the patient often needs urgent medical attention, and may present clinical manifestations such as severe dyspnea, orthopnea, edema, nocturnal cough, and asthenia (Brazilian Guideline on Heart Failure, 2021).

Heart failure decompensation is associated with the presence of precipitating factors that contribute to the acute worsening of the clinical picture. In this sense, McDonagh et al. (2021) indicate infections, acute coronary syndrome, arrhythmias, low adherence to drug treatment, and blood pressure peaks as the main factors that lead to the worsening of heart failure. Thus, the identification of the triggering factor is essential for the proper management

of patients with acute heart failure, since the correction of the precipitating cause can contribute to the stabilization of the patient (Marcondes-Braga et al., 2021).

In view of this clinical scenario, hemodynamic evaluation plays a fundamental role in the stratification and management of these patients, considering that the condition can progressively evolve with signs of peripheral hypoperfusion, such as reduced urine output, hypotension, and cold or cyanotic extremities (Segalla; Bacal, 2022). In this context, hemodynamic evaluation allows patients to be classified into four clinical profiles: A – hot and dry; B – hot and humid; C – cold and humid; and D – cold and dry. In this classification, the terms "hot" and "cold" refer to adequate or reduced blood perfusion, while "dry" and "wet" indicate the absence or presence of congestion, respectively (SOCESP, 2021).

When considering the treatment of decompensated heart failure, supportive measures are critical in clinical management. Oxygen therapy may be indicated in cases of hypoxemia, while noninvasive ventilatory support may improve dyspnea and reduce respiratory distress in patients with pulmonary congestion (Amado et al., 2016). Thus, the initial management of decompensated heart failure is based on the identification of the hemodynamic profile and the immediate implementation of targeted pharmacological therapies, in association with clinical support measures, in order to promote the stabilization of the clinical condition and reduce the risk of complications (Einstein, 2021).

Thus, the definition of the hemodynamic profile directly guides the choice of the therapeutic strategy, allowing for rapid management that meets the specific needs of each patient (Einstein, 2021). Initially, when managing individuals who show signs of congestion, especially those classified as "hot and humid", diuretics are the main pillar of the initial treatment, since they relieve symptoms related to pulmonary and systemic congestion by promoting the reduction of volume overload of the cardiovascular system (ESC, 2021). In addition, in patients with adequate blood pressure, intravenous vasodilators can be associated with the aim of reducing preload and afterload, contributing to an increase in cardiac output (ESC, 2021; Einstein, 2021).

On the other hand, in patients who present signs of peripheral hypoperfusion, i.e., those called "cold", there may be a need to use inotropic agents to optimize cardiac muscle contractility and restore tissue perfusion (Amado et al., 2016). Among this group of drugs, dobutamine and milrinone stand out, which act by promoting an increase in cardiac output. However, its use should be reserved for specific situations, due to the increased oxygen consumption by the myocardium and the risk of developing cardiac arrhythmias (ESC, 2021).

In this therapeutic context, inotropic drugs play an important role in the management of patients who present signs of low cardiac output and tissue hypoperfusion. Among these

drugs, dobutamine stands out, one of the main agents used in the treatment of acute heart failure. Its mechanism of action is predominantly based on the stimulation of myocardial β1-adrenergic receptors, promoting increased cardiac contractility and, consequently, increased cardiac output (Passos et al., 2013). Thus, the drug can contribute to the hemodynamic stabilization of patients with decompensated heart failure, improving tissue perfusion and clinical parameters related to hypoperfusion (Guerra et al., 2024). However, its use should be carefully indicated and monitored, since increased adrenergic stimulation may be associated with adverse effects, such as cardiac arrhythmias and greater myocardial oxygen consumption (Bonatto, 2022). In this context, dobutamine is usually indicated mainly in patients with acute heart failure associated with low cardiac output or cardiogenic shock, and is widely used in hospital environments such as wards and cardiac emergency units (Cabral; Campos, 2023).

Thus, considering the role of inotropic agents in the management of decompensated heart failure, dobutamine stands out as one of the main therapeutic options used in clinical practice for hemodynamic stabilization of patients with low cardiac output. In this context, it is relevant to understand its impact on the clinical evolution of these patients, especially in the hospital setting.

3 METHODOLOGY

The present study is characterized as a literature review, with a descriptive approach, carried out with the objective of gathering and analyzing scientific evidence about the use of dobutamine in the management of decompensated heart failure.

The search for studies was carried out in the PubMed, SciELO and LILACS databases, using controlled descriptors from the DeCS (Health Sciences Descriptors) and MeSH (Medical Subject Headings) vocabularies, such as "Heart Failure", "Dobutamine", "Inotropic Agents" and "Cardiac Output". Articles published in Portuguese and English, available in full, from 2013 to 2024 were considered.

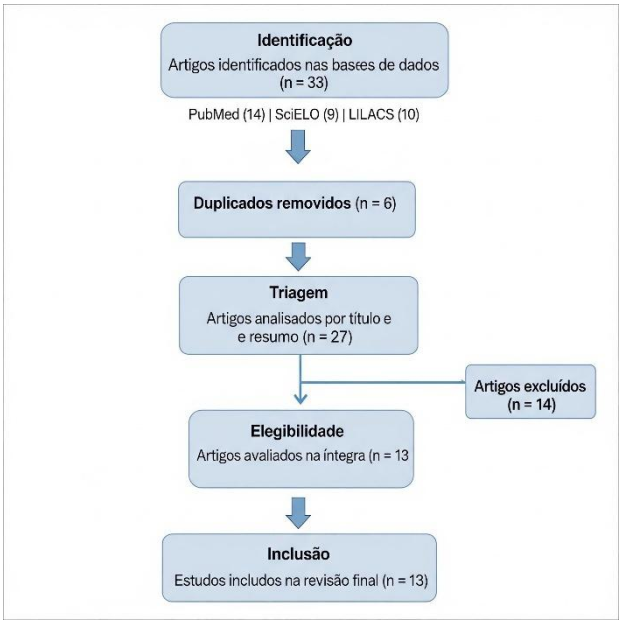
As inclusion criteria, studies that addressed the use of dobutamine or inotropic agents in the context of acute or decompensated heart failure were selected. Duplicate articles, publications that did not have a direct relationship with the proposed theme, and studies that were not available in full were excluded.

Initially, 33 articles were identified in the consulted databases, 14 from PubMed, 9 from SciELO and 10 from LILACS. After removing duplicate studies and analyzing the titles and abstracts, 13 articles were selected for full reading, which made up the final sample of this review.

The study selection process followed the steps recommended by the PRISMA (Preferred Reporting Item for Systematic Reviews and Meta-Analyses) model, including the identification, screening, eligibility and inclusion phases of the analyzed articles.

Figure 1

Flowchart for the selection of studies according to the PRISMA model



Source: Prepared by the authors.

Table 1

Summary of studies included in the review

Author/Year	Type of study	Objective	Contributions
Rangel, 2017	Review	To assess the role of inotropes in acute heart failure	It demonstrates that agents such as dobutamine increase cardiac output, but should be used with caution due to adverse effects.
Amado et al., 2016	Review	To analyze the use of inotropes and vasopressors in cardiogenic shock	It shows that dobutamine is widely used to improve perfusion in patients with low output.
Segalla; Bacal, 2022	Clinical Guide	Provide recommendations for the management of decompensated HF	Highlights the importance of hemodynamic assessment to guide therapy
Bistola et al., 2019	Review	Discuss the practical use of inotropes in acute heart failure	It emphasizes that dobutamine is indicated in patients with low output and hypoperfusion

Guerra et al., 2024	Clinical study	Assessing the impact of Dobutamine in Hemodynamic Stabilization	Notes improvement in debt cardiac and tissue perfusion
Tariq; Aronow, 2015	Review	Evaluates inotropic agents in systolic HF	Highlights hemodynamic benefits and arrhythmia risks
McDonagh et al., 2021	Guideline	Update recommendations for HF diagnosis and treatment	Recommends inotropes in patients with low output
Passos et al., 2012	Review	Discuss evidence on beta-blockers and dobutamine	Demonstrates hemodynamic benefit of dobutamine in acute HF
Cabral; Campos, 2023	Observational study	Evaluate indications for dobutamine in a public hospital	Shows wide use in emergency scenarios
Rossi Neto et al., 2020	Review	Review clinical aspects of acute HF	Discusses therapeutic strategies including inotropes
Pansani et al., 2023	Review	Analyze inotropic therapy in advanced HF	Shows usefulness in refractory patients
Bonatto, 2022	Review	Compare Dobutamine and Milrinone	Discusses clinical criteria for therapeutic choice
Marcondes-Braga et al., 2021	Guideline	Update Brazilian CI recommendations	Reinforces judicious use of inotropes

Source: Prepared by the authors.

4 RESULTS AND DISCUSSIONS

4.1 RESULTS

After the selection and analysis of the studies included in the review, different evidence was identified regarding the hemodynamic and clinical effects of dobutamine in the management of decompensated heart failure. In view of this scenario, the analysis of the 13 selected studies allows us to observe that dobutamine remains one of the main inotropic agents used in the management of this condition, especially in patients who present signs of tissue hypoperfusion (Passos et al., 2012). In general, the studies analyzed indicate that the administration of this drug is associated with the improvement of hemodynamic parameters, mainly due to its positive inotropic effect, which promotes increased contractility of the heart muscle and, consequently, increased cardiac output (Tariq; Aronow, 2015).

In addition to the increase in cardiac output, Bistola et al. (2019) highlight that dobutamine can contribute to the improvement of systemic perfusion and the reduction of

cardiac filling pressures, favoring hemodynamic stabilization in patients with acute heart failure. This effect is related to the predominant activation of myocardial β1-adrenergic receptors, a mechanism that results in increased ventricular contraction force and improved cardiac performance (Amado et al., 2016).

Another aspect evidenced in the literature refers to the action of dobutamine on systemic vascular resistance. Some authors describe that, in addition to its inotropic effects, the drug can exert a discrete peripheral vasodilator action, contributing to the reduction of afterload and favoring the work of the left ventricle. This mechanism can increase cardiac output without causing a significant reduction in blood pressure in most patients (Rossi Neto et al., 2020; Segalla; Bacal, 2022).

The analyzed studies also indicate that dobutamine has a moderate positive chronotropic effect, that is, it promotes an increase in heart rate. Although this effect may contribute to elevated cardiac output, it may also increase the risk of arrhythmias in patients with myocardial electrical instability, which requires close clinical monitoring during its administration (Bonatto, 2022).

Another factor to be considered refers to the comparison of dobutamine with other inotropic agents used in the management of heart failure, such as milrinone. In this sense, studies indicate that dobutamine has some characteristics that influence its therapeutic choice, among which the rapid onset of action and extensive clinical experience with its use in a hospital environment stand out, factors that contribute to its frequent use in acute heart failure scenarios (Cabral; Campos, 2023).

However, despite the observed benefits, studies emphasize that the use of dobutamine should be carried out with caution, especially when considered for prolonged periods. Marcondes-Braga et al. (2021) report that prolonged exposure to the drug may be associated with the development of pharmacological tolerance and an increased risk of adverse effects, such as higher myocardial oxygen consumption and greater predisposition to cardiac arrhythmias.

In general, the findings in the literature indicate that dobutamine plays an important role in the hemodynamic stabilization of patients with decompensated heart failure. However, its use should be directed to specific clinical scenarios and carried out under appropriate monitoring, with continuous evaluation of the therapeutic response.

4.2 DISCUSSIONS

The analysis of the studies included in this review demonstrates that dobutamine remains one of the main inotropic agents used in the management of decompensated heart

failure, especially in patients who have low cardiac output and signs of tissue hypoperfusion (Marcondes-Braga et al., 2021). This finding is in line with recent guidelines and literature reviews, which point to the drug as an important therapeutic option in scenarios of hemodynamic deterioration, particularly when conventional therapies are not sufficient to reestablish adequate systemic perfusion (McDonagh et al., 2021).

From the pathophysiological point of view, the beneficial effects of dobutamine are directly related to its predominant agonist action on myocardial β1-adrenergic receptors. The stimulation of these receptors promotes an increase in ventricular contractility and an improvement in cardiac performance, resulting in an increase in cardiac output and consequent improvement in tissue perfusion (Tariq; Aronow, 2015). These effects are relevant in patients with acute heart failure when associated with reduced ventricular systolic function, a condition in which impaired ejection capacity contributes to the development of peripheral hypoperfusion (Bistola et al., 2019).

In addition to its effects on cardiac contractility, some studies also highlight the ability of dobutamine to promote discrete peripheral vasodilation, contributing to the reduction of systemic vascular resistance and ventricular afterload (Rossi Neto et al., 2020). This characteristic can favor the performance of the left ventricle and potentiate the increase in cardiac output, without causing significant drops in blood pressure in most patients (Segalla; Bacal, 2022). Thus, the drug can play a relevant role in the initial hemodynamic stabilization of patients with acute heart failure.

However, despite the hemodynamic benefits, studies emphasize that the use of dobutamine should be carried out with caution. The adrenergic stimulation promoted by the drug can result in an increase in heart rate and, consequently, greater oxygen demand by the myocardium, factors that can predispose to the development of arrhythmias and other cardiovascular complications, especially in patients who are already at risk of developing arrhythmias and/or other cardiovascular complications. In view of this, continuous clinical monitoring during drug administration becomes essential to ensure greater therapeutic safety (Bonatto, 2022; Pansani et al., 2023).

Another relevant aspect discussed in the literature refers to the comparison between dobutamine and other inotropic agents used in the management of heart failure, such as milrinone and levosimendane. In general, dobutamine has some clinical advantages that justify its wide use, including the rapid onset of action and the great experience accumulated in hospital environments. These factors contribute to the fact that the drug is often chosen in acute situations that require rapid hemodynamic stabilization (Bistola et al., 2019; Cabral; Campos, 2023). On the other hand, some authors highlight that drugs such as milrinone

have a more pronounced vasodilator effect, a characteristic that can be unfavorable in patients who have hypotension or significant hemodynamic instability (Bonatto, 2022; Pansani et al., 2023).

Another widely discussed point refers to the potential risks associated with long-term use of dobutamine. Although the drug is effective in short-term hemodynamic stabilization, the literature suggests that its continued use may be associated with the development of pharmacological tolerance and an increased incidence of cardiovascular adverse events. Among these events, the increase in myocardial oxygen consumption, the worsening of cardiac arrhythmias, and possible negative repercussions on long-term prognosis stand out (Marcondes-Braga et al., 2021; Bonatto, 2022).

In this context, different guidelines and literature reviews emphasize that inotropic agents should be used judiciously, preferably in patients who have clear signs of hypoperfusion associated with low cardiac output, and always with close clinical monitoring (McDonagh et al., 2021; Segalla; Bacal, 2022). Thus, the indication of dobutamine should consider not only the hemodynamic profile of the patient, but also the presence of comorbidities, the risk of complications, and the clinical response to the treatment instituted.

Despite the available evidence on the hemodynamic effects of dobutamine, there are still important gaps in the literature related to the impact of this drug on long-term clinical outcomes. Most studies focus on the immediate effects on hemodynamic parameters, with fewer studies robustly evaluating their influence on mortality, length of hospital stay, and quality of life of patients with decompensated heart failure (Bistola et al., 2019; Marcondes-Braga et al., 2021). In this sense, new clinical studies are needed to broaden the understanding of the role of dobutamine in the management of this condition and to guide increasingly safe and effective therapeutic strategies.

5 CONCLUSION

The analysis of the scientific literature carried out in this study allowed us to understand the role of dobutamine in the management of decompensated heart failure, evidencing its relevance as an inotropic agent in the context of patients with low cardiac output and signs of tissue hypoperfusion. The reviewed studies demonstrate that dobutamine contributes significantly to the improvement of hemodynamic parameters, mainly through the increase in myocardial contractility and the consequent increase in cardiac output, favoring clinical stabilization in acute situations.

However, although its benefits are well established in short-term management, the literature also points to limitations related to long-term use of the drug, including the risk of

arrhythmias, increased myocardial oxygen consumption, and development of pharmacological tolerance. These findings reinforce the need for the use of dobutamine to be carried out judiciously, with adequate monitoring and individualized evaluation of the clinical conditions of each patient.

Thus, it is concluded that dobutamine remains an important therapeutic option in the treatment of decompensated heart failure, especially in scenarios that require rapid hemodynamic stabilization. However, its indication should consider the potential risks associated with the treatment, as well as the specific clinical characteristics of each patient. In addition, the importance of conducting new studies that expand the understanding of the effects of this drug on long-term clinical outcomes is highlighted, contributing to the improvement of therapeutic strategies in the management of heart failure.

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