ICHS

NUR6091 FNP Integrations Capstone

Nitric Oxide and its Effects on Vasculature and Blood Pressure: A Narrative Review

Alexander D. Jimenez DC, RN, FNP-S, IFMCP, CIFM, ATN
Adele Hill, PhD, FNP

Introduction

The regulation of blood pressure and maintenance of vascular health are critical components of cardiovascular function, with nitric oxide (NO) playing a pivotal role. NO is a key signaling molecule involved in endothelial function and hemodynamics. (Abolfazli *et al*. 2024, Smith *et al*. 2020) Early research, particularly the pioneering work of Dr. Marc C. Houston in the 1990s, highlighted the necessity of understanding NO's role, along with cofactors, lifestyle changes, and nutritional adaptations, in preventing inflammation and NO deficiencies.(Houston *et al*. 1998, Houston *et al*. 1999, Dmytriv *et al*. 2024) Since then, numerous studies have advanced this field, especially in recent years.(Gonzalez *et al*. 2023) This research consists of a narrative review of the scientific and medical literature, aimed at presenting the latest findings on NO's effects on endothelial function and blood pressure regulation. By sourcing from PubMed, using keywords such as "Nitric Oxide," "endothelial dysfunction," "blood pressure," "vascular integrity," and "hypertension," this review seeks to enhance the current understanding of NO's role in maintaining vascular integrity and managing hypertension.

Research Objective

The objective of this research is to present and analyze the latest studies and information on the effects of NO on endothelial function and hemodynamics, with a particular focus on blood pressure regulation. Building upon the foundational work of Dr. Marc C. Houston from the 1990s (Houston et al. 1998, Houston et al. 1999, Dmytriv *et al*. 2024), this research aims to integrate updated findings from studies conducted post-2018. The goal is to enhance the current understanding of how NO, along with cofactors, lifestyle changes, and nutritional adaptations, plays a significant role in preventing damage caused by inflammation and NO deficiencies. This review will explore the impact of NO specifically on vascular integrity and thus on hypertension. In doing so, this review will address a singular factor in the multifactorial nature of hypertension, while also exploring the role of NO in other health issues.

Methodology

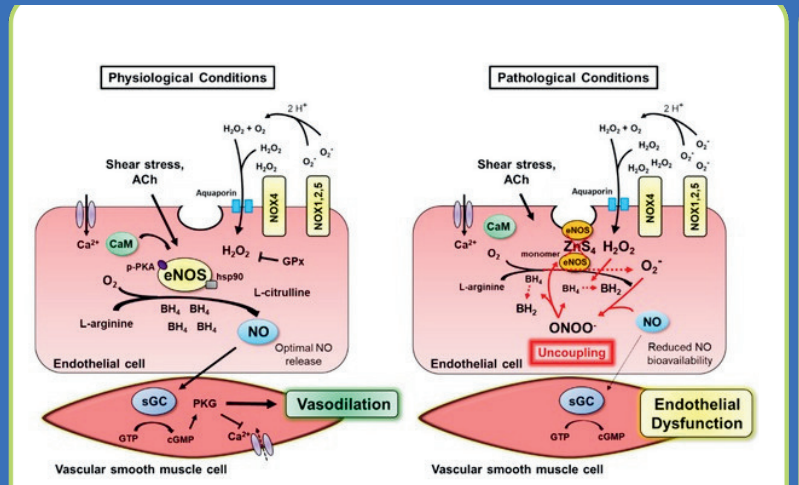
- Database Utilization: PubMed was used as the primary source for gathering relevant research studies and meta-analyses.
- Keyword Application: Specific keywords, including "Nitric Oxide," "endothelial dysfunction," "blood pressure," "vascular integrity," and "hypertension," were employed to identify pertinent studies.
- Data Filtering: The search results were filtered to include studies conducted post-2018, thus ensuring the inclusion of the most recent and relevant findings.

Results

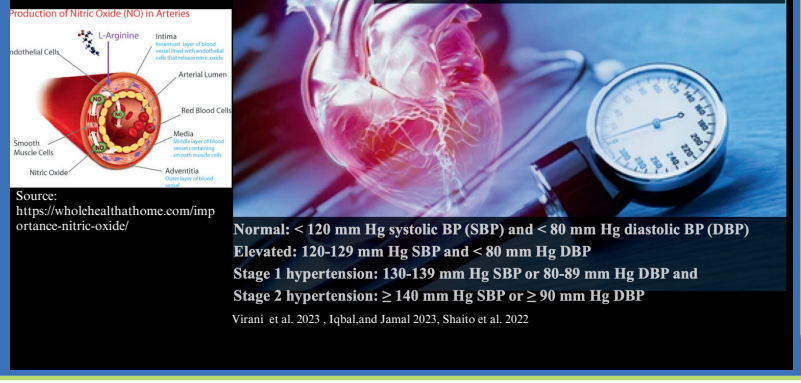
NO plays a crucial role in maintaining endothelial function and regulating blood pressure and consequently is vital to vascular health. (Meza *et al.* 2019, Shaito *et al*. 2022, Smith *et al*. 2020, Wautier *et al*. 2022) NO enhances vascular integrity and prevents inflammation-related damage.(Dri *et al*. 2023) In a very real sense, the vascular endothelium functions as an endocrine organ, a fairly active endocrine organ, as it regulates the vascular tone as part of the maintenance of vascular homeostasis. The endothelial cells also control glucose catabolism by way of insulin. By affecting hexokinase, first enzyme of glycolysis, which phosphorylates glucose to glucose-6-phosphate, insulin enables the glucose to move from the blood into skeletal muscle cells. (Meza *et al*. 2019)

Meanwhile, in healthy individuals, insulin also stimulates blood flow by way of endothelium-dependent vasodilation, but this mechanism is disrupted in settings of type 2 diabetes and cardiovascular disease. (Battillo *et al*. 2024) The vascular endothelium of such patients exhibits poor REDOX control, resulting in a shift toward overproduction by NADPH oxidases (NOX) of reactive oxygen species. (Battillo *et al*. 2024)

Consequently, hyperglycemia, and thus diabetes mellitus, have been hypothesized to induce an imbalance between NOX and endothelial NO synthase (eNOS). Thus, NO may be key to the pathophysiology connecting type 2 diabetes to its vascular complications (Meza *at al.* 2019) Meanwhile, due to its action on vascular smooth muscle, NO also is a potent regulator of blood pressure, meaning that NO-related therapies potentially could be employed by physicians and other clinicians for managing patients' blood pressure according to guidelines of professional organizations, such as the American Heart Association and the American College of Cardiology. (Iqbal and Jamal 2023, Shaito *et al*. 2022, Virani *et al*. 2023)



Meza et al. 2019



Source: https://wholehealthathome.com/importance-nitric-oxide/

Virani et al. 2023 , Iqbal,and Jamal 2023, Shaito et al. 2022

Chronic vascular encephalopathy (CVE), a frequent cause of cognitive impairment, constitutes another vascular disease in whose pathophysiology disrupted NO pathways may play a key role. Not only is study of CVE in connection with NO informing development of NO-related therapeutics for this condution, but also is improving the understanding of post-hypoxic reperfusion injury of the brain. (Dmytriv *et al*. 2024)

A range of studies suggest that pharmacological interventions, lifestyle changes, and nutritional factors together can play a role in optimizing cardiovascular health, partly via NO-related effects.(Gonzalez *et al.* 2023) Interventions may be applicable, not only as interventions against disease, but also for enhancing performance.

Regarding NO and performance, supplements containing agents known to release or cause release of NO have become popular among body builders and other athletes, based on the hypothesis that NO's stimulation of blood flow in muscle tissue will aid muscle growth. Such agents in supplements on the market include L-arginine, L-citrulline, citrulline malate, and various nitrates. However, the efficacy of such products remains to be validated and the purity and dosages of such agents in supplements varies significantly, due to fairly loose regulation of supplements compared with pharmaceuticals. (Gonzalez *et al*. 2023)

Conclusions

- Understanding the effects of NO on endothelial function and hemodynamics is vital for developing effective strategies to manage blood pressure and improve overall cardiovascular health
- There is a knowledge gap, so there is a need for ongoing investigation into NO at all levels:
  - basic science level
  - translational research level
  - clinical trial level
- Future exploration should address existing gaps and should build on the current body of knowledge to advance therapeutic approaches

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