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What Are the Most Effective Risk Factor Management Strategies for The Prevention and Control of Hypertension?

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What Are the Most Effective Risk Factor Management Strategies for The Prevention and Control
of Hypertension?

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Abstract

Hypertension (HTN) affects millions of people globally. With the rising burden of HTN in primary care and its associated morbidity and mortality, it is necessary to explore effective risk factor management to control and prevent it in people most at risk. This research addressed both modifiable risk factors such as obesity, smoking, alcohol, and diet as well as non-modifiable risk factors such as age, race/ethnicity, and family history. The aim of this paper was to examine the most effective risk factor management strategies to control and prevent hypertension. The studies reviewed indicate that there are various risk factor management strategies that are deemed effective in reducing blood pressure (BP) and improving HTN management. These approaches include increasing physical exercise, diet therapy such as the DASH diet, weight loss, and smoking cessation and limited alcohol intake. While each of these strategies is effective, patient adherence to guidelines is essential to promote desirable outcomes. Lastly, regular health check-ups among at-risk populations are effective in managing the risk factors through early detection. Future studies can examine how the implementation of these strategies can minimize or eliminate the need for medication.

Introduction

Hypertension (HTN) refers to the elevation of systolic blood pressure (SBP), diastolic blood pressure (DBP), or both, above normal levels.¹ Recent guidelines provided by the American-College of Cardiology-American Heart Foundation (ACC-AHA) define hypertension as a SBP of 130 mm Hg or higher or a DBP of 80 mm Hg or more.² Advancements in treatment have led to better management and treatment of hypertension (HTN). Despite this, the condition continues to impact millions of lives in the U.S. and around the world. According to the CDC,³ a staggering 45% of adults in the U.S. alone are diagnosed with HTN. These rates are higher in men (47%) than women (43%) and it is more common among non-Hispanic black adults (54%) than non-Hispanic whites (46%), non-Hispanic Asians (39%), or Hispanic adults (36%).³ Overall, these statistics indicate that HTN continues to be a major concern in the U.S. and worldwide.

Also, with the increasing incidence at younger age, it is essential to implement interventions that promote early detection of HTN. According to Hardy and Urbina,⁴ the rates of HTN among adolescents and children in the U.S. have significantly risen. The trend is attributed to physical inactivity, unhealthy diets, obesity, minority race/ethnicity, and family history. Additionally, the burden of HTN is exceptionally high in African countries. Regions such as southern and western Africa have the highest rates of HTN. These high rates are mainly attributed to obesity. Overall, it is essential to address this problem and improve outcomes for vulnerable populations in the U.S. and around the world.

Often known as the ‘silent killer’ due to its asymptomatic nature, HTN is associated with significant morbidity and mortality and this can be attributed to its devastating complications. Several studies have demonstrated that HTN is the predominant risk factor of cardiovascular disease, a leading cause of death worldwide.⁵ According to Unger et al.,⁶ patients with

hypertension face possible complications such as stroke, coronary artery disease (CAD), heart failure, and chronic kidney disease (CKD). Management of HTN is further complicated by its associated comorbidities such as diabetes, lipid disorders and metabolic syndrome.

Depending on the progression of HTN, treatment typically begins with lifestyle modifications which are expected to be maintained throughout the duration of this chronic disease.⁶ These include regular physical activity, limited salt intake, weight reduction, healthy diet with emphasis on the DASH diet, smoking cessation, and limited alcohol consumption. Increasing severity indicates the need for pharmacologic intervention as an adjunct.¹ According to the ACC/AHA guidelines, primary antihypertensive medications include thiazide diuretics, Angiotensin Converting Enzyme Inhibitors (ACE Inhibitors), Angiotensin II Receptor Blockers (ARBs), and Calcium Channel Blockers (CCB). These drugs can be used as single agents or in combination depending on the severity of the disease. However, despite the proven efficacy of these medications, there is an increasing prevalence of uncontrolled and resistant hypertension thus begging the need for evaluation of underlying secondary causes, adherence to medications and lifestyle modifications as well as overall risk factor management.

The risk factors associated with HTN can be divided into two categories: non-modifiable vs modifiable. Non-modifiable risk factors include age (>65years), sex (male>women), race, family history of HTN, and comorbidities such as diabetes, hypercholesterolemia, and renal disease. Modifiable risk factors include overweight and obesity, smoking, physical inactivity, unhealthy diet, and excessive alcohol intake.⁶ The purpose of this paper is to examine the most effective risk factor management strategies for the prevention and control of HTN. The research question is ‘What are the most effective risk factor management strategies for the prevention and control of hypertension?’ The paper will first explore literature related to the modifiable risk

factors and then discuss various risk factor management strategies, and lastly conclude with a discussion of recommendations for healthcare providers to promote better HTN outcomes.

Background

This section includes a literature review of various aspects related to HTN. The aspects reviewed include the modifiable risk factors for HTN as well as lab and radiology screening. Additionally, this section will form a basis for the discussion to answer the research question.

Obesity

Correlation of obesity to HTN

The link between obesity and HTN is underlined in various studies. A Taiwanese cross-sectional observational study⁷ done on 396 middle-aged and elderly participants, of which 200 had HTN, found that people with HTN had a higher body mass index (BMI), waist circumference (WC) and body fat (BF). However, of these indices, WC had a stronger correlation with predicting HTN. Additionally, Leggio et al.⁸ indicated that obesity increases cardiovascular risk and earlier onset of cardiovascular morbidity. Another study by Akpa et al.⁹ found that obesity is linked with at least twice the risk of HTN among women. This risk increases with age and is higher among women. Each of these studies underscores the significant role that obesity plays in the development of HTN. Overall, modifying this risk factor through evidence-based interventions may contribute significantly towards addressing the increasing rates of HTN.

Pathophysiology of obesity related HTN

Obesity increases the risk for endothelial dysfunction by remodeling the arteries and causing arterial stiffness which later triggers negative cardiovascular consequences. Such changes in the vascular phenotype are typically assessed by evaluating markers including but not limited to, pulse wave velocity (PWV) indicating arterial stiffness, vessel diameters to look for

narrowing, and measurements of arteriolar-to-venular ratio (AVR) in retinal vessels to examine arteriolar diameter. Adiponectin and leptin are hormones produced in the adipose tissue with a correlation to obesity. Alterations in the levels of these adipokines has been shown to play a role in the cardiometabolic health of obese patients. Adiponectin which is cardioprotective is decreased in obese patients whereas leptin has a direct correlation with circulating body fat.¹⁰ According to Bielecka-Dabrowa et al.¹¹ these biomarkers can be used to examine arterial wall function, moreover, leptin aids in decreasing sodium levels through excretion, improving heart muscle function and maintaining vascular tone. Studies have shown that leptin affects SBP and DBP and has also been associated with incident HTN. Bielecka-Dabrowa et al.¹¹ demonstrated increased serum levels of leptin and reduced adiponectin in newly diagnosed patients with HTN. Although the mechanism is unknown, the study also linked increased leptin levels to arterial stiffness, measured by pulse wave pressure (PWV). Inversely, results from other studies have linked hypoadiponectinemia to arterial stiffness.

In addition, Köchli et al.¹² aimed to study the relationship between obesity, hypertension, physical activity, and fitness on microvascular and macrovascular health on children aged 6-8 years old. Participants were categorized based on BMI and blood pressure (BP) and assessed on cardiorespiratory fitness via sprinting, physical activity via questionnaires filled by parents, and vascular health by measuring retinal vessel diameters. The results showed narrowing of the retinal arteries and increased large arterial stiffness in children who were overweight and obese, similar results were found on those with high-normal BP and hypertensive BP, all measured independently. Comparably, slower sprinters had wider retinal venules and higher PWV. This study also showed the additive detrimental effects of childhood obesity combined with HTN, obese children with hypertensive BP had narrower vessels and a higher PWV compared to those

with normotensive BP.¹² These results are especially important as they help illuminate the gravity of rising childhood obesity and its associated long-term sequelae. As evidenced by the study, not only does obesity impair the vascular phenotype but it also causes worse outcomes when combined with hypertension. Hence its necessary to look at both BMI and BP in young children to get a better picture of their cardiovascular health.

Overall, these findings can be used as a predictor for the development of HTN as well as to assess overall cardiovascular health in patients with HTN. Based on this knowledge, primary care providers can implement routine screening measures beginning in childhood aimed at prevention of HTN and cardiovascular disease.

Obesity Interventions

One of the main non-pharmacological ways to combat HTN is by weight reduction, especially in obese patients. An observational study by Sabaka et al.¹³ showed that in participants on standard antihypertensive regimen, a decrease in BMI by at least $1\text{kg}/\text{m}^2$ corresponded to a decrease in the presence of uncontrolled hypertension in obese and overweight men and women with HTN. In contrast, increase in BMI was associated with an increase in the presence of uncontrolled HTN. Both results showed a stronger association in obese men than women. Interestingly, BMI decrease in participants with a BMI of less than $25\text{ kg}/\text{m}^2$ showed no significant effect on arterial hypertension control.¹³ This study illuminates the significance of weight control in the efficacy of antihypertensive regimen and demonstrates that maintenance of weight is beneficial in management of HTN compared to weight gain.

According to Villareal et al.¹⁴, weight loss combined with aerobic and resistance exercise helps obese adults attain a better body functional status. Similarly, Kim et al.¹⁵ found that physical activity can lead to a 2-3% weight loss for obese adults within 6-12 months even

without diet modification. With one of the main barriers to exercise being lack of time, Herrod et al.¹⁶ showed positive effects of time-efficient physical activity on resting blood pressure in 48 older adults. The 6-week randomized control trial (RCT) used high-intensity interval training (HIIT), isometric handgrip training (IHG), and unilateral upper limb remote ischaemic preconditioning (RIPC) as interventions and compared these to a non-intervention group. The results showed a reduction in resting SBP by 9mmHg after 6 weeks of HIIT or IHG. However, RIPC did not show any effect on BP.¹⁶ With HIIT and IHG both lasting 15 mins per session and producing remarkable results, patients can be encouraged that implementing a daily exercise routine no matter how short can result in better HTN management and overall cardiovascular health.

Interestingly, Köchli et al.¹² showed a significant association between vigorous exercise and a decreased and undesired arteriolar-to-venular diameter ratio (AVR) in young children. Though this result may have been due to errors related to subjective feedback from the questionnaires filled by parents, it necessitates further investigation as it contradicts conventional principles on the benefits of vigorous intensity exercise on cardiovascular health. The same study demonstrated benefits of physical fitness in improving vascular phenotype in children.¹²

Apart from physical exercise, another intervention to address obesity is diet restriction. Ge et al.,¹⁷ found that dietary programs for weight loss only result in modest weight loss and improvement in cardiovascular health within six months. However, these benefits disappeared within 12 months. Similarly, Lowe et al.¹⁸ noted that a time-restricting diet without other interventions does not result in noticeable improvements in weight loss. Dieting and physical exercise should be combined for optimal weight loss.¹⁴ Therefore, it is essential to examine the types of diets recommended for HTN patients.

Special diets that restrict carbohydrate intake such as the ketogenic diet (KD) are well known for weight loss. Interestingly, in comparison to normal diet, a study on spontaneously hypertensive rats (SHRs) on a KD showed an increase in SBP, cardiac hypertrophy, interstitial fibrosis and oxidative stress injury.¹⁹ A previous study by the same team²⁰ showed that although the KD was effective in weight loss and lowering serum blood glucose levels, it resulted in increased BP, impaired endothelium-dependent vasodilation, and dyslipidemia in SHRs. Overall, the findings from both studies showed aggravation of hypertension and cardiac remodeling. Further studies done on human subjects are needed to better understand the consequences of the KD. Nevertheless, the KD should be recommended with caution after weighing potential risks and benefits, long-term compliance should be discouraged based on these results and routine monitoring of patients' health should be implemented while on the diet. Other dietary recommendations are discussed in the section under 'Dietary Habits.'

In morbidly obese patients, weight loss surgery is necessary. Bariatric surgery procedures are the most common in addressing obesity. These procedures include Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG), and laparoscopic adjusted gastric band (LAGB). RYGB and SG yield effective results in weight loss compared to LAGB.²¹ The efficacy of these surgeries in patients with hypertension has also been tested in various studies. For instance, Schiavon et al.²² found that RYGB resulted in better BP control and HTN remission. Moreover, the results also indicate that patients who undergo this surgery require less medication for HTN. Similarly, Shariq and McKenzie²³ underscore the efficacy of metabolic surgery in addressing obesity related HTN. Therefore, obese patients at risk of HTN should be considered for surgical interventions. Those already diagnosed with HTN should also be referred for surgical

interventions to improve BP values. In instances where surgery is not recommended, pharmacologic intervention can be incorporated.

Weight-loss medications are increasingly being utilized in obese patients. According to Cohen and Gadde,²⁴ medications such as orlistat, and liraglutide are currently approved for weight loss intervention in the U.S. The efficacy of these medications on BP is still clinically inconclusive.²¹ These medications should only be administered on a short-term basis as other interventions are considered and discontinued if there is no significant weight loss.²⁴ However, randomized control trials have examined the efficacy of some of these medications. Sahebkar et al.²⁵ found that orlistat use resulted in metabolic benefits such as reduced BP. SBP reduced by 1.15 mmHg while DBP reduced by 1.07 mmHg. Another metabolic benefit of this medication is the reduction in circulating lipids. The authors found that cholesterol reduced by 0.30 mmol/L, low-density lipoprotein (LDL) reduced by 0.27 mmol/L, while triglycerides reduced by 0.09 mmol/L. Additionally, lorcaserin is also associated with significant weight loss and improved cardiovascular health.²⁶ Overall, these medications can be used by obese patients who do not qualify for surgery in combination with other non-pharmacological weight loss interventions such as physical activity and dietary modification for optimum results.

Tobacco

Pathophysiology of smoking and HTN

Cigarette smoking has long been associated with hypertension. Dikalov et al.²⁷ noted that smoking induces endothelial dysfunction by diminishing nitric oxide and in combination with angiotensin II, causes mitochondrial oxidative stress which cumulatively promotes the development of HTN.

Effect of Tobacco Smoking on BP

A 15-year cohort study by Andriani et al.²⁸ found that smoking had varying effects on the BP of both men and women in Indonesia. For example, in women, smoking caused a significant rise in SBP, whereas it decreased SBP and DBP in men. Also, the mean SBP and DBP was higher in male non-smokers compared to current and former smokers. These findings aligned with a study of Chinese men²⁹ that showed that current smokers had a lower adjusted BP compared to former smokers and nonsmokers. There was also a significant association between former smoking and prevalence of HTN. Overall, the findings from these studies underscore the significant role that smoking plays in the development of HTN. Thus, smoking cessation is necessary to help prevent or manage HTN.

Smoking Cessation

Smoking cessation is believed to be an effective method of reducing BP among hypertensive patients. However, various studies on the effects of smoking cessation present conflicting findings. Andriani et al.²⁸ noted an increase in SBP after smoking cessation. Also as noted by Li et al.,²⁹ former smokers had a higher prevalence of HTN compared to non-smokers. Smoking cessation also increased HTN rates. These findings are disputed by Choi et al.³⁰ who notes that the relationship between recent smoking cessation and HTN is insignificant. However, smoking cessation in the long term reduces the risk of HTN and diabetes. Despite these findings, current guidelines by the American College of Cardiology/American Heart Association (ACC/AHA) underline the importance of smoking cessation in the prevention of cardiovascular disease.³¹

Despite proven long-term benefits of smoking cessation, smokers face many obstacles to quitting, these include withdrawal symptoms such as stress and weight gain, cravings, lack of support and lack of quitting resources. As much as it is the smoker's responsibility to quit,

primary care providers also play a profound role in the patient's cessation journey. Patients sometimes blame themselves for lacking the mind control to be able to quit, and such distorted beliefs can compromise the effectiveness of smoking cessation programs.³² A RCT assessing the effectiveness of a multicomponent smoking cessation service package compared to routine counseling and follow up in patients with HTN and diabetes showed success in cessation with the former. The components of the program included, regular assessment of patient motivation, measurement of carbon monoxide breathed out with visible real-time results, family support and nicotine chewing gum (optional).³³ This goes to show that a strong support system from well-trained medical professionals and family, coupled with patient's determination to quit and pharmacotherapy, can go a long way in attaining successful cessation. Primary care centers should implement similar meticulous approaches as opposed to casual follow up to achieve cessation and improve overall health outcomes of patients. Ideally, these interventions should be started early and offered to all patients to prevent HTN and cardiovascular disease.

Dietary Habits

Some dietary habits can contribute to the possible development of HTN. According to Whelton et al.³⁴, a diet high in sodium and low in potassium, magnesium, protein, and fish fat increases one risk for HTN. Excessive sodium intake raises BP by increasing water retention and systemic peripheral resistance. Moreover, it has been linked to increased arterial stiffness.³⁵ All of these aggravate HTN and induce the development of CVD. Notably, restriction of sodium has the greatest effect on lowering blood pressure. However, like many dietary recommendations, limiting sodium intake can be challenging for many patients. Hence, it may be necessary to find alternative approaches that may be easier to adhere to and can help combat the excessive sodium intake that many patients are accustomed to.

Studies have shown that dietary potassium and nitrate may help in lowering BP by attenuating salt-induced hypertension. Potassium reduces BP via natriuresis therefore, increasing potassium intake through sources such as fruits, vegetables and nuts is beneficial for HTN and can prevent cardiovascular events.³⁶ Nitric oxide which can be derived from dietary nitrate helps promote vasodilation and inhibits vasoconstriction.³⁷ According to Kurtz et al.,³⁷ in salt resistant subjects with normal BP, increase in sodium intake increases cardiac output, promotes vasodilation, and reduces vascular resistance. These effects are diminished in salt-sensitive subjects, therefore, addition of nitric oxide through nitrate rich foods such as beets, kale and spinach can aid in inducing vasodilation and reducing BP. This can also be beneficial in normotensive people to prevent the development of HTN.³⁷ These findings imply that sodium reduction in combination with increased potassium and nitrate intake can help lower BP. Therefore, healthcare providers caring for HTN patients should not only emphasize on limiting sodium intake but also increasing potassium intake by eating more fruits and vegetables rich in potassium, as well as increasing dietary nitrate especially in salt-sensitive individuals. Such lifestyle modifications may be easily adopted by patients compared to physical activity, smoking cessation, or limited alcohol intake.

Some of these dietary recommendations are incorporated in the well renowned Dietary Approaches to Stop Hypertension (DASH) diet. According to the National Institutes of Health (NIH) the DASH diet focuses on limiting saturated fat, cholesterol and sodium while increasing minerals such as potassium, calcium, magnesium as well as fiber and protein.³⁸ Filippou et al.³⁹ found that both SBP and DBP were reduced among adults on the DASH diet with and without HTN. These findings are supported by Mahmood et al.⁴⁰ who suggests that the effectiveness of the DASH diet is equal to that of a single-drug therapy. Given that the United States is becoming

more culturally and ethnically heterogeneous, knowledge on how to tailor the DASH diet to a culturally sensitive eating plan may be warranted in some populations. Also, country-specific guidelines are necessary to ensure optimal effectiveness globally. Therefore, diet can play a significant role in HTN management.

Alcohol

The relationship between alcohol consumption and HTN is underscored in several studies. According to Whelton et al,³⁴ excessive alcohol consumption is a significant predictor of BP. Notably, this risk factor coupled with an unhealthy diet, inadequate physical activity, and obesity accounts for the highest cases of HTN. In the U.S., approximately 10% of HTN cases are linked to excessive alcohol consumption.³⁴ Limiting alcohol intake is associated with reduced BP and overall better HTN management. A systematic review and meta-analysis by Roerecke et al.⁴¹ showed that for people who exceeded 2 drinks/day, reduction of alcohol intake was associated with reduced BP, this effect was insignificant for those who drank less than this. Reduction in both SBP and DBP was strongest in individuals who drank 6 or more drinks/day after they reduced their intake by 50%. Interestingly, Whelton et al.³⁴ notes that moderate alcohol consumption has been associated with higher levels of high-density lipoprotein and reduction of coronary heart disease. Such findings may create ambiguity on the recommended amount of alcohol intake if any. Whelton et al.³⁴ suggests a maximum recommended alcohol intake of 2 drinks per day for men and women with elevated BP or HTN. This however has been contradicted by a more recent meta-analysis by Roerecke et al.⁴² showing differing effects of alcohol intake between men and women. In men, consuming 1 to 2 drinks per day of alcohol was associated with an increased risk for HTN, whereas in women this risk was negligible. In both sexes, alcohol consumption exceeding 2 drinks a day correlated with an increased risk of HTN.

Consequently, this may warrant a change in current guidelines that allow up to 2 drinks/day for men as this has been shown to increase HTN risk.

Nevertheless, red wine, a staple in the Mediterranean diet, has been associated with cardioprotective and antihypertensive benefits when taken in moderation. Resveratrol, a compound abundant in red wine, has been shown to be responsible for this phenomenon.⁴³ Bomfim et al.⁴³ found that long-term (28 days) resveratrol treatment prevented further increase in SBP in SHR, whereas it did not affect SBP in normotensive rats. Another study by da Luz et al.⁴⁴ observed a direct relationship between long term red wine drinkers and coronary artery calcifications compared to abstainers. This finding however was not associated with negative clinical outcomes and was instead attributed to stabilization of the plaques, thus conferring a cardioprotective property due to reduction of major adverse cardiac events (MACE).

Primary care providers should be educated on these findings and with the patient, weigh the benefits and risks of moderate alcohol consumption. Overall, alcohol has been linked with more negative effects than benefits hence it is advisable to limit consumption based on the several associated detrimental effects. Notably, the overall BP reduction due to limited alcohol intake is similar to other non-pharmacological interventions such as physical activity, weight loss diets, and healthy diets.⁴¹ Therefore, a combination of all of these interventions can result in a substantial reduction in BP, better HTN management and improved cardiovascular health outcomes. Primary care providers should work in close partnership with patients to promote each of these interventions for prevention and control of HTN and other cardiovascular diseases.

Lab/Radiology Screening of HTN

Hemoglobin A1c

Hemoglobin A1c (HbA1c) is a well-established marker for overall glycemic control, however, its significance has been shown to extend beyond this. Studies have suggested that patients at risk for cardiovascular disease can be identified by abnormalities in their HbA1c regardless of their diabetic status. Song et al.⁴⁵ noted a correlation between elevated HbA1c levels and the prevalence of HTN among Chinese nondiabetic adults. Specifically, elevated HbA1c was associated with an increase in isolated systolic hypertension rather than diastolic. Moreover, there was a strong interaction between elevated HbA1c, abdominal obesity, and family history of HTN, which are all known to aggravate the risk of HTN. Increased blood glucose has also been linked with arterial stiffness, Wu et al.⁴⁶ showed that increasing fasting blood glucose trajectories were associated with a higher risk for arterial stiffness in nondiabetic adults. This is not only a predictor for HTN but also increases overall risk for cardiovascular diseases. Based on these findings, it is reasonable to imply that lowering the HbA1c confers cardiovascular benefits. From this perspective, routine screening of HbA1c should not be limited to gauging overall glycemic control and diabetes management, it can also be useful in identifying individuals at risk for hypertension and cardiovascular disease, and help combat the disease in its very early stages.

Lipid Panel

Elevated total cholesterol, triglycerides and LDL coupled with low high-density lipoprotein (HDL) has been strongly associated with an increased risk of cardiovascular disease. This is due to its relation to atherosclerosis which damages blood vessels putting patients at risk for adverse cardiac events such as myocardial infarction and stroke. The co-occurrence of HTN with elevated lipid profiles magnifies this risk. Therefore, monitoring the lipid panel and lowering the total cholesterol and triglycerides in patients with HTN can help prevent MACE.

Carotid ultrasound

Carotid intima media thickness (IMT) measured by ultrasound can be used as a marker for target end organ damage in hypertensive patients. According to Magnussen,⁴⁷ carotid IMT has a linear relationship with SBP and is useful in predicting adverse cardiac outcomes in asymptomatic patients such hypertensive patients. In addition, a study by Takase et al.,⁴⁸ noted that carotid IMT can be used a predictor of HTN in normotensive individuals. Specifically, subjects with carotid IMT >0.75mm were at a higher risk of developing new onset HTN.

The feasibility and accuracy of ultrasound has aided clinicians in the diagnostic and management of several conditions. Despite this, the use of point of care ultrasound is generally low globally and mainly established in emergency medicine.⁴⁹ With the above studies supporting that carotid ultrasound can predict HTN, primary care providers should be encouraged to incorporate regular use of this marker in routine well exam visits. This may aid in evading the burden of HTN and its cardiovascular consequences and result in better health outcomes.

Challenges to Current Treatment and Prevention

The most common basis of blood pressure control failure is the utilization of inaptly less antihypertensive medicines prescriptions. Unger et al.⁶ recommend that physicians familiarize themselves with the drug specifications and recommendations to prevent such situations. Also, failure to adhere to medications contributes to uncontrolled HTN. Therefore, patients must be encouraged to be compliant to their medications as prescribed to maintain healthy blood pressure levels.⁶ It is also necessary to maintain healthy nutritional standards to prevent and control hypertension. Regular exercise, proper diet, maintaining a healthy weight, smoking cessation, and stress management play a significant role in hindering hypertension.

Methods

The primary methodology utilized in the current paper is a literature search. The search was conducted on databases provided in the Augsburg library. These databases include PubMed, MEDLINE, and Science Direct. Moreover, Google Scholar was also used to find relevant literature. The search criteria included words such as hypertension and obesity, hypertension and smoking cessation, hypertension and physical exercise, and hypertension and alcohol intake. The search was limited to the last five years to ensure that only current articles are included in this paper. Additionally, studies incorporated in this research include systematic reviews, meta-analyses, prospective observational studies, and randomized control trials. Another inclusion criterion applied is that only articles in English were selected. Overall, this methodology ensured that the author captured valuable information about the research question.

Discussion

After an extensive literature review, it is apparent that each risk factor plays a role in HTN development. Firstly, several studies have demonstrated that obesity is a major risk factor for the development of HTN and cardiovascular disease. As observed by Lin et al.,⁷ waist circumference is strongly correlated to a higher SBP and HTN compared to BMI or body fat percentage. Vascular changes have also been observed in obese children with elevated BP.¹² Weight loss interventions whether through diet, physical activity, surgery, or medications have shown some efficacy in the reduction of blood pressure and overall improved management of HTN.

Engaging in regular physical activity is perhaps one of the most effective risk factor management strategies. The strategy particularly applies to obese and overweight individuals who have been diagnosed with HTN or those at risk of developing the condition. Physical activity can reduce BP in patients with obesity. The interventions can be utilized as primary

therapy for patients with obesity and HTN. Moreover, Kim et al¹⁵ found that physical exercise can significantly reduce weight loss among obese patients. The forms of physical exercise that obese clients with HTN can engage in include aerobic and resistance. These exercises can be individualized depending on the patient's weight loss goal. Additionally, this intervention can be combined with others, such as diet therapy, to realize maximum benefits. According to Villareal et al,¹⁴ combining diet and exercise can significantly reduce weight loss among obese adults. Healthcare professionals should recommend this strategy in obese patients with HTN or those at risk for HTN.

Weight loss surgery has been proven to be the most effective weight loss modality and is recommended for morbidly obese patients. With HTN being a common comorbidity in obesity, metabolic surgical procedures can simultaneously reduce BP since body fat and BP are correlated. Overweight and obese patients with HTN or those at-risk of developing the condition can benefit from weight loss surgery. According to Kang and Le,²¹ surgical options such as RYGB, SG, and LAGB are utilized in helping obese patients reduce weight and can be individualized based on patient's needs. For example, RYGB and SG are more effective in weight loss than LAGB. These surgeries result in desirable outcomes such as lower BP and decrease the need for HTN medication. Additionally, these surgeries are the most effective for managing obesity related HTN.²³ As seen fit, weight loss surgery should be highly recommended in morbidly obese patients with uncontrolled HTN to prevent end organ damage.

Apart from weight-loss surgery, medical professionals can prescribe weight-loss medication for suitable patients. Medications such as orlistat are effective for weight loss and beneficial to BP.^{24,25} These medications can be prescribed for patients who fail to meet surgery prerequisites. Moreover, the medications can also be used prior to considering surgical measures

for weight loss. Additionally, the efficacy of these medications can be enhanced by combining with other interventions such as physical exercise and diet therapy. Overall, overweight and obese patients can benefit from weight-loss medications to prevent and control HTN.

Smoking has also been associated with HTN. Interestingly, studies have shown that current smokers tend to have a lower BP compared to former smokers and non-smokers.^{28,29} In addition, the relationship between former smokers and HTN is linear and in a dose-dependent fashion.²⁹ Of note, smoking cessation has been shown to increase SBP and HTN rates.^{28,29} However, long-term cessation reduces the risk of HTN.³⁰ Thus, smoking cessation is one of most effective strategies to control and prevent HTN. According to Whelton et al³⁴ smoking cessation can reduce the risk of developing cardiovascular disease. While the effects of cessation on BP are evident in the long-term, patients diagnosed with the condition should be encouraged to quit smoking. To successfully assist patients in smoking cessation, it is important to recognize its associated challenges and provide the appropriate support to determined patients. Healthcare providers can use pharmacological treatments such as nicotine replacement therapies (NRT) to help patients quit smoking. The intervention when combined with other strategies can not only assist with cessation but it can also help prevent and control HTN and the myriad of diseases associated with smoking. Thus, primary care providers should assume the role of educating current smokers on the detrimental effects of the habit while constantly assessing their willingness to quit and offering encouragement and useful resources.

Dietary habits such as excessive salt intake have a strong correlation to the development of HTN. With many patients having difficulties to adhere to a low sodium diet, alternatives such as increasing dietary potassium intake through fruits, vegetables and nuts as well as eating nitrate rich foods such as beets and spinach, have been shown to aid in urinary sodium excretion and

vasodilation respectively.^{36,37} Furthermore, Kurtz et al.³⁷ notes that nitrate rich foods can be beneficial in preventing HTN in normotensive individuals. The DASH diet has also been associated with reduction of both SBP and DBP in both hypertensive and normotensive individuals.³⁹ Therefore, healthcare providers should incorporate this information in the nutritional counseling given to hypertensive patients and those at risk.

The recommendable diet for patients diagnosed with HTN reduces sodium intake and increases consumption of fiber, magnesium, potassium, protein, and fish fat. Additionally, diet therapy should be tailored to match a patient's cultural needs. Moreover, diet can be combined with other interventions such as physical exercise to promote weight loss.¹⁴ Further, strategies for compliance should also be initiated for patients who are enrolled for diet therapy. These strategies include telephone follow-up on the dietary advance, group sessions with patients having similar conditions, individual sessions with dieticians, and provision of patient education materials. Moreover, regular reminders to patients can also promote adherence to diet therapy. Through this intervention, healthcare professionals can promote better outcomes for HTN patients.

Additionally, reduction of alcohol intake has been shown to be beneficial in improving HTN. As demonstrated by Roerecke et al,⁴¹ exceeding 2 drinks per day was associated with a higher HTN risk in both men and women and those who drank 6 drinks or more a day showed the highest reduction in BP when they cut down by 50%.⁴¹ Roerecke et al⁴² also showed varying effects of alcohol intake between sexes with men having a higher risk of HTN than women at only 1-2 drinks of alcohol. While excessive alcohol intake increases the risk of HTN, moderate consumption has been shown to be effective. Various studies^{34,40} show that moderating alcohol consumption has beneficial effects on BP. This strategy should be geared towards patients who

want to quit or minimize alcohol intake. Medical professionals should work with patients to develop BP goals and assist them in minimizing or quitting alcohol consumption. Overall, it is essential for healthcare providers to consider this intervention as a way of controlling or preventing hypertension.

Needless to say, the effectiveness of the discussed interventions is largely dependent on patient adherence. Healthcare providers can use motivational interviewing (MI) approaches to enhance adherence for patients with HTN. According to Silveira et al,⁵⁰ MI improves BP control by enhancing self-care and medication adherence in patients with HTN. MI is often provided by trained nurses either in person or via telehealth. The goal of this approach is to support behavior change among persons diagnosed with HTN. For example, healthcare providers can initiate changes in diet, physical exercise, and smoking cessation through MI. Therefore, healthcare providers should educate themselves on MI strategies that can foster a positive change among patients and improve their health outcomes.

Additionally, MI is based on components such as partnership, acceptance, compassion, and evocation. Firstly, the healthcare provider and the patient partner to achieve desired goals and accept each other's role in building the therapeutic relationship. Moreover, compassion ensures that the healthcare provider develops a desire to help relieve suffering, while evocation ensures that change comes from the patient. The approach can be used in primary care settings to modify risk factors such as unhealthy diets, physical inactivity, smoking and excessive alcohol consumption to achieve better BP control. For example, Silveira et al⁵⁰ found that applying MI led to a decrease in SBP by -6.4 mmHg at night and -5.3 mmHg over 24 hours. Thus, this technique should be embraced to enhance the management of risk factors.

Regular blood pressure monitoring is also an important component in maintaining target BP in individuals with HTN. Moreover, routine screening of BP in populations at risk can aid in early detection of HTN and reduce adverse outcomes. This may be especially useful in people with non-modifiable risk factors such as age, race, or family history. According to Schmidt et al,⁵¹ early detection of HTN through screening increases awareness of individuals at risk of the condition. Moreover, with readily available blood pressure monitors in healthcare facilities and the feasibility of the process, the strategy can lower the societal and economic burden associated with HTN through early treatment. The key components of regular screening programs include equipment and trained healthcare professionals, informed consents, therapeutic relationships, and patient education. Healthcare professionals can utilize strategies such as organizing regular HTN screening clinics in communities to promote awareness and identify those at risk. Whether through in-clinic BP monitoring or at-home measurements, regular BP monitoring is essential to control the disease with the latter being more recommended.

Furthermore, with technology being an integral part of the modern world, there is an increasing use of health geared devices and phone applications to help promote healthy lifestyles and manage chronic diseases. A quasi-experimental study assessing the effectiveness of mobile based primary healthcare intervention in increasing medication adherence in adults with high risk of cardiovascular disease compared to usual care showed significantly greater adherence on the intervention group compared to the control group. Similarly, systolic and diastolic BP were significantly reduced in the intervention group compared to the control group.⁵² Today, smartphone applications can be designed with features that can track patients' BP trends, offer healthy diet choices, give reminders to exercise and take medications as well as provide education on HTN and other relevant cardiovascular diseases. Thus, patients can incorporate

smartphones health apps to enhance adherence and for better management of HTN. Healthcare providers can utilize this strategy to encourage behavioral change and monitor patient health status remotely. Additionally, wearable devices such as smartwatches can motivate fitness and improve overall HTN management. Further, Kario⁵³ found that these devices can monitor BP changes and contributed to personalized interventions. For instance, an increase in BP can prompt a patient to seek medical help based on the information collected through the devices. Therefore, these technologies should be integrated into the management of modifiable risk factors to realize better BP control.

Lastly, successfully managing or preventing HTN begins with a competent and knowledgeable clinician. It is critical to ensure that primary care providers (PCPs) have the necessary skills to care for HTN patients. A Canadian study assessing 15 competencies in the management of HTN in primary care noted that although all were highly ranked, the highest ranked included ability to screen and identify HTN, ability to diagnose HTN, knowledgeable in HTN prevention strategies and proper BP measuring technique.⁵⁴ These competencies can facilitate effective management of various risk factors and improve HTN control rates. The ability to identify prevention strategies ensures that PCPs can help modify diet, exercise, alcohol, and smoking for patients at high risk of HTN. Moreover, the ability to diagnose HTN ensures that the condition is detected earlier and interventions to improve outcomes implemented early. Therefore, PCPs should be equipped with these competencies to ensure better care and management of patients with HTN and those at risk.

Conclusion

Hypertension continues to impact the lives of millions of people globally. Despite its impact, risk factor management can be used to improve outcomes related to this condition. Risk factors for HTN include obesity/overweight, excessive alcohol consumption, and inadequate

physical exercise. Moreover, factors such as smoking and dietary habits such as high sodium intake increase the risk of HTN. These factors can be managed and controlled through various strategies. Strategies include diet therapy through interventions such as the DASH approach and increasing physical exercise. Additionally, weight loss is also an effective strategy for managing risk factors such as obesity. Other effective strategies include smoking cessation and moderating alcohol intake. The efficacy of most of these strategies depends on the patient's compliance. Healthcare providers can promote adherence through regular follow-ups and reminders to patients. Lastly, regular health check-ups are an effective strategy for managing HTN among at-risk populations. Healthcare facilities should organize regular clinics to screen patients and initiate appropriate interventions to promote better outcomes. Each of these strategies can be combined with HTN medications to improve efficacy. Overall, effective risk factor management is essential for the management and control of HTN.

Research on the risk factors management for HTN is not exhaustive. Future studies can look at various aspects to promote better medical practice. Firstly, studies can examine how tailoring interventions such as diet, smoking cessation, and alcohol consumption in specific cultures can promote better management of HTN. Secondly, future studies can show how some interventions such as diet and physical exercise can reduce the need for HTN medication. Through these studies, a better understanding of HTN risk factors will be attained for better outcomes.

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