REVIEW ARTICLE

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Lifestyle Modifications in Hypertensive Patients to Reduce Risk of Stroke: A Review

Aiman Perween Afsar[1], Anish Tayal[2], Binita Goswami[1]

1. Maulana Azad Medical College, Delhi, India; 2. University College of Medical Sciences, Delhi, India*

ABSTRACT

Stroke is the second leading cause of death and a major contributor to disability worldwide. Cardiovascular complications, pneumonia, fever, pain, dysphagia, incontinence, and depression are common after a stroke and require specific interventions for their prevention and treatment, with little data to guide the management of these complications. However, management is not feasible for all, especially for Low-and Middle-Income Countries. Therefore, the best way to manage is to reduce the occurrence of stroke. Lifestyle changes such as increased physical activity, dietary modification/weight loss, and smoking cessation are of proven benefit and are likely to improve outcomes in just a month. In this background, this paper aims to assess the key lifestyle modifications that can help prevent the occurrence of stroke in hypertensive patients.

Keywords: Diet, Hypertension, Lifestyle Modifications, Physical activity, Stroke

*See End Note for complete author details

INTRODUCTION

Stroke is defined as a sudden focal neurological deficit, as a result of impaired perfusion to the brain. It is a major cause of morbidity as well as the second leading cause of death in the world.[1] Being a medical emergency, rapid assessment is needed to establish the diagnosis, identify the underlying cause, provide acute treatment, and prevent further complications. A substantial reduction in the incidence and mortality of stroke, as well as disability-adjusted life years, has been achieved in high-income countries as a result of improvement in primary and secondary prevention as well as acute stroke treatment and neurorehabilitation.[2] However, the situation in low-and-middle-income countries (LMICs) is precisely the opposite, with the incidence of stroke increasing two fold over the same time period (1996-2016), and increasingly affecting younger age groups.[2]

A greater number of modifiable risk factors for stroke have been identified in recent literature, especially in LMICs.[3] Cardiovascular complications, pneumonia, fever, pain, dysphagia, incontinence, and depression are common sequelae following stroke, contributing to significant morbidity and mortality, with little data currently available to guide specific interventions for the prevention and management of these complications.[4]

Hypertension is the most prevalent risk factor of stroke with a prevalence of 77% among patients with a history of stroke as compared to 32.89% among controls.[5,6] Univariate (R^2=0.138, $p<0.0001$) and multivariate linear regression models (R^2=0.441, $p<0.0001$) revealed a positive correlation between premature stroke mortality and mean systolic blood pressure (SBP). Conversely, a significant negative association is reported between premature stroke mortality and the percentage of participants with controlled blood pressure ($p<0.0001$), after controlling for age and gender. With the prevalence of Hypertension increasing at a dangerous pace in LMICs,[7] it has become important now more than ever to identify risk factors and encourage lifestyle modifications to protect these patients from poor clinical outcomes following stroke.

While the diagnosis of stroke can be made clinically, identifying characteristic features including a history of sudden onset of neurological symptoms, consisting of unilateral weakness or sensory loss, dysphasia, hemianopia, inattention, and reduced coordination, brain imaging through

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Corresponding author:
Binita Goswami
Department of Biochemistry, Maulana Azad Medical College, Delhi, India
Email ID - binita.dr@gmail.com

Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) is needed to distinguish cerebral infarction from primary intracerebral hemorrhage, which is essential for guiding further treatment interventions.

These imaging techniques are often cost-prohibitive and not accessible to many patients in LMICs, especially low-income patient groups.[8] Thus, while there is certainly an unmet need to improve the healthcare infrastructure to improve access to acute management and prevention of stroke in the long term, instituting measures to reduce the incidence of stroke by reducing modifiable risk factors can significantly reduce morbidity and mortality due to this silent and ever-increasing epidemic.

The current evidence has consistently indicated that behaviors such as smoking, poor diet, excessive alcohol consumption, and physical inactivity are some of the most important modifiable risk factors for the prevention of stroke.[9] Thus, instituting lifestyle changes including increased physical activity, dietary modification/weight loss, and smoking cessation may have a considerable benefit in reducing the incidence as well as complications of stroke, thus improving outcomes and reducing the strain on the healthcare infrastructure, as consistently indicates by studies. This review examines the current evidence on the risk factors of stroke this paper aims to assess the key lifestyle modifications that can help prevent the occurrence of stroke in hypertensive patients.

SEARCH STRATEGY

A literature review was conducted as per the review recommendations of Gasparyan et al.[10] A search was conducted using the PubMed, MEDLINE, EMBASE, ClinicalTrials.gov and SCOPUS databases, using the terms "Stroke OR Cerebrovascular accident OR CVA [Stroke (MeSH terms)]" AND "Hypertension OR High Blood Pressure OR High BP [Hypertension (MeSH terms)] AND "prevention". 1027 articles were identified and ranged from case reports, case series, letters to the editor, and observational studies to narrative reviews, systematic reviews and clinical trials published till December 22, 2021. Relevant articles were independently reviewed and information was extracted falling under the different categories of risk factors of stroke in hypertensive patients, including diet, sleep, smoking, obesity, exercise and awareness, and lifestyle modifications to reduce the risk of stroke. 40 articles were used for qualitative synthesis.

Risk Factors for Stroke in patients with Hypertension

Hypertensive patients have been identified as a vulnerable group for the occurrence as well as poor clinical sequelae of stroke.[5] The risk is particularly high in patients with SBP greater than 130mm Hg and total cholesterol levels greater than 212mg/dl.[11] In addition to underlying disease, several modifiable risk factors compound the risk of stroke. It is estimated that for nearly 82 percent of strokes, five risk factors are primarily associated.[6] These include hypertension, current smoking, obesity, an unhealthy diet, and physical inactivity.

Diet

Poor diet quality can negatively affect body weight and increase the burden of many major chronic diseases including CVD.[6] A diet high in saturated fats, processed grains, and simple sugars has been consistently associated with an increased incidence of stroke.[12] In REGARDS (Reasons for Geographic and Racial Differences in Stroke), the Southern dietary pattern, consisting of an increased proportion of fried food, added fats, organ and processed meats, and sugar-sweetened beverages, there was a 56% higher risk of heart disease and a 30% higher risk of stroke.[13]

Trans fats have adverse effects on lipids and lipoproteins and promote endothelial dysfunction, insulin resistance, inflammation, and arrhythmias and hence are associated with a higher risk of stroke and poor clinical outcomes following it.[14] High intake of (processed) meat has unfavorable effects of saturated fatty acid content, high heme, lipid peroxidation, and high salt content of processed meat on BP.[15] The PURE (Prospective Urban Rural Epidemiology) study indicated that dairy intake was associated with a 23% lower mortality rate whereas Song et al. indicated an 11% increase in cardiovascular mortality rate with dairy consumption as compared with vegetable protein.[16]

Population data from the ARIC (Atherosclerosis Risk in Communities) study indicated an 18% increase in stroke-related mortality rate associated with low-carbohydrate diets using animal-derived protein and fat sources (eg, lamb, beef, pork, chicken).[17] In addition, the ARIC investigators also noted a 23% increase in all-cause mortality rate associated with high-carbohydrate diets, with the optimal carbohydrate intake observed to be 50% to 55%. Sugar-sweetened and artificially sweetened beverages have been correlated with increasing the risk of development of type 2 diabetes mellitus (T2DM) and with atherosclerotic cardiovascular disease (ASCVD risk, both associated with stroke, with a 20% increase in the frequency of diabetes mellitus (DM) with 1 daily serving of these sweetened beverages.[18] In large cohort studies, consumption of added sugar at >10% of daily calories has been associated with an increased mortality rate.[19]

Intake of higher salt amounts is associated with a higher risk for ischemic and hemorrhagic stroke. High salt intake

is estimated to be the most important factor responsible for approximately 20% of all intracerebral hemorrhages.[20] The increased risk is speculated to be a result of hypertension due to high salt intake, leading to fibrosis in the arteries, kidneys, and heart.[21]

Clinical trials have additionally shown that calcium supplementation of >500 mg per day is associated with a significant risk for myocardial infarction and a trend toward an increase in stroke.[22] Additionally, combined calcium and vitamin D, vitamin E intake, beta carotene was associated with an increased risk of stroke.[3,4,19] This is especially important to discourage the popular myth of the utility of antioxidant multivitamin supplements in preventing stroke, whose increasingly indiscriminate dispensing may actually increase the incidence of stroke.

Alcohol

Alcohol consumption is associated with an increased risk of stroke. The association between alcohol consumption and the risk of stroke is J-shaped.[23] While slight to moderate alcohol intake (≤ 2 drinks per day for men and ≤ 1 drink per day for women, respectively) may reduce stroke risk by 30%, higher consumption significantly increases the risk of stroke.[3] Heavy drinking is associated with a higher prevalence of hypertension, hemorrhagic stroke, and cardiomyopathy, whereas moderate drinking is associated with a lower prevalence of coronary artery disease, ischaemic stroke, and sudden cardiac death.[24]

Smoking

Cigarette smoking is an independent risk factor for stroke.[25] Currently, smoking has been shown to increase the risk of stroke two- to fourfold compared to non-smokers.[6,26] There is a dose-response relationship between smoking and cerebral ischemia, with the heaviest smokers at the highest risk due to reduced endogenous fibrinolysis and increased thrombocyte activity, endothelial dysfunction, hypercoagulability, and inflammation, resulting in the progression of atherosclerosis.[27]

Sleep

Poor quality sleep is associated with an increased risk of hypertension and CVD.[28] Inadequate sleep patterns are associated with hypertension, DM, and obesity as well as independently associated with an increased risk of adverse cardiovascular outcomes, such as stroke and myocardial infarction.[29] Reduced sleep duration can result in longer exposure to enhanced sympathetic activity and increased average 24-hour BP and heart rate.[30] In this way, habitual sleep restriction can lead to prolonged enhanced sympathetic nervous system activity, the development of hypertension, and subsequently, an increased risk of stroke and other CVD.[31]

Obesity

Obesity has been identified as a major contributor to the development of hypertension. Each unit increase in BMI has been suggested to increase the risk of stroke by 5%.[3] Although there are many pathophysiologic factors that lead to these observations, increased visceral adiposity around the kidney and accumulated within the kidney can induce a physical renal compression, ultimately resulting in an increase in BP, and consequently increase the risk of stroke.[32] Additionally, pharmacologic challenges in treating hypertension in obese patients may occur due to excess adiposity and its impact on pharmacokinetics and pharmacodynamics.[33]

Lifestyle modifications to reduce the risk of Stroke in patients with Hypertension

The promotion of a healthy lifestyle is the cornerstone for primary and secondary atherosclerotic prevention of stroke in patients with Hypertension.[34] High-intensity physical activity and the reduction of blood pressure have a relative risk reduction of 64% and 30-40% respectively.[35] Global modification of lifestyle has greater benefits than the individual treatment of risk factors.[3] Patients fulfilling all 5 criteria of low-risk lifestyle for stroke (no smoking, regular physical activity ≥ 30 min per day, healthy nutrition, moderate alcohol consumption, Body Mass Index (BMI) <25 kg/m^2 had an 80% reduced risk of stroke as compared to patients fulfilling none of these criteria.[36]

Dietary changes

Several dietary modifications can help significantly in reducing the risk of stroke in hypertensive patients. Studies have shown that it is possible to achieve significant reductions in BP with reduced salt intake in people with hypertension.[37] Therefore, much of the population-level efforts to reduce BP are through salt reduction in the food supply.[38] Reducing sodium intake in those with mild hypertension has been effective at lowering BP (SBP by −8 mmHg and DBP −4 mmHg) to a similar magnitude as pharmacological monotherapy, whereas BP reduction in patients with resistant hypertension was much higher (systolic by 23 mm Hg and diastolic by 9 mm Hg, respectively).[39] Moreover, reduction of dietary salt intake by half a teaspoon was associated with a reduction of cardiovascular events, including stroke by 20%.[40] Similar findings were observed in a double-blind randomized controlled crossover trial in 20 stage 3–4 CKD patients with hypertension.[41] The low sodium intervention contributed to statistically and clinically significant decreases in 24-hour ambulatory BP (SBP/DBP of −10/−4 mm Hg) in addition to decreases in extracellular fluid volume, albuminuria, and proteinuria. Reducing sodium intake to 2000 mg (5 g of salt or 87 mmol of sodium) per day can have considerable benefits in controlling hypertension as well as

reducing the risk of stroke.[42]

In addition to salt reduction, fat supplementation, and the intake of trans fat, and partially hydrogenated oils, present in most animal-derived foods in the diet should be avoided. The intake of foods rich in monounsaturated fatty acids should be encouraged, many of which are plant-derived.[15] A prospective study of United States (US) healthcare professionals with at least 1 risk factor indicated that the replacement of animal protein with plant protein was associated with a reduced rate of mortality from stroke.[16] The consumption of plant-derived omega-3 polyunsaturated fatty acids (from vegetable oils such as walnut, flaxseed, olives, or soybean) led to a decreased stroke risk according to an observational study.[43] According to population data from the ARIC study, food derived from plant sources (eg, vegetables, nuts, peanut butter, whole-grain bread) were associated with a lower mortality rate due to stroke. Dose-dependent inverse association between higher fruit and vegetable intake and reduced risk of total, ischemic and hemorrhagic stroke was found possibly due to improved microvascular function.[44] Fruit and vegetable intake should be increased to five servings a day to ensure adequate intake of some dietary fibers, minerals, vitamins, and other nutrients.[15] They alleviate the risk of stroke by reducing BP levels, improving insulin function, lipid profile fibrinolysis, inflammation, and endothelial function.[45-47]

An increase in potassium intake of 10 mmol/day led to a 40% reduction in stroke mortality.[48] Studies have indicated that a higher potassium intake is associated with a reduction of stroke risk by 21%.[49] Every increase in potassium intake by 1 g per day resulted in a reduction of stroke risk by 11%, mediated by the reduction of BP.[50] Dietary potassium intake should be increased possibly to 100 mmol (3.9 g)/day.[15] Consumption of dietary sources rich in potassium such as avocado, banana, and legumes should be encouraged.[51,52] Additionally, an inverse association was found between dietary magnesium intake and ischemic stroke risk.[53] Polyunsaturated fatty acids, vitamin D and B, potassium, calcium, and magnesium in fish may have favorable vascular effects.[54] An adequate dietary calcium intake is also recommended according to age.[15] This may be attained in the context of a balanced diet through lower-fat milk and dairy products, vegetables, legumes, and calcium-rich drinking water.[15] A systematic review on stroke risk reported that the antioxidant vitamins- folic acid, vitamin B complex, and vitamin C were associated with a lower risk of stroke, as a result of a reduction in endothelial dysfunction, inflammation, and hypertension.[19]

A recent study reported that high plasma levels of lycopene (e.g., found in tomatoes) reduced the risk of stroke by 50%.[55] Chocolate consumption was associated with a lower rate of stroke and CVD, possibly mediated by the anti-inflammatory and antithrombotic effects, increased high-density lipoprotein (HDL), decreased low-density lipoprotein (LDL) oxidation, improved endothelial function, and reduced BP.[56] Moderate caffeine intake is associated with a lower risk of total and ischemic stroke, with consumption of 3–4 cups of coffee or tea (particularly green tea) shown to reduce the risk of stroke in hypertensives.[57] Consumption of sweetened beverages is associated with an increased risk of total and ischemic stroke.[15]

Dietary Approaches to Stop Hypertension (DASH), the American Heart Association, and the United States Department of Agriculture (USDA) food pattern diets promote a high intake of vegetables and fruits, legumes, olive oil, fish, and low dairy intake with a reduced content of saturated and total fat, which is commonly found in a Mediterranean diet pattern, and have been shown to reduce the incidence of stroke by approximately 20-30%.[58] Mixed nuts (6 weekly servings of 30 g) were also associated with a decreased stroke incidence.[58] Nuts improve markers of oxidation, inflammation, and endothelial function. The Mediterranean dietary pattern has also been associated with improved BP because of its optimum content of oleic acid.[59]

Thus, adopting simple measures such as avoiding egg yolks, instead consuming more egg whites, limiting the consumption of meat from any animal to a small serving every alternate day, reducing the consumption of red meat, and instead increasing the consumption of healthier alternatives such as fish and chicken, using whole grains, and avoiding hydrogenated oils (trans fats), sugar, refined grains, and potatoes, can significantly contribute in reducing the risk of stroke in hypertensive patients.[15]

Reduction in alcohol consumption

Alcohol consumption should be in accordance with the 2020-2025 Dietary Guidelines for Americans (i.e., healthy adults should limit alcohol consumption to 2 drinks or fewer in a day for men and 1 drink or fewer for women),[60] which may reduce the risk of stroke by 30%.[3] Moreover, Canadian low-risk drinking guidelines recommend that alcohol consumption should not exceed 14 standard drinks per week for men and 9 standard drinks per week for women.[42]

Physical activity

Engaging in regular, moderate to vigorous physical activity (PA) reduces the risk of developing non-communicable diseases such as blood lipid abnormalities, DM, obesity, and BP in certain hypertensive groups, thus favorably modifying a major risk factor for stroke.[61] Aerobic exercise equal to or greater than 50% of one's maximum capacity can be "protective" against CVD.[62] Additionally, each metabolic equivalent (MET) increase in exercise capacity contributed

to an 18% reduction in stroke-associated mortality risk.[63] Engaging in regular exercise can therefore be a critical behavior that mitigates the risks of developing stroke. Compared to physically inactive individuals (<600 MET metabolic equivalents minutes/week) those who are highly active (>8,000 MET minutes/week, or approximately 2 hours of daily vigorous activity 3-4 times a week) are estimated to have a 25-30% lower risk of stroke.[64] Adults should get at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity each week, or a combination of the two.[64,65]

Smoking cessation

Among smokers, cessation leads to a decrease in stroke risk to levels similar to non-smokers by 5 years.[66] Stroke risk was reduced by 50% one year after quitting smoking, and was comparable to that of non-smokers five years later.[3] The most effective method of cessation is a combination of behavioral therapy, nicotine replacement therapy, and social support.[67]

Weight Reduction

A reduction of 1 kg body weight is associated with a 2/1 mmHg BP reduction.[68] However, stroke mortality is also increased in underweight patients.[3] To date, however, randomized trials on risk modification by weight reduction are lacking. Weight loss strategies should encompass a multidisciplinary approach that includes dietary education, increased physical activity, and behavioral intervention.[69] Maintenance of a BMI of 18.5 to 24.9, and waist circumference < 102 cm for men and < 88 cm for women) is recommended for non-hypertensive individuals to prevent hypertension.[42]

Stress management

Individualized cognitive behavior interventions should be advised.[42] In hypertensive patients, stress management should be considered as an intervention.

Awareness

Gorelick has discussed "windows of opportunity" for the reduction of stroke risk.[70] In his paradigm, the optimal time to control risk factors is in preadolescence or adolescence when lifelong behaviors are being ingrained. Lack of social support, social isolation, and low literacy skills have been negatively associated with adherence to interventions aimed at risky health behavior.[71] Studies have shown that smoking cessation is not easily achieved in stroke patients with cessation rates as low as 11% after twelve months.[72] Cognitive impairments like a lack of motivation and initiative may present a further challenge to high-risk patients trying to change their lifestyle.[73] For risk communication and risk management to be successful, there should be a two-way discussion, providing patients with resources and support to facilitate risk reduction behaviors.[74] Promoting public awareness and public health initiatives against sodium consumption could be a highly cost-effective strategy.

CONCLUSION

Key lifestyle modifications associated with stroke reduction include the effective control of blood pressure through the adoption of dietary changes, including salt restriction and eating a diet rich in fruits, vegetables, and low-fat dairy products, weight reduction, smoking cessation, moderating alcohol consumption, and exercising regularly. Modest weight loss in obese patients can bring hypertension and hyperglycemia under much-improved control. Even if pharmaceutical therapy is optimized to modify risk factors for stroke, the most effective means of reducing stroke risk are those incorporating lifestyle changes. When feasible, this should be the first approach taken with patients.

END NOTE

Author Information

1. Aiman Perween Afsar
Maulana Azad Medical College, Delhi, India
Email ID - afsaraiman@gmail.com
2. Anish Tayal
University College of Medical Sciences, Delhi, India
Email ID - anishtayal3@gmail.com
3. Binita Goswami
Maulana Azad Medical College, Delhi, India
Email ID - binita.dr@gmail.com

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