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Green tea and stroke prevention: Emerging evidence

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Summary
Background: Stroke is a leading cause of morbidity and mortality in many countries. Green tea is a simple and inexpensive beverage that is showing promise in the prevention of several diseases, including stroke. However, epidemiological studies examining the preventive effects of tea on stroke have generated inconsistent results.
Objective: To review the emerging evidence for green tea in stroke prevention.
Methods: Published articles were located by searching the PubMed, ProQuest, CINAHL and other databases, using the keywords 'tea' and 'stroke' with no restriction on publication date. Reference lists of identified articles were also searched for relevant publications.
Results: Two published epidemiological studies on green tea reported positive findings. A large number of studies have also proposed biological mechanisms by which tea or tea components may reduce the stroke risk. Additional studies are required from a variety of populations, assessing duration and different types of tea consumption on subtypes of stroke to provide further evidence.
Conclusion: Green tea is a safe and cheap beverage. Its consumption should be encouraged because it could potentially serve as a practical method for stroke prevention.

Introduction

Stroke is a leading cause of morbidity and mortality in many countries.[1] Stroke consists of three main subtypes, ischemic stroke, intracerebral haemorrhage and subarachnoid haemorrhage,[1] with ischemic stroke accounting for the majority of cases.[2,3] The societal cost attributed to stroke is immense, so that great interest exists in new methods of prevention.[2] The aetiology of stroke is multifactorial, with each subtype having a different risk factor profile.[3,4] However, there remains potential for stroke prevention through dietary factors. Green tea is a simple and inexpensive beverage that is showing promise in the prevention of several diseases.[5] Tea, especially green tea, contains a number of compounds such as flavonoids and theanine that possess strong antioxidant properties and could potentially play a role in the prevention of stroke.[6]

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Epidemiological studies examining the preventive effects of tea on stroke have generated inconsistent results. However, two published studies on green tea reported positive findings.[7,8] A large number of studies have also proposed biological mechanisms by which tea or tea components may reduce the stroke risk. Such mechanisms involved reduced hypertension, atherosclerosis and thrombogenesis, all being established risk factors of stroke.[3] This paper aims to review the evidence of green tea and green tea components in stroke prevention. Although epidemiological evidence for the preventive effect of green tea is the focus of this review, mechanistic evidence from human, animal and in vitro studies as well as limitations of current studies are also considered.

Methods

Published articles were located by searching the PubMed, ProQuest, CINAHL and other databases, using the keywords 'tea' and 'stroke' with no restriction on publication date. A total of 85 articles related to the topic were located. The reference lists of identified articles were hand-searched for further relevant publications. However, only English language articles were retrieved. Pertinent articles were summarized and additional references were cited after carefully reviewing their contents.

Results

Our literature searches found six epidemiological studies specifically investigating tea and stroke risk. This included one cohort study examining green tea, three cohort studies examining tea (unspecified or mainly black tea consumption), one case—control study on tea (unspecified type) and one cross sectional study assessing green and black tea separately. Five cohort studies were located concerning tea components and stroke risk, four of these focused on flavonoids while one study examined the effect of catechins. After briefly reviewing the components and types of tea, findings from these epidemiological studies are presented, followed by evidence from human, animal and in vitro studies that provide the biological mechanisms of green tea action.

Tea components and types

Tea is the second most common beverage in the world after water.[9] Of the total tea produced and consumed worldwide, 78% is black, 20% green and 2% oolong.[10] Black tea is primarily consumed in Western countries, while green tea is mainly consumed in China, Japan, India and a few countries in North Africa and the Middle East.[11] Oolong tea is the main tea beverage in Southern China and Taiwan.[12] The taste of all types of teas can be attributed to the presence of many amino acids, in particular 5-*N*-ethylglutamine (found only in the free amino acid form), also known as theanine. Theanine reportedly makes up approximately 1—2% of the dry weight of tea.[13] Tea contains many components that have demonstrated antioxidant activities and may be related to a reduced risk of stroke.[14—16] The potential benefits of tea are most commonly attributed to catechins, a category of polyphenols in tea including epicatechin, epicatechin-3-gallate, epigallocatechin and epigallocatechin-3-gallate (EGCG). EGCG is the major component, accounting for 40% of the total polyphenol content in green tea extract.[17] It is considered to be the most abundant and active constituent. While different types of tea are originally derived from the same plant, *Camellia sinensis*, they undergo different manufacturing processes, changing the profile of compounds. Green tea leaves are steamed when harvested to prevent fermentation, oolong tea is partially fermented, whereas black tea leaves are allowed to wither and are rolled and crushed, initiating fermentation of the polyphenols present. This process results in oxidation of simple polyphenols to complex compounds such as theaflavins and thearubigins, and reduces the catechin content of black tea to approximately a third of that in green tea.[17] In contrast to green tea, by dry weight, a cup of black tea contains only 3—10% catechins, 2—6% theaflavins, and >20% thearubigins.[18] Therefore, consumption of different types of tea may have varying effects on stroke prevention.

Epidemiological studies on tea and stroke

Green tea and stroke

The effect of green tea on stroke has not been investigated comprehensively in the literature. Table 1 summarizes and compares all epidemiological studies on tea and stroke. A cohort study conducted in Japan first reported an inverse association between tea consumption and stroke.[7] It specifically examined the relationship between green tea consumption and stroke in 5910 women aged 40 years and over. The incidence of stroke was 5.5 times higher for women drinking no green tea relative to those drinking five or more cups daily. More recently, a cross-sectional study conducted in China examined tea drinking habits including dose and type of tea consumed by 14,212 people aged 35—60