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Short Commentary

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Hemorrhagic Stroke: Why can a Low-Intensity Stroke Lead to Extensive Cerebral Hemorrhage?

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Abstract

Currently, there is no definitive opinion on the advantage of surgical treatment of hemorrhages over their medical treatment. However, there is an experimental and theoretical justification for early surgical intervention. The question is discussed: why low-intensity hemorrhagic stroke (micro stroke) can lead to extensive cerebral hemorrhage. The data obtained by the authors of the article are presented that blood serum albumin under conditions of excess glutamate (Glu) and activation of Nitric Oxide (NO) synthesis can lead to further death of nerve cells by the mechanism of necrosis. Such conditions arise during the release of an excess amount of Glu, the formation of NO/NO2 under conditions of nitrosative and oxidative stress. Among famous people (VIP) in the 20th century, many political, state, military and party leaders died of hemorrhagic stroke. Known literature data on these individuals, supplemented by experimental data, may indicate that there is no non-life-threatening local cerebral hemorrhage.

Keywords: Reactive species of nitrogen and oxygen; Hemorrhagic and ischemic strokes; Neurons; Blood serum albumin; Micro strokes and strokes

Short commentary

Hemorrhagic stroke is five times less common than ischemic stroke, but deaths from it are much more frequent [1-7]. This is due to the rapid development of cerebral edema and displacement of the brain tissue by a hematoma (accumulation of blood). Hemorrhagic stroke is the second most common after ischemic stroke. The high-risk group (95% of cases) includes smokers over 50 years of age, suffering from chronic inflammatory diseases, hypertension, overweight and sleep disturbance. Due to constant changes in blood pressure under conditions of nitrosative and oxidative stress that occurs in chronic inflammatory diseases, the vessel wall becomes thinner, and at some point it completely or partially ruptures [6-8].

A micro stroke is a micro damage and disruption of the brain as a result of a lack of oxygen. It does not cause significant harm, but is an indicator of various disorders. At the same time, doctors often do not call such a disease as a micro stroke. Now they are increasingly inclined to believe that this is the same stroke only in a mild form or a transient cerebrovascular accident. Currently, there is no definitively established opinion on the advantage of surgical treatment of hemorrhages over their medical treatment [9,10]. However, in recent years it has come to be considered that, despite the lack of definitive evidence in favor of surgical intervention, there is nevertheless a good theoretical rationale for early surgical intervention. Surgery should be considered justified in patients with moderate to large hemorrhages in the lobes or basal ganglia. Surgery is also warranted in patients with

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progressive neurological deterioration. Elderly patients with a Glasgow Coma Score less than 5, patients with brainstem bleeds, and patients with minor bleeds usually do not benefit significantly from surgery. In patients with cerebellar hemorrhages of more than 3 cm, with compression of the brainstem and hydrocephalus, or with neurological disorders due to thrombosis of cerebral vessels, the thrombus is most often surgically removed [8-10].

Among famous people (VIP) in the 20th century, many political, state, military and party leaders died of hemorrhagic stroke. In the past century, eleven (11) Presidents of the United States were believed to have died of strokes associated with cardiovascular disease. All three top leaders of the countries - F.D. Roosevelt (1882-1945), I.W. Stalin (1878/1879-1953.03.05) and W. Churchill (1874-1965), who took part in the Tehran (1943) and Yalta conferences (1945) (Figure 1), died from cerebrovascular accident. All of them smoked a lot, despite the fact that they suffered from hypertension for a long time. Roosevelt did not live to see Victory Day - at the age of 63 he developed a cerebral hemorrhage. Stalin outlived him and died at the age of 74. Churchill lived a long life (over 90 years), smoked a lot, suffered from obesity. Churchill had a series of small strokes (micro strokes), which led him to dementia at the end of his life.

Figure 1: Participants of the Yalta Conference (1945): W. Churchill, F.D. Roosevelt and I.V. Stalin (left to right).

In the 21st century, the number of US presidents who died of a stroke or coronary artery disease was again calculated. It turned out that out of fifteen US presidents since 1900 – from Theodore Roosevelt (1858–1919) to Ronald Reagan (1911–2004) – thirteen died from this disease. In the 21st century, Ariel Sharon (1928–2014) died of a hemorrhagic stroke [11-14]. He did not smoke, maintained pressure within the physiological norm, but suffered from obesity: with a height of 160 cm, in the last years of his life, his body weight was from 110 to 118 kg. After the first micro stroke on December 17/18, 2005, he returned to work 2 days later. However, on January 4, 2006, a second massive stroke occurred, which required surgical intervention [11,12]. On January 4, 2006, he fell into a coma, in which he remained until his death on January 11, 2014.

Figure 2: Ariel Sharon – Israeli military, political and statesman, Prime Minister of Israel.

In the 21st century, the attention of local and international media (media) has been focused on neurosurgeons. In the public debate that followed, it was suggested that the emergency measures (surgical treatment) were taken only because of the fame of the patient. However, there were also contrary statements that it is very difficult to make a decision on the surgical treatment of famous people (VIP). The provision of emergency care to a major government official requires the medical staff to resolve many administrative issues [12,13]. Why can even local hemorrhages in low-intensity strokes lead to catastrophic consequences?

We have obtained data indicating that blood serum albumin under conditions of excess glutamate (Glu) and activation of nitric oxide/nitric dioxide (NO/NO_2) synthesis can lead to further death of nerve cells by the necrosis mechanism [14]. These data may indicate that there is no non-life-threatening local cerebral hemorrhage. This becomes especially important when the formation of reactive forms of nitrogen and oxygen is activated, when there is an opportunity for the formation of nitric dioxide ($^{\bullet}NO_2$),$^{\bullet}$OH-radicals, and peroxynitrites, which can again turn into highly reactive $^{\bullet}NO_2$ and $^{\bullet}$OH-radicals [15]. These highly reactive radicals oxidize unsaturated fatty acids that are part of membrane lipids. After that, the membranes of nerve cells begin to be actively damaged as a result of the binding of oxidized unsaturated fatty acids by blood serum albumin.

Declarations

Conflicts of interest: The authors declare no conflict of interest.

All authors have read and agreed to the published version of the manuscript.

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