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Undergraduate

# Termination by Aphasia & Carotid Artery Disease: History and Definition

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## Abstract

*Carotid artery disease (CAD) is a serious condition that develops from as early as childhood, and the consequences can be severely disabling and life-threatening. Although uncontrollable risk factors for CAD may include family history and gender, other risk factors involve lifestyle choices, like smoking and alcohol consumption. Unfortunately, many who become aware of CAD become aware of it too late; just as in the case with Leonid Krukov in Termination by Aphasia. People like Leonid Krukov do not realize that CAD does not manifest overnight. Awareness and education of the risk factors for CAD in early adulthood is essential for preventative measures to be effective. Understanding vascular disease, including carotid artery disease, early in life will increase life-expectancy and lower the risk for stroke.*

## Termination by Aphasia

Aphasia [uh-fey-zhuh] is the inability to speak or understand spoken or written language that most often manifests as a result of brain injury or other underlying neurological disorders. Aphasia comes from the Greek aphasia meaning "speechlessness" where a- is "without," -phasis is "utterance," and -phanai is "to speak".

It is 2 a.m. and Dr. Sidney Acker, an intern, is assessing a 64 year old Russian male, Leonid Krukov, who presents to the emergency room with weakness in his right arm.

"Sir, can you tell me your name?" Dr. Acker asks the patient, but Leonid does not speak English. He appears confused and disoriented, so Dr. Acker directs her questions towards Leonid's granddaughter Lyudmila who now anxiously stands next to his gurney. *Who is your father's primary care physician? Does your father have any history of heart disease or diabetes? Is he allergic to any medication? Is he currently taking any medication, and if so what kind?*

Lyudmila is overwhelmed with the profuse questioning, but manages to answer as many as she can. She has a mild Russian accent. "His doctor is Dr. Petrov. My grandfather is very healthy man, his first time in hospital. He does not take medication. My mother give him Fish Oil before she died, I think he still takes the Fish Oil."

Leonid is telling his granddaughter something in Russian but she cannot understand it. Dr. Acker theorizes that given Leonid's age, the weakness in his right arm, the apparent trouble with speech, he is having a stroke but she cannot be sure. She calls Dr. Paulson the neurologist on call, but by the time Acker describes Leonid's condition, and by the time Dr. Paulson directs Acker to give Leonid intravenous tissue plasminogen activator (tPA), a clot-busting drug, it is too late; the four and a half hour mark after the onset of stroke symptoms has long passed. Now it is a matter of hours before Acker realizes the extent of Leonid's brain damage.

Dr. Paulson arrives to Leonid's bedside. Lyudmila is standing beside her grandfather's bed, clutching his hand, her eyes filling with moisture. "Is my grandfather going to be okay?"

Dr. Paulson assesses Leonid who is now slowly regaining his consciousness. "It appears that your grandfather had a stroke, we should run a CT to be sure but we cannot be certain of the extent of his brain damage just yet. Does your grandfather have any history of vascular disease, does he smoke?"

Lyudmila turns to her grandfather and starts to cry. "I don't understand, he is healthy man. He does not drink and never smokes." She glared at her grandfather who opens his mouth to formulate a word. . .

Oh Lyudochka, he begins, if only you knew the truth. My father was a drunken man when I lived in Russia. He beat my mother when he came home intoxicated seeping vodka out of his pores. He always stunk like vodka. He drank his way through life and then everything in it. The money. The food. The tolerance of his family, all washed away. Winters were especially hard on my mother and me. But the winter of 1957 was the hardest of all. My brother, who was three years old, died of pneumonia. I was only seven. My father drank his way through the funeral not because he was grieving, I don't think so, but because he didn't know how to keep his hands away from a bottle for more than an hour.

The next three years were by far the hardest for my mother. She was an orderly at the hospital that wasn't very far from where we lived, a two bedroom apartment mind you. At first, my mother worked during the day, then she started working night shifts, and then finally she never left the hospital it seemed. She mainly worked on call by then, covering the other orderlies' shifts, and running to work the minute the administrators called for her. It was to our advantage, financially of course, that we lived so close to the hospital but I never saw my mother. My father continued to drink. One night, he packed his clothes, stole my mother's gold earrings, the ones her grandmother gave her, took all of our savings, and fled the town with a drunken whore.

My mother was devastated. I did not know it then, but I was happy that my father left. It wasn't abandonment, it was freedom. Life became harder for us that year. My mother was embarrassed that the debaucherous man left her. The neighborhood women pointed and laughed.

I woke to the first fall of snow on a Saturday morning, a day when I usually played soccer or climbed trees. But instead of running towards the school's playground, I walked with my mother to the bazaar. She left me at the entrance of the large market and I watched her limp toward the hospital. I stood next to the babushkas in the bazaar holding a large plastic bag of sesame seeds in one hand and a zipper pocket in the other. I spent that morning selling those seeds and conversing with the babushkas until I saw my mother walk towards me. I was only ten years old. From then on, I spent every Saturday standing next to the babushkas at the bazaar entrance, and when I did not have school I stood there from Monday to Friday. The bazaar was closed on Sundays.

Do you remember when I took you to Moscow Lyudochka? It was in January. You complained that you would freeze before you returned to America. I stood in the bazaar entrance on most mornings in November, December, January and February, so you can imagine the cold. You must understand then why I did what I did, and continued to do. I saved a nickel each day I worked except on those rare short days when my mother relieved me from talking to the babushkas by 2 p.m. and sent me home to finish my studies. It took me a week, on average, to save 75 kopeek and pay for a pack of cigarettes. I never

drank, I could not be like my father, but Lyudochka I have smoked my entire life. Not around you of course, your mother would never allow it, but smoking was the only way I could spend those frigid winter days next to the babushkas. Why didn't they need that small white roll of tobacco? Well Lyudochka, don't be so naïve, those babushkas had layers of insulation – they were prepared for the cold – but I barely weighed 30 kilograms.

Eventually my mother earned the equivalence of her lost savings. She knew that I smoked but she did not stop me, as long as you never drink like your father son, she used to say to me. For a few years I only smoked when I worked. Some babushkas did not mind it because I reminded them of their own sons, but others fled to the other side of the bazaar. As I got older though, I did not know my life without a cigarette, even when I met your grandmother. She did not mind me smoking either, as long as you don't smoke near the children she would say.

This is why you never knew Lyudochka. Your grandmother protected your mother, thereby protecting you from my rotten habits. Call Dr. Petrov, he will tell you my medical history. He will say that I have atherosclerosis and hypertension, and that I was probably due for a carotid ultrasound for the bruit in my neck. I tried my best to take all my medication like the aspirin and Lipitor to lower my cholesterol that your grandmother, and then your mother, used to hide in those Fish Oil bottles. But what I should have done, long ago, was quit smoking. I couldn't. Don't blame me, and please don't be surprised. My only regret now, Lyudochka, is this thing called aphasia.

## Carotid Artery Disease: History and Definition

Peripheral Arterial Disease (PAD) is a condition in which blood vessels are lined with atherosclerotic plaque (or hardening of the arteries). It is defined as "the obstruction or narrowing of the lumen of the aorta and its major branches" which disrupts blood flow throughout the body<sup>6</sup>. Although PAD can affect any artery in the human body, it most commonly affects the carotid, innominate, vertebral (neck arteries), subclavian, celiac, mesenteric and femoral arteries. Thus, carotid artery disease is one manifestation of PAD.

Carotid artery disease (CAD), also referred to as carotid artery stenosis, is a condition in which the carotid arteries become narrowed or blocked. The term carotid [kuh-rot-id] originated around 1660-1670 and was named by the Roman physician, surgeon, and philosopher Aelius Galenus (or better known as Galen) after he observed that the compression of the carotids caused stupor, thus the term *carotid* arose from the Greek *karotides* in which *karos* means heavy sleep, explaining the stupor. Artery [ahr-tuh-ree] is Latin from the term *arteria*, meaning "windpipe", and Greek from *aer*, meaning "air". This term originated around 1350-1400. Until the 1500s it was believed that arteries carried air because physicians at that time did not observe any blood in the vessels after death. And although William Harvey (1578-1657), an English physician, later clarified "in his explanation of the body's circulatory system" that the arteries did, in fact, carry blood and not air, the term *artery* was not corrected to be etymologically accurate<sup>1</sup>. Disease [dih-zeez] is Middle English, and this term originated around 1300-1500. Carotid artery disease is a serious condition that may become life-threatening; therefore a complete definition of this disease and a thorough understanding of its implications may prove to be life-saving. Although the fatal consequences of CAD emerge later in

life, unless brain damage is due to severe trauma, the onset of the disease manifests early – sometimes as early as childhood.

The carotid arteries are located on both sides of the neck. They are referred to as the "neck arteries" and there are three types: the common carotid arteries, the external carotid arteries, the internal carotid arteries. The right and left common carotid arteries differ in position from each other and the location of their origin. The right common carotid artery arises from the innominate artery and is located behind the right sterno-clavicular articulation. The left common carotid artery, on the other hand, arises from the highest part of the aortic arch and is therefore longer than the right common carotid artery<sup>3</sup>. The external carotid arteries originate across the thyroid cartilage and take a slight curve while passing upward and forward, and then inclining backwards to an area between the "condyle of the lower jaw and the external meatus" where they bifurcate into the temporal and internal maxillary arteries<sup>4</sup>. The internal carotid arteries, which supply blood to the anterior region of the brain and the eyes, bifurcate from the common carotid arteries. The size between the internal and external carotid arteries is similar but the internal are larger<sup>5</sup>.

The carotid arteries are the major supply of oxygenated blood to the brain, face and head. The internal carotids carry oxygenated blood to the brain, while the external supply to the face, scalp and meninges. The primary concern of carotid artery disease is embolization.

An embolus is a traveling clot that may have dislodged from a diseased vessel, usually a carotid artery, which may cause temporary or permanent brain damage. Patients with CAD may experience what is called a Transient Ischemic Attack (TIA) if the blood supply to the brain or portions of the brain is inadequate. A TIA is a warn-

ing sign of a stroke – a short lived (up to a 24 hour) period of time in which a patient experiences stroke-like symptoms; however, it does not usually cause any permanent brain damage. On the other hand, if the blood supply to the brain or portions of the brain is completely restricted, then patients are most likely to experience a stroke, also known as a cerebrovascular accident (CVA). A stroke is the necrosis of brain tissue that may cause permanent brain damage. There are two types of strokes, Ischemic and Hemorrhagic.

An ischemic stroke is caused by a blood clot that is formed in an artery and restricts oxygenated blood from entering the brain. The clot can be either embolic or thrombotic. An embolic clot travels to the brain from a different part of the body, whereas a thrombotic clot does not; it is formed within the artery that is affected.

Blood that pools in or outside the brain causes a hemorrhagic stroke. There are three types. The first is an intracerebral hemorrhage which occurs when a blood vessel bursts and causes severe bleeding. The second is a subarachnoid hemorrhage which occurs when a blood vessel bursts outside the brain, causing the excess blood to increase intracerebral pressure and damage brain cells. An aneurysm, a blood filled sac within a vessel, causes the third type of hemorrhagic stroke. Aneurysms pose significant threat to life since the sac may rupture, as the weakness of the vessel's wall allows augmentation, and result in uncontrollable bleeding.

Risk factors for developing carotid artery disease are the same as for peripheral vascular disease (PAD), which include smoking or tobacco use, high cholesterol, atherosclerosis, hypertension (HTN), diabetes mellitus (DM), obesity, diet, a sedentary lifestyle, family history and age.

Smoking or tobacco use is one of the leading risk factors for carotid artery disease. Smoking decreases oxygen levels in blood and in turn forces the heart to work

harder. This increases the risk of blood clot formation (which can be either embolic or thrombotic), hypertension and atherosclerosis.

Cholesterol, one of the components of plaque that is formed within the arteries, is a fat substance that is naturally produced by the liver and is found in certain foods. When high levels of low density lipoproteins (LDL), or *bad cholesterol*, accumulate, the arterial walls harden, a condition referred to as atherosclerosis. Atherosclerotic carotid arteries may lead to a TIA or CVA depending on whether the damage to the brain tissue is temporary or permanent.

Hypertension, commonly known as high blood pressure, is an increased force of blood that pushes against the arterial walls. This induces the heart to pump harder which weakens and puts unnecessary stress on blood vessels. Vessels under hypertensive stress harden and begin to deteriorate, and in turn fail to provide oxygenated blood to body tissues. These vessels may also undergo separation of the arterial wall layers, a condition known as arterial dissection. If the carotid arteries become dissected, and are further aggravated by hypertension, the risk for stroke significantly increases.

Although diabetes mellitus (DM) is a risk factor for carotid artery disease, it is mostly associated with PAD. Insulin resistance or the lack of insulin production by the pancreas causes diabetes, a disorder that is associated with blood sugar metabolism. There are three types of diabetes: Gestational, Type I and Type II diabetes. Gestational diabetes emerges in childbirth. Type I diabetes is insulin dependent which means that the pancreas does not produce enough insulin; this is detected at a young age. Type II diabetes is commonly associated with patients who are diagnosed with peripheral vascular disease. This type of diabetes is not insulin dependent; it is most often developed as a result of excess adipose tissue, obesity.

Obesity, diet, and sedentary lifestyle are risk factors for developing heart disease, hypertension, high cholesterol levels, type II diabetes, and stroke. Age and family history are uncontrollable risk factors that may also lead to the development of peripheral vascular disease and the conditions that result from PAD. Although it is more common for people over the age of 65 to have carotid artery disease as a result of PAD, and suffer the consequences of vascular disease such as TIA or stroke, young people who have been through a severe trauma to the head and neck are also at risk for stroke.

Carotid artery disease is diagnosed based on two classifications; either (1) symptomatic carotid artery stenosis (CAS), or (2) asymptomatic (CAS). Asymptomatic CAS, (without symptoms) often occurs when the plaque build-up in the carotid arteries is very minimal. Asymptomatic CAS is not usually treated with interventional therapy, but it is monitored via ultrasound to supervise against progression, and treated with medication. Patients who do not show symptoms of CAS commonly take medication such as aspirin (blood thinner medication) and statins (cholesterol reducing medication) to prevent the risk for stroke. Symptomatic CAS (with symptoms) is immediately treated with interventional therapy because it is a strong indicator of high risk for stroke. Symptoms of CAS may include light headedness, dizziness, and stupor. But more severe symptoms, or symptoms of a TIA, include: sudden weakness or clumsiness on one side of the body, sudden paralysis of one side of the body, loss of coordination, confusion, dizziness, fainting, headache, numbness in the face or one side of the body, temporary loss of vision and inability to speak clearly<sup>7</sup>. Patients who experience one or many of these symptoms, and those who have a history of PAD and especially carotid artery disease should be urgently evaluated by a vascular

surgeon.

Patients who present with evident warning signs of stroke will be immediately admitted to the hospital for a procedure called carotid artery endarterectomy (CAE). But patients who present with symptoms of CAS, which includes TIAs or other less evident symptoms such as stupor, will undergo further testing via doppler ultrasound, magnetic resonance angiography (MRA), and, or bilateral carotid angiography to confirm the diagnosis and evaluate the severity of stenosis to determine proper treatment. If the severity of the blockage or narrowing in the carotid arteries is relatively minimal in a symptomatic patient, the vascular surgeon may decide to perform a stent placement in the carotid arteries while performing the angiography. Contrary, if the severity of stenosis poses a threat for stroke (which is often classified as 70% stenosis or more) the vascular surgeon may decide that performing a CAE is in the best interest of the patient.

Carotid artery endarterectomy is the most aggressive surgical treatment for carotid artery stenosis. It involves dissecting to the affected artery and surgically removing the plaque within the vessel. The patient will be placed under general anesthesia and prepared and draped in a sterile fashion. First, the vascular surgeon will make a small incision on the side of the neck of the affected artery to expose it. Then, the surgeon will insert a shunt that is placed above and below the artery of the affected area to reroute blood flow. A small incision will be made to open the carotid artery and carefully remove the plaque in one piece. The surgeon may use a superficial vein from the patient's leg to sew over the artery, which is known as a patch, to widen or repair the blood vessel. At the end of the procedure, the surgeon will remove the shunt, check for bleeding and ensure that the artery is well perfused prior to closing. If there are any complications during or after surgery, patients may stay

in the hospital for a few days to be monitored, but usually they are discharged the next day.

Some of the risks associated with carotid artery endarterectomy include stroke and even death. Stroke may occur during the procedure because there is potential for the plaque to dislodge and travel to the brain during the time that the surgeon inserts the shunt to remove the plaque. Although there may be other less common risk factors for this procedure, the techniques for carotid artery endarterectomy are advanced and complication rates are relatively low, but this is a very serious procedure, therefore this level of treatment is preferred to be avoided through preventative care and risk factor modifications.

It may appear that only people over the age of 65 and their caregivers should be concerned about this disease; people of all ages should be well educated about CAD. In fact, according to the Centers of Disease Control and Prevention 34% of people were hospitalized for stroke in 2009 who were younger than 65 years of age, and stroke is estimated to cost the United States \$35.6 billion each year<sup>8,9</sup>. To lower

the risk for stroke as well as annual cost, education of vascular disease should be implemented early since the development of PAD begins with the choices people make early in life. Choices, among many, such as smoking, lack of physical activity, poor diet, sedentary lifestyle, and alcohol and drug use. In fact, plaque buildup may begin in early adulthood and once the consequences of these poor choices become apparent, it is too late for preventative care. Granted, there are risk factors that are not-controllable including gender, family history, race. Nevertheless, understanding the controllable risk factors for PAD, and in turn CAD, early in life may prolong life expectancy significantly and lower the risk for long-term disease by implementing prevention measures (i.e. increasing physical activity, practicing a well-balanced diet, and refraining from smoking, etc.).

Preventative care for Leonid Krukov was too late; he needed to quit smoking long before to lower his risk for stroke. In fact, if he managed his vascular disease properly, and, better yet, if he was not a chronic smoker, he may not have had that stroke.

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## Emma Tkachuk

Emma Tkachuk is a human biology major and a writing minor at UC Merced. She is originally from Ukraine, and has lived in California since 2002 after immigrating to the United States. Her interest in health sciences had led her to focus on human biology, but after taking a few courses in writing she developed an interest in writing both fiction and nonfiction. Her paper on Termination by Aphasia and Carotid Artery Disease: History and Definition is a way to combine fiction and writing in the health sciences respectively.