

VIEWPOINT

Carotid Physiology and Neck Restraints in Law Enforcement

Why Neurologists Need to Make Their Voices Heard

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"I can't breathe" has become an international rallying cry against police brutality after the high-profile murders of Eric Garner on July 17, 2014, and George Floyd on May 25, 2020. These powerful and tragic words have been uttered by dozens of other people, predominantly Black and brown people, across the country under similar circumstances involving vascular "neck restraints" or "carotid restraints": James Thompson, Allen Simpson, Rodney Lynch, Dustin Boone, Roger Owensby Jr, Carl Glen Wheat, Gerald Arthur, and Torris Harris.

As neurologists, we have been inculcated with the adage "time is brain" throughout our training, emphasizing the rapid loss of human nervous tissue with each second that flow of oxygen to the brain is reduced or stopped. In a stroke, where there is an abrupt interruption of blood flow to the brain, the typical patient loses 1.9 million neurons each minute in which stroke is untreated.¹ George Floyd was not killed by a stroke; nonetheless, we found ourselves considering the profound neurologic value of time once again as Derek Chauvin knelt on George Floyd's neck for 8 minutes and 46 seconds.

Police departments across the United States allow for officers to use neck restraints such as the one Chauvin used, with the goal of temporarily rendering a person unconscious or incapacitated. There are 2 types of neck restraints, one involving enough pressure to restrict the airway (chokehold) and another restricting blood flow to the brain by applying pressure to both sides of the neck (stranglehold). These tactics involve using an officer's arm to restrain someone's neck, pressing or laying on a person's back to keep their face down, or knee-to-neck holds.² Here, we review the potential neurologic sequelae of any restriction of blood flow or oxygen to the brain and call for a radical examination of the safety or appropriateness of use of neck restraints by law enforcement. While these techniques are widely used by law enforcement, presumably without harm, the lack of reporting regarding the frequency of medical complications makes it impossible to determine whether this procedure is indeed safe, as it is believed by some, or whether the harm caused is simply not documented. At the very least, there should be transparency about the number of times neck restraints are used and systematic collection and reporting of resulting outcomes, including policy custody deaths and disability.

The human brain generally demands at least 15% to 20% of the total blood in circulation, with some brain structures vulnerable to permanent ischemic damage when this amount falls to even half that.³ Approximately 70% of the blood to the brain flows through the carotid arteries, which is about 600 to 700 mL of blood flow through the carotid arteries every minute.⁴ A 2012

study of the carotid restraint tactic found that the most important mechanism for loss of consciousness was decrease of this cerebral blood flow.⁵ While the singular importance of cerebral perfusion has driven many adaptive mechanisms to preserve this blood supply,^{3,6} there is no failsafe for bilateral loss of carotid artery blood flow. Additionally, stimulating the carotid sinus baroreceptor may cause bradycardia, hypotension, and decreased cerebral blood flow.⁵ Interruption of blood supply to the human brain for as little as 4 seconds can lead to a loss of consciousness. A force of only 6 kg is needed to compress the carotid arteries, which is about the average weight of a household cat or one-fourteenth the average weight of an adult male.⁷

Carotid compression and occlusion have long been understood by researchers and clinicians to cause pathology. In veterinary science, canine models with such carotid pathology have been used as stroke models⁸ and more simply as models quantifying lasting effects of external compression on intracranial circulation using transcranial Doppler studies.⁹ Clinically, decreased cerebral blood flow through carotid compression can cause devastating disability or, if prolonged, death. Compression can also result in a carotid plaque becoming dislodged, embolizing to the brain, and leading to massive stroke. Seizure is another potential complication.

Additionally, mechanical trauma to the cervical blood vessels can cause cardiologic and delayed neurologic sequelae. Arterial dissections may occur and lead to stroke weeks later, making it difficult for the survivor and health care professionals to associate the stroke with the chokehold event.

The negative health consequences of carotid manipulation are not a matter of "dose": neither the duration nor the strength of the force applied fully mitigate potential health risks. Even gentle manipulation of the carotid arteries to control a rapid heart rate vis-à-vis a "carotid massage" has fallen out of favor because of risk of iatrogenic harm to the patient, even at the hands of master clinicians with decades of experience.¹⁰ Carotid massage in rare cases may lead to deadly arrhythmias such as ventricular fibrillation.⁸

In short, the implication that there is a safe way for law enforcement to restrain using carotid manipulation, or traumatic manipulation of cerebral blood flow in any form, is simply false. Carotid compression contributes to potential neurologic sequelae via oxygen deprivation, embolic risk from mechanical vessel wall trauma, or arrhythmia. The possibility of devastating repercussions is too high to merit the use of neck restraints in any circumstance. Proponents of this law enforcement tactic claim that carotid restraint is a safer and more humane alternative to other forms of pacification.² As neurologists, we

know that the current understanding of the brain and carotid neurophysiology and clinical correlation of carotid compression do not support the safe use of chokeholds or strangleholds.

The field of medicine bears witness to the devastating ramifications of brains starved of blood and oxygen every day. We urge

our colleagues to look critically at how medical pathophysiology is misunderstood or misused to justify police brutality. We cannot allow more time to pass without using our voices to advocate for patients' best interest, and we should speak with the same urgency as when we say, "time is brain."

ARTICLE INFORMATION

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