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Vascular neck restraint: Reprieve for a bum-rapped technique

For the first time, a scientific research team has used modern technology to confirm just how a vascular neck restraint works to produce unconsciousness. The findings emphatically refute assertions that this valuable control technique is inherently dangerous and potentially lethal.

"With the majority of subjects [in the study] rendered unconscious and, importantly, [with] no serious adverse events in our subjects, we conclude that VNR is a safe and effective force intervention," writes the lead researcher, Dr. Jamie Mitchell.

He hedges that statement by cautioning that "outcomes could vary" in some populations, such as unhealthy or older subjects, who were not part of the study.

But with young, highly agitated, combative and/or drug- or alcohol-fueled resisters, who are the most likely to warrant VNR in real-life conflicts, Mitchell posited in an interview with *Force Science News* that the technique may work even faster than it did on the healthy, nonintoxicated volunteers his team tested.

The researchers bring solid credentials to the project. Mitchell and Dr. Dan Roach are PhDs, Dr. Israel Belenkie is an MD, and Drs. John Tyberg and Robert Sheldon hold both PhD and MD degrees. All are affiliated with the world-renowned Libin Cardiovascular Institute of Alberta at the University of Calgary in Canada. A/Insp. Chris Butler, a certified Force Science Analyst and presenter and watch commander with Calgary Police Service, served as law enforcement liaison for the project.

The official report of the study ("Mechanism of loss of consciousness during vascular neck restraint") appears in the *Journal of Applied Physiology*, the premium publication in that field. An abstract can be accessed free and the full article downloaded for a fee [by clicking here](#). But be warned: the description there of the study and its results is highly technical and not readily comprehensible to most laymen.

Here are the highlights in less academic language:

BACKGROUND. Although neck restraints have been around for centuries as a martial arts technique, only 2 limited studies have attempted in the past to determine exactly how VNR

works, according to Mitchell--1 in 1943, the other in 1982, long before today's sophisticated monitoring technology was at hand.

One study involved only 5 subjects, with the neck hold on each released before full unconsciousness was actually achieved. The other employed a primitive testing method "that today would be considered unethical," Mitchell says--wrapping a blood pressure cuff around the necks of prison inmates.

In the absence of hard scientific data, speculation thrived. In lawsuits against police agencies, plaintiffs' "experts" testified that VNRs "could possibly" disrupt suspects' blood pressure, breathing, and/or heart rate, possibly causing the heart to stop altogether. The media and community activists raged about deadly "choke holds" and "strangle holds," drawing no distinction between airway vs. vascular involvement. Neck restraints became the culprit de jour in "explaining" in-custody deaths.

"Administrators became understandably sensitive to the use of neck restraints," Butler says. "Some agencies banned them or placed them at the deadly force level of the force continuum."

Before earning his PhD in cardiovascular and respiratory physiology, Mitchell worked as a street cop in Calgary. He once used a VNR to gain compliance in a bar fight and found the technique effective and harmless. Since 2004 Calgary Police Service (CPS) has trained and authorized VNR operationally "without a single incident or complaint of serious injury," Butler says. "We realize that some close-quarters, empty-hand method for overcoming resistance is needed when standard pain-compliance or less-lethal options like OC and the Taser fail in gaining submission."

In 2007, the Canadian Police Research Centre issued a Technical Report that concluded that "while no restraint methodology is completely risk free, there is not medical reason to routinely expect grievous bodily harm or death following the correct application of the vascular neck restraint in the general population by professional police officers with standardized training and technique." That report was authored by Butler and by Dr. Christine Hall, an emergency room physician, prominent researcher of in-custody deaths, and Force Science instructor. [Click here](#) to access it free.

Having followed that research, Mitchell and his colleagues decided that if the physiological process by which VNR works could be precisely identified, lingering controversy and speculation about the technique might finally be resolved.

TESTING. Butler recruited 24 healthy police officer volunteers who ranged in age from 27 to 40. Three were female, none had a history of "relevant" medical problems (such as cardiac, respiratory, or cardiovascular diseases/disturbances), and all were free of medications.

In a clinical laboratory, their height, weight, and neck circumference were recorded and body mass index (BMI) calculated. One at a time they were connected to an array of noninvasive, advanced-level devices that could monitor and measure a variety of physical functions. Baseline data were collected for 2 minutes, then each participant, while seated, was subjected to a "maximum" VNR application by Cst. John Warin, a certified neck-restraint instructor with CPS's Skills & Procedures Unit.

The particular variety of VNR Warin used was the Lateral Vascular Neck Restraint(R) (LVNR) taught by the nonprofit National Law Enforcement Training Center in Kansas City, MO. Like other VNRs appropriate for law enforcement, Butler explains, it requires the bent-arm compression of the carotid arteries on both sides of the neck *"with NO compression on the respiratory structures of the throat.* The other critical factor is support or bracing of the head and neck to protect the integrity of the spinal cord."

RESULTS. Sixteen of the 24 subjects were rendered unconscious within 7-10 seconds, having experienced an 80%-83% reduction of carotid blood flow to the brain. Their loss of consciousness was signaled when their eyes locked in place, unable to continue tracking a fluorescent pen that was being moved about by one of the researchers.

Once Warin released his hold about 2 seconds after this "ocular fixation," the subjects regained full consciousness within another 2 seconds, with no harmful after-effects recorded or reported during a post-release monitoring period. At this writing, months after the experiments, no negative consequences have yet been reported, Mitchell says. Butler adds: "This is consistent with operational police experience and reinforces, from an independent medical perspective, the effectiveness and safety of the technique when properly applied."

Four of the 24 subjects tapped out before becoming unconscious, having decided they didn't want to continue with the test. Four others were released by Warin when they had not lost consciousness after about 23 seconds of application. Instrument readings showed that these subjects experienced significantly less restricted blood flow than the others, even though Warin's pressure was consistent and maximal to everyone. Mitchell suggests that some unidentified anatomical differences may have interfered with the compression in those few who failed to pass out.

Bottom line: the technique proved successful on 80% of the subjects who did not voluntarily tap out.

SIGNIFICANT CONCLUSIONS. When the research data were meticulously parsed and analyzed, these important findings emerged:

- The results "demonstrate that the [only] important mechanism causing unconsciousness during VNR is decreased cerebral blood flow due to bilateral carotid artery compression," the study team reports. Mitchell comments, "This did not come as a surprise. When the supply of blood-borne oxygen to the brain is cut off by at least 50%, the brain cannot sustain consciousness."
- Blood pressure, heart rate, and heart function were not adversely affected during or immediately after VNR application. A sensitive receptor located in the neck, which can send signals to the nervous system thereby evoking changes in heart rate and blood pressure, was not stimulated to an important physiological degree by the carotid compression, Mitchell says, despite speculative assertions about this in the past. Nor was there any evidence that blood vessels in the back of the neck were shut off during VNR, which some critics have speculated could ultimately cause the heart to stop. "Carotid compression did not threaten to produce a stroke or suffocation or create a near-death experience," Hall observes. Vital signs for all participants continued normal after the carotid compression was released and they came to, the study found.
- Respiration in some subjects was interrupted, "but apparently only because they voluntarily held their breath," Mitchell says. No blockage of the airway could be detected.

- Relatively little pressure is required to induce unconsciousness in most people with a properly applied and maintained VNR. "This is an important finding," Mitchell says, "because even the smallest officers should have no trouble attaining and maintaining the minimal pressure required."
- Subjects with bigger necks and a higher BMI tend to reach the point of eye fixation leading to unconsciousness more quickly--"important street information," Mitchell says, "that confirms anecdotal reports from trainers and officers." The reason is unclear, although he guesses that these people "may have more tissue that can be used to compress the vascular system with the same amount of pressure."
- When the technique works, it works fast. Mitchell advises: "If you are applying and holding the VNR properly and the resister is not going out after 11 to 13 seconds, the technique is probably not going to work and you should transition to another force option."
- A proper VNR inflicts only mild discomfort, but as the tap-outs during the research confirmed some subjects readily submit once the hold is in place because they sense what's coming and they don't want to experience unconsciousness. Butler says this is frequently the case in actual street encounters.

CAUTIONS. Will a VNR work as effectively on violently struggling, chemically influenced resisters as it did on the passive subjects in the lab? Mitchell theorizes that the possibility exists it may work even better because blood flow to the brains of strenuously resisting, drug- or alcohol-intoxicated individuals may already be compromised. "However, for obvious reasons, this would be difficult to test in a human model," he says.

The principal risk in a fight, as he sees it, is that an officer's hold on an adversary's neck may slip to the point that the forearm impacts the windpipe. That's why, Butler says, "the VNR needs to be properly trained and practiced so that the right positioning can be maintained under the physical and emotional stress of intense hands-on combat." Protecting the trachea, Mitchell adds, is a "huge consideration."

While the technique is considered safe in general, researchers recommend that as a precaution officers avoid its use with certain populations, except in life-threatening emergencies. As Christine Hall explains, these "sensible restrictions" include:

- **the elderly.** "They have a higher possibility of vascular disease and in general don't tolerate disturbances in cerebral blood flow well."
- **children.** "Kids aged 10 years of age or under have a different neck structure than adults, and their anatomical differences could result in neck damage."
- **persons with Down syndrome.** "They tend to have a large head for their body and an unstable head-and-neck arrangement which may increase the risk of physical injury."
- **visibly pregnant women.** "Apart from the social stigma related to using force against a pregnant woman, if you lose control and she falls there may be injury to the fetus."

Also recognize that when a subject goes out, they'll be dead weight temporarily, so be prepared to lower him/her to the ground and be protective of your own back so it is not strained, Hall advises.

In addition, she stresses that the study in no way endorses arm-bar, C-clamp, or other neck holds that stray from specific VNR parameters. "The findings cannot be used to defend these other techniques," she told *Force Science News*.

LOOKING AHEAD. For future research, Mitchell and Hall are currently designing an investigation of whether individuals with a certain heart condition may be predisposed to in-custody death, regardless of the method of restraint they are subjected to.

LESSON LEARNED? Meanwhile, as a trainer, Butler hopes the current study will "eliminate the completely unjustified, negative attitude toward the VNR" and, in the interest of officer safety, restore confidence in it within the law enforcement community. He views the technique as one of many, from the prone positioning of handcuffed suspects to the electrical discharge from the Taser, that have been bum-rapped as the cause of in-custody deaths.

Often with such deaths, "very little evidence gathered at autopsy points to the cause," he writes. "This being the case, forensic investigators are left to examine the 'proximate event'--that which occurred immediately prior to the subject's demise.

"There have been many cases where the mode of restraint as the proximate event is held responsible for the death even when little or no pathological evidence exists to demonstrate a causal relationship.

"Over the past 3 decades, restraint modalities have been modified, invented, reinvented, and even abandoned with virtually no change in the incidence of death proximal to police restraint. Yet deaths in custody continue to be ascribed to the modality of restraint, even when the mode is dissimilar from case to case.

"This cause-and-effect rationale, also called 'coincidental correlation,' which links a subject's death to the mode of restraint simply because the one occurred directly following the other, is a serious issue for law enforcement administrators. Police agencies and individual officers have been found responsible and criminally and civilly liable for subjects' deaths due to a false perception of cause when only sequence exists."

His hope is that the VNR findings will encourage stakeholders in and out of law enforcement to let science have its say before leaping to conclusions about the next use-of-force controversy that comes along.

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