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## Sudden Death Due to Neck Blows Among Amateur Hockey Players

Barry J. Maron; Liviu C. Poliac; Alan B. Ashare; et al.

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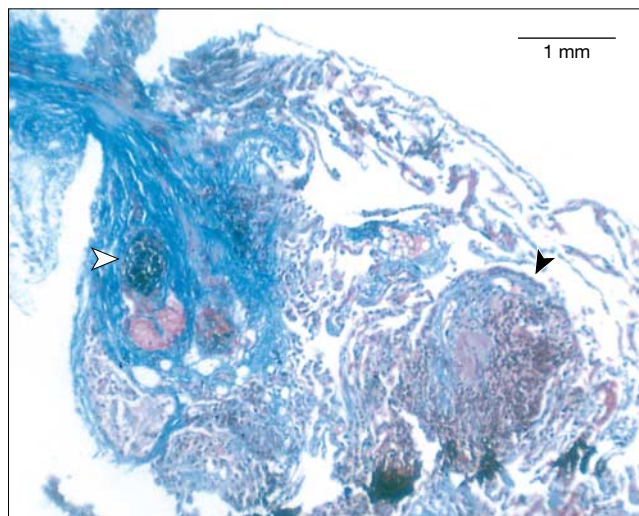
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**Figure 2.** Computed Tomography Scan of the Chest of Patient With Bronchiolitis Obliterans



Scan performed using intravenous contrast demonstrates a ground-glass, mosaic pattern with sharply demarcated borders and surrounding hypodense pulmonary parenchyma, consistent with small airway disease.

**Figure 3.** Transbronchial Lung Biopsy Specimen From Patient With Bronchiolitis Obliterans



Low-power view showing 2 obliterated airways, one with chronic inflammatory infiltrate (black arrowhead) and one with fibrosis alone (white arrowhead) (Masson Trichrome stain, original magnification  $\times 25$ ).

occur within 1 to 12 hours of exposure, while edema of the tracheobronchial tree occurs between 4 and 12 hours. High concentrations induce pseudomembranous changes in the airways, and may result in airway necrosis. The clinical course is frequently complicated by secondary bacterial pneumonias. Our patient's initial ophthalmic and ongoing pulmonary symp-

oms are consistent with exposure to a vesicant such as mustard gas.

The majority of medical reports regarding exposure to mustard gas describe the respiratory symptoms of soldiers involved in various military conflicts, including World War I and the Iran-Iraq war.<sup>3,4,6</sup> None of these reports, however, has described bronchiolitis obliterans resulting from exposure to mustard gas or among civilian populations specifically targeted by chemical warfare. We suggest that bronchiolitis obliterans should be considered in patients with respiratory symptoms who have a history of possible exposure to mustard gas.

Jason W. W. Thomason, MD

Todd W. Rice, MD

Aaron P. Milstone, MD

Division of Allergy, Pulmonary, and Critical Care Medicine  
Vanderbilt University School of Medicine  
Nashville, Tenn

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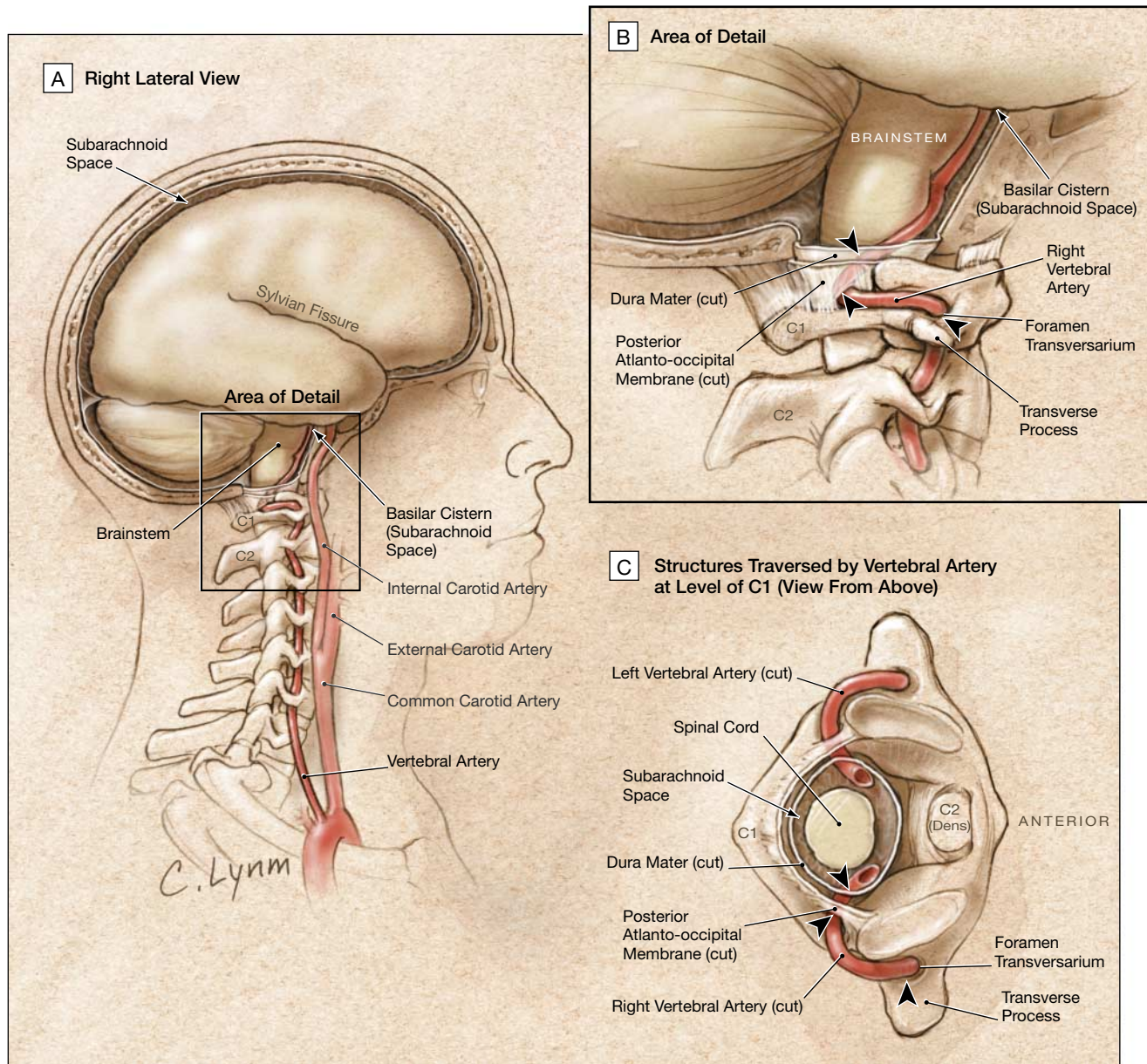
### Sudden Death Due to Neck Blows Among Amateur Hockey Players

**To the Editor:** While most cases of sudden death among athletes have been linked to a diverse group of cardiovascular diseases,<sup>1</sup> we have also reported sports-related sudden deaths triggered by innocent-appearing blows to the chest.<sup>2</sup> Here we expand the clinical profile of sudden death among athletes to include blunt blows to the neck during competitive ice hockey.

**Methods.** We assessed our prospective autopsy-based national registry of sudden cardiovascular deaths in young athletes, 1992 to 2002, composed of cases initially identified from a variety of sources including news media reports (and then subsequently tracked).

**Results.** Of the 370 trained athletes who died suddenly of defined cardiovascular-related causes,<sup>1</sup> 6 cases were selected

**Figure.** Proposed Anatomical Basis by Which a High-Velocity Blow to One Side of the Neck by a Hockey Puck May Produce Vertebral Artery (or Internal Carotid Artery) Rupture



A, Anatomy of the vertebral artery as the vessel courses through the bony canal of the foramina transversarium. B, Enlarged area of detail. C, View from above at the level of C1. In both B and C, arrowheads indicate the 3 anatomical points at which the vertebral artery is rigidly anchored as it traverses the transverse process of the first cervical vertebra through the foramen transversarium, the posterior atlanto-occipital membrane, and the dura mater. A blow to the neck by a hockey puck may produce arterial rupture where the vertebral artery penetrates the posterior atlanto-occipital membrane or the dura mater.

for the present study group. Ages were 9 to 30 years (median, 17); all were male.

During competitive ice hockey, blunt and nonpenetrating blows were delivered to the exposed right (n=4) or left lateral or posterolateral neck area (n=2), just under the mandible between the helmet and neck guard. Fatal blows were inflicted by the puck in 5 (a slap-shot in 4 and a deflected shot in one);

4 events occurred during play on the ice while one individual was sitting on the team bench. The other athlete was struck by a fist during an altercation. Each collapsed immediately and resuscitative efforts were unsuccessful.

At autopsy, death was attributed to dissection and rupture of the vertebral (n=4) or internal carotid (n=1) artery (precise location was unresolved in 1), leading to massive sub-

arachnoid hemorrhage with rapid accumulation of blood within basilar cistern, Sylvian fissures and ventricles, and brainstem herniation (FIGURE). In no individual was a cerebral aneurysm identified.

**Comment.** The scenario of virtually instantaneous death during ice hockey competition in which high-velocity blows to the neck (inflicted by pucks or fist) caused rupture of a major artery has been unappreciated. The precise mechanism by which death occurred is uncertain. Although it is possible that a blow to the neck may directly cause arterial rupture, it is also possible that it can result from reflex hyperextension and rotation of the head (triggered by an unexpected blow). The vertebral artery courses through the foramina transversarium, firmly fixed anatomically at 3 points, and vulnerable to dissection in these areas. Rapid head motion could cause arterial rupture at the rigid anchor points, instantaneously producing massive hemorrhage into the subarachnoid space, increased intracranial pressure, brainstem herniation, and termination of cardiorespiratory function (Figure). Indeed, nonfatal vertebral artery dissections have been reported with hyperextension of the neck in other sports, including football, wrestling, gymnastics, and boxing.<sup>3-5</sup>

Our novel cases, in which blows to the neck by hockey pucks produced subarachnoid hemorrhage, underscore the broad spectrum of causes and mechanisms that may be responsible for sudden death on the athletic field. Awareness of such risks to young athletes is crucial for developing an informed public and

formulating protective measures to enhance the safety of sports activities.

Barry J. Maron, MD  
Minneapolis Heart Institute Foundation  
Minneapolis, Minn

Liviu C. Poliac, MD  
Department of Anesthesiology  
University of Miami Medical Center  
Miami, Fla

Alan B. Ashare, MD  
St Elizabeth's Medical Center  
Boston, Mass

Walter A. Hall, MD  
Department of Neurosurgery  
University of Minnesota School of Medicine  
Minneapolis

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Art is a kind of innate drive that seizes a human being and makes him its instrument. The artist is not a person endowed with free will who seeks his own ends, but one who allows art to realize its purpose through him. As a human being he may have moods and a will and personal aims, but as an artist he is "man" in a higher sense—he is "collective man"—one who carries and shapes the unconscious, psychic forms of mankind.

—Carl Gustav Jung (1875-1961)