

CASE REPORT

*J. E. Smialek,¹ M.D.; J. L. Chason,² M.D.;
Vasudeo Kshirsagar,³ M.D.; and W. U. Spitz,⁴ M.D.*

Secondary Intracranial Subarachnoid Hemorrhage Due to Spinal Missile Injury

REFERENCE: Smialek, J. E., Chason, J. L., Kshirsagar, V., and Spitz, W. U., "Secondary Intracranial Subarachnoid Hemorrhage Due to Spinal Missile Injury," *Journal of Forensic Sciences*, JFSCA, Vol. 26, No. 2, April 1981, pp. 431-434.

ABSTRACT: Fresh intracranial subarachnoid hemorrhage may occur secondary to blast-type injury of the spinal cord. This phenomenon is demonstrated in four cases of gunshot and shotgun wounds involving the spinal column. The significance of such a finding is that the subarachnoid hemorrhage should not be construed to represent an independent injury. Such an erroneous conclusion could jeopardize a theory of self-defense in a homicidal shooting.

KEYWORDS: pathology and biology, hemorrhage, central nervous system

The three most common causes of subarachnoid hemorrhage are (1) head injury, (2) ruptured aneurysm, and (3) hypertension. Spinal subarachnoid hemorrhage is usually an extension of an intracranial hemorrhage. While focal lesions of the cord, such as vascular malformations, are known to produce spinal subarachnoid hemorrhage, it is not generally appreciated that trauma to the spinal cord can also result in intracranial subarachnoid hemorrhage.

Four cases are presented in which noncranial injuries from handgun or shotgun missiles caused separate, large areas of intracranial hemorrhage. The finding of a cerebral subarachnoid hemorrhage in a case of a fatal spinal gunshot injury may be misinterpreted as evidence of a separate blow to the head. Such a conclusion could place a theory of self-defense in considerable doubt. In the cases presented here, the individuals died of gunshot wounds of either the chest or the abdomen. Had the accompanying intracranial

Presented at the 31st Annual Meeting of the American Academy of Forensic Sciences, Atlanta, Ga., February 1979. Received for publication 22 Sept. 1980; accepted for publication 17 Oct. 1980.

¹Deputy chief medical examiner, Office of the Medical Examiner of Wayne County, Detroit, Mich., and clinical assistant professor of pathology, Wayne State University School of Medicine, Detroit, Mich.

²Neuropathologist, Henry Ford Hospital, Detroit, Mich., and clinical professor of pathology, Wayne State University School of Medicine, Detroit, Mich.

³Assistant medical examiner, Office of the Chief Medical Examiner, State of West Virginia, South Charleston, W.Va.

⁴Chief medical examiner, Office of the Medical Examiner of Wayne County, Detroit, Mich., and associate professor of pathology, Wayne State University School of Medicine, Detroit, Mich.

subarachnoid hemorrhage not been recognized as a secondary phenomenon, the correct manner of death in these cases might have been missed.

In each of these cases, the missile injuries involved the spine. The possibility that the spinal subarachnoid hemorrhage was the result of the spinal injury, with the blood having drained into the cerebral subarachnoid space, was initially considered. The lack of continuity between the localized spinal and the subarachnoid hemorrhages could be viewed as not supporting this interpretation. However, a sudden increase in intracranial pressure, a change in position, continued formation and adsorption of cerebrospinal fluid, or some combination of these factors could have led to separate subarachnoid hemorrhages.

Report of Cases

Case 1

During an argument involving several people, a woman accidentally shot her husband with a 12-gauge shotgun. He died within minutes.

The injury to the left lower quadrant of the abdomen measured 38 mm (1½ in.) in diameter. The wound tract involved several bowel loops, the abdominal aorta, and the lower lumbar spine. Many pellets were found at the cauda equina.

The scalp was uninjured and the skull was intact. There was no epidural or subdural hemorrhage noted. Fresh subarachnoid hemorrhage covered almost the entire lateral aspect of the right cerebral hemisphere, with patchy areas of hemorrhage on the left side (Fig. 1). There were no cortical contusions. There was spinal subarachnoid hemorrhage at the cauda equina and lower lumbar cord, but no hemorrhage was noted at the base of the brain or about the cervical or thoracic cord. Microscopic examination confirmed the fresh nature of the subarachnoid hemorrhage and excluded the presence of anoxic brain damage.

Case 2

A 50-year-old man was shot in the chest at close range with a high-powered rifle. The wound tract involved the heart, abdominal aorta, and lumbar vertebrae, and the bullet exited through the right side of the back.

The head was free of injury. Fresh, diffuse, subarachnoid hemorrhage involved the uncus and superior surface of the cerebellar hemispheres. There were no other intracranial abnormalities noted.

Case 3

An 18-year-old male shot himself in the abdomen. He was found lying on the floor with a .22 Magnum pistol at his feet. When found he was conscious, but he died 15 h after an exploratory laparotomy.

The gunshot wound was surrounded by soot. The wound tract involved the stomach, superior mesenteric vein, and the aorta. A small-caliber slug was recovered from the spinal canal at the level of the second lumbar vertebra. The injured right side of the spinal cord was surrounded by localized subarachnoid hemorrhage. A separate, fresh subarachnoid hemorrhage covered both parieto-occipital lobes of the brain. No hemorrhage was present elsewhere.

Case 4

A 23-year-old man was found alone at home with a contact shotgun wound of the left lower quadrant of the abdomen. He was dead on arrival at the hospital.

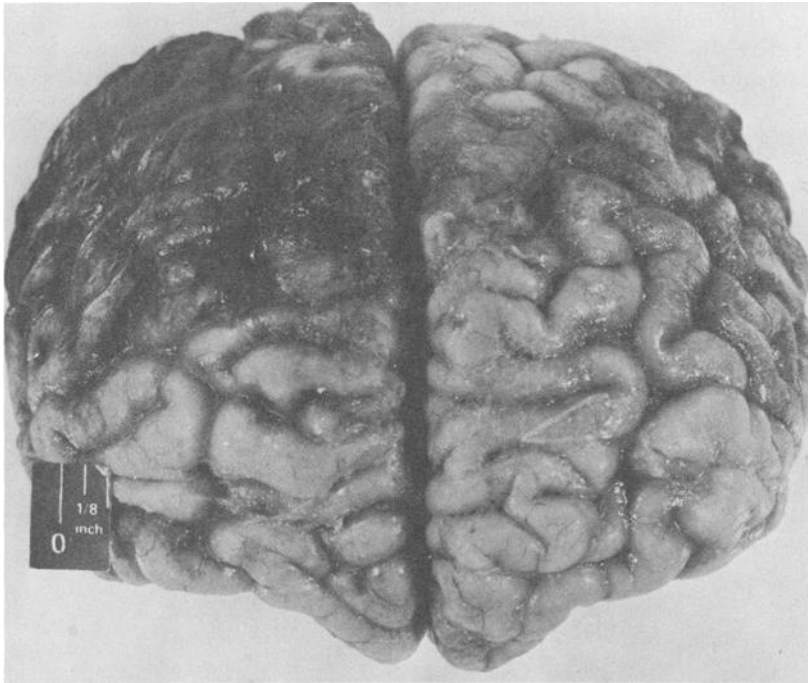


FIG. 1—A frontal view of the brain described in Case 1 shows the fresh subarachnoid hemorrhage over the convexities of both cerebral hemispheres, more pronounced on the right side.

The wound tract involved loops of bowel and the right side of the fifth lumbar vertebra. The cauda equina was severed and surrounded by localized hemorrhage. Two litres of blood were in the peritoneal cavity. Fresh subarachnoid hemorrhage covered both parieto-occipital lobes of the brain, with a separate hemorrhage limited to the base of the brain and over the superior surface of the cerebellum. The remainder of the body exhibited no evidence of injury or disease.

Discussion

Although subarachnoid hemorrhage is most commonly the result of head trauma, it may, in certain instances, result from trauma that does not involve the head. Each of the four cases described had sustained fatal wounds below the neck. In two of the cases, the missile tract involved the lower spinal column. In none of the cases was there evidence of direct head injury. The intracranial subarachnoid hemorrhage found did not appear to be directly related to the site of major injury. This finding suggests that the force of the impact on the lumbar subarachnoid space had been transmitted to the intracranial circulation, resulting in separate intracranial subarachnoid bleeding.

Roussy and Lhermitte, in 1918 [1], described the effects of direct injuries to the spinal cord by bullets or shell fragments. They pointed out that local damage to the cord was related both to the size and velocity of the missile. While noting that local subarachnoid, subdural, and epidural bleeding were often found, they did not comment on a finding of separate intracranial subarachnoid hemorrhage. Accounts of coexisting hemorrhage in the brain and spinal cord have been described by several authors [2]. The majority of these

studies involved blast injuries sustained during war. In such cases, the entire body sustained the blast effect. Guillaïn [3] believed such blast injuries to result from sudden changes in air pressure. In addition to central nervous system damage, extensive hemorrhage occurred in lungs and other internal organs. Similar lesions were observed in individuals who were underwater when explosions occurred nearby.

Schmaus, in 1890 [4], struck animals across the back with a wooden board. The effect of the blows, transmitted over many vertebrae, was thought to result from transmission by a wave of cerebrospinal fluid. This hypothesis is consistent with the findings in our cases. Each involved a high-energy impact to the lower spinal subarachnoid space. The resulting hemorrhage did not extend along the full length of the spinal cord. Other causes of subarachnoid hemorrhage in gunshot wounds, such as anoxia, which could result in diffuse, patchy zones of bleeding, were excluded on the basis of clinical evaluation and study of the portions of the brain most susceptible to hypoxia. The intracranial subarachnoid hemorrhage was most likely the result of a rapidly transmitted wave of pressure within the cerebrospinal space.

The description of this condition has practical relevance. When chest or abdominal gunshot wounds exist, the possibility of the subarachnoid hemorrhage being a secondary rather than a primary phenomenon must be considered. The proper interpretation of such a finding is necessary to avert erroneous legal implications. Should two separate injuries be considered when only one has been inflicted, accurate reconstruction of the circumstances surrounding the death would be jeopardized.

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Address requests for reprints or additional information to
J. E. Smialek, M.D.
400 East Lafayette
Detroit, Mich. 48226