Virchow's Second Protocol; a 21st-Century Review

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Abstract: Rudolf Virchow published several autopsy protocols in his 1876 book on postmortem examinations. The protocols demonstrate the application of the 1875 Regulations to medicolegal practice. The book went through several editions and translations throughout the remainder of the 19th century, but the second autopsy protocol was subject to scathing criticism in 1915. This article summarizes the protocol and reviews the criticism, historic context, and conclusions. Application of 21st-century practice principles is also attempted in order to test the durability of Virchow's methods and protocol across centuries.

Key Words: Virchow, autopsy protocol, autopsy, history, history of pathology, pathology, forensic medicine, forensic pathology

(*Am J Forensic Med Pathol* 2024;45: 322–326)

Rudolf Virchow's little book of 1876, Die Sections-Technik im Leichenhause des Charite-Krankenhauses, relates (1) the context that prompted him to write the book; (2) his own advice on how to perform an autopsy; (3) a discussion and transcript of the regulations, which governed medicolegal autopsies; and (4) several sample autopsy reports (called "protocols"), along with commentary, provided as instructive cases that demonstrate the work product from performing autopsies in accordance with the regulations and Virchow's prescribed methods.[1] Virchow's influence in autopsy practice is amply attested by the multiple editions and translations of his book.[2] However, criticisms did exist.

In 1915, Wadsworth described Virchow's second protocol as follows:

"I know of no better example of the futility of slavishly following a routine procedure than that given in Virchow's second protocol, where, after the examination lasting several hours and the report filling many paragraphs, one finds that the gunshot wound, which was the essential thing, has not been even tolerably described, either as to the size or direction of the wound, its condition in relation to the weapon, or its nature as a lesion, whereas an intelligent examination would have displayed the conditions in a few minutes, and a single paragraph sufficed for its description."[3]

Now a century and a half after Virchow performed the autopsy, and over a century since Wadsworth criticized it, we aim to examine the protocol and comment on it from the perspective of the 21st-century practice of forensic pathology, including creation of body diagram autopsy notes as would occur in modern practice during postmortem examination. Was Virchow's autopsy truly an exercise in futility? Does the protocol suffice for interpretation by others, or does it fail of its essential purpose?

SUMMARY OF THE PROTOCOL

As given in the third American edition of 1891, the protocol begins with conclusions about the case, in prose form. Briefly, that the decedent's ID is known, that he was shot "with a pocket pistol," the cause of death, parenthetical manner of death, the time from injury to death, and incidental findings of pathologic interest.

A brief clinical history follows. The date and duration of the autopsy are stated at the beginning of the autopsy description. In numbered paragraphs, we find a general assessment of the body and then a description of livor mortis (without using the phrase) distinguished in its quality and distribution from cutaneous contusions (again, without using the word). These are differentiated by incision into the areas of interest and application of water to wash away blood.

Rigor mortis is described.

Other cutaneous findings, including those compatible with herpes zoster (documented among pathologic findings at the top of the protocol), are described in quality and distribution and incised.

Early signs of putrefaction are described on the abdomen.

Blood in the hair is described.

Paragraph 8 describes the gunshot entrance wound. It is "a finger's breadth above the middle of the left eyebrow" and described as a small hole. This surrounded by an area of "dry, blackish brown, somewhat depressed border of skin" 1 to 2 mm wide. With a red abraded area of skin extending toward the left. A transverse incision is made through this area to show that the soft tissues have been traumatically dissected off from the bone with areas of tissue bridging and 5 cm of interstitial hemorrhage (and edema beyond that). A fragment of bone (described and measured) is documented at the entrance into the calvaria.

The eyes, nose, mouth, neck, thorax, abdomen, penis, and anus are remarked upon.

Paragraph 18 begins the internal examination.

The scalp incision is described, along with remarks on the blood which issues from the dissection field. The skull defect is further described. The skull sawing is described, and the thickness and quality of the calvaria, as well as the frontal sinus contents, are described. The blood vessels are described. The wound track (with measurements) is described through the outer table, and sinus, then the inner table (with only an average measurement). Bone fragments are described.

The author reports no conflict of interest.

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ISSN: 0195-7910/24/4504–0322

DOI: 10.1097/PAF.0000000000000968

The general configuration of the skull (which is abnormal) then the dura are remarked upon. The wound path in the dura follows.

A right-side subdural hematoma is described in quantity and quality, and after washing with water, an underlying defect in the brain "Situated nearly at the posterior part of the middle lobe, two finger's breadth behind" the Sylvian fissure is described. The surrounding pia mater is described and then the rest of the pia mater.

The head is raised and drawn forward, which causes a bullet to fall out of the injury. The bullet is described and measured.

The left-side dura is incised and reflected. The meninges, vessels, and blood are described, as is a wound path (involves the right corpus striatum). This is explained anatomically and its direction and situation by finger's breadths.

Flattening of the gyri (worse on the left than the right) is noted.

The vessels and pia mater are again described. The configuration/development of the brain is described. The internal structures (ventricles, deep gray matter structures, white matter), cerebellum, and brainstem are described. Postmortem collection of blood in the posterior fossa is noted. The dura mater is removed.

Basicranial fractures ("fissures") are described and measured.

The rest of the internal examination follows (not all is repeated in this summary): A midline incision is made from chin to pubis. The abdomen is opened first. Its contents are described. The thorax follows. The heart is opened, and the quantity and quality of blood are described. The pulmonary artery and aorta are noted as narrowed. Valvular disease is described, and valve competence is tested by water. Pulmonary edema and subpleural emphysema are described. The tongue and tonsils follow. Vasculature, upper aerodigestive tract, and more vasculature are remarked upon. The spleen, kidneys, and adrenal are described (including measurements). The stomach, intestines, and mesentery and gastrointestinal contents described. The intestines are further described. The liver, gallbladder (and bile), and inferior vena cava are described.

Three paragraphs of commentary follow regarding survival, ballistics, and evidence of ongoing digestion.

Lastly, Virchow notes that if legal investigation were to occur on this case (!), he would opine that death was due to the pulmonary edema, which followed the gunshot wound, and that the autopsy gave no evidence to contradict the "assumption" that this was self-inflicted.

ANALYSIS

It must be first made clear that Dr Virchow performed this autopsy under the parameters set forth in the Regulativ fur das Verfahren der Gerichtsartzte bei den gerichtlichen Untersuchungen menschlicher Leichname of 1875. These regulations were the standards legally required for the manner and order in which medicolegal autopsies were to be performed. This is evidenced by the sequence in which the protocol memorializes the dissection. Per the regulations, the brain is to be dissected before the neck and torso. Examination of the torso requires a midline incision, followed by an in situ examination of the abdomen, opening the chest, examining and dissecting the thoracic organs, and then finishing the abdominal dissection.

As a necessary artifact of these regulations, we see that postmortem changes and physical examination findings (including natural disease and traumatic injuries) are interspersed among each other. There is no separate Evidence of Injury section as one would find in a modern forensic autopsy report. Furthermore, a single injury is not described in one place in the protocol. The external and internal features of the gunshot wound are scattered across multiple paragraphs describing the head and brain as the various layers are visualized in the course of the dissection.

Descriptions and interpretations are kept quite separate from one another. The reader is expected to make sense of the descriptions (not always easy) to realize Virchow is describing one of the diagnoses made at the top of the protocol. This is the traditional, and still-commendable, practice in pathology of distinguishing between description and diagnosis, but Virchow's application of this practice seems variably (and not always well-) executed in this protocol.

Common to the period, "measurements" of convenience (finger's breadth) are used, but so are metric measurements. However, the entrance wound is not localized to a point relative to midline or below the top of the head. Figure 1 gives an approximation of how the external findings might be diagramed today. The features around the entrance wound are sufficient for the experienced reader to understand that this was likely a contact range entrance wound, but there is no explicit mention of the presence or absence of muzzle imprint, soot, or gunpowder stippling. The wound path and direction are barely described. The cutaneous contusions are poorly described, as are the basicranial fractures. Yet, much care is taken to describe the splinters of bone in the wound track and the exuding brain matter and blood. Figures 2 and 3 give best-guess diagrams based on the information Virchow provided.

It is not known which other documents supported the narrative provided at the start of the protocol. A timeline of events is given, but commences with presentation to the hospital. The circumstances of the shooting are not included, although asserted to have been self-inflicted. The manner of death is concluded to be suicide, and perhaps this is the reason no legal inquiry was made, but any reader today can see the lunacy of concluding a death was the result of suicide in the absence of a formal investigation. Virchow asserts the autopsy provides no evidence that it was not a suicide. In isolation, this is a foolish statement. A single gunshot wound of the head may look identical in suicidal and homicidal cases. The investigation determines the manner of death. We hope accompanying documents supported the suicidal nature of this death, which were not included in Virchow's little book. The protocol that Virchow published proves nothing.

Range of fire was not a standardized concept at the time this autopsy was performed. Soot and gunpowder deposition were recognized phenomena, but categorization of ranges of fire based on the features of the injury did not exist. Even as late as 1903, we find the forensic literature lacks the now-familiar categories of contact, close, intermediate, and indeterminate/distant range.[4] No conclusions on average soot or gunpowder stippling distances had yet been arrived at. Thus, we can hardly fault Virchow for not classifying the range of fire in this supposed suicidal penetrating gunshot wound of the head. Terminal ballistics were not understood either, and thus, Virchow opined the wound path was much larger than the projectile due to gradual expansion from hemorrhage, rather than forces transmitted to the tissues as the projectile coursed through the brain.

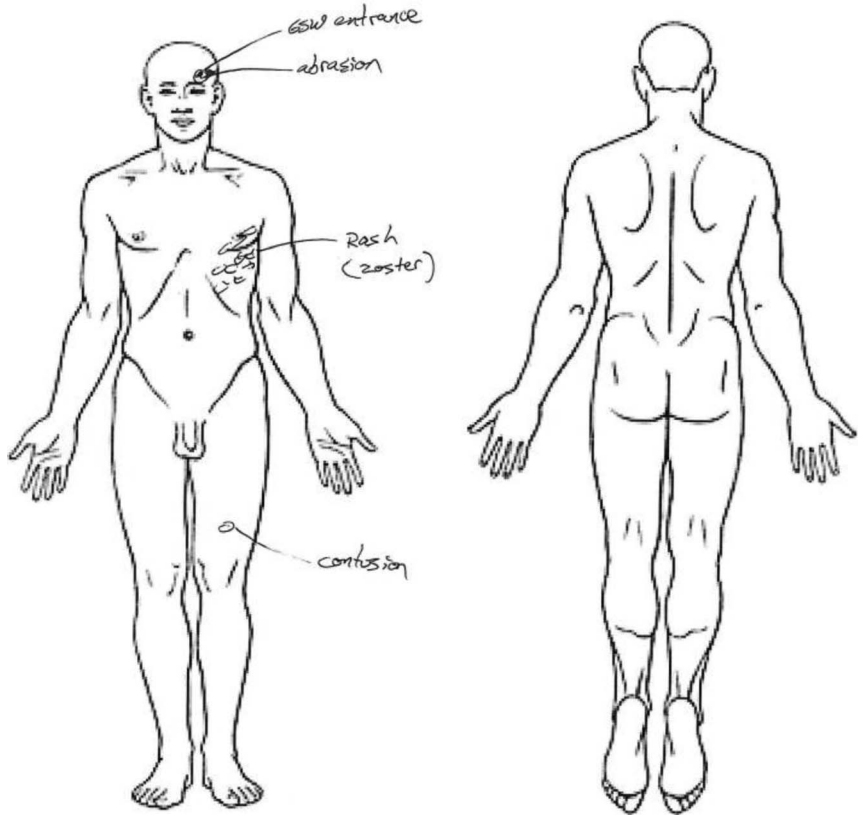

FIGURE 1. A modern autopsy body diagram with an attempt to illustrate some of the findings documented in Virchow's protocol.

Strangely, regarding the timeline provided, Virchow notes the development of pulmonary edema requiring 12 hours or more as evidence for survival duration. However, times provided in the narrative extend from 6:00 presentation to a 4:00 death. Did Virchow really believe he could tell the edema present required an extra 2+ hours between injury and arrival at the Charite at 6:00?

Wadsworth opined that much of the time this autopsy consumed was wasted time. In consideration of the lack of focus and the details given to minutiae while glossing over the truly important points, we are compelled to agree with Wadsworth. Much time was wasted. But the duration and the details in the protocol belie another context besides the regulations. This autopsy took place in a time when the study of pathological anatomy held pride of place in medicine and surgery. As a morphologist, Virchow knew that accurate descriptions of minutiae might someday lead subsequent generations of physicians to greater understanding of the causes and mechanisms of disease. Pathophysiology was poorly understood at the time, and so great attention was given to morbid anatomy. No one truly knew what was important and what was not when trying to explain the origin and course of disease. Thus, equally great attention to detail was given to incidental findings. Consequently, in this protocol, for example, much time is given to the description of blood vessels. Vascular observations being then common due to Cruveilhier's popular theory that phlebitis was central to all pathology.[5]

In essence, this protocol has the appearance of a forensic autopsy performed by a hospital pathologist. It just happened to be on the body of a person who died a death that, in the United States today, would fall under the jurisdiction of a medical examiner.

If this autopsy were done in 2021, following NAME standards,[6] it would have been performed by a forensic pathologist

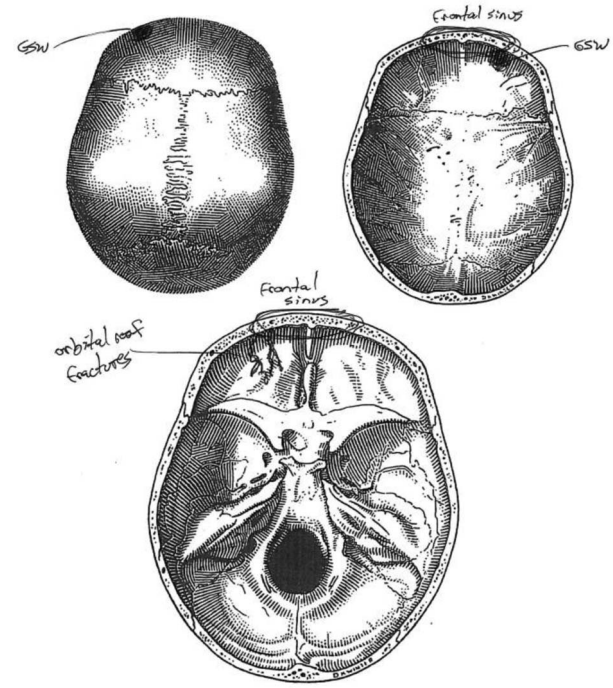

FIGURE 2. A modern autopsy basicranial and calvarial diagram, with an attempt to illustrate some of the features of the gunshot wound described by Virchow.

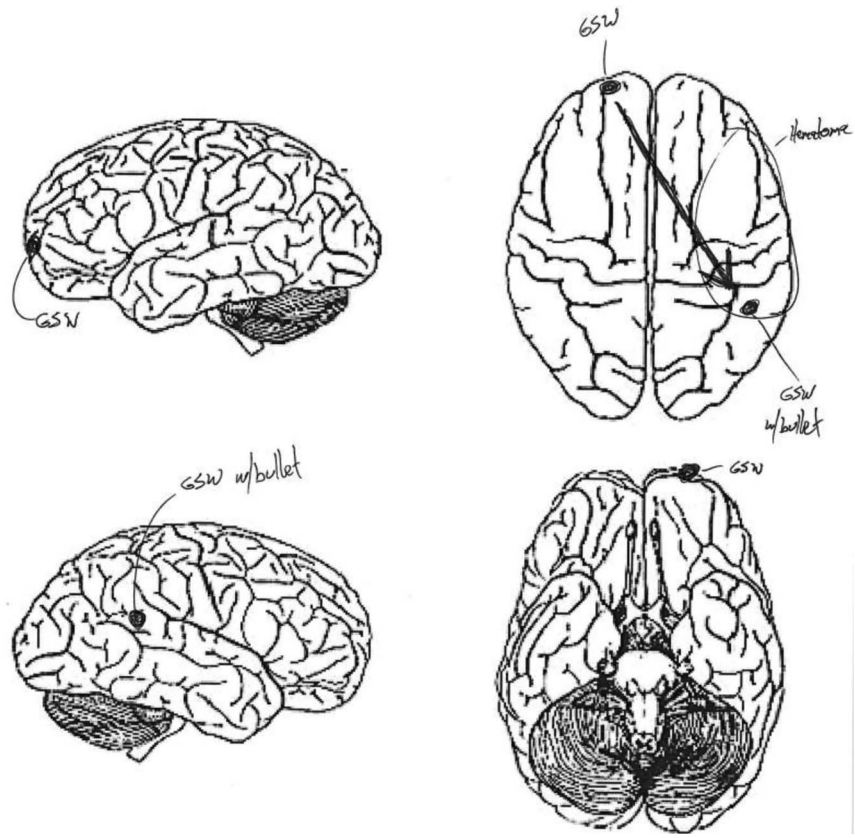

FIGURE 3. A modern autopsy brain diagram, with attempts to illustrate some of the features of the gunshot wound described by Virchow.

—a title that did not exist at the time. It is possible a head-only autopsy would be done to obtain the bullet still in the brain. But a full autopsy is also within the scope of reasonable practice. The autopsy report would have a separate section labeled Evidence of Injury, with all injuries gathered to that section, and all features of the gunshot wound described together in a logical sequence. It is likely that anatomic/autopsy diagnoses would be at the top or bottom of the report, in outline form, with the gunshot wound being listed first, and the other incidental findings below. Toxicology would likely be performed.

The gunshot wound described in the Evidence of Injury section might read as follows:

Entrance: There is a __ x __ inch circular defect, with a __ inch circumferential, drying, and soot-laden marginal abrasion, and an additional __ inch abrasion radiating laterally from the __ o'clock position, on the left forehead, __ inches above the left eyebrow, and situated __ inches below the top of the head and __ inches left of the anterior midline.

Path: The wound path proceeds from the entrance wound through the soft tissues of the scalp, calvarial portion of the frontal bone including the frontal sinus, left frontal lobe of the brain, and terminates at the cortical surface of the lateral posterior aspect of the right parietal lobe of the brain.

Projectile: A deformed metallic projectile falls from the terminus of the wound track during manipulation of the brain.

Associated findings: There is partial traumatic evisceration of brain tissue through the entrance wound. A 5-inch area of interstitial scalp hemorrhage and tissue undermining encompasses the entrance wound. Subdural and subarachnoid hemorrhage are present on the cerebral convexities (greater on the right) with resultant mass effect and flattening of the gyri of the left cerebral hemisphere. There are arborizing fractures of the left orbital roof.*

**Unless this is understood to be part of the decedent's craniocerebral developmental findings that Virchow also mentions.*

Regarding the opinion, cause of death might be listed as "gunshot wound of head" or, perhaps as Dr Virchow suggests, "acute pulmonary edema, due to, gunshot wound of head" or another alternative, as "multisystem failure, due to, gunshot wound of head." Manner of death would only be certified as suicide in the context of adequate investigative information regarding the circumstances and antemortem events surrounding the death.

Virchow remarks at the end of the protocol that the case is noteworthy because of the surprisingly long survival time after a gunshot wound involving the brain. It may be that great care is taken in the protocol describing the blood, brain tissue, and bone fragments near the extremes of the injury because Virchow believed that these were prolonging the patient's life. However, this is not certain.

What is better attested is Virchow's understanding of the nervous system. In the second edition (English) of his *Cellular Pathology* (1860), he begins his lectures on the nervous system with a dissenting opinion.[7] He disagrees with the neuropathologists who have preceded him, by asserting that there is no unity in the nervous system, and that no part of it had been shown to be of greater or lesser importance. (We caveat here that Fluorens had proven by 1824 that the respiratory center was in the medulla oblongata[8] and that *Gray's Anatomy* [1860, second ed] notes that displacement of the dens [which thus injures the medulla] results in instant death.[9]) No sense had been made yet, according to Virchow, of the physiology of the gray matter, and little sense had been made of its relationship to white matter. He was only prepared to say of the nervous system that "Every function possesses its special elementary, cellular organs; every mode of conduction finds paths distinctly traced out for it."

As such, Virchow was not in a position to appreciate that the anatomical location of the gunshot wound in this decedent favored a longer survival time by virtue of it coursing anterior and superior to most of the basal ganglia. Executive functions being compromised, primitive functions were intact for hours.

CONCLUSIONS

We see in Virchow's second protocol artifacts of his time (eg, emphasis on the morbid anatomy of minutiae) and of his expertise (not performing medicolegal autopsies as his full-time occupation). His protocol is tedious, and Dr Wadsworth seems well-founded to say the gunshot wound was not even tolerably described. Nevertheless, with a little effort, it can be sufficiently interpreted by a board-certified pathologist today to reconstruct the findings in a format befitting modern practice standards. Wadsworth is perhaps, then, too forceful in his assertion that Virchow's autopsy was futile (although he did slavishly follow a routine and wasted much time). Wadsworth implies that Virchow's autopsy was unintelligent, but consideration of its context in medical history also leads us to conclude that Wadsworth was perhaps too forceful in that statement as well. As a final conclusion, it should be emphasized that reorganization of the information in the autopsy protocol by using an Evidence of Injury section clearly does much to improve a reader's understanding of the case being reported.

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