

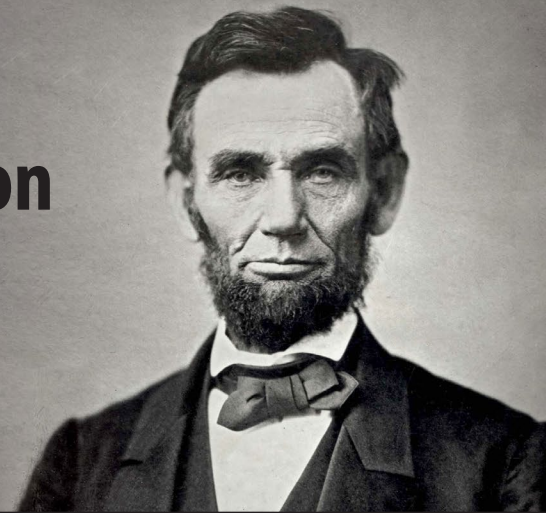
The Anatomy of an Assassination

by

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Part I – The Assassinated

Abraham Lincoln is sometimes considered to be the “last casualty of the Civil War” when he was shot by John Wilkes Booth at Ford’s Theatre on April 14, 1865. Just before 10:30 pm, Booth entered the president’s box and silently approached Lincoln so that his derringer (a small pistol) was likely within a foot of Lincoln’s head. Just before Booth pulled the trigger, Lincoln leaned forward and looked to his left so that the lead bullet entered the back of Lincoln’s skull about one inch to the left of the midline and level with his left ear. It nicked the superior border of the left transverse sinus and then entered the brain. There are discrepancies in the autopsy reports, but most historians agree that the bullet likely crossed the midline and ended up lodged just superior to Lincoln’s right orbit.

Lincoln lost consciousness immediately and never regained it. Dr. Charles Leale, a 23-year-old U.S. Army surgeon in the audience, was the first physician to reach the president. He found Lincoln slumped in his rocking chair, barely breathing and with no pulse. He and several others performed a crude form of CPR and were able to restore respiration and a heartbeat. However, upon finding the bullet hole and noting that one of Lincoln’s pupils was fixed and dilated, Leale pronounced his famous words: “His wound is mortal; it is impossible for him to recover.”

Lincoln was moved to the Petersen house across the street from Ford’s Theater as his condition was deemed too unstable to survive a carriage ride to the White House. A number of physicians kept watch through the night, doing what little they could to delay Lincoln’s inevitable death. The wound continued to bleed and Dr. Leale observed that as coagulated blood and brain tissue plugged the entrance wound, Lincoln’s breathing grew more labored and ragged, and his heart rate slowed. Unplugging the hole caused his respiration and pulse to improve. About 1:00 am, another doctor noted that “spasmodic contraction of the muscles came on,” causing the forearms and wrists to pronate (turn inward) and the chest muscles to contract. Both pupils became dilated and remained so until his death.

Toward dawn, Lincoln’s breathing became intermittent; sometimes a minute would pass between breaths. His pulse grew slower and weaker, and he died at 7:22 am on April 15, 1865.

Questions

1. Given the entrance point of the bullet and where it most likely lodged, name some of the major structures of the brain that the bullet probably passed through.
2. If the bullet had passed directly through the brainstem, would Lincoln have lived as long as he did? Explain your answer.

3. Lincoln's death is generally attributed not to bleeding but to the increased intracranial pressure (ICP) caused by swelling of damaged brain tissue. Given your knowledge of the dura mater and its features, explain how increased ICP can result in death.

4. Do some research to find out what decerebrate posturing is. What significant event probably occurred around 1:00 am to cause both of Lincoln's pupils to dilate and decerebrate posturing to occur?

5. The physicians attending Lincoln noted that his respiration improved when they kept the entrance wound cleared of clotted blood and brain matter. Explain their observation.



Figure 1. Drawing of the death bed scene of President Abraham Lincoln by H. Faber (1865), <https://www.loc.gov/resource/ppmsca.23858/>.

Part II – The Assassin

On April 26, 1865, the porch of Richard Garrett's Port Royal, Virginia farmhouse was crowded with members of the 16th New York Cavalry and several detectives. In the middle of the crowd, lying motionless on his back, was the target of a 12-day manhunt: Abraham Lincoln's assassin, John Wilkes Booth.

Acting on a tip, Lt. Edward Doherty and the cavalry had cornered Booth and an accomplice in Garrett's tobacco barn in the middle of the night. Booth's accomplice surrendered, but Booth had refused, declaring "I will suffer death first."

Booth verbally sparred with the cavalry as they surrounded the barn. Sgt. Boston Corbett aimed his revolver through a gap in the barn wall and carefully watched Booth. When Booth moved toward the door with his carbine leveled, Corbett assumed Booth was going to fire on the soldiers and shot at Booth's arm to disable him. Booth immediately crumpled to the ground.

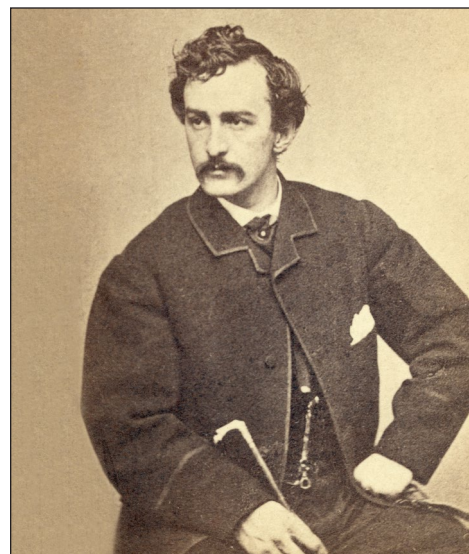


Figure 2. John Wilkes Booth, circa 1865.

The soldiers dragged Booth from the barn and eventually onto the farmhouse porch. Corbett's shot had entered the right side of Booth's neck and exited the left; Booth couldn't move any of his limbs and his breathing was labored. A doctor was called, but left after determining there was nothing to be done. Booth tried to cough but was unable to contract the necessary muscles. Thinking Booth was choking, a detective looked inside his mouth and throat but saw no object or signs of blood. Asking a soldier to raise his hands, Booth stared at them and whispered, "Useless, useless!" His lips turned purple and his throat swelled, causing him to gasp for breath. He died at dawn, several hours after being shot.

Booth's body was hurriedly transported back to Washington and taken aboard the USS Montauk in the Navy Yard to avoid publicity and the attention of Southern sympathizers. An autopsy was conducted 36 hours after Booth's death. Among the doctors were Surgeon General Joseph K. Barnes and Dr. Joseph J. Woodward, both of whom participated in Lincoln's autopsy.

Dr. Barnes noted:

The cause of death was a gun shot wound in the neck — the ball entering just behind the sterno-cleido muscle — 2 1/2 inches above the clavicle — passing through the bony bridge of fourth and fifth cervical vertebrae — severing the spinal chord (sic) and passing out through the body of the sterno-cleido of right side, 3 inches above the clavicle.

Paralysis of the entire body was immediate, and all the horrors of consciousness of suffering and death must have been present to the assassin during the two hours he lingered.¹

Dr. Woodward focused on the damage to the vertebrae and spinal cord:

... The [bullet] perforated the base of the right lamina of the 4th cervical vertebra, fracturing it longitudinally and separating it by a fissure from the spinous process, at the same time fracturing the 5th vertebra through its pedicle, and involving that transverse process. The projectile then transversed the spinal canal almost horizontally but with a slight inclination downward and backward... The ball then shattered the bases of the left 4th and 5th laminae, driving bony fragments among the muscles, and made its exit at the left side of the neck, nearly opposite the point of entrance... Death, from asphyxia, took place about two hours after the reception of the injury.²

After the autopsy, the body was buried in an undisclosed location at the Old Penitentiary on the Washington Arsenal grounds (now Ft. McNair). In 1869, Booth's remains were returned to his family and buried in an unmarked plot in Baltimore's Green Mount cemetery.

¹ Joseph K. Barnes to Edwin M. Stanton, April 27, 1865. Records of the Adjutant General's Office, National Archives.

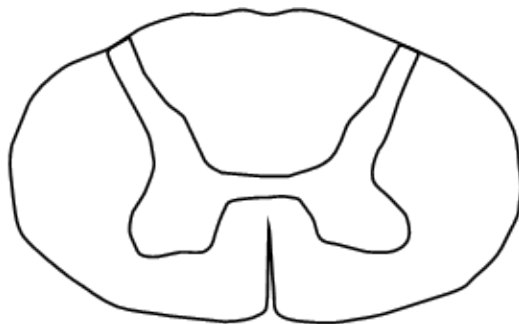
² *The Medical and Surgical History of the War of the Rebellion, 1861–1865*, Vol. II, Part 1. Surgical Volume (Washington, D.C.: Government Printing Office, 1870), p. 452.

Questions

1. a) Label the spinous and transverse processes, lamina, pedicle, and body on the figure of the 4th cervical vertebra (superior view) below.



- b) Draw the spinal cord inside the vertebral canal in the figure above.
- c) Using Dr. Woodward's description, draw the probable path of the bullet in the figure above. Which half of the spinal cord (dorsal or ventral) was more significantly damaged by the bullet?
2. a) On the cross-section of the cervical spinal cord shown below, shade the approximate region destroyed by the bullet (reference your answer to question 1c). Then draw and label the major nuclei and tracts in that area, and describe the deficits produced (include side of the body). Note which correlate with deficits that Booth exhibited.



- b) Based on your answer to part (a), did Booth suffer damage to upper or to lower motor neurons? What signs would he exhibit if he had survived?

3. Describe the anatomical relationship of spinal cord segments, spinal nerves, and vertebrae in the cervical region. Which spinal nerves were affected by the injury?

4. a) What nerve innervates the diaphragm and is critical for respiration? What levels of the cord and spinal nerves are the origin of this nerve?

- b) What conclusions can you draw from the fact that Booth exhibited voluntary but labored respiration immediately after the injury?

- c) Despite initially being capable of voluntary respiration, Booth succumbed to asphyxiation within a few hours. Provide two explanations, one related to the nervous system and one that centers on other factors.

5. The soldiers noticed that Booth was unable to cough, which is typical in some cervical spinal cord injuries. Coughing requires contraction of muscles in the thoracic and abdominal wall as well as the diaphragm. Describe the neural pathways that were damaged and led to the loss of function of these muscles.