



When did she die?

Your medical examiner team has been given the following case to review. It is your job to determine whether the victim died accidentally and what the time of death was. Study the details and complete the medical examiner's report that follows.

The Problem

The victim was found in her home at 10:00 A.M. on Saturday morning by her sister, with whom she was supposed to go jogging. The sister promptly called the police who then notified you, the medical examiner. You noted the following:

- The victim was lying facedown at the bottom of the stairs, facing away from the stairs. The sister indicated the victim was dressed in the clothes she had worn to dinner the night before.
- The victim had no pulse.
- The body was cold to the touch, but the internal temperature, which was measured at 10:30 A.M., was 27°C (room temperature was 20°C).
- Her neck was apparently fractured, and she appeared to have sustained head injuries.
- There were purplish marks on the front of her shoulders and neck; the marks did not change color when touched.
- Her entire body was stiff.
- The victim's eyes were open and cloudy with a thin film.

Additional Police Notes The victim had eaten dinner with her sister at 5:00 P.M. the night before (Friday evening). At dinner, they had agreed to meet at the victim's townhouse at 10:00 A.M. Saturday morning to go jogging. The sister returned to her own home at 11:00 P.M., but she was not sure when the victim returned to her townhouse after dinner. Neighbors did not recall seeing the victim return to her townhouse.

When you performed an autopsy on the victim later that day, you noted that she died of a broken neck and subsequent asphyxiation. The victim was 5 feet 8 inches tall and weighed 130 pounds, her stomach was empty, and her small intestine was full. Your job is to provide police with the time of death.

When did she die? continued**Background**

When a body is discovered, one of the first things that a medical examiner must do is determine the time of death. The medical examiner uses several indicators to help establish the time of death, including body temperature, rigor mortis, discoloration (livor mortis or lividity), and the appearance of the eyes.

Body Temperature When a person dies, the body immediately begins to cool. On average, the body temperature drops at a rate of 0.75°C per hour for the first 12 hours. After 12 hours, the rate of cooling slows by about one half (approximately 0.4°C per hour) until the body reaches ambient temperature, the temperature of the environment. The rate of cooling is also affected by the following factors:

- **Air temperature** – A body will cool faster on a cold winter night than on a warm summer night.
- **Body fat** – Fat tends to insulate the body, so the more fat a person has, the slower the body cools after death.
- **Clothing** – Clothing also insulates the body, so heavy clothing will slow the rate of cooling.
- **Water** – A body in water cools much faster than one in air. Therefore, it is difficult to use body temperature to estimate the time of death for a victim found in the water.

Rigor Mortis At the time of death, the body's muscles are relaxed. However, within 1–2 hours, the muscles begin to stiffen as their stores of adenosine triphosphate (ATP) become exhausted. This stiffening is known as rigor mortis. Rigor mortis begins with the muscles of the face, jaws, and neck, proceeds down the body through the upper arms and torso, and ends with the legs. This process is complete within 8–12 hours after death. As the muscles begin to break down, they begin to relax in the same order as they stiffened. By 24–48 hours after death, the body is totally relaxed again.

Livor Mortis (Lividity) Within 1–2 hours after death, the blood settles into the lowest parts of the body (parts that are closest to or resting on the ground) due to gravity. The red blood cells settle out and break down into the tissues, leaving purplish marks that later become yellow (due to the breakdown of hemoglobin). The color (lividity) becomes fixed in the tissue within 6–8 hours after death. If a body is moved after this time, then the position of the purplish marks may not agree with the position in which the body is found. Finally, if skin appears discolored, but turns white when touched, then lividity has not been fixed and death probably occurred more than 2 hours, but less than 10 hours ago.

Appearance of the Eyes If the eyes remain open at the time of death, then a thin film will appear on them as they begin to dry out. As the blood cells within the body break down, they release potassium. Potassium enters the eyes and causes them to appear cloudy. This process takes approximately 2–3 hours after death; however, if the eyes remain closed after death, then the process takes much longer (approximately 24 hours).

Stomach Contents After you eat, the process of digestion takes place. Digestion begins in the stomach. It takes about 4–6 hours for the stomach to empty its contents into the small intestine. Finally, it takes approximately 12 hours for the food to leave the small intestine. As a rule of thumb:

- Undigested stomach contents—death occurred 0–2 hours after the meal
- Stomach empty—death occurred 4–6 hours after the meal
- Small intestines empty—death occurred 12 hours or more after the meal

When did she die? *continued*

- 6. Plot the data for temperature versus time after death on graph paper.
- 7. Based on the body temperature of the victim, how long has it been since the victim died?

- 8. Estimate the time of death using body temperature.

- 9. Based on the observations of rigor mortis, how long has the victim been dead?

- 10. Where was lividity observed on the body? Was it fixed? How long ago did she die? Was the victim found in the position that she died or was her body moved? Explain your answer.

- 11. Based on the appearance of her eyes, how long ago did she die? Explain your answer.

- 12. Based on the examination of her digestive system, how long after a meal did the victim die? Explain.

Analyze and Conclude

- 13. Based on all of the evidence available, estimate the time of death for the victim. Explain your answer.

- 14. Was the victim's death an accident? Explain your answer.

