

ACTIVITY 12-1

Calculating Postmortem Interval Using Rigor Mortis *Obj. 12.7*

Background:

In old detective movies, a dead body was often referred to as a "stiff." The term refers to the onset of rigor mortis that follows soon after death. In this activity, you will estimate the postmortem interval by analyzing the degree of rigor of the deceased body. Postmortem interval is greatly affected by many variables. In this activity, you will make estimates based only on the state of rigor mortis. Actual postmortem interval estimates require examination of other types of evidence in combination with rigor mortis.

Objective:

By the end of this activity, you will be able to:

Estimate the postmortem interval using rigor mortis evidence.

Time Required to Complete Activity: 30 minutes

Materials (for each group of two students):

Act 12-1 SH
paper
pen or pencil
calculator (optional)
Rigor Mortis section of the chapter

SAFETY PRECAUTIONS:

None

Procedure:

Working in pairs, discuss and answer the following questions dealing with approximating postmortem interval. Refer to the Rigor Mortis section in your textbook, including the reference tables. Discuss variables that could affect PMI. List questions that should be asked and answered about the crime scene and victim before you could refine an estimated PMI.

Questions:

PART A

Estimate the postmortem interval for the following situations. Explain each of your answers:

1. A body was found with no evidence of rigor.
2. A body was found exhibiting rigor throughout the entire body.

3. A body was found exhibiting rigor in the chest, arms, face, and neck.
4. A body was discovered with rigor present in the legs, but no rigor in the upper torso.
5. A body was discovered with most muscles relaxed, except for the face.
6. A body was discovered in the weight room of a gym. A man had been doing "biceps curls" with heavy weights. The only place rigor was present was in his arms.

PART B

Estimate the postmortem interval based on the following information:

7. A frail elderly woman's body was found in her apartment on a hot summer evening. Her body exhibited advanced rigor in all places except her face and neck.
8. A body was discovered in the woods. The man had been missing for two days. The average temperature the previous 48 hours was 10°C. When the body was discovered, it was at peak rigor.
9. An obese man's body was discovered in his air-conditioned hotel room sitting in a chair in front of the television. The air conditioner was set for 18.3°C. When the coroner arrived, the man's body exhibited rigor in his upper body only.
10. While jogging, a young woman was attacked and killed. The perpetrator hid the body in the trunk of a car and fled. When the woman's body was discovered, rigor was noticed in her thighs only.
11. The body is completely stiff. How long has the deceased been dead? Explain your answer.
12. The victim was found in a snowbank alongside a road. His body is rigid. How long has he been dead? Explain your answer, remembering the cold temperature.
13. The body of a runner was found in the park one early, hot summer morning. Her body shows rigor in her face, neck, arms, and torso. How long has she been dead? Explain your answer.

ACTIVITY 12-2

Calculating Postmortem Interval Using Algor Mortis *Obj. 12.7*

Objective:

By the end of this activity, you will be able to:

Estimate the postmortem interval using algor mortis evidence.

Time Required to Complete Activity: 45 minutes

Materials:

paper

pen or pencil

calculator

Algor Mortis section of the chapter

Background:

Estimating a postmortem interval (PMI) using algor mortis evidence only is inexact and unreliable because many variables affect the change of body temperature. However, when algor mortis evidence is considered in combination with other types of evidence, a more reliable PMI estimate is possible. In this activity, you will use the following formulas to estimate PMI based solely on algor mortis evidence. Recall that normal body temperature is approximately 37°C.

SAFETY PRECAUTIONS:

None

Procedure:

Working in pairs, review each of the following examples before discussing and answering the questions. Use the formulas below to estimate the amount of heat loss:

- For the first 12 hours, the body loses 0.78°C per hour.
- After the first 12 hours, the body loses about 0.39°C per hour.

Example 1: What is the temperature decrease for someone who has been dead for 12 hours?

Answer: Temperature decrease ~ $(0.78^{\circ}\text{C}/\text{hour}) \times 12 \text{ hours} \sim 9.36^{\circ}\text{C}$

Example 2: If a person has been dead for less than 12 hours, or the body has lost less than 9.36°C , calculate the estimated PMI. (Use a heat-loss rate of 0.78°C per hour.)

Answer: Temperature of dead body is 32.2°C .

Normal body temperature is 37°C .

$$37^{\circ}\text{C} - 32.2^{\circ}\text{C} = 4.8^{\circ}\text{C} \text{ decrease since death.}$$

How long did it take to decrease 4.8°C ?

$$0.78 (^{\circ}\text{C}/\text{hour}) \times (\text{unknown number of hours}) = \text{degrees lost}$$

$$0.78 (^{\circ}\text{C}/\text{hour}) \times (\text{unknown number of hours}) = 4.8^{\circ}\text{C} \text{ lost by body}$$

Solve for the unknown number of hours since death occurred:

$$\text{number of hours} \sim 4.8^{\circ}\text{C} \div 0.78 (^{\circ}\text{C}/\text{hour})$$

$$\text{number of hours} \sim 6.1 \text{ hours} \sim 6 \text{ hours}$$

Example 3: Is the PMI more than 12 hours or less than 12 hours?

Answer: Recall that if a person has been dead 12 hours or less, the average body loses heat at a rate of 0.78°C per hour. If the person has been dead 12 hours, then $0.78^{\circ}\text{C}/\text{hour} \times 12 \text{ hours} \sim 9.36^{\circ}\text{C}$.

If a body's temperature decreases by 9.36°C , then the person has been dead for ~ 12 hours.

If a body's temperature decreases by more than 9.36°C , then the person has been dead for more than 12 hours.

If a body's temperature decreases by less than 9.36°C , then the person has been dead for less than 12 hours.

For each of the following, state if the person had been dead for more than or less than 12 hours based on the number of degrees decrease in temperature:

1. total decrease of 7.9°C
2. total decrease of 4.4°C
3. total decrease of 11.7°C
4. total decrease of 17.2°C
5. total decrease of 10.6°C

(Answers: 1: less than; 2: less than; 3: more than; 4: more than; 5: more than)

Example 4: Calculate the PMI if a person was dead for more than 12 hours. The temperature of the body when discovered was 22.2°C .

Answer: If the body has cooled more than 9.36°C , then you know that the victim has likely been dead for more than 12 hours. After 12 hours, the body loses heat at a slower rate of approximately 0.39°C per hour. Calculate how many hours beyond the first 12 hours the victim died and add it to the 12-hours heat-loss estimate.

A. What was the total decrease in temperature from the time of death until the body was found?

$$37^{\circ}\text{C} - 22.2^{\circ}\text{C} = 14.8^{\circ}\text{C}$$

- B. Since 14.8°C is more than 9.36°C , you know that the person was dead longer than 12 hours. How many degrees did the temperature decrease after the first 12 hours?

14.8°C decrease since death — 9.36°C decrease the first 12 hours ~ 5.44°C
 5.44°C decrease after the first 12 hours

- C. Recall that the rate of temperature decrease after 12 hours is $\sim 0.39^{\circ}\text{C}$ per hour. Determine how many hours it took to decrease 5.44°C at the reduced rate.

$(0.39^{\circ}\text{C}/\text{hour}) \times (\text{unknown number of hours}) \sim \text{decrease after 12 hours}$

Solve for number of hours:

$\text{number of hours} \sim 5.44^{\circ}\text{C} \div (0.39^{\circ}\text{C}/\text{hour}) = 13.9$ or approximately 14 hours since death

- D. In the first 12 hours, there was a decrease of 9.36°C .
In the next 13.9 hours, there was an additional decrease of 5.44°C .
This results in a PMI of about 25.9 hours (approximately 26 hours).

Questions:

PART A

1. Determine the approximate PMI using evidence from algor mortis. Show your work. Estimate the PMI if the victim's body temperature at the crime scene was 33.1°C .
2. If you discovered that the body in question 1 was found in an air-conditioned room, would that variable increase or decrease your estimated PMI? Explain. What would the new PMI be?
3. Approximately how long has the victim been dead if his body temperature was 25.9°C ?
4. What is the approximate PMI if the body temperature was 15.6°C ?
5. What is the approximate PMI if the body temperature was 10°C ?
6. What is the approximate PMI if the body temperature was 29.4°C ?
7. What is the approximate PMI if the body temperature was 24°C ?

PART B

If you based your PMI estimate of 10 hours solely on temperature decrease, would you reduce or increase your 10-hour estimate if the body had been:

1. Naked
2. Exposed to windy conditions
3. Suffering from an illness prior to death
4. Submerged in a lake

Further Study:

Investigate the procedures used by crime-scene investigators to take accurate body temperature readings.

