A64 The Effects of Hydrochloric Acid (HCl) on Decomposition: Evidence of Preferential Destruction to the Head and Extremities

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Learning Overview: After attending this presentation, attendees will understand the effects of HCl on human remains, specifically demonstrating preferential destruction of the head and extremities over the torso, as replicated in a study using a pig (*Sus scrofa*) to compare the pattern of dissolution. Finally, the effect that estuarine water has on the rate of dissolution of human remains when added to a proportion of HCl was tested.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by offering an example of the taphonomic changes to expect and what lines of evidence persist in a container that could have held human remains in an acidic solution, in hopes of implementing policy change that would make these materials more difficult for criminals to access, therefore decreasing the potential for copycat crimes of this nature.

Due to the growing excitement and popularization of television crime shows, forensic scientists are now faced with the difficult task of analyzing copycat crime scenes, such as those portrayed on *CSI* or *Breaking Bad*. In particular, the disposal of human remains using common household acids has been mimicked by real criminals and led previous researchers to examine the effects of different acids on incomplete human remains. In general, previous studies have found that HCl is the most destructive agent when in contact with human remains, including fragments of femora and teeth.[1-3] HCl, commonly referred to as muriatic acid, is easily available for purchase at home improvement stores and sold in varying concentrations.

This present study expands on previous research by demonstrating the effect that HCl has on human remains in a controlled laboratory setting. Based on previous research with incomplete remains and experiences working on forensic cases, it was hypothesized that the HCl would not preferentially destroy some body parts over others (i.e., head and extremities over torso), and that the addition of estuarine water to HCl would not affect the rate of dissolution. This study tested these hypotheses with three experiments: the first involved an intact, donated human cadaver; the second used an intact pig carcass of similar size to the human; and the third examined the changes to eight donated human fingers. The remains were placed inside polypropylene plastic containers and submerged in a solution of 30% concentration of HCl (human and pig) or a proportion of HCl and estuarine water (fingers only). Quantitative variables included ambient and solution temperatures, pH, salinity, and cortical bone measurements. Qualitative variables included the presence of hair, nails and viscera, color of tissues (using Munsell color cards), and bone change (soft, eroded, pitted, gelatinous, amorphous, and total dissolution). These data were collected at hourly intervals (human=70 hours; pig=408 hours; human fingers=(208 hours) until the conclusion of the experiments after complete dissolution.

Results of the experiments revealed that the human and pig skulls were severely affected in just 13 hours after initial submersion in HCl. In addition, the head and extremities were almost completely dissolved in 70 hours (human) and approximately 87 hours (pig). The fingers in the third experiment took a total of five months to completely dissolve. Weight, solution temperature, and pH (<1) remained relatively consistent for all experiments, and portions of the torsos, including the viscera, persisted throughout the length of the human and pig experiments. Hair, finger and toe nails, and one dental restoration were recovered at the conclusion of the human experiment (Human Experiment 1=70 hours; Human Finger Experiment=3,720 hours). Teeth and nails were not recovered from the pig experiment=432 hours).

Contrary to the hypotheses of the researchers, these results indicated that the HCl could preferentially destroy certain body segments over others, and that pig remains follow a similar pattern of dissolution as that of human remains. Additionally, this study found that adding estuarine water to HCl reduces its dissolution efficiency while continuing to have an extremely acidic pH. These results provide a significant contribution to the current literature and offer an additional example of the taphonomic changes to expect and what lines of evidence persist in a container that could have held human remains in an acidic solution. Additionally, it is hoped this research assists legislators in implementing policy change that would make these materials more difficult for criminals to access, therefore decreasing the potential for copycat crimes of this nature.

Reference(s):

1. Hartnett, Kristen M., Laura C. Fulginiti, and Frank Di Modica. The Effects of Corrosive Substances on Human Bone, Teeth, Hair, Nails, and Soft Tissue. *Journal of Forensic Sciences.* 56, no. 4 (2011): 954-959.
2. Mazza, Alessandra, Giuseppe Merlati, Caterina Savio, Giovanni Fassina, Paolo Menghini, and Paolo Danesino. Observations on Dental Structures When Placed in Contact With Acids: Experimental Studies to Aid Identification Processes. *Journal of Forensic Sciences*. 50, no. 2 (2005): JFS2004292-5.
3. Vermeij, Erwin, Peter Zoon, Mayonne van Wijk, and Reza Gerretsen. Microscopic Residues of Bone From Dissolving Human Remains in Acids. *Journal of Forensic Sciences*. 60, no. 3 (2015): 770-776.

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