



H166 Comparing Sinus Fluid Density in Drowning Versus Non-Drowning Victims Using Postmortem Computed Tomography (PMCT)

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Learning Overview: After attending this presentation, attendees will understand the implications of measuring the density of sinus fluid in drowning versus non-drowning victims using PMCT.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the utility of comparing sinus fluid density between drowning versus non-drowning victims and between fresh water versus ocean water drowning victims.

Drowning is usually a diagnosis of exclusion but there are characteristic autopsy findings described in the literature, including: presence of fluid in the paranasal sinuses and airways, pulmonary edema, water in the stomach, and mastoid air cell hemorrhage.¹ The content and characteristics of the fluid in the various sinuses are typically not analyzed when determining the cause of death. In PMCT, this anatomic area is easily visualized and the fluid character can be described in Hounsfield Units (HU). Prior studies have evaluated sinus fluid with PMCT. Christe et al. identified the amount and distribution of sinus fluid of 10 drowning cases compared to 20 non-drowning control cases.² Kawasumi et al. evaluated sinus fluid density and volume to differentiate salt water versus fresh water drownings.³ A total of 93 cases (22 saltwater and 71 freshwater) were investigated, and it was found that saltwater drowning had a significantly higher fluid density than fresh water drowning.² In both studies, the sinus fluid density in HU was not compared quantitatively between drowning and non-drowning groups.

The goal of this study was to compare the HU of fluid in the sinuses of drowning versus non-drowning victims. PMCT scans from August 2016 to December 2018 were reviewed, and 68 total cases in which fluid was present in the sinuses were examined. Thirty-four drowning deaths were selected for the study group and 34 non-drowning deaths were selected for the control group. The controls included deaths from natural disease, accidents, and homicides. Head trauma was excluded from the controls as blood could be present in the sinuses. An equivalent number of males and females were selected for the drowning (26M, 8F) and control (27M, 7F) groups. The mean ages were 37.0 years (drowning) and 36.6 years (control). Radiologist consultants were blinded to cases and selected the appropriate Region Of Interest (ROI) and measured the average HU of fluid in the sinuses. The mean HU of drownings (25.0936) was lower than the mean HU of controls (30.6895), with a difference of 5.5959 ($p=0.018$). The HU in drownings were compared by location (ocean [11] vs fresh water [23]). The mean HU of ocean (31.0636) was higher than the mean HU of fresh water (22.2384) with a difference of 8.8252 ($p=0.0082$).

There was a difference in the mean HU of the drowning vs. control group, as well as in the ocean vs. fresh water group. While the presence of fluid is not a specific finding, the lower mean HU value in drowning deaths vs. controls represents a lower fluid density, consistent with a more watery fluid. Comparing the mean HU by location shows promising results and may have potential applications such as determining where a victim had drowned or if the body had been moved postmortem.

Reference(s):

1. Dolinak D., Matshes E., and Lew E. *Forensic Pathology: Principles and Practice*. Burlington, MA: Elsevier Academic Press. 2005; 228-230.
2. Kawasumi Y., Kawabata T., Sugai Y., Usui A., Hosokai Y., Sato M., Saito H., Ishibashi T., Hayashizaki Y., Funayama M. Diagnosis of drowning using post-mortem computed tomography based on the volume and density of fluid accumulation in the maxillary and sphenoid sinuses. *European Journal of Radiology*. 2013, 82: e562-e566.
3. Christe A., Aghayev E., Jackowski C., Thali M.J., Vock P. Drowning—Post-mortem imaging findings by computed tomography. *Eur Radiol*. 2008;18(2):283-290.

Drowning, Sinus Fluid, Postmortem CT Scan