H169 Aqueous Fluid as a Viable Substitute for Vitreous Fluid in Postmortem Chemistry Analysis

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Learning Overview: The goal of this presentation is to describe the correlation between vitreous and aqueous analytes and the use of aqueous fluid in the pediatric autopsy setting.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by showing that in certain circumstances, particularly pediatric autopsies, vitreous fluid is not sampled due to the risk of introducing hemorrhagic artifact to the globe of the eye. In the current study, aqueous fluid is shown to significantly correlate with vitreous fluid. If predictable differences are considered, aqueous fluid may be sampled in place of vitreous fluid without the risk of introducing artifact.

Background: Vitreous fluid analytes can be a valuable investigative tool in postmortem forensic examinations. While clinical practice relies on blood for analyte analysis, postmortem chemistry is complicated by factors such as continued cell metabolism and autolysis with cell membrane degeneration, making it unsuitable in the forensic setting. As a preserved site with low cell counts, vitreous fluid is somewhat isolated from these changes, allowing for an evaluation of antemortem chemistry. However, in pediatric forensic autopsies where head trauma is present, vitreous fluid sampling is discouraged if eye removal is warranted to evaluate for retinal hemorrhages so as not to introduce hemorrhagic artefact. Whereas vitreous humor is the predominant fluid of the eye, filling the space between the lens and retina, the anterior chamber between the iris and cornea contains a smaller volume of aqueous fluid, which, when sampled, does not introduce hemorrhagic artifact to the posterior chamber as it is physically separated from the retina. Procurement and analysis of aqueous fluid was proposed as a substitute for vitreous fluid.

Methods: Vitreous and aqueous fluid were sampled concordantly from 22 pediatric decedents (median age=0.67 years) and 42 adult decedents (median age=45 years) at the Medical and Forensic Autopsy Division of the Department of Pathology and Laboratory Medicine at the Medical University of South Carolina between 2011 and 2018. Aqueous fluid was sampled with a 25-gauge needle and vitreous fluid was sampled with an 18-gauge needle at the time of autopsy. Sodium (Na), potassium (K), chloride (Cl), urea nitrogen (UN), creatinine (Cr), and glucose (Glc) aqueous and vitreous concentrations were compared to determine correlation and reliable difference. Samples above or below the detectible limit were excluded from the study.

Results: Spearman's rank-order analysis detected significant correlations between pediatric, adult, and combined pediatric/adult samples, respectively: ρ=0.89, ρ=0.93, and ρ=0.84 between vitreous Na and aqueous Na; ρ=0.96, ρ=0.93, and ρ=0.93 between vitreous K and aqueous K; ρ=0.53, ρ=0.81, and ρ=0.79 between vitreous Cl and aqueous Cl; ρ=0.91, ρ=0.93, and ρ=0.95 between vitreous UN and aqueous UN; ρ=0.79, ρ=0.85, and ρ=0.86 between vitreous Cr and aqueous C; and ρ=0.81, ρ=0.77, and ρ=0.77 between vitreous Glc and aqueous Glc.

Simple linear regression was utilized to assess associations in aqueous analytes based on corresponding vitreous analyte values in pediatric, adult, and combined pediatric/adult samples, respectively. For Na, aqueous values were 23%, 8%, and 12% higher than vitreous Na on average; aqueous K was 6%, 8%, and 5% higher than vitreous K on average; aqueous Cl was 34%, 15%, and 18% lower than vitreous Cl on average; aqueous UN was 3%, 2%, and 2% lower than vitreous UN on average; aqueous Cr was 31%, 13%, and 11% lower than vitreous Cr on average; and aqueous Glc was 11%, 29%, and 16% lower than vitreous Glc on average.

Conclusion: Significant correlation exists between vitreous and aqueous analytes with predictable differences.

Taking into account these differences, aqueous fluid analysis of Na, K, Cl, Cr, UN, and Glc concentrations would be a viable substitute for vitreous in the postmortem setting; however, a more robust study population with further consideration of postmortem interval, age, gender, race, and cause of death is required to determine the difference between aqueous and vitreous analyte values with a higher degree of specificity.

Forensic Pathology, Vitreous Fluid, Aqueous Fluid