H84 Nailfold Capillaroscopy Efficacy in Assessing Postmortem Interval (PMI) Compared to Vitreous Potassium Concentration: A Preliminary Study

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The goal of this presentation is to introduce a new method in assessing PMI that seems to be more effective and reliable than vitreous potassium concentration.

This presentation will impact the forensic science community by demonstrating the originality of methods that have never been used in the forensic sciences to assess PMI.

Background: Postmortem vessel changes have been widely investigated to understand the pathophysiology mechanisms entailing capillary leaks. The multiphase Postmortem Computed Tomography Angiography (PMCTA) method allows one to analyze and restore the anatomy of circulation and is of particular interest in investigating the vascular damage-related causes of death.[1] External aspects of the postmortem modifications, such as hypostasis and color changes, are explained by the microvascular rearrangement in which blood clots precipitate within the vessel and the non-corpuscular part of the blood progressively expands throughout circulation.

An unequivocal and reproducible tool to determine the progressive onset of these changes has not yet been identified; even the efforts of forensic science requires several methods to attempt to establish and quantify the PMI.[2] At present, the most reliable seems to be the analysis of the potassium concentration in the vitreous fluid of the eye. By a mathematic model connecting the rise of this ion to the PMI, some authors have proposed a reasonable accuracy of the time-of-death estimation.[3]

Nailfold Videocapillaroscopy (NVC) is a highly reliable, reproducible, logistically practical, and cost-effective favorable technique, in which the nailfold bed capillaries of the fingers of the hand (excluding the first finger) are directly observed by the operator via a magnification lens (usually 200x). It is extensively used in cardiology, dermatology, and rheumatology settings to assess the capillary shapes, often predictive of clinical outcomes. It has recently been integrated by a software that allows it to perform automatic, instead of ocular, measurements of the number and intensity of capillary abnormalities, thus limiting the inter-observer variability and providing a semiquantitative, validated score.[4] Among the assessable alterations, perivascular edema due to capillary leakage can be easily scored.

Methods: After the approval of the local ethics committee, this study considered one-day consecutive subjects on whom autopsies were performed in the University Hospital. The exact time of death was available for all subjects. The bodies were kept at 20°C and the autopsies were performed in an interval randomly ranging from 12 to 36 hours after death; potassium (mmol/l) vitreous samples were collected, and NVC performed, bilaterally. NVC edema was scored by a dedicated software (VideoCap®) and expressed in a continuous quantitative score, set as *0*=perfectly defined shapes, no flu effect, to 35 (according to the potassium vitreous value range considered in most studies), consisting of completely undistinguishable vessels due to the perivascular "fog."[5-7] Obtained values were plotted versus known PMI by Pearson correlation and multivariate non-linear regression (Analysis of Covariance (ANCOVA)). The PMI was expressed in hours in the decimal system, and the statistical analysis was conducted by SAS/STAT® software Version 9.3. A statistical significance of $p<0.05$ with 95% confidence interval was retained.

Results: A total of 15 non-traumatic and 5 violent deaths were included (13 males and 7 females, average age 60±14 years). Among the 40 collected samples (potassium concentration from both eyes and the average edema score for the eight fingers examined, for both hands), the concentrations of potassium ranged from 8.4mmol/L (PMI of 12 hours) to 35.1mmol/L (PMI of 30 hours), while NVC edema scored, respectively, from 8.8 to 34.9. Both values were positively and significantly correlated with PMI ($p<0.001$) but with a different accuracy: vitreous potassium, $R^2=0.83$ vs. NVC, $R^2=0.99$ ($p<0.05$, 95% confidence interval, 34 degrees of freedom). (See Figure 1, below).

Discussion/Conclusion: The PMI assessment has always represented a cardinal objective of forensic science, supported by increasing accuracy due to technology. The obtained data reflects the pathophysiology of the capillary leaks process that begins immediately after death, being conceptually in line with the potassium increasing concentration in the vitreous after metabolic processes stops. Despite the limited number of observations, this work represents a totally original approach in PMI definition, thanks to the contribution of a very simple, reproducible, and standardized technique. Extended data are needed for the validation of the NVC method in capillary assessment to confirm its reliability in determining PMI.

Figure 1:
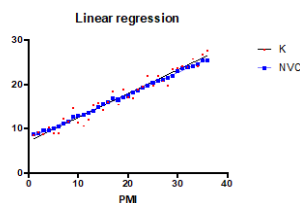
PMI (hours); K, potassium vitreous (mmol/l); NVC edema score.

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Nailfold Videocapillaroscopy, Vitreous Potassium, Postmortem Interval

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