H61 An Affordable Immersion Pump for Postmortem Computerized Tomography Angiography (PMCTA) in Forensic Pathology: The First Ten Cases

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The goal of this presentation is to demonstrate how using an affordable immersion pump (a $16 to $20 device) compares with a roller pump (as part of a Heart-Lung Machine (HLM)) in terms of postmortem vascular filling. Results, particularly for intracranial vessels, are better for the immersion pump.

This presentation will impact the forensic science community by explaining how the replacement of an expensive technology, available since 2005 when PMCTA's were introduced and roller pumps were regarded as de-facto state-of-the-art, with more suitable and massively more affordable technology has the capacity to improve results and expand the user base.

Purpose: Approximately ten years after roller pumps were introduced for forensic postmortem Computed Tomography (CT) angiography, it remains an open question as to why a relatively expensive pump mechanism (costing around $1,000 for a used, old HLM to $80 000 for dedicated top-of-the-line postmortem equipment) is actually necessary for PMCTA. Roller pumps make sense for non-Newtonian fluids like blood, where mechanical hemolysis is also a factor; however, in PMCTA, watery or oily liquid is pumped into the vascular system of a body. After it was established in a feasibility study that a simple immersion pump (priced around $15 to $20) can be calibrated to obtain a linear voltage-flowrate relationship for the contrast agent solution used, and that ideal vascular filling at least as good as a roller pump is achieved, this study presents the results of the first ten cases.

Method and Material: Immersion Pump (IP): a Barwig model 0444 pump (max. 10L/min) was used (required PMCTA flow rate 0.2L/min–0,8L/min) (cost around $16-$20 EUR, power supply from $20 EUR and up). Roller pump/HLM: Stoeckert Shiley HLM (max. 10L/min) was employed. Cases: ten cases from forensic pathology caseload were selected in which PMCTA was seen as relevant and examined with the IP. Ten controls examined with the HLM were used for comparison. Both arterial and venous sides were filled from a femoral access. PMCT/PMCTA: Dual source/energy CT scanner was used (100kVp tube voltage, automatic dose modulation). Reconstructions were obtained on Siemens syngo.via software.

Results: Vascular filling was compared related to cerebral vessels, large vessels, coronary arteries, neck and head arteries, extremity arteries, and, on the same level, veins. Figures show the results. Results were the better with IP. Tube handling was problematic at first but was greatly supported by adding custom 3D-printed support structures.

Discussion: The results may be explained by the fact that the fluid contrast agent admixture is very efficiently pumped by immersion or centrifugal pumps. So, in fact, a physical benefit a roller pump may have for pumping non-Newtonian fluids does not seem to work for this application.

Conclusion: To be able to perform a postmortem CT angiography with very affordable equipment of the same quality as high-priced equipment means that a parametrized method can be validated and employed in far more institutes than when using expensive parts.

PMCTA, Virtopsy, Forensic Imaging

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