Racking the brain! Cerebral Edema on Postmortem Computed Tomography (PMCT) and Forensic Autopsy

Poster No.: C-2016
Congress: ECR 2014
Type: Scientific Exhibit
Authors: N. Berger, G. Ampanozi, T. Ruder, M. Thali, P. Flach; Zurich/CH
Keywords: Statistics, CT, Neuroradiology brain, Edema
DOI: 10.1594/ecr2014/C-2016

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Aims and objectives

Cerebral swelling is a typical finding on postmortem computed tomography (PMCT) in the deceased. However, detection of pre-existing brain edema despite normal postmortem changes is hardly reliable on PMCT and merely based on visual judgment, dependent on the investigator’s experience, as there are no standards yet.

The purpose of this study was to evaluate the diagnostic reliability in differentiation between of pre-existing cerebral edema and physiological postmortem brain swelling on PMCT compared to forensic autopsy and to establish diagnostic criteria for intoxication or asphyxia as cause of death.

Methods and materials

The study collective included 200 deceased (142 males and 58 females), ranging from 20-88 years (mean: 53.2 years). In retrospect 109 cases (out of 200 deceased) were evaluated regarding the following parameters: tonsillar herniation, the width of the outer and inner cerebrospinal spaces and by Hounsfield (HU) measurements of the gray and white matter related to the distinct age groups and causes of death.

Results were compared to the findings of subsequent autopsy as gold standard for diagnosing cerebral edema. Pearson Chi-Square Test and independent t-test (p <0.001) were considered as statistically significant.

Results

Cerebral edema (despite normal postmortem swelling) can be assessed reliable by PMCT based on narrowed temporal horns and with symmetrical herniation of the cerebral tonsils (p <0.001). In cases of intoxication or asphyxia a significant difference (p <0.001) to all other causes of death could be found with a higher deviation of the attenuation between white and grey matter (DGW) >20 HU and the grey to white matter ratio (GWR) >1.58 when leucencephalopathy was excluded.

Images for this section:
**Fig. 1:** Left image: Prominent temporal horns (red arrows). Middle image: Temporal horns are delimitable indicating no pre-existing antemortem or agonal cerebral edema (yellow arrows). Right image: The temporal horns are narrowed indicating an antemortem or agonal present cerebral edema despite normal postmortem changes.

**Fig. 2:** Symmetric tonsillar herniation as diagnostic criteria for antemortem present/agonal cerebral edema. Left image: Herniation of both tonsils (red arrow) below the Mac Rae’s line (yellow line). Right image: Autopsy photograph showing basilar impression of the herniated tonsils (black arrows) as sign for cerebral edema.
Fig. 3: Diagnosis of intoxication/asphyxia as cause of death with white to gray matter difference (DGW) >20 HU and a white to gray matter ratio of (GWR) > 1.58. Left image: Normal postmortem brain without antemortem or agonal cerebral edema or intoxication/asphyxia with a DGW of 12.5 HU and a GWR of 1.36. 2nd left image: Antemortem or agonal cerebral edema without intoxication/asphyxia with a DGW of 11.2 HU and a GWR of 1.28. 2nd right image: Antemortem or agonal cerebral edema with intoxication as cause of death DGW of 22 HU and a GWR of 1.61. Right image: Cases with periventricular leucencephalopathy were excluded as they biased the HU measurements. This case shows a DGW of 17.2 HU and a GWR 1.65. However, this case did not have any intoxication or asphyxia.
Conclusion

Generalized brain edema despite normal postmortem changes can be differentiated on PMCT and white and grey matter HU measurement helps to determine the cause of death in cases of intoxication or asphyxia.

In future increased usage of postmortem magnetic resonance (PMMR) may allow for better differentiation of antemortem and agonal cerebral edema and postmortem brain tissue changes than PMCT alone. However, PMCT is a method that is fast and more readily available for postmortem exams. Still, PMMR may offer in future extensive potential regarding better morphological understanding of the postmortem brain, molecular imaging of intoxication even determining toxicological composition of substances without the need for biopsy or even autopsy. Quantitative measurements by segmentation of the brain volume offer additionally new possibilities for weight determination of organs for a closeness of agreement towards the established benefits of autopsy. In forensic radiology, racking the brain over future feasible applications for a precise and reliable method in brain diagnostics has only just started.

Personal information

The study was conducted by the Virtopsy group at the University of Zurich, Switzerland.

References


Torbey MT, Selim M, Knorr J, Bigelow C, Recht L. Quantitative analysis of the loss of distinction between gray and white matter in comatose patients after cardiac