Biochemistry in traumatic brain injury: Even useful in postmortem setting

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We read Dr. Chirica's research on useful biochemical markers for the assessment of traumatic and hypoxic brain injury with great interest [1]. We entirely agree with her opinion, that biomarker measurement could facilitate the diagnosis of traumatic brain injury (TBI) in clinical management of severely injured living patients as well as in postmortem forensic practice. This becomes of particular interest when considering that TBIs are among the most frequent kinds of traumatic injuries worldwide and are responsible for large numbers of traumatic deaths or cases of long-lasting disability.

Of course, the value diagnosing a TBI via biochemical approaches in fatal trauma autopsy cases is limited when there are severe macroscopic injuries such as skull fractures or intracranial hematomas after TBI [2]. Instead, these investigations are useful in suspect cases with absent morphological features such as diffuse axonal injuries or unknown survival times. Not least, forensic biochemistry becomes crucial in postmortem investigations without subsequent autopsy to confirm or rule out intracranial injuries, since relatives and clinicians are often left without clarification of the cause of death due to low autopsy rates in most of the countries worldwide.

The review of Dr. Chirica repeatedly mentioned the necessity of forensic research for establishment of clinical known biomarkers in postmortem setting. Unfortunately, she did not cite any of the few already published articles concerning biochemistry findings in body fluids of traumatised deceased [2-8] and therefore she did not discuss the promising results of these laboratory advances in contrast to the well-established clinical evaluations that partially are already incorporated in national guidelines of trauma therapy.

Undoubtedly, forensic pathologists might be asked (e.g. in front of courts) about the extent and severity of brain injuries following traumatic impacts or hypoxic periods after cardiac arrests. Until the present day, expert opinions like these are still mainly based on classical autopsy or radiological results and not on findings of blood tests taken while the patients were still alive. Moreover, almost all of the biomarkers are known to be susceptible to agonal and postmortem alterations which means that forensic pathologists need to establish and verify their own postmortem references, since postmortem results are not comparable to clinical ones in general.

The given discussion emphasise how legal medicine needs to consider all promising biomarkers, yet demanding some base-lined requirements which include:

(i) reactive products or structure proteins of the questioned tissue,
(ii) fast responders after cell stress on specific pathways,
(iii) easily accessible in body fluids,
(iv) high discriminatory power concerning the diagnosis in question.

Some of the reviewed biomarkers are already established for measurement in postmortem setting. The main messages indicate that they are useful markers for glial and neuronal damage in fatalities of suspected TBI and that for some, marker elevations may depend on trauma survival intervals. Other promising markers are currently being investigated and our pre-published results indicate their equal usefulness as biochemical proof for TBI. Nevertheless, some further biomarkers, especially for the determination of axonal injuries, remain to be investigated in future research steps.

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Table 1 shows a comparison of the actual state-of-knowledge for the relevant biomarkers of brain injuries in forensic science. The biomarkers themselves are partly also mentioned by [1].

Typical body fluids for postmortem biochemistry are serum samples from heart or femoral vein blood and cerebrospinal fluid (CSF) specimens. Since postmortem serum is subject to hemolytic influences with rising postmortem intervals and therefore predestined for errors in interpreting postmortem values for most of the already investigated biomarkers, the authors suggest only collecting macroscopically clean samples of CSF for standardized forensic biochemistry. Although Dr. Chirica has discussed some confounding aspects about cadaveric CSF, our experiences with this body fluid are consistently rather good. CSF values of most of the biomarkers are to be pointed out as even more reliable for biochemical diagnosis of TBI than measurement in the corresponding serum. During the autopsy, the sampling of the needed CSF is very easy out of the suboccipital space after careful preparation of the cerebellar tentorium by using aseptic syringes, avoiding an iatrogenic blood admixture [6]. Additionally, an external suboccipital puncture allows to collect CSF samples even without opening the skull. The proximity of CSF to the injured brain tissue and an autonomy to potential extracranial sources of the investigated proteins underline the advantages of CSF sampling and analysis.

In conclusion, we would recommend standardised implementation of postmortem biochemistry, also and particularly in trauma cases and further establishment of postmortem biomarker databases through daily casework and extensive research.

Conflict of interest. The authors declare that there is no conflict of interest.

References
5. Li DR, Zhu BL, Ishikawa T, Zhao D, Michiue T, Maeda H. Postmortem serum protein S100B levels with regard to the cause of death involving brain damage in medicolegal autopsy cases. Legal Med. 2006; 8:71-77.