Commentary

Is the grey-to-white ratio valuable enough in prediction for cardiac arrest patients rescued with extracorporeal resuscitation?

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Lee *et al*. retrospectively evaluated the utility of the grey-to-white matter ratio (GWR) in predicting neurological outcomes in 30 extracorporeal membrane oxygenation-assisted cardiopulmonary resuscitation (ECPR)-treated out-of-hospital cardiac arrest (OHCA) patients (1). All of their patients had the brain CT just after the ECMO were implanted and before admission to the ICU. They found all GWR were significantly higher in the good outcome group than in the poor outcome group, and the cut-off value with 100% specificity for the prediction of the poor outcome was 1.21 to 1.24 at different locations or different combinations.

It is generally agreed that poorer GWR suggests hypoxic ischemic change of the brain and thus suggests poorer prognosis. Several prior studies have shown the prognostic accuracy of GWR for predicting the outcome of comatose patients after cardiac arrest using brain CT. Torbey *et al*. first reported a lower GWR observed in comatose patients immediately after cardiac arrest (CT was done within 24 hours of a cardiac arrest) (2). They found basal ganglia level was the most sensitive location on CT for measuring this relationship. In their retrospective study, GWR <1.18 at this level predicted death. Scheel *et al*. studied 98 cardiac arrest patients treated with hypothermia and found GWR <1.16 (average of multiple regions of gray and white matter) predicted poor outcome with 100% specificity and 38% sensitivity within the first 7 days after cardiac arrest (3). The same group further reported a simplified measurement using only four ROIs (putamen and internal capsule bilaterally) which had the same prognostic value (4). They found the simplified GWR <1.11 predicted poor outcome with a sensitivity of 44% at 100% specificity.

The cut-off value for GWR varied a little bit across studies. Lee *et al*. concluded several potential factors which influence the measured gray and white matter density, including age, hemodynamic status related to ECPR, the core body temperature, the timing of CT after achieving successful restoration of circulation, and the protocol for CT at each institution.

Here we would like to emphasize some of factors influencing the measurement of GWR. First is the variation of CT scanners and imaging parameters. Earlier studies have reported the CT number of the gray matter to be 35 or 33 HU and of the white matter 30 or 29 HU (5,6). However, the Hounsfield unit of a certain material is a not an absolute value and it does change with different imaging parameters and different scanner. Attenuation coefficient varies with a chosen X-ray tube voltage (kVp) from the CT scanner since attenuation coefficient has an energy dependent property and many literatures have discovered the significant CT number changes in different kVp for most materials (7). Before we can apply any of the results into practice, we suggest that every center should set up its own cut-off value. The imaging scanners and imaging protocols should be fixed for these patients. Second, the scanning time point is an important factor. In this study, all of the patients had the brain CT just after the ECMO were implanted and before admission to the ICU. The scanning time point is quite early and is more homogeneous than the other results published before. However, because the time point is quite early, probably before the brain density change is discernible in some patients. So the cut-off point is different from prior studies. Kucinski *et al*. reported a gradual decline of the CT number by 0.4 HU every hour during the first 6 hours after the onset of acute ischemic stroke (8). The mean reduction of CT number was reported to be 1.3 HU at 2.5 hours after the onset. These studies indicated that a uniform scanning time point is necessary for these patients for comparison of the GWR. Future studies should address the question of the optimal time point to obtain the CT scan for GWR estimation. And, it would be better if there is a follow-up imaging which helps in determination of the presence of brain ischemia.

Aging is also an important factor that influences the GWR. Aging brains tend to have lower gray matter densities compared to the young brains. Aging brains may have low densities in the basal ganglion caused by dilated perivascular spaces or chronic ischemic changes which might lower the measured gray matter density. Another concern is when there are hypodense lesions in the lobar white matter, either chronic ischemic white matter changes or leukoaraiosis, the GWR may be pseudo-normalized even if the gray matter density has decreased to an abnormal level. In evaluation of aging brains, the GWR criteria should be carefully applied.

In summary, the concept of GWR may be used as an early sign to predict the possible outcome although there still exist some controversial issues. It could act as a simple reference point in the early phase after CPR.

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Footnote

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References

1. Lee YH, Oh YT, Ahn HC, et al. The prognostic value of the grey-to-white matter ratio in cardiac arrest patients treated with extracorporeal membrane oxygenation. Resuscitation 2016;99:50-5.
2. Torbey MT, Selim M, Knorr J, et al. Quantitative analysis of the loss of distinction between gray and white matter in comatose patients after cardiac arrest. Stroke 2000;31:2163-7.
3. Scheel M, Storm C, Gentsch A, et al. The prognostic value of gray-white-matter ratio in cardiac arrest patients treated with hypothermia. Scand J Trauma Resusc Emerg Med 2013;21:23.
4. Gentsch A, Storm C, Leithner C, et al. Outcome prediction in patients after cardiac arrest: a simplified method for determination of gray-white matter ratio in cranial computed tomography. Clin Neuroradiol 2015;25:49-54.
5. Weinstein MA, Duchesneau PM, MacIntyre WJ. White and gray matter of the brain differentiated by computed tomography. Radiology 1977;122:699-702.
6. Cala LA, Thickbroom GW, Black JL, et al. Brain density and cerebrospinal fluid space size: CT of normal volunteers. AJNR Am J Neuroradiol 1981;2:41-7.
7. Cropp RJ, Seslija P, Tso D, et al. Scanner and kVp dependence of measured CT numbers in the ACR CT phantom. J Appl Clin Med Phys 2013;14:4417.
8. Kucinski T, Väterlein O, Glauche V, et al. Correlation of apparent diffusion coefficient and computed tomography density in acute ischemic stroke. Stroke 2002;33:1786-91.

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