Digital probabilistic and principal component analysis of hypoxic-ischemic brain injury

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Aim

The regions at risk of ischemia following cardiorespiratory arrest have not been systematically analysed. This knowledge may be of use in determining the mechanism of ischemic injury at vulnerable sites.

Introduction

Hypoxic coma carries the highest mortality rate among the different causes of coma with only around 30% of patients ever regaining awareness. There are very few studies providing description of the regions at risk of ischemic injury in the context of cardiac arrest. Description of MR findings in the setting of hypoxic ischemic brain injury post-cardiac arrest have used descriptive methodology rather than used a systematic approach. In present study we applied the digital probabilistic method and PCA to study patterns of infarction in hypoxic ischemic brain injury following cardiorespiratory arrest.

Method

The inclusion criteria were: age ≥ 17 years, cardio-respiratory arrest and a coma on admission (2003-2011). Ischemic injury was manually segmented on fluid attenuated inversion recovery (FLAIR) and diffusion weighted (DWI) sequences and linearly registered into common stereotaxic coordinate space. Topography of ischemic injury was assessed using digital probabilistic method (frequency data) and principal component analysis (covariance data). We then performed a sensitivity analysis by sequentially removing patients who did not died.

Results

Forty one patients were included in this series (mean age $\pm$ SD = 51.5 $\pm$ 18.9 years). In our digital atlas (Figure 1), the highest frequency of ischemic injury on the DWI and FLAIR sequences was putamen (0.250), caudate (0.225), temporal lobes (0.0175), occipital (0.0150) and hippocampus (0.125). The first 8 principal components contained 90% of the variance of the data. The first component showed covariance between the deep gray matter nuclei and posterior cortical structures. The sensitivity analysis showed that the pattern of ischemic injury was not changed when the analysis was restricted to patients who died.
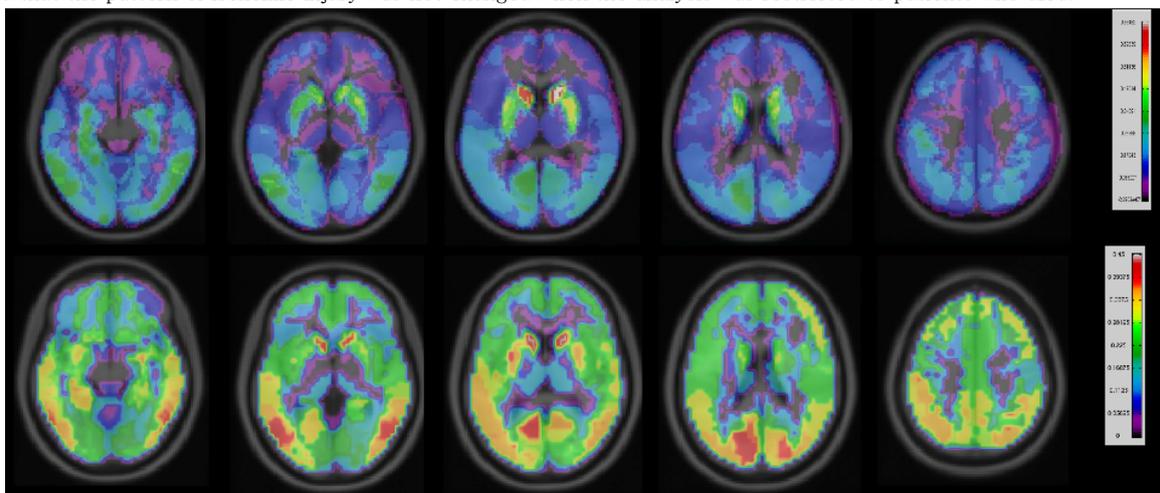

Figure 1: Digital probabilistic atlases of ischemic injury (row 1) and first principal component map (row 2). The color toolbars show the frequency of ischemic injury and the degree of covariance ischemic injury respectively.

Conclusion

We have described the patterns of hypoxic ischemic brain injury. The two different methods show similarity in their emphasis on the deep gray matter nuclei and the posterior cortical structures.

References

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