Use of digital imagery technology for management of post-operational delirium: A feasibility study

E. Tam, K.L. Chu, M.N. Wong, S. Chien, J. Lam, Y.P. Zheng. *Gerontechnology* 25(s*)*

Purpose Postoperative delirium is a frequent and serious complication in older adults after surgery, especially in intensive care. It manifests as acute confusion, impaired attention, and fluctuating consciousness, leading to higher morbidity, longer hospital stays, and increased mortality. Its pathophysiology remains unclear, but studies suggest autonomic dysfunction plays a role. Ernst et al. (2020) found HRV changes may indicate abnormal stress responses in delirium. This study explores whether a preoperative digital intervention “MindfulGarden” (Nicholas et al. 2023) displaying calming nature scenes and sounds, can stabilize autonomic responses and reduce delirium onset. **Method** Subjects admitted to an acute general hospital with hip fractures were enrolled in the study. Delirium was assessed pre- and postoperatively as well as one day after surgery using the 3D-CAM method following spinal anesthesia. ECG-based heart rate variability (HRV) measurements were performed before and after surgery. ECG signals were recorded for five minutes using three leads with an Edan SE-2012 Holter monitor. After surgery, patients participated in a 30-minute digital intervention using “MindfulGarden” prior to returning to the hospital ward. HRV parameters, including time domain measures (SDNN, rMSSD) and frequency-domain measures (TP, HF, LF, LF/HF ratio) were analyzed. **Result** Five patients (mean age: 82) were included in this study. Informed consent was obtained. One patient diagnosed with delirium using the 3D-CAM assessment did not complete the digital intervention. Of the remaining 4 patients, descriptive statistics showed HR increased slightly post-op, while TP and LF decreased. Wilcoxon tests indicated no significant differences between pre-op and post-op HRV parameters ($p > 0.6$). Mann-Whitney tests showed no significant differences between delirium and non-delirium groups at either time point. Spearman correlation revealed LF/HF ratio had a strong positive correlation with delirium ($\rho = 0.76$, $p \approx 0.03$). Chi-square test for time point vs delirium occurrence showed no significant association ($p \approx 0.687$), although delirium prevalence was higher 1 day after surgery (50%). **Discussion** To investigate whether a screen-based digital intervention could help stabilize autonomic responses and reduce the onset of delirium, this study implemented a 30-minute nature-themed imagery session using “MindfulGarden” following hip fracture surgery. Although no statistically significant differences were observed across the three measurement points (Pre-op, Post-op, and 1 day after surgery), trends indicated a slight increase in HR post-operatively, while TP and LF decreased. These findings align with Ernst’s earlier study (2020), which reported reduced LF in patients who developed postoperative delirium. In this study, after the “MindfulGarden” intervention, one patient with pre-op delirium did not exhibit delirium post-op but experienced it again one day after surgery. While the small sample size (n=4) limits definitive conclusions, the digital imagery intervention appears to show potential benefits for delirium prevention. Additionally, manual assessments were complemented by HRV analysis, revealing a positive correlation between LF/HF ratio and delirium—consistent with Ernst’s findings in post-op hip fracture patients. To validate these initial observations, larger studies are required, and longer intervention durations could be more efficient, as suggested by other research.

References

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Affiliation: Jockey club Smart Ageing Hub and Research Institute for Smart Ageing, Department of Biomedical Engineering, The Hong Kong Polytechnic University
Email: eric.tam@polyu.edu.hk