Relationship Between Cognitive Load and Surgical Errors

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Introduction

- Cognitive load (CL) refers to demands on working memory.[1]
- CL can impair surgical performance.[2]
- Electroencephalogram (EEG) and eye-tracking (ET) are effective methods to measure CL.[3,4]
- **The purpose of this study was to determine if EEG and ET are associated with the commission of errors during minimally invasive surgical (MIS) simulated tasks.**

Materials & Methods

- General surgery faculty and residents voluntarily participated.
- After detailing demographics and experience, participants wore EEG cap and mobile ET (shown in images below).
- Participants completed FLS peg transfer laparoscopically and robotically.
- Cortical activity and pupil size were captured and compared between errors (dropped pegs) and flawless execution of the task (no drops) using non-parametric tests.



Emotiv Epoc-X EEG System.
Image from www.emotiv.com



Participant wearing Emotiv Epoc-X EEG System.



Tobii Pro Glasses 2 ET System
Image from www.tobii.com

Results

- Eleven participants completed the study (33.82 average years of age, 55% residents, 64% female, 100% right-handed).
- There were no significant differences in ET-measured CL between drops and successful transfers.
- However, when participants committed errors, they exhibited significantly higher cortical activity in the motor cortex and suppression in the parietal region compared to successfully transferring pegs ($p < 0.05$, Figure 1).

Conclusions

- Utilizing EEG, we documented increased participant CL when committing surgical errors.
- Our findings are consistent with the literature on cortical activation and performance of manual dexterity tasks.[5]
- Additional work may help determine whether early detection of increased CL via EEG can be used for error prevention.

References

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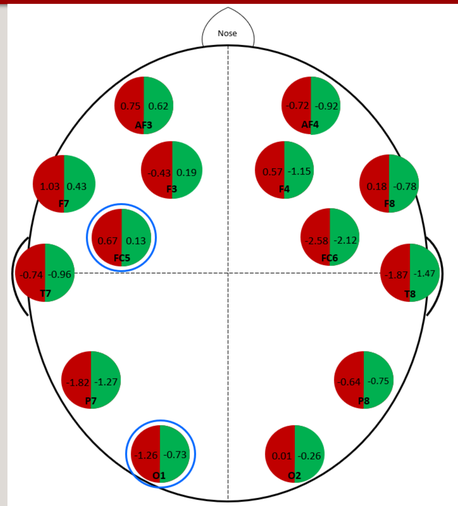


Figure 1a. Difference in Theta Activation between Dropped Pegs and Successful Transfers. Blue circle indicates $p < 0.05$.

Dropped Pegs

Successful Transfers

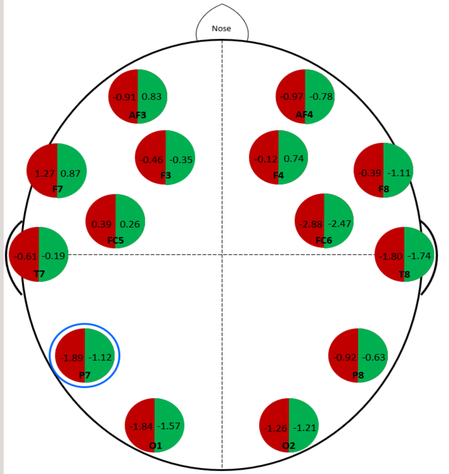


Figure 1b. Difference in Alpha Activation between Dropped Pegs and Successful Transfers. Blue circle indicates $p < 0.05$.

Dropped Pegs

Successful Transfers