Introduction and Objective

- High cognitive workload adversely affects surgeon performance.¹
- Automatically detecting workload could lead to better training and outcomes.²
- Electroencephalography (EEG) is one technology to measure cognitive workload.³
- Alpha bandpower is indirectly related to cognitive workload, while theta bandpower is directly related.⁴

Objective: To determine if cognitive workload can be accurately predicted by EEG during robotic-assisted laparoscopic urologic surgery by comparing high- and low-risk steps.

Methods

- A 14 channel EEG was worn by the surgeons during the robotic procedures.
- The procedures were divided into low- and high-risk segments.
- Low risk segment for partial nephrectomy: before and after hilar clamping
- Low risk segment for prostatectomy: before and after bladder neck and nerve spare portions of the procedure
- High risk segment for partial nephrectomy: during hilar clamping
- High risk segment for prostatectomy: bladder neck and nerve spare portions
- EEGLab with preprocessing pipeline used to determine the alpha, theta mean bandpower, which was used to determine workload.
- ANOVA used to compare cognitive load between the low and high-risk periods and between expert and trainee

Results

- Four surgeons (2 experts, 2 trainees) performed six robotic partial nephrectomy cases and two robotic radical prostatectomy cases.
- The expert surgeons performed the critical portions of the procedures.
- 35 segments decomposed to before/during/after the critical phases were collected
- Among all leads, alpha bandpower was significantly lower and theta bandpower was significantly greater during the critical portions of the procedures compared with bandpower before the critical portions (Figure 5).
- Among all leads, alpha bandpower was significantly lower and theta bandpower was significantly greater for the expert surgeon compared to the trainees.

Conclusions

- EEG was able to predict cognitive workload during robotic urologic surgery.
- This was evidenced by the significant differences in band power between critical and non-critical procedure portions and the significant difference between expert and trainee.
- Measuring cognitive workload can potentially be used as a metric for surgical competency.
- Further studies should be performed to confirm this finding and to explore its application to other aspects of surgical training.

References