November 25, 2014

Research Committee, Research Grant Program
Spina Bifida and Hydrocephalus Association of Canada
647-167 Lombard Avenue, Winnipeg, MB, RB3 0V3

RE: SBHAC Grant – Simulation based training for endoscopic third ventriculostomy

Dear members of the SBHAC Research Committee:

Please consider the enclosed letter as our final report for the project funded beginning July 1, 2012.

In the application submitted to the research committee, our team outlined a research project consisting of two objectives, to be realized over 3 phases. The first objective was to develop and validate a curriculum and assessment measures for simulation-based training of endoscopic third ventriculostomy using a virtual-reality (VR) platform that we have been developing with the National Research Council of Canada (NRC). The second objective was to use this curriculum and the associated assessment measures to determine if simulation-based training results in fewer intraoperative errors among neurosurgical trainees when performing ETV in the clinical setting.

As outlined in our interim report, unforeseen circumstances led to significant delays in the development of the VR platform we planned to use in this study, and subsequently to the timeline of the project as a whole. Since our last report, we have acquired the VR ventriculostomy platform and continued working with NRC to modify some of its features. In addition, a PhD student from our lab has been working full-time on the project, to modify the NRC platform, in order to incorporate multiple training scenarios based on real clinical data.

Due to the complicated nature of scenario development this has been an ongoing process. Alongside scenario development, the ETV simulator has been used during a 'Rookie Camp' organized for all the Canadian first year residents in July for the last 3 years. During the first camp in 2012, as well as subsequently when trying to teach junior residents, we realized that the simulated task was too complex for them, and therefore we further modified the platform to be able to teach residents to accurately target ventricles (which is an essential step for ETV, but also an important step in treating acute hydrocephalus with a ventriculoperitoneal shunt or an external ventricular drain).

As this is a technical skill often performed by Junior residents, the modification was still viewed as beneficial for their training. Again, in order to accommodate for variation in the anatomy and construct a curriculum with increasing order of difficulty, we modified the VR NRC platform. We also created new software to provide immediate feedback to the resident regarding the accuracy of their trajectory and where the tip of their catheter would have been placed. This EVD simulator was tested on 8 residents and results were presented at the International Meeting of Pediatric Neurosurgery in November 2014. We were able to show that there was a good correlation between years of training and performance on the simulator, as well as show that training using progressive levels of difficulty was better than random order of presentation of the cases. Evaluations from the Canadian Neurosurgery Rookie Camp have also demonstrated that residents find practicing with this simulator to be helpful in developing their skills in

targeting the ventricle.

Alongside the VR platform, we have also worked on a physical model for ETV simulation including a printed 3D model, which has been reported in a series of abstracts published in the Canadian Journal of Neurological Sciences and a manuscript published in the Journal of Neurosurgery: Pediatrics. Both the physical and VR models have been tested with residents of different training levels during an ETV training course held in Toronto in 2014. Participants of the course completed an evaluation of each platform, and a manuscript describing the findings from this course is currently in preparation.

We have also made important strides in developing assessment measures that can be used to evaluate trainees' performance in ETV both on the simulators as well as in the operating room. Specifically, we have completed a Delphi study involving an international neurosurgeons who validated the content of 3 expert-based assessment tools: a checklist to assess the procedural steps of ETV, a checklist to assess procedural errors, and a global rating scale of surgical performance. A manuscript detailing the development and validation process for these tools has been submitted to the Journal of Neurosurgery: Pediatrics and is currently under peer review. We are also completing data analysis of a second validation study conducted with colleagues in Naples, where these tools were used to assess the performance of expert and novice endoscopists performing ETVs on physical simulators. This study has demonstrated that the tools are able to distinguish between expert and novice performances, providing validity evidence for their use in assessment of neuroendoscopic skill.

The above demonstrates the progress our team has made towards completing Phase 1 and 2 described in the interim report. However, there is additional work to be done before we can embark on the prospective study to determine the impact of VR training on ETV errors among trainees. Specifically, the remaining training scenarios will need to be completed and tested by the PhD student working on the NRC platform, followed by the validation of our assessment measures in the context of novice training on the VR platform and in the operating room.

We hope that this report will be satisfactory to the Research Committee, but would be happy to provide additional details as requested. We would like to thank the committee for the funding, which allowed us to achieve the progress outlined above. We will continue to work in this direction in order to improve the different simulators developed, and we hope that the translation of our results to the clinical world will improve the quality of life of patients with hydrocephalus.

Sincerely,

Faizal Haji, BHSc, MD, PhD (c)
On behalf of the Simulation based training for endoscopic third ventriculostomy research team