Endoscopic third ventriculostomy training

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Virtual reality (VR) training may alleviate challenges through an accessible, reusable, anatomical model.

Methods: Medical students performed external ventricular drain placements in VR to characterize the learning curve from novice to proficient. Distance from catheter to foramen of Monro and location with respect to ventricle were recorded. Changes in attitudes toward VR were assessed. Neurosurgery residents performed external ventricular drain placements to validate proficiency benchmarks. Resident and student impressions of the VR model were compared.

Results: Twenty-one students with no neurosurgical experience and 8 neurosurgery residents participated. Student performance improved significantly from trial 1 to 3 (15 mm [12.1-20.70] vs. 9.7 [5.8-15.3], P = 0.02). Student attitudes regarding VR utility improved significantly posttrial. The distance to foramen of Monro was significantly shorter for residents than for students in trial 1 (9.05 [8.25-10.73] vs. 15 [12.1-20.70], P = 0.007) and trial 2 (7.45 [6.43-8.3] vs. 19.5 [10.9-27.6], P = 0.002). By trial 3 there was no significant difference (10.1 [8.63-10.95 vs. 9.7 [5.8-15.3], P = 0.62). Residents and students provided similarly positive feedback for VR in resident curricula, patient consent, preoperative practice and planning. Residents provided more neutral-to-negative feedback regarding skill development, model fidelity, instrument movement, and haptic feedback.

Conclusions: Students showed significant improvement in procedural efficacy which may simulate resident experiential learning. Improvements in fidelity are needed before VR can become a preferred training technique in neurosurgery [1)].

An augmented reality (AR) simulator for the practice of ventricular punctures was designed. It consists of a navigation system with a virtual 3D projection of the anatomy over a 3D-printed patient model. Forty-eight participants from neurosurgery staff performed two free-hand ventricular punctures before and after a training session.

Participants achieved enhanced accuracy in reaching the target at the Monro foramen after practicing with the system. Additional metrics revealed significantly better trajectories after the training.

The study confirms the feasibility of AR as a training tool. This motivates future work towards standardizing new educative methodologies in neurosurgery [2).

González-López et al. have developed a 3D printed training model of hydrocephalus so that neurosurgeons without previous experience with endoscopic techniques can acquire these skills, especially in low-income countries, where specific techniques training as this, are relatively absent.

The research question was about the possibility to develop and produce a low-cost endoscopic training model and to evaluate the usefulness and the skills acquired after training with it.

A neuro endoscopy simulation model was developed. A sample of last year's medical students and junior neurosurgery residents without prior experience in neuro endoscopy were involved in the study. The model was evaluated by measuring several parameters, as procedure time, number of fenestration attempts, diameter of the fenestration, and number of contacts with critical structures.

An improvement of the average score on the ETV-Training-Scale was noticed between the first and last attempt (11.6, compared to 27.5 points; $p<0.0001$). A statistically significant improvement in all parameters was observed.

This 3D printed simulator facilitates acquiring surgical skills with the neuroendoscope to treat hydrocephalus by performing an endoscopic third ventriculostomy. Furthermore, it has been shown to be useful to understand the intraventricular anatomical relationships [3)].

Encarnacion Ramirez et al. developed an endoscopic third ventriculostomy training model using 3D printing technology that provides anatomical precision and a realistic simulation. We hope our model can provide an indispensable tool for young neurosurgeons to gain operative experience without exposing patients to risk [4)]

Cadavers were fixed through accepted methods that included formalin injection into the cranial vault. The perfusion system was set up using a series of catheters, tubing, and pressurized saline bag that forced saline into the various neuroanatomical spaces chosen for study.

Results: A neuroendoscope was subsequently introduced to explore and identify relevant neuroanatomical structures as well as to perform a 3rd ventriculostomy and filum sectioning.

Using formalin-fixed cadavers for neuroendoscopic studies and procedural practice is a cost-effective, multipurpose tool that can provide medical trainees with a strong understanding of anatomy as well as procedural practice [5)].

A study aims to develop and establish the content validity of multiple expert rating instruments to assess performance in endoscopic third ventriculostomy (ETV), collectively called the Neuro-Endoscopic Ventriculostomy Assessment Tool (NEVAT).

The important aspects of ETV were identified through a review of current literature, ETV videos, and discussion with neurosurgeons, fellows, and residents. Three assessment measures were subsequently developed: a procedure-specific checklist (CL), a CL of surgical errors, and a global rating scale (GRS). Neurosurgeons from various countries, all identified as experts in ETV, were then invited to participate in a modified Delphi survey to establish the content validity of these instruments. In each Delphi round, experts rated their agreement including each procedural step, error, and GRS item in the respective instruments on a 5-point Likert scale.

Seventeen experts agreed to participate in the study and completed all Delphi rounds. After item generation, a total of 27 procedural CL items, 26 error CL items, and 9 GRS items were posed to Delphi panelists for rating. An additional 17 procedural CL items, 12 error CL items, and 1 GRS item were added by panelists. After three rounds, strong consensus (>80% agreement) was achieved on 35 procedural CL items, 29 error CL items, and 10 GRS items. Moderate consensus (50-80% agreement) was achieved on an additional 7 procedural CL items and 1 error CL item. The final procedural and error checklist contained 42 and 30 items, respectively (divided into setup, exposure, navigation, ventriculostomy, and closure). The final GRS contained 10 items.

We have established the content validity of three ETV assessment measures by iterative consensus of an international expert panel. Each measure provides unique assessment information and thus can be used individually or in combination, depending on the characteristics of the learner and the purpose of the assessment. These instruments must now be evaluated in both the simulated and operative settings, to determine their construct validity and reliability. Ultimately, the measures contained in the NEVAT may prove suitable for formative assessment during ETV training and potentially as summative assessment measures during certification [6].

1)

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