Development of a Perfusion-Based Cadaveric Simulation Model Integrated into Neurosurgical Training

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Introduction

Novel methodologies providing realistic simulation of the neurosurgical operating room (OR) environment are currently needed, particularly for highly subspecialized operations with steep learning curves, high-risk profiles, and demands for advanced psychomotor skills.

Methods

At the USC Keck School of Medicine Fresh Tissue Dissection Laboratory between 2012-2016, 43 cadaveric specimens underwent cannulation of the femoral or carotid artery and artificial perfusion of the arterial system, and/or cannulation of the intradural cervical spine for intrathecal reconstitution of the cerebrospinal fluid (CSF) system. Models were used to train neurosurgical residents in various procedures. Self-assessment of pre- and post-procedure trainee confidence (Likert) scores were compared for each module.

Figure: Endoscopic skull base surgery with internal carotid artery injury.

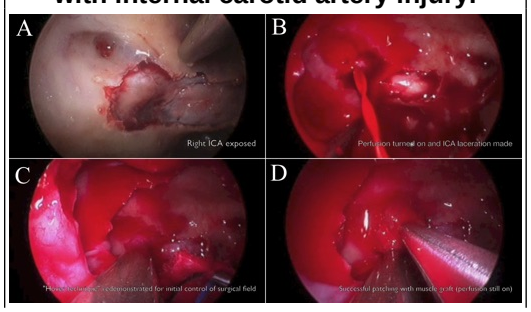
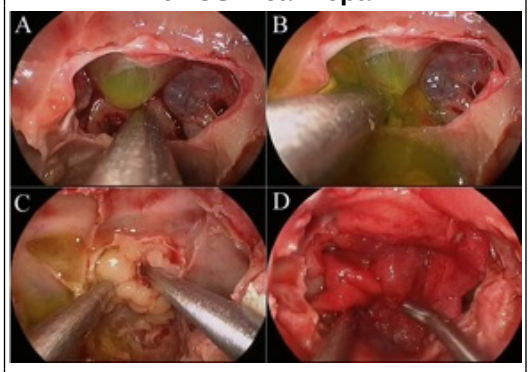


Figure: Endoscopic skull base surgery with CSF leak repair.

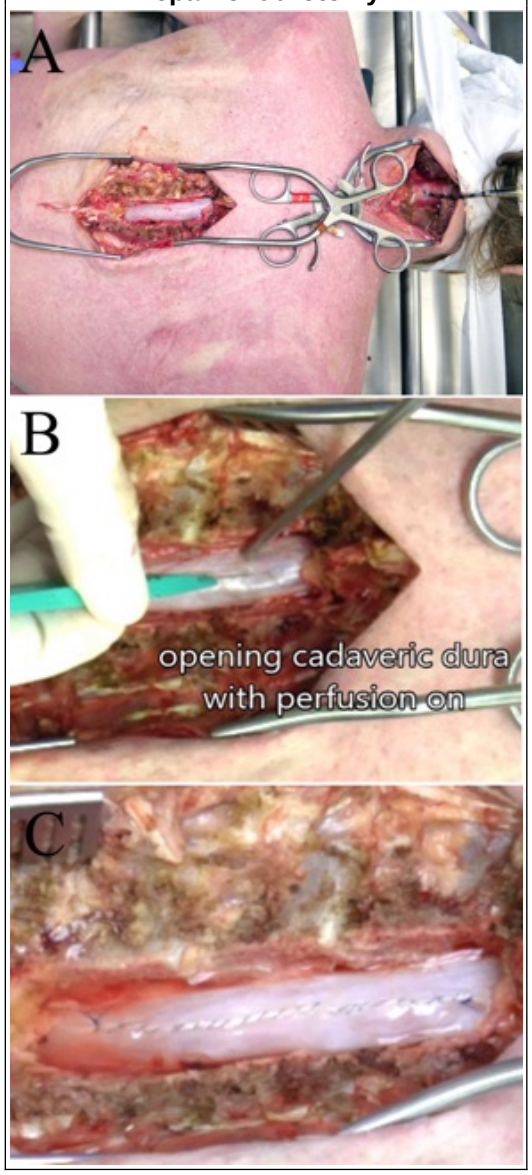


A. Fluorescein-dyed saline egress to mimic a CSF leak. B. Suctioning of CSF leak C. Repair of CSF leak by packing the sella turcica with a fat graft D. and coverage using a pedicled naso-septal flap.

Results

The following novel procedural training methodologies were successfully established: management of a carotid artery injury during endoscopic endonasal approach (n=12), endoscopic endonasal CSF leak repair (n=6) with fluorescein perfusion, carotid endarterectomy (n=4), extracranial-to-intracranial bypass (n=2), insertion of ventriculostomy catheter (n=7), lumbar laminectomy with durotomy repair (n=9), and intraventricular neuro-endoscopy with septum pellucidotomy and third ventriculostomy (n=12). In all instances trainees reported improvement in their post-procedural confidence scores, with mean pre- and post-procedural Likert scores being 2.85 ± 1.09 and 4.14 ± 0.93 ($p<0.05$).

Figure 4. Lumbar laminectomy with repair of durotomy.



Conclusions

Augmentation of fresh cadaveric specimens via reconstitution of vascular and CSF pathways is a feasible methodology for complimenting surgical training in numerous neurosurgical procedures, and may hold implications in the future of neurosurgical resident education.

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