Safety of Live Demonstration Surgery: Experience with Endoscopic Skull Base Surgery

Katie L. Melder MD[1], Monika Freiser MD MPH[2], Yue-Fang Chang PhD[3], John A. Moore BA[1], Stella E. Lee MD[1], Juan C. Fernandez-Miranda MD [4], Eric W. Wang MD[1], Georgios A. Zenonos MD[3], Paul A. Gardner MD[3], Carl H. Snyderman MD[1]
Departments of Otolaryngology[1] and Neurological Surgery[3], University of Pittsburgh Medical Center;
[2] Department of Otolaryngology, West Virginia University; [4] Department of Neurological Surgery, Stanford University

UPMC
LIFE CHANGING MEDICINE

Abstract

Background: Incorporation of live surgery demonstrations in educational programs has been considered a valuable teaching method but continues to be controversial with little data on patient outcomes. There have been no studies regarding televised surgery in the fields of otolaryngology, neurosurgery, or skull base surgery. The objective of this study was to compare outcomes following live surgery demonstrations of endoscopic skull base surgery with case-matched controls.
Study Design: Patients who underwent live surgery broadcasts between 2011 and 2019 at a single tertiary care institution were case matched with controls by surgical approach, tumor pathology, size within 1 cm, tumor invasiveness, and age within 20 years. Patient outcome measures were compared between groups controlling for covariates.
Results: 45 patients undergoing live surgery demonstrations were case matched to 90 patients undergoing routine, non-broadcasted procedures. Most common diagnoses included pituitary adenoma, meningioma, and clival chordoma. There was no differences between groups in complications including post operative CSF leak, meningitis, seizures, vascular injury, cranial nerve injury, and hypopituitarism. No difference was seen in gross total tumor resection or length of admission. Surgical time was significantly shorter (4.37 vs 6.17 hours; p<0.01) and blood loss was significantly less (456.5 vs 638.6 mL; p=0.01) for the live surgery cohort compared to the non-live surgery group.
Conclusion: Live surgery demonstrations of endoscopic skull base surgery procedures did not pose an increased risk of complications or adverse patient outcomes as compared to routine, non-televised surgery. The length of surgery was significantly shorter and the intraoperative blood loss significantly less in live surgery cases.

Introduction

The demonstration of surgery to an audience in real time on a patient, also known as live surgery, is a teaching method utilized at surgical conferences across specialties. The modern version of live surgery typically involves a surgeon performing an operation which is broadcast to an audience located in a separate location. The audience can ask questions and visualize each step of the operation on the projected screen. The goal for the participant is to experience the operation as though they were in the operating room alongside the primary surgeon. This method of teaching undeniably serves as an excellent educational resource; however, some cite ethical and safety concerns. However, there is little data on patient outcomes and therefore a lack of evidence supporting these concerns. The objective of this study was to investigate the safety of live surgery as performed during endoscopic endonasal skull base courses held at our institution. The outcomes of live surgery patients and matched controls were compared.

A

B

Figure 1. A) Endoscopic views, navigation screens, and operating room overhead cameras can all be televised to the audience. Concurrent surgeries can be televised in an alternating fashion. Commentary is provided to the audience by skull base faculty, fellows and guest faculty. **B)**Microphones worn at the mask allow for two-way communication with the audience and moderator

Methods and Materials

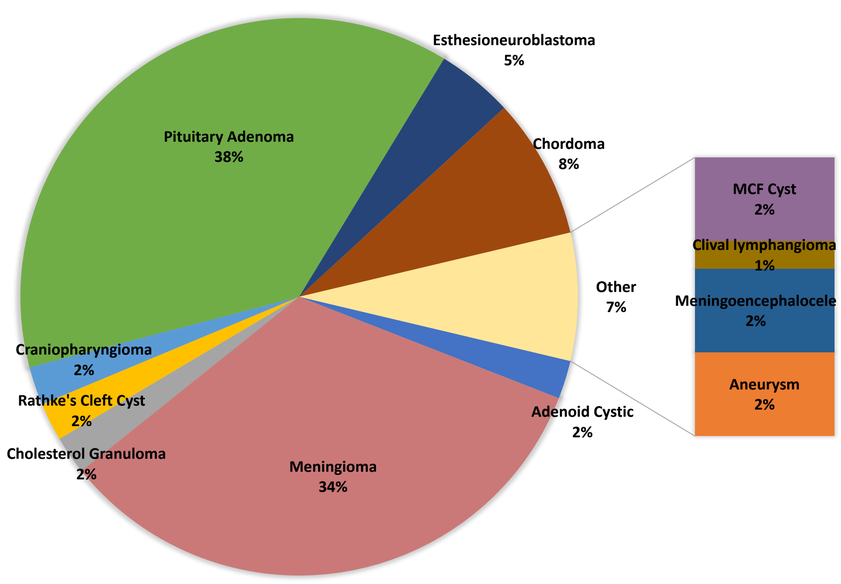
Live Surgery Set Up:
Live surgeries were performed at our institution during skull base courses held 3-4 times annually from 2011 to 2019. Two attending otolaryngologists and two attending neurosurgeons, working in teams of one each, performed the live surgery at each course. Broadcasting technology was used such that any of the following views could be transmitted individually or in combination: the surgeons' endoscopic view, the navigation (CT/MRI) image, and the bird's eye view of the operating room camera (**Figure 1A).** Each attending surgeon wore a microphone attached to their mask and the OR speakers were connected with the lecture hall for interaction with the audience (**Figure 1B**).

Study Design:
A retrospective chart review was performed involving patients who underwent live surgery broadcasts between 2011 and 2019 at a single tertiary care institution. These were case matched with controls by primary surgical approach and location of tumor, tumor pathology, size within 1 cm, and age within 20 years. Patient outcome measures were compared between groups controlling for covariates.

	Non-Live Surgery		Live Surgery		
	n	Mean	n	Mean	p-value
Age	90	57.39	45	59.62	0.417
BMI	90	30.16	45	30.59	0.737
Tumor Size*	87	2.78	44	2.73	0.796
	n	%	n	%	p-value
Smoker	31	34.44	12	26.67	0.361
Female	48	53.33	21	46.67	0.465
Pre-op Visual Loss	51	56.67	18	40.00	0.068
Vascular Encasement	12	13.33	12	26.67	0.056
Cavernous Sinus Invasion	24	26.67	14	31.11	0.588
Prior skull base surgery	13	14.44	10	22.22	0.257

Table 1. Patient demographics and pre-operative tumor characteristics; * = The measurements for meningoencephalocele and aneurysm were not included in tumor size analysis

A



B

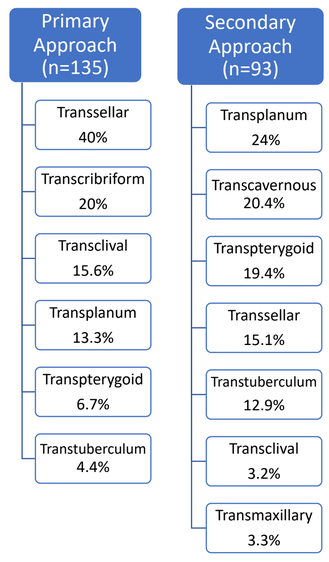


Figure 2. A) Surgical Pathology for both live and non-live surgery (n=135). **B)** Primary and secondary approach for both live and non-live surgery

Results

There were 45 live surgery patients matched with 90 controls. Between the groups, there were no significant differences in patient demographics or pre-op tumor characteristics with the exception of vascular encasement being higher in the live surgery group (26.7% vs 13.3%; p=0.06) (**Table 1**). Pituitary adenoma (38%) and transsellar (40%) were the most common pathology and approach, respectively (**Figure 2**). Surgical time was significantly shorter (4.37 vs 6.17 hours; p<0.01) and blood loss was significantly less (456.5 vs 638.6 mL; p=0.01) for live surgery (**Table 2**). There were no differences in post-operative complications between the two groups (**Table 3**).

	Non-Live Surgery				Live Surgery				
	n	mean	SD	median	n	mean	SD	median	p-value
Surgical time (hrs)	90	6.17	2.93	5.23	45	4.37	1.95	4.00	0.0001*
Length of stay (days)	90	4.87	5.08	4.00	45	4.09	2.96	3.00	0.098
Blood loss (ml)	90	638.61	540.73	500.00	45	456.53	474.72	300.00	0.014*

Table 2. Intraoperative factors and length of inpatient stay.

	Non-Live Surgery		Live Surgery		
	n	%	n	%	p-value
Post-op CSF leak	7	7.78	4	8.89	1.000
Post-op reconstructive/ debridement surgery	10	11.11	4	8.89	0.774
Seizure	2	2.22	2	4.44	0.601
Cranial nerve injury	6	6.67	3	6.67	1.000
Meningitis	3	3.33	1	2.22	1.000
Diabetes Insipidus	4	4.44	0	0.00	0.301
Hypopituitarism	1	1.11	0	0.00	1.000

Table 3. Post-operative complications.

Discussion and Conclusions

Discussion:
In this study, there was no significant difference in complications comparing live endoscopic endonasal skull base surgery patients and matched controls. Two intraoperative markers, length of surgery and blood loss, were significantly lower for the live surgery group. This difference is likely multifactorial: live surgeries may have added attention from OR staff and anesthesia and there is more trainee involvement in non-broadcasted surgeries. This study provides evidence that live surgery can be performed safely without adverse impact on surgical outcomes for patients.
Factors that may contribute to safe live demonstration surgery include performance by experienced surgical teams in their own environment, use of standard technology without testing of new products or devices, and careful patient selection. In addition, the use of a proctor to guide the discussion and lead the process allows the surgeons to maintain their concentration during key portions of the procedure without distraction. The results of this study may not be applicable to situations where surgeons are operating in unfamiliar environments, especially in international courses where communication may be impaired, operating surgeons may not be adequately involved in patient selection, equipment may be deficient, and postoperative care may be provided by others.

Conclusion:
Live surgery did not lead to increased complications as compared to routine, non-televised surgery. This may not apply to surgeries at unfamiliar sites. Continued monitoring of outcomes for live surgeries, through which evidence-based recommendations can be based, is warranted. This study supports the safety of live endoscopic skull base surgery performed in well-selected patients in the hands of experienced surgeons.

Contact

Carl Snyderman, MD, MBA
UPMC Center for Cranial Base Surgery
Email: snydermanch@upmc.edu
Website: www.UPMC.com/skullbasesurgery

References

1. Challocombe B, Wheatstone S. Live surgery: essential surgical education or putting patients at risk? *Ann R Coll Surg Engl* (Suppl) 2010; 92:224-225.
2. Aritbani W, Ficarra V, Challacombe BJ, et al. EAU policy on live surgery events. *Eur Urol*. 2014 Jul;66(1):87-97.
3. Cumpanas AA, Ferician OC, Latcu SC, et al. Ethical, legal and clinical aspects of live surgery in urology-contemporary issues and a glimpse of the future. *Wideochir Inne Tech Maloinwazyjne*. 2017; 12(1):1-6.
4. Rocco B, Grasso AAC, De Lorenzis E, et al. Live surgery: highly educational or harmful? *World J Urol*. 2017 Nov 9. [Epub ahead of print]
5. Williams JB, Matthews R, D'Amico TA. "Reality surgery"–a research ethics perspective on the live broadcast of surgical procedures. *J Surg Educ*. 2011; 68 (1): 58-61.
6. Brunchkhorst O, Challacombe B, Abboudi H, et al. Systematic review of live surgical demonstrations and their effectiveness on training. *Br J Surg*. 2014;101(13):1637-43.