



Abstract

Osteotomy in spine surgery can be used as a marker of increased case complexity and duration. Patients undergo prone positioning and major fluid shifts, which contribute to airway edema and can make reintubation impossible. There is a paucity of evidence as to risk factors for delayed extubation after major spine surgery. In this study, cases involving osteotomy were used as a proxy for complex spine surgery and predictors of prolonged intubation were analyzed. A retrospective, cross-sectional IRB-approved study was performed using a prospectively maintained database containing preoperative and intraoperative variables for spine surgery procedures between January 2006 and November 2016. For each case, the electronic medical record was manually reviewed to affirm that the cases met inclusion criteria. A total of 238 cases met the osteotomy inclusion criteria. 55 patients (23%) were kept intubated after osteotomy surgery. The independent risk factors for delayed extubation were infused crystalloid volume (p = 0.025), administered total fresh frozen plasma (FFP) (p = 0.037), and number of anesthesiologist attending handoffs (p = 0.005). The present study strongly suggest that crystalloid volume administered, fresh volume plasma administered, and number of handoffs are independent risk factors for delayed extubation in major spine surgery. These results can better inform the preoperative identification and optimization of patients for complex spine surgery with the aim of developing a high-risk spine pathway to reduce morbidity and cost of care for patients.

Learning Objectives

- By the conclusion of this session, participants should be able to:
- 1) Identify preoperative and intraoperative predictors of delayed extubation in complex spine surgery
 - 2) Describe the importance of comparing the risks and benefits of post-surgical extubation after complex spine surgery
 - 3) Develop strategies to pre-select high risk spine

Methods

A retrospective, cross-sectional IRB-approved study was performed using a prospectively maintained database containing preoperative and intraoperative variables for 17223 spine surgery procedures between 01/2006 and 11/2016. Preoperative and intraoperative variables included patient demographics, comorbidities, airway risk factors, fluid administration, estimated blood loss, involved personnel, anesthesia time, and prone positioning. The database was queried for cases involving osteotomy and the electronic medical record was manually reviewed to affirm that cases met inclusion criteria. Statistical analysis was performed with R (Version 3.4.1).

Results

A total of 238 cases met the inclusion criteria. 55 patients (23%) were kept intubated after osteotomy surgery. The variables independently associated with delayed extubation were infused crystalloid volume (p = 0.025), administered total fresh frozen plasma (FFP) (p = 0.037), and number of anesthesiologist attending handoffs (p = 0.005).

Table 1				
Table 2. Factors that correlate with delayed extubation after osteotomy procedure.				
	Extubation at End of Case (n=183)	Delayed Extubation (n=55)	P	
			Bivariable model	Multivariable model with interaction variable: EBL*F lactate maximum
Preoperative factors				
Age (mean±SD) (y)	44.3±20.6	54.8±16.6	0.0002	
ASA (1/2/3/4)	(23/88/63/9)	(0/10/20/16)	<0.0001	
Sex (male) (n (%))	87 (45.4%)	24 (43.6%)	0.8778	0.064
BMI (mean±SD) (kg/m²)	26.5±6.1	25.1±6.3	0.1125	
Intraoperative factors				
Mallampati score (1/2/3/4)	(55/98/26/4)	(11/30/11/2)	0.1759	
Anesthesia duration (mean±SD) (min)	262.6±147.7	421.1±149.8	<0.0001	
Number of positions (1/2+)	(164/79)	(64/11)	0.067	
Presence of a line (yes) (n (%))	118 (64.2%)	43 (78.2%)	0.0704	
Presence of a lung ventilator (yes) (n (%))	1 (0.5%)	0 (0%)	1	
Total EBL (mean±SD) (mL)	533.4±661.3	1929.1±1551.4	<0.0001	
Crystalloid volume (mean±SD) (mL)	2545.1±1538.5	4853.8±2404.9	<0.0001	<0.0001
Colloid volume (mean±SD) (mL)	465.1±181.0	209.1±139.4	0.0002	0.025
Total red blood cells (mean±SD) (mL)	128.8±118.7	1029.8±964.8	<0.0001	
Total platelet volume (mean±SD) (mL)	7.5±6.9	115.0±173.9	<0.0001	
Total FFP volume (mean±SD) (mL)	18.0±86.6	457.6±676.3	<0.0001	0.0012
Lactate maximum (mean±SD) (mL)	1.3±0.7	1.9±1.2	<0.0001	0.037
Number of attendings (mean±SD)	1.3±0.5	1.9±0.7	<0.0001	0.005
Case start time (morning/afternoon/evening/night)	(41/122/20/0)	(14/29/9/3)	0.0126	
Case end time (morning/afternoon/evening/night)	(27/68/77/30)	(32/61/10)	<0.0001	
ASA Class = American Society of Anesthesiology Classification System; BMI = Body mass index; EBL = estimated blood loss; FFP = frozen fresh plasma				
Table 1. Factors that correlate with delayed extubation after osteotomy procedure.				

Conclusions

The present study strongly suggests that crystalloid volume administered, fresh volume plasma administered, and number of handoffs are independently associated with delayed extubation in major spine surgery. These results can better inform the preoperative identification and optimization of patients for complex spine surgery with the goal of improving preoperative planning and developing a high-risk spine pathway to reduce morbidity and cost of care.

Limitations

The study was conducted at a single large-scale academic medical center, so results cannot directly be applied to other institutions. It is also limited by its relatively small sample size of 238 cases. A larger multi-center study must be conducted to validate the risk factors associated with delayed extubation in complex spine surgeries. The study was retrospective, so other variables that could potentially affect the decision to extubate were not accounted for. Finally, the available data only allows one to determine whether or not a patient was extubated in the operating room, which sets limitations for the definition of delayed extubation.

References

1. Good CR, Auerbach JD, O’Leary PT, Schuler TC. Adult spine deformity. Curr Rev Musculoskelet Med. 2011;4(4):159-167.
2. Bianco K, Norton R, Schwab F, et al. Complications and intercenter variability of three-column osteotomies for spinal deformity surgery: a retrospective review of 423 patients. Neurosurg Focus. 2014;36(5):E18.
3. Wittekamp BHJ, van Mook WNKA, Tjan DHT, Zwaveling JH, Bergmans DCJJ. Clinical review: post-extubation laryngeal edema and extubation failure in critically ill adult patients. Crit Care. 2009;13(6):233.
4. Cheng DCH. Fast Track Cardiac Surgery Patients. Anesthesiology. 1998;88(6):1429-1433.