EXTUBATION AND THE OPEN ABDOMEN

SUMMARY

The open abdomen has long been considered an indication for continued mechanical ventilation. This leads to increased risk for ventilator-associated pneumonia as well as increased hospital length of stay. This notion has being challenged as it has been shown to be feasible and safe to extubate appropriate patients with an open abdomen following decompressive laparotomy.

RECOMMENDATIONS

- **Level 1**
  - **None**
- **Level 2**
  - **None**
- **Level 3**
  - **Patients with a high admission Glasgow Coma Score (GCS), low Injury Severity Score (ISS) score, and low Abbreviated Injury Score of the chest (AIS-chest) can be considered for extubation prior to open abdomen closure.**

INTRODUCTION

The open abdomen (OA) is a common method for managing a patient's distended or contaminated viscera and avoids the development of significant intra-abdominal hypertension following damage control laparotomy (DCL). Post-operatively, these patients are transferred to the ICU and typically remain intubated until their abdomens are closed. This can be as early 48 hours, but can also extend to several weeks or even months. Prolonged intubation may place such patients at increased risk for ventilator-associated pneumonia (VAP) to as high as 10-20% within 48 hours of intubation (1).

By limiting the number of ventilator days in the OA patient, we may decrease their risk of pneumonia as well as reduce their overall hospital length of stay. Neither the international consensus for open abdomen in trauma nor the updated consensus definitions and clinical practice guidelines from the Abdominal Compartment Society comments on the respiratory strategy for this patient population (2,3).

DEFINITIONS

Damage control laparotomy (DCL) is a procedure commonly utilized in unstable trauma and acute care surgery patients requiring laparotomy for control of hemorrhage and contamination. In such patients, a temporary abdominal closure may be required resulting in what is commonly termed "the open abdomen" (OA) (4).

EVIDENCE DEFINITIONS

- **Class I:** Prospective randomized controlled trial.
- **Class II:** Prospective clinical study or retrospective analysis of reliable data. Includes observational, cohort, prevalence, or case control studies.
- **Class III:** Retrospective study. Includes database or registry reviews, large series of case reports, expert opinion.
- **Technology assessment:** A technology study which does not lend itself to classification in the above-mentioned format. Devices are evaluated in terms of their accuracy, reliability, therapeutic potential, or cost effectiveness.

LEVEL OF RECOMMENDATION DEFINITIONS

- **Level 1:** Convincingly justifiable based on available scientific information alone. Usually based on Class I data or strong Class II evidence if randomized testing is inappropriate. Conversely, low quality or contradictory Class I data may be insufficient to support a Level I recommendation.
- **Level 2:** Reasonably justifiable based on available scientific evidence and strongly supported by expert opinion. Usually supported by Class II data or a preponderance of Class III evidence.
- **Level 3:** Supported by available data, but scientific evidence is lacking. Generally supported by Class III data. Useful for educational purposes and in guiding future clinical research.

The Injury Severity Score (ISS) is an anatomic scoring system that grades the severity of injury to various organ systems (Head & Neck, Face, Chest, Abdomen, Extremity, and External) to give an overall assessment of a patient's severity of injury (5). These categories are measured using the Abbreviated Injury Scale (AIS) which scores injuries on a scale of 1 to 6 with 1 being a minor injury and 6 being unsurvivable (6).

EXTUBATION CRITERIA

Our institution utilizes criteria finalized in October 2013 to guide safe extubation. Our patients are assessed daily for the appropriateness of a trial of extubation. If a patient is requiring continued sedation, this is held and they undergo a Spontaneous Awakening Trial (SAT). Those who appropriately awaken or those not on continued sedation undergo a Spontaneous Breathing Trial (SBT) for 30-120 minutes. If they maintain stable oxygenation (SaO_2 > 90% on FiO_2 < 0.40 and PEEP = 5 cm H_2O), adequate ventilation (no significant change in end-tidal CO_2), hemodynamic stability (heart rate < 130 BPM, systolic BP > 90 mmHg or < 180 mmHg), and do not show signs of excessive work of breathing during the SBT, they are extubated (7).

LITERATURE REVIEW

No randomized controlled trials or large multi-institution studies exist examining extubation in a patient with an OA. Two retrospective studies of OA extubation at Level 1 trauma centers will be summarized. Both were presented in poster format at the 2017 Eastern Association for the Surgery of Trauma Annual Scientific Assembly.

Sujka et al. studied 113 patients who required an OA following DCL over a two-year period. Twenty-three of these patients were excluded for traumatic brain injury or those who died within 72 hours. Forty-three patients were excluded as their OA was closed within 48 hours. Five patients were excluded for pneumonia after 72 hours as the casuality could not be determined to be the initial intubation. . This left 20 patients who were extubated prior to OA closure (PRE group) and 22 patients who were extubated following OA closure (POST group). There were no statistically significant demographic differences between the groups. When comparing the PRE and POST groups, admission GCS was higher in the PRE group (15 vs. 11; p<0.03). Patients in the PRE group also had a lower ISS score (14 vs. 24; p<0.002). The PRE group had the same AIS-abdomen as the POST group, but had significantly lower AIS-chest scores in comparison to the POST group (0 vs. 3; p=0.04).

	PRE Group (n=20)	**POST Group (n=22)**	
	Median (IQR)	**Median (IQR)**	***p* value**
Age (years)	29 (23-42)	33 (23-48)	0.60
Admission GCS	15 (11-15)	11 (10-15)	0.03
ISS	14 (9-18)	24 (17-26)	0.002
AIS-abdomen	3 (3-4)	3 (2-4)	0.95
AIS-chest	0 (0-2)	3 (0-3)	0.04

The number of OA days was significantly less in the PRE group (2.7 vs. 3.8 days; p<0.04). The number of days to extubation from opening of the abdomen was also significantly less in the PRE group (0.5 vs. 7; p<0.001). There was significantly less pneumonia in the PRE group (1 vs. 7; p=0.047).

	PRE Group (n=20)	POST Group (n=22)	
	Median (IQR)	**Median (IQR)**	***p* value**
Admission to completion of DCL (hours)	3.0 (2-6)	3.9 (3-6)	0.10
OA days	2.7 (2-4)	3.8 (3-7)	0.04
OA to extubation (days)	0.5 (0-1)	7 (5-19)	<0.001

The finding of increased pneumonia in the POST group suggests that earlier extubation could lead to less pneumonia. On univariate analysis, factors reaching statistical significance for predicting successful extubation included a higher admission GCS (p=0.035), lower ISS (p=0.008), and lower AIS-chest score (p=0.024). Multivariate analysis did not identify any parameter as an independent predictor of successful extubation.

In the second abstract, Taarea et al. studied 53 OA patients of which 18 patients (4 general surgery, 14 trauma) were extubated with an OA. Thirty-four extubation events were performed in these 18 patients with a savings of 31.5 ± 10.4 ventilator-free hours per extubation event. Patients successfully extubated had lower median ISS scores (12 vs. 19; p=0.038) and SOFA scores (3 vs. 8; p<0.0001) compared to those requiring ongoing ventilator support. None of the patients extubated with an OA required reintubation.

CONCLUSION

The OA does not mandate that a patient continue to be mechanically ventilated. These patients can be evaluated as other patients for extubation with evaluation of awakening, spontaneous breathing, and hemodynamic stability. If these patients meet the standards previously set for extubation, they should be extubated. They have a higher chance of successful extubation when they have a higher admission GCS, lower ISS, and lower AIS-chest score. This may lead to a decreased rate of pneumonia and less morbidity in this patient population.

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