EXTUBATING TRAUMA PATIENTS WITH AN OPEN ABDOMEN FOLLOWING DAMAGE CONTROL LAPAROTOMY

SUMMARY

Damage control laparotomy (DCL) is a procedure commonly utilized in unstable trauma and acute care surgery patients requiring an exploratory laparotomy for control of hemorrhage and contamination. In such patients, a temporary abdominal closure may be required resulting in what is commonly termed an "open abdomen" (OA) (1). The OA has long been considered an indication for continued mechanical ventilation. This leads to increased risk for ventilator-associated pneumonia (VAP) as well as increased hospital length of stay. Recent evidence sugegsts that is both feasible and safe to extubate appropriate patients with an OA following DCL.

RECOMMENDATIONS

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

INTRODUCTION

The OA is a common method for managing a patient's distended or contaminated viscera and avoids the development of significant intra-abdominal hypertension following DCL. Post-operatively, these patients are transferred to the ICU and remain intubated until their abdomens are closed. This can be as early as 24-48 hours, but can also extend to several weeks or even months. Prolonged intubation may place such patients at increased risk for VAP (10-20%) within 48 hours of intubation (2). By limiting the number of ventilator days in the OA patient, the risk of pneumonia may be decreased as well as reduce their overall hospital length of stay.

LITERATURE REVIEW

There are no prospective, randomized, controlled trials to support either Level I or II recommendations on this subject. Neither the international consensus guidelines for OA in trauma nor the updated Consensus Definitions and Clinical Practice Guidelines from the Abdominal Compartment Society comment on a respiratory strategy for this patient population (3,4).

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.

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In the only retrospective study currently published, Sujka et al. reviewed the charts of 113 adult trauma patients requiring an OA following DCL (5). Twenty-three of these patients were excluded for a GCS ≤ 8 with traumatic brain injury, expired/care withdrawn within 72 hours, or the OA was not from their primary surgery. Thus, 31 patients extubated prior to (PRE group) and 59 patients extubated after abdominal closure (POST group) remained for analysis.

Patients were extubated according to institution-specific ventilator weaning guidelines:

- Patients were assessed daily for the appropriateness of a trial of extubation
- If the patient was requiring continued sedation, this was held and the patient underwent a Spontaneous Awakening Trial (SAT)
- Patients who appropriately awakened, or those not on continued sedation, underwent a Spontaneous Breathing Trial (SBT) consisting of CPAP 5 cm H_2O and FiO_2 0.30-0.40 for 30-120 minutes
- If patients maintained stable oxygenation (SaO_2 > 90% on FiO_2 < 0.40), adequate ventilation (no significant change in end-tidal CO_2), hemodynamic stability (heart rate < 130 BPM, systolic BP > 90 mmHg or < 180 mmHg), and did not show signs of excessive work of breathing during the SBT, they were extubated (6)

Successful extubation in the PRE group was measured by the absence of reintubation. Pneumonia was defined as a positive bronchial lavage culture according to our institution's Surgical Critical Care Evidence-Based Medicine Guideline and requiring antibiotic treatment. The lowest GCS without sedation or paralytics from injury to time of surgery was recorded. All OA were managed with the ABThera™ OA Negative Pressure Dressing (KCI USA, San Antonio, TX, USA) and cared for by surgical / trauma intensivists.

There was no difference between the groups with regard to age, gender, Abbreviated Injury Score (AIS)-abdomen or mortality. With regard to mechanism of injury, the PRE group had a significantly higher incidence of penetrating trauma than the POST group. The POST group had a significantly lower admission GCS, higher Injury Severity Score (ISS) and AIS-chest than the PRE group (Table). All patients in both groups underwent definitive primary fascial abdominal closure; no patient required a split-thickness skin graft to their viscera.

	PRE Group	**POST Group**	
	Median (IQR)	**Median (IQR)**	***p* value**
Patients	31	59	
Age (years)	29 (23-44)	32 (23-49)	0.66
Lowest admission GCS	11 (10-15)	10 (9-10)	<0.001
ISS	14 (9-18)	22 (16-26)	<0.001
AIS-chest	0 (0-2)	2 (0-3)	0.01
AIS-abdomen	3 (3-4)	4 (2-4)	0.59
Penetrating trauma	77%	53	0.02
Admission to completion of DCL (hours)	2.6 (2–4)	2.3 (2–4)	0.10
Days from OA to extubation	0.6 (0–1.1)	3.4 (2–8)	<0.001
OA days	2.3 (2–3)	1.8 (2–4)	0.12
Pneumonia	3 (10%)	18 (31%)	0.04
Re-intubation	2 (6%)	2 (3%)	0.61
Tracheostomy	2 (6%)	16 (27%)	0.02
Reopening of abdomen	2 (6%)	3 (5%)	1.0
Mortality	1 (3%)	2 (3%)	1.0
ICU length of stay (days)	2.4 (1-4)	6.7 (4-13)	<0.001
Hospital length of stay (days)	11.4 (7-20)	20.5 (11-34)	0.007
Hospital charges ($1000)	$231 ($168–362)	$398 ($215–732)	0.001

GCS – Glasgow Coma Score; ISS – Injury Severity Score; AIS – Abbreviated Injury Score;
DCL - damage control laparotomy; OA - open abdomen; ICU – intensive care unit

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There was no difference between the groups in time from admission to the emergency department to completion of DCL with OA. Patients in the PRE group who remained intubated post-operatively were extubated in a significantly shorter period of time than the POST group. There was no difference in the incidence of reintubation or re-opening of the abdominal wound following closure between the two groups. The PRE group had a significantly lower rate of pneumonia than the POST group. Given the higher pneumonia rate and average ISS score in the POST group, it is not unexpected that the hospital and ICU length of stay, and hospital charges were significantly higher.

In the multivariate binominal logistic regression, penetrating trauma ($p=0.043$), admission GCS ($p<0.001$), and ISS ($p=0.024$) were identified as significant independent predictors of successful extubation prior to abdominal closure.

CONCLUSION

The OA following DCL does not mandate that a trauma 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 set for extubation, they should be extubated. Patients have a higher chance of successful extubation if they have a penetrating injury, higher admission GCS, lower ISS, and lower AIS-chest score. This may lead to a decreased rate of pneumonia, less morbidity, and decreased hospital resource utilization in this patient population.

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