

Darren Klugman
John T. Berger
Michael C. Spaeder
Amy Wright
William Pastor
David C. Stockwell

Acute harm: unplanned extubations and cardiopulmonary resuscitation in children and neonates

Accepted: 9 April 2013
 Published online: 1 May 2013
 © Springer-Verlag Berlin Heidelberg and ESICM 2013

All work pertinent to this research was conducted at the Children’s National Medical Center, Washington, DC, USA.

Dear Editor,
 Invasive mechanical ventilation is a common therapy used for children and infants in the intensive care unit (ICU). The impact of unplanned extubation (UE) on morbidity and mortality in adults is well described [1, 2]. There remains a paucity of data related to the cardiovascular morbidity associated with UE events in children.

Following review and approval by the institutional review board in accordance and compliance with international ethics standards, we performed a retrospective database review of all UE events in patients admitted to the neonatal, pediatric or cardiac ICU at our institution between July 2011 and December 2012. UE was defined as the removal of an endotracheal tube in a mechanically ventilated patient which was not directed or ordered by a licenced independent practitioner. Cardiovascular collapse was defined as the need for cardiopulmonary resuscitation (e.g., external chest compressions) or circulatory dysfunction immediately

following the UE event. Patients with tracheostomies were excluded from our analysis. Preliminary data were presented at the Pediatric Academic Societies’ and Asian Society for Pediatric Research Joint Meeting in Denver, Colorado in 2011 [3].

There were 119 UE events involving 95 unique patients, and the UE rate (events/100 ventilator days) was 0.5. Cardiovascular collapse occurred in 24 events (20 %), of which 20 involved initiation of cardiopulmonary resuscitation. Four events were characterized by circulatory dysfunction requiring immediate re-intubation without initiation of cardiopulmonary resuscitation. There was no immediate mortality associated with these events. We compared UE event characteristics stratified by presence or absence of cardiovascular collapse (Table 1).

Immediate re-intubation was performed in 75 (63 %) events and was more likely in patients with cardiovascular collapse ($p = 0.01$). Cardiovascular collapse was more likely in younger patients ($p = 0.048$).

It has been recognized for some time that UE carries with it significant morbidity increasing the risk of nosocomial infection and length of mechanical ventilation and ICU stay [1]. This is the first study that we are aware of that assesses the frequency of cardiovascular morbidity associated with UE in children.

While much of the cardiovascular morbidity occurred in our neonatal population, our data suggest that unplanned extubations in critically ill children and neonates can lead to previously unrecognized morbidity. Despite recent advances in cardiopulmonary resuscitation and extracorporeal membrane oxygenation, in-hospital cardiac arrest portends poor outcomes with survival to discharge rates hovering around 25 % [4]. Our study is limited by the lack of long-term follow-up data to assess the impact of UE on mortality. However, our data do suggest there is potential for increased mortality associated with UE events.

In conclusion, the frequency of cardiovascular morbidity in children

Table 1 Unplanned extubation event characteristics stratified by presence or absence of cardiovascular collapse

Event characteristics	CV collapse (n = 24), no. (%)	No CV collapse (n = 95), no. (%)	p value
Age (days)	49 (IQR 20–86)	67 (IQR 29–24 months)	0.048
Intensive care unit			0.08
CICU	4 (14)	10 (11)	
NICU	18 (75)	56 (59)	
PICU	2 (7)	29 (31)	
Primary diagnosis			0.17
CHD	4 (17)	11 (12)	
Neurological	0	10 (11)	
Prematurity	13 (54)	33 (35)	
Respiratory infection	2 (8)	20 (21)	
Other	5 (21)	21 (21)	
Pre-UE ventilator days	6 (IQR 1–13)	4 (IQR 1–11)	0.90
Ventilator weaning phase	4 (17)	29 (31)	0.30
Patient receiving sedation	15 (63)	59 (62)	0.81
Patient restrained	3 (13)	27 (28)	0.18
Immediate re-intubation	21 (88)	54 (57)	0.01

CV cardiovascular, IQR interquartile range, NICU neonatal intensive care unit, PICU pediatric intensive care unit, CICU cardiac intensive care unit, UE unplanned extubation

with UE events is high. Previously published benchmark data for pediatric UEs might not take into account the potential serious consequences of these events [5]. Efforts to decrease rates of UE are paramount. Our data demonstrate important morbidity associated with pediatric and neonatal UEs which we believe support including UEs in the discussion of preventable harm events.

Conflicts of interest On behalf of all authors, the corresponding author states there is no conflict of interest.

References

1. de Lassence A, Alberti C, Azoulay E et al (2002) Impact of unplanned extubation and reintubation after weaning on nosocomial pneumonia risk in the intensive care unit: a prospective multicenter study. *Anesthesiology* 97:148–156
 2. Krinsley JS, Barone JE (2005) The drive to survive: unplanned extubation in the ICU. *Chest* 128:560–566
 3. Klugman D, Berger JT, Galiote J, Stockwell DC (2011) Impact of unplanned extubations in a children's hospital. *E-PAS*:752011
 4. Topjian AA, Berg RA, Nadkarni VM (2008) Pediatric cardiopulmonary resuscitation: advances in science, techniques and outcomes. *Pediatrics* 122:1086–1098
 5. da Silva PS, de Aguiar VE, Neto HM, de Carvalho WB (2008) Unplanned extubation in a pediatric intensive care unit: impact of a quality improvement programme. *Anaesthesia* 63:1209–1216
- D. Klugman (✉) · J. T. Berger ·
M. C. Spaeder · D. C. Stockwell
Division of Critical Care Medicine,
Children's National Medical Center,
111 Michigan Avenue, NW,
Washington, DC 20010, USA
e-mail: dklugman@childrensnational.org
Tel.: +1-202-4765321
Fax: +1-202-4765868
- D. Klugman · J. T. Berger
Division of Cardiology,
Children's National Medical Center,
Washington, DC, USA
- A. Wright
Division of Trauma and Burns,
Children's National Medical Center,
Washington, DC, USA
- W. Pastor · D. C. Stockwell
Division of Quality Improvement,
Children's National Medical Center,
Washington, DC, USA