Association of Preventable Harm and Surgical Mortality in Children

Simone Laing MD[1], Yaqi Hu MD[1], Christian Mpody MD[2], Alice T. Coombs MD[1], Olobukola O. Nafiu MD[2]

1.Department of Anesthesiology, Virginia Commonwealth University Health System, Children's Hospital of Richmond, Richmond, VA

2. Department of Anesthesiology & Pain Medicine, Nationwide Children's Hospital, Columbus, Ohio

Background

Surgical care in pediatric patients poses inherent challenges in the perioperative period. Patients receiving surgical care have the highest incidences of PH and is associated with increased perioperative morbidity and mortalities in adults. The prevalence of preventable harm in pediatric surgical population is not well studied and the consequences of preventable harm including the outcomes are not well delineated.

The aim of this study is to examine the incidence of preventable harm in pediatric surgical population over time, and to evaluate the impact of preventable harm events on patient outcomes.

Methods

We performed a multicenter, 1:1 propensity-score-matched, retrospective study of children (<18 years) undergoing inpatient surgery across 49 U.S. tertiary children's hospitals participating in the Pediatric Health Information System (2016-2022). Our primary outcome was 30 post-operative mortality. We also evaluated the association of PHs with ICU admission, unanticipated mechanical ventilation, and post-operative hospital length of stay. We defined PH as the occurrence of any of the following: 1) Adverse drug events (class A1 and B1), 2) Hospital acquired infections (central line bloodstream infection, catheter-associated urinary tract infections, clostridium difficile infection, and gram-negative pneumonia), 3) hemolytic transfusion reaction, and 4) deep venous thrombosis. The secondary outcome was the aggregate number of PH cases that could have been prevented.

Results

	Preventable harm			
Outcome	**No**	**Yes**	**Odds ratio(95% Confidence interval)†**	**P-values**
	No. of event(%)‡	**No. of event(%)‡**		
Mortality	156(2.2)	482(6.8)	3.24(2.71,3.88)	<0.001
ICU admission	3454(48.4)	5353(75.0)	3.20(3.00,3.42)	<0.001
Mechanical ventilation	2144(30.0)	4449(62.4)	3.86(3.62,4.10)	<0.001
Extended hospital stay	840(11.8)	2740(38.4)	4.67(4.30,5.08)	<0.001

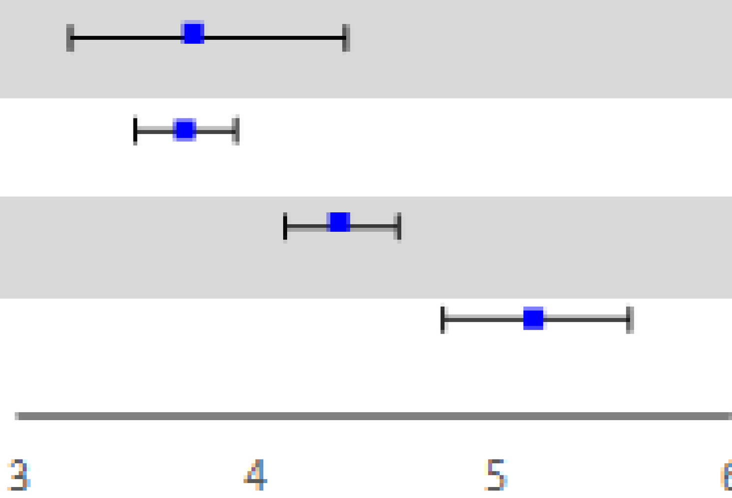

Figure 1. Propensity score-adjusted analyses of mortality and morbidity PHIS 2016-2022. We retained children (<18 years) who underwent inpatient surgical operations.

‡Percentages are for row.

†Estimated using propensity score-adjusted logistic regression models with general estimating equations.

Abbreviation: PHIS, Pediatric health information system.ICU, intensive care unit.

Among 729,211 children who underwent inpatient surgery, 1.0% (n=7250) had suffered from PH. Children with PH had a three-fold higher risk of 30-day post-operative mortality compared to children without PH (6.8% vs. 2.2%; propensity-adjusted odds ratio [OR]: 3.24, 95% confidence intervals [CI]: 2.71,3.88, P<0.001) (Figure 1). 56% percent of surgical burden of mortality among children who suffered from PHs could have been avoided if PHs did not occur (population attributable fraction: 56.4%, 95%CI: 48.7%, 63.0%). Additionally, PH was associated with a higher risk of ICU admission (75% vs 48.4%; propensity-adjusted OR:3.20, 95%CI: 3.00,3.42, P<0.001) (Figure 1). Moreover, children with PH were almost 4 times more likely to require mechanical ventilation than children without PH (62.4% vs 30.0%; propensity-adjusted OR:3.86, 95%CI: 3.62,4.10, P<0.001) (Figure 1). Lastly, children with PH were nearly 5 times more likely to experience an extended length of hospital stay than those without PH (38.4% vs 11.8%; propensity-adjusted OR:4.67, 95%CI: 4.30,5.08, P<0.001) (Figure 1).

Discussion

This is the first study to evaluate the mortality and mortality burden of PHs in surgical pediatric patients. Increased odds ratio of mortality, ICU admission, mechanical ventilation, and extended hospital stay have significant outcome, policy and economic implications.

Conclusion

We found that PH was associated three-fold increased risk of 30-day post-operative mortality, a heightened probability of ICU admission, a nearly four-fold increased risk of requiring mechanical ventilation, and an almost five-fold risk of prolonged hospital stays compared to their peers without PH. These alarming outcomes emphasize the dire need for enhanced strategies and interventions to prevent harm in the pediatric surgical setting..