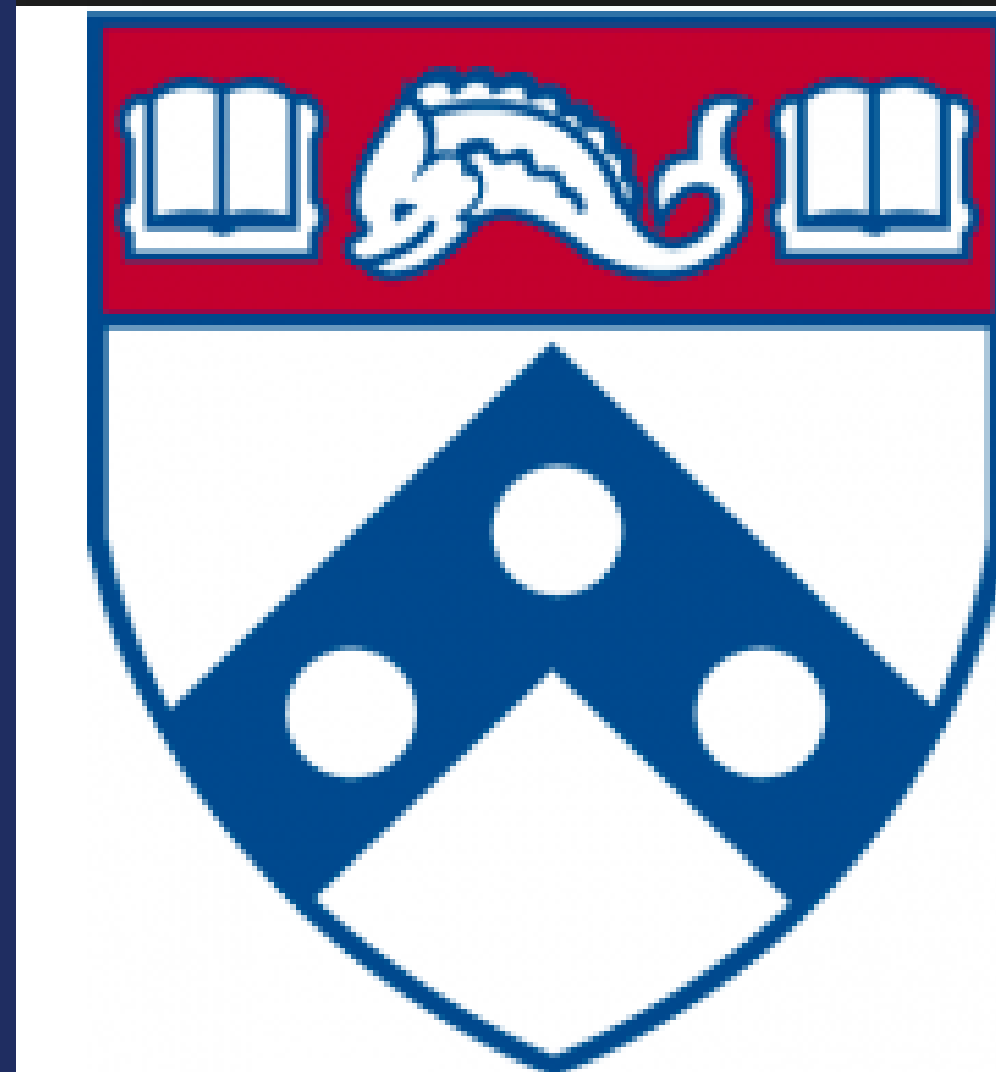




The impact of ventilation technique on complications in The **PeDI** Difficult Airway Registry

Annery G. Garcia-Marcinkiewicz, M.D., John E. Fiadjoe, M.D., H. Daniel Adams, B.S., Vikrim Patel, M.D., Harshad Gurnaney, MBBS, MPH, Kenneth Peeples, MPH, MSW, Justin L. Lockman, M.D., Pete Kovatsis, M.D., on behalf of the PeDI Investigators

The Children's Hospital of Philadelphia, Philadelphia, PA



Abstract

Background: The optimal ventilation approach in children with difficult airways remains controversial. There are no studies comparing various ventilation techniques in adults or children with difficult airways. To address this concern, we reviewed ventilation approaches in pediatric patients with difficult airways from the Pediatric Difficult Intubation (PeDI) registry.

Objectives: The purpose of this study is to provide anesthesiologists managing pediatric airways comparisons between ventilation techniques during intubation in order to increase their ability to make informed decisions while planning airway management. The incidence of muscle relaxant use in difficult airways from our data is described, as well the incidence of switching from one ventilation technique to another.

Methods: We reviewed 1,406 encounters of anticipated difficult airways from the PeDI registry. For each encounter in the registry, we documented the attending anesthesiologist's a priori ventilation plan. We categorized our results based on this plan and categorized complications as severe and non-severe.

Results: Twenty-five percent of the spontaneous ventilation group had complications, which was significantly higher than the controlled ventilation with muscle relaxant (14%) and the controlled ventilation without muscle relaxant groups (15%), $p < 0.0001$.

Conclusions: In children with anticipated difficult tracheal intubation, controlled ventilation techniques are associated with fewer complications than spontaneous ventilation techniques. Controlled ventilation in children with difficult airways may play a role in securing the airway with few complications. Training in maintaining adequate depth of anesthesia during spontaneous ventilation may also present an opportunity for improvement.

Background

- The optimal ventilation approach to perform tracheal intubation in children with difficult airways remains controversial.
- The frequency of using various ventilation approaches and their associated complications remains unknown.
- The (Pediatric Difficult Intubation [PeDI]) registry is a multicenter quality improvement database that prospectively collects intubation data in anesthetized children who are difficult to intubate with standard direct laryngoscopy.
- We a priori designed the registry to capture the planned and eventual ventilation techniques, the use of neuromuscular blocking drugs and related complications.

Objectives

- To determine the impact of planned ventilation technique on severe and non-severe complications during difficult intubation of pediatric airways
- To determine the incidence of switching from the planned ventilation technique
- To describe the incidence of muscle relaxant use in difficult airways

Methods

- Prospectively collected data from the PeDI registry comparing the complication rates of patients with difficult airways were retrospectively analyzed
- All intubations entered in the database between September 4th, 2012 and February 29th, 2016 from the 16 participating medical centers were included in this study
- Patient criteria for inclusion were age less than 18 years old and suspected or actual difficult direct laryngoscopy (past or present). A standardized registry data entry form was completed following airway management and entered into a centralized REDCap database

Results

- 16 centers with 1,754 difficult airway encounters
- 1,406 encounters with anticipated difficult airways
- Patient characteristics are represented in Table 1
- For each encounter, the attending anesthesiologist's a priori ventilation plan was documented. The results were categorized based on this plan: 495 controlled ventilation with muscle relaxant encounters, 349 controlled ventilation without muscle relaxant encounters, 559 spontaneous ventilation encounters (Figure 1, 2)
- 137 (25%) of 559 of the spontaneous ventilation group had complications, which was significantly higher than the controlled ventilation with muscle relaxant, 71 (14%) out of 495, and the controlled ventilation without muscle relaxant groups, 51 (15%) out of 349, [$p < .0001$, (Figure 3)].
- The planned ventilation technique remained the final ventilation technique used in 435 out of 559 (78%) of the patients in the spontaneous ventilation group, 473 out of the 495 (96%) of the patients in the controlled with muscle relaxant group, and 295 out of the 349 (85%) of the patients in the controlled without muscle relaxant group
- The incidence of muscle relaxant use occurred in 495 out of 1406 (35%) of difficult airway cases.

Table 1: Patient Demographics

Variable	Ventilation Technique			P - value
	Spontaneous	Controlled with muscle relaxant	Controlled without muscle relaxant	
Age, yr	5.6(0.7 - 13.1)	6 (0.7 - 12. 6)	6.9 (1.2 - 12.7)	0.4867
Body Weight, kg	16.9 (6.3 - 35)	17.7 (7.15 - 37.2)	19.5 (8.62 - 35.7)	0.1277
Gender (male) n%	309 (38.67)	287 (35.92)	203 (25.41)	0.5878
ASA [n(%)] I	3 (33.33)	5 (55.56)	1 (11.11)	0.0193
ASA [n(%)] II	79 (32.38)	87 (35.66)	78 (31.97)	
ASA [n(%)] III	370 (40.84)	310 (34.22)	226 (24.94)	
ASA [n(%)] IV	60 (42.25)	59 (41.55)	23 (16.2)	
ASA [n(%)] V	0	1 (100)	0	
ASA [n(%)] E	43 (46.74)	32 (34.78)	17 (18.48)	
Diagnosed or suspected syndrome n%	455 (41.63)	363 (33.21)	275 (25.16)	0.0063
Abnormal exam (%)	10 (66.67)	2 (13.33%)	3 (20%)	0.084

Figure 1: Planned Ventilation Technique

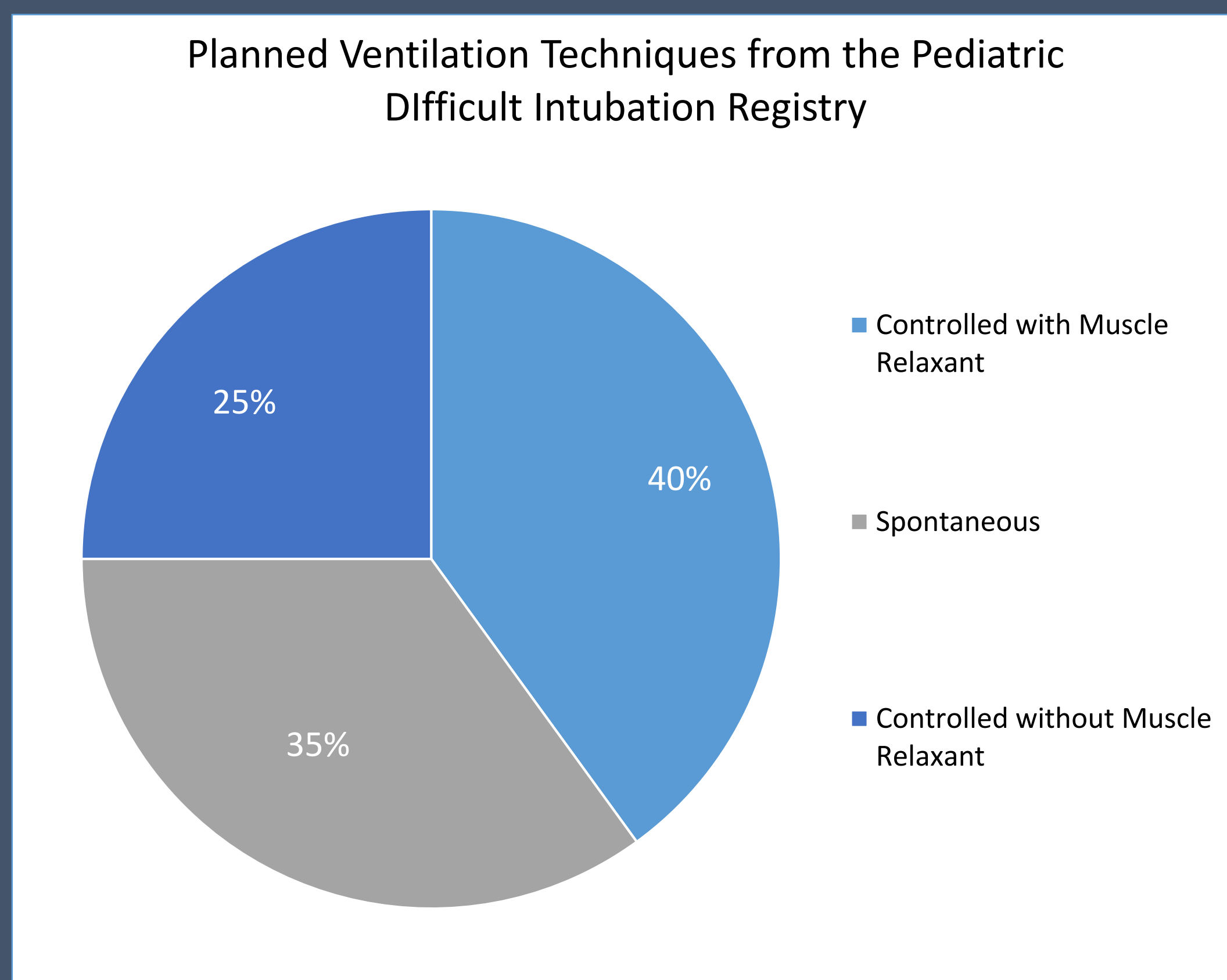


Figure 2: Patient Inclusion Criteria

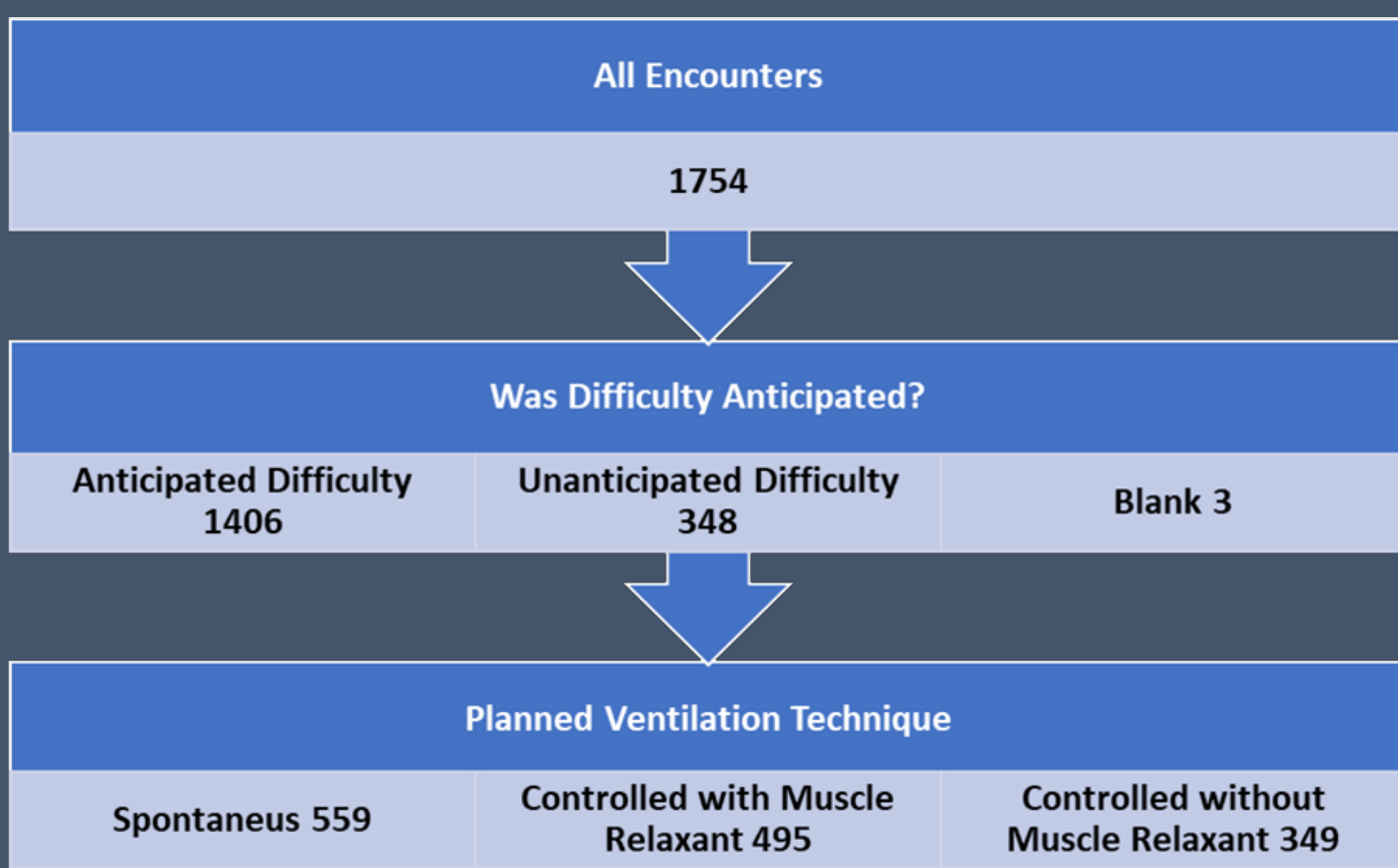
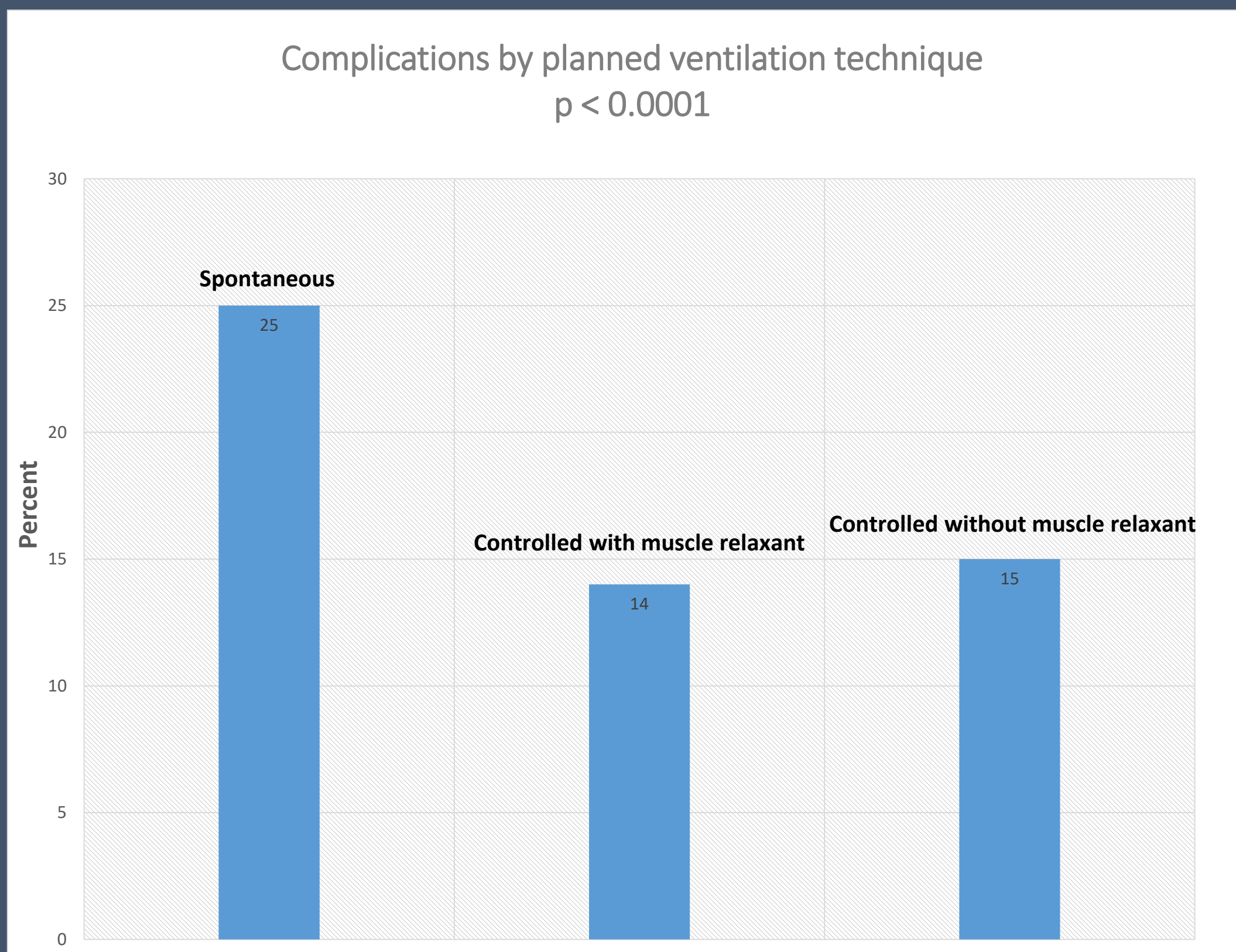


Figure 3: Total Airway Management Complications



Conclusions

In children with anticipated difficult TI, controlled ventilation techniques are associated with fewer complications than spontaneous ventilation techniques. Controlled ventilation in children with difficult airways may play a role in securing the airway with few complications. Training in maintaining adequate depth of anesthesia during spontaneous ventilation may also present an opportunity for improvement.

References

- Fiadjoe JE, Nishisaki A, Jagannathan N, Hunyady AI, et al. Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) registry: a prospective cohort analysis. *Lancet Respir Med* 2016; 4:37-48.
- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)- a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009; 42: 377-81.
- Graciano AL, Tamburro R, Thompson AE, Fiadjoe J, Nadkarni VM, Nishisaki A. Incidence and associated factors of difficult tracheal intubations in the pediatric ICUs: a report from the National Emergency Airway Registry for Children: NEAR4KIDS. *Intensive Care Med* 2014; 40: 1659-69.
- Nishisaki A, Turner DA, Brown CA, Walls RM, Nadkarni VM, and the National Emergency Airway Registry for Children (NEAR4KIDS), and the Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network. A National Emergency Airway Registry for children: landscape of tracheal intubation in 15 PICUs. *Crit Care Med* 2013; 41: 874-85.
- Politis GD, Frankland MJ, James RL, ReVelle JF, Rieker MP, Petree BC. Factors associated with successful tracheal intubation of children with sevoflurane and no muscle relaxant. *Anesth Analg* 2002; 95: 615-20.
- Woods AW, Allam S. Tracheal intubation without the use of neuromuscular blocking agents. *Br J Anaesth* 2005; 94: 150-8.