Comparing Ventilation Quality During One-Handed Versus Two-Handed Mask Holding Techniques During Induction Of Anesthesia In Children Using The Pneurip^{tm} Device

Presenting Author: B. Randall Brenn MD**,** Vanderbilt University Medical Center
Co-authors: Tariq Rahman PhD, Gosia Lutwin-Kawalec MD, Nicole Aronson MD, Karen Sacks APN, Dinesh K. Choudhry MD FRCA**,** Alfred I duPont Hospital for Children

Introduction: During induction of anesthesia in children, significant variability is seen in mask holding technique among different anesthesia practitioners. Some hold the facemask using one hand and others use two hands with varying degrees of airway patency. The two- handed jaw-thrust technique has been shown to have superior airway patency than a one- handed technique in adults (1). The aim of our study was to evaluate if two handed-mask airway technique with jaw thrust (THA) is superior to one-handed technique mask airway with chin lift (OHA) in providing a patent airway during inhalational induction of anesthesia, using a new noninvasive device called the *pneu*RIP^{TM}(2).

Methods: Following IRB approval and consent, 60 children between 1 to 8 years, with obstructive sleep apnea (OSA) due to enlarged tonsils and adenoid, scheduled for T&A were enrolled in the study. Those with abnormal airway anatomy and ASA III and over were excluded.

In conjunction with routing monitoring parameters, we used a new noninvasive device called the *pneu*RIP^{TM} to access airway patency. The pneuRIP utilizes respiratory inductance plethysmography (RIP) to measure abdominothoracic synchrony for the evaluation of obstructed versus nonobstructed pattern of breathing. Two bands (RIP bands) are placed on the patients: one around the rib cage (at nipple line) and one around the abdomen (level of umbilicus) connected to a transmitter. The ribcage signal and the abdominal signal are wirelessly recorded by a third-party device. These bands objectively measure the primary outcomes of phase angle (PA) and labored breathing index (LBI). Additional outcome measures recorded were tidal volume (Vt), minute ventilation (MV), breaths per minute (bpm), and airway obstruction scale (AOS).

In a prospective, randomized crossover study, children were randomly divided in three groups of 20 each, based on the induction technique used. After placement of the bands, anesthetic induction was started and while children were breathing spontaneously the different mask techniques were used according to the predetermined randomization: Group 1 subjects had: OHA for 30 seconds and then switch to THA for 30 seconds. Group 2 subjects had: THA for 30 seconds and then switch to OHA for 30 seconds. Group 3 subjects had: THA for full 60 seconds

Nominal variables were analyzed with chi-square, numeric variables using Anova, and ordinal data with the Kruskal-Wallis test. A p-value of <0.05 was considered significant.

Results: The study groups were demographically similar. The THA technique was found to have significantly greater tidal volume and minute ventilation and lower phase angle, LBI and LBI10 that the OHA technique. In addition, the airway obstruction score was also reduced with the THA technique. (see Table)

Conclusion: From this study, we conclude that THA as measured by *pneu*RIP^{TM} and clinical parameters, provides better airway patency than OHA during inhalational

induction of anesthesia in children with documented obstructive sleep apnea due to enlarged tonsils and adenoids. We also believe that the *pneu*RIP™ might be used as a mask ventilation training device for practitioners learning how to manage obstructed airways.

References: 1. Joffe AM, Hetzel S, Liew EC. A Two-handed Jaw-thrust Technique is Superior to the One-handed "EC-clamp" Technique for Mask Ventilation in the Apneic Unconscious Person. Anesthesiology 2010; 113: 873-9. 2. Rahman T, Page C, Bonnefoy JR, Shaffer TH. *pneu*RIP™: A Novel Respiratory Inductance Plethysmography Monitor. J Med Device. 2017 Mar;11(1):110101-110106

Table 1. Measured Variables by Technique

Variable	One Hand		Two Hand		Two Hand Control		Sig.
	N=40		N=40		N=40		
	Mean±SD	95% CI	Mean±SD	95% CI	Mean±SD	95% CI	
Phase Angle	98.6±34	(87.8-109.3)	81.2±24.1	(73.5-88.9)	84.9±33.5	(74.1-95.6)	0.034[1]
LBI	2.0±1.2	(1.62-2.39)	1.4±0.3	(1.32-1.49)	1.6±0.7	(1.35-1.80)	0.004[1]
LBI10	2.10±1.43	(1.64-2.55)	1.53±0.46	(1.38-1.68)	1.51±0.75	(1.27-1.75)	0.028[1] 0.022[2]
Vt	97.8±57.2	(79.5-116.1)	136.7±59.7	(117.8-156.0)	136.3±72.3	(113.2-159.4)	0.019[1] 0.021[2]
Min Vent	3375±2140	(2690-4059)	4942±2182	(4244-5640)	4705±2049	(4049-5360)	0.004[1] 0.016[2]
RR	32.1±15.3	(27.3-37.1)	39.1±25.2	(31.0-47.2)	35.6±12.7	(31.5-39.6)	NS
BPM	34.2±9.2	(31.3-37.2)	34.0±9.2	(31.0-36.9)	35.3±9.1	(32.9-36.2)	NS
Low spO2	99.9±0.7	(99.6-100)	99.9±0.3	(99.8-100)	99.7±0.7	(99.5-100)	NS
AOscale (mean rank)	71.58		55.27		46.54		0.015[1] 0.000[2]

SD=Standard Deviation, Vt=Tidal Volume, RR=Respiratory Rate, BPM=Breaths per Minute, NS=Not Significant, AOscale=Airway Obstruction Scale, 1=Significance between One Hand v Two Hand, 2=Significance between One Hand v Two Hand Control