BAPA meeting

MUSCLE RELAXANTS SHOULD BE USED FOR TRACHEAL INTUBATION

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Conflict of interest

- Merck/ MSD: departmental funding for clinical trial on sugammadex in pediatric patients/ consulting services
- PhD thesis (2011) on sugammadex

- I don’t use muscle relaxants in every child

Because

- Not always needed

- And sometimes a really bad idea
  - *Anterior mediastinal mass*
  - *Large neck mass*

Difficult tracheal intubation in neonates and infants. NEonate and Children audiT of Anaesthesia pRactice IN Europe (NECTARINE): a prospective European multicentre observational study

Nicola Disma[1,*], Katalin Virag[2], Thomas Riva[3], Jost Kaufmann[4,5], Thomas Engelhardt[6], Walid Habre[7], and NECTARINE Group of the European Society of Anaesthesiology Clinical Trial Network[‡]

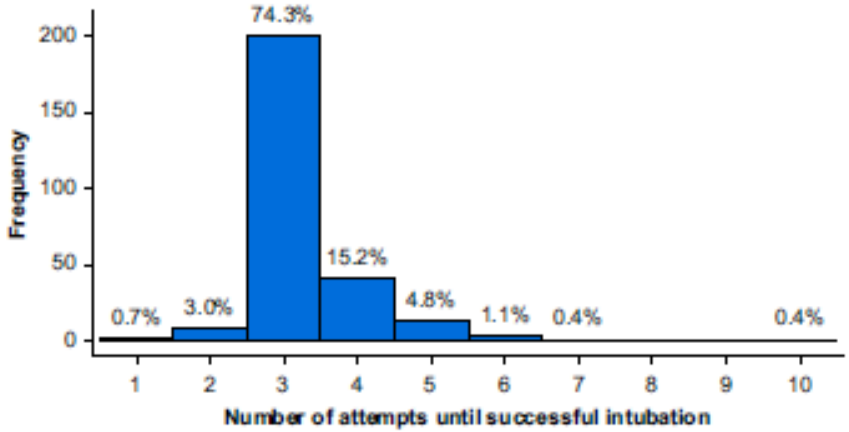

Fig 2. Number of attempts until successful intubation.

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Tracheal intubation in children

- Not more difficult, but…
- Children can become hypoxemic quickly because
  - *Smaller FRC*
  - *Higher oxygen consumption*
- Can lead to desaturation, bradycardia and cardiac arrest
- > 3 attempts direct laryngoscopy increases risk of complications

Fiadjoe J et al; Lancet Respir Med 2016

Difficult intubation = spontaneous ventilation?

PEDI Registry

- Database on difficult tracheal intubations in children < 18 yrs
- Started in 2012 by the Society for Pediatric Anesthesia
- Difficult intubation defined:
  - *Difficult laryngeal exposure with direct laryngoscopy (CL class ≥ 3)*
  - *DL physically impossible due to anatomical reasons*
  - *Failed DL within preceeding 6 months*
  - *Anesthesiologist deferred DL because of a poor chance of success*

A Retrospective Analysis of Neuromuscular Blocking Drug Use and Ventilation Technique on Complications in the Pediatric Difficult Intubation Registry Using Propensity Score Matching

Annery G. Garcia-Marcinkiewicz, MD,* H. Daniel Adams, MD,† Harshad Gurnaney, MBBS, MPH,* Vikram Patel, MD,‡ Narasimhan Jagannathan, MD, MBA,§ Nicholas Burjek, MD,§ Janell L. Mensinger, PhD,‖ Bingqing Zhang, MPH,* Kenneth N. Peeples, MPH,*¶ Pete G. Kovatsis, MD,¶ and John E. Fiadjoe, MD,* on behalf of The PeDI Collaborative

- 1289 patients with anticipated difficult DL, mask ventilation or both
- Initial ventilation technique:
  - *507 spontaneous ventilation*
  - *453 controlled ventilation with NMBA*
  - *329 controlled ventilation without NMBA*

Anesth Analg 2020;131(2): 469-479

Table 2. Outcomes by Ventilation Technique

		Initial Ventilation Technique						
	All Patients	Controlled Ventilation With Muscle Relaxant		Controlled Ventilation Without Muscle Relaxant		Spontaneous Ventilation (With and Without CPAP)		
N	1289	453	Std.Res	329	Std.Res	507	Std.Res	*P* Value
Any complications, n (%)	242 (18.77)	69 (15.32)	−2.4	49 (14.89)	−2.09	124 (24.46)	4.21	<.001
Any severe complications, n (%)	24 (1.86)	9 (1.99)		5 (1.52)		10 (1.97)		.868
Cardiac arrest	13 (1.01)	6 (1.32)		1 (0.3)		6 (1.18)		.356
Severe airway trauma	9 (0.7)	1 (0.22)		2 (0.61)		6 (1.18)		.244
Death	3 (0.23)	1 (0.22)		2 (0.61)		0		.189
Aspiration	1 (0.08)	1 (0.22)		0		0		.607
Pneumothorax	1 (0.08)	0		1 (0.3)		0		.255
Any nonsevere complications, n (%)	218 (16.91)	60 (13.25)	−2.58	44 (13.37)	−1.98	114 (22.49)	4.29	<.001
Hypoxemia	112 (8.69)	35 (7.73)	−0.9	16 (4.86)	−2.85	61 (12.03)	3.43	.001
Minor airway trauma	49 (3.8)	15 (3.31)		9 (2.47)		25 (4.93)		.214
Esophageal intubation with immediate recognition	33 (2.56)	15 (3.31)		7 (2.13)		11 (2.17)		.454
Laryngospasm	34 (2.64)	1 (0.22)	−3.99	12 (3.65)	1.32	21 (4.14)	2.71	<.001
Epistaxis	20 (1.55)	5 (1.1)		3 (0.91)		12 (2.37)		.159
Bronchospasm	9 (0.7)	1 (0.22)		4 (1.22)		4 (0.79)		.267
Pharyngeal bleeding	15 (1.16)	8 (1.77)		2 (0.61)		5 (0.99)		.294
Arrhythmia	3 (0.23)	0		2 (0.61)		1 (0.2)		.266
Emesis	2 (0.16)	1 (0.22)		0		1 (0.2)		1
Other	30 (2.33)	8 (1.77)		7 (2.13)		15 (2.96)		.455
Total intubation attempts, mean (SD)	2.42 (1.69)	2.44 (1.64)		2.34 (1.49)		2.45 (1.85)		.615

If the omnibus χ^2 test is significant at α level of .05 then the post hoc Std.Res would be calculated, with absolute value >3 being seen as significant deviation.
Abbreviations: CPAP, continuous positive airway pressure; SD, standard deviation; Std.Res, standardized residual.

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Conclusion

- Spontaneous ventilation:
- Higher odds of complications (also after matching) (OR 2,07)
- Higher odds of airway reactivity (OR 2,7 compared to controlled ventilation + NMBA)
- Higher incidence of non-severe complications

- Inadequate plane of anesthesia predisposes to airway reactivity

Difficult or impossible facemask ventilation in children with difficult tracheal intubation: a retrospective analysis of the PeDI registry

Annery G. Garcia-Marcinkiewicz[1,†], Lisa K. Lee[2,‡,*], Bishr Haydar[3], John E. Fiadjoe[4,5], Clyde T. Matava[6], Pete G. Kovatsis[4,5], James Peyton[4,5], Mary L. Stein[4,5], Raymond Park[4,5], Brad M. Taicher[7], Thomas W. Templeton[8], and on behalf of the PeDI Collaborative

British Journal of Anaesthesia, 131 (1): 178–187 (2023)

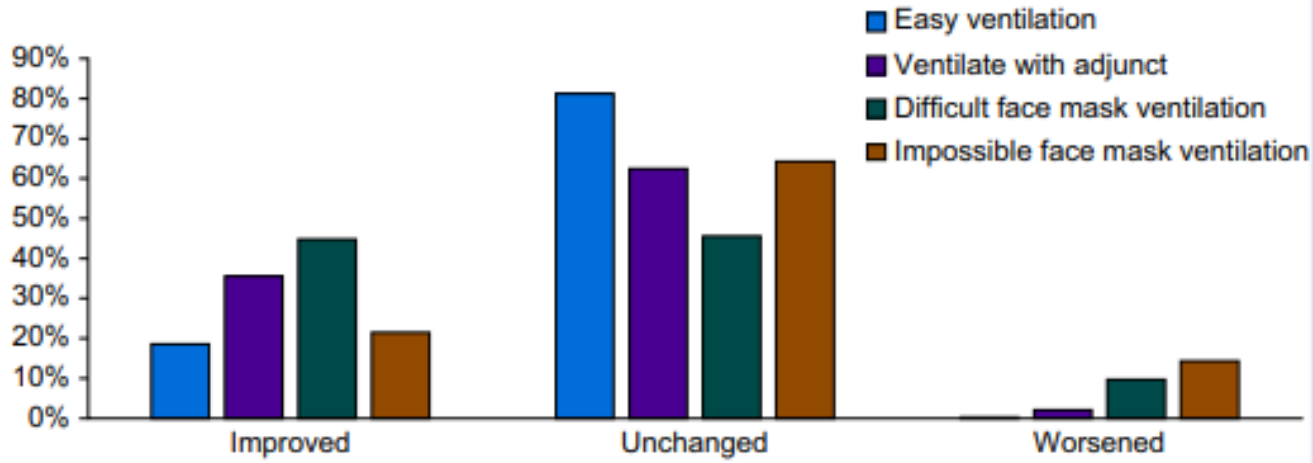
- 5453 cases: 429 difficult / 54 impossible mask ventilation= 9% of children with difficult intubation
- Factors associated with difficult ventilation
  - *Infant*
  - *Weight < 5th percentile or increased weight*
  - *Use of IV sedation or induction*
  - *Tracheal intubation attempted on the ICU*
  - *Glossoptosis*
  - *Limited mouth opening*
  - *Treacher Collins syndrome*

Complications of difficult ventilation

Table 4 Complications by level of difficulty with mask ventilation. Grade 1 mask, easy mask ventilation; Grade 2 mask, mask ventilation requiring an oral airway or other adjuvant.

	Difficult mask (n=429), *n* (%)	Impossible mask (n=54), *n* (%)	Mask grade 1 or 2 (n=4970), *n* (%)
Any complication	170 (39.6%)	36 (66.7%)	930 (18.7%)
Minor airway trauma (dental and lip)	24 (5.6%)	2 (3.7%)	128 (2.6%)
Severe airway trauma (glottis, subglottis, palatoglossal arch and intraoral)	8 (1.9%)	5 (9.3%)	26 (0.5%)
Arrhythmia	4 (0.9%)	1 (1.9%)	4 (0.1%)
Aspiration	2 (0.5%)	0 (0%)	3 (0.1%)
Bronchospasm	9 (2.1%)	2 (3.7%)	33 (0.7%)
Cardiac arrest	22 (5.1%)	6 (11.1%)	18 (0.4%)
Death	6 (1.4%)	0 (0%)	6 (0.1%)
Epistaxis	12 (2.8%)	3 (5.6%)	44 (0.9%)
Oesophageal intubation immediately recognised	12 (2.8%)	0 (0%)	113 (2.3%)
Oesophageal intubation delayed recognition	0 (0%)	1 (1.9%)	4 (0.1%)
Hypoxaemia (oxygen saturation < 90% for more than 45 s or 10% decrease in baseline saturation for more than 45 s)	108 (25.2%)	24 (44.4%)	359 (7.2%)
Laryngospasm	21 (4.9%)	7 (13.0%)	79 (1.6%)
Pharyngeal bleeding	18 (4.2%)	5 (9.3%)	90 (1.8%)
Pneumothorax	1 (0.2%)	1 (1.9%)	3 (0.1%)
Vomiting	0 (0%)	0 (0%)	10 (0.2%)
Other	16 (3.7%)	3 (5.6%)	85 (1.7%)

Change in ease of face mask ventilation after administration of neuromuscular blocking agents



	Improved (*N*=461), *n* (%)	Unchanged (*N*=1226), *n* (%)	Worsened (*N*=30), *n* (%)
Easy ventilation	175 (19)	764 (81)	2 (0)
Ventilate with adjunct	223 (36)	392 (62)	13 (2)
Difficult face mask ventilation	60 (45)	61 (46)	13 (10)
Impossible face mask ventilation	3 (21)	9 (64)	2 (14)

Cannot ventilate? Paralyze!

GUIDELINES

Airway management in neonates and infants

European Society of Anaesthesiology and Intensive Care and British Journal of Anaesthesia joint guidelines

Preparation for airway management and pharmacological treatment (outside resuscitation). **Recommended**:

- Adequate level of sedation/ anesthesia during airway management to ensure comfort and safety
- Use of NMB before tracheal intubation when maintaining spontaneous breathing is not necessary
- Risks and benefits of NMBA administration should be balanced for the individual patient and team skills

Disma N et al, BJA 2024; 132: 124-144; Eur J Anaesthesiol 2024; 41: 3-23

NMBAs for airway management

- Use of NMBA was found to improve the quality of intubation conditions and to decrease the median number of orotracheal intubation attempts
- Higher rate of successful first attempt
- Even at low dose of NMBA (rocuronium)
- Reduces the incidence complications, such as laryngospasm

Disma N et al, BJA 2024; 132: 124-144

Deep sedation instead of relaxation?

Without NMBAs?

- Deep sedation level needed for good intubation conditions
- Propofol can cause hypotension
- Especially in neonates and prematures
- Less optimal intubation conditions

Simons SHP et al, Acta Paediatr 2013; Welzing L et al, Paed Anaesth 2010

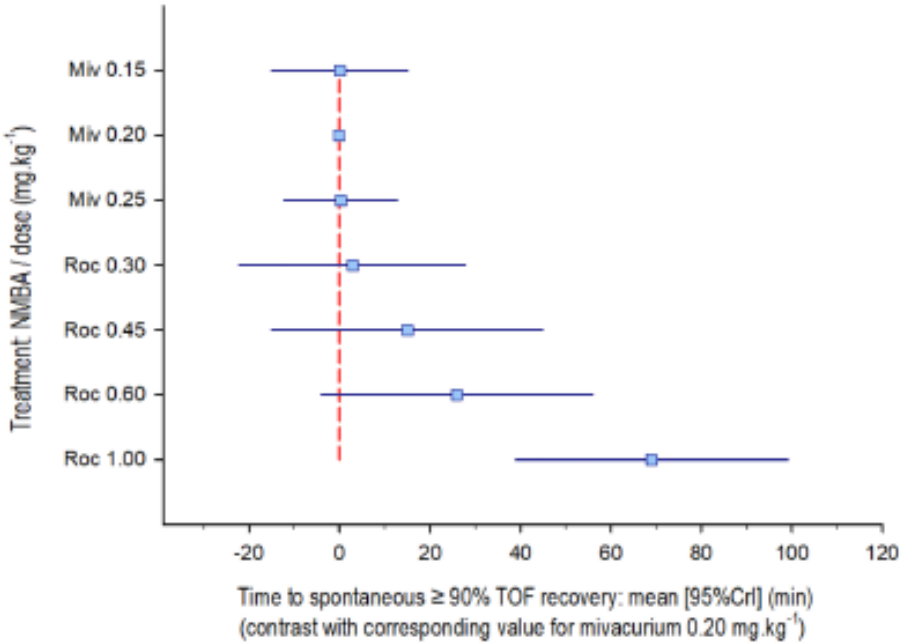
Propofol / remifentanil ± rocuronium

- RCT in 70 infants 3 weeks to 4 months
- Propofol 3 mg/kg and remifentanil 2 mcg/kg
- Rocuronium 0,2 mg/kg (n=36) or saline (placebo) (n=34)
- Intubation conditions excellent/ good/ poor
- 20% placebo vs 3% roc group: ≥2 conditions poor
- 4 first attempts abandoned in placebo vs 0 in roc group
- Max depression of T1 at 4,3 min (2,7- 7,7)

Gelberg J et al, Acta Anaesthesiol Scand 2014

Any downsides to relaxation?

NMBAs in children



Vanlinthout L et al, Paed Anaesth 2024; Accepted for publication

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NMBAs in children

- Network meta analysis in 71 trials on NMBAs in children
- Time to TOF ratio 90% was in children > 2 years old;
  - *mean 42 min shorter than in neonates*
  - *mean 22 min shorter than in infants (1 month- 1 year)*
- The difference in time to recovery TOF 90% increased with the use of aminosteroidal NMBAs and inhalation anesthesia
- Large inter-individual variation of time to recovery NMB

Vanlinthout L et al, Paed Anaesth 2024; Accepted for publication

Conclusion

- Create optimal circumstances for tracheal intubation in children
- The first attempt is the best attempt
- NMBAs may help optimise: don’t be afraid to use it!
- No hemodynamic effects
- A low dose can be sufficient
- When NMBAs have been used: always measure the TOF ratio, even after a single dose

Thank you