Neonatal resuscitation guideline adherence

Simulation study and framework for improvement

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Objectives

- Evaluate adherence of Dutch paediatricians to the ERC guideline on neonatal resuscitation
- Assess their theoretical knowledge of neonatal resuscitation
- Create a framework with strategies to improve (neonatal) resuscitation guideline adherence

Introduction

- 10% of all newborns require respiratory support at birth
- 1% requires resuscitation, including ventilations, compressions, and medications
- Inadequate cardiorespiratory support may inflict pulmonary and/or cerebral damage
- ERC and AHA guidelines for resuscitation of newborns at birth
- Previous studies showed insufficient compliance with the NLS or NRP algorithm
- These studies mainly used video-based assessment instead of CPR quality metrics
- Many studies reported guideline deviations, but no recommendations to improve adherence

Methods

Design: Observational simulation study and systematic literature search

Setting: Simulation centre of a Dutch level III perinatal care centre

Subjects: 46 Dutch general paediatricians, not specifically prepared for NLS

Interventions:

- 23 multiple-choice questions on newborn resuscitation
- Simulated neonatal resuscitation scenario (involving a term newborn), using a model-driven, high-fidelity neonatal patient simulator providing CPR quality metrics
- Assessment of more readily visible items of the neonatal resuscitation algorithm on video
- Systematic literature search to collect publications pertaining to guideline adherence

Results

- 45 paediatricians completed the MCQ, 34 participated in the scenario
- Median years of working experience in paediatrics 13 (IQR 8-21)
- 21 (46%) participants attended NLS course; median of 4 years (IQR 2-5) since last NLS certification
- Median of 70% (IQR 59-78) of the MCQ answered correctly (Table 1)
- Adherence was suboptimal, based on CPR metrics (Table 2) and video recordings (Table 3)
- 10 notable publications identified that contributed to our framework (Table 4)
- Main framework categories: characteristics of professionals, environment/equipment, and guidelines

Table 1. Multiple-choice test results (n=45)

No.	Abridged versions of the questions	Correct
1	How effective is plastic wrapping?	66.7%
2	Gestational age below which wrapping is indicated?	84.4%
3	Possible consequences of hypothermia?	80.0%
4	Heart rate below which umbilical cord pulse is unreliable?	57.8%
5	Reliability of heart rate assessment by auscultation and feeling cord pulsations?	55.6%
6	Importance and reliability of color to assess oxygenation?	80.0%
7	Reliability of Apgar scores to assess effectiveness of resuscitation?	80.0%
8	Correct head position and airway opening manoeuvres?	95.6%
9	How to determine correct oropharyngeal airway size?	77.8%
10	Gestational age/weight above which LMA can be considered?	33.3%
11	Most important barrier to adequate lung inflation?	26.7%
12	How should inflation breaths be performed?	82.2%
13	Correct rate of ventilations?	35.6%
14	Do T-pieces and self-inflating bags deliver constant PIP and PEEP levels?	84.4%
15	Acceptable (pre-ductal) oxygen saturation at 5 min?	66.7%
16	How/at which site should a pulse oximeter be applied?	66.7%
17	Rise in oxygen saturation in preterm infants and after caesarean section?	53.3%
18	Correct compression/ventilation ratio and events per minute?	40.0%
19	Heart rate below which chest compressions should be started?	82.2%
20	When should FiO ₂ be increased?	75.6%
21	Correct epinephrine dose?	68.9%
22	Recommended administration route of epinephrine?	95.6%
23	When should delayed cord clamping be performed?	40.0%

Table 2. Resuscitation quality metrics (n=34)

	Median (IQR)	Range	ERC guideline ^a	Correct, n (%)
Start inflation breaths (sec)	55 (47-72)	36-206	≤60	19 (56%)
Inflation breath duration (sec)	1.67 (1.47-1.67)	1.08-2.83	2-3	8 (24%)
Maximum PIP (cm H ₂ O)	19 (18-19)	15-37	20	29 (85%)
Airway open (% of available time)	83 (76-92)	39-100	100	3 (8.8%)
Start chest compressions (sec)	108 (90-151)	67-254	-	-
Compression rate (per min)	120 (114-120)	102-142	100-120	17 (50%)
Effective chest compressions (%)	38 (24-48)	10-69	100	0 (0%)
Events per minute	138 (130-145)	124-172	120	4 (11.8%)
Administration of epinephrine (sec)	377 (320-497)	211-677	-	-
Time to recovery (sec)	444 (388-565)	271-719	-	-

^a The 2010 ERC guideline was used as a reference, because this study took place just before the update in 2015

Table 3. Scores for items assessed by video observation (n=34)

Item	Correct performance, n (%)
Drying the newborn	32 (94%)
Removal of wet towels	18 (53%)
Hat placement	23 (68%)
Temperature management (above 3 items combined)	17 (50%)
Heart rate assessment (by auscultation)	34 (100%)
Use of pulse oximetry	32 (94%)
Increase in oxygen concentration (at start compressions)	25 (74%)
Correct epinephrine dose	28 (82%)

Table 4. Part of the framework with recommendations to improve (newborn) resuscitation guideline adherence

Characteristics of the guidelines	Guideline development and content	Examples / extra information
	Increase the quality of evidence supporting guideline recommendations	A clear scientific base promotes adherence
	Assemble evidence showing that adherence improves patient outcomes	
	Ensure that guideline recommendations are feasible	First 60 sec of NLS algorithm is a challenge
	Create simple, concise, and convenient guidelines, avoid complexity	Less text, more figures/algorithms, no ambiguities
	Use mnemonics to facilitate recollection	MRSOPA
	Ensure that local, regional, national, and international guidelines are aligned	ABC versus CAB sequence
	Provide guidance for tailored interventions	For comorbidities and specific circumstances (e.g. CDH)
	Compose guideline writing group of credible, representative experts and opinion leaders, but also of end users from different disciplines	Nurses, residents, general paediatricians
	Use instruments to assess guideline quality	Most notably, the AGREE II instrument
	Guideline dissemination and implementation	
	Use active, multi-faceted implementation strategies	Educational outreach, interactive education
	Avoid passive, traditional dissemination strategies	Websites, conferences, didactic lectures, emails

Conclusions

• Neonatal resuscitation guideline adherence among general paediatricians needs improvement

• Our framework is meant to improve (neonatal) resuscitation guideline adherence

AHA, American Heart Association; CDH, congenital diaphragmatic hernia; CPR, cardiopulmonary resuscitation; ERC, European Resuscitation Council; IQR, interquartile range; LMA, laryngeal mask airway; MCQ, multiple choice questions; MRSO-PA, Mask adjustment, Reposition airway, Suction, Open mouth, Pressure increase, Alternative airway; NLS, newborn life support; NRP, neonatal resuscitation program; PEEP, positive end-expiratory pressure; PIP, positive inspiratory pressure

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