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Role of Suction-Based Airway Clearance Devices in Pediatric Foreign Body Airway Obstruction

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Introduction

- Foreign body airway obstruction (FBAO) represents a significant cause of morbidity and mortality in the pediatric population. Factors including pediatric anatomy, chewing and swallowing difficulties, developmental stages, habits and behaviors, and children's toys and foods increase risk of FBAO in children.[1,2]
- BLS guidelines for FBAO management in responsive children ages 1-8 call for a series of subdiaphragmatic abdominal thrusts, which increase intrathoracic pressure to force air and the foreign body out of the airway.[3,4] Abdominal thrusts have higher reports of injury compared to all other FBAO interventions, with risk of thoracic, vascular, and gastro-esophageal injury.[5-7]
- Novel suction-based airway clearance devices (ACDs), including LifeVac and Dechoker, are non-powered, externally applied, and utilize a negative pressure system to remove an obstruction from the airway.[6,8] They are straight-forward to use and less invasive than abdominal thrusts.
- This research aimed to address the following question: In children with foreign body airway obstruction, are suction-based airway clearance devices superior to established pediatric BLS guidelines for abdominal thrusts in terms of successful foreign body removal and ease of use?

Methodologies

- PubMed online database was searched using terms "dechoker," "lifevac," or "suction-based airway clearance." Subsequent searches included terms "children" or "pediatric" and "choking," "foreign body airway obstruction," or "basic life support." Articles published within the past five years were given the most consideration.
- Inclusion criteria: articles published within the past 5-7 years, articles that have been peer-reviewed, and studies with documented population, methods, results, and conclusions.
- Exclusion criteria: non-peer-reviewed studies, studies with vague unconfirmed case reports, "letter to the editor" articles, and research study design proposals without any reported results.
- A manikin study, an adolescent simulator system study, a cadaver study, a retrospective analysis, and a prototype review are included for direct analysis and interpretation of results.

Results

Manikin Randomized Trial

Study model: removal of simulated food bolus from manikin patient using LifeVac, Dechoker, or abdominal thrusts in randomized order; assessing efficacy and usability

- LifeVac demonstrated a higher **success rate** than abdominal thrusts, while Dechoker did not.
- LifeVac and abdominal thrusts were found to be **easier to use** than the Dechoker.[5]

Adolescent Simulator Study

Study model: removal of hotdog piece from adolescent manikin patient using LifeVac pediatric mask; assessing number of trials to successful removal

- Obstruction was removed in 472 of 500 trials in one attempt, in 497 of 500 trials in two attempts, and after three attempts all obstructions were removed successfully with the LifeVac.[9]

Cadaver Study

Study model: removal of small, medium, and large boluses from a recently deceased cadaver patient using the LifeVac; assessing number of attempts to successful removal

- LifeVac successfully removed a simulated food bolus in the first attempt in 49 out of 50 trials.[7]

Retrospective Analysis

Study model: retrospective descriptive analysis evaluating efficacy and safety of LifeVac and Dechoker via reports of use to the manufacturers

- LifeVac was the last intervention used in 123 of 124 reported events, and all patients survived.
- Dechoker was the last intervention used in 60 of 61 reported events, and all patients survived with the exception of one case in which survival was not confirmed.[10]

Prototype Review

Study model: prototype review comparing airway pressure generation for established resuscitative measures and the LifeVac device

- Range of 5.4-179 cm H_2O for all established resuscitative maneuvers, including abdominal thrusts, chest compressions, and back blows.
- Range of 26.5-57 cm H_2O for abdominal thrusts.
- Mean of 434.23 ± 12.35 cm H_2O peak airway pressure generation for LifeVac.[11]

Discussion and Conclusion

Efficacy:

- The two manikin studies, the cadaver study, and the retrospective analysis all clearly demonstrate the efficacy of suction-based ACDs, especially the LifeVac, with superior efficacy compared to abdominal thrusts and complete success rates.[5,7,9,10]
- The prototype review provided evidence that the airway pressure generation of the LifeVac is significantly greater than that of abdominal thrusts, also suggesting the potential for superior efficacy in real-life practice.[11]

Usability:

- Suction-based ACDs offer a more straightforward and easier-to-use model, utilizing an externally applied device that can be applied to a child's face while the child is in a more feasible position, such as lying down or sitting with a support behind them.
- While participants in the manikin randomized crossover trial demonstrated equal understanding of how to use abdominal thrusts and suction-based ACDs, the LifeVac was found to be easiest to use upon actual implementation.[5]

Looking ahead:

- Suction-based ACDs have significant potential to play a role in emergent pre-hospital intervention in pediatric FBAOs.
- Future study proposal: A randomized controlled study design comparing abdominal thrusts to the LifeVac and the Dechoker on pediatric manikin models with an assessment of efficacy, based on successful obstruction removal and rate of removal, as well as usability, based on rescuer assessment of ease of use.
- Creation of a more streamlined, unbiased reporting system for individuals to report the use of suction-based ACDs and to record success, ease of use, and adverse outcomes or harms.

Impact on PA practice:

- Pediatric providers could be in the position to counsel parents on the use of suction-based ACDs and provide anticipatory guidance and recommendations to families and schools to have these devices present in the home and classroom to reduce the morbidity and mortality of FBAO emergencies in the pediatric population.

Literature Cited

1. Mayorathan U, Manikkavasakar S, Pranavan S. Accidental Choking in Children: An Area To Be Focused on. *Cureus*. 2022;14(2):e22459. doi:10.7759/cureus.22459

2. Dowd MD. Choking in Children: What to Do and How to Prevent. *Pediatr Ann*. 2019;48(9). doi:10.3928/19382359-20190819-01

3. Part 9: Pediatric Basic Life Support. *Circulation*. 2000;102(suppl_1):I-253. doi:10.1161/circ.102.suppl_1.I-253

4. Heimlich J. A Life-Saving Maneuver to Prevent Food-Choking.

5. Patterson E, Tang HT, Ji C, Perkins GD, Couper K. The efficacy and usability of suction-based airway clearance devices for foreign body airway obstruction: a manikin randomised crossover trial. *Resuscitation Plus*. 2021;5:100067. doi:10.1016/j.resplu.2020.100067

6. Couper K, Abu Hassan A, Ohri V, et al. Removal of foreign body airway obstruction: A systematic review of interventions. *Resuscitation*. 2020;156:174-181. doi:10.1016/j.resuscitation.2020.09.007

7. Juliano M, Domingo R, Mooney MS, Trupiano A. Assessment of the LifeVac, an anti-choking device, on a human cadaver with complete airway obstruction. *The American Journal of Emergency Medicine*. 2016;34(8):1673-1674. doi:10.1016/j.ajem.2016.03.047

8. Dunne CL, Peden AE, Queiroga AC, Gomez Gonzalez C, Valesco B, Szpilman D. A systematic review on the effectiveness of anti-choking suction devices and identification of research gaps. *Resuscitation*. 2020;153:219-226. doi:10.1016/j.resuscitation.2020.02.021

9. Lih-Brody L, Singer M, Brody E. 382 Lifevac: A Novel Device for the Resuscitation of the Adolescent Choking Victim. *Annals of Emergency Medicine*. 2017;70(4, Supplement):S149-S150. doi:10.1016/j.annemergmed.2017.07.352

10. Dunne CL, Osman S, Viguers K, Queiroga AC, Szpilman D, Peden AE. Phase One of a Global Evaluation of Suction-Based Airway Clearance Devices in Foreign Body Airway Obstructions: A Retrospective Descriptive Analysis. *Int J Environ Res Public Health*. 2022;19(7):3846. doi:10.3390/ijerph19073846

11. Patel PB, Shapiro NL. Portable, non-powered, suction-generating device for management of life-threatening aerodigestive tract foreign bodies: Novel prototype and literature review. *International Journal of Pediatric Otorhinolaryngology*. 2019;118:31-35. doi:10.1016/j.ijporl.2018.12.014

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