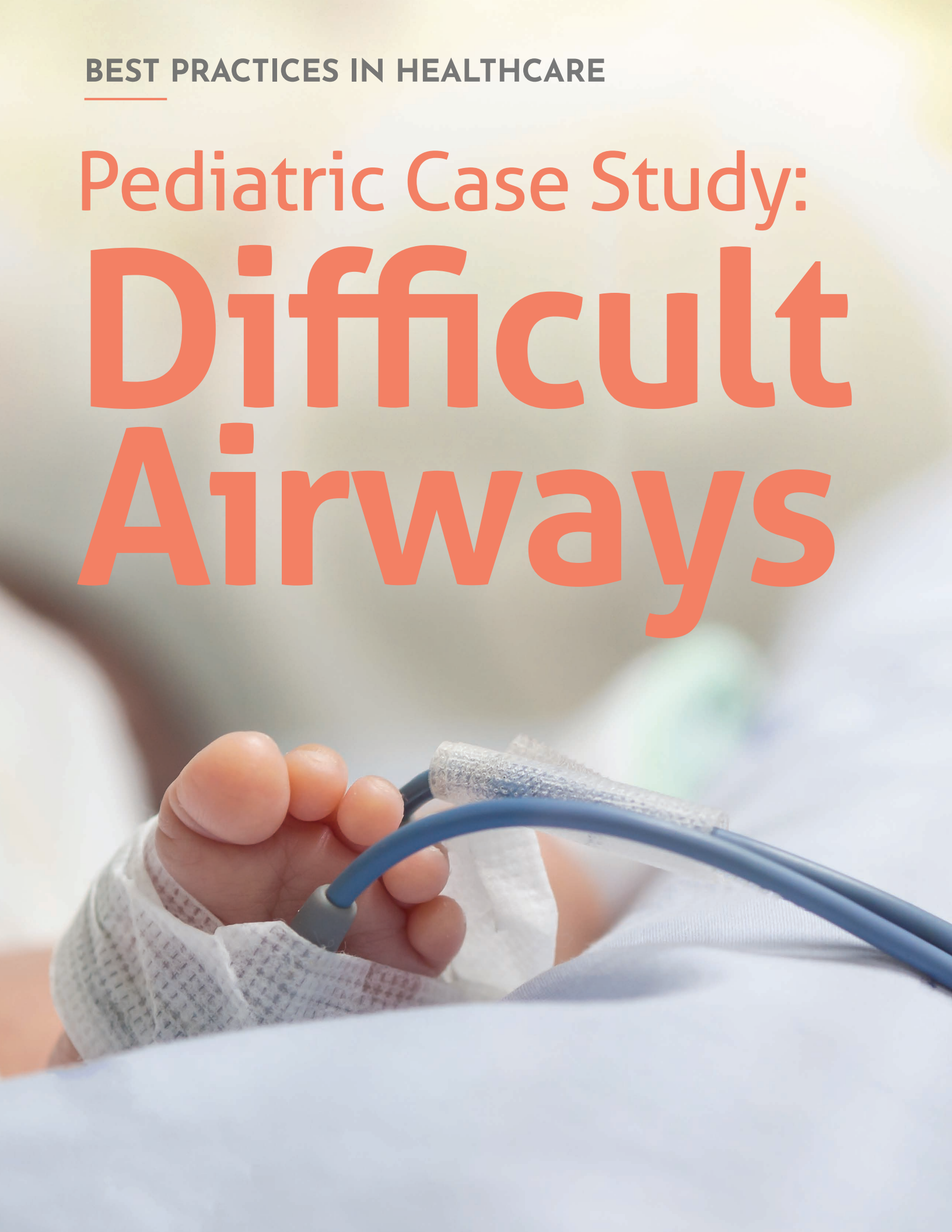
BEST PRACTICES IN HEALTHCARE

Pediatric Case Study: Difficult Airways



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Pediatric anesthesia is challenging and complex. Compared to adult anesthesia, our small patients have significant variations in physiology and anatomy, both of which present as unique challenges. When difficult pediatric airways are suspected, it can test the most skilled anesthesia care providers. Our patient's best interest is served when we participate and aid in the formulation of an airway management plan that will deliver the best possible outcome.

Pediatric anesthesia is more than simply adult anesthesia with smaller equipment or reduced drug doses. It's important for the anesthesia technologist to be familiar with the anatomical and physiological differences to best assist anesthesia providers. Some important characteristics that must be considered in pediatric care include increased heart rate, increased demand for oxygen, and reduced functional residual capacity (FRC). Some other considerations include cardiac output, which in a neonate is dependent on their heart rate, an increased metabolic demand, and consequently an increased demand for oxygen. Furthermore, pediatric patients have smaller alveoli and reduced lung compliance, however, their chest wall is very compliant. This mismatch results in chest wall collapse during inspiration and low FRC at exhalation. A well preoxygenated adult may have 5-8 minutes of oxygen reserve whereas a neonate may have less than a minute (Butterworth et al., 2018). Neonatal patients have decreased FRC and desaturate very quickly. Consequently, it is imperative to preoxygenate patients for no less than 5 minutes. We may revert to masking after failed intubation attempts. In regards to anatomical differences, pediatric patients have larger heads in relation to body size. They also have a larger tongue in relation to their mouth opening, as well as a longer and more "floppy" epiglottis which can impede our intubation efforts. Moreover, they also have a narrower nasal passage, an anterior glottic opening, and shorter trachea when compared to adults. Suction should be readily available since secretions can easily obstruct the airway. As mentioned, pediatric patients characteristically have a large tongue and large occiput. This combination can result in a flexed head and tongue that obstructs the airway. Providing a donut-shaped pillow and a shoulder roll will correct the flexion, provide better visualization of the vocal cords, and stabilize the head. A makeshift pillow and shoulder roll can be made from sterile towels (Image 1). This ensures that the suprasternal notch and external auditory meatus is horizontally aligned for the best results (Image 2). Adjunct airway devices such as nasal trumpets or oral airways will help adequately ventilate, oxygenate and manage the

Image 1: Headrest and shoulder roll

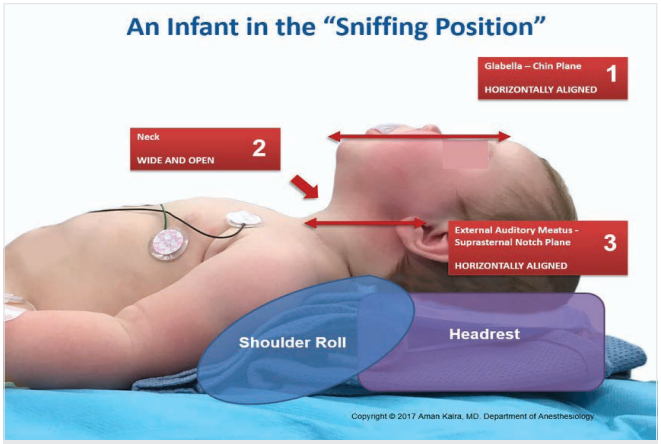

Image 2: Sniffing Position (Kalra, 2017)

patient. Table 1 shows the approximate sizing, however, the Anesthesia Care Team (ACT) should reassess and confirm the sizing after physical assessment of the patient. In some cases an adjunct airway may not be suitable for the patient or the appropriate size may not be available so utilizing jaw thrust will assist in opening the airway. The anesthesia provider is in the best position to provide an adequate mask seal and jaw thrust while the anesthesia tech or a second anesthesia provider ventilates the patient. Signs of chest rise, condensation on the mask, and end-tidal CO2 indicate a patent airway.

Difficult Intubation

Many of us are familiar with the physical exams to determine the ease of intubation. This includes mallampati classification, thyromental distance, and temporal mandibular joint mobility. These exams make it easier for providers to prepare if a difficult intubation is suspected. For unanticipated difficult intubations, it's important to keep the *Difficult Airway Algorithm* in mind. In an anticipated difficult intubation such as ours, we still keep the basics of the algorithm in mind, but we should also prepare with additional equipment that is specific to the patient's needs. Anesthesia techs should always set the anesthesia provider up to succeed because maximizing the chance of success will also provide the patient with a positive outcome. Should the provider fail at intubating more than twice, the complication rates may rise if alternative approaches are not considered (Fiadjoe et al., 2015).

Sometimes a difficult airway is suspected, but the anesthesia provider may still opt for direct laryngoscopy. In pediatric patients, Millers are often preferred to a Mac blade, however, if a Wis-Hipple (Wis for short) or Phillips is available, it may provide a better view for the provider. There are also the alternative devices and modes of intubation such as using a Glidescope, C-Mac, or Fiberoptic scope. Depending on the patient's airway pathology different devices and contingency plans can be discussed to see what would be optimal for that specific airway condition.

"Great caution needed to be taken to not injure or rupture the encephalocele, however, the encephalocele took up most of the exterior space as well as the oral cavity leaving only a small opening."

Case Report

A full-term newborn weighing 3.8 kg presented with an encephalocele protruding into the oral cavity through a cleft lip with cleft palate. The encephalocele was visible out of the patient's mouth and past the lips. Great caution needed to be taken to not injure or rupture the encephalocele, however, the encephalocele took up most of the exterior space as well as the oral cavity leaving only a small opening. It was noted that obstruction was not evident as the patient was on room air while awake, however, while sleeping the patient would have sporadic periods of desaturation.

Induction Plan

Prior to the case, we discussed what size and type of endotracheal tube (ETT), what method of intubation would be appropriate, and contingency plans. Due to the severity of the encephalocele, the use of oral airways, nasal airways, LMAs, and direct laryngoscopy were contraindicated. Prior to the start of the case, we knew who would be a part of the ACT and assigned different roles so it would be clear during the case. Our ACT consisted of two anesthesia techs and three physicians. Our plan was to sedate the patient and keep them spontaneously breathing throughout the intubation attempt.

We all agreed that the fiberoptic scope (FOB) would be the best equipment to use. Use of intubating LMAs would be contraindicated due to possible rupture of the encephalocele. To create more space in the oral cavity, we also discussed using magill forceps to pull the tongue out and away, as well as a surgical retractor to pull the mouth open.

Induction

Upon arrival, our patient was connected to standard ASA monitoring. Timeout was performed and we began pre-oxygenating our patient. During preoxygenation there was some obstruction that was resolved with a jaw thrust maneuver. Ketamine, dexmedetomidine, and propofol were titrated to the patient's physiological response. In addition, 2% sevoflurane was also used to deepen sedation while keeping the patient spontaneously breathing.

	Premature	Neonate	Infant	Toddler	Small Child	Large Child
Age	0-1 month	0-1 month	1-12 months	1-2 years	3-8 years	8-12 years
Weight (kg)	0.5-3	3-5	4-10	8-16	14-30	25-50
Suction Catheter (Fr)	6	6	8	8	10	12
Oral Airway	000-00	00	0 (40 mm)	1 (50mm)	2 (70 mm)	3 (80mm)

During preoxygenation, we verbalized the steps of the plan as well as our contingency plan once more. This ensured that our ACT was on the same page and that observing personnel in the room were also aware of our plan. When ready, the attending anesthesiologist verbalized what medications had been given and gave direction for the next steps. Once the bed was lowered (to facilitate passage of the FOB) one anesthesia tech performed jaw thrust, one physician used the retractor to gently pull the lip, and another anesthesia tech used the magill forceps to pull the tongue out and to the right. The physician holding the retractor also held the breathing circuit connected to an uncuffed 2.5 ETT so we could passively oxygenate with 100% oxygen. The FOB was already defogged, lubricated, and loaded with a cuffed 3.5 Oral RAE ETT. The anesthesiologist was able to navigate the FOB past the encephalocele and towards the glottic opening. As a result of the minute anatomy, intubating neonates takes patience and small movements to find and identify familiar structures. Anesthesia techs should be familiar with different anatomical structures to help the anesthesia provider identify the location of the FOB. Finally, in order to prevent a laryngospasm, propofol should be bolused prior to advancing the FOB though the vocal cords. The patient was successfully intubated followed by visible chest rise, misting, and end tidal waveform.

"As a result of the minute anatomy, intubating neonates takes patience and small movements to find and identify familiar structures."

Complications

While we anticipated this to be a difficult intubation, induction and intubation went extremely well. Some important complications to consider are laryngospasms and 'Can't Ventilate, Can't Intubate."

Laryngospasm is a complication that can lead to hypoxia, pulmonary edema, or even cardiac arrest (Collins, et al. 2019). Stage II of anesthesia is not skipped during mask induction therefore the chances of laryngospasm is increased. Anesthesia techs should be able to anticipate what the anesthesia provider needs in the case of a laryngospasm. In the *Anesthesia and Critical Care Review* podcast, Dr. Wolpaw and Dr. Schwengel (2017) discusses how providing continuous positive pressure ventilation (CPAP) with a tight seal via jaw thrust can break a laryngospasm, however, if the laryngospasm persists, succinylcholine may be required. Many pediatric patients cannot tolerate IV placement in preop and therefore do not have IV access during induction. If the patient does not have IV access during a laryngospasm then succinylcholine may be administered intramuscularly.

Can't ventilate, Can't intubate (CVCI) is an emergency complication that will have everyone's adrenaline rushing. According to the *Difficult Airway Algorithm*, these situations can end in a cricothyrotomy for an emergency airway. With this being said, our ACT collaborated with an Otolaryngologist who was ready and on standby during intubation. The anesthesia tech should be prepared to assist the provider in various ways. From masking to ventilating to IV placement, it is important to anticipate the needs of the patient and provider for the sake of patient safety.

Discussion

Patients with cleft palate and/or cleft lip won't always present as a difficult intubation, however, it is important to have a conversation with the anesthesia provider about what proper tools or equipment are available and on standby. As anesthesia techs, we know our equipment best, but we should always have the humility to ask questions when we are unsure. There is no shame in testing and checking how different equipment functions and fits. For example, our FOB is 3.0 mm in diameter and would not fit a 3.0 oral RAE ETT, however, would fit a 3.0 straight ETT. It is paramount to check these things prior to the start of the case versus when the patient is already in the room. If pediatric patients are uncommon at your hospital ensure the provider is set up for success by having the correct laryngoscope (size and one they are comfortable with) and ETT. Having a shoulder roll and/ or headrest available may also help with the provider's view but is not always necessary. Make sure to frequently use closed-loop communication and support the provider throughout the intubation.

Anesthesia providers have a high stress job that often involves them being the sole person to diagnose and treat any problems that arise. These situations are often critical moments that happen quickly. We can alleviate their stress and improve patient outcomes by being knowledgeable, prepared, and ready. Anesthesia technologists and technicians work as a second pair of hands and eyes to assist the anesthesia provider. Meticulous planning, communication, and coordination are key to the successful management of the patients in any operating room.

References

Butterworth, J. F., Mackey, D. C., & Wasick, J. D. (2018) Morgan & Mikhail's Clinical Anesthesiology 6th Ed.

Collins, S., Schedler, P., Veasey, B., Kristofy, A., & McDowell, M. (2019) Prevention and treatment of laryngospasm in the pediatric patient: A literature review. *AANA Journal, 82*(2).

Fiadjoe, J.E., Nishisaki, A., Jagannathan, N., Hunyady, A. I., Greenberg, R. S., Reynolds, P. I., Matuszczak, M. E., McGowan Jr., F. X., Litman, R. S., & Kovatsis, P. G. Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) Registry: a prospective cohort analysis. *The Lancet Respiratory* 2015;4:37–48.

Kalra, A. (2017). An infant in sniffing position [Photograph]. *Pediatric Anesthesia Digital Handbook*. **https://www.maskinduction.com/positioning-infants-and-children-for-airway-management.html**

Wolpaw, J. (Executive Producer). (2017, February 28). Pediatric respiratory anatomy and physiology with Dr. Schwengel (No. 36) [Audio podcast episode] *In Anesthesia and Critical Care Reviews and Commentary* [Audio podcast]. **http://accrac.com/episode-36-pediatric-respiratory-anatomy-and-physiology-with-dr-schwengel/**

Take the QUIZ On The Next Page

Continuing Education Quiz

To test your knowledge on this issue's article, provide correct answers to the following questions on the form below. Follow the instructions carefully.

1. Pediatric patients have different anatomy compared to adults. Which of the following are true about pediatric airways?
a. They have a longer trachea
b. They have a compliant chest wall
c. They have a longer and floppy epiglottis
d. A & B
e. B & C
f. None of the above

2. What may the anesthesia tech assist with during a difficult intubation and/or a difficult mask?
a. Ordering medication
b. Masking the patient
c. Bagging and ventilating the patient
d. Providing an adjunct airway
e. A, B, & C
f. B, C, & D

3. To set up the anesthesia provider for success during intubation, what can the anesthesia tech have available to help with positioning?
a. Provide blankets to make a ramp
b. Reverse trendelenburg the bed
c. Provide a shoulder roll
d. Provide a headrest
e. A & B
f. C & D

4. What are signs of a successful intubation?
a. Misting of the tube, chest rise, and end-tidal CO2 waveform
b. Misting of the tube, chest rise, and tachycardia
c. Misting of the tube, chest rise, and 100% SpO2
d. No signs of a leak

5. Since pediatric patients typically do not come with an IV and we must mask induce them, what stage of anesthesia is not skipped?
a. Stage I - Induction
b. Stage II - Excitement or delirium
c. Stage III - Surgical
d. Stage IV - Overdose

6. If the anesthesia provider fails an intubation attempt, what should the tech immediately be ready to return to?
a. Another intubation attempt
b. Mask ventilating
c. Other ways to deliver oxygen such as by nasal cannula
d. A machine leak check

7. What are the ways to break a laryngospasm?
a. Ventilate the patient normally
b. Use of a paralytic such as succinylcholine
c. Ventilate the patient use continuous positive pressure ventilation (CPAP)
d. Using an adjunct airway such as oral airway or nasal airway
e. B & C
f. All the above

8. What type of communication should be frequently used in the operating room?
a. Verbal communication
b. Written communication
c. Face-to-face communication
d. Assertive communication
e. Closed-loop communication

9. LMAs are useful in any type of difficult airway.
a. True b. False

10. Which of the following is not a speciality pediatric laryngoscope?
a. Wis-Hipple b. Phillips
c. Mac d. Miller
e. Matar

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The answers to the Spring 2022 "Pediatric Difficult Airways" Quiz are: *(circle answers)*

1:	A	B	C	D	E	F	**6:**	A	B	C	D		
2:	A	B	C	D	E	F	**7:**	A	B	C	D	E	F
3:	A	B	C	D	E	F	**8:**	A	B	C	D	E	
4:	A	B	C	D			**9:**	A	B				
5:	A	B	C	D			**10:**	A	B	C	D	E	

Quiz 2 of 2

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