6-Month-Old Former Preemie Girl for MRI

Rita Agarwal MD Associate Professor of Anesthesiology, The Children's Hospital Denver
Presented by: Desmond Henry MD, Chair Pediatric Anesthesia , The Children's Hospital, Denver
Dheeraj Ahuja MD: Staff Anesthesiologist; Lourdes Medical Center, Pasco, Washington

Goals:
After participating in the Problem Based Learning Discussion the participant will:

1. Discuss the management of infants and children presenting for imaging studies.
2. Discuss the recognition and management of the difficult airway in pediatric patients in the MRI environment.
3. Discuss the anesthetic issues related to Hurler Syndrome, with particular attention to providing care in the MRI environment.

Case: A 6-month-old, infant born at 34 weeks is scheduled for an MRI of the brain. The MRI is being done as part of her work up for failure to thrive and multiple minor anomalies.

1. What anesthetic/sedation techniques would you consider for a 6 month old infant undergoing MRI of the brain?
2. Would your options change if she were being done as an outpatient?
3. Would your decisions be different if she were being done at a pediatric hospital versus a general hospital?
4. How would these decisions change for a different imaging study, such as a combined brain and spine MRI, or combined MRI and CT?

The child had been visiting from out-of town and had developed a "cold" 2 weeks prior to this encounter. She was admitted because of hypoxia and was now on nasal cannula You examine the child and find that she has micrognathia (unrecognized by her primary care providers) and several other minor congenital anomalies including abnormal vertebrae and cleft palate. On further questioning family laughingly tells you that she snores a lot at night and sometimes seems to obstruct. She had been hospitalized at birth and been on oxygen for a couple of months but they were told that was due to her immature lungs.

1. What other information would you now request?
2. In light of this additional history is sedation an option?
3. How do you recognize and diagnose a potentially difficult airway in young infants?
4. How might this information change your management?
5. If you elect to proceed with general anesthesia, what are your options for airway management?

6. Where (OR, Radiology Suite, MRI) would you induce this patient?

You elect to proceed with general anesthesia, and to induce in the MRI suite. Upon inhalational induction the patient's oxygen saturation drops to 80%, and it is impossible adequately ventilate her with mask ventilation. You perform direct laryngoscopy and cannot recognize any laryngeal structures. She desaturates rapidly, An LMA is successfully placed.

1. Would you proceed with the LMA?
2. If this were an MRI, total spine or other combined radiologic procedure would it change your mind?
3. If you elect to place an endotracheal tube, how will you proceed? What is the rationale for placing an ETT in a non-painful relatively short procedure for which only immobilization is required?
4. Where would you intubate her (in MRI, other radiology area, OR)
1. If you proceed with the LMA, are there any special considerations during emergence (deep, awake)
2. How would you counsel her family after this encounter

After her work-up is complete, the patient is diagnosed with Hurler Syndrome. She returns 2 weeks later when you are on call for placement of a gastrostomy. Would you manage her airway any differently?

Pre-Procedure Evaluation

The pre-procedure evaluation of children presenting for imaging studies is very similar to that of those requiring surgery. There are, however special challenges relating to the radiology, or off-site environment. Physicians ordering imaging studies represent a broad range of specialties, many of whom may not be familiar with the anesthetic implications of acute and chronic disease. These physicians may be not be aware of the need for optimizing patient care before embarking on an anesthetic. Your resources and support systems are often limited.

When taking history of children presenting for imaging studies, it is helpful to focus on those risk factors specific to remote-site anesthesia. As part of this evaluation it is important to keep in mind your particular resources and back up. It may be prudent in some cases to start the anesthetic in the more controlled environment of the operating room and transport the patient to radiology. Recognition of potential problems can be more difficult because of time constraints and the less than ideal environment. Most imaging studies only require immobilization and are not stimulating. Intubation is frequently not necessary. In an infant with a difficult airway avoidance is often the best policy (Lane). This child had had several prior hospitalizations, her micrognathia and obstructive sleep apnea had never been diagnosed prior to this time. Evaluating the airway in a young infant can be challenging. One simple and rapid approach to the problem is the COPUR scale (Lane) The table below is adapted from his work.

C-chin

From the side view the chin is:

Normal	1
Small, moderately hypoplastic	2
Markedly recessive	3
Extremely hypoplastic	4

O-Opening

Interdental space between front teeth

> 40mm	1
20-40 mm	2
10-20mm	3
<10	4

P-Previous Intubation or OSA

Previous attempt easy	1	
No previous attempt, no hx OSA		2
OSA, previous hx difficult intubation	3	
Extremely difficult previous intubation, trach, or patient unable to lie supine	4	

U-Uvula

Mouth open tongue out

Tip of uvula visible		1
Uvula partially visible	2	
Uvula concealed, soft palate visible	3	
Soft palate not visible	4	

R Range

Oberve line from eye to orbit, estimaterange of motion looking up and down

>120°	1
60°-120°	2
30°-60°	3
< 30°	4

Prediction Points

5-7 Easy normal intubation
8-10 laryngeal pressure may help
12 more difficult, fiberoptic may be less traumatic
14 Difficult intubation, fiberoptic or other advanced technique
16 Dangerous airway, consider awake intubation, potential trach

Our patient had a small to markedly recessive chin (2 or 3) her mouth opening was 20-40mm (2), She did have a history consistent with OSA (3), her soft palate could be visualized when she was crying (3) and normal range of motion (1) for a total score 11-12. Our expectation was that she would be difficult, but not impossible with conventional laryngoscopy.

Management of Infants and Children in the MRI Environment

There has been described many anesthetic techniques for the management of infants and children in the MRI scanner. (Malviya, Jorgensen, Funk) Techniques include, but are not limited to: sedation (chloral hydrate or pentobarbital), propofol infusion, inhalation agent administered via LMA or endotrachaeal tube. Extremely young infants can sometimes be scanned after they are fed and swaddled without medication. Although many of the techniques used by non-anesthesia care providers have high success rates, none have a 100% success rate and most have side effects. Malviya et.al has shown that the effects of many of the medications administered by non-anesthesiologist guided sedation programs (such as Nembutal and choral hydrate) last for many hours after the procedure and although mild, patients can have distressing side effects. Agitation, nausea, vomiting, delirium and lethargy are among the more common side effects seen with these medications. Respiratory depression can occur. If the scans last longer additional medication may be required, increasing the potential for complications.

As a result anesthesia departments are being increasingly called on to help anesthetize/sedate these patients. For children with pre-existing complex medical problems particularly airway involvement, sedation with long acting fixed agents is probably not prudent. . In many centers patients are induced with volatile agent, intravenous access is established, and the patient is maintained with a propofol infusion. Often this can be accomplished without any airway adjunct, or with simply positioning the head in a sniffing position with or without an oral or nasopharyngeal airway. In other a supraglottic airway device or endotracheal tube may be required.

Our patient had a significant history of OSA. In addition, the patient was micrographic, all of which would lead one to conclude that the patient would likely need to have her airway secured. Both endotracheal tubes and LMA'sand other supraglottic airway devices have been successfully used in this setting. Some feel there is a higher rate of failure of LMA's in infants less than one year of age. After securing the airway with an endotracheal tube or LMA, anesthesia is usually maintained with volatile agent such as sevoflurane or desflurane.

Difficult Airway in the MRI Environment

The patient presented had several issues which predict a complicated MRI anesthetic. How one proceeds from here is dependent on the resources available in his or her radiology department. If your department has difficult airway equipment available in the radiology suite, and the space to use it (i.e. can take fiberoptic equipment into magnet room or nearby.) then proceeding in the radiology suite may be a viable option. If, on the other hand, that equipment is only available in the main operating room, it may make sense to induce and intubate in the OR, and then proceed to MRI. Remember that the Magnet room environment is, at best, difficult to function in. The MRI bed may be difficult to maneuver into an optimal position for laryngoscopy, although many MRI departments have MRI compatible beds that can be used for induction. The staff present may not be accustomed to providing assistance during an "airway drill", airway equipment may not be MRI safe or compatible, and help may be a long way away.

Therefore, when deciding how to proceed with this patient, one must make an honest assessment of their situation with regard to the ability to manage a difficult airway in the radiology department. Newer, more portable techniques (Glidescope, McGrath, Shikani optical stylet etc), increase options for securing the airway. Another issue that should be considered ahead of time is where and how to recover the patient.

Hurler Syndrome and MRI Anesthesia

Hurler syndrome is a type of mucopolysaccharidosis. In these syndromes there is an accumulation of mucopolysaccharides in connective tissue. Many of the clinical manifestations of this disorder have potential anesthetic implications. Patients with Hurler syndrome typically have significant developmental delay, which will likely preclude them from completing imaging studies without anesthesia or sedation. They have significant airway issues, including large lips, tongue, tonsils and adenoids. They frequently have significant obstructive sleep apnea. In addition the epiglottis may me located higher than normal and they can have granulomatous tissue in their airway.(Baum, O'Flahererty) Indeed, Hurler has been described as the "worst airway problem in pediatric anesthesia." (Baum and O'Flaherty). Additionally, these children can have coronary artery narrowing and cervical spine instablility.

When taking care of these children in the MRI environment, special caution is warranted. Their propensity for airway obstruction will frequently make techniques that do not include a secure airway ill advisable. Again, since these children can possess very challenging airways, and most specialized airway equipment in not MRI compatible, it may be advantageous to secure their airway in the controlled environment of the operating room. The ECG may contain significant artifact in the MRI environment (REF). This may be important in children with significant cardiac issues related to their syndrome. Also, many MRI studies will involve changes in patient position or coil. It will be especially important to remember these children may have cervical instability when moving their position during the scan.

References

Malviya S, Voepel-Lewis T, Eldevik OP, et al. Sedation and General anesthesia in children undergoing MRI and CT: adverse events and outcomes. *British J of Anaesth.* 8;6:743-48.

Jorgensen NH, Messick JM, Gray J, Nugent M, Berquist TH. ASA monitoring standards and magnetic resonance imaging *Anesth Analg.* 79:1141-7.

Lane G. Intubation Techniques. Operative Techniques in Otolaryngology 16: 166-170,2005

Funk W, Taeger K. Anesthesia for magnetic resonance imaging/computed tomography Current Opinion in *Anesthestionlogy* 2000;13:429-32.

Malviya S, Voepel-Lewis T, Tait AR, et al. Pentobarbital vs chloral hydrate for sedation of children undergoing MRI: efficacy and recovery characteristics. *Paediatr Anaesth.* 14;7:589-95

Mason KP, Sanborn P, Zurakowski D, et al. Superiority of pentobarbital versus chloral hydrate for sedation in infants during imaging. *Radiology* 230;2:537-42.

Baum VC, O'Flaherty JE. Hurler Syndrome. In Anesthesia for genetic, metabolic, and dysmorphic syndromes of childhood