6-Month-Old Former Preemie Girl for MRI

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 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, former premature infant 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 are your options for techniques would you consider for a 6 month old infant undergoing MRI of the brain?
2. How would these options change for a different imaging study, such as a combined brain and spine MRI, or combined MRI and CT?

You examine the child and find that she has and profound micrognathia (unrecognized by her primary care providers) and several other minor congenital anomalies including abnormal vertebrae and cleft palate). She is on nasal oxygen. The primary care team caring for her on the floor tells you that she has signs of OSA during sleep; including snoring with pauses.

1. In light of this additional history is sedation an option?
2. What other information would you now request?
3. How might this information change your management?
4. If you elect to proceed with General Anesthesia, what are your options for airway management?

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 difficult to maintain her airway with mask ventilation. You perform direct laryngoscopy and cannot recognize any laryngeal structures. She desaturates rapidly, and is impossible to ventilate adequately. After two attempts, an LMA is successfully placed.

1. Would you proceed with the LMA?
2. You elect to place an endotracheal tube, how will you proceed?
3. If you proceed with the LMA, are there any special considerations during emergence (deep, awake)?
4. Where would you recover this patient?
After her work-up is complete, the patient is diagnosed with Hurler Syndrome.

1. Of the known anesthetic issues associated with this syndrome, which are of special significance in the MRI environment?

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. In addition, one should always keep in mind the environment they will be working in. The role of the anesthesiologist is often one of an educator in addition to clinician in this setting.

Many patients presenting for imaging studies are seen by the anesthesia department immediately before their planned procedure. For the vast majority of children, this is adequate. If your department has an anesthesia pre-operative consultation service, it may be beneficial to have complex children evaluated before their scheduled study. The key is educating physicians when an anesthesia consultation is appropriate.

When taking history of children presenting for imaging studies, it is helpful to focus on those risk factors specific to remote-site anesthesia. Examples are; history of difficult airway or examination revealing a potential difficult airway, difficult intravenous access, or history of serious sedation or anesthesia complications such a cardiopulmonary failure or malignant hyperthermia.

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 endotracheal tube. Extremely young infants can sometimes be scanned after they are fed and swaddled without medication.

When approaching the pediatric patient for an MRI study it can be useful to consider the characteristics of the patient and the planned imaging study. Characteristics of the scan which may favor one technique include length of scan, position and number of times the coil will need to be changed. Scans greater than 60 minutes in length can outlast the sedation, thus necessitating additional dosing. Multiple changes of position or coil can also stimulate the patient and cause additional drug to be administered.

Many Pediatric Radiology programs have developed a sedation program. Typically, these protocols will utilize agents such as pentobarbital or chloral hydrate. (Malviya, Mason) With careful patient selection, these techniques are simple, safe and effective. Often, young children, less than two years of age, presenting for short (less than 45-60 minute) scans can be successfully sedated utilizing oral medication. With careful monitoring, and close supervision this can be a safe and effective technique, which avoids the need for invasive airway management, which for small infants can be challenging in the MRI environment.

General anesthesia can be administered in a number of fashions. 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.
Our patient had a significant history of OSA. In addition, the patient had severe 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’s have been successfully used in this setting, although 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. cannot take fiberoptic equipment into magnet room.) 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, 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.

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 be 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 instability.

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


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