SPA 2007 Winter Meeting PBLD

Medical Error in a Trauma Patient Requiring CPR

Learning objectives:

1. Develop an anesthetic management plan for the pediatric trauma patient.
2. Develop a treatment strategy for the pediatric patient with an intraoperative cardiac arrest.
3. Develop an approach for the disclosure of a medical error.

Case and Questions:

You are starting a preoperative evaluation in the Emergency Department for your next case on a patient that arrived 30 minutes ago:

The patient is a 4-year-old boy involved in a motor vehicle accident.

According to the report given by the paramedics, the car was on fire with heavy smoke present inside the vehicle. The patient was not wearing a seat belt or present in a car seat. A large amount of shattered glass was present on the patient's face. Loss of consciousness did not occur.

The patient has a small forehead contusion and is repeatedly rubbing his left eye. He also has a large contusion on the right chest and an open, left forearm fracture. No other obvious injuries are present including thermal injury.

Intravenous access currently consists of one 24 gauge peripheral IV (right hand) after multiple attempts were unsuccessful. No additional medical history is available at this time.

The patient appears awake and alert. He is crying, appears in pain, and is uncooperative. He is immobilized with a backboard, arm splint, and a cervical collar. The Emergency Department physician is currently re-evaluating the patient.

Questions:

1. What are the priorities in the initial evaluation and management of a pediatric trauma patient?

2. What traumatic injuries are more unique in pediatric patients when compared to adults?

3. How do you determine if an inhalational injury is present? If present, how will you manage this? Is pulse oximetry a reliable monitor for the detection of inhalational injury?

The patient has remained in stable condition while in the Emergency Department and is scheduled for percutaneous central line placement due to an anticipated prolonged hospital stay and difficult IV access. This will be followed by examination of both eyes with possible foreign body removal vs. open globe repair and open reduction of the left forearm.

NPO: two hours ago for solid food.
No known drug allergies.

Weight: 16 kg

Vital signs are:
Temperature 96.8 F, Heart rate 168 (sinus tachycardia), Respiratory rate 34,
Blood pressure 110/54, Oxygen saturation 99% (FiO_2 40%).

In the Emergency Department, the patient has received 300 cc of Lactated Ringers. Laboratory and radiological studies were completed. The preliminary result of the portable chest x-ray that is present at the patient's bedside is "no acute disease, clinical correlation recommended."

The parents were not present at the hospital but telephone consent from the mother is obtained. The only significant past medical history you obtained is reactive airway disease requiring the occasional use of albuterol.

Questions:

4. What preoperative information including physical examination, laboratory, and radiological studies would you request? How will you determine if the patient is optimized to go to the operating room?

5. The cervical spine film (cross table lateral) is reported as having C_2-C_3 subluxation. What is the clinical significance of this and will this change your management? What is SCIWORA (Spinal Cord Injury Without Radiographic Abnormality)?

6. Describe your plan for induction of anesthesia; will you use succinylcholine?

Induction of anesthesia is uneventful. The airway is secured in a rapid and atraumatic fashion. Vital signs are stable immediately after induction. The peripheral intravenous line is functioning well. The patient has been placed on positive pressure ventilation. Two units of crossmatched packed red blood cells are available.

The surgeon places a percutaneous central line in the right subclavian vein without apparent complications. Cefazolin has been administered. Approximately two minutes later, the pulse oximetry monitor is reading "no signal." Incision is about to occur when the blood pressure monitor is reading "error." The electrocardiogragh monitor is showing

sinus rhythm. You assume the monitor failures are just artifact but decide to feel for a carotid pulse; no pulse was palpable.

Questions:

7. What are the initial steps in the management of a pediatric cardiac arrest?

8. Suppose the rhythm develops into ventricular fibrillation. What pharmacological and/or electrical therapy would you choose and in what sequence?

9. What is(are) the etiology(ies) of this intraoperative cardiac arrest?

The resuscitation continues for about 30 minutes. The patient survives the resuscitation and the case is quickly completed. A chest tube is placed in the right chest wall followed by a rush of air. You soon discover that the chest x-ray that was present at the patient's bedside was from a different patient. Your patient's chest x-ray shows a large, right pneumothorax.

The patient is hemodynamically stable but in critical condition. An initial attempt at extubation in the operating room is unsuccessful. The patient is brought to the intensive care unit intubated, sedated, and pharmacologically paralyzed. It is unclear at this time what the long-term neurological outcome will be due to the prolonged resuscitation. The parents are now in the hospital's surgery waiting area.

Questions:

10. Have you changed your opinion as to the cause of the cardiac arrest? Is the cardiac arrest due to the presence of an undiagnosed preoperative pneumothorax? If so, what can be done to prevent this from occurring to another patient in the future?

11. While you are transporting the patient to the intensive care unit, the surgeon is about to go speak with the parents. What would you like to discuss with the surgeon prior to him speaking with the parents?

12. After patient care is concluded, what do you tell the parents? What should be discussed during the disclosure of a medical error?

I. Introduction:

Traumatic injuries in children are the most common cause of death in the United States for children above one year of age. This will account for over 20,000 deaths this year alone. Most traumatic injuries in children are a result of one of the following: motor vehicle accidents, child abuse, drowning, thermal injury, or falls. Anesthesiologists should be familiar with the initial evaluation and management of pediatric traumatic injuries in order to continue this care in the perioperative setting. Most anesthesiologists are familiar and current with adult cardiac resuscitation such as Advanced Cardiac Life Support (ACLS). However, the etiologies and treatment for cardiac resuscitation are different for pediatric patients than adults. Pediatric Advanced Life Support (PALS) was created by the American Heart Association for cardiac resuscitation of the pediatric patient. Unfortunately, the occurrence of medical errors with significant morbidity or mortality is not rare. Most anesthesiologists have little experience with the disclosure of medical errors to patients or parents.

II. Pediatric Trauma (Questions 1-6):

Based on the Advanced Trauma Life Support (ATLS) course developed by the American College of Surgeons, the initial evaluation of the pediatric trauma patient is termed the primary survey. The sequence of the primary survey can be remembered as “ABCDE” and includes: A (Airway), B (Breathing), C (Circulation), D (Disability), and E (Exposure/Environment). The airway should be evaluated for patency and opened using a jaw thrust technique if obstructed. Immobilization of the cervical spine should be maintained. The patient's breathing and ventilation should be evaluated and immediate intervention should take place if not adequate. Circulation is evaluated by blood pressure, sensorium, and skin turgor. Control of hemorrhage should also take place which can typically occur by the application of direct pressure. Disability is evaluated by looking for potential neurological injuries. The Glasgow Coma Scale (GCS) is the most commonly recognized scale to estimate the severity of neurological injury; a modified pediatric version is available. A GCS score of 8 or less implies significant neurological injury and immediate intubation is strongly recommended. Exposure of the entire patient should occur. The environment should consist of a heated treatment area that is ideally prepared in advance of the patient's arrival.

The establishment of an adequate and secure airway cannot be overemphasized. All trauma patients should initially receive 100% supplemental oxygen. Patients should be monitored with frequent blood pressure measurements along with continuous electrocardiography and pulse oximetry. Two large bore intravenous lines that are appropriate for age should be placed. For hypotension, an initial fluid bolus of 20 cc/kg of isotonic crystalloid is administered.

The secondary survey is a complete assessment of all organ systems. It is not begun until the primary survey is complete and the patient is in overall stable condition. If the patient is not in stable condition, then resuscitation continues with possible emergent transfer to the operating room. A complete history and head-to-toe evaluation occurs as well as

frequent reassessment of vital signs. If deteriation should occur, regression to the primary survey and resuscitation should take place. A complete neurological exam and imaging including CT (Computerized Tomography) scans and FAST (Focused Abdominal Sonography for Trauma) exams are completed during the secondary survey; the diagnostic peritoneal lavage (DPL) though less popular since the increased availability of CT and FAST exams would also occur at this time. Laboratory studies are also completed during the secondary survey.

Pediatric trauma patients develop unique injuries when compared with adults. Head injuries are the most common isolated injuries and the leading cause of death in pediatric patients; one explanation for this would be the disproportionately large head present in pediatric patients. Thoracic injuries are the second leading cause of death for pediatric trauma patients. Due to increased ribcage pliability, severe internal injury can occur in pediatric patients without external signs such as rib fractures. Blunt abdominal trauma can frequently be treated with close observation and lack of operative treatment. However, penetrating abdominal trauma will usually require surgical exploration.

The priority in management of a potential thermal injury is to evaluate the airway for inhalational injury. Inhalational injury should be evaluated by history, signs of respiratory distress, and burns to the perioral area as well as the presence of carbonaceous sputum or singed nasal hairs. Inhalational injury may be present with the absence of external thermal injury. If any sign or symptom suggesting inhalational injury is present, one should strongly consider early endotracheal intubation to secure the airway before further airway compromise or increased difficulty with future laryngoscopy occurs. Appropriate resuscitation measures to maintain normovolemia should then follow.

Children have an increased head to body surface ratio when compared with adults. As a result, different estimations of burn assessment than the "rule of 9's" used for adults takes place. Pulse oximetry reads carboxyhemoglobin as oxyhemoglobin. Therefore, this will underestimate oxyhemoglobin and prevent detection of hypoxemia. An arterial blood gas with co-oximetry will detect the presence of carboxyhemoglobin. Treatment for elevated carboxyhemoglobin centers on the administration of 100% oxygen.

The preoperative evaluation should include a complete patient assessment. Vital signs should be stable and appropriate for age. Sensorium, urine output, and skin turgor as well as vital signs can be used to evaluate and estimate the patient's preoperative volume status. A comprehensive airway evaluation should be done including the cervical spine. Past medical and surgical history is obtained if available. A list of injuries and the management done prior to the operating room should be acquired. Special attention to fluid management will be important to estimate preoperative volume status and assist with intraoperative fluid administration. Laboratory studies such hemoglobin, electrolytes, coagulation studies, and arterial blood gas with co-oximetry should be reviewed. The results should be obtained for radiological studies such as plain films and CT Scans.

Cervical spine injuries in children generally occur less often than in adults and commonly

occur at a higher location; this is usually at or above C_{-3}. However, pseudosubluxation of the cervical spine is a common and benign finding in children. This is usually seen as the anterior displacement of C_{-2} onto C_{-3}. However, in this case, one must differentiate pseudosubluxation versus a true cervical spine injury. After consultation with the surgeon, pseudosubluxation can be excluded by placing the child's head in the sniffing position and repeating the film; pseudosubluxation will be reduced with this maneuver. If neck tenderness, decreased sensorium, or neurological deficits are present, one must assume a cervical spine injury exists and surgical consultation is strongly suggested. A CT scan of the cervical spine may be helpful in the identification of lesions not visible on the plain film. However, SCIWORA (Spinal Cord Injury Without Radiographic Abnormality) is a functional injury that has been estimated to occur in approximately 25-50% of pediatric patients with spinal cord injuries. This type of injury cannot be visually detected and therefore not excluded with standard radiographic examinations or CT scans.

Induction of anesthesia should begin with pre-oxygenation followed by intravenous induction using a rapid sequence technique with cricoid pressure. If the patient is thought to be hypovolemic, a preoperative fluid bolus prior to induction should be given if the patient's condition permits. If concern exists regarding possible cervical spine injury, which applies to most trauma patients, then one should also incorporate in-line immobilization of the cervical spine during intubation and all patient transfers. Etomidate is an appropriate induction agent if hypovolemia is suspected. Succinylcholine or rocuronium are both acceptable choices for neuromuscular blocking agents. Considerations for a possible open globe should also be incorporated into the induction plan such as the use of intravenous lidocaine and attempting to establish a deep plane of anesthesia prior to airway instrumentation. One should be vigilant for the development of undiagnosed traumatic injuries to manifest during the intraoperative course.

III. Cardiac Arrest/Pediatric Advanced Life Support (Questions 7-9):

Initial steps during a cardiac arrest should include calling for help and the code cart/defibrillator. Verification of a secure airway and ventilation should follow. Chest compressions should be started without delay. The FiO_2 should be 100% with the vaporizers turned off. Emergency drugs can be delivered by the endotracheal or intraosseous routes if loss of intravenous access should occur.

The 2005 PALS pulseless arrest algorithm incorporates pulseless electrical activity (PEA), asystole, ventricular fibrillation (VF), and pulseless ventricular tachycardia (VT). The first decision to be made is if the rhythm is shockable (VF/VT) or not shockable (Asystole/PEA).

If the rhythm is not shockable, as asked in question #7, follow the asystole/PEA algorithm. Resume CPR (cardiopulmonary resuscitation) and administer epinephrine every 3-5 minutes 10 mcg/kg IV or IO and 100 mcg/kg if given via the endotracheal tube. After 5 cycles of CPR, reevaluate the rhythm to determine if it is shockable or not shockable. After this has been determined, follow the appropriate algorithm. One should

attempt to identify and treat possible contributing factors such as hypoxia, hypovolemia, acidosis, pneumothorax, trauma, and cardiac tamponade. Based on this case scenario, a tension pneumothorax should be strongly considered.

For shockable rhythms (question #8) such as VF or VT, defibrillate one time at 2 J/kg and resume CPR immediately. Five cycles of CPR follow. If the rhythm is still shockable, defibrillate once at 4 J/kg and resume CPR. After defibrillation, epinephrine is given every 3-5 minutes. The dose for epinephrine is 10 mcg/kg IV or IO and 100 mcg/kg if given via the endotracheal tube. Five cycles of CPR then occur followed by evaluation of the rhythm. If the rhythm is shockable, defibrillate at 4 J/kg followed by resuming CPR. One then will administer antiarrhythmics. Antiarrhythmics include amiodarone 5 mg/kg IV push or lidocaine 1 mg/kg. This cycle of 1 shock followed by 5 cycles of CPR is repeated until a decision is made to terminate efforts or the rhythm is not shockable. The smaller defibrillator paddles are used for infants less than 1 year old or less than 10 kg. Vasopressin has not been incorporated into the 2005 PALS guidelines.

IV. Medical Error Disclosure (Questions 10-12):

The origin of this cardiac arrest could have come from several categories including cardiac, respiratory, medical error, or traumatic etiologies. Specifically, several etiologies such as cardiac contusion, cardiac tamponade, pulmonary embolism, pneumothorax, arrhythmias, electrolyte disorders, hypovolemia, and anaphylaxis should all be initially considered in the differential diagnosis. However, two likely causes of the cardiac arrest are from the central line insertion producing a tension pneumothorax or the presence of an undiagnosed preoperative tension pneumothorax combined with positive pressure ventilation.

Ideally, a meeting should take place with the parents, surgeon, and anesthesiologist all present. This should be in a quiet and private location. Social workers and/or clergy should also be offered to the parents to be present. A discussion with the surgeon before speaking to the parents to review the intraoperative events is recommended to prevent conflicting stories. Plan what to say to the parents in advance. Tell the parents what you know and what you don't know. An objective and compassionate discussion on an appropriate educational level for the parents should be the objective. The truth should be told even though it is uncomfortable and has possible legal implications. It is possible that by doing such you may avoid future litigation. However, remember that everything you say to the parents and write in the medical record is discoverable and can be used in future litigation. Patients or parents may forgive mistakes when told upfront, in detail, with a full explanation. Saying you are sorry that the event occurred is acceptable.

Your risk management department and/or malpractice insurance company should be notified as soon as possible about the events of this case. This may occur before or after speaking to the parents. The anesthesia record should be reviewed for accuracy, legibility, and completeness. A separate progress note can be used to document additional patient care details such as management in the intensive care unit and/or additional intraoperative information. Alterations to prior entries in the record should not be done.

One should be cautious about writing in the medical record any details that are not objective findings such as a suspected error among other staff or attempting to assign blame to another party. An internal investigation to identify the cause for the incorrect chest x-ray being placed at the patient's bedside should occur along with possible solutions for prevention of this error in the future. The physician should continue to give regular follow-up visits to the patient as well as be readily available to the parents for future questions that may develop.

References:

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