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Managing the Complex Issues of Pediatric Nonaccidental Trauma: A Simulation-Based Case of a Critically Injured Child

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Abstract

Introduction: Trainees generally have insufficient training in managing critically ill and injured pediatric patients due to limited exposure to such patients. Patient simulation experiences allow trainees to learn management skills needed in such a crisis. Herein, we describe a case regarding a critically injured pediatric patient. This case requires trainees to use teamwork skills, medical knowledge, and technical skills to manage the patient. **Methods:** We developed a team-based simulation regarding the resuscitation of a critically injured child—a toddler with multiple injuries, all requiring emergent care. The case was developed for senior medical students and residents and can be completed in a single 1-hour session, including a debriefing period. We also address psychosocial issues of managing a critically injured child by having the mother and her boyfriend present for part of the case. The team must address the underlying issue of suspected nonaccidental trauma while managing a medical resuscitation. **Results:** We have performed this scenario with a cohort of 100 trainees. Through direct observations, all teams have been able to manage the patient successfully. The average response to the effectiveness of the case in terms of developing pediatric resuscitation skills was very positive, with scores of 6.7 on a scale of 1 to 7. **Discussion:** Medical simulation has been demonstrated to be a valuable tool for assessing the knowledge and skills of trainees. This pediatric simulation improved learners' general understanding of managing a pediatric resuscitation. Accordingly, this case has been incorporated as part of resident and medical student training.

Keywords

ATLS, Simulation, Emergency Medicine, Child Abuse, PALS, Pneumothorax, Pediatrics, Pediatric Trauma, Critically Injured Child

Educational Objectives

By the end of the module, learners will be able to:

1. Identify a critically injured child and associated abnormal vital signs in a pediatric patient.
2. Perform resuscitation by following Advanced Trauma Life Support and Pediatric Advanced Life Support guidelines.
3. Recognize signs of suspected nonaccidental trauma.
4. Manage the clinical and social aspects of nonaccidental trauma in a child.
5. Recognize the complications of engaging parents and family in the resuscitation of a child.
6. Develop team organization and team-centered communication skills toward management of a crisis involving a pediatric patient.
7. Develop individual resuscitative skills for pediatric patients.

Appendices

A. Simulation Case.docx
B. Evaluation Tool.pdf
C. Laboratory Studies .pdf
D. Imaging Studies.pdf
E. EKG.pdf

All appendices are peer reviewed as integral parts of the Original Publication.

Introduction

There is a general consensus in academic literature that trainees do not gain enough formative experience regarding pediatric resuscitations. For example, a survey study demonstrated that pediatric residency program directors perceived their residents' pediatric procedural skills as being suboptimal and recommended specific curricular interventions to address such deficiencies.[1] The underpinnings of this issue are that most learners have limited exposure to critically ill and injured pediatric and neonatal patients.[2] Limited trainee exposure to life-threatening medical conditions may put the welfare of critically ill and injured children at risk.[3] Moreover, limited exposure may also lead to either an overall lack of confidence in caring for such patients or an unfounded overconfidence. The overconfidence may arise because the learner is not receiving proper feedback in a key clinical area and often, in the absence of feedback, learners, by default, think they are doing better than they truly are, especially when compared to accepted standards.[4] For example, in one cohort, residents demonstrated an excellent fund of knowledge, as evidenced by their success on the Pediatric Advanced Life Support (PALS) exam, yet the majority of test subjects were subsequently unable to perform proper airway or vascular management procedures during a skills workshop.[5] Many of these skills (interosseous placement, nasopharygeal airway placement, using a bag valve mask) are fundamental, easy to teach, and vital to the care of critically ill patients.

Other modalities to teach and assess relevant procedural and critical care skills are needed in order to achieve clinical proficiency, given the observation that learners do not get enough pediatric critical care experience.[3] To address and close performance gaps, we have used simulation to help learners gain experience in a wide variety of less common patient presentations, including pediatric resuscitations. The use of simulation-based training allows for deliberate practice in a safe environment and affords opportunities for focused debriefing, which is important to identifying and addressing performance and knowledge gaps observed during training sessions.[6] This is especially important in managing crisis situations where one needs not only clinical and procedural skills but also critical thinking skills.[7] One such crisis is the management of a critically injured child.

This simulation case was developed with several objectives in mind. In addition to managing the medical aspects of the case, learners are also asked to engage the mother of the patient regarding the concern for nonaccidental trauma (NAT). This can be a difficult aspect of patient care for many learners, and having experience engaging patients and families in difficult discussions is an important part of medical education and training. Also, the presence of the mother during the resuscitation adds more nuisances, which are consistent with the reality of managing a critically injured child while addressing family concerns and issues. Numerous studies have demonstrated the benefits of having the family present during pediatric resuscitations, and data have shown such a presence does not interfere with patient care.[8,9] Furthermore, addressing NAT as a possible cause of injury and incorporating the principles of family-centered care are two best-practice recommendations from an expert panel based on proceedings from the Council of Residency Directors' academic assembly in 2010, which explicitly addressed pediatric emergency medicine issues.[10]

While other modules within MedEdPORTAL concern pediatric resuscitations and pediatric trauma,[11-13] this module addresses team structure, basic procedural skills, and managing social dynamics of the case. Related cases published on MedEdPORTAL include "Rapid Cycle Deliberate Practice: Application to Neonatal Resuscitation,"[11] which focuses on teaching through repetition by using increasingly difficult scenarios; "A Pediatric Death From Non-Accidental Trauma,"[12] which concerns a child who is fatally injured; and "Pediatric Emergency Medicine Simulation Curriculum: Blunt Abdominal Trauma,"[13] which is a comprehensive pediatric blunt abdominal trauma resource.

Methods

We developed a team-based learning simulation case (Appendix A) regarding the resuscitation of a critically injured child—a toddler with multiple injuries requiring emergent care. The case allows learners to employ active learning to identify the underlying injuries and stabilize the simulated patient using both

PALS and Advanced Trauma Life Support (ATLS) protocols. Moreover, the simulation team members need to address the psychosocial issues of managing a critically injured child by having to determine if they want the mother and her boyfriend present for part of the resuscitation. The team must also address issues of NAT while managing the resuscitation. This is important because it more closely approximates the reality of such difficult situations.

Educators using this simulation should familiarize themselves with the case material, which contains the scenario setup, the simulated patient's initial presentation and relevant history of present illness, mannequin positioning, important findings regarding the physical exam, and relevant laboratory data (Appendix C) and imaging studies (Appendices D & E). The case also contains some guidelines for debriefing. Instructors should be familiar with PALS, ATLS, and how to properly perform the procedures required. Also, the facilitators have cues for guiding select sections of the primary and secondary surveys. For example, during the secondary survey, if the simulation team asks about the eye exam, the facilitator should say, "What are you looking for?" If the team then asks questions regarding the patient's responsiveness and trauma-related questions (e.g., pupil responsiveness, periorbital ecchymosis or crepitus), full details should be provided by the facilitator. The facilitator can gauge for him- or herself how much information to provide or is needed.

Equipment/Environment

Equipment to manage a pediatric trauma alert should be available, including appropriate, weight-based intubation equipment and pediatric-sized endotracheal tubes, as well as airway adjuncts as needed, such as a bag valve mask, pediatric-sized chest tubes, a needle for chest decompression, PALS medications, IV supplies, and Broselow tape. In place of Broselow tape, trainees have used phone-based applications that are readily available for most smartphones and have been shown to be effective.[14] Imaging studies provided with this case (chest X-ray and X-rays of the pelvis and femur) may be projected, viewed on a computer or tablet, or printed and handed out to the learners during the case. Laboratory values are also provided to be printed, projected, or disseminated as needed.

For mannequin setup, we use a Laerdal MegaCode Kid with SimMan 3G software. Vital sign changes that can be projected on a monitor may be done in real time as the case evolves or be preprogrammed. The simulated patient should be lying supine on a stretcher, and makeup should be applied to represent abrasions and bruises to forehead, left chest, and right femur. The left leg should be externally rotated. The simulation takes place in an emergency medicine resuscitation room stocked with airway equipment, as well as equipment and medication as necessitated by PALS and ATLS.

Personnel

There should be one facilitator in the room to run the case and help move it along by giving cues as needed. We also recommend a simulation technician to set up the case and run the scenario as described above. Before the case, the technician should apply makeup to the mannequin that becomes apparent when the team exposes the patient (primary survey). The lead facilitator typically plays the role of the consultants; other confederates may also play these roles if additional personnel are available. For simplicity, we ask the participants to make a phone call by directly speaking to a facilitator who is posing as the consultant. If key interventions (say, calling a surgeon for chest tube placement) are not yet done, the consultant will state they are unavailable, which will impel the team members to perform the intervention themselves. At this point, the consultant may prompt the team to the next step, for example, by asking if they have placed a chest tube yet. The premise here is to get the team to sufficiently stabilize the patient prior to asking the consultant to intervene; for example, the team should identify the femur fracture before calling an orthopedic consult, intubate the patient before consulting the pediatric critical care team, and so forth. For added complexity, the facilitator may ask the team to describe the procedures to ensure the team understands the key steps, for instance, by asking the team to identify landmarks for a chest tube or confirm proper endotracheal tube placement.

Assessment

The team will need to consult pediatric surgery, orthopedic surgery, and the pediatric critical care team. A consult to social work or relevant child protective services should also be made. We have noted that prompting at this point in the case may be necessary for final disposition of the patient. Students and residents may require different degrees of assistance regarding whom to consult. The team still needs to consult the relevant social services authority regarding NAT.

The case was developed for senior medical students and pediatric, emergency medicine, and anesthesia residents and is intended to be completed in a single, 1-hour session. We use additional observers to take notes on the team's performance; these notes are used to guide the debriefing. An evaluation checklist (Appendix B) is included to allow the instructor to assess whether the team has addressed the critical actions associated with the case.

Debriefing

After completion of the case, the team is led to another room. In the first part of the debriefing, each team member states his or her reactions to the scenario, which allows them to express their emotions.[15] Once this phase of the debriefing is over, the facilitators ask more detailed questions regarding the case and its outcomes and address any observed performance gaps.[16,17] Foci for the debriefing are provided as listed below, and the debriefing should be allowed to progress as needed by the team. For example, some teams want to focus on the social issues of NAT, whereas other teams are more concerned with following ATLS and PALS protocols. If time allows, the team may have an opportunity to revisit the simulation in order to practice select procedures.

Specific debriefing topics are as follows:

- Group organization: The team organizes and maintains that organization throughout the scenario.
- Resuscitation: The team performs an organized resuscitation following established ATLS and PALS guidelines.
- Identification of and concern for NAT: The team uses clinical exam findings and history to suspect NAT as the etiology of the patient's injuries.
- Identification and treatment of pneumothorax: The team uses clinical exam findings and the chest X-ray to identify the abnormality and treats it with tube thoracostomy. The team also consults pediatric surgery for further management.
- Identification and treatment of hypothermia: The team uses clinical exam findings and vital signs to identify the hypothermia and treats it with rewarming.
- Identification of orthopedic injuries: The team uses clinical exam findings and X-rays to identify rib fractures and femur deformity. The team consults orthopedic surgery for further management.
- Management of family: The team chooses the option to involve the mother, providing her with an invitation to join resuscitation, updating her on events, and explaining interventions.
- Follow-through on NAT: The team discusses the suspicion of NAT with the mother and notifies social work and/or relevant child protective services.

Results

Participants in this case have been anesthesia, emergency medicine, and pediatric residents and fourth-year medical students. We have also used this case as part of our conference didactic sessions in place of a formal lecture. To date, we have had approximately 100 learners run through this simulation case. A faculty member skilled in running simulations and debriefing has been the lead instructor for the case.

Quantitative data were obtained from a survey of 21 emergency medicine and anesthesia residents. Select queries in the survey included the following: The material was clearly explained, the simulation included important points to remember, and the debriefing effectively stimulated discussion for future learning. With regard to the clarity of the material, learners rated the module as a 6.4 on a Likert scale of 1

to 7. Trainees also thought the key learning objectives were clearly underscored (6.4), the material was applicable to their career (6.4), and the simulation generated discussion and interest in future learning (6.6). The overall rating for the simulation module was 6.6. The overall score for instructor effectiveness was 6.8.

Qualitative feedback included comments such as the following:

- “Great learning experience, I appreciate learning to work together as a team.”
- “It made me think about how to improve team dynamic.”
- “This material is applicable to my career.”
- “Dedicate some time addressing team organization.”
- “Provide more time during simulation cases to teach effective team communication.”
- “Add review sessions that address content of the simulation case.”

Discussion

Children rarely present to the emergency department critically ill or injured. This underscores the need for assessing learners’ skills in pediatric resuscitation through direct observations via real clinical experiences or in the controlled environment of a medical simulation.[18] The latter is critical because it fosters a safe environment to practice in, which in turn allows learners to make mistakes and then review processes via focused learner-centered debriefing sessions.[15] We have used simulation at our institution extensively, and this module represents our continued effort in this area.

The case itself constitutes an amalgam of several actual pediatric trauma cases we have seen at our institution. In debriefing actual pediatric trauma cases with trainees, we noted the technical aspects of managing a critically injured patient were indeed often as important as managing the social aspects of the patient’s care. During debriefing sessions both with real cases and after this simulated case, we have observed that learners often want to focus on the social issues of the case once they feel comfortable with their medical management of the injured child. In part, we feel this is because the emotional toll of managing the family during a pediatric crisis is not typically addressed during training yet remains an important aspect of patient care for both the family and the physician.[19] For this reason, the components regarding engaging the mother and family presences during the resuscitation are integral to the case.[9]

At our institution, most residents have already taken ATLS and/or PALS and have some familiarity with the management of critically ill children. Medical students, while less adept at ATLS and PALS, still complete the scenario successfully with guidance as needed. For example, we have observed no significant deficits in the students’ ability to recognize the need for a definitive airway for the patient, to administer IV fluids, or to call consults. Both students and residents are able to identify and address the key critical care issues of the case. Details regarding procedures have been managed readily in brief bedside teaching sessions after the case. We have used pediatric emergency medicine faculty to assist with the debriefing so as to provide their insight into managing this case and, in particular, addressing family concerns. Pediatric emergency medicine faculty can also provide personal stories of their own experiences that both normalize the anxiety of caring for a critically ill child and underscore the complexity of such cases.[20]

One aspect of debriefing worth noting is the challenge of addressing the family. While the mother is explicitly instructed not to interfere in the scenario and, upon arrival, states that she wants to stay with her child, it is up to the team to let her remain in the room or not. The mother will be compliant with any instruction given to her by the team. On debriefing, teams often want guidance on how best to manage the family and the scenario’s social aspects, and frequently, there is some disagreement amongst participants during the debriefing. For example, should the mother be present during the medical resuscitation, or should she also be charged with a crime? Often, there are no clear answers for many of the potential questions due to the ethical complexity of NAT. We plan on using this scenario as part of a larger collection of cases for assessing team building during critical situations.

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