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Fever and Seizure in a Young Infant: A Simulation Case

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Abstract

Introduction: Fever in early infancy is a common problem for which management can be challenging. All residents need to be able to recognize critical illness such as meningitis in febrile infants and manage complications such as seizures. Many new residents are not competent performing bedside procedures as there is little opportunity to perform them while in medical school. This simulation case revolves around fever and subsequent seizures in an infant. Designed to last 2 hours, the case is specific for subinterns but is relevant for clerkship students and interns in pediatrics, family medicine, and emergency medicine.

Methods: In this case, a 5-week-old infant presents with fever and lethargy. He develops seizures with respiratory depression requiring antiseizure medication and respiratory support. His final diagnosis is bacterial meningitis. Major equipment required includes an infant mannequin and an infant lumbar puncture task trainer. **Results:** A pilot study was conducted in 2015 with all subinterns on the pediatric service. Students' perceived competence in diagnosis/management, procedural skills, and managing complex pediatric cases rose sharply after completing the session. Critical actions include obtaining IV access, performing blood and urine cultures, considering lumbar puncture, recognizing respiratory depression, performing bag and mask ventilation, administering antiseizure medication, counseling parents, and starting appropriate anti-infective therapy. **Discussion:** This clinical simulation case allows students to demonstrate clinical reasoning skills, procedural skills such as performing a lumbar puncture and bag-mask ventilation, and management skills. Materials are provided for students to perform self-assessments of perceived competency in procedural, diagnosis, and management skills related to the case.

Keywords

Simulation, Fever, Lumbar Puncture, Spinal Puncture, Seizures, Meningitis, Pediatrics, Subintern

Appendices

- A. Simulation Case.docx
- B. Lab Results.docx
- C. Critical Actions Checklist.docx
- D. Faculty Reference Material.docx
- E. Standardized Patient Information.docx
- F. Flow Diagram.docx
- G. Case Summary.docx
- H. Lumbar Puncture Procedure References.docx

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

Educational Objectives

By the end of the simulation, the learner will be able to:

1. Practice shared decision making in a team setting about the diagnosis and management of an infant with fever and seizure.
2. Employ effective communication skills with the parent of a critically ill child as well as with team members when there is uncertainty in diagnosis and management.
3. Demonstrate procedural skills in an infant, including lumbar puncture, urethral catheterization, and bag-mask ventilation.

Introduction

Numerous studies have demonstrated the effectiveness of simulation-based education for medical students.¹⁻⁴ While there are several published resources for using simulation in either the pediatric clinical clerkship or pediatric residency,⁵⁻⁷ few resources have been published to be used by students in their fourth year.

This module may be used by itself with fourth-year students. This case may also be used in conjunction with two other cases we are preparing (described in the Discussion section below); as a unit, the three modules will cover many acute management issues in pediatrics without excessive overlap. The cases

were originally designed as weekly educational sessions for students completing an acting internship in pediatrics. The case may also be used for first-year residents in pediatrics, family medicine, or emergency medicine or as part of a capstone course in pediatrics at the end of medical school.

Our intention is to provide a safe environment for learning and practicing management, procedural, and communication skills with pediatric patients and their families in a realistic clinical setting.⁸ The case is designed to meet multiple learning objectives. Designed to last more than an hour, it can be shortened to meet local goals. Because of the case's length and focus on diagnosis and management skills, it is appropriate for fourth-year students and pediatric interns.

The case easily allows for development of an interprofessional educational experience with the inclusion of nursing, respiratory therapy, and pharmacy students. A recent study showed improvement in interprofessional teamwork skills when interprofessional education was employed using a nursing student in a pediatric clinical simulation scenario with medical students.⁹

Methods

The case is fully presented in the simulation case file (Appendix A). Laboratory values (Appendix B) are formatted for easy lamination. Individual lab results are provided to students when requested. A reference for normal laboratory values is also included. The critical actions checklist (Appendix C) also includes the self-assessment tool used in pilot-testing for this case. The self-assessment tool was administered at the start of the monthlong rotation for fourth-year students at our institution and again at the end of the month, so the questions reflect the three sessions the participants have gone through. A faculty reference document (Appendix D) with information for facilitators to review to help guide the discussion following the case is also provided and can be adapted for student use as well. An in-depth description of the case from the standardized patient/parent (SP) point of view (Appendix E) is the template used at our institution to provide SPs with in-depth information about their character and is especially important since the case is longer than typical simulation scenarios. A one-page flow diagram (Appendix F) can be used with a two-sided summary of the case (Appendix G) for easy quick reference during the case for both the facilitator and the simulation center technician. References to information about how to perform an infant lumbar puncture (Appendix H) are also included. The information could be reviewed prior to the session by participants or following the case as part of debriefing and/or skills-station practice. Please see below for recommended equipment, personnel, assessment methods, and debriefing ideas:

Equipment/Environment

- Infant mannequin or life-sized baby doll.
- Infant lumbar puncture task-trainer model.
- Infant warmer or hospital bed.
- Pedi code cart.
- Length-based tape.
- Pediatric intensive care unit resuscitation card.
- 22-g IV needle × 2.
- Tourniquet.
- Microbore extension set.
- IV connector set.
- IV pole.
- Extra IV tubing.
- Saline flushes (4).
- 1-cc, 5-cc, 10-cc, 20-cc syringes.
- 18-g or 20-g 1.5-in needles.
- Bags of normal saline, ½ normal saline, lactated ringers, Normosol.
- Saline or glucose water 2-cc vial (Sweet-Ease).
- Infant bag and mask (two sizes mask).
- Nasal cannula, venturi mask, nonrebreather mask.

- Oxygen tubing.
- 22-g 1.5-in spinal needle × 2.
- Lorazepam one vial.
- Diazepam one vial.
- Levetiracetam one vial.
- Acetaminophen suppository.
- Pediatric urine catheterization kit OR:
 - 5 french feeding tube.
 - Lubricating jelly.
 - Simulated swabsticks.
 - Sterile urine cup.
 - Sterile gloves.
- Ampicillin (small bag).
- Gentamicin (small bag).
- Ceftriaxone (small bag).
- Vancomycin (small bag).
- Acyclovir (small bag).
- Tape.

Personnel

- Parent: gives history, answers questions. This role is ideally filled by an SP.
- Nurse: assists in carrying out orders, enlists help from students for various tasks. This role is ideally filled by a nursing student, but the facilitator could play the role.
- Simulation staff member: changes vital signs on monitors as indicated, turns mannequin to seizure mode at appropriate time, gathers any missing equipment during case.
- Facilitator: provides physical exam findings and assists students in finding equipment. Alternatively, facilitator could be out of the room, watching through one-way glass and listening with headphones.
- Optional: knocks on the door (students should politely turn them away):
 - Registration: comes in to obtain insurance information from patient.
 - Housekeeping: comes in to clean room.
 - Maintenance worker: washes floors/vacuums immediately outside, making noise.

Assessment

Students complete a self-assessment tool regarding perceived competence in specific procedures and diagnosis and management skills before and after the modules. We provide detailed formative assessment following the case and thoroughly review each learning objective in addition to reviewing a critical actions checklist with students. We communicate to students that our priority is to create a safe space to make mistakes and learn from them. Thus, in our institution, we do not include the simulation sessions as part of a student's official evaluation.

Debriefing

We use a student-centered *plus-delta* approach for debriefing. In this technique, the facilitator focuses first on what the students feel they did well and then focuses on what the students feel they would want to do differently.¹⁰ Facilitators review educational content with participants based on the questions noted below.

General questions for all participants:

- What went well?
- What could have been done differently?
- How did you work as a team?
- What was the clinical scenario? What happened?

Specific questions related to educational content:

- Review the differential diagnosis of fever in a young infant.
- Describe potential organisms and choice of antibiotics for a young infant with possible meningitis.
- Discuss optimal timing of antibiotic administration in suspected meningitis.
- Discuss the risks, benefits, and timing of lumbar puncture in an ill infant, including the option of delaying the procedure.
- Compare and contrast febrile seizures with other etiologies of seizure.
- Discuss oxygen delivery and respiratory support options.
- Discuss the importance of considering neglect or abuse in health care settings.
- Discuss communication challenges with a distraught family member.

Results

This case has been used approximately 25 times with an estimated 50 fourth-year students during their monthlong acting internship rotation in pediatrics from 2013-2016. Generally, students completed two other simulation exercises on different days, for a total of three clinical simulation exercises. In 2015, participating students completed a survey before and after their acting internships regarding the educational value of the simulation exercises ($n = 13$). After completing the sessions, students reported increased competence in performing procedures including lumbar puncture as well as in diagnosing and managing key pediatric conditions including fever in a young infant and seizure management (Table 1). Students also reported improved confidence in managing complex pediatric situations as well as several other areas related to clinical competence (Table 2).

Table 1. Mean Score for Students Self-Reporting Level of Competence ($n = 13$)^a

Skills	Presession		Postsession		<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Procedural skills					
Lumbar puncture	1.81	0.83	3.63	0.87	.000
Bag and mask ventilation/oxygen delivery	3.00	1.51	3.92	0.64	.049
Urinary catheterization	3.00	1.32	4.08	0.95	.020
Diagnosis and management skills					
Fever in infancy	2.81	0.91	4.08	0.76	.000
Respiratory distress in a child	2.69	1.08	3.85	0.38	.001
Seizures in a child	2.44	0.81	3.92	0.64	.000
Communicating with a "difficult" parent	3.56	1.09	4.23	0.6	.059
Working within a team setting to solve clinical problems	4.44	0.96	4.77	0.44	.262

^aBased on a 5-point Likert scale (1 = *not at all competent*, 5 = *very competent*).

Table 2. Mean Score for Students Following Simulation Exercises^a

Question	<i>M</i>	<i>SD</i>
This simulation experience improved my . . .		
Clinical decision-making skills	4.62	0.51
Procedural skills	4.69	0.48
Confidence in managing complex pediatric situations	4.54	0.66
Ability to manage "difficult" parents/patients	4.23	0.6
Ability to work in a team setting making clinical decisions	4.54	0.52

^aBased on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*).

Two faculty members developed and have used this case extensively, and an additional four faculty members (pediatric hospitalists and a pediatric intensive care unit attending physician) have also used the resource. Minor changes in the scenarios have been made based on their feedback (e.g., having the mannequin available during the scenario to perform the lumbar puncture in the room if desired). Preparation time for facilitators was minimal and included reviewing the case, reading any of the background resource material that they felt would be helpful for teaching, and reviewing the debriefing methods. Arriving 15-30 minutes early to confirm room setup and clarify expectations and plan with simulation center staff and the SP is essential.

Student comments included the following:

- "Thank you for the simulation sessions—when I did an away rotation in pediatric emergency medicine, I was so much more confident when I was asked to do my first LP [lumbar puncture]."

- “I liked how the sessions were longer than most simulation I’ve been involved with. In the short sessions, it’s easier to weasel my way through, but here I really had to think.”

Discussion

Based on surveys and informal feedback, this case has become a successful tool for clinical learning. It is a self-contained resource with all necessary instructions and additions to provide a successful educational experience. It may be used in isolation or in combination with two related cases. It adds to the growing number of published resources for use in the fourth year of medical school or early internship.

The case was designed as part of a series of three cases used for weekly educational sessions for subinterns in pediatrics. As a group, the three cases provide a broad coverage of urgent general pediatrics issues without excessive overlap. The other cases will be written up and submitted for publication following this one. The data obtained from the surveys reflected participation in all three of the sessions, so although specific information is pertinent to this case (seizure management, lumbar puncture), the more general assessment is not specific to this case.

One drawback to our data is the small number of participants. University of Vermont Children’s Hospital is a small academic center with only 16-18 subinterns rotating through general pediatrics each year. We felt that the benefit of disseminating the resource outweighed the limitation of small sample size, but further study could be pursued using the included surveys or with surveys designed with the intention of examining content mastery.

The case was presented as part of a workshop entitled Designing Simulation Exercises for Sub-Interns at the Council of Medical Student Education in Pediatrics (COMSEP) Annual Meeting on April 9, 2016, in St. Louis, MO, and the resource was revised based on feedback. Also, we plan to expand the pool of facilitators for the cases and possibly use the cases as a model for acting internships in other disciplines.

At this time, we have not provided summative evaluations for the students participating in the modules. In informal surveys, students have been unanimous in their belief that feedback on their performance should be formative. We have included a critical actions checklist to provide a minimum objective measurement of participant performance.

We encountered several challenges inherent in the format of the case. Consistent with national trends, most acting interns have never attempted a lumbar puncture on a live infant and have only performed any lumbar puncture on an adult mannequin. We have included some references with instructions for performing an infant lumbar puncture (Appendix H). If students opt to perform a lumbar puncture during the case, facilitators can either break role to instruct students or allow them to attempt the procedure and provide instruction with task trainers following the case.

During the case, only one student performs the procedure, sometimes with the help of a fellow participant. We found skills stations, either at the bedside following the case or in a separate, task-trainer room, helpful to provide proper instruction and practice in procedures for all participants.

It is difficult to provide physical exam findings without breaking roles. Although some mannequins are impressively realistic, the limitations of more subtle physical findings such as capillary refill are problematic. In our cases, the facilitator breaks role to provide physical exam findings. Other options are to provide a printed record of the physical exam (if given as an entire exam, students are not required to ask for specific findings related to the clinical presentation) or to have the findings relayed over audio as requested.

The SPs in our center are accustomed to short 10- to 20-minute cases, and since the case is 45-60 minutes long, we provided the SP with more information so he or she could stay in role more effectively despite unforeseen questions or actions by participants.

We initially had difficulty freeing the acting interns from clinical responsibilities, and it seemed to increase their workload upon returning to the wards following the session. Over time, we developed a model similar

to the residents' weekly afternoon continuity clinic, where the student would be excused, with scheduled afternoon coverage, as an educational continuity clinic.

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Prior Presentations

Rideout M, Raszka W. Designing simulation exercises for sub-interns. Workshop presented at: Council on Medical Student Education in Pediatrics (COMSEP) Annual Meeting; April 9, 2016; St. Louis, MO.

Ethical Approval

This publication contains data obtained from human subjects and received ethical approval.

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