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Problem-Based Learning Discussion on Neuraxial Anesthesia in Parturients With Repaired Tetralogy of Fallot

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Abstract

Introduction: Approximately 1% of all children born in the United States suffer from congenital heart disease, and 25% of those affected are born with critical congenital heart disease requiring surgical intervention. Advances in cardiac surgery have allowed an increasing number of patients with complex congenital heart disease to live into adulthood. It is important that anesthesiologists understand the particularities of providing safe clinical care for these patients in different situations. **Methods:** This problem-based learning discussion (PBLD) was created to expose medical students, anesthesiology residents, and anesthesiology faculty members to potential clinical situations involving the management of an adult parturient with a repaired tetralogy of Fallot defect who is in labor. The discussion focuses on reviewing and reinforcing an understanding of the clinical implications of the defect before and after repair, as well as the specific anesthetic considerations with regard to these patients. **Results:** This PBLD has been delivered on two separate occasions to a number of faculty members ($N = 10$), resident physicians ($N = 12$), a medical student ($N = 1$), and nurse anesthetists ($N = 2$) within our institution. It has been very well received and has stimulated discussion surrounding care for an adult parturient with a complex cardiac history within our facility. The exercise was evaluated anonymously by all participants and has been very positively reviewed. **Discussion:** We are confident that this PBLD, after significant efforts, has become a substantial and informative learning tool for medical students, anesthesiology residents, nurse anesthetists, and faculty alike.

Keywords

Anesthesiology, Epidural, Thoracic Surgery, Tetralogy of Fallot, Neuraxial Anesthesia, Cardiac Surgery, Parturient

Appendices

- A. Case Stem and References.docx
- B. Learning Discussion.docx
- C. Resources That Informed the Submission.docx

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

Educational Objectives

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

1. Describe the changes in cardiovascular physiology that occur during pregnancy.
2. Describe tetralogy of Fallot (TOF) and complete surgical repair of TOF.
3. Acknowledge the potential late outcomes after TOF repair.
4. Discuss anesthetic considerations for neuraxial anesthesia in a parturient with repaired TOF.

Introduction

According to estimates from the Centers for Disease Control and the National Birth Defect Registry, one out of every 2,518 babies born in the United States has tetralogy of Fallot (TOF). This accounts for approximately 1,657 new cases annually.¹ TOF is a family of diseases characterized by similar intracardiac anatomy: an aorta that overrides both ventricles, a ventricular septal defect, a right ventricular outflow tract obstruction, and a hypertrophied right ventricle.

Occurrence of serious adverse cardiac events during labor in adult patients with a history of remote TOF repair varies from relatively uncommon to more than an appreciable risk. Singh, Bolton, and Oakley

concluded from their research that pregnancy in a patient with TOF repair can be managed in a normal manner with no special precautions as it is highly unlikely that there will be any complications.² In their retrospective study of 31 patients, nine patients had mild pedal edema, one patient experienced mild dyspnea, and one patient experienced extrasystoles that were also present prior to pregnancy. None of the 31 parturients experienced syncopal episodes or chest pain. A literature review describing the outcome of pregnancy in 2,491 women with various congenital heart disease found that cardiac complications were seen in 11% of pregnancies, most commonly heart failure (4.8%) and arrhythmia (4.5%).³ Of note, all of the parturients with TOF in this study had undergone complete repair prior to pregnancy. These papers highlight the need for increased vigilance over this group of women for uncommon but potentially serious cardiac complications, especially ventricular arrhythmia and heart failure.

This problem-based learning discussion (PBLD) is designed to facilitate a group exchange focused upon clinical decision-making when selecting neuraxial anesthetic techniques in an adult parturient with a history of a remotely repaired TOF. A clinical scenario is provided as a means to enable review of TOF and repair techniques and understand the most frequently encountered remote sequelae. After a brief overview of the defect and of common palliative and corrective surgeries for TOF repair, participants proceed to a specific discussion concerning the management of an adult parturient with repaired TOF and neuraxial anesthetic technique options. Questions that accompany the case guide the conversation, and the answers provided are based on a current literature review. The target audience for this PBLD is physician anesthesiologists, certified registered nurse anesthetists, anesthesiology residents, medical students, and other physicians and health professionals who would have involvement in the care of a parturient with a remote TOF repair undergoing a neuraxial anesthetic technique for the management of labor pain.

In general, pregnancy outcomes in parturients after a repaired TOF with neuraxial anesthesia are favorable. However, it is noted that in approximately 19% of patients, recognition and management of congestive heart failure are necessary.⁴ It is for this reason that this PBLD was created. Additional resources that informed the creation of this discussion are noted in Appendix C.

Methods

This PBLD was originally designed to facilitate a 1-hour discussion on neuraxial anesthesia in parturients with repaired TOF. The case stem and associated questions were given to participants 4 days in advance of the group session in order to provide adequate time to review the pertinent topics. Review was guided by, but not limited to, the suggested references provided at the end of this case. Participants were encouraged to examine the relevant medical literature and to then develop their own preliminary thoughts on the management of this case.

The PBLD consisted of a case stem with references (Appendix A) and a learning discussion (Appendix B). The case stem with references explained the case that the PBLD would be centered on. The case stem included references; the participants were encouraged to explore the references in order to gain a better understanding of TOF in general. At the start of the PBLD, the facilitator reviewed the case stem with the participants, including the pertinent medical history, vital signs, and results of initial investigations. After ensuring that all of the participants fully understood the clinical scenario, the facilitator began the learning discussion by posing the first discussion question to the participants. The facilitator made sure to impart to the participants that this was a group learning environment and that people should feel free to share their knowledge and ideas. The learning discussion provided with the PBLD helps the facilitator guide the ensuing discussion for each question, as it contains very specific answers to each of the discussion questions. After completing the first nine discussion questions, the facilitator then reviewed the labor course with the participants. After again ensuring that the participants fully understood that portion of the clinical course, the facilitator continued to the last four discussion questions. At the conclusion of the PBLD, the facilitator asked the participants if they felt that all of the educational objectives had been met during the 1-hour discussion. A survey was then distributed to all participants; this allowed them to give anonymous feedback about their experience during the PBLD.

Each attendee filled out an anonymous evaluation to help us to improve the quality of the PBLD. The evaluation consisted of four questions. The questions are listed below:

1. What was your overall impression of the session? Positive/negative?
2. Did you learn anything from the session?
3. Will this change your practice in the future?
4. Do you have any ideas for improvements?

The anonymous feedback from participants in the original PBLD was used to create a modified PBLD that better reflected the learners' needs. Prior to the second PBLD, learners were given additional time (2 weeks vs. 4 days) to review the case and supplementary material. The list of references given to the learners was shortened to four. Each of the provided references was a website; this was done so that busy learners could review the information on a computer or even a smart phone. The new group of PBLD participants included some faculty members, some of the same anesthesiology residents from the first session, new CA-1 residents, medical students, and some nurse anesthetists. On this occasion, we allotted 90 minutes for the discussion, and we allowed the natural flow of the discussion to dictate the order in which we posed the discussion questions. We made sure to involve each learner in the discussion from the beginning and incorporated many new ideas and potential clinical scenarios into the PBLD. At the conclusion of the second session, each participant was asked to anonymously submit feedback for the following questions:

1. If you found this discussion helpful, please describe what aspects were most useful.
2. Do you have any suggestions for improving the PBLD?
3. Is there anything that you may adopt into your clinical practice as a result of this discussion?
4. Is there any topic that you feel required more in-depth discussion?

After receiving additional feedback from editors, we modified the stem significantly to allow for a better flow to the PBLD. We attempted to create a more robust clinical pathway with clinical questions that were placed at crucial clinical times. We then showed this newly designed stem to residents and faculty members who had previously participated in our PBLD sessions and asked for feedback on the changes.

Results

Five anesthesiology residents, six anesthesiology faculty members, and one fourth-year medical student participated in the initial offering of the PBLD. Two of the faculty members, including the faculty moderator, were cardiothoracic fellowship-trained and had significant experience with congenital heart disease. Although the participants were given 4 days to review the topics and references, many admitted that they had only looked at a few references the night before the PBLD session. The PBLD took 70 minutes to complete. The first portion of the PBLD, the case stem and nine discussion questions, took approximately 40 minutes to complete. The second portion, which included the labor course and four discussion questions, took 30 minutes to complete.

Ten of the 12 participants were extremely active in the discussions that took place for each question. An anesthesiology faculty member and the medical student did not actively participate in the discussion and preferred to listen to the ideas that were being reviewed. After completion of the PBLD, all of the participants were given a survey to complete. All 12 responses were positive. Each participant stated that he or she acquired knowledge during the PBLD. Seven of the participants commented that it was very beneficial to hear other practitioners' varying approaches to the case during the discussion, and four of the six of the faculty members agreed that they would likely change their practice in the future. All five of the residents and the medical student specifically commented on how they appreciated information on congenital heart disease and its implications in adults after the repair. Four of the participants gave specific suggestions on how the PBLD could be improved.

The second offering of the PBLD included four anesthesiology faculty members (one had attended the first offering), three CA-2 anesthesiology residents (all three had participated in the first offering), four CA-1 residents (none had attended first offering), one medical student (a fourth-year medical student who had not participated in the initial PBLD), and two nurse anesthetists. The participants had been given 2 weeks to prepare for the PBLD. Although most of the participants stated that they had waited until the previous night to review the documentation, two faculty members and four of the CA-1 residents stated that they had reviewed the information much earlier. The repeat participants also commented that they appreciated the extra time that they had received to review the information. The PBLD took 90 minutes to complete. The first portion of the PBLD, the case stem and eight discussion questions (including added clinical paths), took approximately 60 minutes to complete. The second portion, which included the labor course and four discussion questions (including added clinical paths), took 30 minutes to complete.

All 14 participants in the second offering of the PBLD were extremely active in the discussions that took place for each question. After receiving feedback from the initial PBLD, the facilitators were diligent in ensuring that all learners felt comfortable asking questions and participating in the discussion. After completion of the PBLD, all of the participants were given the revised survey to complete. All 14 responses were favorable. All participants stated that they had found the discussion to be very helpful. All four of the participants who had also attended the first PBLD commented on how they appreciated the different clinical paths that we took during the second offering of the PBLD. They agreed that it was worth attending the second session to absorb that additional information. All four of the faculty members agreed that they had learned information that would likely change their practice in the future. All four of the CA-1 residents commented that some of the material was beyond their scope of knowledge, but three of them complimented the facilitators for “finding ways to include them in the discussion” and “trying to relate the information to their clinical practice.” The nurse anesthetists both reported that the PBLD was a good refresher for them on congenital heart disease and was a great learning experience. Ten of the participants stated that they had no suggestions for improving the PBLD. One of the faculty members stated that this could be used as a grand rounds topic to involve more of the anesthesiology department. A CA-1 resident reported that he would like the PBLD to have been shorter, as the length of the discussion made it difficult to keep his attention. None of the learners gave any answers to the question asking if there were any topics that needed more in-depth discussion.

After receiving additional feedback from editors and revising the PBLD to create a better clinical flow, we asked two faculty members and the three CA-2 residents who had previously participated in the prior PBLD offerings to give us feedback. We are happy to report that all the feedback received was extremely positive. The residents, in particular, commented on how they felt that the PBLD flowed more smoothly and that this method of delivery was much more “clinically stimulating.” One of the faculty members even discussed presenting this PBLD at a cardiac anesthesiology or obstetric anesthesiology conference in the future.

Discussion

The impetus to create this PBLD was an actual patient with repaired TOF who presented to the labor and delivery ward at 37 weeks. She represents a growing number of people with repaired congenital heart disease who will now live well into adulthood as a result of profound advances in modern medicine and cardiothoracic surgery. As the operative techniques to treat these diseases improve, anesthesiologists are increasingly likely to encounter adult patients with complex cardiovascular physiology due to repaired congenital heart disease.

Design of the PBLD proved to be a difficult process. We felt it was imperative that all learners, including medical students, anesthesia residents, and faculty members, were able to learn a significant amount during the 1-hour session. For that reason, we decided to create basic and advanced educational objectives. We decided that this would ensure that each group, regardless of level of education, would be able to gain knowledge from the PBLD. The first three educational objectives were basic. We felt that the medical students and anesthesia residents would be able to learn the most from those topics. The second

three educational objectives were advanced topics. We felt that those topics would likely be more appropriate for the anesthesia residents and faculty.

The information that we received from the evaluations was very helpful to us. The fact that all of the attendees stated that they had learned a great deal during the PBLD was particularly important to us because, during the creation of the PBLD, we had struggled over how to ensure that learners of all levels would benefit from the session. We were also excited to find out if the faculty would change their practice as a result of the session; we were ecstatic to discover that two-thirds of the anesthesia faculty members reported that they would change their practice as a result of the PBLD. Finally, we were anxious to learn what improvements our learners would suggest for the PBLD. The suggestions we received included “adding more graphic materials, including pictures and videos,” “clearer descriptions/definitions of tetralogy of Fallot and right-sided heart failure,” “earlier dissemination of the PBLD,” and specifically “involving all learners in the discussion.”

We examined these suggestions and focused on making the improvements to the PBLD. First, we distributed the PBLD materials 2 weeks in advance to give busy learners adequate time to prepare. We also removed the long list of references and included four references that could be examined on a home computer or smart phone; this was done to make it as easy as possible for the learners to prepare. We also added different clinical paths to the PBLD, which we tried to incorporate into the natural flow of the discussion. Finally, we noted the importance of specifically including each participant in the discussion in the future.

We found that during the second PBLD session, we were able to enhance the depth of the discussion and encourage broader participation among learners of different education levels and backgrounds. Feedback was overwhelmingly positive, as several respondents stated that talking through their ideas served to solidify complex concepts and provoked thoughtful consideration of their patient care. Finally, it was very rewarding to read the comments of the participants who had attended both PBLDs. All four of the participants noted that attending the second session was very worthwhile for them, as the changes we had made to the first PBLD enhanced their learning experience greatly.

After receiving feedback from the reviewers, we set out to improve the flow of the presented case so that it could have the maximum benefit to learners in the future. After modifying the PBLD, we received great feedback from learners who had experienced this PBLD in the past. We are confident that this PBLD, after significant efforts, has become a substantial and informative learning tool for medical students, anesthesiology residents, nurse anesthetists, and faculty alike.

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Ethical Approval

Reported as not applicable.

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