A discussion regarding problem-based learning in medicine with special reference to anaesthesiology

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Abstract

The medical sciences have a history of delivering education with problem-based learning (PBL) which is used in many medical schools worldwide: a sequence of PBL is the case study. This article documents the pedagogy of learning with case study methods in medical teaching. Historically, problem-based learning in medicine dates from 1969 and was based on the concepts of critical and independent thinking, problem-solving and decision making capabilities considered to be very important skills for the practice of medicine. The scope of this article is to find the place of PBL in teaching and learning clinical anaesthesia. Over the last 44 years, there have been a large number of publications related to PBL and this method has been adopted in a few anaesthesia departments worldwide. At Uppsala University, not only PBL, but all learning theories have been adopted and the theoretical studies are a precursor to using case studies in learning anaesthesiology. Although one may argue against this teaching method due to the possible limitation regarding the selection of appropriate cases, it has been proved that students have found great satisfaction in learning this way and case studies are popular sources for improving understanding.

Keywords: problem-based learning; education; medical sciences; anaesthesia

History and background

The philosophy of the case study method of learning originally goes back to John Dewey and Jean Piaget who emphasized learning through experimentation and practice or an ‘active, inquiry based education’ in which knowledge was associated with action. In the traditional lecture, knowledge was seen as a quantity [1], the recitation of the terms, skills and facts were transferred to the students similar to primary education techniques. Historically, the traditional primary educational technique was simple oral recitation [2] to which, quoting from Socrates, “There remains the question”. In medicine, the first year class enrolled in a system of learning based on problem solving instead of only rote learning discipline-oriented subjects began in 1969 at McMaster University, Hamilton, Ontario, Canada [3]. The concepts of critical and independent thinking, problem solving and decision making were considered to be very important skills for the practice of medicine [4, 5]. Despite no background in educational psychology, Howard Barrows [4] developed the PBL experience at McMaster starting from the premise that learning in small groups for the study of clinical problems would make medical education more interesting and relevant for their students. In the early 90’s the Medical Faculty of Uppsala University, Sweden, changed the structure of teaching from the large proportion of lectures to a more integrated form with more interaction between departments including problem-based learning in clinical medical studies [6]. Despite this, the curricular format was felt to be didactic and removed from clinical settings. Therefore, a new curri-
curriculum related to patient-orientated learning was implemented in the last 2 years at the Medical Faculty in Uppsala. It seems that more sophisticated methods of teaching for medical students and residents were required to address the increasing amount of medical information, new highly developed technologies and new medical procedures. Anaesthesiology is a complex specialty that demands working in different clinical and operative settings such as the operating room, the post-operative ward, the pain clinic, the intensive care unit, the emergency room, radiology suites, and obstetrical wards.

Definition

Learning is defined as “a process that leads to change” in knowledge, beliefs, behaviours, and attitudes of the learner [7]. Problem-based learning (PBL) is a student-centered pedagogy in which students learn about a subject through the experience of problem solving. Students learn both thinking strategies and domain knowledge in a different way from traditional classroom/lecture teaching. Because the method of PBL in medicine involves case studies this article attempts to find elements of this method in the teaching of anaesthesiology. The fundamental principle underlying the case study method is the achievement of a deeper understanding if the students learn lessons and gain understanding and judgment through practical experience. Case study method teaching challenges students to learn skills that will be appropriate to deal with the practical problems that they will face as doctors [8].

Learning theories in anaesthesiology

All the learning theories (behavioural, cognitive, constructivist and humanist approaches) are adopted in teaching learning modern anaesthesiology for residents in anaesthesiology [9]. These different categories of learning theories presented here are not mutually exclusive and Baker found that anaesthetists are familiar with and use all four learning styles [10].

a. Behaviourist theory can be recognized in a competency-based curriculum [11]. For example, in ultrasound based central venous puncture and inserting of a catheter (CVC), the expected competencies are clear, the anatomical location was previously memorized and learned with help of a teacher and the location of the vein reinforced by the instructor.

b. Cognitive learning takes the view that learning resides within the individual’s memory and that internal cognitive processes, such as perception, information processing, storage and retrieval are social learning. The case presented above with central venous puncture may be adapted to cognitive learning where retrieving the location of the vein from memory is reinforced by repeated practice.

c. The constructivist approach is promoted in “learning by doing” or maximizing exposure to clinical experiences as proposed in the experiential curriculum for anaesthesia residency training [12]. The use of simulation for treatment of pneumothorax resulting as a side effect of central venous catheterization, allows the anaesthesia residents to experience unexpected clinical situations which are consistent with an experiential learning approach. During a repeated similar scenario, residents can actively learn from their experience [13].

d. Problem-based learning adopts the learner-centered focus where the role of the teacher is to enable learners to recognize and reach their potential. In this case, anaesthetists try to individualize learning objectives by finding more information about a subject, and they make use of self-directed learning strategies and self-assessment.

PBL curriculum for residents in anaesthesiology, intensive care and pain

The benefits of this approach include self-motivated acquisition of knowledge and better communication skills, problem-solving, increase in students’ intellectual satisfaction and improvement in their clinical performance [14]. PBL is an educational approach specifically designed for small-group learning. Residents in anaesthesiology and critical care receive weekly a series of carefully planned, authentic, and contextualized medical problems that are then discussed by trainees under the supervision of a senior physician. For each problem, the group identifies objectives that are then reviewed individually. Subsequently, trainees’ findings are shared and discussed during a follow-up session (University of Toronto) [15]. Generally, when engaged in problem-based learning, the students follow the seven-step process [16] (problem clarification, problem definition, problem analysis, sifting and sorting information, identification of learning objectives, self-directed learning, reconvening as a group for further discussion). A practical example of the PNL curriculum for trainees was described for the residents in intensive care at the University of Toronto [15]. The following steps are described:

1. Problem selection is based on selecting a module from the website designed for this purpose. There is no a specified order for completing the modules.

2. Problem introduction is restricted to a session with a duration of between 30 and 90 min during which the group reads the problem, one section at the time.
The tutor asks the trainees questions about the understanding of the scenario, the appropriate management and treatment in order to identify areas of uncertainties in the trainees’ knowledge and to identify specific learning objectives.

3. During a self-study period of between 2-14 days, each trainee is responsible for reading about the objective assigned during the first session.

4. In the final sessions of between 60-90 min dedicated to the review of the learning objectives, each trainee presents to their colleagues a summary of the material reviewed. This is a style of active learning with goals to help the residents develop flexible knowledge. The instructor (known as the tutor in PBL) facilitates learning by supporting, guiding, and monitoring the learning process.

PBL curriculum for students learning anaesthesia at Uppsala University

Anaesthesia, intensive care therapy and pain treatment learning are distributed over several years during medical education at Uppsala University. In the 6th session the students are divided into groups of 12-16 persons who under a two week period are scheduled to learn basic knowledge about anaesthesia. They have a person designated to teach them, usually an anaesthetist who is also a PhD student in anaesthesiology. The course starts on the first day with a lecture about anaesthesia and its components, drugs used to induce, maintain and recover from anaesthesia, and methods and complications related to this. In the first day a patient case is presented that will be followed under the next 2 weeks period. All the aspects of anaesthesia presented in the theory are followed in the case. The students learn by themselves but there is also a physician to supervise them in each component and who also conducts the discussion. The theory is combined with practical aspects as seen in the program attached (Appendix 1 and 2). The practical goals are achieved in the operating rooms and are related with maintaining the free airways including intubation, inserting peripheral lines, seeing regional anaesthesia, understanding monitoring and help extubating the patients. This is not an example of a typical PBL, but the case studies are derived, as a step from PBL.

Pros and Cons

The PBL method has produced divergent opinions. There are pros and cons for the advantages of the PBL method. Colliver [17] concluded that there was no convincing evidence that problem-based learning was more effective than conventional methods, claiming that “the ties between educational theory and research (both basic and applied) are loose at best”. In my view, the case study method might be argued against due to the selection of the cases that might not be completely representative for future practice. I believe that it is important to draw a distinction between case studies as solving a practical problem in a difficult situation and seeking to find a theoretical solution appropriate for all similar situations. A common question that I have to raise against PBL is how does one know if the cases used cover all the field of knowledge? My main concern is that there may be attempts to “generalize” the same method of treatment for different situations. I would say therefore that I am a supporter of both theoretical and PBL methods.

Wilhelm Dilthey, a German philosopher, claimed in 1910 that human studies “are founded on the relation between lived experience, expression and understanding” [18]. Indeed the pros of case studies are that they are natural experience. We expect a case study to carry a message that will help the students towards further understanding and curiosity. These are not possible without a degree of satisfaction from the medical students. Therefore among the “pros” would be the students’ satisfaction with the case method study. In an inquiry named “Klinikkurt” (Klinisk kursutvärdering or clinical course inquiry) that started in 2009 and is now organized each year and compares the placement related with learning between different specialties in Uppsala University Hospital, the students ranked anaesthesia at the top for several years in a row. “Klinikkurt” is an indicator of the best teaching and care for the students and is considered to be the best feedback for the pedagogical activity in the hospital. We can therefore assume that case study teaching, a sequence of PBL, is associated with increased satisfaction for the learning of anaesthesia among medical students. Also there is evidence that graduates of the PBL curricula demonstrate equivalent or superior professional competencies compared with graduates of more traditional curricula [19].

Conclusion

Anaesthesia education seems to have become more and more dependent on problem-based learning, especially when a part of this is the use of case studies. The argument advanced here is that case studies in anaesthesia are reliable procedures for learning. Problem-based learning increases the students’ knowledge and motivation. However, the question that remains to be answered in the future is the extent to which the use of this method should be in proportion to guided learning. But apparently it seems that it can “better prepare graduates to cope with uncertainty”.

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O discuţie privind învăţământul bazat pe probleme, cu referire specială la anestezie

Ştiinţa medicală are o istorie în ce priveşte învăţământul bazat pe probleme (problem-based learning, PBL), care este sistemul utilizat în multe școli de medicină din lume. O succesiune în PBL este realizată prin prezentarea unui caz clinic. Prezentul articol aduce argumente pentru procesul de învăţare prin utilizarea metodelor de studiu de caz în învăţământul medical.

Din punct de vedere istoric, PBL datează din 1969 şi a fost bazat pe conceptele gândirii critice şi independente de rezolvare a problemei şi pe capacităţile de decizie considerate a fi abilităţi foarte importante în practica medicală. Scopul acestui articol este de a stabili locul PBL în cadrul procesului de predare-învăţare a anesteziei clinice. De-a lungul ultimilor 44 de ani au fost publicate numeroase articole legate de PBL, iar această metodă a fost adoptată în câteva departamente din lume. La Universitatea din Uppsala, nu numai PBL dar şi toate teoriile privind învăţarea au fost adoptate, iar studiul teoretic este premergător studiilor de caz în învăţământul medical. Din punct de vedere istoric, PBL datează din 1969 şi a fost bazat pe conceptele gândirii critice şi independente de rezolvare a problemei şi pe capacităţile de decizie considerate a fi abilităţi foarte importante în practica medicală.

Rezumat

Ştiinţa medicală are o istorie în ce priveşte învăţământul bazat pe probleme (problem-based learning, PBL), care este sistemul utilizat în multe școli de medicină din lume. O succesiune în PBL este realizată prin prezentarea unui caz clinic. Prezentul articol aduce argumente pentru procesul de învăţare prin utilizarea metodelor de studiu de caz în învăţământul medical.

Cuvinte cheie: învăţarea bazată pe probleme, educaţie, ştiinţa medicală, anestezie

References

16. Bloom BS, Masia BB, Krathwohl DR. Taxonomy of Educational Objectives. Longmans Green, New York, 1964
Appendix 1. Anaesthesia, session 6, medical students Uppsala University

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Program</th>
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<tbody>
<tr>
<td>Monday</td>
<td>08.15-12 13-14</td>
<td>Introduction to anaesthesia</td>
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<tr>
<td></td>
<td></td>
<td>Case presentation</td>
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<td></td>
<td>13-13.45</td>
<td>Practical moment related with airways maintaining</td>
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<tr>
<td>Tuesday-Thursday</td>
<td>08-16</td>
<td>Practice on the operation theater</td>
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<tr>
<td>Friday</td>
<td>08.00-12.00</td>
<td>Moment 1 – Preoperative examination and premedication</td>
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<td>Are there any associated diseases? ASA classification; Risk of difficult intubation? Risk of aspiration? What are the main points with preoperative examination? Moment 2 – Fluid therapy; Preoperative; Perioperative; Postoperative Difference between resuscitation with crystalloids and colloids, blood products</td>
</tr>
<tr>
<td>Monday</td>
<td>08.15 – 12.00</td>
<td>Case study Moment 3 – Monitoring; Basic knowledge; Need for central venous pressure monitoring, arterial monitoring; Rapid Sequence Induction; Drugs; Gastric catheter? Positioning of the patient; Complications</td>
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<tr>
<td>Tuesday</td>
<td>08.15 – 12.00</td>
<td>Case study Moment 4 – Pain treatment; Postoperative pain treatment; Difficult airways Postoperative seminaries</td>
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<tr>
<td>Wednesday</td>
<td>08-16</td>
<td>Practice operation room and postoperative care unit</td>
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<td>Thursday</td>
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<td>Simulator training at clinic training centrum (3 students at a time)</td>
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<td>08.30-10.00, 10.15-11.45, 12.30-14.00 and 14.15-15.45.</td>
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<tr>
<td>Friday</td>
<td>08-11</td>
<td>Multiple choice questions (MCQ) exam, opinions about the course and questions about muddy points</td>
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Appendix 2. The main goals of the anaesthesia course for students in session 6 Uppsala University

**Theoretical goals**

3. General anaesthesia: the three components: sleep, analgesia, muscle relaxation
4. The clinical grades of hypnosis, analgesia, muscle relaxation
5. Drugs used in anaesthesia
6. Contraindications
7. Different types of anaesthesia and describing the steps from preoxygenation to extubation, drugs, monitoring during anaesthesia
8. Select the type of anaesthesia for different procedures
9. Free airways and ventilation
10. Laryngospasm, bronchospasm
11. Intubation/extubation risks
12. Rapid sequence intubation
13. Postoperative ward
14. Pain treatment
15. Regional anaesthesia
   - Local anaesthesia, plexus block, spinal/epidural anaesthesia
16. Intravenous fluid treatment
   - Pre- and postoperative, monitoring, treatment of deficits
18. Access lines: CVK, peripheral and arterial lines
   - Why? Indications? Complications