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Modified use of team-based learning in a general surgery course for fourth-year medical students

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Abstract

Team Based Learning (TBL) is a form of education based on student-centered learning in a crowded community consisting of small groups under the guidance of an expert trainer. Acute pancreatitis and fluid electrolyte disorders are important and difficult subjects of general surgery. This study was conducted in order to evaluate the success rates of team-based learning in undergraduate general surgery education. This prospective study study was performed in Kocaeli University School of Medicine, General Surgery courses. TBL study was applied for acute pancreatitis and fluid&electrolyte balance lessons. Readiness assurance and application oriented activities were done in each lesson. Readiness assurance quesitons were prepared for discussing and understanding the pathophysiology. After discussing tthe questions, each group tried to solve a patient oriented case. At the end of the course, a two-part questionnaire were applied to all students in order to take the feedbacksTotal 150 students from three courses included to the study. The vast majority of the students (130 people 86.6%) thought that the TBL study was better than the didactic lecture. And student wanted to Average score in all groups in TBL exam was 84.8. TBL study achieved high acceptance by the students. Although a new method, they adopted easily. General surgery subjects are suitable for this type of education model.

Keywords: general surgery, medical education, student-centered, team-based learning

1. Introduction

Medical education whose main purpose is to train "good physicians", is a lifelong education. Following classical lecture-based education, new education models have come to the fore in the 21st century. The tools that are used in new educational models are community-based practices, teamwork, and communication skills. Medicine is not only the knowledge but also, decision, evaluation, communication, discussion and collaboration. The strategies of the new programs are student-centered, problem-based, integrated, and systematic. The need for new learning methods has emerged because of the increasing number of students every year, the increase in the channels of access to information, technological developments, the need to analyze the lessons in which how much information should be given, the need for discussion opportunities to support communication skills among students

Team Based Learning (TBL) is a form of education based on student-centered learning in a crowded community consisting of small groups under the guidance of an expert trainer (1). In this method, in order to realize individual and team level learning, in-class and out-of-class activities and special tasks must be fulfilled by students (1,2). TBL provided the opportunity to continue teaching in a manner that was engaging, catered for larger number of students in decision making, and promoted active small group and class discussions (1). This method envisions a medical education where students had prepared for the lesson, actively participated in the exercises, defend their decisions passionately and frankly, and leave the session with information they can use in their professional life (3).

This study was conducted in order to evaluate the applicability of teamwork-based learning in undergraduate general surgery education in reaching the learning objectives and search the the students' perception of the model.

2. Materials and Methods

In our study, the Team-Based Learning (TBL) method was applied in the fluid& electrolyte balance and acute pancreatitis lessons during the theoretical practices of the Kocaeli University Faculty of Medicine Grade 4 General Surgery practice. The contribution of these two courses to the general surgery examination passing grade was 2%. Total 150 fourth-year medical students from three practice groups in acute pancreatitis and fluid&electrolyte balance modules were included in the study.

The stages of classical team-based learning are selfstudy reading, individual readiness assurance test (IRAT), team

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readiness assurance test (TRAT), immediate feedback, and clinical problem-solving activities respectively. Self-reading is study period out of school for IRAT and TRAT. In our study, pre-TBL learning goals were determined in the preparation phase. Teams were grouped by the trainer according to modular arithmetic Mode 7 within the order in the student's name list. Students in each group were about 6 or 7.

Table 1. Individual Readiness Assurance Test (IRAT) for Fluid&Electrolyte balance

1.Which of the followings are mostly found intracellular electrolyte ?
a. Cation: potassium, calcium, sodium Anion: Chlorine, Protien, Bicarbonate b. Cation: Sodium, manganese, protein Anion: Phosphate, Organic acid, Chlorine c. Cation: Potassium, Magnesium, Sodium Anion: Phosphate, Bicarbonate, Protein d. Cation: Sodium, Calcium, UreaAnion: Chlorine, Phosphorus, Sulphate e. Cation: Potassium, Protein, Calcium Anion: Protien, Glucose, Phosphorus
2. Which of the following is wrong about the changes that can be seen in the body as a result of excessive sweating in summer?
a. ADH is secreted from the posterior pituitary when plasma osmolarity rises above 295 mOsm / kg with dehydration. b. With dehydration, there is a drop in blood pressure. ANP release decreases due to the decrease in pressure in the atrium. Low ANP activates the sympathetic system and increases Renin release. Increased Renin release stimulates aldosterone. c. The electrolyte responsible for plasma osmolarity is sodium. We do not expect a decrease in osmolarity due to sodium loss with sweating. d. Tachycardia, tachypnea, muscle cramps and nausea are observed in the patient's clinic. Central nervous system findings occur due to sodium loss. e. Aldosterone stimulation due to dehydration occurs with the renin angiotensin system.
3.Which of the following is wrong about the causes of hypokalemia?
a. It is seen in patients with prolonged nasogastric tube drainage because of greater potassium loss from the stomach b. Since there is no sodium reabsorption in patients with ileocutaneous fistula, potassium loss is also accompanied. c. In the presence of giant villous adenoma in the colon, excessive potassium loss is observed due to diarrhea. d. Potassium reabsorption from the kidneys does not occur in renal failure. e. In high-dose insulin therapy, hypocalcemia is seen as potassium enters the cell.
4.Which of the following is true about the calcium mechanism?
a. Hypocalcemia is seen in patients with pancreatitis due to the precipitation of calcium in the pancreas. b. In hypocalcemia, twitching around the mouth and spasms in the fingertips are seen. c. We expect hypocalcemia due to hungry bone syndrome in patients with parathyroid hormone over 300pg/mL. d. Peptic ulcer, lethargy, weakness, constipation are the signs of hypocalcemia. e. In the presence of hypercalcemia, if there are ECG findings, the primary treatment is to protect the heart with calcium gluconate.
5.Which of the following metabolic conditions is not seen in hypokalemia?
a. Increase in plasma bicarbonate level b. Variable urinary potassium excretion c. Urine pH below 7.35 d. Increased urinary acid excretion e. Increase in pCO2 level in the compensated period
6.Which is the most reliable way to follow intravenous fluid therapy?
a. Blood pressure b. Respiratory rate c. Skin turgor-tonus d. Pulse e. Urine output
7.Which of the following is not one of the factors leading to Magnesium deficiency?
a. Starving b. Furosemide use c. Acute pancreatitis d. Hyperladosteronism e. Chronic alcoholis

As a result, students were prevented from forming groups with people whom they feel close to. Students were asked to prepare for fluid& electrolyte balance and acute pancreatitis courses. Resources to be used for course topics were presented to students. These were textbooks and lecture notes prepared in our department (Temel cerrahi Ed. İskender Sayek, Gunes Kitabevi, 2009; Schwartz's Principles of Surgery, Ed. F. Charles Brunicardi 10th edition, McGraw-Hill Education).

At the stage of Readiness Assurance, students were first given IRAT, which consists of multiple-choice questions (Table 1, Table 2). Total duration of IRAT was 7 minutes. The effect of this exam on the TBL score was 25%.

Afterwards, the predetermined teams came together. Team representatives were selected by the trainer from among the students with the least participation in the classes. Thus, these students was also provided to contribute at the highest level. Team Readiness Assurance Test was given to the teams, consisting of the same questions. Meanwhile, the instructor walked around with the students during the team discussions. He encouraged them to research and discuss. Total duration of

TRAT was 15 minutes. Questions were answered at the end of the exam. But answers of some questions were deliberately given wrong.

After the exam, the teams objected to the answers in writing and verbally with the help of the training materials. The teams whose objection was justified got points for that question. Those who did not object could not get any points for that question, even if their answers were correct. Scores were given the each member of the teams. The effect of this exam on the TBL score was 50%. The aim was to encourage students to object to what they thought was correct and to encourage them to make adequate preparation before coming to class.

Afterwards, the instructor gave lesson about the missing part of that subject. During the application phase, the same teams were asked open-ended questions to solve problems over case reports or lecture topics. These questions were answered by the team representative. Case questions were:

1. The patient with gastric outlet obstruction due to gastric ulcer has a nasogastric tube. Daily output from this nasogastric tube is 1000cc. He has no additional chronic diseases. Plan the fluid treatment of this patient.

2. How do you examine the patient who comes to the emergency room with signs of acute pancreatitis for local and systemic complications?

Diagnosis and treatment steps were discussed. Students in each group gave a score between 1 and 10 to the students in their group. Thus, giving feedback to students with inadequate participation by their peers was more effective for these students to question this situation and criticize themselves. Peer assessment also had a 25% effect on the TBL score. In this course, students were informed about scoring at the beginning of the TBL exercise.

At the end of the course, a questionnaire consisting of five-point Likert-scale (scored from 1 to 5) questions were applied to the students about the TBL session (Table 3). And also another quesitonnaire about TBL and traditional lectures were applied. The answers were strongly agree, agree, neutral, disagree and strongly disagree.

2.1. Statistical Analysis

At the end of the General Surgery Practice, the students were applied final general surgery examination in which 2 multi-choice questions about fluid&electrolyte balance and acute pancreatitis were exist.

The correct answer rate of students who entered TBL education were compared with the correct answer rates of previous year when traditional methods had been performed. The mean IRAT and TRAT scores were given as mean ± SEM. Data were analyzed by SPSS 20.0 (Chicago, IL, USA). Student t-test was used for comparision. A p-value less than 0.05 was considered statistically significant.

3. Results

The mean IRAT scores of the students in fluid&electrolyte and acute pancreatitis lessons were 3.1±0.8 and 4.2±1.2 respectively. The mean TRAT scores of the students in fluid&electrolyte and acute pancreatitis lessons were 5.6±1.8 and 6.1±0.8 respectively. The difference between IRAT and TRAT scores in fluid&electrolyte and acute pancreatitis lessons were significant (p=0.001 and p=0.01 respectively).

In the questionnaire questions, which are scored according to the Likert scale and the average of the results are taken, most of the students agreed that the TBL approach was very successful in terms of achieving the learning objectives and student participation. Again, the students thought that the course content of this study was well understood (Table 3).

Fig. 1. Students discussing during Team Readiness Assurance Test

The vast majority of the students (130 people 86.6% and 122 people 81.3%) thought that the student effort in the TBL study was higher than the traditional lecture method and the TBL study was better than the didactic lecture (Fig. 1).

While 132 (88%) of the students were willing to increase studies, 18 students (12%) did not want to increase it (Figure 2). Average score in all groups in TBL exam was 84.8. As a result of the peer assessment within the group, everyone in the group gave full points to each other. Although TBL was applied to the students in our study for the first time, it was observed that the students quickly adapted to this method.

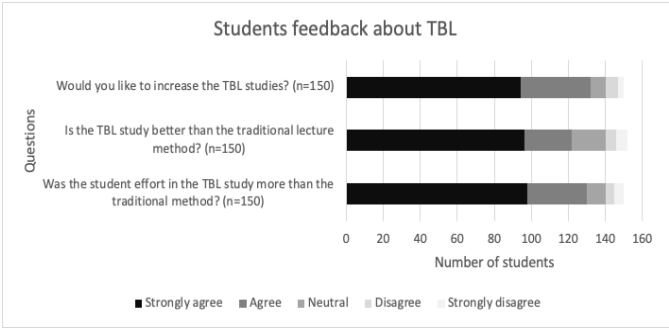

Fig. 2. Feedback evaluation of TBL among students

The succes of students after TBL method in fluid&electrolyte balance questions in final general surgery examination was higher than the students after lecture based method (Table 4). This difference was not significant in acute pancreatitis answers.

Table 2. Individual Readiness Assurance Test (IRAT) for acute pancreatitis

1.Which of the following is wrong about the mechanism of acute pancreatitis?

a. Inflammation due to oxidation of increased fatty acids is seen in acute pancreatitis caused by hyperlipidemia. Amylase may not increase in these cases.
b. Trypsin activation is seen due to increased trypsinogen production in hypercalcemia.
c. SPINK gene mutation is seen in idiopathic pancreatitis
d. Alcohol consumption acts by increasing the sensitivity of cholecystokinin in pancreatic cells.
e. Carsinoma of the head of the pancreas, Stones in ampulla vater, sphinchter of Oddi dysfunction act by increasing pancreatic duct pressure.

2.Which of the following clinical signs is not one of the local complications of acute pancreatitis?

a. Peptic ulcer
b. Pancreatic abscess
c. Pancreatic pseudocyst
d. Portal vein thrombosis
e. Obstructive jaundice

3.Abdominal pain like a belt around the trunk, nausea and vomiting begin in the patient after ERCP. The patient has obvious tenderness and defense in the epigastric region. Acute pancreatitis is considered in the patient. Which of the following tests is not needed in regarding the diagnosis and treatment of the patient?

f. Abdominal computed tomography
g. WBC
h. Glucose
i. LDH
j. Amylase

4.In the treatment of acute pancreatitis, make the treatment matching according to the following purposes. Multiple matches can be made.

Suppression of pancreatic exocrine function ...
Supporting lung functions ..
Supporting kidney functions ...
Suppression of cholinergic response ...
Elimination of etiology in biliary pancreatitis ...
Suppression of inflammation ...
* NG insertion
* Somatostatin administration
* Application of analgesia
* Discontinuation of oral intake
* Plasma transfusion
* Antibiotic treatment
* Hydration according to urine output
* Providing fluid balance from 40cc / kg
* ERCP
* Cholecystectomy
* N-acetylcysteine
* Calcium treatment
* Insulin therapy
* Pulmonary respiratory physiotherapy
* Dialysis
* Red blood cell transfusion
* TPN

5.Which of the systemic complications of acute pancreatitis is wrong?

a. Sudden blindness
b. Hypoglycemia
c. Hypocalcemia
d. Shock
e. Myocardial infarction

6.Which of the following is not one of the causes of acute pancreatitis?

a. Alcohol
b. Hydatid cyst
c. Gallstone
d. Exogenous estrogen
e. Mumps

7.What is the most common type of shock due to acute pancreatitis?

f. Hypovolemic shock
g. Septic shock
h. Obstructive shock
i. Cardiogenic shock
j. Neurological shock

Table 3. Evaluation of the success of TBL study among student

Questions	Mean±SD
How successful is the TBL study in achieving the learning objectives?	4.24±0.3
How well understood the content of the TBL study?	4.10±0.2
How successful is the TBL study in terms of student participation?	4.20±0.3

Likert-scale (scored from 1 to 5) was used

Table 4. Comparison of rate of the correct answers of the student in TBL and previous lecture based method

	TBL	Lecture	p
Fluid&Electrolyte Balance	80%	50%	P=0.02
Acute Pancreatitis	70%	60%	P=0.1

Student T test used

4. Discussion

In this study, we presented the application of the team-based learning method in the acute pancreatitis and fluid&electrolyte balance modules in the period 4 general surgery practice. The results of the feedback received from the students. TBL has been a good method that have been successfully applied in preclinical courses such as anatomy, pharmacology, pathology, physiology as well as clinical courses such as ophthalmology and endocrinology (4-7). Studies have shown that the short and long term learning goals are achieved at a high rate with TBL (4-7). In the TBL method, it was observed that the active participation and continuity of the students was higher (2,4). In our study, the learning objectives were achieved at a high rate.

In TBL study desing, the students who came without preparing for the TBL study are noticed in the İndividual Readiness Assurance Test (IRAT) and these students are not attended to the lesson (8). There was no such thing in our study. It is observed that students who come prepared to the lessons (high IRAT scores) are more involved in the TBL process. In our study the mean TRAT scores were significantly higher than IRAT. This shows us that team work, colaboration is very important for learning. A clear strength of TBL is having multiple, small groups of students in each teams, promoting inter and intra team discussion and peer learning (9,10). It was determined that students who came unprepared to the sessions generally did not like the peer assessment phase and these students generally made bad evaluations about their peers (8). In our study, it was observed that students gave full points to each other in peer assessment. This situation can be associated with the first time that students encounter the TBL method. If this method is applied more frequently, it is thought that this situation will change, it will cause students to feel responsible for each other and come prepared for the lesson, and it will increase active participation.

In a study comparing TBL and traditional learning method, no difference was found in the ratio of students paying attention to the lesson, while satisfaction and active participation of students in the lesson were higher in TBL. At the end of the study, the students stated that they preferred this method to the traditional method (9). In our study, a comparison was made by assessing the correct answere rates in final examination. Correct answer succes rate in fluid&electrolyte balance is higher in TBL method. This looks like a success but outcomes of learning is not only the correct answers. Medical education is not only the achieving the correct answers of the tests. That's the reason why new methods are needed in medical education. Previous studies comparing TBL, conventional and peer-asisted learning has showed better learning outcomes in TBL method (11). The comparsion of outcomes were evaluated by Objective Structured Clinical Examination (OSCE) in that study (11). The diffifulty in performing outcome measurement in general surgery phase 4 students is difficult especially special topics like fluid&electrolyte balance and acute pancreattitis. For this reason we presented our study with test documents for future studies. Outcome measurements for TBL and traditional methods in these special topics of General Surgery haven't been evaluated before. Better way obtaining is the feedback of students. There are several studies that measure the succes of TBL by students' feedback (12,13). Most of the students thought that the student effort in TBL was more than the traditional method and that TBL was a better and more successful method than the traditional method. It has been observed that students who have low success in traditional methods have more learning success in TBL method (10).

TBL is very different from problem-based learning (PBL) and other small group approaches because there is no need for more than one faculty or room in this method. Students should come prepared for the sessions. Each student is individually responsible for contributing to team productivity. The trainer must be an expert, but does not require any prior experience to run a successful TBL session. Students do not need any specific instructions from the stage they learn how to be collaborative and productive. In the previous studies favorable results about TBL were obtained when TBL was compared with other active learning methods like problem based learning or case based learning (10,14,15). TBL can replace the traditional lecture method or can be used as a complement to this method.

TBL is an education model with active participation of students, improving communication skills, increasing personal motivation, and achieving high success and satisfaction with a single instructor in classes with more students (1). With this method, students' attention can be kept alive and students gain experience in problem solving. It becomes more interesting because it goes through case reports and problem solutions, and enables students to develop problem-solving strategies. However, the time allocated is insufficient due to the fact that such education models are not widespread enough. It can be applied in limited internship groups in certain classes yet. The adaptation process to these new methods can be difficult for students who have grown up with classical learning methods from an early age. Questions in readiness test are important for the quality of TBL session. These questions must include arguable topics and also contain the basic pathophysiology of the lesson. Here in our study, as seen in the questions, the students can discuss the pathophsiology of acute pancreatitis, electrolyte disturbances. Questions determines the how students think and discuss the lessons. Because of the difficulty in preparation of questions, here we presented our questions. It's seen that these questions are well enough for discussion of the acute pancreatitis and fluid&electrolyte balance. In general

surgery education, fluid&electrolyte is a difficult subject for the mentors to teach and fort he students to learn. Because, there are so many biochemical reactions in it and also so many clinical scenario in it. When compared with the lesson acute pancreatitis, correct answer rate in the fluid&electrolyte lesson is less. These kind of questions can be collected and TBL question banks can be formed in future.

Nowadays, students prefer traditional methods rather than such active participation methods because there are factors that can put pressure on students such as medical specialty exams and these are mostly theoretical knowledge-based exams. They may think that such new learning models are a waste of time. For this reason, while such methods which are more catchy and have more contribution to professional life are encouraged to be preferred in medical education. It should also be considered to revise the specialty exams and medical education exams in line with these methods. In this way, students will be able to look at these methods from a more objective perspective. More studies should be done on student-centered learning methods and these methods should be made widespread in this way.

As a results, TBL study achieved high acceptance by the students. Although a new method, they adopted easily. General surgery subjects are suitable for this type of education model. Preperation of questions are the most important part of TBL session.

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