

Effectiveness of problem based learning on student's knowledge construct in I MBBS students - A cross-sectional study

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Received: 26th January, 2018

Accepted: 02nd February, 2018

Abstract

Introduction: Traditional teaching methods aid students to procure subject knowledge content but not knowledge construct. Problem based learning (PBL) is evolving as one of the paramount methods of improving students' knowledge construct.

Objective: To evaluate the effectiveness of Problem based learning as an instructional tool in procurement of content knowledge, critical thinking and problem solving skills in cardiovascular Physiology among I MBBS students.

Materials and Methods: Thirty students from I MBBS were randomly selected for the study. They were administered with pre-test, exposed to one hour of problem based teaching and again administered with post-test the next day.

Results: There was statistically significant improvement in students' knowledge construct in cardiovascular physiology following exposure to problem based teaching methods.

Conclusion: PBL was found to be an effective instructional tool in development of critical thinking and problem solving skills among medical students

Keywords: Knowledge construct, pre-test, post-test.

Introduction

Basic medical science subjects like anatomy, physiology, pathology etc are the backbone for medical practice. Students have to base their entire career on the comprehensive understanding of physiological principles. The further understanding of Para clinical and clinical subjects are also based on their understanding in physiology. Therefore in the first year, students devote a substantial time in learning physiology. However, the usual feedback from Para clinical and clinical faculties is that students are not answering even the basics. The reason is that when the students are asked on the subject directly, they are able to answer but when prodded in application scenario they are incompetent to correlate. The reason is that students have good subject knowledge content but not knowledge construct. One important challenge in medical education is to improve the knowledge construct that enables them to translate their knowledge into useful application. Problem based learning (PBL) is evolving as one of the paramount methods of improving students' knowledge construct and it has been supported by studies done in Lahore and China.^{1,2} Problem based learning is a student centred pedagogy in which students learn about a subject through the experience of solving an open ended problem.³ Studies to evaluate the effectiveness of Problem based learning (PBL) in India are few and far between. This study aims at studying the effectiveness of PBL in I MBBS Cardiovascular Physiology.

Material and Methods

All consenting I year MBBS students of Aarupadai Veedu Medical College, Puducherry were included in the study. Each student was assigned with a number and through random number table the students were selected till the desired number of thirty was reached. Though the selected students have been exposed to classical or traditional teaching methods in Cardiovascular Physiology they were further given one week of time to prepare. A module containing case based scenarios of Cardiovascular Physiology was carefully crafted by the senior faculties of the department. The typical module contained case scenarios and application based questions related to the scenarios. The key to those questions were also prepared in accordance with the latest literature and their veracity was established (Appendix1). The thirty students were called for the pre-test and given one hour to answer the pre-test questions. Maximum marks were set for 20. Then they were given one hour of classroom teaching on this problem based questionnaire (Figure 1). The session was made as interactive as possible and student participants were facilitated to ask and clear their doubts. To prevent the carry over effect the students were asked to come on the next day to perform the post test. Students' test was applied to assess the significance of difference between pre-test and post-test marks and SPSS version 20 is used for the analysis.

Results

The students scored an average of 2.93 marks [14.67%] during the pre-test session. Then they were exposed to one hour classroom teaching on problem based questionnaire. The next day they were administered with post-test questions and the mean score was 13.6 [68%]. Students "t" test was applied, which indicated a significant improvement in students problem solving ability and knowledge construct in cardiovascular physiology following problem based learning. [Table 1]

Discussion

The study showed a statistically significant improvement in students problem solving ability and knowledge construct in cardiovascular physiology which was similar to the study conducted in Islamabad⁴. Feedback from students were mostly positive and they expressed their interest to include such PBL exercises in their routine curriculum in addition to the traditional didactic lectures as they felt it improves not only their applied knowledge of physiology but also for better understanding of the subject content. However some studies show students in traditional programs scored higher than students in PBL curriculum,⁵ whereas a meta-analysis showed no significant difference between knowledge that PBL students and non-PBL acquire.⁶ Hence, further assessment may be needed to provide more insight into the effectiveness of PBL and its wider application.

Table 1

Test	Mean	Standard Deviation	Standard Error	Mean Difference	P Value	Confidence Interval
Pre Test	2.93	1.387	0.358	-10.667	<0.001	-13.219 to -8.115
Post Test	13.60	5.320	1.369			
Pre Test Percent	14.67	6.935	1.791	-53.333	<0.001	-66.094 to -40.573
Post Test Percent	68.0	26.511	6.845			

- Appendix 1:** Problem based learning in cardiovascular physiology
- I. Patient Mrs. A, 40 year old female presented with history of fall and loss conscious for 10 minutes. On examination pulse is 136 per minute and blood pressure 90/60 mm Hg. Patient complains of mild thirst and giddiness.
 - i. What do you think regarding the presentation? Where is the primary pathology and why?
 - ii. What are the common real life causes that can result in aforementioned scenario?
 - iii. What are the other relevant histories you will elicit for this case?
 - iv. Explain the symptomatology with the relevant physiology you learnt.
 - v. Outline the physiological basis of management of this case.
 - II. Patient Mrs. B, 50 year old brought to the emergency room, found unconscious at home.
 - i. How will you assess and manage the patient? Explain the physiological basis for the same.
 - ii. In cases of absent heart sounds what will be your immediate management.
 - iii. What are the major steps of cardiopulmonary resuscitation?
 - iv. In the same patient if the heart sounds are present, single out the most important parameter to be evaluated. Explain the physiological basis.
 - v. What are the other causes of loss of consciousness?
 - III. Patient Mr. C, 25 year old met with road traffic accident, sustained multiple injuries and fractures. On arrival to the primary health centre his pulse was feeble, pulse rate 120/mint and his systolic BP was 80mm Hg. The PHC does not have blood bank facility. The nearest facility is around 50 km.
 - i. What is your immediate action? Justify your action.
 - ii. Name few parenteral preparations and classify them.
 - iii. What is your choice of parenteral fluid and why?
 - iv. What are the precautions you will take regarding posture during the transport? Explain their physiological basis.
 - v. What are the other steps you will take in addition to the previous action?
 - IV. Patient Mr. D, 20 year old presented with breathlessness on lying down. He feels relieved on standing. On enquiry he revealed that he had repeated attacks of sore throat and skin infection in his childhood. On examination the first heart sound (S1) in the mitral area is loud and murmur is auscultated during diastole.
 - i. What do you think is the cause of breathlessness?
 - ii. How the breathlessness is relieved on assuming erect posture?
 - iii. What is the cause of poor valve function?
 - iv. How do you like to treat the patient at this point?

- v. Compare and contrast the pulmonary circulation from the systemic circulation and explain their significance in medical practice.

Case I

Question 1 Key:

A case of compensated shock.

Tachycardia (HR 60-100), Hypotension (SBP 100-139mm Hg, DBP 60-89mm Hg)

Thirst and giddiness (Global cerebral hypoperfusion)

Question

2 Key: Hypovolemia (Diarrhoea, vomiting, Bleeding)

Vasovagal shock (Distributive shock)

Cardiogenic shock (CCF)

Question 3

Key: H/o Loose stools and vomiting

H/o Trauma and Blood loss

H/o Drug intake, insect bite

H/o Chest pain, difficulty in breathing and poor exercise capacity.

Question 4

Key: Tachycardia (BR mechanism)

Hypotension (Fluid loss, poor cardiac output) $BP = CO \times TPR$, $CO = SV \times HR$,

SV is proportional to contractility and venous return (VR).

Thirst and giddiness (poor blood and oxygen supply to the brain)

Question 5

Key: Investigations: PCV, BP measurement, Hydration of oral mucosa, ECG.

Rehydration after excluding CCF.

Electrolyte correction if any

Blood transfusion – in case of acute blood loss.

In case of distributive shock, the vasoactive agents causing acute hypotension counteracted with drugs like steroids (restoration of anti-inflammatory, capillary permeability) Adrenaline for vasoconstriction.

Case -2

Question 1

Key: In an unconscious patient one must first assess the functioning of the cardiovascular system assessed by palpation of pulse both carotid and radial. Auscultation of heart sounds and measurement of blood pressure must be done. The second step is to assess the CNS which includes spontaneous breathing, pupillary reflexes. If there are no positive signs in CVS and CNS the other causes suspected includes hypoglycemia and dyselectrolytemia.

Question 2

Key: First step is to recheck. This includes checking the working of stethoscope and palpation of central arterial pulsation preferably carotid pulse. In the event of proved absent cardiac heart activity one must immediately undertake cardio pulmonary resuscitation.

Question 3

Key: Unresponsive, No breathing or No normal breathing (Shout for help)

Open airway - look for signs of life – check pulse within 10 seconds

Give 2-5 initial breaths, if no regular breathing -

Recheck pulse every 2 minutes.

Give 30 chest compressions followed by 2 breaths.

Assess rhythm:

1. Shockable rhythm (VF, VT) → Give 1 shock, resume CPR immediately for 2 Minutes.
2. Non shockable rhythm (Asystole) → Resume CPR immediately for 2 minutes (30 compressions and 2 breaths x 5 cycles).

Check for every 2 minutes until ALS team take over the patient.

Question 4

Key: Spontaneous breathing. Its rate, rhythm, depth and type are to be assessed. The oxygen demand of the heart and brain are very high. During the initial few minutes the oxygen reserve from blood and alveoli barely sustain the minimal oxygen demand. This is followed by intense hypoxia and irreversible tissue damage in these organs. Therefore, in the presence of shock heart sound, the next preferable parameter of choice to be evaluated is breathing.

Question 5

Key:

- a. Hypoglycemia – Glucose estimation- Treatment - 25% Dextrose.
- b. Electrolyte imbalance – Electrolyte estimation (Na, Cl, K, HCO₃). Treatment Deficit corrected with IV fluids, K solution and sodabcarb solution.
- c. Cerebral concussion – If vitals are normal, wait and watch for automatic recovery.

Diagnosis is established by post-concussion syndrome

Case -3

Question 1

Key: Immediate steps to gain an IV access. Then the most important thing is to replenish the vascular volume. This is because the force of contraction is dependent on the preload. A poor preload will result in poor contraction and decreased stroke volume. This results in decreased cardiac output and BP. The parenteral fluids available are crystalloids and colloids.

Question 2

Key: The parenteral fluids can be divided into crystalloids and colloids. The crystalloids include 0.9% NaCl solution, RL, 5% dextrose, 5% DNS. The colloids include 40%, 70% Dextran, Gelatin, Starches.

Question 3

Key: Colloids will be the first choice. This is because, unlike the crystalloids, the colloids will remain only in the vascular compartment. This will help in improving the cardiac contractility and BP. In the absence of colloids, crystalloids can be tried.

Question 4

Key: The person should be put in supine posture; this will eliminate the effect of gravity and improve the venous return, which in turn normalizes the preload and cardiac contractility, which finally improves the Blood pressure.

Question 5

Key: Oxygen therapy. We have included only the volume expanders which will help to improve the perfusion pressure. However, we are not replacing all the components of blood, including the oxygen transporter Hb. As a result, oxygen carrying capacity of the patient blood in the present condition is poor and must be improved by oxygen supplement. This increases the dissolved oxygen content and helps in improving oxygen availability to the tissues.

Case -4

Question 1

Key: Long standing mitral stenosis increasing the resistance to venous return for the left ventricle. This results in increased capillary hydrostatic pressure in the pulmonary circulation which forces more fluid in to the pulmonary interstitium that results in difficult gas exchange and increased work of breathing.

Question 2

Key: Decreased Venous return decreases right heart output, relieving congestion in pulmonary circulation and reducing the pulmonary edema. This results in easy gas exchange and decreased work of breathing. This relieves the breathlessness (difficulty in breathing).

Question 3

Key: The person here is suffering mitral stenosis (MS). This is because of an immunological assault by our immune system on the valve proteins. This is because of the structural similarity between streptococcal M protein and the cardiac valve protein (Molecular mimicry).

Question 4

Key: Surgical replacement of the affected valve.
Cardiac ionotropes (To increase the cardiac contractility)

Diuretics (To reduce fluid over load)

Propped up position (To reduce pulmonary edema)

Diet – Salt restriction (To reduce fluid retention)

classroom in addition to the participants for overall benefit of students.

Conclusion

Problem Based Learning was found to be an effective instructional tool in development of critical thinking and problem solving skills among medical students. It can be widely instigated after further assessments.

Acknowledgement

We would like to acknowledge the help and support of Dr.D.Amudharaj, Assistant Professor, Department of Physiology, Aarupadai Veedu Medical College & Hospital, Puducherry, all the participants for their enthusiastic participation and the Department of Physiology.

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Fig.1: Principal Investigator Dr.N.Gowdhaman giving the problem based learning for the entire