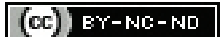


Case-based Learning as a Means of Reforming Pathology Teaching in Second Year Undergraduate Medical Students: An Interventional Study at a Medical College in Maharashtra, India

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ABSTRACT

Introduction: Case-based Learning (CBL) is a relatively recent Teaching and Learning (TL) method in medical subjects, including pathology, in India. It is learner-oriented, similar to problem-based learning and may enhance medical students' analytical and problem-solving skills.

Aim: To determine the effectiveness of CBL in increasing students' interest in learning pathology and improving their analytical skills and to assess students' perception of this method through feedback.

Materials and Methods: This comparative interventional study was carried out at Dr. Ulhas Patil Medical College and Hospital, Maharashtra, India over two weeks in August 2020, involving 90 second year undergraduate medical students (II MBBS) studying pathology. The topics were 'Megaloblastic anaemia' and 'Chronic Myeloid Leukaemia (CML)'. Students were divided into two groups (A and B, n=45 each). One group was taught

using Didactic Lectures (DL); the other used CBL in small groups. A common Multiple-Choice Question (MCQ) post-test assessed analytical skills after each class. Student feedback on CBL was collected using a five-point Likert scale. Groups were interchanged for the CML session. Mean post-test scores and feedback scores were calculated. Statistical comparison was performed using Student's t-test (Statistical Package for the Social Sciences (SPSS) version 16.0), with p-value <0.05 considered statistically significant.

Results: CBL post-test scores were significantly higher than DL scores (p-value=0.03 and p-value=0.0138). The mean feedback score was excellent (4.4), with most students favouring CBL and reporting superior understanding.

Conclusion: CBL promoted active learning, enhancing analytical skills and proving highly acceptable to II MBBS students as a TL method in pathology.

Keywords: Didactic lecture, Medical education, Problem-based learning

INTRODUCTION

In the current medical education landscape, identifying effective TL methods to achieve learning outcomes is crucial [1]. Improving reasoning, critical thinking and problem-solving skills in undergraduates is essential for successful practice [2]. In Indian medical colleges, teaching is predominantly conventional lecture-based, particularly in first and second MBBS subjects [3]. DLs are teacher-centred and lack student involvement [1]. CBL is a learner-oriented TL method used across various disciplines. While established in business and law schools, its use in medical schools is relatively recent, with limited literature. CBL has been found effective in engaging students in various MBBS topics. There is limited data at present showing that it can be an effective teaching learning tool in different medical subjects like Pathology, Pharmacology, Microbiology and Biochemistry [4-6]. It stimulates intrinsic motivation, promotes deep learning and integrates knowledge and practice [7-13]. It also improves communication skills and decision-making, encouraging self-directed learning [1,2,14-16].

In pathology, CBL can transform teaching from classroom DLs to student problem-solving through real-life case scenarios [1,2]. It shifts pathology teaching from theory to practice, encouraging knowledge application and retention [17]. It improves higher-order cognition and is a more effective and acceptable student-oriented method than DL [18,19]. CBL has also been used as part of the clinical training in undergraduate medical students of the fourth and

fifth years to enable them applying pathology services in clinical practice [20]. Moreover, in oncopathology also it was found to be successful in pilot testing of standard cancer cases for determining the validity of the questions and cases acceptability [21]. The new Competency-based Medical Education (CBME) pattern in India recommends newer techniques, including CBL [22]. This study addresses the paucity of literature on CBL in pathology in Maharashtra, aiming to determine its effectiveness in increasing student interest and improving analytical skills and assessing student perception.

MATERIALS AND METHODS

This comparative interventional study was carried out at Dr. Ulhas Patil Medical College and Hospital, Maharashtra, India over the period of two weeks in August 2020 after obtaining approval from the Institutional Ethics Committee (IEC)(DUPMCH/IEC/2020/01, 07/01/2020).

Inclusion criteria: II MBBS undergraduate medical students studying pathology at this college who gave informed written consent were included in the study.

Exclusion criteria: The non consenting students and the consenting ones who could not attend both the parts of study, were excluded due to their partial participation.

A total of 92 undergraduate medical students of II MBBS studying pathology at this college had given informed written consent'

however, only 90 students attended both sessions of this study. The two students were excluded due to their partial participation.

Three faculties willing to participate in this study were included to conduct the didactic lectures and carry out the sessions of CBL. All of them were trained in Revised Basic Course Workshop in Medical Education Technologies, Curriculum Implementation Support Program (CISP) and Basic Course in Biomedical Research (BCBR).

The topics were 'Megaloblastic anaemia' and 'CML'. Students were divided into two groups- first half roll numbers were assigned Group A (n=45) and the later half was assigned Group B (n=45). One group (Group A) was taught by means of DL and other (Group B) was taught by CBL method after subdividing into three small groups of 15 students each with the topic megaloblastic anaemia in the first session. Both DL and CBL were followed by a MCQs test for assessing recall and analytical skill. This was followed by collection of student's feedback in form of questionnaire assessing the acceptability of CBL, student's perception of self-directed learning etc., with the score being given according to the 5-point Likert scale ranging from strongly agree (score 5) to strongly disagree (score 1) [23].

DLs followed the curriculum, using PowerPoint and a whiteboard. CBL case scenarios were provided two days prior, with specified references. Each small group was assigned a faculty. At the beginning of the session the faculty briefed the learning objectives to the students. These learning objectives were the same as that of DL. The students' discussion followed. The faculties facilitated the discussion with the help of focused questions: helping students to develop approach towards reaching the probable diagnosis from clinical history provided, identify the aetiology, describing the pathogenesis, identifying the clinical features, planning the investigations needed for arriving at the diagnosis and confirming it and the expected results in these cases. Also, faculty kept the students motivated for proceeding the session and maintained the time limit.

For second session with the topic of CML, groups of students attending DL and CBL in megaloblastic anaemia were interchanged and taught the topic, with MCQ test and students feedback collection being followed. The students who could not attend both sessions were excluded from study. The teacher for DL and facilitators in CBL groups were the same to prevent observer bias. Furthermore the assessment of the effectiveness of the teaching learning tool was in the form of MCQs, again observer bias was avoided though having same faculty/facilitators in two study groups.

To avoid the carryover effect in crossover design of this study washout period of one week was there between the two sessions.

STATISTICAL ANALYSIS

MCQ scores were analysed using SPSS version 16.0. Mean scores and standard deviations were calculated. Student's t-test was used for comparison, with $p < 0.05$ indicating significance. For the Likert scale, questions 11, 12, and 13 (negatively framed) were reverse-scored before calculating the mean.

RESULTS

Ninety students completed both sessions. CBL students scored significantly higher on the MCQ post-tests than DL students [Table/Fig-1,2]. The percentage of students scoring < 5 marks was more in DL (approximately one forth) than CBL (fewer than 10%) [Table/Fig-1]. Approximately 5% and 10% students scored 9-10 marks in first and second sessions in CBL, in contrast to none in DL. The overall mean feedback score was 4.4 ranging from 4.2-4.8, with maximum students agreeing to the positive way of presentation, conduction of the activity and the maintenance of students' attention and involvement throughout the activity, [Table/Fig-3], with most students strongly favouring CBL.

Topic	Teaching method (N=45)	Number of students with marks obtained out of 10% (No. of students)			
		<5	5-6	7-8	9-10
Megaloblastic anaemia	DL	28.89% (13)	44.44% (20)	26.67% (12)	0
	CBL	8.89% (4)	48.89% (22)	37.78% (17)	4.44% (2)
Chronic Myeloid Leukaemia (CML)	DL	24.44% (11)	42.22% (19)	33.33% (15)	0
	CBL	8.89% (4)	42.22% (19)	40.00% (18)	8.89% (4)

[Table/Fig-1]: Scores of students in both topics with separate Teaching Learning (TL) method- DL and CBL.

Test topic	Teaching method	Mean score \pm SD	p-value
Megaloblastic anaemia	DL	5.6 \pm 1.415	0.03*
	CBL	6.2 \pm 1.464	
Chronic Myeloid leukaemia (CML)	DL	5.7 \pm 1.42	0.0138*
	CBL	6.4 \pm 1.56	

[Table/Fig-2]: Mean scores of megaloblastic anaemia and Chronic Myeloid Leukaemia (CML) in DL and CBL.
p-value < 0.05 significant; Students t-test used

S. No.	Question		Strongly agree (5)	Agree (4)	Not sure (Neither agree, nor disagree) (3)	Disagree (2)	Strongly Disagree (1)	Total no. of students	Mean score
1	The way of presentation was good.		75 (83.3%)	13 (14.5%)	2 (2.2%)	0	0	90	4.8
2	I completely understood the topic discussed.		55 (61.1%)	19 (21.1%)	6 (6.7%)	6 (6.6%)	4 (4.4%)	90	4.2
3	Session conducting methodology was up to my expectations.		56 (62.2%)	24 (26.7%)	6 (6.7%)	2 (2.2%)	2 (2.2%)	90	4.4
4	Content of the session was adequate to enhance learning.		49 (54.4%)	30 (33.3%)	8 (8.9%)	2 (2.2%)	1 (1.1%)	90	4.3
5	My enthusiasm for this course has grown because of this activity.		61 (67.8%)	19 (21.1%)	4 (4.4%)	4 (4.4%)	2 (2.2%)	90	4.4
6	Way of presentation kept my attention and involvement throughout the session.		71 (78.9%)	11 (12.2%)	5 (5.6%)	2 (2.2%)	1 (1.1%)	90	4.6
7	Enhanced my analytical and problem solving skills.		57 (63.3%)	26 (28.9%)	5 (5.6%)	2 (2.2%)	0	90	4.5
8	I conducted self-directed learning.		54 (60%)	27 (30%)	6 (6.7%)	2 (2.2%)	1 (1.1%)	90	4.2
9	Enhanced my ability to retrieve and utilise information.		50 (55.6%)	33 (36.7%)	4 (4.4%)	2 (2.2%)	1 (1.1%)	90	4.4
10	More enjoyable than conventional teaching.		51 (56.7%)	19 (21.1%)	15 (16.7%)	4 (4.4%)	1 (1.1%)	90	4.2
11	Knowledge learned through student activity was fragmentary and lack of systematicity was there.	Score	2 (2.2%)	6 (6.7%)	4 (4.4%)	61 (67.7%)	17 (18.9%)	90	2.1
		Mean with reverse scoring for calculation							3.9
12	Student activity increased my academic burden to some extent.	Score	2 (2.2%)	3 (3.3%)	5 (5.6%)	58 (64.4%)	22 (24.4%)	90	1.9
		Mean with reverse scoring for calculation							4.1

13	I discourage this Teaching Learning (TL) method.	Score	0	2 (2.2%)	3 (3.3%)	16 (17.8%)	69 (76.7%)	90	1.3
		Mean with reverse scoring for calculation							4.7
Overall mean score of feedbacks (Mean (average) of mean scores of individual questions)*									4.4

[Table/Fig-3]: Students feedback scores (in Likert scale).

Overall mean score of feedbacks (Mean (average) of mean scores of individual questions)*; (Questions 11, 12 and 13 were negatively framed, thus the responses were scored reversely for final calculation of mean of the mean scores of feedback.); *Overall mean score of feedbacks=An average of the mean scores of each question of feedbacks

DISCUSSION

This study demonstrates CBL's superiority over DL in enhancing student interest, analytical skills, and overall satisfaction. Topics 'Megaloblastic Anaemia' and 'Chronic Myeloid Leukemia' were chosen for present study due to their importance in clinical practice as well as pathology curriculum. The significantly higher MCQ scores in CBL align with previous research [4-6,24-27]. The improved performance reflects increased enthusiasm and active participation. CBL's integration of clinical details and pathophysiology leads to better understanding [28]. Analytical skills when roused using problems or cases boost higher levels of cognition and in-depth understanding along with better retention of knowledge. CBL can be considered as blend of course-centered problem solving and correlated examples, which are types of clinical correlation [28]. Thus, it gives more efficient correlation of clinical details to pathophysiology as indicated by better post-test scores also. Clinical reasoning ability and course grades improvements have been found to be result of implementing clinical correlation activities in other works as well [29-32]. This contrasts with DL's limited scope for interaction.

The scoring has also been found to be significantly higher in other forms of assessments as post-quizzes, modified essay question [27,33] etc., indicating enhanced application of knowledge facilitated by CBL process. It also has being found to be effective in eliciting and maintaining the attention and interest in teaching various medical subjects. Internet and others for microscopic images or photomicrographs and clinical images that have been used in CBL's aid may also have a role in this [34].

Positive feedback indicates high acceptability of CBL [17,20,35]. Students appreciated the presentation, understanding, methodology, and content which are consistent with similar studies [17,20,35]. They reported increased enthusiasm, attention, confidence, and self-directed learning. This was also evident from the observations of students' discussion in the CBL session and better performance in MCQs. Majority students agreed that CBL was more enjoyable than conventional teaching method. Overall the session was nice to learn about Megaloblastic anemia and CML, and majority hoped that all topics could be conducted with case based approach.

Some students felt the knowledge was fragmentary and that CBL increased their academic burden to some extent, thus they discouraged this activity. This might be indicating the need of students to be more prepared for CBL with some foundational knowledge being imparted by other mean. When 'how CBL was introduced' was studied in a work, the achievement scores and autonomous motivation were both the highest in the group in which CBL (also a part of SDL) was introduced after lecture based learning [36,37]. Adequate preparation for both faculty and students is crucial for successful CBL. A research found the negative impact of lack of adequate preparation on a CBL experience for both faculty and students, especially due to lack of time and funds for faculty training [38]. CBL may be most effective when used after DL, perhaps as a practical teaching tool, aligning with the CBME pattern.

Limitation(s)

The sample size of the study was small which limits generalisability, hence larger studies of longer duration with bigger sample size are needed to establish CBL as routine teaching tool in medical education.

CONCLUSION(S)

CBL has higher effectiveness in enhancing enthusiasm, involvement and active participation of students in the discussion of topics than conventional DL. CBL also helps to improve students' focus and their critical thinking reflecting in the higher post-test scores. Though it is a resource intensive activity requiring adequate prior preparation and ample of time, an attempt still should be made to include CBL in majority of topics in Pathology and to overcome the challenge to fit it in academic curriculum. More efforts should be made to refine CBL so that it should become a part of everyday teaching.

REFERENCES

- [1] Bhardwaj P, Bhardwaj N, Mahdi F, Srivastava JP, Gupta U. Integrated teaching program using case based learning. *Int J Appl Basic Med Res.* 2015;5:S24-S28.
- [2] Ginzburg SB, Deutsch S, Bellissimo J, Elkowitz DE, Stern JN, Lucito R, et al. Integration of leadership training into a problem/case based learning program for first and second year medical students. *Adv Med Educ Pract.* 2018;9:221-26.
- [3] Nimesh A, Mehndiratta M, Kar R, Garg S, Puri D. Teaching aids in medical education: An integrated approach over conventional methods. *Indian J Med Biochem.* 2021;25(3):113-17.
- [4] Vora MB, Shah CJ. Case-based learning in pharmacology: Moving from teaching to learning. *Int J Appl Basic Med Res.* 2015;5(Suppl 1):S21-S23.
- [5] Joshi KB, Nilawar AN, Thorat AP. Effect of case based learning in understanding clinical biochemistry. *Int J Biomed Adv Res.* 2014;05(10):516-18.
- [6] Tathe SS, Singh AL. Case based lecture versus conventional lectures for teaching medical microbiology to undergraduate students. *Int J Cur Res Rev.* 2014;6(4):35-41.
- [7] Ghosh S, Pandya HV. Implementation of integrated learning program in neurosciences during first year of traditional medical course: Perception of students and faculty. *BMC Med Educ.* 2008;8:44.
- [8] Srinivas V, Kotwal A, Tekian A. Effect of case based learning on undergraduate medical students in pathology [Internet]. [cited 2016 May 30]. Available from: <http://www.fairmer.org/education/fellows/abstracts/10Srinivas.pdf>.
- [9] Srinivasan M, Wilkes M, Stevenson F, Nguyen T, Slavin S. Comparing problem-based learning with case-based learning: Effects of a major curricular shift at two institutions. *Acad Med.* 2007;82:74-82.
- [10] Ciraj AM, Vinod P, Ramnarayan K. Enhancing active learning in microbiology through case based learning: Experiences from an Indian medical school. *Indian J Pathol Microbiol.* 2010;53:729-33.
- [11] Jamkar AV, Burdick W, Morahan P, Yemul VY, Sarmukadam AV, Singh G. Proposed model of case based learning for training undergraduate medical student in surgery. *Indian J Surg.* 2007;69:176-83.
- [12] Nair SP, Shah T, Seth S, Pandit N, Shah GV. Case based learning: A method for better understanding of biochemistry in medical students. *J Clin Diagn Res.* 2013;7:1576-78.
- [13] Gupta K, Arora S, Kaushal S. Modified case based learning: Our experience with a new module for pharmacology undergraduate teaching. *Int J Appl Basic Med Res.* 2014;4:90-94.
- [14] Kapoor N. Teaching pathology of breast cancer to medical undergraduates by case based learning method. *Indian J Cancer.* 2015;52:215-56.
- [15] Qamar K, Rehman S, Khan MA. Effectiveness of case based learning during small groups sessions at army medical college. *J Coll Physicians Surg Pak.* 2016;26:232-33.
- [16] Singhal A. Case based learning in microbiology: Observations from a North West Indian medical college. *Int J Appl Basic Med Res.* 2017;7:S47-S51.
- [17] Datta A, Ray J. Case based learning in undergraduate pathology- a study to assess its efficacy and acceptability as teaching-learning tool. *IAIM.* 2016;3(6):93-100.
- [18] Dubey S, Dubey AK. Promotion of higher order of cognition in undergraduate medical students using case-based approach. *J Educ Health Promot.* 2017;6:75. Doi: 10.4103/jehp.jehp_39_17.
- [19] Grover S, Sood N, Chaudhary A. Reforming pathology teaching in medical college by peer-assisted learning and student-oriented interest building activities: A pilot study. *Educ Health.* 2017;30:126-32.
- [20] Bezuidenhout J, Wasserman E, Mansvelt E, Meyer C, van Zyl G, Orth H, et al. Clinical rotation in pathology: Description of a case based approach. *J Clin Pathol.* 2006;59(4):355-59. Doi: 10.1136/jcp.2005.029454.
- [21] Sayed S, Lester SC, Wilson M, Berney D, Masia R, Moloo Z, et al. Creation and pilot testing of cases for case-based learning: A pedagogical approach for pathology cancer diagnosis. *Afr J Lab Med.* 2017;6(1):01-07. Doi: 10.4102/ajlm.v6i1.637.
- [22] Shah N, Desai C, Jorwekar G, Badyal D, Singh T. Competency-based medical education: An overview and application in pharmacology. *Indian J Pharmacol.* 2016;48(Suppl 1):S5-S9. Doi: 10.4103/0253-7613.193312.

- [23] Joshi A, Kale S, Chandel S, Pal D. Likert Scale: Explored and explained. *Br J App Sci Technol*. 2015;7:396-403. Doi: 10.9734/BJAST/2015/14975.
- [24] Fatima N, Shameem M, Nabeela, Khan HM. Evaluation of case-based lectures for teaching medical microbiology. *IRJET*. 2015;2(2):272-75.
- [25] Kireeti AS, Reddy DS. Case Based Learning (CBL), a better option to traditional teaching for undergraduate students in curriculum of Paediatrics. *Asian J Biomed Pharm Sc*. 2015;5(45):39-41.
- [26] Shrestha B, Subedi S, Koirala U, Paudel I, Paudel S. Evaluation of efficacy of online case based learning as a teaching learning tool in undergraduate oral pathology course. *Birat J Health Sci*. 2021;6(1):1341-45. Doi: 10.3126/bjhs.v6i1.37627.
- [27] Cai L, Li YL, Hu XY, Li R. Implementation of flipped classroom combined with case-based learning. *Medicine*. 2022;101(5):e28782. Doi: 10.1097/MD.00000000000028782.
- [28] Klement BJ, Paulsen DF, Wineski LE. Clinical correlations as a tool in basic science medical education. *J Med Educ Curric Dev*. 2016;3:179-85. Doi: 10.4137/JMECD.S18919.
- [29] Surapaneni KM, Tekian A. Concept mapping enhances learning of biochemistry. *Med Educ Online*. 2013;18:01-04.
- [30] Sheakley ML, Gilbert GE, Leighton K, Hall M, Callender D, Pederson D. A brief simulation intervention increasing basic science and clinical knowledge. *Med Educ Online*. 2016;21:30744.
- [31] Diaz-Perez JA, Raju S, Echeverri JH. Evaluation of a teaching strategy based on integration of clinical subjects, virtual autopsy, pathology museum, and digital microscopy for medical students. *J Pathol Inform*. 2014;5:25.
- [32] Jacobson K, Fisher DL, Hoffman K, Tsoulas KD. Integrated cases section: A course designed to promote clinical reasoning in year 2 medical students. *Teach Learn Med*. 2010;22:312-16.
- [33] Shrestha A, Marla V, Rimal J, Shrestha S, Keshwar S, Zhimin J. Case based learning as a dynamic approach towards learning oral pathology. *bioRxiv*. 2021;10:1101/2021.04.02.438062. Doi: 10.1101/2021.04.02.4380627.
- [34] Telang A, Jong N, Dalen JV. Media matter: The effect of medium of presentation on student's recognition of histopathology. *J Clin Diagn Res*. 2016;10(12):JC01-JC05. Doi: 10.7860/JCDR/2016/22208.8969.
- [35] Nishal A, Patel J, Balvalli R, Yadav PP, Jayani P, Singh R, et al. A comparative study of case-based learning vs. traditional teaching method in pathology in Indian medical graduates. *J Med Edu*. 2022;21(1):e127188. Available from: <https://doi.org/10.5812/jme-127188>.
- [36] McLean SF. Case-based learning and its application in medical and health-care fields: A review of worldwide literature. *J Med Educ Curric Dev*. 2016;3:39-49. Doi: 10.4137/JMECD.S20377.
- [37] Raychaudhuri S, Kahlon N, Sidam D, Singh M, Pujani M, Singh K, et al. Introducing case study-based panel discussion as an effective means of self-directed learning in phase 2 MBBS students: A cross-sectional study. *J Clin Diagn Res*. 2023;17(7):EC05-EC08. Doi: 10.7860/JCDR/2023/64380.18150.
- [38] Nordquist J, Sundberg K, Johansson L, Sandelin K, Nordenstrom J. Case-based learning in surgery: Lessons learned. *World J Surg*. 2012;36:945-55.

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