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Original Research Article

Case-Based Learning Versus Traditional Lectures in Undergraduate Pharmacology: An Interventional Study among Second-Year MBBS Students

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Abstract:

Background: Pharmacology is a core subject in the undergraduate medical curriculum, providing the scientific basis for rational therapeutics. However, it is frequently perceived by students as complex and difficult to translate into clinical practice when taught predominantly through traditional didactic lectures. Contemporary medical education emphasizes student-centred, active learning strategies that promote clinical reasoning and long-term retention. Case-based learning (CBL) is one such approach that integrates theoretical knowledge with real-life clinical scenarios, encouraging active participation, problem solving, and meaningful learning.

Objectives: The present study aimed to compare the effectiveness of traditional lecture-based teaching and case-based learning sessions in pharmacology among second-year MBBS students.

Methods: This prospective interventional study was conducted among second-year MBBS students at a tertiary care teaching institution. Participants were divided into two groups: one group received conventional didactic lectures, while the other participated in CBL sessions facilitated by faculty using prevalidated clinical case scenarios. Baseline demographic characteristics, including age and gender distribution, were recorded. Knowledge acquisition was assessed using pre-test and post-test questionnaires with a maximum score of 15. Data were analyzed using descriptive statistics, and results were expressed as mean ± standard deviation and percentages.

Results: Baseline characteristics and pre-test scores were comparable between the traditional lecture and CBL groups, indicating similar baseline knowledge levels. The mean pre-test scores were 7.0 ± 2.2 in the lecture group and 7.1 ± 2.1 in the CBL group. Following the intervention, post-test scores improved in both groups; however, the improvement was substantially greater in the CBL group. The mean post-test score in the CBL group was 9.2 ± 3.8 compared with 7.2 ± 2.3 in the traditional lecture group, demonstrating superior learning outcomes with CBL. Student feedback revealed a high level of acceptance of CBL. More than four-fifths of participants expressed that CBL should be continued for other pharmacology topics.

Conclusion: CBL was more effective than traditional lectures in improving knowledge acquisition and was highly acceptable to undergraduate medical students. Incorporating CBL routinely into pharmacology teaching may better equip medical students with essential clinical reasoning skills and promote long-term learning.

Keywords: Active learning, Case-based learning, Clinical reasoning, Pharmacology education, Undergraduate medical students.

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Introduction

Traditional didactic lectures in pharmacology often promote passive learning and make it difficult for students to apply theoretical knowledge in clinical practice. [1] Active learning strategies such as CBL are designed to address this gap by engaging students in discussion of realistic clinical problems, encouraging critical thinking and self-directed learning. [2] CBL uses written case scenarios containing patient history, examination findings and investigations to stimulate analysis, discussion and decision-making in small groups. Studies in pharmacology and physiology have shown that CBL improves test performance, student motivation, and perceived relevance to future

prescribing. [3,4] In traditional pharmacology teaching, large-group didactic lectures often emphasise factual recall over application, leading to poor integration of basic concepts with clinical decision-making and rational prescribing. [5] Several reports from Indian medical colleges highlight that students perceive pharmacology as dry and difficult to relate to real patients, reinforcing the need for active, student-centred methods. [6]

Case-based learning (CBL) uses authentic or simulated clinical scenarios as the trigger for learning, encouraging students to identify learning issues, search for relevant information, and apply pharmacological principles to diagnosis and therapy. This approach promotes deeper learning, supports self-directed study, and helps bridge the gap between basic sciences and clinical disciplines. [7,8]

Meta-analyses in medical and pharmacy education have shown that CBL improves academic performance, case analysis skills, and learner satisfaction compared with traditional teaching methods.9 Similar benefits have been reported across disciplines such as physiology, community medicine, and nursing, suggesting that CBL is a broadly effective strategy for health-professional education. [10]

In India, curriculum reforms and competency-based medical education frameworks explicitly recommend the use of case-based, small-group, and integrated teaching methods in basic subjects including pharmacology. However, there is still limited evidence from individual institutions on the practical implementation of CBL in routine pharmacology teaching, especially in large batches of undergraduate students. [11] The present study was therefore planned to introduce structured CBL sessions, compare them with traditional lectures, and document student perceptions in a typical second-year MBBS cohort.

Aims and Objectives

- To introduce case-based learning as a teaching–learning method in pharmacology for second-year MBBS students.
- To compare the effectiveness of CBL with traditional lectures using post-test scores.
- To assess students' perceptions regarding CBL using a structured feedback questionnaire.

Materials and Methods

Study design and setting: This was a prospective, interventional, quasi-experimental study conducted in the Department of Pharmacology of a tertiary care teaching hospital over a period of three months (August–October 2025).

Participants: The study population comprised second-year MBBS students enrolled in the pharmacology course during the academic year 2025–2026. All students who were present on the day of the sessions and who provided written informed consent were eligible for inclusion. Students who did not give consent, were absent for any part of the intervention, or failed to complete either the pre-test, post-test, or feedback questionnaire were excluded from the final analysis.

A total of 120 students were invited to participate. Of these, 112 students consented and completed all components of the study, and their data were included in the analysis (response rate 93.3%). The mean age of participants was approximately 20 years, with both male and female students represented. No other specific demographic restrictions were applied, as all eligible batch students were considered to improve generalizability.

Group Allocation: Participants were divided into two comparable groups (Group A and Group B) using simple random allocation based on a computer-generated list of roll numbers. Each group contained approximately equal numbers of students (56 per group). To minimise contamination and maintain feasibility in a routine teaching schedule, a crossover design was adopted:

- Group A received CBL for Topic 1 and traditional lecture for Topic 2.
- Group B received Traditional lecture for Topic 1 and CBL for Topic 2.

Topics and learning materials: Two clinically relevant pharmacology topics (for example, "Drug therapy of hypertension" and "Pharmacotherapy of bronchial asthma") were selected from the regular undergraduate curriculum. For each topic, the following were prepared and validated by two senior pharmacology faculty members:

- Structured clinical case scenarios (for CBL sessions).
- A set of multiple-choice questions (MCQs) or short-answer questions for pre-test and post-test (same blueprint, parallel forms).
- A structured student feedback questionnaire based on a 5-point Likert scale.

Content validity of the test and feedback tools was ensured through expert review, and necessary modifications were made before use.

Conduct of teaching sessions: Each topic was covered in two separate sessions of 1 hour each (one CBL session and one traditional lecture session), scheduled within the normal timetable. For CBL, students in the respective group were further divided into small groups of 8–10, each facilitated by a faculty member:

1. A brief orientation on the CBL process was given.
2. The clinical case scenario was distributed, and students were asked to read and discuss the case, identify learning issues, and relate pharmacological principles to diagnosis and treatment.
3. The facilitator guided discussion, clarified doubts, and ensured participation by all students without directly providing answers.
4. Each group presented their key points, followed by a short summarising discussion by the facilitator.

For the traditional lecture sessions, the same topic content was delivered to the other group using a conventional classroom lecture (chalk-and-talk and/or PowerPoint) with limited interaction.

Outcome measures: Cognitive gain was assessed using topic-specific MCQ tests administered immediately before (pre-test) and after (post-test) each session.

Each test consisted of 15 questions carrying one mark each, with a maximum score of 15. Student perception of CBL was evaluated at the end of all sessions using the structured feedback questionnaire, which included items on understanding, clinical application, interest, interaction, and preference for future use of CBL.

Ethical considerations: The study protocol was reviewed and approved by the Institutional Ethics Committee prior to initiation. Participation was voluntary, written informed consent was obtained from all students, and confidentiality of individual responses was maintained. The intervention was integrated within routine teaching, and no academic disadvantage accrued to any student as both groups ultimately received coverage of all topics.

Results

Baseline demographic characteristics and pre-intervention knowledge scores were comparable between the traditional lecture and CBL groups (Table 1). The mean age of students in the traditional lecture group was 20.3 ± 1.1 years, while that in the CBL group was 20.1 ± 1.0 years. Gender distribution was similar in both groups (traditional lecture: 25 males and 35 females; CBL: 24 males and 36 females). Pre-test scores did not differ appreciably between groups, with mean scores of 7.0 ± 2.2 in the traditional lecture group and 7.1 ± 2.1 in the CBL group, indicating comparable baseline knowledge.

Table 1: Baseline characteristics and test scores

Variable	Traditional lecture (n=56)	CBL (n=56)
Mean age (years), mean ± SD	20.3 ± 1.1	20.1 ± 1.0
Male : Female	25 : 35	24 : 36
Pre-test score (out of 15), mean ± SD	7.0 ± 2.2	7.1 ± 2.1
Post-test score (out of 15), mean ± SD	7.2 ± 2.3	9.2 ± 3.8

Following the educational intervention, both groups showed improvement in post-test scores; however, the increase was more pronounced in the CBL group. The mean post-test score in the traditional lecture group was 7.2 ± 2.3, whereas students exposed to CBL achieved a higher mean score of 9.2 ± 3.8 (Table 1). This difference demonstrates superior learning outcomes with the CBL approach. The bar diagram (Figure 1) illustrates the higher mean post-test scores in the CBL group compared with the traditional lecture group, visually reinforcing the quantitative findings.

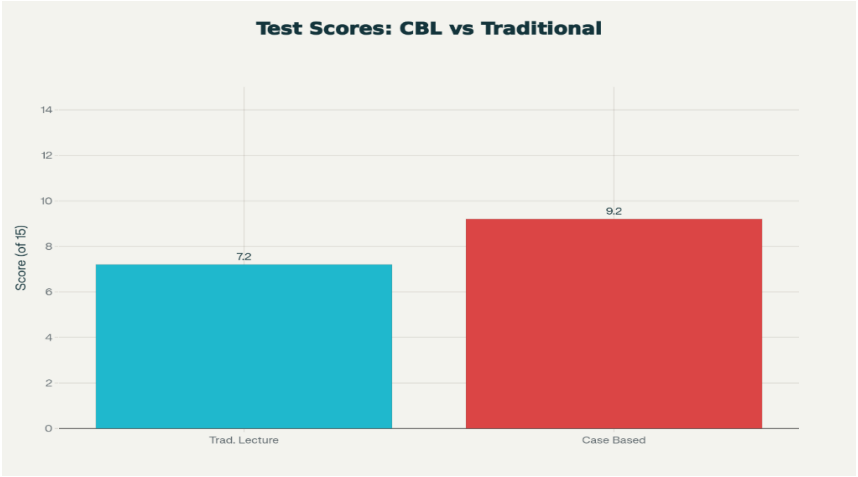

Fig 1: Bar diagram showing mean post-test scores in traditional lecture and CBL groups

Student perceptions of CBL were assessed using a structured Likert-scale feedback questionnaire, and the responses are summarized in Table 2.

A substantial proportion of students either strongly agreed or agreed that CBL improved their understanding of the topic (86%) and enhanced their clinical problem-solving ability (84%). Improved interaction with peers and faculty was reported by 78% of participants, reflecting the interactive nature of CBL sessions.

Importantly, the majority of students (89%) expressed that CBL should be continued for other pharmacology topics, indicating high acceptability and perceived educational value.

Table 2: Student feedback on CBL (Likert scale)

Feedback statement	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)
Improved understanding of the topic	60 (45%)	54 (41%)	14 (10%)	6 (4%)
Helped in clinical problem-solving	58 (43%)	55 (41%)	16 (12%)	5 (4%)
Improved interaction with peers and faculty	50 (38%)	52 (40%)	20 (15%)	7 (7%)
Should be continued for other pharmacology topics	70 (53%)	48 (36%)	10 (8%)	4 (3%)

Overall perception of CBL was highly favorable. As depicted in the pie chart (Fig 2), most students rated CBL as "highly useful" or "useful," with only a small minority expressing neutral or negative opinions. A large proportion of participants reported that CBL sessions were interesting, stimulated critical thinking, and facilitated better integration of pharmacological concepts with clinical practice.

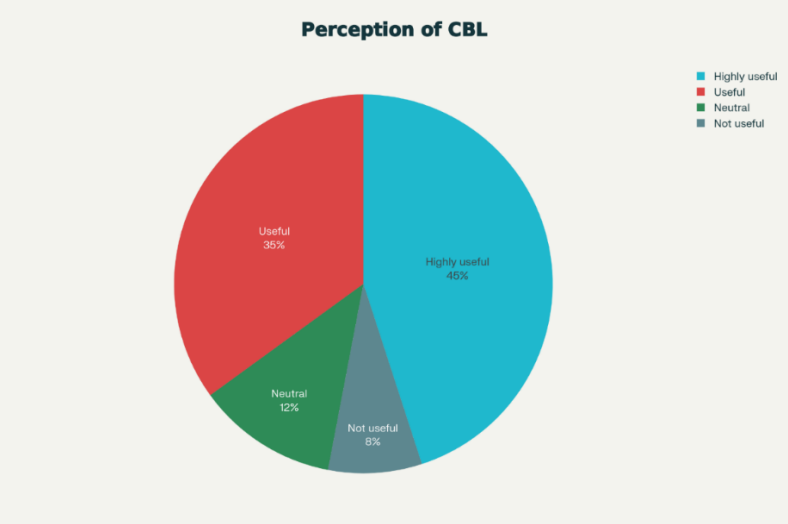

Fig 2: Pie chart showing overall student perception

Collectively, these results demonstrate that CBL not only improves academic performance compared with traditional lectures but is also well received by students, supporting its incorporation into routine pharmacology teaching.

Discussion

The present study demonstrates that CBL leads to improved short-term academic performance and high student acceptance compared with traditional lecture-based teaching. Students exposed to CBL achieved higher post-test scores, reflecting enhanced understanding and better application of pharmacological concepts. These findings are consistent with reports from pharmacology and other basic science disciplines, which have shown superior learning outcomes and favorable learner perceptions with CBL methodologies. Kaur G et al. [12] reported increased student attendance during CBL sessions ($P = 0.008$), although no significant difference was observed in test performance ($P = 0.98$). Importantly, 84% of students perceived CBL as a better teaching–learning method than traditional didactic lectures, and faculty members observed greater student interest and motivation. Their findings highlight the role of CBL in improving student engagement, satisfaction, and classroom dynamics, even in large-group settings. Similarly, Chiranjeevi UK et al. [13] demonstrated significantly higher scores in both knowledge-based and application-based questions among students exposed to CBL ($P < 0.001$). Nearly 90% of participants reported positive perceptions and strongly supported its inclusion in the curriculum. These observations reinforce the ability of CBL to enhance both conceptual clarity and clinical application of pharmacology. High levels of student satisfaction have also been reported by Garg P et al. [14] where 95% of stu-

dents agreed that CBL improved comprehension, 96% found it interesting, and an equal proportion felt it facilitated clinical correlation of pharmacological principles. Their conclusions support CBL as an effective learning tool that promotes clinical orientation in pharmacology teaching.

International evidence further supports these findings. Özdener F et al. [15] observed that most students considered CBL more useful than traditional methods, as it enabled easier linkage with real-life clinical cases. Notably, learning outcomes were independent of students' preferred learning styles, suggesting that CBL is adaptable across diverse learner profiles and applicable beyond clinical pharmacology.

CBL promotes analytical thinking by encouraging students to apply theoretical knowledge of drug mechanisms, indications, and adverse effects to realistic clinical scenarios. This contextual learning facilitates integration of basic pharmacology with clinical decision-making and rational prescribing, thereby addressing a commonly perceived gap between classroom teaching and clinical practice.

The favorable student feedback observed in this study, particularly regarding improved understanding, clinical relevance, and interaction with peers and faculty, further supports the educational value of this approach. The present study also aligns with the work of Nishal A et al. [16] who reported a significant improvement in mean post-test scores ($P < 0.001$) and found that 87% of students perceived CBL as useful for better understanding, retention, and development of critical thinking and decision-making skills. Faculty unanimously supported its incorporation into the routine curriculum, emphasizing its role in bridging theoretical knowledge and clinical skills.

Likewise, Sehgal RS et al. [17] demonstrated statistically significant improvements in post-test and retention test scores with CBL and reported enhanced student interest and self-directed learning.

Collectively, these studies indicate that CBL promotes analytical thinking by encouraging students to apply drug mechanisms, indications, and adverse effects to realistic clinical scenarios, thereby narrowing the gap between classroom teaching and clinical practice.

The consistently high student preference for extending CBL to other pharmacology topics underscores its acceptability and perceived educational value. Enhanced peer discussion and increased faculty–student interaction during CBL sessions may further contribute to improved engagement and collaborative learning. Meta-analytic evidence from medical education literature also supports the association of CBL with higher knowledge scores and better case-analysis skills, suggesting that the benefits observed in this single-institution study are likely generalizable.

Despite its advantages, certain practical considerations must be acknowledged. Successful implementation of CBL requires trained faculty, adequate preparation time, and well-designed, contextually relevant case scenarios, particularly when managing large undergraduate cohorts. Rather than replacing traditional lectures, CBL appears most effective as a complementary strategy. Overall, the findings strongly support the integration of structured CBL sessions into the pharmacology curriculum to enhance learning outcomes, student motivation, and clinical reasoning skills.

Conclusion

CBL is an effective, student-friendly teaching–learning strategy in pharmacology, demonstrating superior academic performance and more favorable learner perceptions compared with traditional didactic lectures. By promoting active participation and contextual understanding, CBL enhances clinical reasoning and facilitates the application of pharmacological principles to real-world scenarios. The regular incorporation of structured CBL sessions, supported by appropriate assessment methods and constructive feedback, can strengthen students' preparedness for rational prescribing and informed clinical decision-making in future medical practice.

Limitations

The study was conducted in a single institution with one batch of second-year MBBS students, which may limit the generalisability of the findings to other colleges or curricula.

The study assessed only immediate post-test scores and short-term perceptions; long-term retention of knowledge and impact on prescribing behaviour were not evaluated.

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