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Integrating clinical reasoning principles in case-based learning sessions for first-year medical students: Lessons learned

Dinesh Kumar[1*], Ramakrishnan Rajprasath[2], Magi Murugan[2]

[1]Department of Anatomy, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India
[2]Department of Anatomy, Pondicherry Institute of Medical Sciences, Puducherry, India

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Abstract

Background: Conventional pedagogies for case-based learning are designed with the intention of helping the student appreciate the relevance of content they learn and kindle their curiosity. However, these pedagogies embody certain shortcomings which inhibit them from reaching the intended objectives. The main aim of our initiative is to improve traditional case-based learning using the principles of clinical reasoning.
Methods: *A priori*, two sessions were conducted in which two vignettes were administered to first-year medical students. We obtained the perceived acceptance which was equivalent to Kirkpatrick level 1 learning outcomes.
Results: Overall outcomes were highly positive in terms of acceptability, fostering curiosity, increasing the relevance of learned content, and helping students learn to think in a logical way.
Conclusion: With the increasing need for incorporating clinical reasoning skills in medical education, it is imperative that these skills are taught beginning with the preclinical years of medical education.

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Introduction

Case-based learning provides students with a venue to correlate contents learned in the classroom to professional practice. It lies somewhere in between conventional structured learning and unstructured, freelance learning.[1] Vignettes are commonly used in clinical teaching because of their ability to generate waves of explanations and potential solutions in the prescribed situation by applying prior knowledge.[2]

Traditional case-based learning sessions traditionally have focused less on the development of clinical reasoning skills, approaching them from a bottom-up manner.[3] The cardinal shortcoming of using a simpleton case scenario is that it makes the students think that the clinical diagnosis is based only on attribution. Furthermore, traditional vignettes used for case-based learning in pre-clinical disciplines are dampened by subconscious heuristics and anchoring biases inculcated upon students by preceding lectures and coursework.[4] For example, a vignette on inguinal hernia begins, "A 35-year-old male presenting with swelling in the inguinal region…" This template presentation can potentially bypass the reasoning process and anchor the students to an immediate 'diagnosis,' which ultimately defeats the objective of critical thinking. This heuristic can contribute to cognitive errors in future practice by directing students to jump to premature diagnosis based on faulty clinical patterns.

Clinical reasoning skills plays a crucial role in real-world practice. These skills require linking multiple pieces of information pertaining to patients' circumstances and investigations in order to reach a specific diagnosis. The pedagogies designed for clinical reasoning[5-8] differ from case-based learning in five aspects: (1) they reduce cherry picking and require, instead, organization of specific knowledge into models made of symptoms/signs which eventually lead to diagnosis; (2) they subject the students to ambiguity; (3) they allow reflective understanding; (4) they help students ascertain the complexity involved in clinical encounters rather than arriving at a specific diagnosis; and (5) they help students consider the clinical

***Corresponding author:** Dinesh Kumar, Email: dinesh.88560@gmail.com

reasoning process to be a professional skill that can be learned under supervision.

Despite the emerging need for teaching clinical reasoning skills beginning with the pre-clinical years, it is not easy to develop standard pedagogies owing to practical difficulties. First, the 'dual process theory,' a widely acclaimed theory for understanding the clinical reasoning process, demands a mix of analytical (hypothetico-deductive) and pattern recognition processes.[9] A first-year undergraduate student, being largely unexposed to such clinical scenarios, does not possess much of a pattern recognition process and mostly likely will default to using an intuitive process. Thus, the only thought process which could be used for training clinical reasoning skills is hypothetico-deductive reasoning. In order to learn clinical reasoning skills, it is necessary to distil the required critical information from a broader vignette, which also contains, by design, irrelevant or distracting pieces of information.[10]

We used Kuhn's[11] principles for designing our clinical reasoning exercise. Kuhn divided the clinical reasoning process into three subcomponents: (I) Hypothesis generation based on initial data; (II) Refinement of hypothesis based on subsequent information; and (III) Characterization of final picture followed by devising a treatment. The process of problem representation develops over time when students begin to grasp the process from illness scripts and organize information in the form of a diagnostic hypothesis.[12,13] Our objectives were to promote clinical reasoning abilities among first-year undergraduate medical students and to achieve that we modified the traditional Maastricht seven-jump process model.[14] This is similar to students being taken through the journey of a patient from the time of presenting in a hospital to the post-operative period.

Materials and Methods

A priori, we administered a clinico-anatomical case vignette to 150 first-year medical students in the 2017-2018 academic year after obtaining the approval from the institute ethics committee. The session was held after completion of regional anatomy of that particular region (abdomen and pelvis) to ensure that students possessed the requisite anatomical knowledge to solve the vignette. The vignette (Box 1) consisted of (1) presenting the case history and clinical examination; (2) analysing the history and collecting ideas; (3) providing additional information by means of radiological imaging; (4) brainstorming, categorising and re-brainstorming based on information provided; (5) formulating a systematic inventory of ideas and learning objectives by establishing connections; (6) streaming a surgical video and selected post-operative complications pertaining to gross anatomy; and (7) synthesising knowledge and generating discussion based on probe questions. The vignettes were validated among three anatomists to ensure that a student could reach the correct diagnosis *per se* by applying core anatomical knowledge.

Box 1. Model lesson plan for the clinical reasoning session

Topic: acute appendicitis
Methods used: narrative case scenarios, PowerPoint presentations, buzz groups

Outlining of session
Segment 1: presenting the case history with signs / symptoms
Segment 2: presenting the physical examination in chronological order with 2 probe questions
Segment 3: presenting case specific clinical features explained with relevant clinical pictures (2 probe questions)
Segment 4: basic investigation and radiological images (1 probe question)
Segment 5: discussing the clinical scenario with probe questions using think, pair and share method. (2 probe questions);
- arriving at anatomical diagnosis of clinical condition

Segment 6: displaying the operative video for appendix removal with rolling verses (2 probe questions)
Summary and reflection

Student reaction to the innovation was then captured using a Likert scale feedback rating form which consisted of six items: (1) Was the vignette were interesting (2) Did the vignette involve several disciplines? (2) Has the vignette increased the relevance of the content learnt in regional anatomy? (3) Has the session improved your diagnostic abilities? (4) Was the session interesting? (5) Could you solve the probe questions based upon prior knowledge? 6) Was the vignette complex (in terms of students' perception)? In addition, students were asked to provide reflective open-ended responses for qualitative inputs. The responses were tabulated and analysed by descriptive statistical methods and expressed in measures of central tendency.

Results

The overall feedback from students was highly positive. Considering the fact that the students were being exposed to vignettes for the first time, we anticipated some confusion regarding the degree of complexity, level of understanding of the content, and the level to which the core anatomy content could be transferred to the vignette and relevance. Most of the students [126 of 150; 84%] students felt that the vignette had helped them understand the subject in a better way. Similarly, majority of the students [111 of 150; 74%] felt that they could appreciate the relevance of content they had learnt in regional anatomy and found the exercise interesting because of its hypothetico-deductive nature. However, a fraction of students [27 of 150; 18%] related that the vignette was complex to an extent and they therefore could not answer the probe questions. In the open-ended responses, students provided additional responses that expanded on these findings: "the vignettes help in bridging the gap between what we learn in theory and what we get to see in patients," "solving the case helps me think in a more logical way," and "able to get the feel of managing the patient from admission to post-operative period."

Discussion

The clinico-anatomical case vignettes were unique in that students were taken on a "guided tour" whereby anamnestic clinical information and information obtained from images have to be corroborated in order to reach a diagnosis. We believe our modified clinico-anatomical case vignette would be efficacious over traditional case-based teaching due to its ability to fulfil Schmidt's criteria[15]: activating relevant prior knowledge, encoding specificity by providing a context for learning, and elaborating the knowledge further. In contrast to the whole-case approach which is followed in traditional case-based learning, we adopted a "serial-cue" approach where information is disclosed in a sequential fashion in order to stimulate hypothetico-deduction (Table 1).[17]

In clinical settings, the process of achieving a diagnosis can be deconstructed into four phases: noticing, interpreting, responding, and reflecting.[18] The process of noticing involves the ability of a person to grasp the required clinical information from the prescribed clinical scenario. Lasater[19] further divided this phase of noticing into focused observation, recognizing deviations from expected patterns, and further information seeking. For example, when the history suggests a "50 year old female presenting with blood discharge from the nipple" along with other information, students need to focus upon this as key feature, collect other information based on theoretical knowledge, and try to recognize a pattern.

In our pedagogy, upon being exposed to clinical features, students were expected to prioritize the features, make sense of them, and interpret them. Subsequently, depending on the inferences made from the investigations, a diagnosis was offered. In each step, the reasoning process was shaped by the supervising faculty, who asked students to discuss with peers and articulate their reasoning pathways.[8] Eventually, the hypotheses posed by the students were either rejected or retained by the faculty. In the last phase, reflection, students evaluated their reasoning process and recognized the cognitive pitfalls they had encountered. The analytical aspects of this pedagogy could be compared with Lonergan's[20] "full act of knowing" because students received, understood, and judged clinical features to affirm at conclusion. In the process, students generated a hypothesis and judged it based on sufficient reasons. The feedback obtained from the students who participated in these clinical reasoning sessions were very positive and the majority of students related that their reasoning abilities improved because of the ability to integrate all the aspects of the organ system they had been studying.

We observe that among students involved in 'think-pair-share' activities, few were curious enough to consider other possibilities, resulting in generating a diagnosis earlier than others. This haste in generating a hypothesis interfered with the reasoning process of other students[21] particularly the students who may learn more slowly. Secondly, a fraction of students, being unfamiliar with the process of deduction, opted for premature closure of the case with cherry-picked information. Last, some failed to integrate sequential cues and resorted to an anchoring bias for reaching a diagnosis.

Limitations

We would like to share few potential pitfalls which could be encountered while planning this pedagogy. First, the process involves rigorous planning and a large commitment of time; failing this, the results could be cumbersome or unproductive. Secondly, the format of presentation - similar to illness scripts of real patients - needs to be scrutinized so that it will not impose a large cognitive load and at the same time, will not be shallow. Specific care has to be taken to manage the intrinsic load of the vignette by adopting the principles of cognitive load theory.[22] Third, the facilitator, who is the linchpin in orchestrating this challenging group learning process, should be competent enough to handle these constructivist sessions. In our experience, we found that experienced clinicians, owing to their profound levels of clinical expertise, often failed to adapt to the level of first-year students and therefore, tended to make the process overly complex. For fruitful sessions, it would be worthwhile for pre-clinical faculty to master basic clinical reasoning supervision capabilities to facilitate such sessions.

Table 1. Clinical reasoning abilities applied while solving clinico-anatomical case vignettes[a]

Probe Question	Skill	Associated Reasoning Skill	Mechanism Of Reasoning
From case history	Data acquisition	Identifying Describing	Student differentiates the essential points from the case history, describes in sequence and locates the anatomical structures that would have been likely involved
From physical examination	Problem definition and differential diagnosis	Comparing Correlating Defining	Student compares the salient points from the physical examination with the possible anatomical structures, tries to correlate the presenting problems and defines them in logical sequence
From investigations	Generating hypothesis and diagnosis	Analysing Evaluating Synthesizing	Student narrows down the plausible anatomical diagnosis by differentiating from closely related ones and confirms the diagnosis by synthesizing the points in sequence
From treatment	Solution	Executing	Student follows the treatment protocol and identifies the different anatomical structures encountered during the procedure

[a] Inputs from Elizondo-Omana et al.[16]

Conclusion

Seeing the emerging need for incorporating clinical reasoning principles in traditional case-based learning sessions, we designed clinico-anatomical case vignettes for first-year medical students. We spotlighted a strategy for inculcating foundational clinical reasoning skills and would like to explore the proof of benefits by means of crossover controlled studies in further studies. Although measuring the improvement in students' diagnostic reasoning abilities is a daunting task, we would like to share this initiative with peer academicians because these minor changes might subsequently culminate in a paradigm shift, ultimately helping students become more effective medical professionals.

Ethical approval

The initiative is approved by the Institute Ethics Committee, Pondicherry Institute of Medical Sciences (ethical committee number: IEC: RC/17/58).

Competing interests

On behalf of all the authors, the corresponding author declare that there are no competing interests to be declared.

Authors' Contributions

The concept and framework were designed by DK; the session was conducted by DK and RP. The perception was collected and analysed by MM. The manuscript was prepared by DK and edited by MM. The technical editing was done by RP.

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