Journal of Sports Medicine and Allied Health Sciences: Official Journal of the Ohio Athletic Trainers Association

Volume 4
Issue 3 *JSMAHS Spring 2019 Issue*

Article 4

March 2019

Commentary: The Use of Case-based Learning and Concept Mapping to Teach Students Clinical Reasoning

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*The Use of Case-Based Learning and Concept Mapping to Teach Students Clinical Reasoning: A Commentary**

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**This publication is a commentary piece on teaching methods toward improving clinical reasoning. The goal of a commentary is to draw attention to current trends and shed light on future directions of a topic.*

Introduction: Teaching students as inexperienced clinicians the process of evaluating athletic injuries and medical conditions is often challenging. Utilizing case-based learning and concept mapping as educational tools can facilitate growth in the clinical and diagnostic decision making process. **Discussion**: Experienced clinicians regularly employ case pattern recognition and hypothetico-deductive reasoning in clinical settings. Each type of reasoning is prone to anchoring and confirmation bias, devaluing relevant information, and framing effect if not utilized correctly. Classroom instructors and preceptors can use case-based learning and concept mapping to help students as inexperienced clinicians organize their thinking and more effectively apply their knowledge. **Implications**: The use of case-based learning and concept mapping to teach the process of evaluating athletic injuries and medical conditions can help students as inexperienced clinicians: improve clinical reasoning skills; decrease bias; develop more efficient and effective clinical reasoning; become more confident in what steps come next; value clinical data equally and impartially; and more effectively use hypothetico-deductive reasoning.

INTRODUCTION

Teaching students as inexperienced clinicians the process of evaluating athletic injuries and medical conditions can be challenging for many classroom instructors and clinical preceptors. Various approaches to injury evaluation are cited in the literature.[1-3] There is general consensus around beginning with a history and progressing in a stepwise fashion to complete the examination process – the goal being to arrive at a probable diagnosis that can be used to guide therapeutic goals and treatment. Many classroom instructors use a traditional lecture format to provide a lot of information to students quickly. We do not believe this approach by itself adequately prepares students to clinically reason with that information.

The challenge associated with a linear method of teaching an evaluation is that a patient rarely presents in a stepwise fashion clinically thus complicating the process of organizing, prioritizing, selecting, and reasoning through the appropriate data. Typically, a patient presents with a condition and describes the associated complaints in no particular order. The student utilizes their clinical knowledge and experience to determine which signs and symptoms are clinically meaningful to the diagnosis and management of the condition. We offer the following representative example as an illustration of this problem:

While instructing an upper body evaluation course that included orthopedic and general medical conditions to first year athletic training students (using a linear model as described above), The following scenario was presented as part of the final practical exam.

> Jaime is a sophomore soccer player on your high school team. Approximately 15 minutes into the game, a defender tripped Jaime causing her to land on the soccer ball. Jaime tried to catch

herself with her left outstretched arm but primarily landed on the left side of her abdomen. The official stops play and motions you on the field. After a brief initial assessment on the field, you remove Jaime from the game as a precautionary measure. In the minutes that followed, Jaime began to develop pain in her left shoulder and became increasingly nauseous. Perform a complete assessment of this injury.

In this testing scenario, the athletic training student (ATS) began to work her way through the evaluation, with a standardized patient answering her questions appropriately. The ATS focused primarily on the fact the Jaime fell on an outstretched hand and was experiencing pain in her left shoulder, directing her evaluation to a shoulder pathology. JH intended the ATS to clinically reason through the scenario, developing a differential diagnosis, with a splenic injury as the eventual diagnosis. Instead, the ATS focused on the shoulder pain, completing a masterful exam of the shoulder, which yielded few positive findings. With some prompting, she checked for rib fractures and assessed blood pressure, but went back to a shoulder injury in the end. The standardized patient continued to emphasize the symptoms associated with splenic injury, to no avail. It was not until JH told the ATS that the patient had become unresponsive that she began to question whether the injury was something else.

We believe the ATS struggled with a probable diagnosis because her assessment prematurely and incorrectly focused on the shoulder, limiting the probable diagnosis to her knowledge and experiences with shoulder pathology. Had the ATS received instruction with case-based learning and concept mapping to support a systemic and broader assessment of the injury, as a supplement or alternative to the lectures she had participated in, the student's clinical reasoning may have resulted in a more comprehensive differential diagnosis and accurate probable diagnosis.

DISCUSSION

The following discussion presents common approaches to teaching clinical reasoning skills in the classroom, biases associated with clinical reasoning skills, and how use of case-based learning and concept maps can enhance the teaching/learning process by helping a student organize and clinically reason with information provided to them.

Hypothetico-deductive Reasoning and Case Pattern Recognition

The challenge presented to classroom instructors and clinical preceptors is how to teach clinical reasoning processes in a manner that best prepares learners for clinical practice. In 2009, Geisler and Lazenby[4] advanced the discussion in athletic training education of the importance of helping ATSs think by presenting two types of clinical reasoning: hypothetico-deductive reasoning (HDR) and case pattern recognition (CPR).

Using HDR, the clinician formulates multiple hypotheses that are proven and/or disproven as they progress through an evaluation. In the end, the clinician decides on a conclusion or probable diagnosis based on the results of this process. Alternatively, CPR is more intuitive and differs from HDR through recognition of important data and detail early in the evaluation. Early recognition of important details prompts and directs the clinician in the subsequent evaluation to confirm a probable diagnosis. With CPR, the clinician draws upon their experience and knowledge, arriving at a diagnosis more efficiently, whereas with HDR the clinician methodically works through various hypotheses in a less timely manner. These two clinical reasoning approaches represent how inexperienced and experienced clinicians differ in their approach to novel or complex clinical situations, although the two are not mutually exclusive.

According to Geisler, classroom instructors and clinical preceptors should initially focus on teaching clinical reasoning through HDR.[5] Beginning with HDR provides students a foundation and framework to build their clinical decision-making skills. If classroom instructors and clinical preceptors use CPR extensively without a proper explanation of their clinical decision making process, students may devalue or never be exposed to the importance of a methodical evaluation. Geisler and Lazenby refer to this as a miseducative experience.[4] Returning to the example above, the ATS followed CPR, albeit without the necessary knowledge and experience to do so. Her failure was because she was not adequately prepared to use HDR and CPR. In addition to the problem of misapplication of approach to the evaluation, the student also unknowingly demonstrated multiple biases common to even the most experienced clinician.

Biases

A common yet important threat to the validity of the clinical reasoning process is that of bias. Common biases include anchoring, confirmation bias, devaluing relevant information, and framing effects.[6] Anchoring bias is making judgements based on an initial piece of information.[7] Inexperienced clinicians are particularly susceptible to anchoring bias, where the anchor is commonly the first information obtained.[8] In the example above, the ATS failed to pay attention to the worsening symptoms, choosing to focus instead on the shoulder pain she ascribed to falling on an outstretched hand. Anchored to the shoulder injury, the ATS also exhibited confirmation bias.[6] With confirmation bias, a clinician narrowly seeks information that supports his or her initial impression. In the example, the ATS performed a number of special tests for the shoulder to confirm a shoulder injury, becoming frustrated when further tests failed to confirm the initial assessment. Secondary to these biases, the ATS ignored the patient's growing nausea, as this rarely relates to a separated shoulder or clavicular fracture, common injuries associated with falling on an outstretched hand. Choosing to devalue relevant information, such as increasing nausea, decreased the possibility of determining the true cause of the shoulder pain.[6] Last, the ATS experienced framing effect bias, or in other words, the thought processes changed based on how the information was presented.[6] Remember, the clinical scenario was part of the final exam for the upper body. The student had spent several weeks in the course reviewing the shoulder due to the multidimensional and challenging nature of a shoulder exam. Undoubtedly, the ATS studied the shoulder extensively and with that mindset, framed the scenario in relationship to a shoulder injury.

Case-based Learning and Concept Maps

The ATS in the example above obtained her clinical knowledge primarily through lecture-based instruction and clinical experiences. Although this is just one example, it represents numerous cases we have seen educating athletic training, medical, and/or physician assistant students who have difficulty thinking through the decision making process without a tool and guided learning to better understand how a clinician thinks. Employing a pedagogical approach that stimulates critical thinking is a challenge when educating future clinicians in the classroom and clinic. We propose using case-based learning (CBL) and concept mapping (CM) as a supplement or an alternative to lecture-based instruction to teach HDR and limit biases in the evaluative process.

Case-based learning requires students to apply their knowledge to real-life scenarios encountered in clinical settings using constructivist theory.[9] Constructivist theory is founded on students integrating new knowledge with the knowledge they already possess.[10] Students move from passive learning, or memorization, with little intent to understand or connect the information, to active learning where they assimilate the information for deeper understanding, which eventually leads to improved performance. In CBL the classroom instructor or clinical preceptor guides students through a case that presents an authentic condition that they must work through to arrive at a probable solution or diagnosis. Students accomplish this either working individually or as part of a group. Case-based learning has been implemented successfully in a number of fields, including business, law, and medicine.[11] Benefits include collaborative learning, development of intrinsic and extrinsic motivation to learn, and integration of knowledge and practice.[12]

A concept map is a way to organize information diagrammatically, forming links between like concepts. The foundation of CM began with Novak and Gowin, with connections to Ausubel's assimilation theory and the constructivist theory of learning.[13, 14] Similar to CBL, CM builds upon what the individual knows by selecting a given topic, developing a list of related factors, and then articulating how all of the factors relate. Students connect the factors via linking words that highlight the connections, resulting in a

Figure 1. Orthopedic injury concept map template

diagram demonstrating how the entire concept is interrelated and connected, i.e., the big picture.[15]

Essentially, CM visually works through a case and is a viable tool to educate students as inexperienced clinicians in the classroom and during supervised clinical experiences. Benefits include improvement in critical thinking, decreased cognitive load (amount of mental effort being used in working memory), and application of learned material.[16-19]

Figure 1 is an example of integrating CM with CBL to guide a student through an evaluation of an athletic injury. The focal point in the map is the patient's presenting condition as outlined in the case.

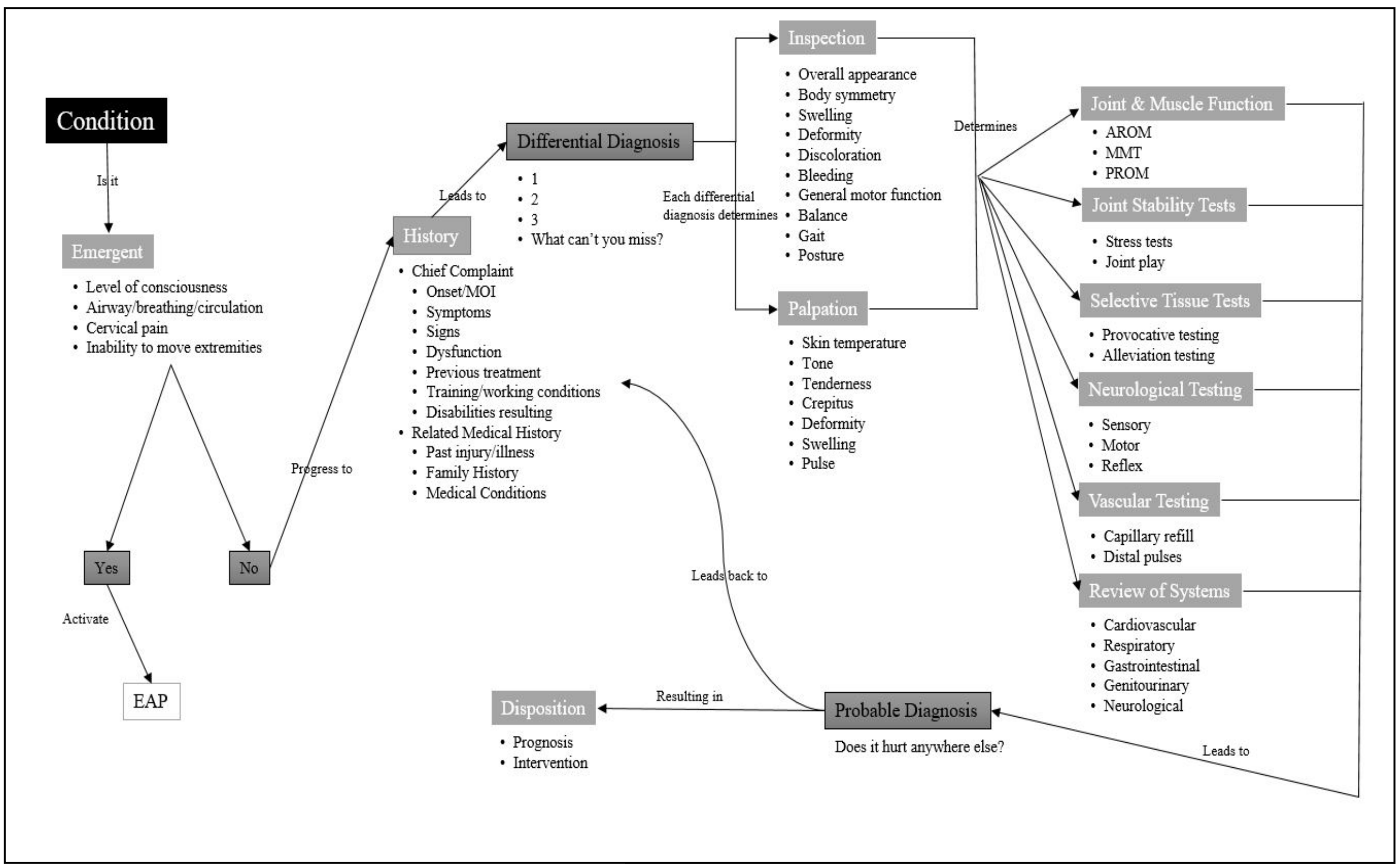

Figure 1. Orthopedic injury concept map template

After determining whether the condition is emergent, the student either activates the emergency action plan or continues with a detailed history. A comprehensive history allows the student to form an initial differential diagnosis and articulate connections between clinical data (concepts) and underlying pathology.

With a differential diagnosis in mind (including prioritization of any "cannot miss" diagnoses), the student practices HDR to rule in and rule out each potential diagnosis. As needed, they may create a separate concept map for each diagnosis. These maps help the student direct their continued history and physical examination by drawing upon their knowledge of the conditions (e.g., relevant anatomy, signs, and symptoms). The information obtained during the continued history and physical examination determines the diagnostic tests performed. In the end, the student arrives at a probable diagnosis that directs the intervention strategies, management plan, and ultimate prognosis.

Teaching using CBL and CM does not eliminate biases, but following the process facilitates a more systematic and critical decision-making process. When developing a differential diagnosis and working through each diagnosis systematically following HDR principles, anchoring and confirmation biases are greatly limited. Encouraging a student to keep all data collected in mind ensures they will not devalue relevant information as they work through the case. Moreover, determining "cannot be missed" diagnoses decreases the potential for framing effect to cloud judgement.

IMPLICATIONS

Based on the existing research literature and face validity of using CBL and CM to teach clinical reasoning, it appears a relevant and timely topic in athletic training education with clear opportunities for application. The need exists for original research to determine the effects of such use. We recommend using CBL and CM as a supplement or an alternative to the traditional approach of lecture and lab for the instruction of examination, diagnosis, and intervention competencies. Learning how to reason through an evaluation clinically can be a daunting task. Too often students as inexperienced clinicians either miss steps or do far too many steps because they are uncertain what to include and/or what not to include in the evaluation. Further, they add to this uncertainty anchoring and confirmation biases, the devaluing of relevant information, framing effect, and the desire to practice CPR without the experience or expertise to do so. We believe that by teaching students using CBL and CM to unbiasedly reason through an evaluation, with HDR as a guide, their confidence in what steps come next can improve. The CBL and CM approach provides a bridge between HDR and CPR by helping students formulate their thinking in an intentional way, slowing down the process, and facilitating greater clarity in the clinical reasoning process. It can also provide an enhanced method of instruction for educators focused on the process of student learning.

The need exists for further study and evaluation of the application of CBL and CM in athletic training pedagogy. This paper provides an initial conceptual framework for the application of an empirically demonstrated model of teaching clinical reasoning to students in a healthcare setting and has clear implications for our teaching and learning models

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