Clinical Reasoning of Medical Students in a Public University in Brazil

O Raciocínio Clínico dos Estudantes de Medicina em uma Universidade Pública do Brasil

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PALAVRAS-CHAVE

– Diagnóstico.
– Resolução de Problemas.
– Métodos.
– Pesquisa Qualitativa.
– Educação Médica.
– Internato e Residência.

ABSTRACT

The aim of this research was to understand the reasoning developed by medical students in a public university in Brazil. This research on education included semi-structured interviews and film recordings of interns discussing 10 clinical cases. A sample of 16 interns analyzed cases presented on a notebook computer with a webcam. They were instructed to verbalize all their thoughts on the procedures they would use. The film recordings and transcripts of the interviews were analyzed. Quantitative data was evaluated using Yates' chi-squared test and speech analysis was used to evaluate the transcripts. The theme worked on in the practice of reasoning was: the student's perceptions of their clinical practice. Of the 160 diagnoses, 57% were done with analytical reasoning and 43% with non-analytical reasoning. The hypothetical deductive method was employed by 31% of the interns and the inductive method was employed by 69%. The diagnostic accuracy was 81% correct for easy cases and 85% correct for difficult cases. We observed two empirical categories: the cognitive universe of the student and the patient's context.

KEYWORDS

– Diagnosis.
– Problem Solving.
– Methods.
– Qualitative Research.
– Medical Education.
– Internship and Residency.

RESUMO

Esta pesquisa teve como intuito compreender o raciocínio desenvolvido pelos estudantes de Medicina de uma universidade pública do Brasil. Trata-se de uma pesquisa educacional, que abrangeu filmagens da resolução de dez casos clínicos e entrevista semiestruturada. A amostra foi formada por 16 internos, que responderam aos casos, apresentados em um notebook com webcam, e foram instruídos a verbalizar todo pensamento neste procedimento. Para a análise foi realizada a transcrição das falas e a observação da filmagem. Os dados quantitativos foram avaliados pelo Teste do Qui-Quadrado com correção de Yates, e os descritivos, por análise de discurso. O tema trabalhado na prática do raciocínio foi: percepções dos alunos de sua prática clínica. Entre as 160 resoluções, 57% foram por raciocínio analítico e 43% por não analítico. O processo hipotético-dedutivo foi empregado por 31% dos internos, e o indutivo por 69% dos participantes do estudo. A acurácia diagnóstica foi de 81% de acertos nos casos fáceis e de 85% de acertos nos casos difíceis. Observamos duas categorias empíricas: o universo cognitivo do estudante e o contexto do paciente.

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INTRODUCTION

Two recent innovations in medical education, problem-based learning and evidence-based medicine, presuppose a discussion on clinical reasoning. Problem-based learning can be understood as an attempt to introduce the formulation and testing of hypotheses in a pre-clinic curriculum. Evidence-based medicine is an example of applying statistical decision theory to a medical clinic[1].

From an educational point of view, clinical reasoning is a prime component of medical competency; the related objective of reasoning aptitude is a requisite in medical school[2]. In recent years, many researchers have tried to explain the interactions between the factors that influence clinical reasoning, such as cognitive knowledge[3], context of the patient[4], level of expertise[5], and the degree of difficulty of the clinical cases[6,7].

The aim of this research is to understand the process of clinical reasoning developed by medical students in a public university in Brazil, identifying: the type of reasoning employed to solve clinical cases, the hypothesis elaboration method, the diagnostic accuracy, and the perception of the interns in the clinical practice.

METHODS

Context

This research on education was conducted in 2009 from the experiences of interns in a medical school at a public university in Brazil where the fundamental methodology of the curriculum was problem-based learning. The internship program is the last phase of this medical school and lasts two years[8].

Participants

The sample was made up of 16 interns in the sixth year of medical school. The interns were invited to participate via e-mail. The first in each rotation that responded was contacted by telephone to schedule a meeting. The random sample included 8 male and 8 female interns.

The only exclusion criteria were interns in the same rotation as those who had already been contacted. The interns signed a form giving free and clear consent and the project was approved by the Ethics Committee at the University Hospital at Londrina State University, no 195/2008.

Material elaboration

A series of ten clinical cases were prepared with Microsoft Office Word 2007. Each case contained the presenting symptoms, past history, and laboratory data of the patient. The topics chosen conformed to the epidemiological reality for the state of Paraná, Brazil and had been included in this medical school's curriculum.

Three specialists categorized the cases into two types: five easy cases (cholecystopathy, infectious mononucleosis, systematic lupus erythematosus, hypothyroidism and pneumonia) and five difficult cases (congestive heart failure, bacterial endocarditis, pulmonary tuberculosis, diabetic nephropathy and acquired immunodeficiency syndrome). The diagnoses determined by the specialists were in agreement 96%. The differences were discussed among the clinicians and a final diagnosis was established for all cases.

A semi-structured interview[10] was chosen for this research, made up of two main questions about the issue being explored by the researcher while allowing the students to express their personal opinions. This interactive method between researcher and participant was considered an adequate strategy to study the interns' perceptions in relation to their clinical practices.

Pilot study

A pilot study was conducted with four medical students at the same university but they did not participate in the final research. This procedure was important to test the students' comprehension of the questions.

Meetings

The meetings began with the intern individually solving the series of clinical cases, one case presented per page, while alternating the order of complexity. The webcam from a notebook recorded the process.

The initial page contained instructions on how the intern should proceed: verbalize all thoughts during the resolution of the cases, do not return to a previous case, do not request explanations about the cases during the process. Unlimited time was given to solve a case.

In the second part of the meeting, following the case studies, the intern was interviewed by a researcher. All the interviews were transcribed for speech analysis. The following questions were used in the interview:

— With the data given in this clinical case, describe how you would make the diagnosis.
— Do you always use this method? Are there cases where you have used a different method of reasoning?

Statistical analysis

The study included video recordings of the interns during interviews where they discussed clinical cases. These videos were edited and observed by two researchers who took notes and classified: the type of clinical reasoning used by the intern

(analytical or non-analytical), the diagnostic accuracy and the hypothesis elaboration method.

In order to measure the diagnostic accuracy, the last answer given by the intern was considered to be the final answer.

Statistical analysis was used to measure the total frequency of events and the statistical significance using Yates' chi-squared test where p = 0.05.

Qualitative analysis

For the qualitative analysis, interviews were interpreted using a type of speech analysis called the Structure of the Phenomena Studied[11]. This method seeks a greater understanding of the theme researched by investigating the speech of the participants, focusing all analysis on the main issue — the elaboration of clinical reasoning.

The analysis of the phenomena studied is composed of two distinct phases: individual analysis and general analysis.

The individual analysis involved a general reading of the subject's speech, without any interpretation on the part of the researcher. The objective of this initial reading was to familiarize the researcher with the content of the subject's speech. After the reading, significant units were selected from each speech (words or phrases related to the theme studied — the subjects' clinical reasoning). After selecting these units, a grouping was made for each person interviewed. For example, when a student stated various times that the signs and symptoms of diseases were the main focus for their reasoning, we counted the number of times the subject spoke about this aspect of clinical reasoning.

For the general analysis, all the interviews were reread to find a relationship among them, where discussions of the diverse cases had a common pattern. The significant units selected within each interview were compared among the diverse speeches to find similarities and differences among the answers and personal opinions of the interns.

For example, when two or more interns stated the importance of acquiring clinical skills in medical school, we kept a running total of this statement to see if it followed a pattern.

This method of comparing significant units to identify similarities and differences expressed by the interns allowed us to construct themes to study the practice of clinical reasoning.

The results of this research involved overlapping information and the construction of themes to separate the data from the case studies and the interviews[12].

The methodology described is part of a doctoral thesis in Health Science. This article focuses on the results related to the type of clinical reasoning, the diagnostic accuracy, the hypothesis elaboration process and the qualitative data about students' perceptions of their clinical practice.

RESULTS

The first results presented are the quantitative data, such as the type of clinical reasoning employed by the students, the diagnostic accuracy and the hypothesis elaboration process. Next we present the qualitative research data in two empirical categories, the cognitive universe of the student and the patient's context.

We had a total of 160 filmed analyses of clinical cases, 80 easy cases and 80 difficult ones. The distribution of the type of reasoning employed by the students in the resolution of the problems is shown in Table 1.

A statistically significant difference between the diagnostic accuracy and the degree of difficulty of the cases was not found (Table 2).

Table 1
Distribution of the type of reasoning and the degree of difficulty of the cases, Brazil, 2010.

Type of Reasoning Cases	Analytical	Non-Analytical	N total
Easy	39 (49%)	41 (51%)	80 (100%)
Difficult	53 (66%)	27 (34%)	80 (100%)
Total	92 (57%)	68 (43%)	160 (100%)

Yates' chi-square test = 4.32 and p = 0.0376.

Table 2
Distribution of correct and incorrect clinical cases by degree of difficulty, Brazil, 2010.

Diagnostic Precision Cases	Correct	Incorrect	N total
Easy	65 (81%)	15 (19%)	80 (100%)
Difficult	68 (85%)	12 (15%)	80 (100%)

Yates' chi-square test = 0.18 and p = 0.6729.

We observed two different hypothesis elaboration processes: hypothetical deductive and inductive. Hypothetical deduction was employed by 5 (31%) interns, who focused on the principal complaint of the patient, the signs and symptoms, and the epidemiological profile and history of the patient. The inductive process was utilized by 11 (69%) interns.

The interns in this study, through the practice of clinical reasoning, revealed some principles that guided their attitudes which were divided into two categories: the cognitive universe of the students and the patient's context.

They exhibited their cognitive universe, that is, the knowledge acquired during the development of their clinical ability. This knowledge was shown in the following four statements:

1. The importance of basic sciences:

> "Well, I have to know anatomy to visualize the body of the patient and think in terms of anatomy and physiology, what is altered, physiopathology and semiology." (intern 14)

2. Acquired ability:

> "I think that this is important, not being closed, but embrace your knowledge. So, open up more, if you could be a general practitioner, of all [...]" (intern 10)

3. Epidemiological data:

> "There are diseases that follow this history closely, the epidemiology that is. Each pathology, I go by the epidemiology, if I have more certainty of this!" (intern 5)

4. The knowledge of signs and symptoms of various diseases:

> "I try to see if those exams make me think of a specific pathology that can cause the symptoms described by the patient." (intern 9)

The second category described by the interns in relation to their clinical practice was the patient's context. They specified four important items in developing a relationship with the patient:

1. Thoroughly examine the patient during anamnesis:

> "I think in a sequence: I see if they are male or female, ask their age, their race, their profession and where they are from." (intern 11)

2. Listen attentively to the history of the patient:

> "I listen to the history, taking into consideration the age of the patient, the place they live, and, depending on its importance to the case, their race." (intern 15)

3. Capture the data presented:

> "When I am taking a history, I will collect the data. So, everything begins with the origin of the person, their age, the epidemiological data, I always search for the causes that can explain the complaint of the person." (intern 1)

4. Sort through the data from a complete physical exam, but with a specific purpose.

> "I see the patient, converse with him, solicit risk factors, family history, good and bad habits that tell me something and then I do the physical exam. The first is a general physical exam, then a specific physical exam." (intern 7)

The participants in this study also approached the individuality of each case with the confirmation of the facts.

> "There are other cases where I start with the exams; I go from top to bottom. I take the exams and see what is changed. Then I confirm the data of the physical exam with those that match [...]" (intern 9)

DISCUSSION

In relation to the type of clinical reasoning employed, we observed a tendency to use analytical reasoning in complex cases — 66%, in accordance with Mamede et al.6 that concluded that ambiguous cases lead to reflection, not permitting doctors to become attached to automatic reasoning.

Experienced doctors use both methods of reasoning. Non-analytical reasoning, when correct, is efficient and a sign of experience. Analytical reasoning is a form of reflection, but should not be applied to all cases and is not always necessary[13].

On the other hand, when a doctor applies analytical reasoning in difficult or rare cases, the expectation is that their performance improves[14].

Non-analytical reasoning is noted as a main component of diagnostic accuracy in all measures of expertise. For this reason, clinical professors should recognize its importance and teach it using various examples as a supplement to the analytical process[15].

Tavinder et al.[16] and Eva[17] believe that when teaching both forms of clinical reasoning, the professor should not present them as mutually exclusive; on the contrary, both types of reasoning need to be learned as complements that can improve diagnostic accuracy.

It is important to train students to use both methods of clinical reasoning, automatic and analytical, to provide flexibility when processing information and better prepare them for the wide variety of problems in an ambulatory practice[18].

The students of active learning methodologies have systematically learned a process of thought that prioritizes: the predominance of reasoning based on acquired knowledge, the systematic use of clinical information and the elaboration of extensive diagnostic explanations. As a consequence, they

exhibit a "backward-directed" reasoning, that is, they produce extensive explanations with relevant biomedical information[19].

It would be harmful to only teach students a script of diseases; diagnostic errors are committed when physicians rely heavily on the similarities between cases[20].

Clinical experience makes a complex activity easier in the same way that experience increases confidence in the non-analytical method; yet effective diagnosis involves the two distinct modes of thought, complementing each other and acting in harmony to overcome the limitations of human memory[21].

The results of this research demonstrate that the participants utilized both distinct modes of thought.

In relation to the diagnostic accuracy, we did not find a statistically significant difference in our study with the degree of difficulty of the cases.

Heemskerk et al.[7] analyzing the performance of residents identified a better diagnostic performance in easy cases (97.8% vs. 77.3% for difficult cases).

Elstein[13] believes that the result of one clinical case is a poor indicator of another since medical performance can vary greatly.

Diagnostic accuracy increases with education and experience in a specific subject13,14,23.

In regards to the hypothesis elaboration processes (hypothetical-deduction and induction). The inductive process was utilized by 69% interns of this research.

Heemskerk et al.[7], reported that 54% of the cases were solved using hypothetical-deduction, 33% using induction and the other 13% using non-analytical reasoning. Hypothetical-deduction and induction are conscious, active, analytical methods.

In spite of the two types of hypothesis elaboration being used in clinical practice, evidence-based medicine favors the advantages of hypothetical-deductive reasoning in the medical decision process. The big difference between physicians is not in the form of hypothesis elaboration, but in their general vision, in respect to the results of the exams and their clinical conduct[22].

However, McLaughlin et al.[18] believe that the inductive process is free of systematic error because no primary hypothesis is formed that can be incorrect; and they affirm that the inductive process is applied by experienced doctors. These results contradict our data which show 70% of the interns used induction.

Thinking about qualitative analysis in this study, the interns expressed two principles in their clinical practice: the cognitive universe of the students and the patient's context.

The cognitive universe was described as acquired knowledge during the curse in order to develop clinical skills. This knowledge was shown in the four statements mentioned in our results: the importance of basic sciences, acquired abilities, epidemiological data, and the knowledge of signs and symptoms of various diseases.

The acquisition of knowledge has already been considered only a useful instrument in clinical problems solving[24]. Recently, however, this belief has changed.

Knowledge should be organized to be clinically useful, unless it cannot help in a clinical practice[13]. The structures of medical knowledge and the strategies of reasoning are interrelated constructions[7].

Clinical reasoning depends on a balance between different types of knowledge, including the biomedical mechanisms that govern the functions of the human body and the clinical characteristics of disease[15].

Understanding the mechanisms that cause disease can create a valuable cohesion with the clinical characteristics of disease[15,21].

Training students with active learning methodologies develops cognitive structures that enable better processing of the patients' data, since students confront patients' problems early on[25]. The participants in this study showed development in this performance.

Diagnosis involves the application of knowledge. This suggests the increase of knowledge should improve diagnostic performance. Yet the way in which knowledge is structured also influences diagnostic performance[26].

Students' performances improve when they have specific concepts more aligned with diagnostic activities. The challenge is in molding the knowledge[26].

The participants in this study made reference to this balance of knowledge, including the addition of epidemiological data and its association with technical skill.

The increase of knowledge of signs and symptoms of various diseases is very important to clinical solving problems. We must remember that, this knowledge also should be organized to be clinically useful.

In relation to the second category described by the interns — the patient's history — they discussed four important items in developing a relationship with the patient: a thorough examination during anamnesis, attentively listening to the history, capturing the data presented, and sorting through the data from a complete physical exam but with a specific purpose.

Doctors need to be involved in context, paying attention to the symptoms of the patient, their history and their suffering. Listening to the patient is very important, even when the diagnosis is already clear. Being an active listener is the best diagnostic tool[27].

Listening to a patient shows respect, sympathy and commitment to the client. These abilities surpass technical, scienti-

fic performance and guide students in a more integrated, complete and humane training.

The participants in this study also approached the individuality of each case with the confirmation of the facts.

In verifying the proposed hypotheses, it is important to be aware of confirmation error, that is, the tendency among doctors to seek data that confirms their hypotheses without considering data that can refute it[23].

The students of this research expressed the necessity of having a broad vision, without forgetting that small details could transform a situation, and always verifying if propositions were correct.

CONCLUSION

This approach uncovered some facets of the phenomena studied. One important point was the use of two forms of clinical reasoning: analytical and non-analytical, which showed equal efficiency in relation to the diagnostic accuracy but depended on the degree of difficulty of the clinical cases.

The use of induction by the interns showed good results for fundamental teaching with active learning methodologies, which encouraged students to consider all the facts and find ways to link them.

The interns showed an understanding of the importance of cognitive knowledge, in content as well as in the structure and application of learning to further the well-being of the patient.

The patient's context was also valued by the medical students, principally, showing the necessity of listening attentively to the patient. This result demonstrates an approach geared to the development of a humane medical practice.

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Célia Cristina Fornaziero: coleta de dados, análise e redação final. Pedro Alejandro Gordan: análise de dados e redação. Mara Lúcia Garanhani: análise de dados e redação do texto

CONFLITO DE INTERESSES

Declarou não haver.

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