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# Introduction to clinical pathology: A brief course of laboratory medicine in the field for medical students

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## Abstract:

**OBJECTIVES:** Teaching of clinical pathology to medical students has been ignored in many countries such as Iran. We aim to introduce a practical brief course and its proper timing.

**MATERIALS AND METHODS:** Three groups of medical students from consecutive years of entrance passed a 1.5 working day practical course on the field. Their level of knowledge was assessed by pre- and post-tests. Their idea and satisfaction were gathered by questionnaires.

**RESULTS:** Knowledge of students became significantly higher after the course. Their satisfaction was high. Students in later year of education got significantly higher marks. Most of the students wished such a course should be away from basic sciences period and as near as possible to internship.

**DISCUSSION:** Due to overloaded curriculum of general medicine in Iran, we decided to run a brief practical course of laboratory medicine education for medical students. Although the course was practical, the knowledge of students became higher. Students with more clinical experience and knowledge absorbed more. Being actively involved in the classes lit the enthusiasm of students and made them satisfied with the course. It seemed that the course should be placed in later years of clinical training to get the best uptake and results.

## Keywords:

Clinical pathology, medical students, teaching

## Introduction

According to different studies, about two-third of medical decisions are based on laboratory results<sup>[1]</sup> surely because of objective data that they can provide for the health-care providers.<sup>[2]</sup> Besides, laboratory tests can provide data that help doctors to screen early risk factors; consequently choose preventive and less-invasive actions, monitor suitable remedy, and track the fate of diseases.<sup>[3]</sup> Due to increasing pressure on physicians to visit more patients in different and even odd conditions that limits the time for proper history taking and physical examination, they count

on paraclinic results such as laboratory medicine.<sup>[4]</sup> Obviously, as a medical specialty, this area has been markedly become more sophisticated as a matter of number, kind, and complexity of tests and methods recently. The little attention paid to clinical pathology (laboratory medicine) subjects in medical school curricula has been mentioned in literature, especially in Iran.<sup>[5]</sup>

Based on literature, it has been observed that active learning approaches improve comprehension and learning,<sup>[6]</sup> critical thinking, communication abilities, requested attitudes and manner;<sup>[7]</sup> decreasing misconceptions and expanding motivation.<sup>[8,9]</sup> Active teaching-learning

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methods in clinical pathology disciplines are needed to raise the interaction and interest among the students and to help them have more permanent remainder of knowledge, especially in a crowded discipline.

General medicine in Iran is a 7-year course with the following four phases: basic sciences (2.5 years), physiopathology or preclinical (1 year), clinical clerkship (2 years), and finally internship (1.5 years). Two comprehensive examinations have been put after basic sciences phase and before internship. During the course, at least 290 official and standard units should be passed by the students. Among them, about 12 units belong to pathology. Until now, unfortunately, the major focus has been on general and surgical pathology; consequently clinical pathology has been ignored as a key part of practice of medicine to be learned by medical students classically. We noticed the lack of laboratory medicine teaching in official curriculum and by considering the possibility of overload, we decided to run a short course of introduction to laboratory medicine. On the other hand, we did not have any experience or evidence to know where this course should be taken place in different phases of general medicine education in Iran, so we tried the course in different phases after basic sciences phase.

We hope such studies can help officials to decide how, where, and when to prepare a place for teaching of clinical pathology to undergraduates of medical schools in Iran and all over the world to make them better physicians who can cope better with the rush of data coming from this area of expertise.

## Materials and Methods

A convenience sampling method was used in the study. Informed consent was obtained from participants after explaining the study plan. The target population was year 3 (first semester of preclinical years), 4, and 5 (1<sup>st</sup> and last year of clinical clerkship) medical students who voluntarily enrolled to take part in the study. The preliminary introduction and short explanation of the course was done by clinical pathologists. Three groups of medical students in the following order agreed to participate in the study: in the last year of clinical-phase training (21 students), in the 1<sup>st</sup> year of clinical-phase training (22 students), and physiopathology-phase students (23 students). They all took pretest including twenty multiple choice questions (MCQs) prepared by two clinical pathologists and appraised by clinicians according to goals determined for a medical student to know about clinical pathology laboratory for this crash course as follows:<sup>[10]</sup>

- Being familiar with the structure of a general laboratory in a public hospital

- Basic understanding of health information system/laboratory information system, reception and reporting sections
- Basic understanding of laboratory errors and their causes
- Basic attempts in specimen handling and being familiar with special anticoagulants
- Basic approach/tests in clinical microbiology section
- How to do Gram-staining and examine the slides
- Most important test in clinical hematology and fundamentals of instruments
- How to prepare peripheral blood smear and examine the slide
- How a clinical biochemistry section and an autoanalyzer work out
- Basic approach to an emergent test and a critical value
- Basic rules in blood banking (concepts, different tests and forms, types of products...)
- Basic tests in parasitology and urine analysis
- Basic concepts and tests in hormonal assay, immunology, and serology
- Basic rules and statistics in quality control of different sections and quality assurance.

## Course plan

There was a session for knowing about the basic construct, rules, protocols, official chart, and variety of tests and theoretical concepts of clinical pathology presented with a clinical pathologist. The overall importance and duty of a clinical laboratory was presented by a clinician. A general tutorial was performed in laboratory for the trainees in experiment group. Then, students were randomly divided in small groups of 4–6 people. In different days, they attended hematology and blood bank, biochemistry, microbiology, urine analysis, parasitology, immunology, and serology sections of clinical laboratory. It took three working days (8 am–2 pm) for a given small group to finish the course. At the end, the posttest was performed. A questionnaire was given to each student with the following questions:

- I am satisfied with the course
- The course should take place at basic science years
- The course should take place at pathophysiology years
- The course should take place after starting clinical years
- The course should take place before starting internship
- The course should take place after starting internship.

They could rank the questions as: 1 (the most agreed), 2, 3, 4, and 5 (the least agreed). Their general opinion about the course was asked at the end as an open-ended question. Questions of the tests were divided into five parts according to the goals.<sup>[10]</sup>

To determine whether there was an increase in knowledge, we compared the before and after quiz results using a paired *t*-test. ANOVA test was used to compare the results of all groups in the same examination. An open-ended anonymous survey was used to assess student satisfaction with the introduction to clinical pathology (ICP). To obtain facilitator feedback, we used an anonymous survey that contained a combination of open-ended and specifically graded questions.

## Results

Ultimately, we could get the results of three groups at two categories of knowledge and satisfaction. Knowledge-based MCQ test was completed by 63 students (19, 21, and 23, respectively) who were involved in the statistical analyses. Other volunteers were not included in the statistical analysis due to incompleteness of before or after tests.

Maximum and minimum ages of participants were 20 and 27 years ( $22.3810 \pm 1.33717$ ), respectively. Gender distribution of groups was (male vs. female) 11 versus 8, 17 versus 4, and 11 versus 12, respectively, in Groups 1, 2, and 3. Mean pre- and post-test results in all participants were  $9.1429 \pm 2.9830$  and  $16.1270 \pm 2.28947$ , respectively. The difference was statistically significant ( $P < 0.05$ ). Tukey's test showed that there was significant difference between the two groups.

There was a significant difference between pre- and post-tests of each group ( $P < 0.05$ ). It is shown in Figure 1.

Comparison of posttests of all groups showed a significant difference ( $P < 0.05$ ). Tukey's test showed that there was a significant difference between the two groups except Groups 2 and 3.

Satisfaction opinion of students about the course was evaluated by Likert scale as 1 for the best and 5 for the worst. The mode of data was 2 (good) and there was no 5. Percentage of each mark distribution was 41.3% (great), 44.4% (good), 12.7% (mediocre), and 1.6% (bad) as shown in Figure 2.

When participants were asked about the recommended time of this course, most of them (57.1%) thought the best time to be preinternship (clinical clerkship). Distribution of student's opinion is shown in Figure 3.

## Discussion

Previous reports mentioned medical graduates are not capable of responding to related inquiries about laboratory tests. Also they cannot infer laboratory results in the most efficient approach. These problems are, because of insufficient compulsory knowledge

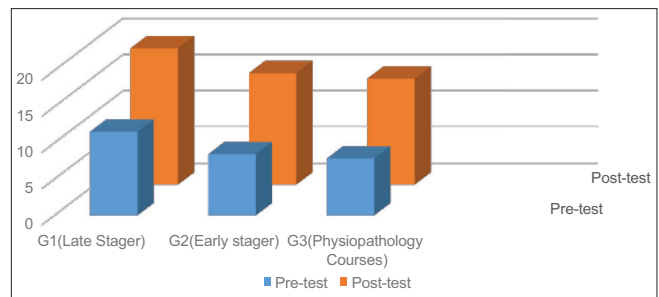


Figure 1: Result of knowledge-based multiple choice questions pre- and post-tests of different groups

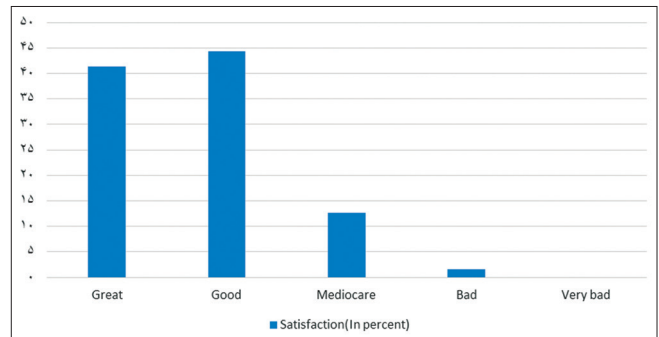


Figure 2: Satisfaction opinion of participants in percentage

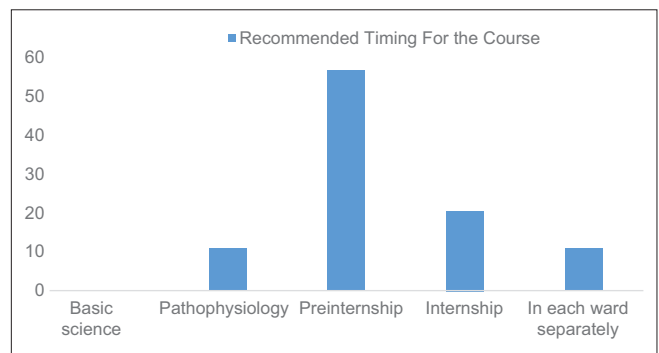


Figure 3: Distribution of students' opinion about the best timing for introduction to clinical pathology

about clinical pathology and all parts of laboratory medicine.<sup>[4,10-13]</sup> The main cause of this knowledge insufficiency is likely owed to the absence of official curriculum of education in clinical pathology field. Teaching of medical students and residents with focus on clinical education without attention to laboratory medicine as a separate core for can causes lack of complete ability to handle the patients paraclinical data in proper manner.<sup>[4,6]</sup>

An ideal course of teaching should finally bring trainees suitable knowledge and competency according to major goals of the curriculum.<sup>[14]</sup> Attaining the enough amount of knowledge can be easily determined by pre- and post-ICP quiz results.<sup>[3]</sup> Knowledge of the participants regardless of their level of education was improved

through a 1.5 working day curriculum as shown by test results; however, it disclose a restricted extent of knowledge gained newly. Results revealed that a rather proper improvement of laboratory medicine knowledge can be absorbed by medical students in different years of their course using just a short period of a pure practical crash course of training. Unfortunately, no study has yet done to show that after graduation this knowledge can be useful in practice for better service. This issue possibly can be evaluated by following and comparing the practice of experiment and control group in the near future.

In fact, one of the main purposes of this course was to make the atmosphere of clinical laboratory in a general hospital known for medical students. This makes them a good opportunity to get familiar with clinical pathologists', technologists', and technicians' domain. Such a mentioned opportunity in the current official curriculum is not available for them classically. In open-ended questionnaire, some of the participants wrote that getting familiar with clinical pathology laboratory and its personnel was an exciting experience for them. It can be predictable that having a good mental background about laboratory can help them to cooperate with this ward better when they are in real practice.

As a matter of fact, the main problem of performing such a course is locating the specified time in an already overloaded curriculum. Hence, we decided to run a brief package. Obviously, a 1.5-day ICP course is too short for teaching the whole recommended material;<sup>[4,10]</sup> however, that time was more than what all other students get during their entire education.

An interesting result came out of the study as we compared posttests of three groups that showed a significant difference in mean s. The difference was significant between the 5<sup>th</sup> year students with other two groups. There was a difference between two other groups in favor of 4<sup>th</sup> year students over 3 months but it was not significant. We assumed that, with more number of participants, the difference would be statistically significant. With regard to this part of results, we conclude that the more the students would have been trained in clinical medicine, the better they can get through laboratory techniques and knowledge. This would prepare us a good recommendation for choosing a good placement for timing of the course. We hypothesized that this course needs to be accomplished in clinical training phase near to internship; as we see that the more clinical knowledge the students had, the better they perform in laboratory and the faster and the stronger they learn.

We believe that for designing a better scheduled and more efficient period, such course or something similar

should be used by other universities and should be implemented at various time periods during the official curriculum. Finally, the results should be obtained together and an ultimate recommendation should be derived.

Some advice from participants and some experiences from facilitators surely made us a better way to perform much better. Most students did not like prolonged lectures, otherwise they liked the concepts in practice, especially when they were with some fun and competition; for example, results of Gram-staining and counting on a peripheral blood smear. The tours around different parts of laboratory were well accepted by most of the participants. Involvement of laboratory staff would make some students more comfortable at laboratory, which was mentioned by some researchers.

Conclusively, we have designed a 1.5-day introductory course for learning clinical pathology for medical students. Through the ICP, 63 medical students visited general medical laboratories under the supervision of a clinical pathologist, watched and performed selected major tests of each branch laboratory medicine, and achieved general concept of techniques and science of clinical pathology through interaction with clinical pathologists, technologists, and technicians. A 20-MCQ pre- and post-test demonstrated a statistically significant increase in knowledge. Similar ICP formats could be implemented by other medical schools to successfully impart laboratory medicine concepts to medical students.

We highly recommend our colleagues in different institutions to have more studies trying to evaluate more models and patterns of teaching clinical pathology. It will also be curious to find how this course may have affected the later practice of participants in comparison with others who did not contribute.

### Recommendation

The authors strongly suggest putting a course of clinical pathology at the phase of clinical clerkship like other practical rotations of clinical wards for students. It should include lectures for general information and protocols, round and rotations in different sections of a general laboratory for seeing and doing tests under direct supervision of a clinical pathologist, an introduction of quality control, laboratory informatics and economy, and finally interpretation of tests.

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## Conflicts of interest

There are no conflicts of interest.

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