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Early Incorporation of Ultrasound Into the Medical Curriculum Through its Association with Human Anatomy

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ABSTRACT

Introduction: ultrasound is one of the most important imaging techniques in medicine with unique advantages: portable, low cost and provides real-time imaging.

Objective and Methods: The objective was to evaluate the perception of medical students about the implementation of ultrasound in the medical course through the application of a questionnaire, based on the Likert Scale, containing twelve questions about the course involving topics such as workload and clinical applicability of the information learned with descriptive analysis of the data.

Results and Discussion: There is a perception of the need for a longitudinal ultrasound curriculum and the authors suggest, as a first step of this process, the association between Anatomy and Radiology and Imaging Diagnosis with other insertions in Semiology and clinical surgical disciplines with a more robust ultrasound course in later stages of graduation.

Keywords: Education medical; Students, medical; Ultrasonography; Anatomy.

Introduction

Ultrasonography has several advantages, including bedside assessment, ease of use, non-invasiveness, absence of radiation or contrast, in addition to being a low-cost method, occurring in real time and facilitating decisions in the medical emergency^{1,2,3,4,5}.

Ultrasound skills improve the information collected in the physical examination and provide the physician with greater skill in caring for patients, especially individuals who are in serious condition or who need quick decisions^{3,5,6}. As such, a general understanding of the different imaging modalities, as well as basic interpretation skills of these studies, are becoming increasingly important in medical practice^{2,6,7,8,9}.

In this context, throughout the medical course, students must acquire a basic knowledge of radiology and ultrasound, noting that their use in medical practice, regardless of the specialty in which they progress, will be essential and, over the years, it is necessary the increase in educational activities to explore this aspect^{4,10,11,12}.

There is unquestionable interdisciplinarity between the disciplines of Anatomy and Radiology, and is important to incorporate recent technologies, which is the current trend to be followed in the educational sphere, with the implications of this process still needing to be debated^{6,13,14,15}.

Given all these aspects, ultrasonography was recently incorporated as a teaching modality in our institution and the aim of the present study was to assess the perception of medical students about its

beginning as well as limitations and virtues in this process.

Materials and Methods

The current work is classified as descriptive and transversal type. Medicine students who started ultrasonography classes in 2019, from the Medicine course at the Faculty of Medical Sciences and Health of Juiz de Fora (SUPREMA), were selected. They were informed about the study and consent through the informed consent form. The study was approved by the Ethics Committee (CAAE nº 74369317.2.0000.5103). The inclusion criteria were students who started the ultrasound course at a medical school in 2019 and students who did not complete the ultrasound course (because it is an optional subject), who did not respond adequately or completely the questionnaire were excluded or who did not wish to participate in the study. This non-probabilistic sampling aimed to assess the perception of students regarding the incorporation of ultrasound in that educational institution.

The course consisted of two weekly 90-minute classes with exposure of images of the main pathologies followed by hands-on training for a period of two weeks for two academic semesters.

Data collection was carried out through simple interviews. The instrument used was a structured questionnaire with closed questions, previously tested with 12 multiple-choice questions based on the Likert Scale, each with five options: completely agree, partially agree, neutrality, partial disagree,

and complete disagree. To determine what would be essential to address in the questionnaire, three main sources were used: “The German ultrasound society”, “National Competence-Based Learning Objectives for Undergraduate Medical Education (NKLM)” and the literature published in the main research databases.

The following aspects were addressed: knowledge of instructors on the subject, improvements in

Table 1

Variables	Answers	Percentage
My instructor had complete understanding about the class	I totally agree	75,8 %
	I partially agree	21,2%
	Neutral	0
	I partially disagree	0
	I totally disagree	3%
The class improved my clinical skills	I totally agree	39,4%
	I partially agree	48,5%
	Neutral	9,1%
	I partially disagree	3%
	I totally disagree	0
The class helped to improve my organizational skills	I totally agree	27,3%
	I partially agree	18,2%
	Neutral	45,5%
	I partially disagree	9,1%
	I totally disagree	0
The class helped me to consolidate prior knowledge	I totally agree	48,5%
	I partially agree	39,4%
	Neutral	3%
	I partially disagree	9,1%
	I totally disagree	0

Table 2

Variables	Answers	Percentage
I will use my skills learned in the course in practice future	I totally agree	63,6%
	I partially agree	24,2%
	Neutral	12,1%
	I partially disagree	0
	I totally disagree	0
The ultrasound skills will add traditional skills of semiology	I totally agree	87,9%
	I partially agree	12,1%
	Neutral	0
	I partially disagree	0
	I totally disagree	0
In relation to the level of satisfaction From practical training through the ultrasound	I totally agree	39,4%
	I partially agree	45,5%
	Neutral	9,1%
	I partially disagree	0
	I totally disagree	3%
Were you satisfied with your curve? of learning during the course	I totally agree	24,2%
	I partially agree	54,5%
	Neutral	12,1%
	I partially disagree	9,1%
	I totally disagree	0

clinical skills after the course, improvements in organizational skills, consolidation of previous knowledge, perception of use in future practice, addition to semiology knowledge, level of satisfaction with the course, learning curve, need for more hours/ classes, earlier start of graduation, improvement of anatomy knowledge and need to insert new health technologies. Data were descriptively analyzed using relative frequency distribution tables.

Table 3

Variables	Answers	Percentage
The ultrasound class needs More hours	I totally agree	87,9%
	partially agree	9,1%
	Neutral	3%
	I partially disagree	12,1%
The ultrasound class should be inserted earlier in medical course	I totally agree	18,2%
	partially agree	51,5%
	Neutral	15,2%
	I partially disagree	3%
The ultrasound classes improved my knowledge of human anatomy	I partially disagree	12,1%
	I totally disagree	18,2%
	I totally agree	45,5%
	partially agree	45,5%
Considers important the insertion of New technologies for students of medicine	Neutral	6,1%
	I partially disagree	0
	I totally disagree	3%
	I totally agree	97%
	partially agree	3%
	Neutral	0
	I partially disagree	0
	I totally disagree	0
Total		33 (100%)

Results and Discussion

At the end of the study, 33 medical students were interviewed, 93.9% of whom are students from the 10th period of medicine and 6.1% from the 11th period of medicine at the institution of higher education.

Initially, it is important to emphasize the perception that the instructors had an excellent knowledge of ultrasound (approximately 97% approval) and can perform an excellent service for the students. Other studies such as Toledo *et al.*, Camilo *et al* and Nourkami-Tutdibi N *et al.* demonstrated the need to assess the quality of the ultrasound course, including through OSCE and evolutionary assessments of knowledge acquired before and after the course. In this last study mentioned, the most important point of the study was precisely the submission of students to the OSCE to assess the quality of the course's didactics, finally observing the level of knowledge acquired by the students^{4,7,8,16}.

Another fact that corroborates previous studies, is that ultrasound can improve and consolidate clinical

skills and prior knowledge, both with almost 88% of affirmative answers. This information, despite being intuitive, clearly demonstrates that there is enormous interdisciplinarity between the knowledge of ultrasound with medical practice and with other undergraduate disciplines. Consequently, it must be reinforced that the introduction of this modality improves and consolidates the course and other disciplines in a global way, connecting concepts and making professionals more complete.

It should be noted the lower rate of the personal learning curve in relation to other criteria (less than 80%). Toledo *et al.*, 2021, in their work on ultrasound teaching, showed a similar conclusion, as the method presents a difficult practice that requires greater dedication and continuity over time, the students' perception is that they cannot reach a level of excellence at first. Thus, we emphasize the need for a longitudinal ultrasound curriculum with its insertion at different times in the undergraduate course^{5,11}.

It is essential to emphasize that students believe that having an ultrasound associate with the ability to use it will improve their skills in semiology. All students believe that ultrasound (100%) would be able to improve the physical examination. Thus, training non-radiologists in interpretation skills is essential to reduce unnecessary image exam requests and allow faster and more efficient diagnosis^{9, 10, 11,12}.

Another relevant fact was to verify the huge percentage (87%) of positive responses when considering the practical application of ultrasound knowledge. The interpretation and use of images are no longer reserved for radiologists, it requires education focused on practical interpretation skills to decrease the error rate of non-specialist physicians, especially in newly graduated physicians who are predisposed to overestimate their skills and have less experience in physical examination^{10,11,13}.

In the table above, we analyzed initially contradictory data, but relevant after a thorough analysis: 97% of students would like more hours/class in the ultrasound course, but there is a lot of division in the answers about the best time to enter the course. Students want a longer ultrasound course, with more hours/classes, but they believe that, due to technical difficulty and the need to provide clinical, surgical, anatomical and semiology knowledge, it should still be carried out from the middle of the graduation course or at least have doubts about the best time^{4,9,12}. It is also highlighted by the association with other answers and analyses, that students notice the need for insertions of ultrasound through other subjects of the basic and technical course, such as anatomy and semiology^{6,7}. Thus, the perception of students through the answers

is the same as that of several important authors: the need for a longitudinal ultrasound curriculum with insertions in initial undergraduate subjects such as Anatomy and Semiology associated with more robust theoretical practical classes in more advanced stages of the course¹⁶.

It is also noteworthy the very high association with 91% improvement in knowledge of human anatomy and the completeness (100%) of the study participants consider essential the insertion of new technologies. Ultrasonography allows the visualization of blood vessels, nerves, muscles and organs in real time, something of great value for anatomy students who currently have most of their teaching on inanimate mannequins, as well as helping to improve their understanding of the three-dimensionality of anatomical structures^{4,5,6}. Early exposure to radiological cross-section images during introductory anatomy and dissection courses enhance students' understanding of anatomy and radiology. Finally, the exchange with the imaging specialty, which inherently requires the incorporation of technology, can be an opportunity for the insertion of technology in undergraduate practice since the beginning of the course^{15,16}.

Some limitations are recognized in our study. First, the number of students included was small. Second, only short-term knowledge was assessed. Finally, an analysis was performed only on perception data. However, our objective was exactly to translate the first perceptions about the implementation of ultrasonography, providing a possible and agile change of course in teaching.

Conclusion

The teaching of ultrasound and new technologies is essential for future medical practice and needs to be improved in medical schools. Incorporation at earlier stages of the course and association with anatomy can be encouraged, as well as subsequent association with other disciplines. The gap that occurs between the basics of anatomy and semiology and the teaching of medical imaging makes students have difficulty in the practical application and in taking advantage of the course itself. It is natural and essential for students to incorporate new technologies and there is a perception of the need for a longitudinal ultrasound curriculum, and the authors suggest as a first step in this process the association between Anatomy and Radiology and Diagnostic Imaging with other insertions in Semiology and clinical surgical disciplines with a more robust ultrasonography later course in more advanced stages of graduation.

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