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Role of magnetic resonance imaging and cross sectional images in Neuroanatomy Course Syllabus

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ABSTRACT

Radiology has been developing dramatically during the previous years. With enhancements in magnetic resonance imaging (MRI) and computed tomography (CT), the role of the radiologic technologist has also been changing. Skills in cross-sectional anatomy are vital to assist the technologist in MRI and CT to identify the anatomy being imaged and to communicate effectively with the radiologist and physicians. Our study plan had two parts performing two methods (A and B). In the method of A which applied in the first half of the semester (8 weeks), our education was based on the lecture in which the lecturer used power point slides in a classroom and examined on the human body in an anatomy lab. In the method B which applied in the 2nd half of the semester (8 weeks), the education plan was based on the lecture, using power point slides, body examination and using MRI images from homemade software (Cross Sectional Anatomy of the Skull and Brain software; Tehran, Digital Medical Group, Iran). It seems that planning efficient methods for fast and simple learning, which are less dependence to memory and consolidation of learning in anatomy of nervous system is necessary in the academic educational system.

KEY WORDS: MRI, Imaging, course plan, education.

1. INTRODUCTION

University of medical sciences in addition to providing health care services to people is also responsible for training the needed skilled human resources of the different parts of the society. This requires that medical education continues to be under review and will try to fix flows in its promotion. The medical education process is under the different variables. These factors are: student, trainer, training, educational methods, and learning resources, developing process of educational technologies and electronic learning, timely response to the growing changes in modern technologies. From one hand, management of training plans in the age of communication lead to the learner up to date; on the other hand, having a skilled physician as the output of medical education system causes public health. Learning different skills such as e-learning can make it easy for student to use the knowledge and medical school is laid around the use of such skills and knowledge. Since it is important that the intelligence community has lead constant changing in the medical knowledge, as every 4 to 5 years, on average, %50 of medical knowledge and during 7 to 8 year %75 of it becomes old. Naturally, the whole obtained knowledge and abilities at the end of the general practitioner or specialized sufficient for therapeutic activity in the future. The effects of e-learning growth in the field of medical sciences are impressive and, it is important to consider the effect of electronic learning in medical sciences (Education, 2003, Ruiz, 2006). The studies in medical schools appear to show that the clinical education is an important part of medical education that without it training the qualified physician is so hard. The most important concern of medical educators either in Iran or the other countries is to do their best to provide an effective relationship between theoretical learning and field of work for the student. On the other hand, information technology (IT) and the effect on curricula are considered as the future challenges. In this regard, the activity of the researcher is to check the status of e-learning in medical education. Transition in to communication era and effective living in information-based society requires an understanding of its features. One of the social institutions which have undergone vast changes is the training and learning institution in the level of public institution, excellent education and learning. In the transition to an information society, the major role is the alumni community; learning and training should be planed based on new approach. The prerequisite of this transition is fast development of electronic training, from the lowest level to the highest level of the training system of the country. The science growth model is transition from one paradigm to another paradigm. And in any field, one paradigm can be formed. IT is a new paradigm that is applicable in any field and in addition to creating other paradigm, causes a change in the face of our world and has provided the appropriate training requirement tailored to the needs of the present. For example, electronic training has created a new paradigm in the training and learning field and has provided the learning requirement in anything, for anyone, anytime and anywhere appear to show that different countries such as America, Canada, Australia and

China are pioneers in the use of e-learning medical education (Khan, 2004; Sharp, 2006). In medical schools of America such as Harward, Colombia, Bostone and Mishigan online medical courses (often basic sciences) and computer-based (computer-based education). On the other hand, anatomy is one of the important courses for the student (Gogalniceanu, 2008; Fitzgerald, 2008; Shaffer, 2004; Matzkin, 2005). Since renaissance anatomy of the human body has been known as the central core of the medical training and consecutive year, has played this role, students and paramedics becomes familiar with medical language in addition to learning the anatomy (Parker, 2002). Anatomy is not only the studying of the structure and morphology, but also the student in addition to anatomy learning, becomes familiar with the geography of body (Guttmann, 2004). All the human either consciously or unconsciously are constantly processing spatial information about the surrounding area (Khoshvaghti and Ghasemi, 2010). Such information are the stimulator of mind to visualize, curiosity and recognition (Pani, 2005). In the past, 3-dimensional (3D) and spatial mostly limited to 2-dimensional (2D) images in the books and medical Atlases which somewhat were able to help understanding of the anatomy, however, many of the students had problem with anatomy understanding; specially some of them can hardly change the 2D images in their mind. Generally, the reasons of failure to understand 3D are:

a) Transition from 2D structures to the individual imagination and creating the 3D concept, is not a simple process (Miles, 2005).

b) The students are not able to draw up the mental images of 3D objects.

c) It is not usual to encounter with 3D objects (Reeves, 2004).

d) We don’t often concentrate during the 3D learning (Patten, 2007).

Therefore, it is logical if we assume encountering with 2D images (in the books, medical atlases, pictures drawn on the whiteboard or handouts) is not enough to help the student to create the 3D images in their mind (Gurny, 2003, Shin, 2011). 3D images of is an important topic in anatomy learning (Khalil, 2008, Sempere, 2011). One of the processes of creating 3D images is considering the same active object which is the pattern of the 3D object. As human beings is a 3D object, medical education moves in order to learn anatomy (Hauptman, 2010). Spatial understanding of the anatomic structure is an important subject in anatomic learning (Nicholson, 2006).

Human anatomy is one of the basic sciences in medical studies. Since the advent of X-rays to the current date, imaging techniques to picture the human body have become an indispensable instrument for identifying and managing manifold conditions. Previously, contemporary medicine desires to reach precise diagnoses, establish suitable treatments, study prognoses and monitor disease development. Anatomical knowledge is a key to all of this. Radiology has been developing dramatically during the past few years. With enhancements in magnetic resonance imaging (MRI) and computed tomography (CT), the role of the radiologic technologist has also been changing. Skills in cross-sectional anatomy are significant to help the technologist in MRI and CT to detect the anatomy being imaged and to communicate effectively with the radiologist and physicians (Rostamzadeh, 2014).

Conventional radiology; notwithstanding the fact that this technique utilizes ionizing radiation, conventional radiology shows an important place in diagnosis for the reason that it is available and broadly accessible. The images obtained are the result of the overlapping anatomical structures. Physicians should be acquainted with the anatomical and pathological info provided because, along with the patient’s clinical history and physical examination, it can be crucial to proper diagnosis. It helps to prevent not only false-positive diagnoses that may lead to a host of complementary tests but also the dreaded false negatives that contribute to significant diagnostic delay Sectional anatomy

The residual three diagnostic approaches are all sectional methods that primarily use the axial, coronal or sagittal planes but they can also use any oblique plane that is suitable for presenting the anatomy and pathology. Sectional anatomy is the usual method of presenting modern diagnostic methods. It is little known and is spatially difficult to understand. It must be viewed sequentially to prevent errors in analysis and needs important software provision to see the images (Figure 1).

a) Ultrasound: This sectional method is extensively used and is based on sound waves, meaning that it is without side effects. It differs from other imaging techniques because it allows dynamic and real-time visualization of anatomical structures. It provides information about an anatomical region through sections of that region, although it does not include all the region’s structures in a single section. The resulting image can be problematic to infer since it is operator-dependent and only the person who created it knows what type of section was made.

b) Computed tomography: This is an imaging technique that offers comprehensive anatomical info of an area of the human body since it images the whole region. As a result, it offers images in axial plane which can later be reformatted into other planes and even turned into three-dimensional images thanks to volumetric data acquisition. The advent of multislice and helical CT has augmented its status as a diagnostic tool, and today it has become indispensable for the diagnosis and follow-up of many diseases. Because this technique uses ionizing radiation it must be employed with caution. However, multislice technology and new low-radiation techniques have intensely reduced the scanning time and thus the radiation dose, all of which promises well for the technique’s prospect.

Iodinated non-ionic contrast media can be administered by a power injector. This allows vessels to be visualized directly and increases the density of organs and tissues, thus allowing them to be better characterized and facilitating diagnosis.

c) Magnetic resonance: This is a sectional method based on applying radio waves to a magnetic field. It provides an essential image of the central nervous system and musculoskeletal soft tissues. It does not utilize ionizing radiation so it can be tailored for children and expecting mothers from the second trimester on. The chief problems are longer scan times and higher cost. Prolonged scan times and confined spaces can also cause claustrophobia. Also, given the magnetic field some patients with metal implants or pacemakers cannot be scanned using this technology.

One of the important questions of the anatomy educator is that which method is more appropriate for efficient teaching of 3D information (Marks, 2000).

It is hard to describe different parts of neurology and interactional parts and the educator usually teach theoretically. Because of the complexity of nervous system and the elegance of anatomic nervous system; it is not efficient to apply older methods to teach anatomy (Pani, 2013).

Older methods cause problem. The anatomy of nervous system is so elegant that many of the students forget it quickly (Kubo, 1998). According to the mentioned limitations, it seems to be necessary planning efficient methods for fast and simple learning, which are less dependence to memory and consolidation of learning in anatomy of nervous system (Ramsden, 2003, Warren, 2006).

2. MATERIALS AND METHODS

This experimentally study was planned to evaluate the level of learning in different educational degrees of medical students who studied at the Iran University of Medical Sciences. The study population was including medicine students in basic sciences level (n=24), medicine students in intern stage (n=6), radiology (resident) students (n=12), neurosurgery (resident) students (n=8). Students who passed neuroanatomy courses of were eligible to participate in the study. The course name was cross sectional anatomy and it was offered from October 2013 to December 2013. Three specific questionnaires were planned for different steps of the study. Students who had no cooperation to fill in the questionnaires and those who had no acknowledge the reluctance to participate in the education were exclude from the study. Our study plan had two parts performing two methods (A and B). In the method of A which applied in the first half of the semester (8 weeks), our education was based on the lecture in which the lecturer used power point slides in a classroom and examined on the human body in an anatomy lab. In the method of B which applied in the second half of the semester (8 weeks), the education plan was based on the lecture, using power point slides, body examination and using MRI images from homemade software (Cross Sectional Anatomy of the Skull and Brain software; Tehran, Digital Medical Group, Iran). Figures 2-4 are samples of T2 weighted image of brain provided by the software. Semester course plans included goals and learning expectations and educational content of any sessions were available to students.

Students were forced to study related session content before starting each educational session. The course trainer asked question by dividing the content of any session in two small units. The course trainer had listened to the answers and with the help of the other students. From the beginning to the end of the sessions of each half semester, any student has been given a specific questionnaire to test the learning by marking the number from 0 to 20. At the end of each part, the student's satisfaction from teaching method was determined by a method similar to the learning test, on the basis of 20. Finally, an exam was performed. The questions were selected from a questions bank. The difficultly index of the exam was medium, as it had very difficult, difficult, medium, easy and very easy questions. The number of all groups of the questions was equal. Statistical analysis (Student T-test and repeated measured ANOVA) was performed applying SPSS (version 19; SPSS Inc, Chicago, IL, USA). P-value are two sided at a significant level of α=0.05.

3. RESULTS

Our data base showed that 37 females and 13 males (average age of 21.5±1.04) were participated in the study. The student's satisfaction of the teaching in the method of A was about %58; while in the method of B was about %82. The results of the study are summarized in table 1. As table 1 reveals, lecture made student less uneasy than question-answer method teaching by student had made a medium anxiety. Thus, at the end of the session there was a significant reduction in the student's anxiety by this method of teaching (p=0.0001).

Findings appear to show the average academic achievement in the method of teaching by student is about (15.10) and question-answer (14.80) is significantly (P=0.0064) more than the score obtained by lecture (12.62). There was not any significant difference between the girl's anxiety and the boy's, academic achievement and their satisfaction of the teaching method.

Table.1. Teaching method and its related variables

Variables studied	Teaching method	Mean ± SD			Result Repeated measure ANOVA
		Girls	Boys	The whole class	
Satisfaction from teaching	The master lecture	3.23±0.11	3.51±0.24	3.35±1.19	P=0.031
	Question-Answer	3.57±1.32	3.73±1.19	3.65±1.25	
	Taught by MRI images	5.09±1.26	5.10±1.19	5.10±1.21	
Anxiety	The master lecture(first)	1.95±1.11	1.89±0.99	1.92±1.04	P=0.017
	The master lecture(end)	1.76±0.83	1.68±0.67	1.72±0.75	
	Question-Answer (first)	6.09±2.30	6.31±2.76	6.20±2.50	
	Question-Answer (end)	4.47±2.01	6.10±2.37	5.77±2.18	
	Taught by images MRI (inception)	4.47±1.24	4.15±2.06	4.32±1.67	
	Taught by images MRI (end)	3.33±1.65	3.42±1.42	3.37±1.58	
Learning	The master lecture	13.00±2.40	12.21±1.87	12.62±2.18	P=0.0064
	Question-Answer	14.95±1.62	14.63±1.34	14.80±1.48	
	Taught by MRI images	15.33±1.23	14.84±1.50	15.10±1.37	

Discussion: The rudimentary sciences of anatomy, physiology and biochemistry have reinforced the teaching of medicine for decades. In the 1879 Hunterianoration, stated that: "The awareness of the facts of anatomy [is] vital to the practice of surgery, and to an appreciation of physiology; and their correct education endorses the practice of attention, and of precision which is the subordinate of attention. Still it may be questioned whether. The result is proportionate to the time and labor expended. Certainly there is no subject which men exhibit so much proneness to forget. The knowledge, painfully acquired, is strikingly held and cheerfully let go".

Human anatomy formulates the basis for clinical medicine; thus its place in the medical curriculum deserves cautious awareness. Despite the information explosion from medical research and the rapidly expending diagnostic and therapeutic possibilities of medical technologies, operational health care still rests on a solid anatomical foundation; this comprises the basis of clinical diagnosis, the physical examination.

Nowadays it is clearly that cross sectional anatomy is completely dependent to medical imaging and radiological sciences. Moreover, cross sectional anatomy is a basic course for some diagnostic courses in radiology such as evaluation and interpretation of radiographs. Therefore, in educational system in order to have a complete learning for trainers such as radiologist students, cross sectional anatomy should be trained accompanying with images obtained from CT-scan, MRI, and ultrasound (Fatehi, 2016).

Increasing technology of web and electronic information the Internet has become the preferred medium for e-Learning in the field of education. Medical education requires a variety of material; educational, graphical, physical, and factual information. The traditional medical education involves the use of texts, lectures, images, and books. This old style of medical education is enhanced through incorporating e-Learning strategies. With the advancement in the technology, electronic learning has become an essential asset in the field of medical education, especially in radiology education because of intense imaging involved in the study. Radiology education is important not only for radiographers or doctors specializing in radiology but is equally important for junior doctors and undergraduate medical students so that they do not miss any critical finding while reviewing images. In medical education, radiology teaching is a significant part of the undergraduate medical curriculum. Significant improvements in diagnostic imaging in current years have formed novel approaches in which to portray the construction and function of the human body, counting functional and molecular imaging and magnetic resonance spectroscopy. Furthermore, improvements in information technology have increased the methods in which diagnostic images can be displayed, stored and transferred. The 3D reconstructions and "virtual endoscopy" can now be performed in seconds, and picture archiving and communication systems (PACS) allow transfer of diagnostic images to multiple sites, not only for clinical but also for educational purposes. Furthermore, although the importance of anatomy in the undergraduate medical curriculum remains undisputed, there is currently debate concerning methods for delivering anatomy teaching. In particular, the use of cadavers for dissection has been identified by some as expensive, time-consuming and potentially hazardous. Indeed, certain novel medical schools have castoff dissection altogether, seeking substitute methods in anatomy education, counting the use of diagnostic images. Although radiologists have been involved in anatomy teaching to medical students for decades, the above factors have led to a renewed interest in the place of diagnostic imaging in undergraduate medical education. The purpose of this article is to review the deployment of diagnostic imaging in the learning of anatomy and other basic sciences, highlighting new opportunities and discussing the relationship to cadaveric dissection. Regarding to advantages of imaging to cadaveric dissection with such educational possibilities offered by the use of medical imaging, it could be asked whether there remains any need to use cadaveric dissection for teaching anatomy. However, many course trainers consider that dissection offers benefits that cannot be achieved with anatomical models or medical images. Certain structures may be tough to show sufficiently with current imaging techniques, for instance peripheral nerves with complex courses. Also, dissection confers an appreciation of the "feel" of tissues and organs, and provides an occasion for students to confront issues surrounding trauma and death in methods that medical images cannot. There are few data comparing the effectiveness of imaging and dissection as alternative tools for learning anatomy. On the other hand, studies have suggested a synergistic relationship between these styles of education. Radiography of cadavers for instruction purposes was proposed more than 20 years ago, and merging medical imaging with cadaveric dissection has been described to create a high level of student interest in gross anatomy that has been confirmed by student feedback at our institution. The combination has been shown to improve students' capability to recognize anatomical structures is related with high levels of lasting information retention. The accessibility of medical images in the dissection room has been shown to enhance the independence and proficiency of students and improve the efficiency of their dissection time. Provision to students of a set of cross sectional images (CT or MRI) for the individual cadaver they are dissecting has great possibility to increase the benefits of this combined learning approach even further (Fatehi, 2016).

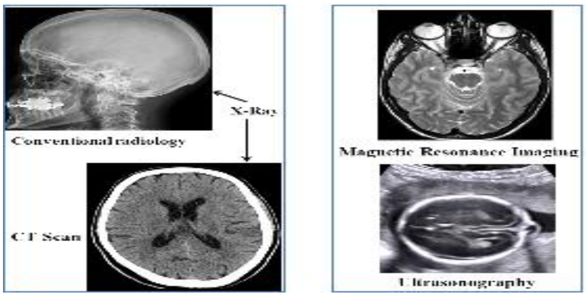

Figure.1. Imaging technologies that use the different electromagnetic waves for cross sectional visualization in medical imaging applications.

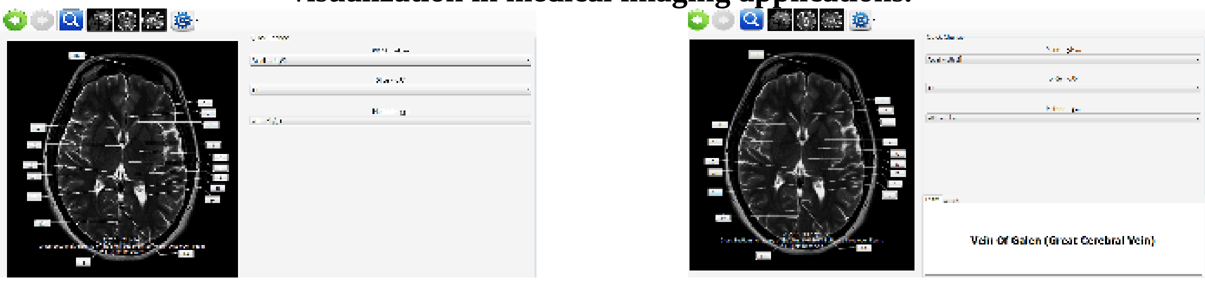

Figure.2. An axial T2 weighted image of brain in level of frontal sinus, which is a sample of images provided by the homemade software (Cross Sectional Anatomy of the Skull and Brain Software).

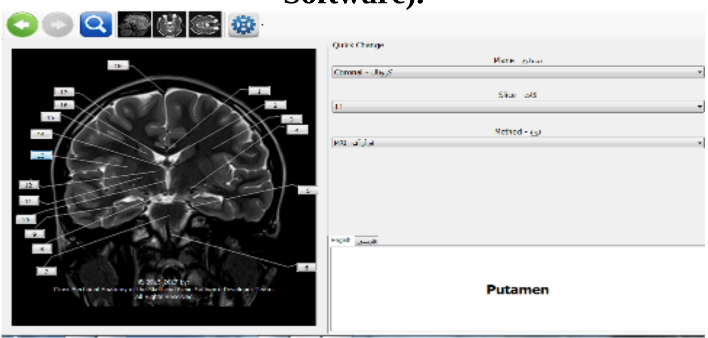

Figure.3. A coronal T2 weighted image of brain in level of external acoustic meatus and tympanic region of temporal bone which is a sample of images provided by the homemade software (Cross Sectional Anatomy of the Skull and Brain Software).

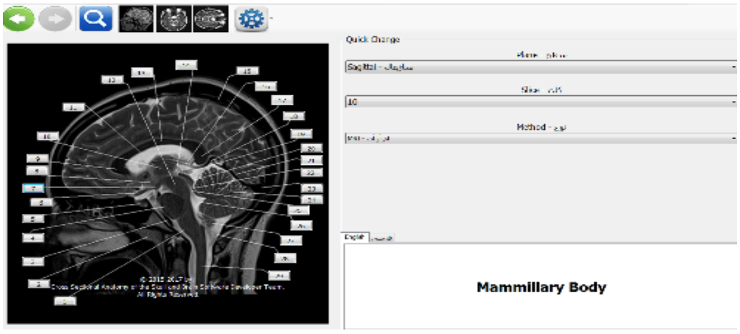

Figure.4. A sagittal T2 weighted image of brain in mid-sagittal plan of body which is a sample of images provided by the homemade software (Cross Sectional Anatomy of the Skull and Brain Software).

4. CONCLUSION

While the main emphasis in the early years of medical education is on standard anatomy, the use of nonstandard radiographs need not be excluded at this stage, because disease processes often reveal anatomical features not visible on normal studies. Similarly, Pathological calcification can disclose the size and position of the adrenal glands, which are normally invisible on plain radiographs. In this method, students gain immediate awareness of the clinical relevance of anatomical knowledge while also gaining familiarity with radiological signs. Much can be learned from diagnostic images included in clinically indicated examinations of patients, and additional opportunities are offered by imaging examinations of volunteers purely for educational purposes. Although more expensive, MRI offers even greater opportunities to demonstrate not only anatomy but also physiology and biochemistry. Functional MRI can demonstrate regional brain activation during a variety of cognitive tasks, and MRI spectroscopy can display the relative concentrations of biochemical molecules in a range of tissues. The use of imaging examinations in this method does create ethical issues arising from the possibility of finding incidental pathology. These issues already exist within medical education, for instance when students test their own urine for glucose, and are essentially no different when using imaging tests. However, obtaining written informed consent may be advisable, and it should also be made clear that students should not see imaging tests performed for educational purposes as an alternative to seeking medical attention through normal channels.

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