Innovative Methods of Teaching of Radiology to Undergraduate (MBBS) Medical Students

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Abstract
Main objective was to introduce radiology to medical students in their formative years itself. To start with radiological anatomy and then extend it to applied anatomy. We have tried an innovative and unique method of teaching radiology to undergraduate (MBBS) medical students. 28 medical students in their IX semester were included in this study. The study was divided into two module-Module-I-CHEST X-RAY; Module-2-CARDIAC X-RAY. Each module had specific structures, in the given x-ray, for learning. Each module lasted 6 days, each day devoted to particular structure of the day. Initially the students were given lecture-demonstration of chest x-ray. Later students were taken around for a mini-exhibition of chest x-rays in the same venue. At the end, students were asked to answer a questionnaire based on the topic of the day. On the last day there was interactive session during which correct answers were given, discussion on what mistakes the student had made; any doubts were cleared. On the last day of each module, students were asked to identify structures marked in normal chest x-rays for a practical orientation. A post-survey done at the end of both modules. The students felt that more time should be devoted to radiology and that the study should be extended to other x-rays and other radiological modalities. In the post-test survey 76% and 62% from module-1 and module-2 respectively wrote positive comments encouraging more such studies.

Keywords: Medical (MBBS) Undergraduate-innovative radiology teaching.

Introduction

In most medical schools all over the world, anatomy and medical imaging are not taught to a level to prepare undergraduate medical students for future entry into specialist training programmes (1). In the modern day clinical practice the importance of radiology is enormous. An ideal doctor should know how best to utilise radiology during his medical career as well when he starts practicing. Further the current generation of doctors have become very much dependant on radiology for making a diagnosis. Therefore it is imperative that the medical student learns radiology at the undergraduate level itself. A good clinician is one who has adequate radiological knowledge. To make good clinicians radiology should be taught at doctor –formative years itself, i.e in the undergraduate study years itself.

There is no specific teaching method yet available for introducing radiological anatomy (2). At present, during MBBS undergraduate study radiology is almost neglected. In some schools radiology theory classes are held during the first clinical year itself, where student is not in a position to appreciate the value of radiology subject, for he is a novice to even clinical medicine. The ideal time to introduce radiology to medical students would be in the final clinical years where the student has some clinical exposure and he is able to understand and utilise radiology best, not only for improving his examination performance but also to bring out a better clinician in himself (3). The current generation of doctors have become very much dependant on radiology for making a diagnosis. Therefore it is imperative that the medical student learns radiology at the undergraduate level itself**.**

Most students are motivated for learning basic radiology not only for their examination purpose but also to make them better physicians. We have taken up radiological anatomy in our first phase of study. Chest x-ray was taken up initially as there can be better radio-anatomical correlation.

We have devised an innovative and unique method of teaching radiology to undergraduate medical students. This method was very successful in our initial pilot study period, wherein chest x-ray interpretation was taken up. We hope and trust that this method could be extended to other x-rays like abdomen, limbs, spine, etc as well to other radiological modalities like ultrasonography, CT scan, etc. To the best of my knowledgement no such study has been made in the past in our part of the country. In every study, living anatomy could be combined with applied anatomy.

Methods

28 medical students in their IX (final year MBBS) semester during their routine radiology posting were included in this study. The hospital ethics committee approval was obtained. The students were briefed about the pilot study. Initially we took the chest x-ray interpretation for our pilotstudy modality. Chest x-ray is one which any doctor would come across in his day-to-day practic/career. The study was divided into two module-Module-I-CHEST X-RAY; Module-2 CARDIAC X-RAY. Each module lasted 6 days (Table-1) with a post-survey done at the end. The schedule for each module is shown below. The details of teaching activities for each module is given in Table-2.

Table-1 Overview of Two Modules

	MODULE-1	MODULE-2
DAY 1	Introduction To CXR	Introduction To Cardiac- X-Ray
DAY 2	Bony Cage & Diaphragm	Cardiac Situs, Shape, Size
DAY 3	Lungs	Cardiac Silhouette, Specific Chambers
DAY 4	Pleural Covering	Pericardium
DAY 5	Mediastinum	Great Vessels & Pulmonary Vasculature
DAY6	Practicals, Intreactive Session,Discussion, Post-Test Survey	Practicals, Intreactive Session, Discussion, Post-Test Survey

Table-2 Details of Teaching Activities in Each Module

DAYS	MODULE-1	MODULE-2
1	Introduction to x-rays; common views; AP view vs PA views; radiographic density; Good quality CXR; What to look for ?	Common views; AP vs PA view; Cardiac silhouette Good quality Cardiac x-ray; What to look for ?
2	Bones seen in CXR; Radiographic landmarks; Common eg. of altered density,contour	Normal cardiac situs, shape, size. How to measure cardiac size. Common eg of abnormal cardiac situs, shape, size.
3	Lungs-lobes, zones; Broncho-pulmonary segments; Fissures; Hilum. Common eg. of altered density, hilar, fissural positions.	Normal cardiac silhouette, components of it, Normal cardicac chambers. Common eg of abnormal cardiacsilhouette, chamber enlargement.
4	Pleural layers; divisions. Costo-phrenic angles. Common eg. of altered density	Normal pericardial layers; divisions; cardio-phrenic angles. Common eg. of altered density
5	Mediastinum definition; divisions; normal major structures in each; Common eg. of altered density, masses.	Great vessels- aorta, PA- normal size, shape. Normal pulmonary vasculature- arterial and venous. Common eg. of altered size, vasculature
6	Discussion, open session, Post test survey	Discussion, open session, Post test survey

This pilot programme had a six-step study for each module.

1. Initially the students were given lecture-demonstration of chest x-ray. The lecture part consisted of power-point presentation of chosen topic for about 45 minutes.

2. The students were taken around for a mini-exhibition of chest x-rays in the same venue. There were ten x-ray view boxes, each having two chest x-rays (x-rays displayed according to the topic covered that day). Totally twenty x-rays were displayed with labels on them. Oral demonstration was also given simultaneously.

3. At the end of the lecture–demonstration students were asked to answer a questionnaire based on the topic of the day. There were ten one- word answer questions specific for each day. Students were asked to answer what they heard, what they saw and what they learnt.

4. Later students were asked to identify structures marked in normal chest x-rays. Each student had to identify 20 structures, in the twenty normal x-rays displayed on view boxes, in twenty minutes.

5. On the last day there was interactive session in which correct answers were given, discussion on what mistakes the student had made, any doubts were cleared.

6. Finally each student was asked to give his candid comments on the feed-back forms given to them.

Total time spent in radiology department by each student everyday of the study was 75 minutes.

Each student had to answer fifty specific questions and ten post-survey general questions in each module.

Results

Of the 28 students posted in the radiology department only 24 regularly attended the pilot study on all the days. Other four students were absent on any one day or other. The students who were present showed much interest attended the class regularly and took active part in interactive session.

In the written test 38% in module-1 and 26% in module wrote all ten questions correctly. The percentage of students who scored between 7-9 was 58 and 50 for module-1 and module-2 respectively (TABLE-3).

In the practicals 22% from module-1 and 18% module-2 scored more than fifteen of twenty correct answers. The percentage of students who scored between 10-15 was 62 and 50 for module-1 and module-2 respectively (TABLE-4).

Overall the results were encouraging. The students felt that more time should be devoted to radiology and that the study should be extended to other x-rays and other radiological modalities.

In the post-test survey 66% and 52% from module-1 and module-2 respectively wrote positive comments encouraging more such studies (TABLE-5).

Table-3 Marks Obtained in Written Test N=24 X5 for each Module

marks	Module 1	Module-2
10	46/120 (38%)	32/120 (26%)
7-9	70/120 (58%)	60/120 (50%)
< 7	4/120 (3%)	28/120 (23%)

Table- 4 Marks Obtained in Practicals N=24 X20 for each Module

MARK	MODULE-1	MODULE-2
>15	110/480 (22 %)	90/480 (18 %)
10-15	300/480 (62 %)	240/480 (50 %)
< 10	70/480 (14 %)	150/480 (31 %)

Table-5 Post-test survey

PARAMETER	MODULE-1	%	MODULE-2	%
TOTAL NO. ANSWERED	23/28	82	26/28	85
ONLY 9 Q ANS.	18/23	78	20/26	76
COMMEN NOT ANS.	5/23	21	6/23	26
NO COMMENTS SUGGE.	6/18	33	6/23	26
POSITIVE COMMEN.	12/18	66	11/23	52

Conclusion

Radiology can be integrated into medical curriculum in a phased manner, for making them better future clinicians. This is only a qualitative, student perception, feedback study. Since it is teacher-oriented study. His teaching calibre and charisma plays a major role in attracting students. However the response from the students were very encouraging. We plan to introduce subject of radiology-oriented towards basic clinical studies, in a phased manner, in order to make better physicians of tomorrow. Radiology could be integrated into medical curriculum in a phased manner. During the 12 (6 DAYS FOR EACH MODULE) days of this course, students will develop on-going skills through self-evaluation as well as receive informal feedback from assigned radiologists. A pre-test is conducted at the start of the course to guage the students' abilities in x-ray interpretation. Following the completion of the course, there was a formal post-test covering content discussed in the modules.

Discussion

The medical student(s) of present generation should continually seek to improve their knowledge and skills by multiple means, be able to self-evaluate and apply new knowledge to his or her practice. Radiology has the ability to provide in vivo 2D, cross sectional, 3D and 4D views of the living body in health and disease. This ability to view living anatomy and pathology, as well as normal physiology and pathophysiology makes radiology images compelling to support and augment undergraduate teaching in anatomy, physiology and pathology. Radiology truly provides a link between undergraduate and postgraduate medical practice, as well as between classical undergraduate disciplines and day to day clinical practice.

The introduction of modern imaging techniques, especially ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI) has enormously expanded the already considerable importance of sectional anatomy. The radiologist, neurologist, internist, chest physician and oncologist, as well as specialists in the various fields of surgery, have had to re-educate themselves in the appearances and relationships of anatomical structures in transverse and vertical section.

Over the last few years there has been a proliferation in the growth,development and utilization of imaging technology.Radiology has become central to confirming clinical diagnosis.

Indeed, precise diagnosis, as well as the detailed planning of therapy (for example, the ablative surgery of extensive cancer) and of interventional radiology, often depends on the cross-sectional anatomical approach. Therefore introducing the subject of radiology to medical students has become a necessity. There are several reports about how each medical college adapts itself to this new challenge.

In 2007, the University of Sydney, Sydney Medical School, reviewed its curriculum, with 23 anatomy and six imaging recommendations for improvement [2]. In 2008, a new integrated anatomy and imaging curriculum was implemented, with total teaching hours changing from 50 to 170 hours.

Key points for the medical imaging component were: improving spatial and 3-dimensional imaging anatomy comprehension, recognition of key imaging anatomy structures and the use of medical imaging in clinical practise. The total medical course runs for four years, the first two based at the University campus, the last two based at clinical sites.

The Cleveland Clinic Lerner College of Medicine of Case Western Reserve University (CCLCM), developed (4) an innovative and unique approach to anatomy education. The challenge was to create a human anatomy course in the context of a problem-based, organ-systems-oriented curriculum stressing small-group, interactive learning, with no lectures and no traditional tests or grades. The available class time for this program in the first year was one morning a week for 1 hour 50 minutes for approximately 30 weeks.

In an integrated method of education, medical students were introduced to radiology in their preclinical years, a study in Pakistan. Their study aimed to document and

compare the current level of teaching duties, teaching methodologies, and teaching rewards among radiologists and residents in private and public teaching hospitals in Karachi, Pakistan (5).

In order to make the radiology study effective I have the following suggestions;

1. Radiological anatomy should be taught during first year itself. This would make the student understand better the cross-sectional anatomy, understand in depth the anatomy of complicated organs/regions. Knowledge of cross sectional anatomy would help the students during his surgical training and clinical examination. A live, in-vivo anatomy by real time images would be a boon to young doctors.

2. Students should be exposed to radio-pathological correlation as often as possible.

3. During clinical posting, radiological interpretation of common diseases should be encouraged, during rounds and class discussions.

4. This method of radiology teaching should be extended to other x-ray studies (like abdomen, spine, barium studies, etc.) and other radiological modalities (ultrasonography, CT scan etc).

The medical student(s) of present generation should continually seek to improve their knowledge and skills by multiple means, be able to self-evaluate and apply new knowledge to his or her practice.

Radiology has the ability to provide in vivo 2D, cross sectional, 3D and 4D views of the living body in health and disease.

This ability to view living anatomy and pathology, as well as normal physiology and pathophysiology makes radiology images compelling to support and augment undergraduate teaching in anatomy, physiology and pathology.

Radiology truly provides a link between undergraduate and postgraduate medical practice, as well as between classical undergraduate disciplines and day to day clinical practice.

In many ways the skills needed to look at diagnostic radiographs are the same ones used for performing physical examinations on patients. For example, careful observation of findings coupled with a systematic review of systems are the same in both. Actually, review of radiographic images could be called an "internal physical examination. The current generation of doctors have become very much dependant on radiology for making a diagnosis. Therefore it is imperative that the medical student learns radiology at the undergraduate level itself. Most students are motivated for learning basic radiology not only for their examination purpose but also to make them better physicians.

In most medical schools all over the world, anatomy and medical imaging are not taught to a level to prepare undergraduate medical students for future entry into specialist training programmes.

There is no specific teaching method yet available for introducing radiological anatomy. Hence our innovative, unique technique is formulated.

Therefore introducing the subject of radiology to medical students has become a necessity. There are several reports about how each medical college adapts itself to this new challenge. The University of Sydney, Sydney Medical School, reviewed its curriculum, with 23 anatomy and six imaging recommendations for improvement. Now a new integrated anatomy and imaging curriculum was implemented, with total teaching hours changing from 50 to 170 hours.

Key points for the medical imaging component were: improving spatial and 3-dimensional imaging anatomy comprehension, recognition of key imaging anatomy structures and the use of medical imaging in clinical practice.

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