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Role of abdominal ultrasound - an aid in teaching of pre-clinical anatomy

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Abstract

Introduction: Ultrasound teaching of anatomy was commenced for the first time in November 2015 with the start of new academic year for First and Second Year MBBS students. Here we present results of a survey done to find the student feedback on teaching of abdomen with the help of ultrasound from second year MBBS students.

Objective: To assess if the ultrasound teaching can be integrated in the subject of Anatomy and to know the students perspective on abdominal ultrasound teaching.

Methodology:Ultrasound classes were held once a week. Students were divided into smaller group – each group consisted of 15 students and had both the genders in the group. The academic year consisted of two semesters- 8 classes were held in the first semester and 8 more classes were held in the second semester.

A survey was done by requesting the second year students to fill up the questionnaire and be frank in their opinion. The survey was done after completion of both the semesters and prior to their final examination. 96 students out of class of 100 participated and completed the survey. Questionnaire attached.

Results: The survey results show encouraging response of students seeing live images of upper abdominal organs.

Conclusion: The Ultrasound is a feasible tool for teaching of anatomy and can enhance the learning of live abdominal anatomy for preclinical students.

Key Words: ultrasonography, pre-clinical student, anatomy, abdomen

Introduction:

Ultrasound technology is progressing leaps and bounds. Ultrasound has become more miniaturized, more economical, portable, hand held and can be used in a dissection laboratory. The technology is noninvasive and no ionizing radiations, no harmful rays are emitted by the equipment. The new name of the equipment is Sonoscope or visual stethoscope of the 21st Century and some branding as next Pocket Stethoscope[1]. Stethoscope is routinely introduced to medical students for listening to heart, lung and bowel sounds. Stethoscope is a misnomer as you cannot see (scope) with it, perhaps the better name would have been Stethophone as it has only an audio component[2]. Ultrasound is a real scope and is unique in the sense that it makes visible to the students the live structures hidden beneath the skin-heart pumping, valves closing and opening, blood flowing, diaphragm moving, liver parenchyma, splenic and portal veins, hepatic veins and inferior vena cava, aorta, gall bladder, kidneys and much more[3].

A growing tendency nowadays in medical education is introducing ultrasound teaching in medical colleges at an undergraduate level, particularly in USA. Many medical school educators have realized theusefulness of this technique as an aid to teaching anatomy, physiology, pathology and physical diagnosis[4]. Ultrasound act as a useful adjunct to teach anatomy in a clinical context to medical students[5].The majority of medical students believed that it is feasible and

beneficial to use ultrasound in conjunction with traditional teaching methods to teach Gross Anatomy[6]. Medical students found the addition of Ultrasound training to be valuable,not only in enhancing the knowledge of anatomy, but also increasing their interest and experience in ultrasound imaging[7].

Ultrasound images are black and white except the Doppler component, which is colored, to see the vascularity and blood flow. The pictures are not photographic pictures like heart shadow seen on chest x-ray, soft tissue shadows of liver, spleen, kidney seen on plain x-ray abdomen. The ultrasound images may be difficult to interpret when seen for the first time, the appearance can be that of snow falling on the ground from the sky and quite confusing. The students need time and patience to interpret the images and once the basic of ultrasound is understood, the images are better appreciated and interpreted by the students[4]. The students should have the knowledge of anatomy to interpret the ultrasound images. The better the knowledge of anatomy, the easier is the interpretation of the images. Therefore ultrasound enhances and reinforces the anatomy and should not be counted as adding new material in the curriculum at the cost of existing material[8].

Methodology:
The Ultrasound teaching of Anatomy in Hamdard College of Medicine & Dentistry commenced from November 2015 and lasted till the end of the teaching session till August 2016. There were two semesters in the academic year, first semester from 16th November till 16th March and second semester from 11thApril to 22nd August 2016. The survey was done on 26th August 2016. The student were having their 2nd Semester Examination in September 2016 and their final annual examinations in October 2016.

The second year MBBS class had 100 students. For ultrasound teaching they were divided into smaller group of 15 each. The ultrasound classes were held once every week on Monday lasting 50 minutes. Eight ultrasound classes were held in the first semester and further eight classes were held in the second semester. The full cycle to complete the whole class took 7 sessions. Each student on the average was able to attend two classes of ultrasound.

The ultrasound equipment was kept in Dissection Hall. To start with, one ultrasound equipment loaned by a faculty member was available. In the month of April 2016, one more ultrasound machine was donated by a well-wisher. In the second session, the students were encouraged to have 'hands on' practice with the probe and equipment.

The region of Abdomen in Gross Anatomy was covered with the first semester theory lectures. The students were already sensitize to Abdomen and its contents prior to ultrasound classes on abdominal real time images.

Each class was exposed:

- Introduction to basic ultrasound equipment
- The demonstrations of live upper abdominal organs on the volunteer.
- In the second semester, the students were encouraged to have "hands on" practice on the volunteer.

The aim of the ultrasound class was to introduce the students to the abdominal organ images created by ultrasound technology. The students were able to see real time images of the liver, gall bladder, kidneys, diaphragm and through the subxiphoid view chambers of heart, valves and heart pumping[9]. The emphasis was on the ease with which the live images were seen, without any invasive procedure and contrast and at the same time there was no radiation hazards. The focus was on interpreting the images and not on acquiring the images. We were not aiming to teach students how to perform ultrasound scan. Our purpose was to introduce them to this safe, non-invasive and widely available imaging technique with its unique strength and weaknesses and enhance their learning of anatomy in the

process.The students are routinely introduced to imaging technique like x-rays, both plain and contrast, cross sectional images related to CT scan and MRI images. They are not introduced to Ultrasound Images, this imaging technique is most economical &least hazardous, non-invasive and easy to demonstrate.

Ultrasound Equipment:Toshiba Capasee 3.5.00 MHz and Pie 3.5-5MHz

Volunteers:
Volunteers were paid volunteers. Prior to accepting them as volunteer, they were screened so as to exclude any abnormality. They were male and co-operated in exposing the abdomen to the extent required. Female paid volunteers have also agreed to act as patients and plans are to induct them in ultrasound sessions exclusively for females initially, taking into considerations local culture and acceptance.

Questionnaire:
Questionnaire carrying 10 questions related to understanding of abdominal ultrasound was filled.

Statistical Analysis:
Data was analysed on SPSS version 20.Frequencies and Percentages were calculated for categorical variables.

Results:
The students were very positive about the integrating abdominal ultrasound in anatomy. 78.1% student stated that this was excellent and good initiative whereas 21.9% felt that this was valuable needing further improvement. None of the students found it to be a waste of time or not interesting.

Breakdown of student responses on the image identification of upper abdominal visceras:

Liver Image: 80.2% of students were able to understand the normal liver image where as 19.8% did not understand the liver image. None of the students mentioned that the liver was not identifiable. Liver is the biggest single solid viscera in the upper abdomen and easily picked up on the ultrasonography. Student do have difficulty in orientation when liver image is seen for the first time. With explanation and line drawings, they have better comprehension of the liver image.

Gall Bladder: 77.1% understood the Gall Bladder images. 17.7% did not understood Gall Bladder images whereas 4.2% did not identify Gall Bladder images. To visualize Gall Bladder the volunteer should be fasting for about 4 hours, allowing the time for bile to accumulate in the Gall Bladder. If the volunteer had a recent meal, the Gall Bladder will be empty, because of contraction by cholecystokinin, and the image will be either very small or absent. May be in some of the session, the volunteer had a recent meal and student (4.2%) were not able to identify Gall Bladder.

Hepatic Veins: The three hepatic veins, right, middle and left veins draining into inferior vena cava is demonstrable and appreciated by students. 87.5% of students easily understood the images of hepatic veins whereas 10.4% did not understand and 2.1% were not able to identify hepatic veins.

Kidney: Kidney was the most easily understood image (92.7%). The kidney images are reniform and bean shape, easy to recognize by students.

Open Ended Questions:
Black and White Images: The majority of students had the misconception(62.5%) that if the images were colored, they would be able to understand them better. Ultrasound images are black and white and the best ultrasonography equipment will still give the images black and white. The color Doppler is employed to see the blood flow and vascularity. The images can be improved by better resolutions. The probe which weused was 3.2-5.00 MHz probe, good enough for abdominal scan. More resolutions can be improved by having 10.00 to 12.00 MHz probe. The higher the resolution, the less the depth of sound waves and deeper images are not seen. The higher resolutions probe are better to see the superficial structures like nerves, vessels,

Table I: *Student responses on the image identification of upper abdominal visceras*

Image identifications	Liver	Gall Bladder	Hepatic Veins	Kidney
Clear easily understandable	37.5%	45.8%	52.1%	62.5%
Blurred easily understandable	42.7%	31.3%	35.4%	30.2%
Not understandable	19.8%	17.7%	10.4%	3.1%
Not identifiable	0	4.2%	2.1%	4.2%

tendons etc. The black and white TV and color TV are very different from ultrasound monitors and have no relevance to ultrasound images.

Less time allotted: 20.8% student felt that time allotted for ultrasound session was inadequate. The ultrasound classes was in small groups of 15 students and on the average each student attended two classes of ultrasound of 50 minutes each during the academic session of two semester. Ultrasound may be introduced during the theory lecture to the whole class and more time may be available to practical session to smaller group.

Opportunities for students to have hands on practice: 13.5% of the students requested to let them have the practice of using ultrasound probe on the volunteer. During the second semester, the students were given the probe to have 'hands on' practice. This created more excitement and empowered the students to see the images off and on and in varied planes.

Discussion:

Advances in technology have made portable ultrasound an outstanding readily available teaching tool[10].

During the teaching of gross anatomy of Abdomen, the students had the opportunity to attend ultrasound lab (located in Dissection Hall) and observe the live images of abdominal viscera, liver, hepatic veins, portal veins, diaphragm, gall bladder, kidneys, inferior vena cava, aorta, subxiphisternal view of the pumping heart and valves[11]. This imaging technology revealed living anatomy[12] in new ways and students were excited and thrilled to see real time images.

Not only students were able to see the live images, a number of ancillary advantage were noticed too.

Surface Anatomy: Surface anatomy was taught in a big way. The students were able to see where was the xiphisternum, what constitute the costal cartilages, where was the umbilicus, the location of pubic symphysis, the anterior superior iliac spine , iliac crest- the bony points palpable and visible land marks[13].

Physical Examination: The students were introduced to physical examination- inspection, palpation, percussion and auscultation. Inspection and palpation were mainly demonstrated during the ultrasound probe placement on the volunteers.

Art of Communication and Medical Ethics: The students were taught how to introduce themselves to the volunteer, how to thank him and respect his dignity by covering him properly. Volunteers were grade 1 employee, the attraction being getting paid and students were instructed not to misbehave or pass any remarks.

Cross Sectional Views: The students had a chance to see longitudinal and transverse cross sectional view of upper abdomen, with changing the probe position. The images were visible on the ultrasound monitor and were also projected on a big TV screen with extension.

The ultrasound images shown on the volunteers were of normal anatomy. The volunteers were prescreened and were free of any abnormality. The volunteers were requested to avoid eating anything for 2-3 hours prior to class, to make the gall bladder fill up with bile for easy demonstration.

During the second semester ultrasound session, the students were given a chance to hold the probe and have 'hands on' practice on the volunteer under the supervision of the teacher. This made the session more interactive and interesting. The aim was not to make student sonographer, but to introduce them to ultrasound equipment.

Many students were eager to know how the ab-

normal images like stones in the Gall Bladder and Kidneys appear. Some girl students also requested to demonstrate uterus and pelvic organs. The students were shown abnormal ultrasound from the collections we have from our own patients from Department of Radiology.

Ultrasound has been shown to help students explore and to reinforce concept covered in anatomy and physiology. At the University of South Carolina, ultrasound is introduced during student orientation, before medical school even begins. Aside from being taught in preclinical courses such as anatomy and physiology, ultrasound is also featured in introduction to clinical medicine[14] course and included in the observed clinical examination (OSCEs)[15] at the conclusion of clinical clerkship in internal medicine (thyroid scan, ultrasound-guided central line placement) family medicine (abdominal aortic aneurysm scan),[16] obstetrics/gynaecology (transabdominal scanning in pregnancy)[11] and surgery (focused assessment with sonography in trauma scan (FAST)).[17] One of the big benefits of longitudinal integration is that it allows instructors to avoid falling into the trap of trying to teach the students everything at once[18].

Conclusion:
Abdominal Ultrasound teaching enhances the anatomical knowledge of abdominal organs and is student friendly. 78.1% felt this was a good initiative, almost 80% stated that they were able to understand the images and 62.5% felt confident that their understanding of abdomen has improved.

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Role and contribution of authors:

Dr Tasir A. Mumtaz, Associate Professor, Dept of Radiology, Hamdard College of Medicine & Dentistry, Karachi, provided the clinical input.

Dr Hemant Kumar, Professor, Dept of Anatomy, Hamdard College of Medicine & Dentistry, Karachi. The concept, data collection and its analysis was critically analyzed and gave the final approval

Dr Iffat Raza, Assistant Professor, Dept of Anatomy, Hamdard College of Medicine & Dentistry, Karachi did statistical analysis.

Dr Zakiuddin G. Oonwala, Visiting Professor of Clinical Anatomy, Dept of Anatomy, Hamdard College of Medicine & Dentistry, Karachi. The concept, data collection and its analysis was critically analyzed and gave the final approval

Dr Syeda Bushra Ahmed, Lecturer, Dept of Anatomy, Hamdard College of Medicine & Dentistry, Karachi, initiated with audio interview of students and followed up with the questionnaire.

QUESTIONNAIRE

Name optional:

Class Second Year MBBS:

Q1. How did you find the session related to abdominal ultrasound?
1. Excellent
2. Good Initiative
3. Valuable but needs improvement
4. Waste of time
5. Not interesting

Q2. How much have you identified regarding ultrasound of Liver
1. Clear and easily understandable
2. Blurred and easily understandable
3. Blurred and not understandable
4. Not identifiable

Q3. How much have you identified regarding ultrasound of Gall Bladder

1. Clear and easily understandable
2. Blurred and easily understandable
3. Blurred and not understandable
4. Not identifiable

Q4. How much have you identified regarding ultrasound of Hepatic Veins

1. Clear and easily understandable
2. Blurred and easily understandable
3. Blurred and not understandable
4. Not identifiable

Q5. How much have you identified regarding ultrasound of Kidneys

1. Clear and easily understandable
2. Blurred and easily understandable
3. Blurred and not understandable
4. Not identifiable

Q6. If your response in any of the questions 2 to 5, related to viscera (Liver, Gall bladder, Hepatic veins and Kidneys) is 3 or 4, then what were the reasons? You can tick more than one option:

1. Ultrasound images are black and white
2. Method of teaching was not appropriate
3. I was unable to observe due to large number of students.
4. Less time allocated for the session

Q7. To what extent, this ultrasound session has improved your understanding of abdominal anatomy. Tick one option.

1. Confident
2. Somewhat confident
3. Not sure
4. More practice required
5. Not at all

Q8. What were the drawbacks of this session? You can tick more than one options:

1. No drawbacks
2. Less time allocated for the sessio1n.
3. Frequent change of Volunteers
4. Large number of students
5. Any other drawback please specify.

Q9. If you are requested to become a volunteer for ultrasound session, would you like to become a subject?

1. Yes
2. No

Q10. Any suggestions to improve the session.

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