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Anatomy in a modern medical curriculum

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ABSTRACT

Anatomy in undergraduate education has been in decline for many years. Some suggest that it has fallen below a safe level. Balances between detail and safety, and assimilation and application of anatomy have yet to be established as the methods of teaching undergo another metamorphosis. For doctors, the human body is the focus of investigation and intervention on a daily basis; for this reason, the study of anatomy in some form will continue to be essential to safe medical practice. It is necessary for core knowledge of anatomy to be assimilated by all doctors in order to practice and communicate safely. It may be true that most doctors do not need to dissect a cadaver or study a prosection in order to practice, but if it can improve their understanding of what they do and why they do it, this surely has to be of benefit both for the safety of the patient and satisfaction of the doctor as a professional. Integration of newer teaching modalities and modern technology will encourage interest and retention of anatomical knowledge and its clinical relevance. Anatomy has a promising future in postgraduate specialist and surgical training. Detailed knowledge should be integrated into specialist training when it is clinically relevant allowing specialists of the future to practice safely and accurately and also to provide a strong base for future clinical developments.

KEYWORDS

Anatomy – Teaching – Learning

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Doctors without anatomy are like moles.
They work in the dark and the work of their hands are mounds.
Tiedemann: Heidelberg, 1781–1861

Anatomy has been a cornerstone of medical education for hundreds of years. Many argue that it has survived the most demanding pedagogic test – time. However, in recent years, human anatomy has been slowly squeezed from the medical curriculum.

Anatomical knowledge supports examination of a patient, the formation of a diagnosis and communication of these findings to the patient and other medical professionals. Whilst it has been argued that many areas of basic science will change over the course of a doctor's professional life, obviating their inclusion in a 'core curriculum', human anatomy will certainly remain constant. It provides a platform of knowledge suitable to all medical careers.

Anatomy is obviously essential for surgeons but also has value for anyone who performs an invasive procedure on a patient; carries out emergency procedures; examines radiological imaging; performs a physical examination of a patient; refers a patient to another doctor; or explains a procedure to a patient. These tasks are common to all branches of medicine. Arguably, all of these tasks can be done without underlying knowledge of anatomy by following protocols and guidelines and using pattern recognition. This may be a cost-effective approach, and can rapidly provide service provision to a health service, but learning without understanding cannot be regarded as a deep approach to learning,[1] will not provide a basis for future development, and as such should not be regarded as adequate for training doctors of the future.

Not only is there an educational and professional standpoint but also litigious factors supporting doctors' need for anatomical knowledge. Between 1995 and 2000, there was a 7-fold increase in claims associated with anatomical errors submitted to the Medical Defence Union and, recently, 32% of claims made to the Medical Defence Union in general and vascular surgery were reported to be for 'damage to underlying structures'.[2]

There is also public and media pressure for doctors to have knowledge of anatomy. The public's fascination with human anatomy has been recently exposed with the 'Body World' exhibitions of Prof. Von Hagens[3] and television programmes such as 'Anatomy for Beginners'. In a recent online poll, 94% of the public thought that doctors should have practical experience of real human anatomy.[4] A discrepancy between expectation and reality may exacerbate future legal claims.

Anatomy in decline?

For nearly 30 years, there has been discussion of the decline in undergraduate knowledge of anatomy amongst the surgical community.[5–9] These studies report reductions in allocated time, teaching staff and dissection in most anatomy courses. It is very difficult to assess objectively whether this reduction in anatomy teaching has been excessive. However, the few studies that have been conducted suggest that the knowledge of the qualifying doctor is now below an acceptable level.[10–12]

Anatomy has an established value in medical education and is supported by students, clinicians, anatomists and the general public. Is the decline of anatomy a result of reductions in time and resources allocated to anatomy teaching or is it a result of the changes in teaching methodology?

Teaching anatomy

Much debate has arisen about how to teach anatomy. This polarises into those that favour dissection of human cadavers and those that support newer teaching modalities (*e.g.* self-directed learning, problem-based learning [PBL], and computer-assisted learning [CAL]). These standpoints tend to be supported by either the traditionalists (predominantly surgeons and anatomists) or the modernists (predominantly educationalists), respectively. This, however, does not address the fundamental reasons why anatomy is in decline.

Anatomy as a subject has suffered as a result of its failure to evolve and adapt quickly enough. Under old-style medical training, students were expected to learn detail with little understanding of relevance. Learning anatomy became a rite of passage rather than an educationally valid process and clearly required reform. Anatomy has suffered as a subject because it is regarded as banausic, archaic, didactic, traditional, overly factual and unable to adapt to modern educational methods – an obvious target for those looking to reduce curriculum content and modernise the learning experience.

Anatomy is also subject to many extrinsic pressures. Maintaining a dissecting room in accordance with national and European laws is very costly and changes in anatomy departments and surgical training have reduced the numbers of medically qualified anatomy teachers.[13] This is within the context of an increase in numbers of medical students which puts more pressure on an overstretched system.

The combined problems of a banausic image and an unsupportive academic infrastructure may explain the decline of anatomy as a subject more than the teaching methodology changes in the last 15–20 years.

In an analysis of teaching and learning, it is necessary to examine the curriculum, the mode of teaching, the quality of how this is delivered and the infrastructure within which it is delivered.

Learning anatomy

In the UK, the General Medical Council (GMC) offers no guidance on what is a minimum knowledge requirement for any medical subject but instead leaves it to the medical schools to determine their own curricula and own methods of assessment. Traditionalists perceive a decline in knowledge and attribute it to the modern methods of teaching and learning. Reformers point to evidence that modern approaches offer equivalent results in assessment when compared to traditional courses. It seems that there are three aspects that need to be resolved: when, how much, and how to teach anatomy.

When should anatomy be taught?

Historically, anatomy has been taught predominantly in the first undergraduate year. Although anatomical knowledge is assessed again in many specialist professional examinations, there is very limited exposure to anatomy teaching in later training. This is educationally unsound, as an excessive amount of seemingly irrelevant material in a curriculum encourages superficial learning.[14] Given only one opportunity to teach anatomy, it is difficult to calculate the quantity of anatomical detail that should be included: should a course be preparing future generalists or specialists? A solution would be to integrate anatomy vertically into medical education so that students are exposed to anatomy teaching throughout undergraduate (pre-clinical and clinical), postgraduate and later professional training. This would provide relevant anatomy at an appropriate level of detail to the stage in training or career development. Tailoring theoretical learning to a particular specialty would reduce the amount of unnecessary theory learnt.

How much anatomy should be taught?

A minimum working knowledge should be that which allows an independent practitioner to practice safely, and to communicate with other medical professionals and patients effectively.

Recently, some of the country's leading anatomists have put together some guidelines on an anatomy curriculum which they feel any independent medical practitioner should know.[15] This consensus should be welcomed, as it allows a benchmark to be set for medical schools. It is hoped that it will allow better comparisons of teaching methodology and permit meaningful assessment of both medical students and teaching establishments to take place.

The professional colleges have also produced syllabi outlining the level of anatomical knowledge that they expect from their members when examined. Specialist trainees will rightly require more detailed knowledge of anatomy than the guidelines of Dyball *et al.*,[15] but at a later stage in their training. Consequently it may be that these specialist levels of knowledge can only be met by vertically integrating anatomy into medical training.

How should anatomy be taught?

Traditionally, learning anatomy has been dissection-based. Dissection has become synonymous with traditional courses and has come to be regarded as the antithesis of problem-based learning (PBL). However, dissection would appear to be ideally suited to self-directed learning: students exploring a subject for themselves at their own pace, in a practical way and according to their own personal interests. Surgeons advocate experience with dissection not only to help to learn anatomical detail but to familiarise students with the variation in anatomy and to obtain an appreciation of fully exposed structures that cannot be seen through the window of an operation but that might be damaged inadvertently. Perhaps most significantly, students have a high regard for dissection as a learning resource in the anatomy course[16] and many other learning outcomes have been identified by students.[17] Dissection allows haptic (based on a sense of touch) appreciation of 3-D anatomy unlike any other teaching facility. However, dissection as a learning modality has been marginalised from medical curricula to the despair of some academics.[18–20]

In the last 15–20 years, some universities have embraced other learning modalities. One of the most popular alternatives is problem-based learning (PBL) developed at McMaster University in the late 1970s by Barrows and Tamblyn.[21] They developed a medical school curriculum based solely on small group, student-centred learning. The rationale behind this was first that problem-based rather than memory-based learning created a more usable body of knowledge and second that the medical skills that were most important for treating patients were problem-solving skills rather than memorisation. Key to its success was that, by working in small groups, students identified deficiencies in their knowledge and skills and resolved these themselves.

The original advantages identified in PBL methodology were in accordance with many of the suggestions of the reforming policies of the GMC. This concordance with educational theory may explain why PBL has been adopted so readily in many medical schools rather than for any evidence-based pedagogical advantages.

It is recognised that the purpose of medicine is to train competent doctors with both good clinical skills and other key skills. However, reduced public funding in higher education may mean that PBL is seen as a means of teaching a larger group of students, using less face-to-face contact. The modern and different approach of PBL may be attractive to institutions trying to seek favour with the GMC. Finally, PBL passes the responsibility of learning to the student.

Much has been written on PBL in the particular context of learning medicine and anatomy. Overall, in the context of basic science teaching, non-PBL courses seem to be slightly favoured although PBL courses seem to produce more confident, practically-minded doctors.[22–25] The PBL enthusiasts claim that if there is little difference in scientific knowledge and improvements in other areas, then it justifies the methodology. However, many of these studies are conducted in centres where PBL has been introduced with enthusiastic proponents with now well-established, PBL-based courses. It is equally difficult to establish a justification for including dissection in an anatomy course and conclusive evidence is unlikely to be found.

It is unlikely that any future study will prove conclusively the supremacy of one teaching method over another. PBL can be delivered in a useful and constructive way or can be an excuse for low teaching levels and disorganised education. Similarly, dissection can provide an opportunity for self-directed learning and 3-D awareness of anatomy or can be an expensive, undirected practical class.

The future of anatomy

It is undisputed that anatomy still has a role in the process of training doctors and supporting modern medical practice. All medical schools, new and old, still maintain anatomy as a core subject in their curricula. Over the last 20–30 years, all anatomy curricula have been reduced to lessen the factual burden on students and make time for teaching other skills. This reduction will have an effect on the training of future surgeons (and some other specialists) but perhaps it is the specialists', or anatomists', responsibility to provide the necessary training at a later, more appropriate, time in training. Unfortunately, the evidence suggests that the curricula and teaching have diminished too much, to an extent where safety and clinical practice might be compromised. If this is the case, it can be attributed to reduction in resources and the resultant effects on teaching methodology in the modern medical curriculum.

Anatomy has traditionally been delivered at the beginning of medical education to provide a basis for clinical training and practice. A dogmatic support amongst traditionalists for detailed anatomy courses may have been detrimental to the evolution of anatomy as a subject. Reformers regard these teaching methods to be 'old-fashioned' and incompatible with modern learning practices possibly without appreciating the many benefits of the traditional approaches.

If old-style anatomy teaching is dead, anatomy needs to reinvent itself as a subject. It should evolve to address the requirements of any subject in a medical curriculum in the 21st century. Some progress has been made. There has been a move from passive, didactic, highly detailed courses towards functionally and clinically relevant courses irrespective of the method of teaching.

For further progress to be made, the traditionalists have to concede that learning large quantities of detailed anatomy is unnecessary for the majority of medical careers, whilst a core of knowledge must be covered and assimilated by all students. Some progress has been made in defining core knowledge.[16] If a core of knowledge is agreed, then its assimilation must be

assessed rigorously not only in the first year of medical school but with on-going assessments throughout clinical school and beyond. Acceptance of the concept of core knowledge also requires recognition that this will be inadequate for specialist training. Students entering medical careers which require a more detailed knowledge of anatomy will need access to specialised anatomy training at later stages in their careers. A sustainable solution is for anatomy departments to forge educational and financial links with hospital departments and some medical schools are exploring this option.[26] This would allow vertical integration of anatomy into the medical school curriculum from the first year of medical school, through clinical school and into specialist training, reinforcing the core anatomy by appreciation of its clinical relevance. Involvement of clinical specialists would give them the opportunity to shape the anatomy syllabus according to good clinical practice and advancing techniques, maintain their own knowledge (making them safer practitioners), and help to address the staff shortages in anatomy teaching. The criticisms of specialists about their juniors' lack of anatomical knowledge would be addressed directly and it should produce safer, more competent practitioners, less likely to make mistakes and incur litigation in the future.

How then should students and trainees learn anatomy? First, modernisation should draw on the fact that human anatomy has an innate fascination, not only with medical students and doctors, but with most other healthcare workers and a significant proportion of the general public. Anatomy must shake off the image of being old-fashioned and welcome clinical relevance, the IT revolution, models, body painting, and radiographic images. Anything that stimulates interest in anatomy should be promoted. This, however, does not exclude prosection and dissection as a learning resource and nor does it mean anatomy teaching without appropriate staffing and other resources. The value of new resources such as computer-assisted learning have to be assessed in terms of how much they contribute to the assimilation of core knowledge and student understanding and not in terms of how cost-effective or politically appropriate they are.

The challenge should not be to determine supremacy of one methodology over another but to maximise the learning benefit available from the different methods. The purpose of PBL is to develop reasoning skills, enable learning within a relevant context, encourage work-related skills, and promote self-directed learning. Appropriate use of dissection and prosections can meet many of these aims and have additional benefits. The dissection room should not be abandoned when the evidence is that students and trainees who have minimal exposure to dissections often demand dissection/prosection-based teaching at a later date. It must be established what is core knowledge (at the various stages of medical education) so that standards are not allowed to inexorably decline as more cost-effective solutions are explored.

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