The Anatomical Society

Synopses from the Anatomical Society One Day Symposium 25th September 2002

Anatomical education: Recent advances and future developments

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Introduction to symposium. By S. McHanwell (Chairman of the Anatomical Society Education Committee). *University of Newcastle, UK*

The idea of an Anatomical Society One Day Symposium specifically to address issues in anatomical education was first put forward two years ago. The stimulus for such a Symposium was two fold. The Society has for a number of years included as part of its regular meetings an Education Discussion Session on a topic of interest to those involved in anatomical education. However the inevitably full nature of the programmes of those meetings means that the time available for education sessions is limited and so it was felt that a Symposium held over the course of a day would permit fuller discussion of the topics covered. More fundamentally the feeling has been growing that as Anatomy Departments across the UK are subsumed into larger units, and the teaching of whole body anatomy and physiology seems to be declining in many curricula, the Society should take more of a lead role in stimulating discussion about issues of common interest to teachers of anatomy.

This One Day Symposium is organised around two main themes. In the morning session we will be attempting to take a snapshot of anatomy curricula in a variety of courses around the UK. Anatomy is an important part of many courses and not just medicine and so presentations have been included from colleagues teaching both physiotherapy and radiography courses. Defining how much anatomy students should know is a perennial problem and thus the morning session includes two talks dealing with the problems of defining learning outcomes in anatomy. In both cases these involve defining outcomes in relation to medical curricula but it is hoped that these will serve as a model in relation to other curricula. Finally the morning session will conclude with some discussion of new assessment tools.

Problem based learning is occupying an ever more important role in medical education in the UK and so the whole afternoon session has been devoted to this important topic and includes presentations from a wide range of different curricula.

Anatomy is a key component of medical, dental, physiotherapy, radiography, speech and language therapy courses and I hope that this Symposium will provide an opportunity for an extended discussion of its place in those courses in all their varied forms. I also hope that if successful it will be the first of a series of such meetings organised by the ASGBI periodically. Finally, I hope it will encourage more people to come to the regular Education Sessions held as part of the Scientific meetings of the Society and participate in the often lively discussions that we have.

[1] **Is CLASy anatomy good medicine?** By B.S. Mitchell and D. Patten. *Centre for Learning Anatomical Sciences, School of Medicine, University of Southampton, UK.*

The medical curriculum at the School of Medicine in the University of Southampton is integrated, with basic sciences mainly in the early years. In the Centre for Learning Anatomical Sciences (CLAS) we teach medical students all aspects of anatomy, and our subject is placed within 6 systems courses in the first two years. Thus all systems and regions of body are studied in parallel with the other appropriate basic sciences. Our aim is to offer learning material that both informs and stimulates our students, and prepares them for later parts of their BM course, and subsequent careers. In their studies we equip them with skills in time management and team working, and in understanding and using clinical and anatomical terminology etc.

At Southampton academic staff act as facilitators to develop students as independent learners by encouraging self-direction. This learning style was devised by Professor David Bulmer (Foundation Professor of Human Morphology) and his colleagues at the University of Southampton in the early 70s. Since that time although the style and course content has been refined and updated the pedagogic principles remain. Students examine prosections in conjunction with a text that directs them towards observation of the specimens and that also defines the breadth, depth and scope of what has been determined to be relevant to the student. The text also contains examples of clinical significance, questions to reinforce relevance, and reference to other learning resources such as radiographs, plastic models, plastinated specimens and bones. Where appropriate links are made with embryology and histology. There are, however, also keynote lectures and tutorials. In relation to educational theory David Bulmer was ahead of his time. He espoused teaching that related structure to function, and that restricted details to those which were important and that would be reinforced in clinical training. He recognised that the reduction of coverage at undergraduate level would need an expansion of teaching at postgraduate level.

In CLAS our present course relates to contemporary educational theory. Students learn well by doing and learn well by taking responsibility for their own learning. The resource based and self-directed learning styles that are employed in our practical classes should encourage ‘deep learning’ rather than superficial learning that is the consequence of the rote learning of traditional anatomy courses. Teachers need to think as students do and be aware of the misconceptions they encounter in their learning, both within their discipline and in their learning methodologies. The task-based approach of our handbooks and deployment of staff as facilitators are designed to reflect this. Our handbooks are designed to define what we expect our student to know. Integration of knowledge between disciplines through coherent and collaborative course design is a feature of the Southampton curriculum. In relation to practical examinations we aim to ensure that all our assessments are constructively aligned with the learning outcomes and activities experienced by the students.

Finally, students' perceptions of medicine as a career are changing and the way in which young people approach their learning has also changed in the last 15 years. Our approach in teaching and learning needs to reflect this.

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[2] **Relevant anatomy in limited time - the Imperial College London approach**. By J.A. Firth. *Human Anatomy Unit, Faculty of Medicine, Imperial College London, UK*

Background

The undergraduate school of medicine of Imperial College London originated from the incorporation of St Mary's Hospital Medical School and subsequently of Charing Cross and Westminster Medical School into the College. The Faculty of Medicine also incorporated the Royal Postgraduate Medical School and the National Heart and Lung Institute, adding considerable research strength but rather few people interested in making a major contribution to undergraduate medical education.

Numbers, space and time

In the five years since the merger the annual intake has risen from 280 to a notional 320 (actually about 370 in 2002). Over about the same period, numbers of anatomy academic staff have fallen from twelve to seven, thanks to retirement, resignation and restructuring. The attractions of new medical schools that value experienced teachers more highly seems certain to reduce this number further. Accommodation is that formerly used by CXWMS for an entry of 150, consisting of a dissecting room and support facilities plus a former histology lab now converted into a clean anatomy lab used for teaching of imaging, living anatomy and osteology. Both have good audio-visual and IT facilities but are inadequate for our student numbers, so, apart from lectures, teaching is based on quarter-classes and each practical session is taught four times in a day.

Introduction of a new six-year MBBS, BSc curriculum resulted in an allocation of 84 hours of anatomy classroom time per student, distributed over two years.

The curriculum context

During a "second look" at the new curriculum in 2001, we reorganised Years 1 and

2 into four main themes. Leaving aside the themes dealing with "Molecules Cells and Disease" and "Foundations of Clinical Practice", anatomy was partitioned between two themes. In Year 1 anatomy of the thorax, abdomen and pelvis is taught in parallel with the cardiovascular, respiratory, alimentary and urinary systems within a "Life Support Systems" theme. In Year 2, anatomy of head, neck, spine and limbs lies parallel to neuroscience, musculoskeletal system, endocrinology and pharmacology within the "Life Cycle and Regulatory Systems" theme. This created a situation in which we could deal with anatomy in a regional manner while linking it effectively to the multidisciplinary teaching about body systems.

Developing a core curriculum in anatomy

Our approach to curriculum definition stems from the view that undergraduate anatomy teaching should provide the anatomical basis for:

- physical examination of patients
- interpretation of medical imaging
- safe conduct of basic procedures in routine and emergency situation.

In addition it should:

- provide a sound anatomical basis for postgraduate study in any speciality
- equip the student with a grasp of the relationship between structure and function at the macroscopic level
- develop a critical approach to received wisdom on these matters.

We did our initial design work using teams chaired by an anatomist, and containing an appropriate assortment of experts with insight into the region under discussion (who were warned that they were also likely to be co-opted to teach). For example, the team for Head, Neck and Spine included a second anatomist who also led neuroscience teaching and consultants from neurology, A & E, ENT and anaesthetics. The method was for each clinical member to come to the first meeting with a shortlist of anatomical issues essential to physical and radiological examination, interpretation of clinical presentations and basic procedures in the region under discussion. Lively discussion ensued in which crucial issues were added, weaker contenders were thrown out of the balloon, and the efforts of anatomists to save their favourite trivia were brutally crushed. After the meeting the anatomist-chairman assembled the fragments into a set of key objectives, added material essential to join the major issues together and proposed a pattern of classes that might deliver the goods. This was circulated and torn to pieces at the second meeting, leading to a second draft that received minor tweaking at the third meeting.

Teaching methods and learning situations

Despite the wish of a previous Rector of Imperial College to persuade us that we could teach anatomy well by virtual reality technology, nobody was prepared to abandon the cadaver notwithstanding the mess and expense involved. Initially we attempted to deliver the dissection room-based part of the curriculum using prosections that were progressively stripped down between teaching sessions. However, the labour for a single prosector assisted by an academic or two was crippling and, despite the fact that "demonstrator-led tutorials over prosections" emerged as the students' preferred learning method, we agreed that the workload was unacceptable and that study of the trunk should involve dissection by students, accelerated by the prosector doing such time-consuming jobs as reflecting skin flaps and "windowing" the rib cage and the abdominal muscles between sessions. We concluded that prosections seemed to work very well for head neck and spine (invariably massacred by inexperienced dissectors) and for limbs (in which the least important bits took most time). Interestingly, the re-introduction of dissection caused the ranking of this approach to rise in student evaluations. Perhaps what this tells us is simply that students appreciate any approach that works and is done with conviction and esprit.

As most doctors deal with living, conscious patients and seldom see much of the inside except through imaging, we committed nearly half the practical teaching time to living anatomy and interpretation of radiology. We refer to "living" rather than "surface" anatomy to emphasise the way in which surface features provide the basis for prediction, auscultation and palpation of deep structures - it conveys the right sense of "seeing under the skin". We place great emphasis on student participation as "patients" and "doctors", and aim for students to work in pairs for seated examination and in fours for horizontal examination. Most students have no problems over this. The ground rules for these classes are that nobody has to undress beyond what is acceptable to their personal standards or their faith traditions, but that those who cannot act as "patients" in a particular class should take a full part in examining others and also empathise with the feelings of real patients during examination. This code seems acceptable to all our students.

Study of imaging is currently based on PowerPoint presentations to a quarter-class group with questions and answers and a demonstrator or two providing support.

Our overall experience is that the approach of keeping students busy with a mixed diet of small-group learning approaches provides the variety needed to maintain interest and stimulate both fundamental and clinically oriented thinking about anatomy. Within reasonable limits, the need to deliver the goods in limited time provides a powerful stimulus for us to think about the purposes of our teaching and avoid self-indulgence. The fact that a medicine-surgery firm takes place in the second term of Year 2 is also a powerful incentive to learning.

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[3] **Anatomy for physiotherapists**. By I. Beith. *Physiotherapy Division, King's*

College London, UK

The Chartered Society of Physiotherapy has included the following statement in their framework curriculum for qualifying programmes regarding the knowledge required to underpin Professional practice.

Students need to develop a thorough knowledge and understanding of the normal anatomy and physiology of the living human body for those systems commonly encountered in physiotherapy practice (that is, the neuro-muscular, musculo-skeletal, cardio-vascular and respiratory systems) and informed by a problem-solving approach.

An understanding of human anatomy is therefore a necessary requirement of all 28 qualifying degree programmes in the UK. As the nature of the work of physiotherapists is diverse, the requirement for different aspects of anatomy to be learned is, as highlighted above, equally diverse. This includes a number of different regions and systems. In addition there is a need for high levels of skill in recognising specific anatomical structures relative to the body surface. Hence surface anatomy using observation and palpation needs to be taught thoroughly to ensure safe and effective examination, assessment and treatment of physical impairments via physical treatments. The learning of such information has traditionally used lectures by members of different disciplines, dissections and prosections staffed by anatomy departments and surface anatomy taught by the lecturers in physiotherapy. Whilst a problem solving approach will be used as a physiotherapy programme progresses, a large number of qualifying programmes are still likely to offer human anatomy as a separate unit initially.

A comparison of the number of training places for physiotherapy with those in medicine offered through the UCAS system in 2001 shows a level approximately one third of those in medicine (2000 vs 6000). There are therefore a substantial number of physiotherapy students requiring a good grounding in human anatomy. In addition there was an 11% increase in physiotherapy training places between the years 2000 and 2001, and the number of training places for Chartered Physiotherapists in the UK is intended to increase by 50% between 2000 and 2010. There is therefore an increasingly large cohort of physiotherapy undergraduates across the country for whom an understanding of anatomical principles is essential.

The future of how human anatomy is taught to physiotherapists may be influenced by the availability of enough cadaveric specimens for dissection for the increasing number of student physiotherapists. Most programmes still offer an insight via prosections but whether this detracts from the insight gained is not certain. Assessment of anatomy teaching is now also achieved using IT packages which has been found to be useful by both staff and students. Other recent developments include the use of interactive learning packages for example via CD-ROM. These are becoming increasingly sophisticated and have been proposed as not only an adjunct to the traditional methods of teaching anatomy but even as a substitute. It seems likely that such interactive media will be more commonly used, and improvements in virtual reality programmes may allow such media to be used to educate the physiotherapists of the future.

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[4] **Anatomy for radiographers**. By N. Lock. *Kingston University and St George's Hospital Medical School, London, UK*

Since the discovery of X rays by Roentgen in 1895 they have been used to image human anatomy, in fact the first image on a screen was that of Roentgen's own hand, the first hard copy on a photographic plate was that of his wife's hand. The use of X ray really accelerated during the First World War where both sides used X rays to pinpoint the position of metal fragments within the body and fractures. In the beginning there was little distinction between what we would now call radiographers, radiologists and amateurs. However during the 1920s as the dangers of X rays became appreciated the professional distinctions were formed.

These roles remained quite static and training roles developed. Radiographers, were in the 1960s required for the first time to be state registered with an associated restricted title. This was both a curse and a blessing: it resulted in an inflexible national syllabus with centrally set examinations that only changed slowly, but had the benefit that only those state registered could work as radiographers in the NHS.

This situation continued into the late 1970s and, it must be said, worked well. The anatomy taught to radiographers pre registration was heavily biased to the skeleton and major organs in the thorax and abdomen. Most Schools of Radiography were based in hospitals and the teaching was didactic, perhaps with the use of models and textbooks specifically aimed at radiographers. The level of knowledge was aimed at giving radiographers enough knowledge to be able to position patients and assess the resultant images. There was a little pathology and physiology again aimed at a level such as to allow assessment of the images

The mid 1970s saw an explosion in imaging technologies, mainly in computed tomography, ultrasound and nuclear medicine. The advent of these new imaging modalities put the existing syllabus under pressure, as now the modality required greater knowledge of anatomy. The growth in ultrasound particularly drove a need for more detailed anatomical knowledge of the soft organs as radiographers were increasingly being asked to provide ultrasound based measurements of the fetus for obstetricians.

During the early 1980s some schools of radiography developed links with higher education institutions to offer post registration course that were more relevant to the needs of the service. These courses were not bound by the statutory bodies so could begin to incorporate anatomical knowledge that was appropriate for the task. The late 1980s and early 1990s saw all hospital based schools of radiography move into the higher education sector, usually into a "new" university. This allowed the development of individual anatomy modules focused on what the students needed to know.

In the last couple of years there have been two new entries in the pedagogic lexicon: multidisciplinary education, and problem based learning. In St George’s Hospital Medical School the radiographers undertake the same course in anatomy as the MBBS students and participate in the same problem based learning sessions.

In addition developments in techniques coupled with increasing demand for services have lead to role extension, where radiographers undertake procedures and provide the diagnosis of the image. The wheel has therefore come full circle.

With this perspective it’s now possible to generally predict the level of anatomical knowledge required by radiographers and how this will probably be taught.

There is a need for a general introduction, which will be of importance for several groups of students. It needs to contain the basic nomenclature used in anatomy, so students can access the language, an overview of the systems including the skeleton and position of the major system components. It will probably be taught as a series of lectures and demonstrations supported using an IT platform and reinforced by a problem based learning exercise. One such scenario could be a student being involved in an accident that resulted in a fractured pelvis, the students would be directed to study the anatomical structures associated with the pelvis as well as the pelvis itself. From this and other information they are able to consider the implications for the patient in the widest context, they also benefit from being in a multidisciplinary group as this helps show them the importance of each team member’s activity.

After this introductory period, or semester, the anatomy components will be integrated into the modules relating to professional practice. These modules for undergraduate radiographers are broadly divided into the skeletal system and the viscera as the techniques used to image these still make up the bulk of radiographic examinations. Taking the chest radiograph as an example, the students will have studied the major anatomy in the previous sessions and will now reinforce the anatomy by looking at pathologies that produce changes in the normal radiographic appearance. In addition to the normal and abnormal anatomy the students learn the surface landmarks that are needed to correctly position a patient for the examination.

When the students have completed this theoretical section they are placed in clinical departments to practice skills, under supervision, on patients. Clinical radiographers who have undertaken a student-training course supervise the student while they are on placement. The function of these staff is to integrate the theory and practice to enable students to be competent in execution a set of radiographic procedures. A central part of this process is to identify anatomical variants and adjust their technique accordingly, and to interpret the images they have taken. This interpretation is a two stage process, firstly to use the normal anatomy to check the technical quality of the image and secondly to identify and abnormality that may indicate the need for further views to be taken.

This pattern of the integrating anatomical knowledge is common to all radiographic education, each of the different imaging modalities produces images that are based on different physical concepts and so the appearance of the anatomy changes. For example bones appear white on film based radiography and CT but are black on a magnetic resonance scan. The radiographers needs to know not only the physics that produces these images but the underlying anatomical structure and variations due to pathological changes The education and training associated with role extension in radiography over the next few years will require a sound footing in anatomical knowledge. This I believe will be delivered by a combination of demonstrations, seminars and IT supported materials.

The condensed message is - if radiographers can form an image of the anatomy then they need to know that anatomy.

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[5] **The Scottish Anatomists: defining anatomy contributions to learning outcomes for medical undergraduates in Scotland**. By I. Stewart (on behalf of The Scottish Anatomists). *Biomedical Sciences (Anatomy), University of Aberdeen, UK.*

The Scottish Anatomists is an informal grouping of anatomists from the five Scottish medical schools (Aberdeen, Dundee, Edinburgh, Glasgow, St Andrews) and the University of Newcastle. It is a non-constitutive grouping which has been meeting for about 15 months ' previous annual meetings of Scottish anatomists had lapsed. The recent meetings were triggered by discussions held during the preparation of the Crawford report into the difficulties being experienced by Anatomy at Edinburgh University following a restructuring of their Faculty and their undergraduate medical teaching programme. Although not an official representative organisation, its regular attendees include those from each medical school who have the responsibility for organising the delivery of undergraduate medical teaching in Anatomy and for the administration of dissecting room facilities. The reduction in Anatomy staffing, at all grades, has reduced the opportunity for debate within institutions. It is apparent from the topics raised at the meetings of the Scottish Anatomists that it provides a useful forum for the exchange of ideas and information, and discussion of topical issues. Its informality supports an environment for sharing experiences from different institutions but can avoid the internal political issues that so often mar intradepartmental discussion (at the present time all Anatomy "departments" in Scottish medical schools are subsumed into large multidisciplinary units).

Almost coincident with the formation of the Scottish Anatomists was the publication of a document from a formally constituted body "The Scottish Deans' Medical Curriculum Group". This group has a remit to "foster closer links between the five medical schools in Scotland and in particular to promote the exchange of ideas on all aspects of medical education and to encourage collaboration between the schools in areas of curriculum development and implementation." One of their major projects is "The learning outcomes project". This ongoing project has the aim of identifying and agreeing the main learning outcomes that clearly define the abilities of the medical graduate from any of the Scottish medical schools. Their deliberations have resulted in the publication of a document entitled "Learning Outcomes for the Medical Undergraduate in Scotland: A foundation for competent and reflective practitioners".

The learning outcomes document includes a total of 88 separate outcomes listed under 12 domains. Each domain relates to one of three key elements:

- what the doctor is able to do
- how the doctor approaches their practice
- the doctor as a professional

Associated with each learning outcome in the document is a short list of topics that "could" represent teaching and learning topics which would contribute towards achieving that learning outcome. A search through the document reveals only one reference to anatomy. This listing was associated with the learning outcome "Normal structure and function of the individual as an intact organism and of each of its major organ systems". Thus anatomy could contribute towards achieving this outcome. It was also the only outcome which made direct reference to physiology.

The Scottish Anatomists have reviewed the content of the learning outcomes document. Our more detailed consideration made it apparent that anatomy teaching contributed widely to many of the outcomes. Indeed, of the 88 outcomes listed, anatomy contributed to up to 54: there was some variation between medical schools, in part related to the type of course (prosection/dissection based) provided.

Clearly, also, the level of importance of anatomy teaching varied in relation to satisfying individual learning outcomes. We therefore graded the contributions:

1. Anatomy teaching is directly relevant to this outcome. In determining this group we asked the question "Would this outcome be satisfied if there was no Anatomy teaching?"
2. Anatomy makes significant contribution towards this outcome but is not the only contributor.

3. Anatomy is not a prime source but makes a supportive contribution - this group would include generic skills such as data retrieval, IT etc.

Of the total learning outcomes (88) that anatomy contributed to (54), we concluded that anatomy made a major contribution to 24. Most of the contributions involved the more practical dissecting room teaching environments, including opportunities for the development of communication and problem solving skills, and group working. Certainly anatomy teaching contributes more to the development of medical undergraduates than the learning outcomes document implies.

Feedback from the Scottish Deans' Medical Curriculum Group is awaited as to the judgments we have made. The Scottish Anatomists intend to advance the process of curriculum development by defining the anatomical knowledge and learning methods which will best satisfy the learning outcomes appropriate for the new graduate in medicine. This may include defining a core anatomy curriculum and the methods by which an anatomy core curriculum can be delivered and assessed.

The Scottish Anatomists provides a small workable coalition to examine issues of interest to the future development of the anatomy discipline. This paper has concentrated on a particular exercise that the Scottish Anatomists have carried through. Other issues, some broad such as anatomy science teaching, others more practical such as a common (Scottish) plastination facility, have been and will be discussed at our meetings. As many anatomy departments are small, regional coalitions can provide the critical mass necessary for effective debate and practical collaboration, as well as providing a broader base of opinion for driving forward policy within home institutions.

(An electronic copy of the Learning Outcomes for the Medical Undergraduate in Scotland: A foundation for competent and reflective practitioners (amended December 2001) document appended with the anatomy contributions is available from i.stewart@abdn.ac.uk).

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[6]**Setting a benchmark for anatomical knowledge and its assessment: a core curriculum for the teaching of anatomy to medical students**. By R. Dyball[1], C. Davies[2], S. McHanwell[3], J.F. Morris[4], I.G. Parkin[1], S. Whiten[5] and J. Wilton[6] (members of the Anatomical Society Education Committee). [1]*University of Cambridge,* [2]*St George's Hospital Medical School London,* [3]*University of Newcastle,* [4]*University of Oxford,* [5]*University of St Andrews and* [6]*University of Birmingham, UK.*

In the past students were, arguably, overloaded with facts but not adequately prepared for effective communication with patients. This has been addressed in many schools by the introduction of problem based, self directed and patient centred learning. Common sense dictates however that there must be a necessary minimum of factual knowledge in basic medical disciplines to allow any medical practitioner to examine a patient effectively and to undertake straightforward procedures. Whilst recognising that it may be hard to obtain universal agreement on the details of the core knowledge required we here attempt to establish a necessary minimum of anatomical knowledge for all future medical practitioners. All doctors (and medical students at the stage appropriate to the course they are following) should have the expertise outlined below. Without such a level of knowledge, it is our view that no one should be allowed to work independently with patients.

1. ***Language***. Understand and use accepted anatomical language to describe normal structure.
2. ***Vertebral column***. Understand: normal posture (curvatures); intervertebral joints and the anatomy underlying common pathology (back pain, disc lesions, spinal cord and nerve injury, whiplash injuries); the anatomy underlying lumbar puncture and interpretation of vertebral images.
3. ***Upper limb***. Know: the major bones; muscle groups, their function and innervation; the position of major veins (venepuncture); the position of the radial artery (pulse) and brachial artery (blood pressure); why the shoulder dislocates easily; the sites of common fractures and the complications that might follow them; the principles of nerve testing; the axillary lymph nodes and their relevance to the lymphatic drainage of the breast and metastasis.
4. ***Lower limb***. Know: the major bones; muscle groups, their function and innervation; complications of femoral neck fractures; which ligaments give stability to knee and ankle and how to test their integrity; the vulnerability of the common peroneal and sciatic nerves; how to test the nerves; how blood is lifted out of the legs and the consequences of the failure of this mechanism; the positions of femoral, popliteal, posterior tibial and dorsalis pedis pulses.
5. ***Head and neck***. Know: the anatomy necessary to examine the nasal and oral cavities including the paranasal sinuses and tonsils; the salivary glands; thyroid gland; eyelids and conjunctivae; cranial nerve function; the positions of the carotid arteries and jugular veins; the anatomy of maintaining an airway and inserting an endotracheal or nasogastric tube.
6. ***Neuroanatomy***. Know: the positions and functions of the main intracranial structures eg the cortex, cerebellum, basal ganglia, thalamus, limbic system and brainstem; the layout of the cerebral arteries, meninges and venous sinuses in relation to skull fractures; the layout of the subarachnoid space and of the ventricular system (to allow assessment of symmetry in scans or radiographs); the approximate layout of the major ascending and descending tracts.
7. ***Thorax***. Be able to demonstrate: the positions of the heart, pleurae and lungs; the position and function of heart valves, where they can be auscultated and why the coronary arteries are important; know something of the movements of the chest wall and diaphragm in respiration.
8. ***Abdomen***. Know: the positions and functions of the liver and gall bladder,

the stomach, small and large intestines including the appendix, kidneys, ureters, pancreas, adrenal glands and spleen and their layout within the peritoneum; have some knowledge of why the portal circulation may be involved in pathology; have some knowledge of the abdominal wall in relation to incisions, hernias and referred pain.

9. ***Pelvis***. Know: the positions of the bladder, urethra, rectum and anal canal; the structure of the pelvic floor; the anatomy of continence; the anatomy of reproduction (the male and female internal and external genitalia; ovaries, uterine tubes, uterus, vagina, labia, clitoris; testis, vas deferens, prostate, scrotum, penis); what can be palpated on rectal and vaginal examination.

All the structures listed above should be recognised using standard diagnostic imaging techniques.

We believe that all those who design courses in UK medical schools, whether traditional, integrated or problem-based, should ensure that their medical students learn in such a way that they become generally familiar with the anatomy summarised in this document. Such a level of knowledge is necessary for effective examination of a patient and for diagnosis. The summary above briefly defines what we mean by "generally familiar". A more detailed document can be obtained from the authors. It is shorter than but covers similar ground to the document prepared by the Nederlandse Anatomen Vereniging (*European Journal of Morphology* **37**, 228 - 325).

An important corollary of this belief is that such a standard of knowledge should be expected at the relevant level of examination, regardless of the teaching and examination methods used. Such a level of knowledge should therefore serve as the benchmark for anatomical knowledge.

We are trying to set standards not impose them. Documents available from the GMC (http://www.GMC-uk.org) are valuable to course designers who are trying to define "core" knowledge but are, in themselves, not sufficiently detailed to allow those who teach anatomy to set a curriculum. When we have established the extent of knowledge expected, we hope that our colleagues in the Anatomical Society and the British Association of Clinical Anatomists will agree to place this summary, or an expanded version of it, on their websites so that it is accessible to all teaching staff, students and examiners. Soon after we do this we plan also to code each heading so that students and those who design curricula can segregate the material covered by the different headings into sub-categories related to different functions to fit into systems based or integrated curricula.

We now ask our colleagues to suggest addition or removal of specific items. If our summary represents more than it is reasonable to ask a medical student to know, it must be reduced. If it is inadequate, it must be expanded.

In relation to setting standards for examinations we also seek the advice of colleagues on whether we should expect our students to be able to gain a high mark (e.g. 70% pass mark) in examinations covering this material. It seems logical that if the points listed reflect realistic a core of necessary knowledge, we should expect students to know more than half the material described.

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[7] **The role of assessment in a case-led outcome-based anatomy curriculum**.
By P. Bradley. *Sub-Dean for Teaching Learning and Assessment, School of Medical Education Development, University of Newcastle upon Tyne, UK.*

The process of curriculum reform in Newcastle Medical school has led to the adoption of a case-led curriculum. The cases are presented to the students as realistic clinical scenarios and are populated with patients who have real lives in a real world. The teaching that the students receive is directly relevant to the cases, aspects of which act as triggers for defining learning outcomes. Thus a patient with angina will lead to learning about the coronary circulation whilst the patient with GORD will trigger learning about the oesophagus and stomach. The cases are designed so that appropriate triggers are set for all the major body systems but the level of detail taught is determined predominantly by the time allocated within the curriculum for anatomy teaching. The nature of the triggers themselves is also important in determining the anatomy curriculum. Since many of the anatomical triggers relate to physical examination or to imaging it makes educational sense that anatomy teaching should reflect this. I have previously suggested (Bradley 2001) that detailed anatomy teaching should be considered a postgraduate topic and that undergraduates need to know only enough anatomy to be able to perform at PRHO level. A consequence of this and of using case-based triggers is that ‘pure’ anatomical knowledge will be reduced but that the ability to use applied anatomical knowledge will increase.

If the nature and relevance of student learning about anatomy is to change then it follows that the nature of assessment must also change. Any assessment system must be directed towards assessment of the stated objectives or outcomes of the course. In Newcastle we have adopted the approach to outcomes recommended by the GMC in which outcomes are classified into three main categories ‘What the doctor is able to do’, ‘How the doctor approaches practice’ and ‘The doctor as a professional’. These are abbreviated to ‘What, ‘How’ and ‘Who’. Students are assessed in each of these three strands and must achieve a satisfactory grade in each strand before being permitted to progress to the next stage of the curriculum. The various components of our examination - True/False statements, EMI, Data Interpretation and Problem Solving, and OSC/PE all contribute some marks to each of the strands.

The OSC/PE (Objective Structured Clinical and Practical Examination) is a hybrid of the old anatomy spotter and a clinical skills OSCE. Some spotter stations would be recognisable to all those who have run anatomy examinations (Identify "A". Identify "B" etc). Other stations which examine areas such as Medicine in the Community would not normally be found in the Dissecting Room. The spotter stations typically contribute to the 'How' strand of assessment, which in Stage 1 of the curriculum is predominantly knowledge based. Analysis of our first round of examinations in the new curriculum has shown good correlation between student performance in the 'How' strand of three of the assessment components (T/F, EMI and OSC/PE) with only the Data Interpretation (DIT) paper showing low correlation. (see Figs 1 and 2 below).

Figure 1. Correlation of results in 'How' strand of assessment between EMI and OSCPE components.

Figure 2. Correlation of results in 'How' strand of assessment between Data Interpretation and OSCPE components.

These results have led me to the conclusion that we are over assessing the students in the 'How' strand and that we could easily remove one of the components of the examination. Given the nature of the revised curriculum one could argue that the ability to recognise the genitofemoral nerve or the ovarian artery on a prosected specimen is not achieving any relevant learning outcome and that it is time for the spotter exam to be abandoned.

This is not to say that anatomical knowledge should no longer be examined, but I would like to propose that the testing of anatomical knowledge in the context of clinical scenarios, or as part of an examination of clinical skills, would be more relevant to the way in which modern medical graduates are going to be working. This approach would sit more comfortably in a case-led curriculum. This proposal will inevitably lead to charges that we will be dumbing down our Anatomy teaching. The argument could be made that, since assessment drives learning, without a 'spotter' style examination students will not bother to learn anatomy. I would strongly refute that suggestion. Provided that adequate anatomy learning objectives are set and provided that these are assessed in an appropriate manner then contextualised learning will still take place. Surely it is time to break undergraduate anatomy from the historical shadow of the surgeon and concentrate on providing a curriculum that has relevance and applicability.

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[8] **Teaching and learning anatomy in Maastricht**. By H.W.M. van Straaten[1], F. Thors[1] and L. Schuwirth[2]. [1]*Department of Anatomy and Embryology, and* [2]*Department of Educational Development and Research, Maastricht University, The Netherlands*

PPOBLEM BASED LEARNING

Educational approach

Problem based learning (PBL) is a student-centred approach relating basic disciplines directly to medical problems. In Maastricht, a Medical Faculty was initiated in 1974 with a PBL curriculum which is thematically organised in multidisciplinary blocks of 4-6 weeks during a 4 years preclinical programme. In tutorial groups students analyse cases utilising a "seven jump" procedure under the supervision of a faculty member (tutor). This procedure begins with 5 steps in one meeting: (1) clarifying difficult terms, (2) formulating problem(s), (3) brainstorming, (4) analysing explanations, and (5) formulating learning objectives. The latter are subsequently studied individually using information from libraries and other resources (step 6). This is supported by lectures, practical courses, skills trainings, orientation to health care settings, etc. In the next tutorial group meeting, the study results are reported (step 7). Of these activities, only the tutorial group meetings are obligatory. Thus, students spend most of their time searching information and studying.

Assessment

A fact-orientated summative test using true/false questions is administered at the end of each block. In addition, progress testing is used. This is a longitudinal assessment approach where 4 written tests per year are administered to all medical students of all year classes simultaneously. The items are attuned to graduate level. Progress of the individual students towards the end level is thus assessed. The mean correct minus incorrect scores increase from about 6% on the first test to about 40% at graduation, which is also the level of the reference group of physicians (Van der Vleuten et al., 1996). In addition, students are examined on practical skills once a year.

(Dis)advantages

Studying in a PBL setting has several advantages. Firstly, learning within a relevant context leads to better retention of knowledge. Secondly, interdisciplinary integration of relevant knowledge occurs. Thirdly, the acquisition of knowledge occurs in the same order as it is applied in real practice. The PBL system requires self-direction and self-responsibility. Moreover, the student learns to deal with conflicting information, because information from various resources is reported back in the tutorial group. Also, educational aspects are developed: see one, do one, teach one. In the group, the students learn about their own functioning, become trained in collaboration and communication. Most of all, to work in a PBL setting is experienced to be more joyful than in a traditional setting (Schmidt, 1993).

But, as a consequence of studying patients' cases, the information from the different disciplines is fragmented, and not as systematic as in traditional learning settings. Because of the lack of integration within a discipline students will never cover the whole domain of a discipline. In addition, this leads to feelings of insecurity about their own knowledge.

ANATOMY IN MAASTRICHT

Organisation of Anatomy/Embryology in a PBL environment

The Department Anatomy/Embryology is equipped with a dissecting room with 7 tables and a microscopy room with 35 microscope seats. Two rooms for living anatomy, each equipped for 20 students are present as well. The relative small size of the rooms is a direct consequence of the student-centred approach. Topics in anatomy, histology and embryology are woven into cases in many blocks, and lectures/practical courses, linked to these cases, are presented.

In the first block, students are obliged to attend an introductory practical on microscopy and one on the dissecting room. All subsequent practicals are optional. Students sign up for a specific subject, which is presented to small groups (20-30), for 2 hours. In a course of 40 practicals in anatomy and 3 practicals in embryology over 4 years, participants study an exhibition of dissected specimens and models, with a paper legend or instruction present, and on demand assistance. For the histology course (10 practicals) microscopes, selected sets of slides, paper instructions and assistance are available. For living anatomy, students practise on each other, in preparation for a physical-diagnostic training in the skills lab. The practicals are preferentially constructed in collaboration with a clinician or skills-trainer to warrant clinically relevant anatomy. Although the exhibitions of the practicals can be attended besides the scheduled meetings as well, very few students use this possibility.

Systematic dissection

A lot of students indicated the importance of dissection for their medical education. Therefore, dissection courses were offered to second and third year students, although discordant with the ideology of PBL. Many students sign up for these courses, which cover the subjects head/neck, thorax, abdomen and locomotor apparatus.

Effect of PBL on anatomical knowledge

The effectiveness of teaching Anatomy/Embryology in Maastricht was tested in a comparative study to the anatomical knowledge and insights of students of the 8 medical faculties in the Netherlands. It appeared that no difference of factual anatomical knowledge was found between the mean scores of all medical faculties. For the knowledge on clinical anatomy, however, Maastricht students performed significantly better (Prince et al. submited).

Disadvantages of the PBL system as related to anatomy

It has been proven difficult to cast anatomical goals in a PBL mould. Especially during the brainstorm phase of the tutorial group meeting, lack of knowledge results easily in too general learning objectives. Moreover, students run into difficulties by reporting verbally without visual aids.

Students often avoid anatomical, histological and embryological topics, because they perceive these disciplines as complicated. This is not penalised by the assessment system, because its multidisciplinarity allows a student to neglect a specific discipline. During the fifth and sixth year, some students recognise lacks in their anatomical knowledge and ask for help.

Much of the anatomical knowledge and insights is not tested optimally in paper exams.

Reform of the PBL curriculum

In the new curriculum, which started in 2001, one of the major changes concerns revision of the assessment system to meet the educational goals of the disciplines better. This implies a wider variety of testing procedures, including assignments, reports, case-based questions and computerised tests. For our discipline, computerised tests with anatomical or histological images testing basic knowledge in clinical questions are developed. Also practical assessment in the dissecting room is in preparation. The practicals on histology will be computerised.

Epilogue

Although from the perspective of Anatomy/Embryology the PBL approach has led to a reasonable achievement of the educational goals, there is still much to be improved. One of the major disadvantages has been the disproportional stress on written assessment, which may have negatively influenced the students' learning behaviour. This is why the current development focuses on revision of the assessment system.

Prince, CJAH, Van Mameren, H, et al. (submitted). Does problem based learning lead to deficiencies in basic science knowledge: an empirical case on anatomy.

Schmidt, HG (1993). Foundations of problem-based learning: some explanatory notes." *Medical Education* **27,** 422-32.

Van der Vleuten, CPM., Verwijnen, GM, et al. (1996). Fifteen years of experience with progress testing in a problem-based learning curriculum. *Medical Teacher* **18,** 103-10

[9] **Anatomy in problem based curricula: Glasgow's experience**. By J. Shaw-Dunn. *Department of Anatomy, The University, Glasgow, UK.*

In Glasgow a traditional Anatomy course of topographical dissections and systematic lectures was swept away in 1997 when a fully problem based medical course began.

The new course, based loosely on practice in Maastricht, has five-week blocks, each with nine case studies on a given body system or about a specific topic such as pain. At each session the students discuss the case in small groups and identify objectives for further study. The objectives are worked out in practical classes and guided reading before the group reassembles to share its results.

In the first Martinmas term Block 2 provides an early anatomical 'Cook's Tour' of the body. The case studies follow the examination and primary treatment of a road casualty, woven round a simple ten hour dissection of the trunk. Thereafter almost all the blocks in second and third year have practicals which contain anatomy as short dissections or as demonstrations of micrographs or plastinated parts in conjunction with physiological and clinical components. Interested students can choose from several special study modules in anatomy, often with dissection. These are popular choices for up to one third of the class, and are a recruiting ground for intercalated students.

In the regular course anatomy is examined with anatomical drawings or diagrams in modified essay questions. The tradition of rote learning is weak and the ability to name structures can be remarkably patchy. However, with a careful selection of cases, a problem based scheme is entirely suitable for learning clinical anatomy. Anatomy has the biggest toe hold of all the preclinical subjects in the new scheme and a course of 150 hours will cover a fair amount of the syllabus outlined by Richard Dyball and the Scottish Anatomists. The disciplined beauty of systematic anatomy may be hard to find in the new course, but there are enormous gains in immediacy from learning anatomy where and when you need it.

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[10] **Anatomy in a new born Medical School**. By J. McLachlan. *Peninsula Medical School, Universities of Exeter and Plymouth, UK.*

Peninsula Medical School is part of the expansion in medical education planned by the government to begin in September 2002. It is set up jointly between the Universities of Exeter and Plymouth in association with NHS partners. The first year intake will be 127 rising in subsequent years to 167.

Peninsula Medical School has chosen to adopt problem based learning as a core instructional strategy. This will be complemented by early clinical contacts in the community and by extensive clinical skills training. The community and clinical skills activities are co-ordinated with the problem based learning cases so the course is both horizontally and vertically integrated from the very beginning.

Anatomy teaching within problem based learning context poses opportunities and challenges. To support student learning around anatomy we are providing purpose built Life Science Resource Centres on both of the Phase 1 sites. These custom designed and built facilities are modelled on the human anatomy resource centre at Liverpool Medical School.

After extensive consideration of educational principles we have decided not to use cadavers in anatomy teaching. This is because we aim for the students to learn relevant information in context only, across all parts of the course. By and large students do not experience patients as cadavers, rather they encounter patients as living individuals and through imaging techniques. Our position is that if this is the most relevant way to learn anatomy, then this is the way anatomy should be taught.

The student environment in the Life Science Resource Centre is therefore richly equipped with a wide range of models and imaging technologies. Particular emphasis is laid on 3D virtual reality techniques. There will be an extensive living anatomy programme featuring peer examination, as well as the use of professional models. Ultrasound imaging capabilities will be available full time in the resource centres, so the students may directly carry out noninvasive imaging techniques.

We regard it as being extremely important to evaluate this programme as it proceeds. Base line measurements of students' knowledge will be taken at the beginning of the course and regularly upgraded on the basis of international comparisons through the progress test examination. In addition extensive use will be made of analysis of formative feedback activities, which will be undertaken by students on a continuous basis.

Use of cadaveric material poses a number of problems. These include the expense of the facility, the health hazards posed by the material itself, and the difficulty of identifying suitably qualified teachers. These difficulties are significant but were not an important factor in our making this decision.

We look forward to evaluating the consequences of this programme and to sharing experiences with others.

Our expectation is that the integration of the Life Science Resource Centre with the Clinical Skills programme will be of particular value to the students on the course.

We appreciate that our approach is a departure from the traditional. However the focus of medicine is changing and the mere fact of something being traditional does not demonstrate its validity. In particular it may be that traditional anatomy teaching has negative predictive validity in that if an examination normally given to students at the end of a traditional anatomy course were to be administered to junior and senior doctors, there is at least a possibility that they would perform less well as they became more senior.

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[11] **Historic perspective on problem based learning**. By J. Hamilton. *Academic Director of Phase 1 Medicine, University of Durham, Stockton Campus, UK.*

The historic perspective will be presented drawing upon the original main direction finder for problem based learning which is the 1910 Flexner report.

The speaker's experience in the early years of McMaster Medical School and the evolution of problem based learning and in particular the key role of the Foundation Professor of Anatomy, Professor Jim Anderson, will highlight some of the important intellectual principles within problem based learning

The constraints and opportunities in learning anatomy through problem-based learning will be examined through personal experience in McMaster (Canada), Ilorin (Nigeria) and Newcastle (Australia).

The usual focus of problem based learning is on individual cases. The flexibility of the method will be illustrated by examples from other disciplines.

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