

1-1-2010

Review of anatomy education in Australian and New Zealand medical schools

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Citation

Craig, Steven J.; Tait, Noel; Boers, David; and McAndrew, Darryl J., 2010, Review of anatomy education in Australian and New Zealand medical schools, 212-216.

<https://ro.uow.edu.au/medpapers/24>

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Abstract

Anatomy instruction at Australian and New Zealand medical schools has been the subject of considerable debate recently. Many commentators have lamented the gradual devaluation of anatomy as core knowledge in medical courses. To date, much of this debate has been speculative or anecdotal and lacking reliable supporting data. To provide a basis for better understanding and more informed discussion, this study analyses how anatomy is currently taught and assessed in Australian and New Zealand medical schools. A mailed questionnaire survey was sent to each of the 19 Australian and 2 New Zealand medical schools, examining the time allocation, content, delivery and assessment of anatomy for the 2008 academic year. Nineteen of the 21 (90.5%) universities invited to participate completed the survey. There was considerable variability in the time allocation, content, delivery and assessment of anatomy in Australasian medical schools. The average total hours of anatomy teaching for all courses was 171 h (SD 116.7, range 56/560). Historical data indicate a major decline in anatomy teaching hours within medical courses in Australia and New Zealand. Our results reveal that as there is no national curriculum for anatomy instruction, the curriculum content, instruction methodology and assessment is highly variable between individual institutions. Such variability in anatomy teaching and assessment raises an important question: is there also variable depth of understanding of anatomy between graduates of different medical courses?

Keywords

education, australian, zealand, review, anatomy, schools, medical

Disciplines

Medicine and Health Sciences

Publication Details

Craig, S. J., Tait, N., Boers, D. & McAndrew, D. J. (2010). Review of anatomy education in Australian and New Zealand medical schools. *ANZ Journal of Surgery*, 80 (4), 212-216.



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Key words

anatomy, Australia, medical education, New Zealand.

Abbreviations

AMC, Australian Medical Council; RACS, Royal Australian College of Surgeons.

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The corresponding author is not a recipient of a research scholarship.

Accepted for Publication 12 October 2009.

doi: 10.1111/j.1445-2197.2010.05241.x

Instruction in human anatomy at Australian and New Zealand medical schools has received considerable attention in the medical literature¹⁻⁴ and the media recently.⁵⁻⁹ Some commentators have lamented the gradual devaluation of gross anatomy as core knowledge in Australasian medical schools. There has been widespread contention that as a result, the level of basic anatomical knowledge held by medical graduates might be inadequate for clinical practice.¹⁰ Supporters of the modern medical education curriculum in Australasia argue that it is inappropriate to focus unduly on teaching unnecessary detail in basic sciences, including gross anatomy, often to levels irrelevant to clinical practice.^{11,12} To date, much of the debate on this matter has been speculative or anecdotal, lacking reliable supporting data.

Leung *et al.* (2006) reported that average teaching hours for gross anatomy had dropped markedly in US medical schools during the 20th century, from 549 total hours in 1902 to 167 total hours in 1997. In the UK and Ireland, the average time allocation for teaching gross anatomy was 124.5 h in 1999–2000.¹³ Although there is little reliable

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A mailed questionnaire survey was sent to each of the 19 Australian and 2 New Zealand medical schools, examining the time allocation, content, delivery and assessment of anatomy for the 2008 academic year.

Nineteen of the 21 (90.5%) universities invited to participate completed the survey. There was considerable variability in the time allocation, content, delivery and assessment of anatomy in Australasian medical schools. The average total hours of anatomy teaching for all courses was 171 h (SD \pm 116.7, range 56/560).

Historical data indicate a major decline in anatomy teaching hours within medical courses in Australia and New Zealand. Our results reveal that as there is no national curriculum for anatomy instruction, the curriculum content, instruction methodology and assessment is highly variable between individual institutions. Such variability in anatomy teaching and assessment raises an important question: is there also variable depth of understanding of anatomy between graduates of different medical courses?

quantitative data for Australasian medical schools, a recent curriculum review conducted by the University of Sydney found that gross anatomy teaching had reduced from approximately 500 h per year in its former undergraduate medical degree to 52.5 h in its new graduate medical programme.¹⁴ Similar reductions in teaching hours are also reported at other established Australian medical schools.^{10,15} Based on these figures, it has been estimated that the total hours dedicated to anatomy teaching have reduced by as much as 80% since the introduction of problem-based, graduate medical programmes.

Deciding what represents an adequate knowledge of clinical anatomy is a difficult task. Currently, there are no guidelines provided by the Australian Medical Council (AMC) or by any other body with a vested interest (such as the Royal Australian College of Surgeons (RACS)) regarding a core anatomy curriculum or appropriate minimum content for anatomy curricula. There is a need to define a core curriculum for all components of anatomy studies: embryology, micro-anatomy and gross anatomy. Furthermore, there

is no current standardized testing, either in the form of university exit exams or medical licensing exams, to ensure adequate standards are being set and met. Each medical school is free to design and assess its gross anatomy teaching time, methods, and curriculum. This has led to concerns that there is considerable variation in the level and content of anatomy instruction between medical schools and in the depth of understanding in medical graduates.

Although there has been much debate regarding the teaching of undergraduate anatomy recently, current and objective data on anatomy instruction and assessment in Australasian medical schools is lacking. This study analyses how anatomy is currently being taught and assessed in Australasian medical schools to provide a basis for more informed discussion.

Methods

An electronically mailed questionnaire survey was conducted to analyse contemporary anatomy teaching and assessment in Australasian medical schools. The survey was sent to a pre-identified individual active in teaching anatomy within each of the 19 Australian and 2 New Zealand medical schools. Respondents were asked to complete the survey with data relevant to the 2008 academic year. Ethics approval was given by the University of Wollongong's Human Research Ethics Committee.

Table 1 Medical schools participating in the survey

Australian National University
Bond University
Deakin University
Flinders University
Griffith University
James Cook University
Monash University
Sydney University
University of Adelaide
University of Auckland
University of Melbourne
University of New South Wales
University of Newcastle
University of Otago
University of Queensland
University of Tasmania
University of Western Australia
University of Western Sydney
University of Wollongong

Results

Nineteen of the 21 medical schools (90%) responded to the survey (Table 1). One university offering 4-year graduate MB BS programmes with two campuses, one in Sydney and another in Fremantle, did not respond to the survey. Each anatomy department was asked to define and comment on the amount of gross anatomy instruction, teaching methods used, staff involved in teaching gross anatomy, integration of gross anatomy with other subjects, and assessment methods and standards used.

Course structure

All respondents define the type of course within which they taught as a problem-based curriculum. Five (26%) of the courses were undergraduate entry, seven (37%) were postgraduate entry, and seven (37%) had combined undergraduate and postgraduate entry criteria. There were eight (42%) 4-year courses, five (26%) 5-year courses and six (32%) 6-year courses. Two courses with combined undergraduate and postgraduate entry had differing course lengths and were classified under the course length with the higher number of enrolled students. This method of classification is used in the remainder of this paper.

Gross anatomy teaching

The average number of hours of gross anatomy teaching per year by course length is shown in Table 2. Respondents were asked to give the approximate number of hours of gross anatomy teaching offered in each year of their course, inclusive of practicals, lectures and tutorials. The average total hours of gross anatomy teaching for all courses was 171 h. The average total hours of gross anatomy was highest for 6-year courses (221.7 h) followed by 4-year courses (179.7). Surprisingly, 5-year courses had the lowest total average (96.2). Over 90% of gross anatomy teaching was delivered in the first half of all courses.

Prosected human material was the resource most consistently used for teaching anatomy (Table 3), with 79% of courses using it every session and 21% of courses using it for most sessions. Models were used commonly to teach gross anatomy, with 15 courses (79%) using them in most or every session. Computer-generated images were used to varying degrees across courses. Medical imaging was used to teach gross anatomy in at least some sessions in all courses at the 19 respondent universities. Plastinated specimens were used for teaching at only nine medical schools (47%). Human dissection experience was available in 15/19 courses (79%); however, 6 of

Table 2 The average number of hours of gross anatomy teaching by course length (\pm SD) *min/max*

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
4-year courses (<i>n</i> = 8)	75.1 (47.6) 9/180	89.9 (43.1) 35/170	13.2 (26.1) 0/80	1.5 (3.3) 0/10	N/A	N/A	179.7 (77.7) 75/300
5-year courses (<i>n</i> = 5)	44.2 (9.7) 30/60	42.4 (14.3) 17/60	9.6 (10.6) 0/29	0	0	N/A	96.2 (23.7) 56/120
6-year courses (<i>n</i> = 6)	47.8 (28.4) 0/87	89.7 (56.6) 25/180	75 (124) 0/350	4.5 (8.8) 0/24	4.7 (4.7) 0/24	0	221.7 (158.1) 85/560
All courses (<i>n</i> = 19)	58.4 (39) 0/180	77.3 (49.1) 25/180	31.8 (79.8) 0/350	2.1 (5.8) 0/24	1.5 (5.5) 0/24	0	171 (116.7) 56/560

Table 3 Resource use for teaching gross anatomy

	Every session	Most sessions	Some sessions	Rarely	Never
Prosected human material	79% (15)	21% (4)	0.0% (0)	0.0% (0)	0.0% (0)
Plastinated specimens	21% (4)	21% (4)	0.0% (0)	5% (1)	53% (10)
Models	67% (12)	17% (3)	11% (2)	6% (1)	0.0% (0)
Computer-generated images	17% (3)	11% (2)	39% (7)	22% (4)	11% (2)
Medical imaging	44% (8)	17% (3)	39% (7)	0.0% (0)	0.0% (0)

Table 4 Type and average number of staff per medical school

	Average number of staff per medical school (\pm SD) <i>min/max</i>
Full-time academic	3.3 (1.8) 1/8
Full-time clinically qualified	1.2 (1.5) 0/6
Part-time clinically qualified	2.4 (3.4) 0/11
All clinically qualified (full-time/part-time)	3.5 (4.0) 0/14
Other part-time (including senior medical students, physiotherapists, technical staff, PhD students)	4 (5.6) 0/20
Total	10.8 (6.3)

these courses only offered a dissection experience as an optional elective. Only three courses offered a whole-body dissection experience. The remainder offered the dissection of a single body part or region only.

The courses surveyed differed in the breakdown of gross anatomy across organ systems or anatomical regions. The mean number of system/regions taught was 6 (\pm 3), although two curricula were dependent upon the current problem-based learning cases and had no defined systems/regions. There was considerable variation in the classification of systems and no discernible pattern in the order in which they are delivered. Eight of the 19 courses (42%) had a dedicated introduction block.

Staffing

On average, 11 staff per medical school were involved in teaching gross anatomy, but only 3 were full-time academic staff (Table 4). The majority of staff involved in teaching gross anatomy were part-time, nonclinical staff including senior medical students, physiotherapists and technical staff. There was an average of 3.5 clinically qualified staff (either full-time or part-time) per medical school.

Integration

Fourteen of the 19 courses (74%) specifically integrated gross anatomy teaching with other subjects. Most commonly, anatomy was integrated with clinical skills (eight courses), but it was also integrated with pathology (two courses), radiology (two courses) and clinical scenario teaching (two courses).

Assessment

Multiple-choice questions were the most commonly used means of assessing gross anatomy (16 of the 19 medical schools (84%)). Modified essay questions were used by 12 medical schools (63%), and extended matching questions were used by six schools (32%).

Nine of the 19 medical schools (47%) utilized practical-based identification for assessment of gross anatomy.

Nine of the 19 (47%) medical schools required students to complete a specific anatomy assessment. The majority of medical schools (10 of 19) integrated anatomical assessment into applied cases with other basic sciences in problem-based assessments. Because anatomy was integrated with other content for assessments in most courses, there was no minimum level of achievement set for gross anatomy in 11 of the 19 courses, only for the overall integrated paper. In such courses, students can perform very poorly in gross anatomy but do well in other disciplines and still pass the course (as specifically commented by several universities). The remaining universities (8 of 11) required a pass grade (50%) or higher in gross anatomy to progress within the course.

Discussion

Our results indicate that for the 2008 academic year, there was considerable variability in important aspects of anatomy instruction in Australasian medical schools. This is an indication of the current climate in which basic sciences, including anatomy, are taught in Australian and New Zealand medical schools. As there is no national curriculum or framework for the teaching of anatomy, curriculum content, instruction methodology and assessment are entirely at the discretion of individual institutions.

A comparison with available historical data indicates that there has been a major decline in time allocated to teaching gross anatomy within medical courses in Australasia. The total hours of anatomy teaching was also highly variable between institutions surveyed, ranging from 56 h to approximately 500 h. The average total hours for Australian and New Zealand schools (171 h) is comparable with US figures¹⁶ but is nearly 50 h greater than the reported average for UK and Irish medical schools.¹³

It is difficult to comment on what represents a sufficient amount of gross anatomy teaching time, especially given the likely variation in teaching quality and intensity. One measure of the adequacy of current gross anatomy instruction is provided by a survey by the Australian Medical Student Association survey of all Australian medical schools in 2006. That survey found that 73% of responding students regarded the number of hours of anatomy teaching they received to be too little and that only 40% felt they would graduate knowing enough anatomy to become a competent doctor.¹⁷

Although there have been many calls for more time to be devoted to teaching anatomy at Australasian medical schools, it has also been suggested that the level of anatomy required by junior doctors is minimal and that it is now the duty of surgeons and anatomists to

deliver anatomy education to the level required in postgraduate training programmes.¹² The introduction of graduate diplomas and master's degrees incorporating surgical anatomy instruction by some Australasian universities, for example, seems testament to this opinion and may be an indication of the direction of anatomy education in Australia and New Zealand.

It may surprise many practising doctors and past graduates to learn that currently over half of all universities surveyed (53%) had no specific assessment for gross anatomy and integrated all basic science knowledge into applied, case-based assessments. Further, as anatomy is integrated with other content for assessments in these courses, there was no minimum level of achievement for gross anatomy, only for an overall integrated paper. As such, several institutions contended that students could do very poorly in gross anatomy but well in other disciplines and still progress in, and graduate from, their course. The first author of this study, a recent University of Sydney graduate, can recall fellow students omitting to study anatomy in the lead up to barrier exams, in favour of other basic science subjects in which they were well versed, in order to maximize their chances of passing integrated, case-based assessments.

The reduction in the allocated time for anatomy teaching within medical schools has presented medical educators with the task of determining what anatomical information is essential for undergraduate medical students and how to best deliver it.¹⁸ Curriculum management and resourcing pose significant problems, especially as time and resources available for teaching anatomy have reduced. Perhaps a result, some Australian medical schools are reported to have reduced cadaveric dissection¹⁸ and have introduced new and innovative teaching methods and technologies.^{12,19,20}

Parker (2002) analysed the amount of human dissection available to Australian medical students and found that although 8 of the 11 (72%) medical schools operating in 2000 offered a dissection experience, it was compulsory in only 3 schools (27%). Our study reports that dissection experience is currently available at 15 of the 19 (79%) courses surveyed and is compulsory at 9 (47%) of these. These figures suggest that there may be a trend towards restoring the importance of anatomical dissection in medical curricula.

The results of our survey also indicate a relative lack of technologically based teaching aids, such as CAT scanning, to facilitate the transfer of anatomy learning into clinical practice. Given the advances in 3D imaging, it is surprising that more institutions are not utilizing this medium as a teaching tool in at least some form. There are several international reports of computer-based 3D tools for teaching human anatomy that allow features such as detailed manipulation of images with 'mouse-click' dissection for specific pathologies.²¹ These tools have been reported to increase anatomical knowledge and recall but do not appear to be utilized widely in Australasian medical schools presently.

Only 5 of the 19 courses surveyed offered anatomy teaching, either directed or integrated, in the latter half of their courses, and no courses offered anatomy teaching in the final year of their course. Given the challenges in teaching gross anatomy in increasingly crowded and time-poor medical curricula, it seemed logical that there would also have been a stronger trend to have directed anatomy teaching integrated with other subjects (such as clinical scenarios),

particularly in the latter stages of courses. A key tenet of problem-based courses has been to strongly integrate clinical subject matter into the earlier stages of courses, often at the expense of basic sciences. However, it appears that as yet, basic science has not been integrated into the later stages of courses to compensate.

Our study reports that the majority of staff involved in teaching anatomy in Australasian medical schools are nonacademic/non-clinically qualified staff, including senior medical students, physiotherapists and technical staff. There was considerable variability in the number of clinically qualified staff, with several universities reporting that no clinically qualified staff were involved in teaching gross anatomy, while at other institutions the overwhelming majority of staff was clinically trained. The historic practice of anatomy instruction by career anatomists, supplemented by surgical registrars studying for exams, surgeons reducing their clinical practice or retiring surgeons, now seems unsustainable at many medical schools. Reliance on part-time, nonacademic and nonclinical staff seems to be a reality of the modern anatomy department.

The variability in gross anatomy teaching and assessment in Australasian medical schools revealed in our study raises one very important question: is there also variable depth of understanding of gross anatomy between graduates of different medical courses? This question is beyond the scope of this study and is a matter for further investigation. However, we believe that consideration should be given to developing undergraduate learning goals or guidelines for anatomical teaching. This would require involvement of national bodies such as the AMC and the RACS. A standardized national curriculum and perhaps even a standardized national examination to assess anatomical knowledge prior to graduation may be needed to ensure all graduates attain at least some minimum acceptable knowledge base in gross anatomy. While the standards of resourcing, teaching, and assessment in gross anatomy are variable, the anatomy and anatomical problems of safe clinical practice, even at a junior level, are similar everywhere.

Further study is also required to elicit which method(s) of teaching, learning and assessment of anatomy in medical courses are most efficacious. As courses become shorter and curricula more crowded, curricula and methods must maximize the effectiveness of initial anatomy teaching, available resources and technologies, and, most importantly, the recall and application of anatomy knowledge in medical practice.

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