EDUCATION

The dissection course – necessary and indispensable for teaching anatomy to medical students

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Summary
Anatomy is a major basic subject in medicine and related biomedical sciences. A central tool most universities use for teaching anatomy is the "dissection course," in which medical students learn the basic constructional principles of the human body by dissecting a cadaver. In recent years, the relevance and value of the dissection laboratory have been under discussion at different universities due to high costs and problems of shortness in time in some medical curricula. Indeed, during the last 10 years, several universities in the US and the UK have abandoned dissection and have moved from a cadaver-oriented to a cadaverless anatomy. This development results in a fundamental discussion on the role of the "dissection course" in the medical curriculum, ultimately raising the question as to whether we should continue teaching anatomy by dissection. This article presents nine arguments for the dissection course as a central tool for teaching macroscopic anatomy and is an attestation to the continuation of the use of cadaver material in anatomical laboratories within the auspices of scholastic and university order for the benefit of future physicians with due respect and honour guaranteed for every donor.

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Introduction

Anatomy, the science of human biology, is a major basic discipline every student or professional has to learn when entering medicine or biomedical sciences.

Scientific anatomy can be traced back to the world famous publication of Vesalius’ “De humani corporis fabrica libri septem” (Basel, 1543) (Figure 1).

Anatomical dissection became an integral part of the medical curriculum in the 1800s in the form of “prosection” (Enke, 2005). Over the centuries, the practice of cadaver use in anatomical institutes has evolved from a historical public spectacle, “Anatomia publica”, to modern educational anatomical dissection based on donor programmes. During their lifetime, potential donors release their body after death for purposes of research and education as set down in a legally binding and secure testament, leading to reverent security of donor assurance.

The reverence and honour offered the donor is often reflected today in an interconfessional ecumenical funeral service not only attended by students of the anatomy lab but also planned and

Fig. 1. Cover of book one “De humani corporis fabrica libri septem”, Basel, 1543. For an annotated translation of the complete book, see Garrison et al. (2003), http://vesalius.northwestern.edu/. Publication with permission of Prof. Daniel H. Garrison, Department of Classics, Weinberg College of Arts and Sciences, Northwestern University, Chicago, IL, USA.
carried out with musical accompaniment and ceremonial attestation (Pabst and Pabst, 2006).

With the advent of new techniques and computer science, alternative methods of teaching anatomy came into existence. With their refinement and the ubiquity of websites and widespread availability of computer programs to almost all medical students, an alternative concept of teaching anatomy arose: “the cadaverless gross anatomy lab”. This trend was strengthened by inherent rampant curriculum changes paying tribute to scientific advances due to the increase in manageable knowledge in cellular and molecular biology and genetics to be taught to medical students. Since teaching gross anatomy in a dissection course for students is costly and medical faculties suffer from financial constraints, a debate has thus ensued: cadaver versus cadaver-less anatomy teaching (Aziz et al., 2002; Arraez-Aybar et al., 2004; Granger, 2004; Guttmann et al., 2004; McLachlan, 2004; Pawlina and Lachman, 2004; Topp, 2004; Vazquez et al., 2005; Biasutto et al., 2006; Winkelmann, 2007; IFD-Internet Forum Discussion, 2006).

The following thesis will be an attestation to the continuation of the use of cadaver material in anatomical labs within the auspices of scholastic and university order for the benefit of future physicians with due respect and honour guaranteed for every donor. Moreover, it will set forth nine tenets against the sole use of plastinized cadaveric material and the sole use of models and/or computers in place of fixed cadavers as has recently taken place in some parts of the academic world. The subsequent argumentation is a strong plea for continuation of the cadaver-centred dissection course as an integral and indispensable component of the classical dissection labs for teaching anatomy.

### Nine arguments for the dissection course as the core of gross anatomy education

#### The practical argument

In current medical education much attention is paid to passive analyses, to impersonal acquisition of knowledge and to diagnostics and therapies without any direct bodily contact. However, “medicine” is an art that inter alia requires manual skills. Doctors not only analyse, they also act, and when doing so, they use their hands, be it as a surgeon or as a general practitioner, be it with a scalpel or with a laryngoscope. The art of ‘touching’ patients’ bodies as performed by physicians is naturally entirely different from everyday contact in that doctors’ touchings are analytical and instrumental, or part of operations or surgical interventions. The gross anatomy lab offers the unique possibility to learn and practice manual skills required for analytical “doctoral touching”.

Plastinates and ‘body slices’ do not fulfill these requirements, since they do not allow such contact and practical training.

#### The argument of hypothetical seeing and thinking

According to Karl Popper knowledge acquisition occurs via testing and falsification of hypotheses (Popper, 1959). Indeed, the doctor’s diagnostic view on his/her patient is not only analytical. Doctors diagnose by putting forward hypotheses and evaluating them. The range of diagnostic and therapeutic tools will depend on this hypothesizing process of observing and thinking. The dissection course can be seen as a preparation to this profoundly medical and scientific view of man and the world. Students equipped with dissection scalpels and forceps not only see, they also think (well, ideally at least): “When I cut at this site, I normally should see this or that”. If such is the case, then you have learned something. If something unexpected emerges, then you have also learned something. Unlike the living body, a cadaver does not punish errors. In contrast, these errors may even lead to deeper insight.

Plastinates or anatomical models, on the other hand, do not allow such a way of thinking and hypothetical deductionism.

#### The didactic/constructive argument

According to Theodor W. Adorno “A man of science knows the nature of things insofar as he is able to construct them” (Horkheimer and Adorno, 1971). It stands to reason that passive acquisition of knowledge (reading, hearing, observing) is far less efficient than active acquisition of knowledge (acting, discussing, constructing). Dissecting can be seen as acting, or even better, as organized acting in groups. Dissecting strategies should be planned; step-by-step actions should be discussed in advance and – last but not least – the anatomy should be re/constructed after the dissection. The relatively soft, pliable cadaveric material used in the dissection course is not just dismembered, it is dissected in such a way that it can be put back together again. Indeed, there is nothing more informative and useful than trying to reconstruct
the dissected convolutes of the guts and abdominal organs back to their original positions.

Plastinates or models, however, are rigid structures that do not or at least only partially permit de/reconstruction.

The educational psychological argument

Knowledge acquisition is most efficient when involving as many senses as possible. It is therefore most expedient from an educational psychological point of view to bring in as many contextual sensory impressions as possible into educational processes. This approach is fully warranted in the case of a dissection course, during which students must activate all senses to literally comprehend. In this respect, dissection courses serve as a unique, powerful tool to convey macroscopic knowledge.

Glossy presentations and plastinates may serve as short-term “edutainment” (education+entertainment = edutainment) but do not engrave the basic concepts of anatomy into the long-term memory of students.

The philosophical/medical argument of distance and proximity

Being a physician implies occupying a position in the tug of war between subject and object in a very specific way. In a sense, patients should be regarded as the ‘object among objects’ and the doctor’s objective view should result in sound, useful diagnoses and valid therapies. Obviously physicians also deal with patients, who should be considered not only as objects but also as human beings and hence subjects, whom doctors should respect and understand as such. One of the most important qualities of a good physician is the way in which (s)he is able to combine both roles, i.e. that of neutral observer and that of compassionate helper.

The extent to which students are successful in this dual role will be disclosed for the first time in the dissection course. The first arduous step required of students in dissection courses is the cold objectivism of the cadaver, which may still be seen as an individual, sometimes even with a personality. The cadaver, the specimen, should be converted into an ‘object’, an object among objects in the students’ minds. Only then can it be dissected.

In the next – and still more difficult – step, this ‘object’, while gradually losing its original form during the dissection process, should begin to tell the story of the human being to whom it belonged. The fragility of bones may point to the painful process of osteoporosis, the fine-spun muscles to a bedridden history, the calcified coronary arteries to infarction…

At the end of the course, the objects, the specimens, the cadaver, the donors regain their names and the status of being a subject. They are cremated in a personal way. Many medical faculties in Germany organize central memorial ceremonies for the donors, whose urns are personally carried to their graves by the students themselves.

Any degree of mastering such attitudes, which are indispensable for practising in the medical profession, is impossible when working with plastinates, which will remain objects among objects and which only serve purely illustrative functions.

The argument of stereotypy

According to Nietzsche (1880), man is a ‘dividuum’ and hence divisible, an opinion that is certainly true from an anatomical point of view. Every human being – everyone who is reading this text – is, however, also an ‘in-dividuum’, i.e., divisible but at the same time unique. This uniqueness, which the patient wishes to see respected by his/her doctor – and quite rightly so – also pertains to physical properties. Differences exist and differences do matter. An example: the fact that no pulse is felt at the usual location on the wrist does not necessarily mean that the patient is dead – the artery in the hand might rather follow a different course. Each year, teachers and students will experience the very cosmos of diversity based on a universal, common constructional plan, and this in the same surprising and unexpected individuality of a patient that is revealed in front of the physician. This feeling of surprise at the identification of such a variation during the dissection course is a highly informative and enriching experience, for those who can be proud of discovering it, for those who have identified it and for those who try to explain it. The decisive element, just like in real life, lies in the momentary effect of surprise about individuality and the way of dealing with it – flexibility when dealing with something that deviates from the rule. These aspects are trained in a gross anatomy course.

A series of plastinates, even one showing the most common variations, quickly loses its novel character. Accordingly, teachers tire of the same identical variants and students quickly know the list of exposed variations by heart. The ‘individuum’ returns to the status of ‘dividuum’: a heap of known, exchangeable components.
The argument of ‘connective tissue’

Plastinates or anatomical models are final products and miss a vital aspect of the human body. There is hardly any organ that “appears just like that”. Instead, organs need to be laboriously and elaborately uncovered before being removed, excised and cut out of connective tissue envelopes, fasciae and adipose tissue. Many of the seemingly well-delineated entities in anatomy (e.g., the collateral bands of joint capsules) appear as artificially created units: in reality, they are ‘nothing more’ than distinct regions within the connective tissue continuum of, e.g., a joint capsule. They are created by means of a scalpel. Other organs, however (e.g., lungs or cruciate ligaments), indeed just ‘appear in a clearly delineated way’ as one further explores the cavities in which they lie.

Plastinates do not afford this experience to the observer: all structures are immediately exposed. The difference between ‘production’ and ‘discovery’ is denied.

Yet it is this connective tissue, these tough or fragile areas, these clefts and separating walls, in which nerves and blood vessels are contained that form the very essence of a surgeon’s skills. It is through this connective tissue – and not through the organs proper – that (s)he clears a path to the organ of interest. In addition, connective tissue is the area through which pathological processes invade the organism and the area through which the major body pathways run from one region to another. Connective tissue both connects and separates, joins and partitions the organism. The skilful, mechanical and topographical approach to this tissue is a prerequisite to gaining insight into anatomy. To prospective surgeons it is even more essential: only during the dissection course are the necessary skills developed to deal with this important component of the human body (connective tissue).

Once again, plastinates or models conceal this process of dealing with connective tissue. In addition, the totally different consistency of the various tissues is reduced to sheer uniformity.

The argument against the ‘plastinate authenticity’

Eighty percent of the human body is comprised of water and fat. The dissection course specimens still possess these essential parts of our being. In plastinates, however, these 80% are replaced by synthetic material, leading to the loss of authenticity. Equally unreal are the misleading colours of plastinates, which indeed are painted vividly. Authentic colours and the state of the organ surfaces are not exposed by this technique or that method. Body surfaces (mat, fibrous, velutinous or sparkling) are visualized far better by means of conservation methods that do not mask fat or water.

The argument of the life of knowledge

Admittedly, gross anatomy is no longer about new discoveries, but rather about reproduction of knowledge gleaned over centuries. Nevertheless, the following premise holds true for anatomists (as well as for anyone reading this text): collected knowledge is not equal to reproducible knowledge and skills. You may have learned at school how to solve a differential equation and perhaps even know where to look it up again; however, you will most probably not find the solution unless differential equations are your daily activity. Or else: you have lost the procedural knowledge of solving the equation.

Knowledge does not live in books, it lives in the mind. It does not only survive by production but also – and mainly – by reproduction. Whatever is known and written down somewhere, but is no longer practised, is useless. Production and reproduction of knowledge in dissection courses, however, will help to conserve and save practised knowledge, and therefore be beneficial also for future generations of physicians.

Conclusion

This article reinforces the central role of the dissection course in medical education by means of nine subjectively selected arguments. The necessity to maintain ‘hands-on’ cadaver dissection (or to re-establish it in those medical faculties that abandoned it in the last few years) is also evident from several other recent publications. Thus, in his critical review on the role and quality of anatomy teaching in the UK, A. Raftery, Consultant General Surgeon at the Northern General Hospital Sheffield, has emphasized the need for a core curriculum that provides an anatomical basis for patient examination and has listed the benefits of dissection according to Professor Harold Ellis, London: “Dissection teaches the basic language of medicine and some manual dexterity. It introduces an understanding of three-dimensional anatomy and the concept of biological variation. It
introduces students to team working and fosters communication skills between individual students and groups. It acclimatizes students to the reality of death and teaches respect for the body”. Similar conclusions were drawn by Rizzolo and Stewart (2006) who state that “problem-solving in the dissection laboratory develops the habit-of-minds of clinical practice…, relating dissection to imaging modalities develops the spatial reasoning skills needed to understand computer simulations…” and “the human face of dissection fosters self-reflection and integration of the cognitive and affective skills required for medial practice”. The value of the classical approach to teaching anatomy in medical education was emphasized in a retrospective evaluation by 1029 medical doctors who applied for their specialist examination at the Medical Council of North-Rhine, Germany, in 2002 and 2003 (Hofer et al., 2006). Similar observations were made in another state of Germany (“Niedersachsen”) where candidates of the specialist examination were asked to retrospectively evaluate the importance of the disciplines and classes taught in the medical curriculum: anatomy was ranked to be of equally high importance as internal medicine (Pabst and Rothkötter, 1996).

A synoptic view of all available evaluations and arguments makes a strong case for keeping cadaver dissection as an essential part of medical education and as an indispensable basis for other educational approaches, such as living anatomy, seminars on clinical aspects, problem-oriented learning, as well as anatomical and computed modalities. We as professional anatomists should support human cadaveric anatomy as a superior tool to achieve anatomical knowledge.

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For more information on Vesalius see also http://www.cas.northwestern.edu/classics/faculty/vesalius.htm

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