

Teaching clinical anatomy: from general practice to state-of-the-art surgery

Jean H.D. Fasel¹, Gilles Mentha² and Jan De Maeseneer³

¹Anatomy Sector, Department of Cellular Physiology and Metabolism, University Medical Centre, Geneva, Switzerland, ²Department of Visceral Surgery, University Hospitals, Geneva, Switzerland and ³Department of Family Medicine and Primary Health Care, Gent University, Gent, Belgium

SUMMARY

The amount of time allocated to teaching gross anatomy within medical curricula has been drastically curtailed worldwide. There is thus a need for core syllabi detailing the level of knowledge all medical students should reach. Against this background, the present study was aimed at determining a compulsory core of anatomical knowledge relevant for non-specialised, i.e. general medical practice. The design of the study was a modified Delphi consensus approach, i.e. the survey relied on a panel of independent experts. 7 general practitioners of high professional profile were asked to identify, in an exhaustive list of the structures included in the current international anatomical terminology, those elements which they considered to be indispensable for their practice. This paper presents the results concerning the digestive tract, with special emphasis on the liver. The current anatomical nomenclature names 499 structures under the alimentary system. Out of these, 442 were judged unanimously. This corresponds to an 88.6 % consensus of opinion. 148 (29.7%) have been settled as indispensable for general medical practice. Based on these results, a 3-level-strategy for teaching anatomy has been implemented. Its main features are briefly described in the paper.

Key words: Anatomy – Teaching – General Practice – Family Medicine – Surgery

INTRODUCTION

The amount of time allotted to teaching gross anatomy within medical curricula has been drastically curtailed since decades, both in the USA and Europe. Despite this matter of fact, very few studies have been aimed at the inevitable adaptation of the *content* of anatomical teaching. This is in striking contrast with the countless drafts debating on purely formal issues concerning teaching *methods*. And this matter of fact is becoming a major concern for surgical faculties, because of the decline in standards of anatomical knowledge of junior residents and its role in possible loss in quality of patient care (Ger, 1996; Willan, 1996; Kaufmann, 1997; Ellis, 2002; McKeown et al., 2003; Older 2004; Hanna and Tang, 2005; Bell, 2009).

Against this background, the present study was intended to determine a compulsory core of anatomical knowledge relevant for non-specialised, i.e. general medical practice, hypothesised to allow an adaptation of anatomy teaching to the shortened curricular conditions given.

This article presents (i) the results of a Delphi survey entrusted to a panel of family practitioners concerning the digestive system, with special reference to the liver; and describes (ii) a possible strategy of subsequent implementation of the results into the medical curriculum as realised at our University.

MATERIALS AND METHODS

The design of the study was a modified Delphi

Corresponding author: Jean H.D. Fasel. University Medical Centre, 1 Rue M. Servet, CH-1211 Genève, Switzerland.
Tel: +41-223795318. E-mail: jean.fasel@medicine.unige.ch

Submitted: 25 June, 2013. *Accepted:* 8 August, 2013.

consensus approach, i.e. a survey entrusted to a panel of independent experts (Helmer, 1966; Dalkey, 1969; Kilroy, 2006), as follows:

Questionnaire content

The questionnaire consisted in the full list of the structures named in the current international anatomical nomenclature, with a brief description and sketch for each item (FCAT, 1998; Dauber, 2008). The number of the discrete anatomical structures listed was 499 for the digestive system as a whole, and 69 for the liver.

For each anatomical item, the participants were asked to indicate whether, in their opinion, it was indispensably required for their general medical practice or not. If considered as essential, the entity had to be marked and the reason of its relevance mentioned.

Selection of participants

Seven general practitioners were selected as members of the expert jury on the basis of unreservedly fulfilling the following professional profile:

Possession of the title "Recognized General Practitioner" (Arzt für Allgemeine Medizin FMH:

Foederatio medicorum helveticorum). This requirement ensured that the contributors had undergone the postgraduate training recognized as fulfilling the conditions laid down by the Society of Swiss Medical Practitioners (FMH).

At least 3 years of professional experience in his or her own practice. This condition was imposed to make sure that their knowledge, mostly acquired in hospitals, should have been fully oriented towards the specific need of general practice.

As well as medical conditions (in the wider sense of the word, including ophthalmologic, otorhinolaryngologic and dermatologic conditions), the patients under their care must also include those requiring minor surgery, pediatric and simple gynecological and obstetric diagnoses and treatments. In this way, only those active in full general medical practice were admitted.

Rounds

After the first round, a second stage was performed, consisting in a discussion of those items that had not been unanimously selected or declined. This run yielded a definitive consensus on which anatomical entities are indispensable for good general medical practice.

Table 1. List of the anatomical structures of the digestive system according to the international anatomical nomenclature (FCAT, 1998; Dauber, 2008), settled as indispensable for good general medical practice in the present study

Mouth	Upper and lower lip, philtrum, angle of mouth; oral cavity, cheek; oral vestibule, papilla of parotid duct, gingiva; oral cavity proper, mucosa, hard and soft palate; sublingual caruncle, sublingual fold
Oral glands	Major and minor salivary glands; parotid gland, parotid duct, sublingual gland, submandibular gland
Teeth	Deciduous and permanent teeth; incisor, canine, premolar and molar including third molar; upper and lower dental arcade; clinical crown, neck and clinical root; periodontium, dentin, enamel, pulp cavity, dental pulp, root canal
Tongue	Apex, body and root; dorsum and inferior surface, lingual papillae, terminal sulcus, foramen caecum, lingual tonsil, frenulum, muscles of tongue
Isthmus of fauces	Soft palate, uvula, palatoglossal and palatopharyngeal arch, tonsillar fossa, palatine tonsil, tonsillar capsule
Pharynx	Naso-, oro- and laryngopharynx; pharyngeal tonsil, opening of auditory tube, pharyngeal lymphoid nodules; piriform recess, pharyngo-oesophageal constriction
Oesophagus	Cervical, thoracic and abdominal part; bronchoaortic and diaphragmatic constriction
Stomach	Cardia, fundus, body, pyloric antrum, pylorus, greater and lesser curvature, cardiac notch, angular incisure, gastric folds
Small intestine	Circular folds; duodenum: superior, descending, inferior and ascending part, duodenal ampulla, major and minor duodenal papilla, duodenal glands; duodenojejunal flexure; jejunum; ileum
Large intestine	Caecum: ileal orifice, vermiform appendix; colon: ascending, transverse, descending and sigmoid colon; right and left colic flexure, semilunar folds, haustra, omental appendices, taeniae coli; rectum: transverse folds, rectal ampulla; anal canal: anal columns, anal pecten, internal and external anal sphincter, anus
Liver	Right, left, quadrate and caudate lobe, inferior border, porta hepatis, right, left and common bile duct
Gallbladder	Fundus, body and neck, cystic duct, bile duct, sphincter of ampulla
Pancreas	Head, body and tail, pancreatic duct, accessory pancreatic duct

RESULTS

The current international anatomical terminology names 499 structures under the alimentary system (FCAT, 1998). Out of these, 442 were judged unanimously in the first round: 130 (26.1%) were chosen as relevant by all the experts involved, 312 (62.5%) by none of them. This corresponds to a consensus of opinion in 88.6 % of the anatomical structures. 57 entities (11.4%) were not unanimously selected or declined: 5 were selected by six participants, 4 by five, 9 by three, and 39 by one contributor. After discussion in the second run, a consensus was obtained for a total of 148 (29.7%) structures that were finally settled as indispensable for good general medical practice. They are listed in Table 1.

DISCUSSION

The two striking facts emerging from this study are (i) the very high agreement between the interpretations offered (including 88.6% of the items) already in the first round. This result is in good accordance with those obtained so far for other functional systems (Fasel et al., 1998; 1999; Ta-

ble 2), and suggests that a common trunk responding to a largely uniform need for gross anatomy within the field of general medical practice (GMP) does exist; (ii) the relatively modest quota of structures mentioned in the international anatomical nomenclature that were considered to be relevant for GMP. For the digestive system, less than a third (29.7%) of its anatomical structures was judged to be essential (Table 2). This draws attention to the possibility to reduce the amount of anatomical information taught, without endangering the basic knowledge required for general medical practice. On the contrary, it can be assumed that, by throwing unnecessary ballast overboard, the learning of the essential facts is improved.

Such a list of anatomical structures indispensable for GMP, however, is only one step towards a clever adaptation as regards content of anatomy teaching to the conditions prevailing in our days. An implementation of this common trunk into a realistic curriculum is demanded. That is what we did at our Faculty, by introducing a three-stair strategy for anatomy teaching, as follows:

1. For the undergraduate phase 1 (also called

Table 2. Synopsis of the number of anatomical structures relevant to general medical practice, settled by functional systems investigated so far, including the results of the present study for the digestive system.

Functional System	Number of anatomical structures denoted in the current international terminology	Structures ascertained as relevant to general medical practice in the present and previous studies			
		Number	Percentage	Consensus	
1 Skeletal	861	288	33.4	89.3	
2 Articular	280	078	27.9	89.3	
3 Tendon Sheaths and Bursae	070	012	17.1	87.1	
4 Respiratory	268	081	30.2	91.0	
5 Urinary	084	025	29.8	88.1	
6 Genital					
	Female	135	044	32.6	91.9
	Male	121	037	30.6	90.1
8 Endocrine	039	015	38.5	97.4	
9 Cardiovascular Arteries	585	077	13.2	94.5	
10	Veins	375	036	09.6	92.8
11 Lymphoid	Lymph Nodes	169	026	15.4	92.3
12 Nervous, Central	Meninges	035	019	54.3	82.9
13	Brain	623	063	10.1	92.3
14 Nervous, Peripheral	Cranial Nerves	204	021	10.3	96.1
15 Sense Organs	Ear	275	036	13.1	92.7
16 Digestive		499	148	29.7	88.6

Bachelor in some countries of Europe, encompassing the study years 1 to 3 in Geneva), anatomy teaching is devoted to the common core mentioned, relevant to GMP.

2. During the undergraduate phase 2 (Master, years 4 to 6 in Geneva), gifted students interested in surgery or radiology are taught anatomy. This allows them to vigorously deepen their anatomical knowledge and skills.
3. At the level of postgraduate and continuing education, further detailed and focused anatomy is acquired, particularly oriented to the demands for higher surgical examinations.

These 3 stages are illustrated, with the liver as an example, in Figs. 1 to 3.

Thus, a first characteristic of this teaching program is the core of anatomical knowledge, compulsory to all medical students. Attempts to stipulate or define core syllabi in anatomy have been published for different disciplines, for instance for surgery (Standring, 2009), radiology (Gregory et al., 2009), dentistry (Davenport, 2012) or topo-

graphical and surface anatomy (McHanwell et al., 2007). In the present study, however, relevance to general medical practice (GMP) has been chosen as the decisive parameter, for several reasons. First, the fact that medical students, in their overwhelming majority, want to and will become practicing clinicians, means that efficacious anatomy teaching has to be *clinically* oriented. However, under this heading, all medical specialties have in principle to be included. Considering this fact, it is intuitively clear and has also been demonstrated many years ago (Lippert, 1974): The knowledge required for the various clinical specialties exceeds by far any currently available time at the pregraduate level, so relevance to general practice as the criterion for determining a common trunk seemed to be a reasonable approach.

The second distinct feature of the program pro-

Figs 1-3. A three-stage strategy for anatomy teaching according to the “Geneva road map”, illustrated for the liver as an example

Fig. 1. At undergraduate Phase 1 (Bachelor; years 1-3) level, the anatomical entities taught are those relevant to general medical practice. *Anterior view of the liver. 1 anatomically right lobe, 2 falciform ligament, 3 anatomically left lobe, 4 inferior border of the liver, 5 gallbladder (fundus).*

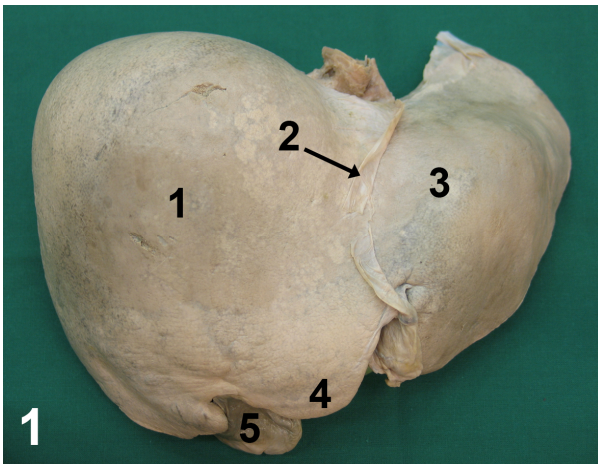


Fig. 2. For undergraduate Phase 2 (Master) students, anatomy instruction is adapted specifically to the specialty intended (here surgery). *Intraoperative situs showing the right posterior sector by vascular demarcation after temporary occlusion of the corresponding sectorial portal branch in a patient with several lesions in segments 6 and 7.*

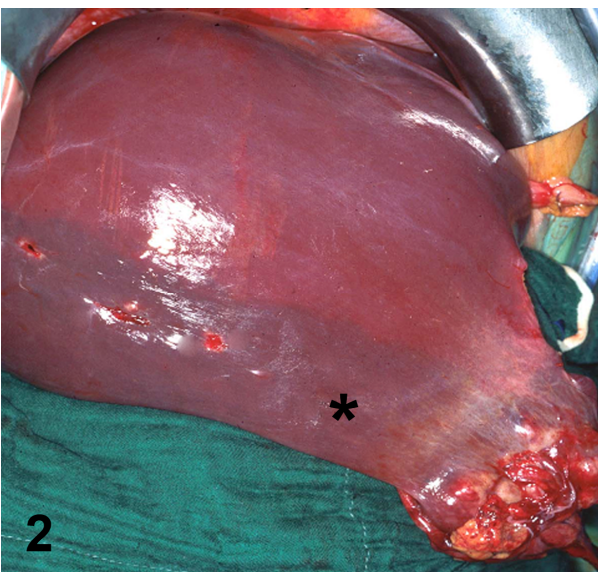
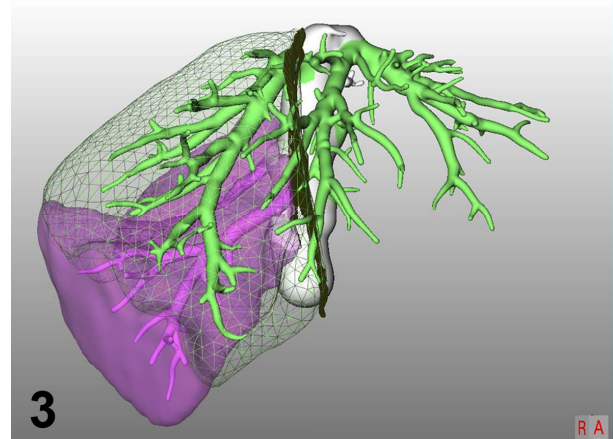


Fig. 3. During postgraduate and continuing education, state-of-the-art workshops oriented to the demands for higher surgical examinations and research are offered. *This figure represents a computer assisted functional volumetric risk analysis in view of a border-line liver resection.*



posed, definitely of interest for surgeons, consists in the fact that it extends anatomy teaching to the undergraduate phase-2 years of medical studies (in Geneva: years 4 to 6). This is made on a selective basis, in the sense that particularly gifted students are offered the possibility to perfect their anatomical knowledge and skills. For students interested in surgery, the teaching tools embrace detailed cadaveric dissections, surgical exercises on cadavers, assistance in the operating room, personal readings of both American and European classics for surgical anatomy (Testut and Jacob, 1929; Pernkopf, 1937; Hollinshead, 1982; Lanz and Wachsmuth, 2004), journal clubs, and lectures given by anatomists and surgeons. Such teaching, however, presupposes close and definite cooperation between the Departments of Surgery and Anatomy within the Medical Faculty (Fasel et al., 2005).

Finally, at the level of postgraduate and continuing education, regular workshops on surgical anatomy are organized. These exercises are aimed, among others, at an optimal preparation of the national examinations for obtaining the title of recognized specialist. For future orthopedic surgeons, for instance, each session is devoted to one surgical approach discussed and practiced on an anatomical specimen. We also set great store on contributing to cutting-edge surgical procedures by offering hands-on workshops on cadavers, e.g. for robotic surgery (our Anatomy Department owns a DaVinci Roboter), or for natural orifices transluminal endoscopic surgery (Hagen et al., 2008). In these contexts, we use fresh frozen cadavers, found optimal by participants (Reed et al., 2009).

Last, but not least, a purpose of anatomical activities at this level is to contribute to research projects, including liver surgery, allowing residents to develop and reinforce their academic profile (Majno et al., 2002; Fasel et al., 2007; 2010).

In summary, the vertically and horizontally integrated stage-by-stage program proposed – we would be delighted to name it the “Geneva road map for clinical anatomy teaching” – allows, in our opinion and experience, (a) reducing anatomy teaching to the time framework currently available at the undergraduate level, without jeopardizing, even likely improving, the knowledge necessary for general medical practice. This is our pragmatic solution to the pressing question of the content of obligatory anatomy teaching; (b) maintaining (or reestablishing) high standards of anatomical knowledge for surgeons. This is the modest, but probably not negligible contribution of the anatomist to first-class surgical patient care.

ACKNOWLEDGEMENTS

We cordially thank Prof. Thomas V. Perneger, M.D., Quality of Care Service, University Hospitals of Geneva, for his highly appreciated methodological advice.

REFERENCES

- BELL RH JR (2009) Presidential address. *Surgery*, 146: 533-542.
- DALKEY NC (1969) The Delphi method: an experimental study of group opinion. *RAND Research Memorandum RM-5888*: 1-79.
- http://www.rand.org/pubs/research_memoranda/2005/RM5888.pdf [Accessed June 25, 2013].
- DAUBER W (2008) *Feneis' Bild-Lexikon der Anatomie*. 10. Aufl. Thieme, Stuttgart/New York.
- DAVENPORT W (2012) Trends in the Anatomical Sciences: How are we teaching North American Dental Students? www.anatomy.org/sites/default/files/pdfs/William_Davenport_2012.pdf [Accessed July 30, 2013].
- ELLIS H (2002) Medico-legal litigation and its links with surgical anatomy. *Surgery (Oxford)*, 20: i-ii.
- FASEL JHD, GAILLOUD P, VU NV (1998) A core anatomy program for medical undergraduates. *Acad Med*, 73: 585-586.
- FASEL JHD, BADER C, GAILLOUD P (1999) Anatomy teaching for medical undergraduates: General practice as a guideline? 14. The brain. *Clin Anat*, 12: 115-119.
- FASEL JHD, MOREL P, GAILLOUD P (2005) A survival strategy for anatomy. *Lancet*, 365: 754.
- FASEL JHD, DEMBÉ JC, MAJNO PE (2007) Fascia: a pragmatic overview for surgeons. *American Surgeon*, 73: 451-453.
- FASEL JHD, MAJNO PE, PEITGEN HO (2010) Liver segments: an anatomical rationale for explaining inconsistencies with Couinaud's eight-segment concept. *Surg Radiol Anat*, 32: 761-765.
- FCAT (Federative Committee on Anatomical Terminology) (1998) Terminologia anatomica (International Anatomical Terminology). Thieme, Stuttgart/New York, pp 47-56.
- GER R (1996) Basic surgical training. 4: American and British scenes compared. *Clin Anat*, 9: 173-174.
- GREGORY JK, LACHMAN N, CAMP CL, CHEN LP, PAWLINA W (2009) Restructuring a basic science course for core competencies: an example from anatomy teaching. *Med Teach*, 31: 855-861.
- HAGEN ME, WAGNER OJ, SWAIN P, PUGIN F, BUCHS N, CADDEDU M, JAMIDAR P, FASEL J, MOREL P (2008) Hybrid natural orifice transluminal endoscopic surgery (NOTES) for Roux-en-Y gastric bypass: an experimental surgical study in human cadavers. *Endoscopy*, 40: 918-294.

- HANNA SJ, TANG T (2005) Reduced undergraduate medical science teaching is detrimental for basic surgical training. *Clin Anat*, 18: 465-469.
- HELMER O. (1966) The use of the Delphi technique in problems of educational innovations. *RAND Corporation Paper P-3499*: 1-22. <http://www.rand.org/pubs/papers/2006/P3499.pdf> [Accessed June 25, 2013].
- HOLLINSHEAD WH (1982) *Anatomy for surgeons*. 3 volumes. 3rd ed. Harper & Row, Philadelphia.
- KAUFMANN MH (1997) Anatomy training for surgeons – a personal viewpoint. *J R Coll Surg Edinb*, 42: 215-216.
- KILROY D, DRISCOLL P (2006) Determination of required anatomical knowledge for clinical practice in emergency medicine: national curriculum planning using a modified Delphi technique. *Emerg Med J*, 23: 693-696.
- LANZ TV, WACHSMUTH W (2004) *Praktische Anatomie. Ein Lehr- und Hilfsbuch der anatomischen Grundlage ärztlichen Handelns*. Sonderauflage in 7 Bänden. Springer, Berlin / Heidelberg / New York.
- LIPPERT H (1974) Der anatomische Begriffsbedarf in klinischen Fächern. *Verh Anat Ges*, 68: 503-506.
- MAJNO PE, MENTHA G, MOREL P, SEGALIN A, AZOULAY D, OBERHOLZER J, LE COULTRE C, FASEL J (2002) Arantius' ligament approach to the left hepatic vein and to the common trunk. *J Am Coll Surg*, 195: 737-739.
- MCHANWELL S, ATKINSON M, DAVIES DC ET AL (2007) A core syllabus in anatomy for medical students. Adding common sense to need to know. *Eur J Anat*, 11 (Suppl. 1): 3-18.
- MCKEOWN PP, HEYLINGS DJ, STEVENSON M, MCKELVEY KJ, NIXON JR, MCCLUSKEY DR (2003) The impact of curricular change on medical students' knowledge of anatomy. *Med Educ*, 37: 954-961.
- OLDER J (2004) Anatomy: a must for teaching the next generation. *Surgeon*, 2: 79-90.
- PERNKOPF E (1937, 1941, 1943, 1952, 1957, and 1960) *Topographische Anatomie des Menschen*. In 4 bzw. 7 Bänden. Urban & Schwarzenberg, München / Berlin / Wien.
- REED AB, CRAFTON C, GIGLIA JS, HUTTO JD (2009) Back to basics: use of fresh cadavers in vascular surgery training. *Surgery*, 146: 757-563.
- STANDRING S (2009) New focus on anatomy for surgical trainees. *ANZ J Surg*, 79: 114-117.
- TESTUT L, JACOB O (1929 et 1931) *Traité d'anatomie topographique avec applications médico-chirurgicales*. En 2 volumes. 5^{ème} éd. Doin, Paris.
- WILLAN P (1996) Basic surgical training. 2: Interactions with the undergraduate medical curriculum. *Clin Anat*, 9: 167-170.