"Topical Issues of Experimental and Clinical Morphology"
West Kazakhstan Marat Ospanov State Medical University
30 - 31 May 2013 in Aktobe

Historical and Scientific Collocation of Anatomy in Italy

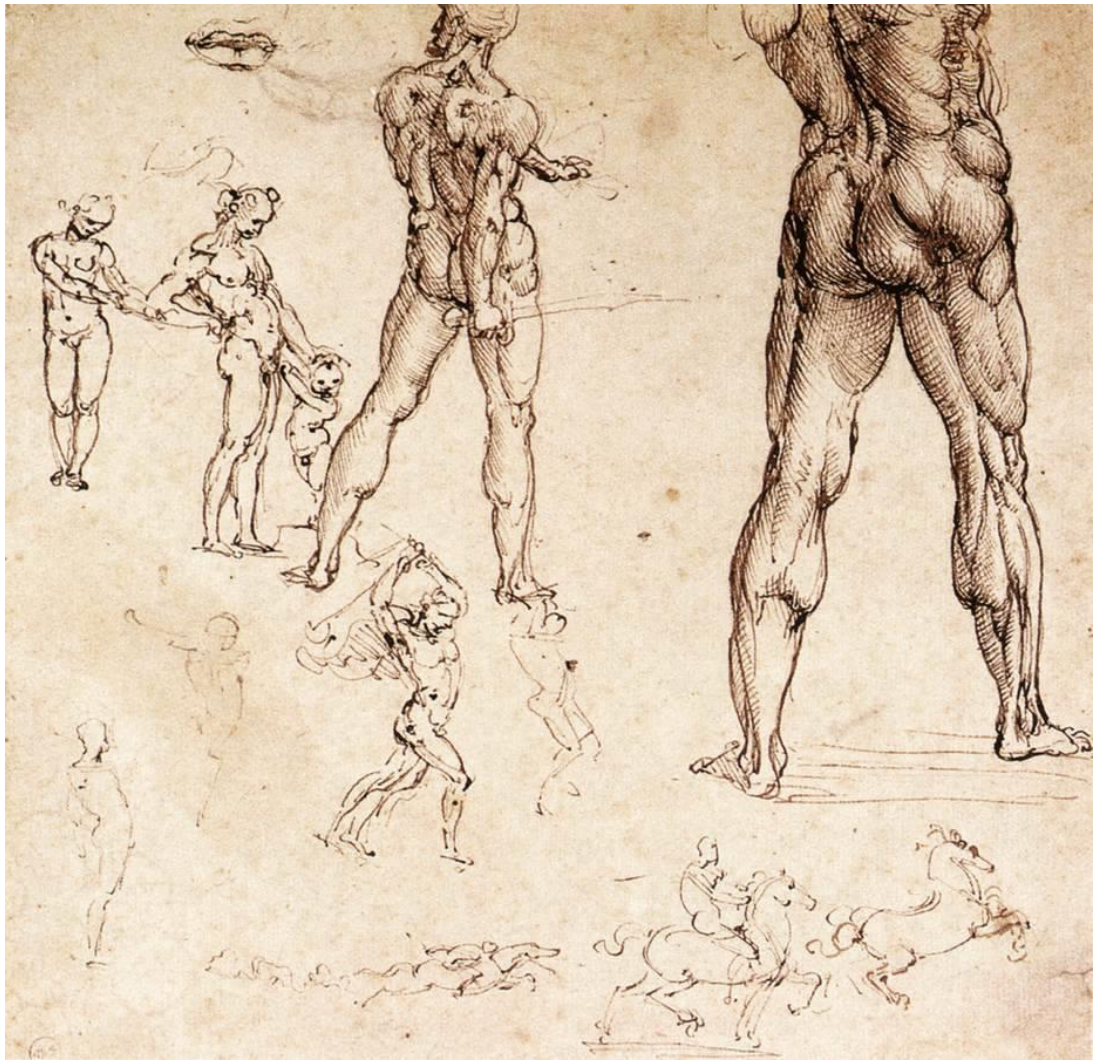
by

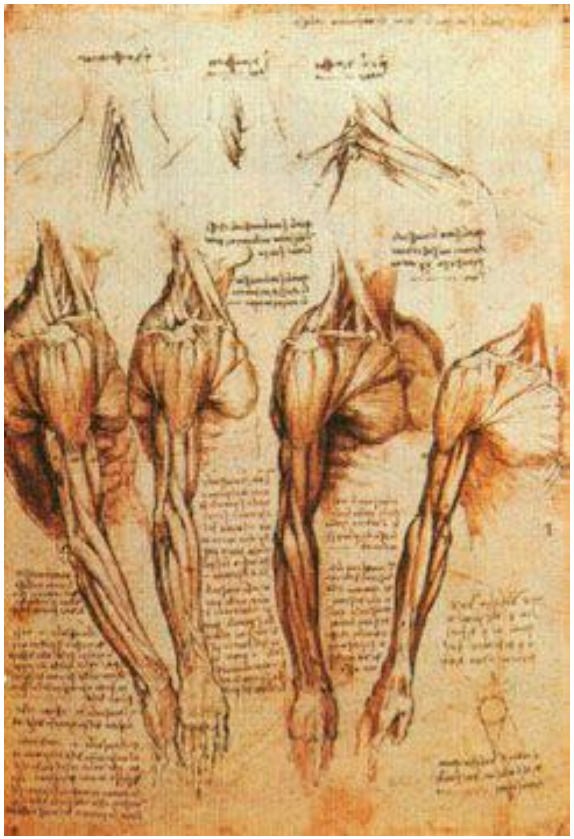
Guido Macchiarelli
University of L'Aquila, Italy

The human body is scientifically and systematically studied in Italy, by means of the *technique of dissection*

Bartolomeo Eustachi, (n. San Severino Marche) 1550-1574

Art, Anatomical illustration and Science

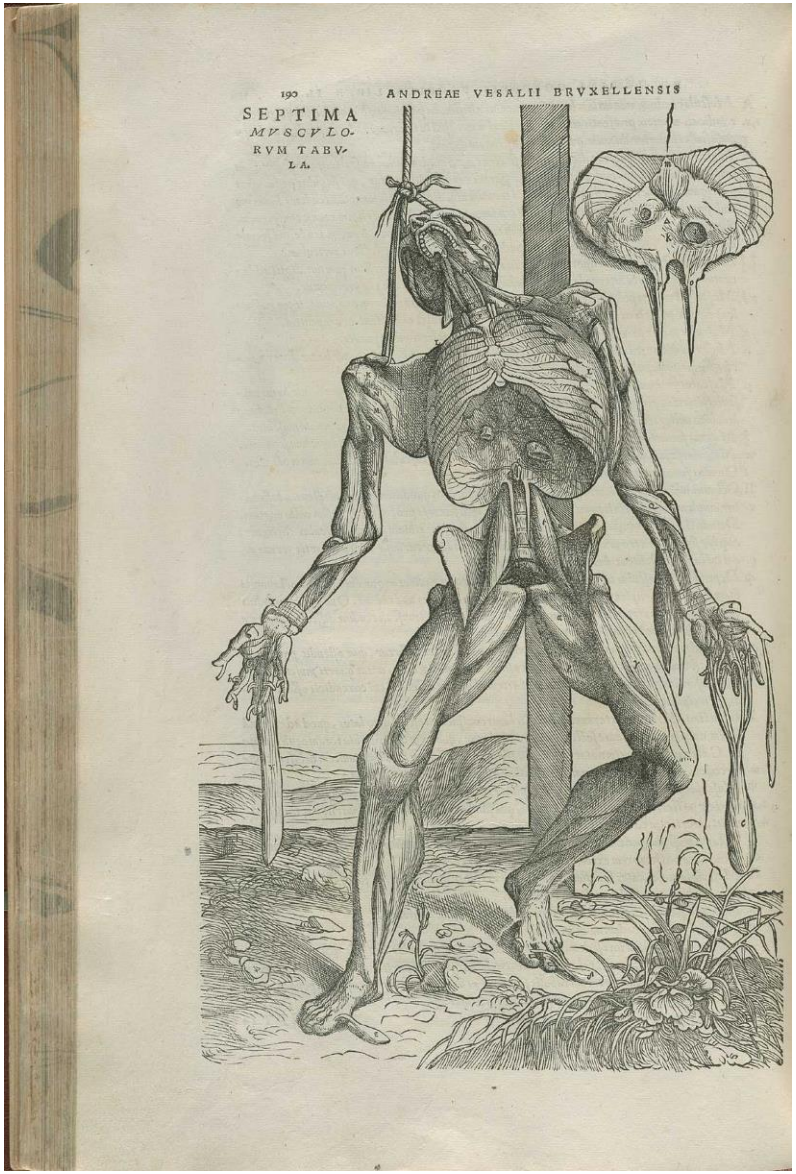




LEONARDO DA VINCI (1452-1519)

The New Age of Anatomy: **Andrea Vesalio**

1514-1564



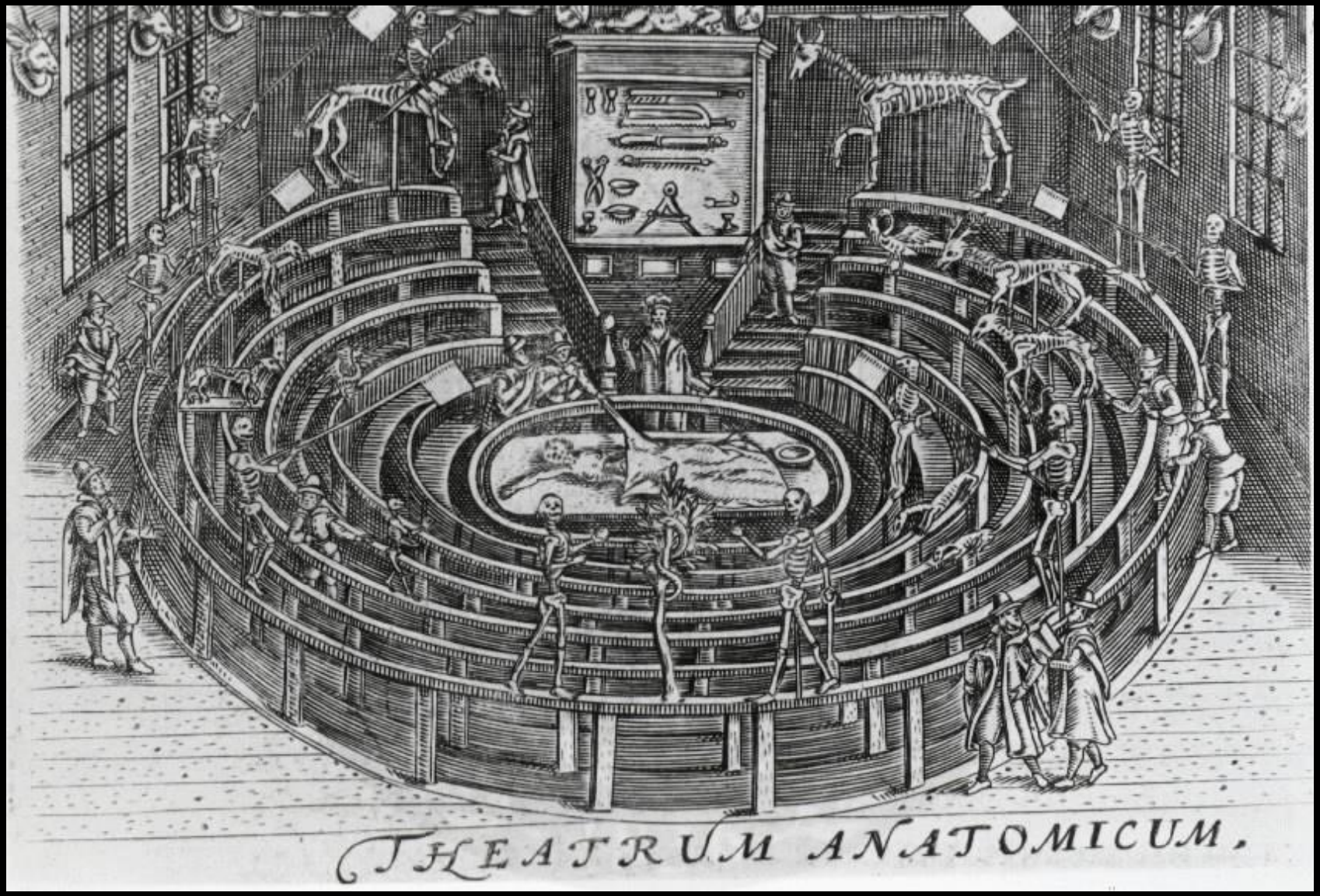
De Humani Corporis Fabrica (1537-1543)

Tavola dal *De humani corporis fabrica* di A. Vesalio. Le prime **tavole anatomiche** erano rappresentazioni ancora a metà strada fra arte e scienza: il cadavere era inserito in un paesaggio e in un ambiente ritratti con attenzione.

Un cadavere anatomizzato ne seziona un altro, rappresentato come una statua greca mancante di un braccio. La rappresentazione anatomica, essenziale negli studi di medicina, costituisce uno speciale settore dell'iconografia (un incontro privilegiato fra arte e scienza), sviluppatasi molto lentamente nel XVI e XVII secolo, sino a raggiungere l'efficacia didattica delle tavole moderne.

Pupils of Vesalio:
Realdo Colombo (1516-1559,
Gabriele Fallopia (1523-1562),
Fabrici di Acquapendente (1533-1619)
Bartolomeo Eustachio (1500 ?-1574)

Anatomy becomes a form of Theatre



Fabrizio di Acquapendente (1533-1619)

Surgeon and professor at Padua from 1565 to 1616. He published numerous treatises on surgery and was the teacher of Harvey. He built the first Stable anatomical theater in Padua in the world. The theater was circular, the students stood, and the table was in the center, so you have a clear vision of the corpse lying on the table. Other theaters until then were mobile.

The theater in Padua is the oldest anatomical theater building in the world, is still perfectly preserved. It can be visited at Palazzo del Bo.

Realdo Colombo *(1515 - 1559)*

Eur J Obstet Gynecol Reprod Biol. 2010;151(2):130-3.

COLOMBO AND THE CLITORIS.

Stringer MD, Becker I.

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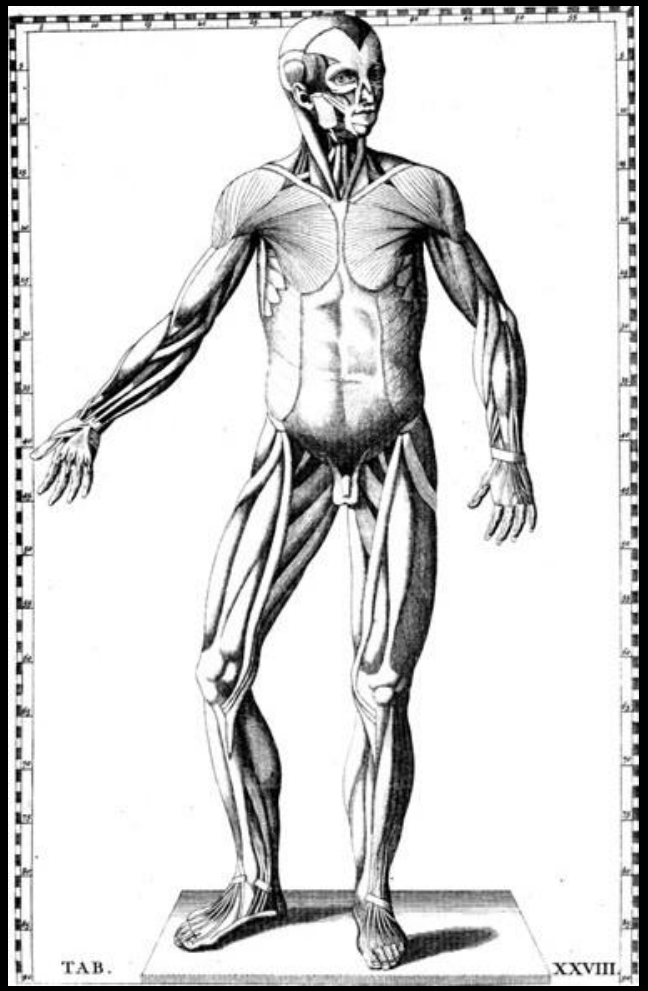
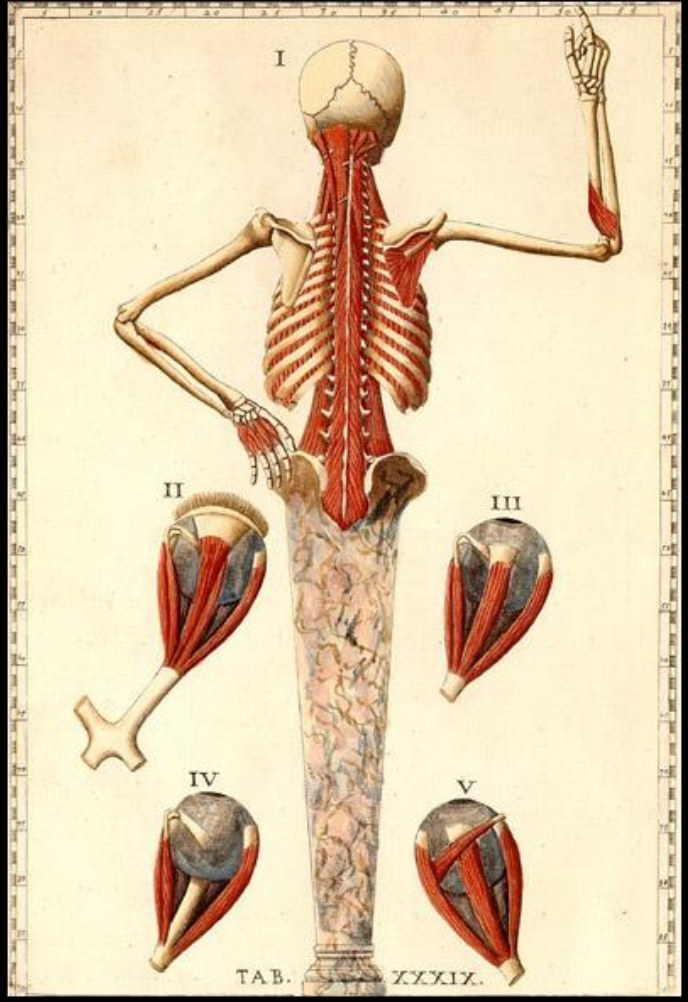
In 1559, the Italian anatomist Realdo Colombo (1515/6-1559) claimed to have "discovered" the clitoris. Closer scrutiny reveals that whilst he certainly emphasized the role of the clitoris in female sexuality, his claim to priority is unfounded. The clitoris had been known to Greek, Persian, and Arabic writers on medicine and surgery, albeit with misconceptions about its function. Colombo is best known for his definitive description of the pulmonary circulation but here too the question of priority is mired in controversy. Whilst Colombo was an extremely accomplished and successful anatomist, contemporary professional rivalry probably encouraged exaggerated claims of priority. Modern anatomical studies have greatly advanced our understanding of the surgical anatomy of the clitoris, optimising the ability to preserve its function during genital surgery.

Initially a student, then the successor of Andreas Vesalius to the Chair of Anatomy at the University of Padua, he taught anatomy at Pisa (1546) and Rome (1549). He was master of Andrea Cisalpino

Its name remains linked to the work De Re Anatomy (Venice 1559), enhanced by a front page attributed to Veronese: memorable work, especially in the parts relating to the description of the pleura, peritoneum and lens. His excellent research led him to discover the small circulation, or pulmonary circulation, according to a theory already advanced by Michael Servetus, which he completed with the original anatomical observations and assessments.

Bartolomeo Eustachi
Eustachius)
(c. 1500 -1574)





Court physician to the Duke of **Urbino** and Cardinal Giulio della Rovere. *In 1552 he prepared a series of playful anatomical plates that featured figures placed inside a box with graduated measurements to help readers identify the location and scale of the parts.*

Bartolomeo Eustachi - [anatomist]
Giulio de'Musi - [artist]

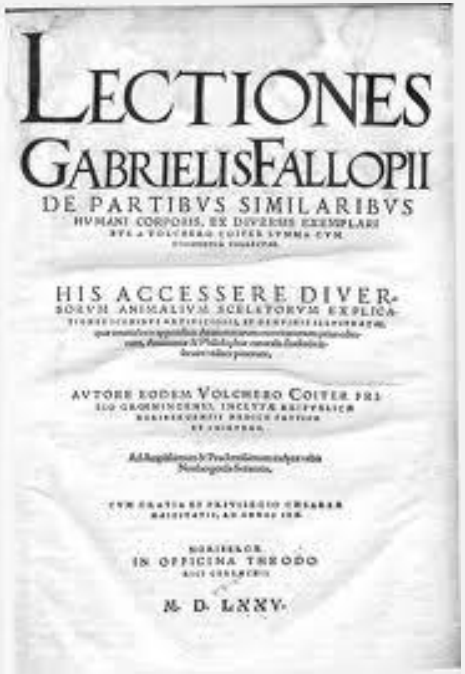
A skeleton jauntily points to the top of the page. Its pelvis is fused to the top of a columnar pedestal, metaphorically suggesting the structural functions of hips and legs. The quartet of giant eyeballs and colorization are 18th-century additions. Rome, 1783. Hand colored copperplate engraving. National Library of Medicine.

Gabriele Falloppio

Gabriele Falloppio o Falloppia (Modena, 1523 ca. – Padova, 9 ottobre 1562)

Italian Botanic, Anatomist, Surgeon and naturalist.

Observationes anatomicae, Venezia 1561, and Colonia 1562

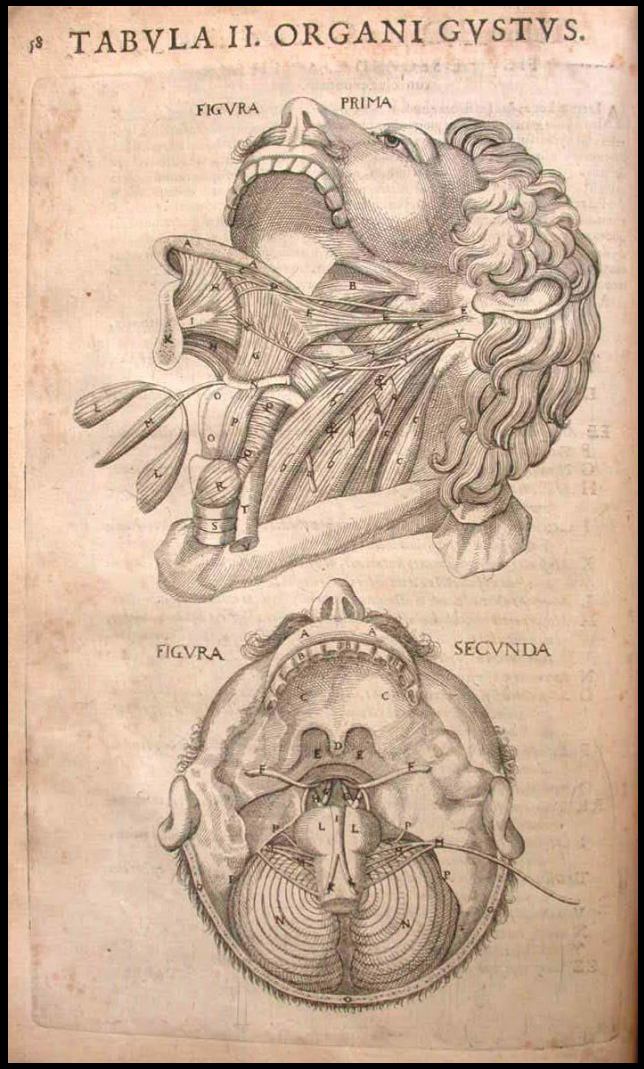


Giulio Casserio *(c.1552-1616)*

A pupil of Fabricius at Padua, to whom he was successively servant, assistant and eventually deputy.

Casserio was a signatory to William Harvey's doctoral diploma from Padua in 1602, as teacher of anatomy, physic and surgery.

He greatly extended the knowledge of human anatomy, in particular refining the anatomy of the sense organs and the laryngeal apparatus.



The figure shows a deep dissection into the neck with the mandible removed, while the lower is a horizontal section exposing the base of the brain, spinal cord, cranial nerves and arteries.

Baskin, Leonard, 1922
The anatomist

Teaching Anatomy today ?

THE ANATOMICAL RECORD (NEW ANAT.) 269:20–32, 2002
DOI 10.1002/AR.10046

ARTICLE

The Human Cadaver in the Age of Biomedical Informatics

M. ASHRAF AZIZ,* JAMES C. MCKENZIE, JAMES S. WILSON, ROBERT J. COWIE, SYLVANUS A. AYENI, AND BARBARA K. DUNN

Major national and international critiques of the medical curriculum in the 1980s noted the following significant flaws: (1) over-reliance on learning by rote memory, (2) insufficient exercise in analysis and synthesis/conceptualization, and (3) failure to connect the basic and clinical aspects of training. It was argued that the invention of computers and related imaging techniques called to question the traditional instruction based on the faculty-centered didactic lecture. In the ensuing reform, which adopted case-based, small group, problem-based learning, time allotted to anatomical instruction was severely truncated. Many programs replaced dissection with prosections and computer-based learning. We argue that cadaver dissection is still necessary for (1) establishing the primacy of the patient, (2) apprehension of the multidimensional body, (3) touch-mediated perception of the cadaver/patient, (4) anatomical variability, (5) learning the basic language of medicine, (6) competence in diagnostic imaging, (7) cadaver/patient-centered computer-assisted learning, (8) peer group learning, (9) training for the medical specialties. Cadaver-based anatomical education is a prerequisite of optimal training for the use of biomedical informatics. When connected to dissection, medical informatics can expedite and enhance preparation for a patient-based medical profession. Actual dissection is equally necessary for acquisition of scientific skills and for a communicative, moral, ethical, and humanistic approach to patient care. *Anat Rec (New Anat) 269:20–32, 2002.* © 2002 Wiley-Liss, Inc.

KEY WORDS: computer-assisted learning; CAL; curricular reform; cadaver dissection; biomedical informatics; haptic experience; humanistic approach; ethics; medical education; patient-centered instruction; problem-based learning; PBL; gross anatomy; peer group learning; diagnostic imaging; education

INTRODUCTION

In 1542, Vesalius inaugurated the age of science and science-based medicine by testing published anatomical information against the facts revealed by cadaveric dissection (Nuland, 1989; Anderhuber, 1996; Bouchet, 1996; Porter, 1997). The approach of Vesalius founded the initial steps of the scientific method: data collection by direct observation of the body; a provisional explanation (hypothesis) of the data; and further observational tests of the hypothesis. By placing the deceased human at the core of his investigations, Vesalius implicitly reaffirmed the patient-centered Hippocratic canon. Harvey elaborated the Vesalian paradigm by adding quantitative observations and experimental tests on nonhuman models as further refinements of the scientific/diagnostic method (Nuland, 1989).

Dissection-based anatomical analyses facilitated the following: (1) inventory and classification of bodily components, (2) the development of a vocabulary for describing the body with clarity and precision, and (3) mapping (topographical anatomy) of bodily organs and their surface projection later used in physical diagnosis (Fig. 1). In the 18th century, Morgagni elaborated the dissection method to conduct autopsies to connect symptoms with deep-seated pathology (Nuland, 1989; Porter, 1997). Thus, he created the means for attain-

Dr. Aziz received his Ph.D. from the University of Wisconsin, Madison, and is an Associate Professor in the Department of Anatomy at Howard University College of Medicine (HU-COM), teaching "Gross and Developmental Anatomy" and "Evolutionary Morphology". His research program focuses on evolutionary morphology of the primates with reference to the masticatory muscles–temporomandibular complex. Dr. McKenzie received his Ph.D. from the University of Kansas and is an Associate Professor in the Department of Anatomy at HU-COM, teaching "Gross and Developmental Anatomy" and "Histology and Cell Biology". His research program examines hormonal and neuroendocrine factors in hypertension. Dr. Wilson received his Ph.D. from the Medical College of Virginia and is currently an Associate professor in the Department of Anatomy at HU-COM, teaching "Gross and Developmental Anatomy" and "Neurosciences". His research program focuses on the neurophysiological basis of Parkinson disease. Dr. Cowie received his Ph.D. from East Tennessee State University and is a Professor in the Department of Physical Therapy at Winston-Salem State University, teaching "Gross and Developmental Anatomy" and "Neurosciences". His research program primarily consists of the neural topography of the vestibulocochlear system. Dr. Ayeni, is an Adjunct Professor at HU-COM, where he teaches "Neurosurgery". His research program focuses on the anatomy of the posterior cranial fossa with reference to the cranial nerves. Dr. Dunn received her Ph.D. from the University of Wisconsin, Madison, and her M.D. from Georgetown University. Currently, she is the Program Director at the National Cancer Institute and an Adjunct Instructor at George Washington University. Her research program examines breast cancer genetics and prevention.
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THE ANATOMICAL RECORD (PART B: NEW ANAT.) 281B:4–5, 2004

DEBATE FORUM

New Path for Teaching Anatomy: Living Anatomy and Medical Imaging vs. Dissection

JOHN C. MCLACHLAN*

How should we best teach anatomy? For centuries, the answer has been through dissection. A few have argued that prosections can replace the experience of individual dissection. Until recently, no one has argued that the cadaver can be dispensed with altogether.

Peninsula Medical School, one of four new medical schools to open recently in the United Kingdom, has taken this radical step (McLachlan et al., 2004). So, what was behind our thinking? We asked ourselves how doctors encounter anatomy in clinical practice. The answer is through living and surface anatomy on the one hand, and medical imaging on the other. It therefore seemed to make sense to teach students anatomy in these contexts right from the beginning. This matches our desire for authentic experiences throughout the course. Students meet patients in community settings in their first days. They learn clinical skills from the first week, throughout the entire course. In teaching anatomy, we decided that we would rely on living anatomy delivered to the students through the extensive use of peer examination and life models and on medical imaging delivered by qualified radiologists.

This decision received comment in the media and has stimulated criticism and discussion. It was not, incidentally, based on costs. Our program is expensive in clinician time, especially for radiologists, and trained anatomists are still required as teachers.

ANATOMY TEACHING

Anatomy teaching takes place in tutor-led small groups (eight students per group; 80 sessions per student over years 1 and 2). Medical imaging (20 sessions) is led by clinical radiologists and features X-rays, ultrasound, MRIs, CT, and 3D imaging. Living anatomy (40 sessions) is studied through consented peer examination, supported by life models. Palpation and auscultation are covered, along with projection of still and moving images onto the body surface. Life-size full-color transverse cryosections and other imaging material are used with the living body, and high-verisimilitude body painting of underlying structures has proved useful. Portable ultrasound equipment is available to visualize structures in the living body. There are 24 integrated structure and function lectures in the first 2 years, although this is a problem-based learning course, which does not rely on didactic methods. Arts and humanities are integrated with anatomy learning as a core curriculum activity to help expand awareness of humane issues.

Our course has sometimes been misrepresented as the use of either plastic models or 3D computer models in place of cadavers. These are valuable adjuncts to anatomy learning, but not a substitute for working with the living human body.

A variety of benefits have traditionally been ascribed to the use of dissected or prosected material in anatomy teaching, some of which can be achieved by other means. For instance, self-directed learning and teamwork can be developed in a variety of settings, such as problem based learning groups. Manual dexterity can usefully be practiced in clinical skills settings. Application of the scientific method is a slightly implausible benefit of dissection, but can be developed in more relevant ways by studying the application of scientific method to current topics.

It is a widely held view that dissection gives students a 3D view of human anatomy and reinforces knowledge acquired in lectures and tutorials. We believe that our students can achieve this 3D understanding by working extensively with living bodies in conjunction with projection of color images on the surface of the body, which can be dissected away layer by layer; by use of color transverse sections in association with the living body; and by extensive use of imaging. Indeed, modern 3D reconstruction and imaging methods give views of the internal structures of individual living patients during medical procedures that can be superior to those observed during dissection, and this may modify surgical practice in the near future.

Dissection is frequently seen as serving purposes of personal develop-

In 2004, Dr. McLachlan moved to the new Peninsula Medical School, in the southwest corner of the United Kingdom, as director of phase 1 of the course. Last year, he was appointed professor of medical education in the medical school. He is a National Teaching Fellow and advises the General Medical Council on revalidation for doctors and on professional standards for overseas doctors registering in the United Kingdom.
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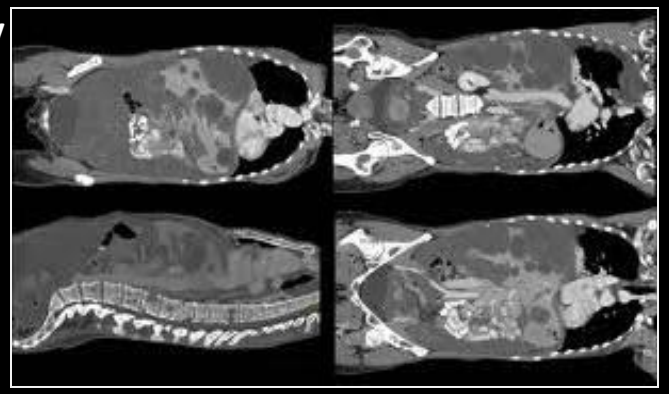
Medical Students,
688 Boylston Street,
Boston, ca. 1890

CT total Body



THE ANATOMICAL RECORD (PART B: NEW ANAT.) 281B:2–3, 2004

DEBATE FORUM

To What Extent Is Cadaver Dissection Necessary to Learn Medical Gross Anatomy? A Debate Forum

GEOFFREY D. GUTTMANN, RICHARD L. DRAKE, AND ROBERT B. TRELEASE

In this Olympic year of 2004 in Athens, Greece, which is considered the birthplace of modern Olympics, controversy was inescapable. Whether it was the points awarded by the judges for gymnastics, Paula Radcliffe dropping out of the women's marathon, or drug-testing scandals, controversy swirled. So, too, we find there is controversy within the arena of anatomical education for medical students. Athletes performed their tasks "just in time"; anatomical sciences educators, however, may have the luxury of time to contemplate the controversial issues they face today or they may have change thrust upon them—administratively, or through the fiat of best medical education practice.

The controversial issue for this year's educational debate is to what extent is cadaver dissection necessary to learn medical gross anatomy. One of the moderators (G.D.G.) proposed a debate on whether dissection is necessary for learning medical gross anatomy for publication in *The Anatomical Record (Part B): The New Anatomist*. The question was refined to our current title. We bring this debate to the anatomy community through the pages of this journal and also through an online virtual issue on dissection and medical education, available at www.wiley.com/anatomy/dissection.

The format of this debate forum was designed to be similar to a formal debate. The moderators invited several anatomists to present and defend their positions on the topic. There were two proponents: one pro, arguing that dissection is necessary to learn medical gross anatomy, and one con, arguing that dissection is not necessary to learn medical gross anatomy. The proponents stated their positions independently. There were also two rebuttal debaters, one pro and one con. The rebuttal writers had the opportunity to review the proponent papers for each position and then present a response supporting their own position. The authors were allowed only limited space to make their arguments and were encouraged to provide data and references in support of their positions.

Dr. Noelle Granger, from the University of North Carolina School of Medicine, was the proponent for the pro position and presented arguments based on her and her students' experiences (Granger, 2004). Her position was supported by many references. Dr. John McLachlan from the Peninsula Medical School (Plymouth, U.K.), where cadaver dissection is not part of the anatomical education program, supported the con position and described the rationale for their institution's gross anatomy teaching program (McLachlan, 2004).

The rebuttal for the pro aspect was coauthored by Dr. Wojciech Pawlina, from the Mayo Clinic College of Medicine, and Dr. Nirusha Lachman, of the Durban Institute of Technology in South Africa. Pawlina and Lachman (2004) expanded on some of the ideas discussed in the proponent papers and drew a link between dissection in the gross anatomy laboratory and the acquisition of clinical skills, as well as the development of professionalism and professional attitudes for medicine. Dr. Kimberly Topp, from the University of California, San Francisco, authored the rebuttal for the con aspect. Topp (2004) made a point-by-point rebuttal to the pro arguments presented by Granger (2004) and indicated where she believed cadaver dissection may not be necessary in medical education.

It is worth noting that anatomy is not only the study of morphology or the structure and function of the members of the zoological or botanical kingdom, but also the geography of a biological entity. In this case, the human anatomist is actually a geographer of the human body. As geographers of the human body, we use atlases to find our way around. Many of us use exploratory learning such as dissection with other clinical resources like images generated by medical imaging modalities both to teach anatomy and to expand the anatomical knowledge base. After a number of visits, we become familiar with the places we have visited, just like one becomes familiar with a new town once one has driven around it. Value judgments aside, it is inescapable that the extent we experience hands-on and personal or emotional aspects of this educational journey directly affects not only how we teach the geography of the human body but also how and what our students learn. This also affects the knowledge they take with them into clinical practice as physicians.

Dr. Guttman is a moderator of this forum and a member of the journal's Panel of Reviewers. Drs. Drake and Trelease, both moderators of this forum, are members of this journal's Editorial Advisory Board.
We encourage reader feedback. Please direct all responses and comments to the editors at newanat@wiley.com and be sure to add "debate forum" to the subject line.

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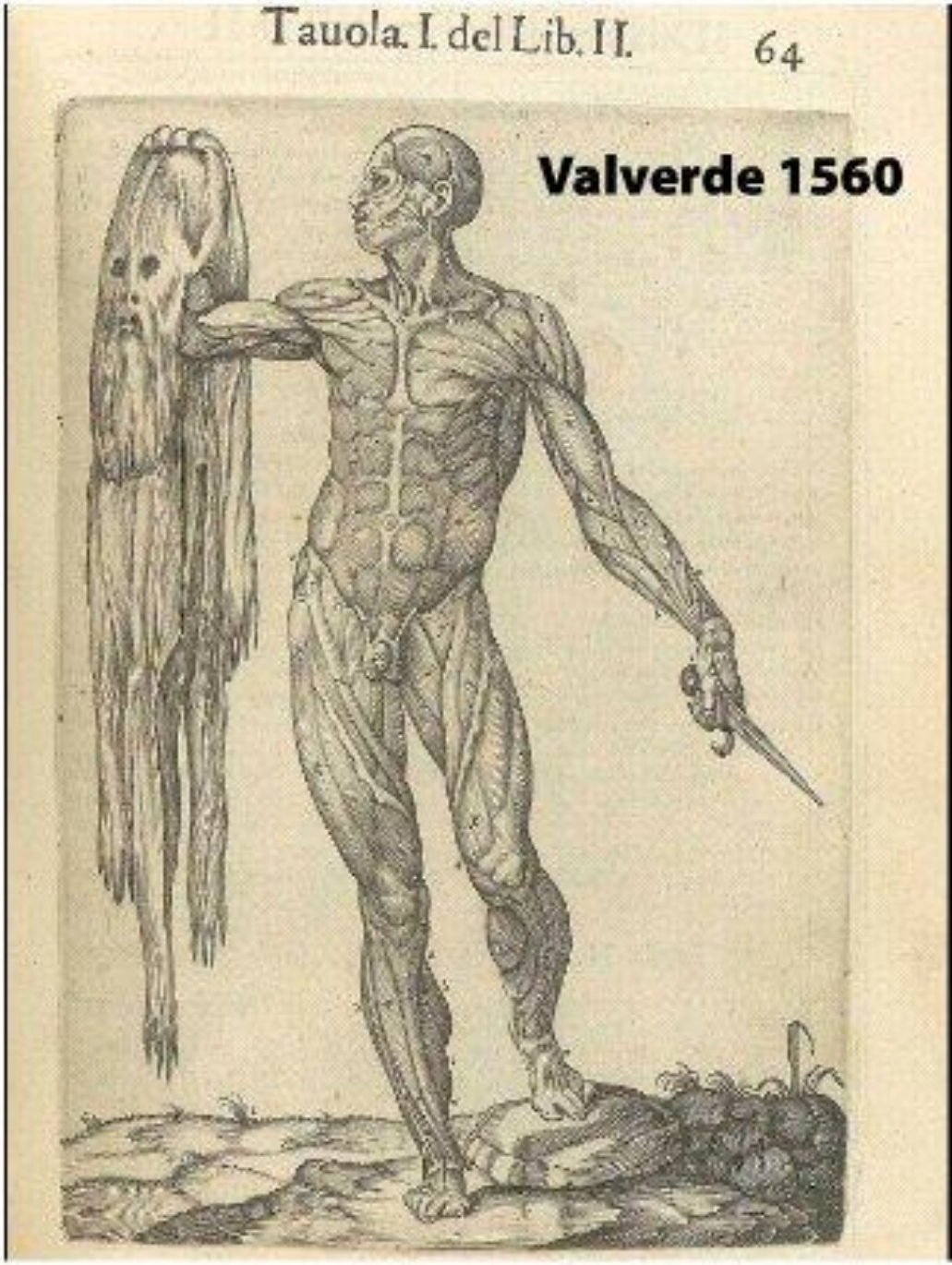
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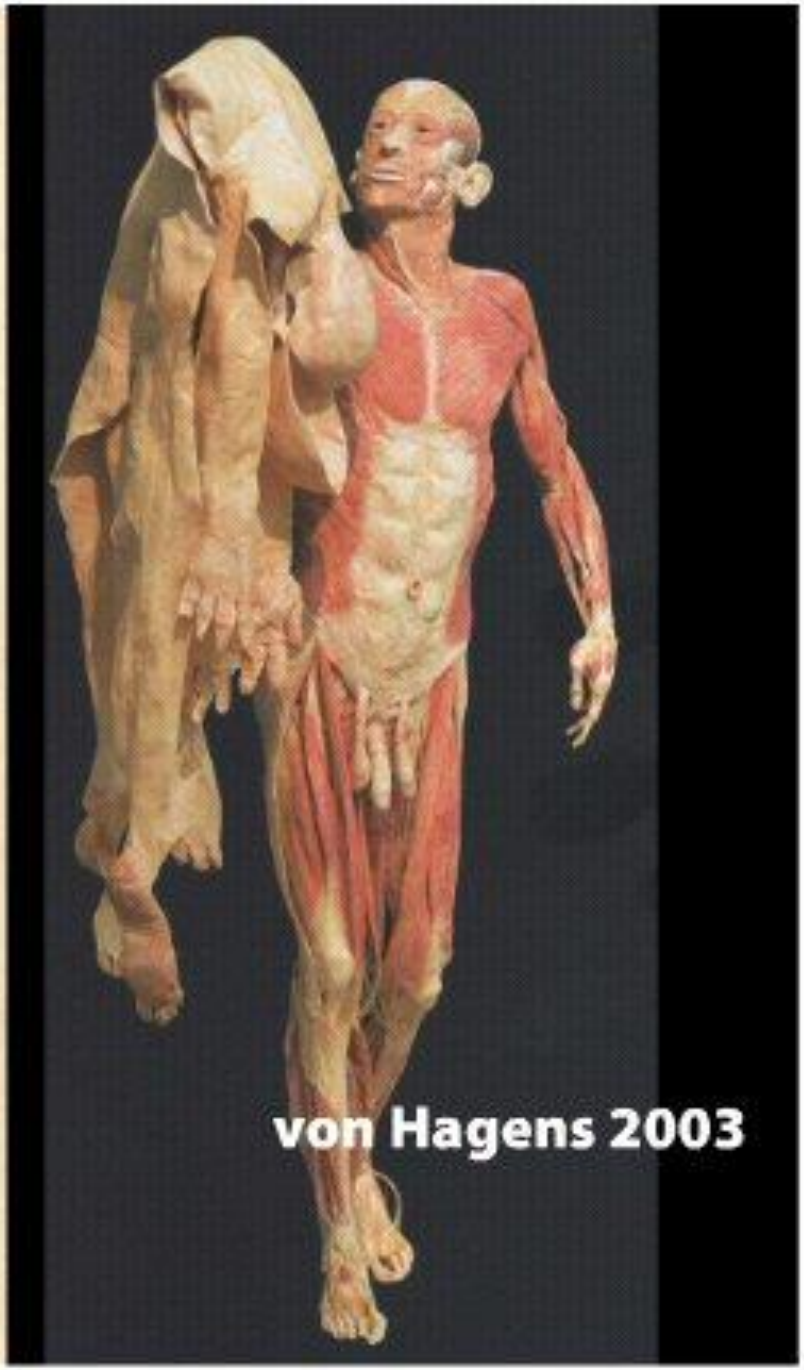

von Hagens 2003

TODAY AND THE FUTURE

FUNCTIONAL ANATOMICAL IMAGING IN ALIVE PERSONS

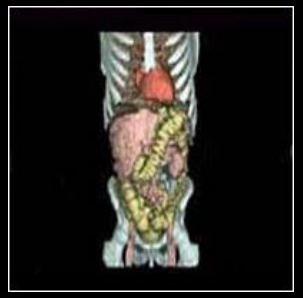
Ultrasounds

2D and 3D Foetus head

Tomography (CT)

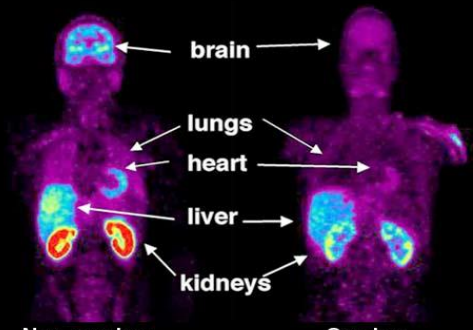
Skull CT

Magnetic resonance (NMR)



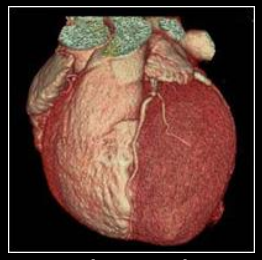
Head and Total Body NMR scans

Pet Tomography (PET)



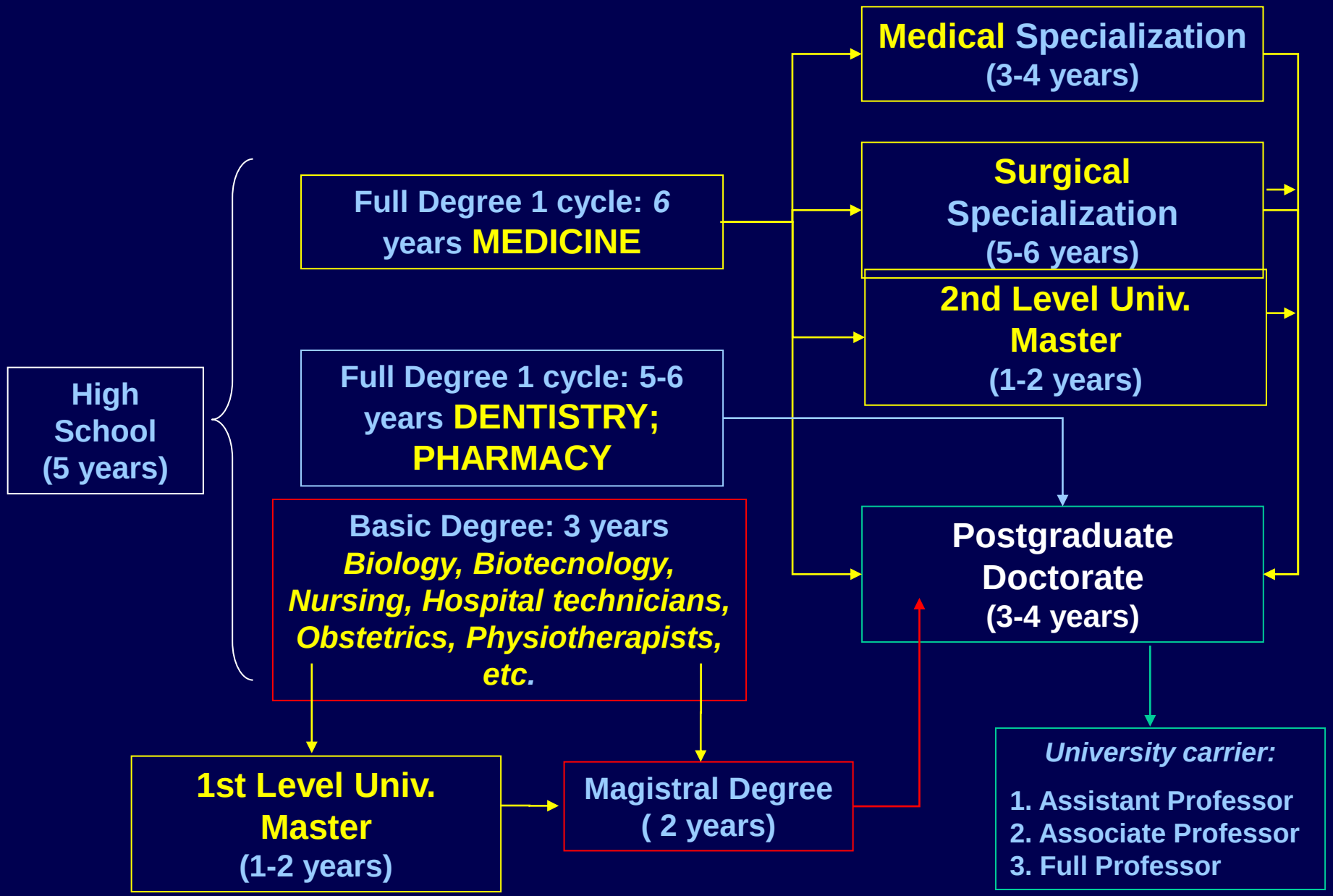
PET Scans Show Cigarette Smoke Affects Peripheral Organs

Molecular Imaging



Cardiac Calcium Scoring

The University Biomedical Curriculum in Italy: after 2000



Anatomy Curricula in Italy

1. SYSTEMATIC ANATOMY
    1. Locomotor System
    2. Circulatory System
    3. Splancnic Systems
    4. Neuroanatomy & SO
2. TOPOGRAPHIC ANATOMY
    1. Body Planning
    2. Head and Neck
    3. Trunk
    4. Limbs
3. MICROSCOPIC ANATOMY

Schools of Medicine	Number of Credits in Anatomy
BARI	21,5
BOLOGNA	20
BRESCIA	18
CAGLIARI	18
CATANIA	16
CATTOLICA(MI-RM)	16.5
CHIETI	19
FERRARA	19
FIRENZE	18
GENOVA	18.5
L'AQUILA	18
MESSINA	15
MILANO S. RAFFAELE	18
MOLISE	13
NAPOLI	18
PADOVA	15
PALERMO	15
PARMA	20
PERUGIA	16
PISA	18
ROMA SAPIENZA	19
ROMA TOR VERGATA	15
SASSARI	12
TORINO	16
VERONA	18
Professional Schools ALL	**3**
Other Curricula	**6**

The City of L'Aquila, capital of the Abruzzo Region, is located high in the mountains of central Italy surrounded by some of the highest ranges of the Apennines.

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And just an easy one hour motorway drive from Rome

L'Aquila


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CABINA
ELETTRICA