

A plea for an extension of the anatomical nomenclature: Organ systems

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ABSTRACT

This article is the third part of a series aimed at correcting and extending the anatomical nomenclature. Communication in clinical medicine as well as in medical education is extensively composed of anatomical, histological, and embryological terms. Thus, to avoid any confusion, it is essential to have a concise, exact, perfect and correct anatomical nomenclature. The Terminologia Anatomica (TA) was published 20 years ago and during this period several revisions have been made. Nevertheless, some important anatomical structures are still not included in the nomenclature. Here we list a collection of 156 defined and explained technical terms related to the anatomical structures of the human body focusing on the digestive, respiratory, urinary and genital systems. These terms are set for discussion to be added into the new version of the TA.

KEY WORDS: Anatomical terminology; anatomical nomenclature; Terminologia Anatomica

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INTRODUCTION

This article is the third part of a series aimed at correcting and extending the anatomical nomenclature. It concludes technical terms denoting morphological structures of the human body concerning the anatomical nomenclature of the nervous system and senses^[1] and locomotor system^[2] as a contribution. General remarks about the history and clinical relevance of the anatomical terminology and nomenclature were mentioned in our previous articles, including the importance of anatomical nomenclature in avoiding ambiguous and unclear communication and discussion. Lists of the new proposed anatomical terms to be included in the Terminologia Anatomica (TA) are available [1-12].

The latest comprehensive anatomical nomenclature reference was published by the Federative Committee on Anatomical Terminology (FCAT) in 1998 [13]. The second edition of the TA was published by the Federative International Programme on Anatomical Terminology (FIPAT) in 2011 [14], but only with minimal changes compared to the first edition. During the past 20 years, terminologies of all branches of anatomy have been updated. In 2008, the FCAT published the

latest revision of the histological nomenclature under the title Terminologia Histologica [15]. In 2009, the FIPAT replaced the FCAT, and issued the Terminologia Embryologica (TE) in 2013 [16]; quickly after it, came its first revision titled Terminologia Embryologica 2 (TE2) [17]. Then, in 2017, the Terminologia Neuroanatomica (TNA) was published [18], comprising terms from the central nervous system (CNS), peripheral nervous system (PNS), and sensory organs. The FIPAT is working further on the odontological, anthropological, and orobiological nomenclatures. The extent of anatomy is very large and this article suggests a list of terms to be incorporated into the new version of the TA [13]. Our aim is to encourage broad discussion and criticism by anatomical as well as clinical experts across the world.

The authors gathered terms missing in the TA that they encountered during their educational and scientific work. Many of the stated terms are described in classical textbooks and are well known by anatomists, that is the reason why they are presented without supporting references. Several other terms have been corrected or newly suggested for anatomical structures previously not well defined.

Terms written *in bold italics* are new terms suggested for incorporation into the TA, terms written in *plain italics* already exist in the TA, terms within quotation marks are non-recommended or obsolete, and terms in parentheses are synonyms, eponyms or pure explanations. In total, **156** terms are proposed

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for incorporation into the TA: 10 in *Anatomia generalis*, 29 in *Systema digestorium*, 33 in *Systema respiratorium*, 5 in *Cavitas thoracis*, 10 in *Systema urinarium*, 14 in *Systemata genitalia*, 26 in *Cavitas abdominis*, and finally further extensions of previously processed chapters (29 in *Juncturae*, *Musculi*, *Systema cardiovasculare*, *Systema lymphoideum*, and *Systema nervosum et Integumentum commune*). The list of Latin terms with their English equivalents is provided in Table 1.

Anatomia generalis

- The general terms for the serous fluids filling the serous cavities should be added, similarly to *liquor cerebrospinalis*, *humor aquosus*, and *perilymph et endolympha*. These serous fluids are **liquor pericardii** inside *cavitas pericardiaca*, **liquor pleurae** inside the paired *cavitas pleuralis*, and **liquor peritonei** inside *cavitas peritonealis*.
- The basic Latin terms indicating the age period of the human should be included in the TA as well. **Neonatus** for a newborn (0–28 days after birth); **infans** for a baby (1 month – 2 years), **impubis** for a kid; **iuvenis** for a youth, consisting of **pubescens** for a kid during puberty (pubescent), and **adolescens** for a young individual between puberty and adulthood (adolescent); **adultus** for an adult; and **senex** for a senior.

Systema digestorium

- To describe directions in the digestive tube, special general terms are used: **oralis** describing the direction toward the mouth (direction against normal movements of food/chylus/feces) and **aboralis** defining the opposite direction from the mouth toward the anus.
- The internal surface of the teeth is termed by two specific denominations, differentiating the upper and lower teeth: *facies palatinalis* and *facies lingualis*, respectively. A general term independent on the position in either jaw is missing and can be named **facies oralis dentis**.
- **Tractus angularis** is a thickened oblique band of *fascia parotidea* in the area of *angulus mandibulae* passing continuously into *lamina superficialis fasciae cervicalis* and separating the gland and *spatium (trigonum) submandibulare*.
- *Septum linguae*, a sagittal band of dense connective tissue, fades out basally and changes into a sagittally oriented space filled with loose connective tissue termed **spatium medianum linguae**.
- **Canalis paralingualis** is a muscular slit in the tongue between *musculus hyoglossus* and *musculus genioglossus*, containing *arteria lingualis*.
- *Glandula parotidea* is divided with *plexus intraparotidicus nervi facialis* into two parts (called “lobes” in clinical

medicine) – *pars superficialis et profunda*. The majority of the gland (80%) overlies *musculus masseter* and the mandible, the minority (*pars retromandibularis*) extends medially between the posterior margin of *ramus mandibulae* (ventral border), *musculus sternocleidomastoideus* and *venter posterior muscoli digastrici* (dorsal border) and *ligamentum stylomandibulare* (dorsal and deep border) through **foramen stylomandibulare** into *spatium prestyloideum*. The narrowest part of the gland passing through *foramen stylomandibulare* is termed **isthmus**. In some sources, isthmus is designated to interconnect *pars superficialis* and *pars profunda*, which is not correct.

- Polystomatic glands of the oral cavity were analyzed by Imai et al. in 1989 [19]. They concluded that the formation of one gland with multiple excretory ducts (polystomatic gland) is embryologically impossible and that no such gland exists. That is why *glandula sublingualis* has only the excretory duct called *ductus sublingualis major* (of Bartholin) and opening at *caruncula sublingualis*. All the other ducts belong to **glandulae sublinguales minores** which open via *ductus sublinguales minores* at *plica sublingualis*. Similarly, all other small salivary glands of the oral cavity, covering a group of several independent glands, should be termed in plural – **glandulae linguales anteriores** (of Blandin and Nuhn) and **glandulae retromolares** [19].
- The terms *musculus tensor veli palatini* and *musculus levator veli palatini* are derived from the non-preferred synonym *velum palatinum* for *palatum molle*. The more consistent would be to change them to **musculus tensor palati mollis** and **musculus levator palati mollis** and use as preferred terms.
- The denomination of the duodenum parts should be consistent. A suitable counterpart for *pars superior* should be **pars inferior** (the second term in the TA) and not the until-now preferred *pars horizontalis*.
- **Promontorium duodeni** is a localized bulging along the medial contour of the middle part of *pars descendens duodeni* that results in a slight widening of the duodenal lumen. It serves as an orientation point in radiology to localize *papilla duodeni major* which sits on or immediately below *promontorium duodeni*.
- **Ansaе intestinales** is a general term for the intestinal loops describing their folding and arrangement in the abdominal cavity as a whole.
- At flexures of the gastrointestinal tract where the gut alters direction and where it changes from mobile to sessile (apposed to the peritoneum) or *vice versa*, the mesenteric or mesocolic confluence occurs. Not every flexure is officially termed and here is the list of all flexures of the

TABLE 1. List of Latin terms with their English equivalents

Latin term	English term
1. <i>Anatomia generalis</i>	
<i>Liquor pericardii</i>	Pericardial fluid
<i>Liquor pleurae</i>	Pleural fluid
<i>Liquor peritonei</i>	Peritoneal fluid
<i>Neonatus</i>	Newborn
<i>Infans</i>	Baby
<i>Impubis</i>	Kid
<i>Iuvenis</i>	Youth
<i>Pubescens</i>	Pubescent
<i>Adolescens</i>	Adolescent
<i>Adultus</i>	Adult
<i>Senex</i>	Senior
2. <i>Systema digestorium</i>	
<i>Oralis</i>	Oral
<i>Aboralis</i>	Aboral
<i>Facies oralis dentis</i>	Oral surface of tooth
<i>Tractus angularis</i>	Angular tract
<i>Spatium medianum linguae</i>	Median lingual space
<i>Canalis paralingualis</i>	Paralingual canal
<i>Pars superficialis glandulae parotidea</i>	Superficial part of parotid gland
<i>Pars profunda glandulae parotidea</i>	Deep part of parotid gland
<i>Pars retromandibularis glandulae parotidea</i>	Retromandibular part of parotid gland
<i>Foramen stylomandibulare</i>	Stylomandibular foramen
<i>Isthmus glandulae parotidea</i>	Isthmus of parotid gland
<i>Glandulae sublinguales minores</i>	Minor sublingual glands
<i>Glandulae linguales anteriores</i>	Anterior lingual glands
<i>Glandula retromolares</i>	Retromolar glands
<i>Musculus tensor palati mollis</i>	Tensor palati mollis muscle
<i>Musculus levator palati mollis</i>	Levator palati mollis muscles
<i>Pars inferior duodeni</i>	Inferior part of duodenum
<i>Promontorium duodeni</i>	Duodenal promontory
<i>Ansa intestinales</i>	Intestinal loops
<i>Flexura ileocaecalis</i>	Ileocecal flexure
<i>Flexura coli descendents</i>	Flexure of descending colon
<i>Flexura rectosigmoidea</i>	Rectosigmoid flexure
<i>Arteriae intestinales rectae</i>	Straight intestinal arteries
<i>Venae intestinales rectae</i>	Straight intestinal veins
<i>Processus appendicularis hepatis</i>	Appendicular process of liver
<i>Fissura sagittalis dextra et sinistra</i>	Right and left sagittal fissure
<i>Ligamentum venae cavae</i>	Ligament of vena cava
<i>Angulus ileocaecalis</i>	Ileocecal angle
3. <i>Systema respiratorium</i>	
<i>Columella</i>	Columella
<i>Recessus apicis nasi</i>	Recess of nasal apex
<i>Pons nasi</i>	Nasal bridge
<i>Lamella basilaris</i>	Basilar lamella; basal lamella
<i>Recessus frontalis</i>	Frontal recess
<i>Recessus terminalis</i>	Terminal recess
<i>Sinus lateralis</i>	Lateral sinus
<i>Recessus suprabullosus</i>	Suprabullar recess
<i>Recessus retrobullosus</i>	Retrobullar recess
<i>Cellulae ethmoidales supraorbitales</i>	Supraorbital ethmoidal cells
<i>Plica synovialis articulationis cricothyroidea</i>	Synovial fold of cricothyroid joint
<i>Plica synovialis articulationis cricoarytenoidea</i>	Synovial fold of cricoarytenoid joint
<i>Tonsilla laryngea</i>	Laryngeal tonsil
<i>Commissura anterior laryngis</i>	Anterior laryngeal commissure
<i>Commissura posterior laryngis</i>	Posterior laryngeal commissure
<i>Maculae flavae</i>	Maculae flavae
<i>Impressiones costarum</i>	Impressions of ribs

(Contd.)

TABLE 1. (Continued)

Latin term	English term
<i>Sulcus arteriae subclaviae</i>	Groove for subclavian artery
<i>Impressio costae primae</i>	Impression of first rib
<i>Sulcus venae brachiocephalicae sinistrae</i>	Groove for brachiocephalic artery
<i>Sulcus aorticus</i>	Aortic groove
<i>Impressio oesophagea</i>	Esophageal impression
<i>Sulcus venae cavae superioris</i>	Groove for inferior vena cava
<i>Sulcus venae azygoi</i>	Groove for azygos vein
<i>Sulcus oesophageus</i>	Esophageal groove
<i>Bronchus subsegmentalis ordinis quartae anterior et posterior</i>	Anterior and posterior fourth-order subsegmental bronchus
<i>Bronchus subsegmentalis ordinis quintae anterior et posterior</i>	Anterior and posterior fifth-order subsegmental bronchus
<i>Bronchus subsegmentalis ordinis sextae anterior et posterior</i>	Anterior and posterior sixth-order subsegmental bronchus
<i>Area interpleuralis superior</i>	Superior interpleural area
<i>Area interpleuralis inferior</i>	Inferior interpleural area
4. <i>Cavitas thoracis</i>	
<i>Mesopneumonium</i>	Mesopneumonium
<i>Recessus retrooesophageus dexter et sinister</i>	Right and left retrooesophageal recess
<i>Recessus infracardiicus</i>	Infracardiac recess
<i>Processus subcostalis recessus costodiaphragmatici</i>	Subcostal process of costodiaphragmatic recess
5. <i>Systema urinarium</i>	
<i>Lamina prerenalis fasciae renalis</i>	Anterior layer of renal fascia
<i>Lamina retrorenalis fasciae renalis</i>	Posterior layer of renal fascia
<i>Constrictio renalis ureteris</i>	Renal constriction of ureter
<i>Constrictio iliaca ureteris</i>	Iliac constriction of ureter
<i>Constrictio vesicalis ureteris</i>	Vesical constriction of ureter
<i>Vertex vesicae urinariae</i>	Vertex of urinary bladder
<i>Plica ureterica vesicae urinariae</i>	Ureteric fold of urinary bladder
<i>Curvatura subpubica</i>	Subpubic curvature
<i>Curvatura prepubica</i>	Prepubic curvature
<i>Papilla urethralis</i>	Urethral papilla
6. <i>Systemata genitalia</i>	
<i>Adnexa</i>	Adnexa of uterus
<i>Canalis isthmi uteri</i>	Canal of isthmus of uterus
<i>Canalis vaginalis</i>	Canal of vagina
<i>Septum vesicovaginale</i>	Vesicovaginal septum
<i>Area trigonalis vaginae</i>	Triangular vaginal area
<i>Sulcus coronarius penis</i>	Coronary groove of penis
<i>Ligamentum scrotale</i>	Scrotal ligament
<i>Diaphragma urogenitale</i>	Urogenital diaphragm
<i>Trigonum urogenitale</i>	Urogenital triangle
<i>Nervus cavernosus penis major</i>	Greater cavernous nerve of penis
<i>Nervi cavernosi penis minores</i>	Lesser cavernous nerves of penis
<i>Nervus cavernosus clitoridis major</i>	Greater cavernous nerve of clitoris
<i>Nervi cavernosi clitoridis minores</i>	Lesser cavernous nerves of clitoris
7. <i>Cavitas abdominis</i>	
<i>Pars supramesocolica cavitatis peritonei; compartimentum supramesocolicum</i>	Supramesocolic part of peritoneal cavity; supramesocolic compartment
<i>Pars inframesocolica cavitatis peritonei; compartimentum inframesocolicum</i>	Inframesocolic part of peritoneal cavity; inframesocolic compartment
<i>Sinus mesentericus dexter et sinister; compartimentum inframesocolicum dextrum et sinistrum</i>	Right and left mesenteric sinus; right and left inframesocolic compartment
<i>Spatium subperitoneale</i>	Subperitoneal space
<i>Spatium preperitoneale</i>	Preperitoneal space
<i>Radix mesocoli transversi</i>	Root of transverse mesocolon
<i>Radix mesocoli sigmoidei</i>	Root of mesocolon sigmoideum
<i>Pars flaccida omenti minoris</i>	Flaccid part of lesser omentum
<i>Pars condensa omenti minoris</i>	Condensed part of lesser omentum
<i>Apex omenti majoris</i>	Apex of greater omentum
<i>Recessus hepaticus bursae omentalis</i>	Hepatic recess of omental bursa; hepatic recess of lesser sac
<i>Recessus splenorenalis</i>	Splenorenal recess
<i>Plica splenoomentalis</i>	Splenoomental fold

(Contd.)

TABLE 1. (Continued)

Latin term	English term
<i>Fossa umbilicalis profunda</i>	Deep umbilical fossa
<i>Recessus umbilicalis</i>	Umbilical recess
<i>Fascia retropancreatica</i>	Retropancreatic fascia
<i>Fascia retrocolica</i>	Retrocolic fascia
<i>Recessus supravesicalis</i>	Supravesical recess
<i>Plica vesicalis transversa</i>	Transverse vesical fold
<i>Fossa paravesicalis anterior et posterior</i>	Anterior and posterior paravesical fossa
<i>Plica ductus deferentis</i>	Fold of ductus deferens
<i>Plica ureterica peritonei</i>	Ureteric fold of peritoneum; ureteric peritoneal fold
<i>Fossa subovarica</i>	Subovarian fossa
<i>Plica sacrogenitalis</i>	Sacrogenital fold
<i>Fossa femoralis</i>	Femoral fossa
8. Others	
<i>Articulatio uncovertebralis</i>	Uncovertebral joint
<i>Syndesmosis mandibulae</i>	Mandibular syndesmosis
<i>Raphe buccopharyngea</i>	Buccopharyngeal raphe
<i>Linea alba cervicis</i>	Linea alba of neck
<i>Cupula diaphragmatica</i>	Diaphragmatic cupula
<i>Fornix diaphragmatis dexter et sinister</i>	Right and left diaphragmatic dome
<i>Facies superior diaphragmatis</i>	Superior surface of diaphragm
<i>Facies inferior diaphragmatis</i>	Inferior surface of diaphragm
<i>Fascia diaphragmatica superior</i>	Superior diaphragmatic fascia
<i>Fascia diaphragmatica inferior</i>	Inferior diaphragmatic fascia
<i>Spatium retroadductorium</i>	Retroadductor space
<i>Crista supracondylaris lateralis</i>	Lateral supracondylar crest
<i>Crista bifurcata lateralis</i>	Lateral bifurcate crest
<i>Fasciculus ventromedialis ligamenti cruciati anterioris</i>	Ventromedial fascicle of anterior cruciate ligament
<i>Fasciculus dorsolateralis ligamenti cruciati anterioris</i>	Dorsolateral fascicle of anterior cruciate ligament
<i>Rami retroperitoneales anteriores</i>	Anterior retroperitoneal branches
<i>Impressio renalis, gastrica, colica et pancreatica (splenis)</i>	Renal, gastric, colic and pancreatic impression of spleen
<i>Ansa nervi auriculotemporalis</i>	Ansa of auriculotemporal nerve
<i>Ramus frontalis rami meningei nervi mandibularis</i>	Frontal branch of meningeal branch of mandibular nerve
<i>Ramus parietalis rami meningei nervi mandibularis</i>	Parietal branch of meningeal branch of mandibular nerve
<i>Circulus tonsillaris</i>	Tonsillar circle
<i>Cavitas trigeminalis</i>	Trigeminal cavity
<i>Haustra digiti</i>	Haustra of fingers; digital haustra
<i>Hastrum digiti proximale, medium et distale</i>	Proximal, middle and distal digital hastrum

gut: *flexura duodenojejunalis*, ***flexura ileocaecalis***, *flexura coli dextra*, *flexura coli sinistra*, ***flexura coli descendens***, ***flexura rectosigmoidea***, *flexura sacralis*, and *flexura anorectalis* [20].

- Fine vessels supplying both the small and large intestines, branches of *arteria marginalis coli* (“artery of Drummond”) or branches of the most peripheral, i.e. the last, arcades of *arteriae colicae*, are called ***arteriae intestinales rectae***, accompanied with homonymous veins – ***venae intestinales rectae*** [21].
- ***Processus appendicularis hepatis*** (“lobus appendicularis”; “lobus linguiformis”; “lobe of Riedel”) is a variant tongue-like process extending caudally from *lobus dexter hepatis* lateral to *vesica biliaris*, extending beyond the level of the most caudal *cartilago costalis* when seen on cross-sectional images. As it is not a true accessory lobe of the liver but an anatomical variant of its right lobe, it

should not be term “lobus”. Its incidence is approximately 17.5% (ranging from 3.3% to 31%) and is found 3 times more frequently in females [22,23].

- ***Fissura sagittalis dextra et sinistra*** are perpendicular depressions on *facies visceralis hepatis*. The right one consists of *fossa vesicae biliaris* and *sulcus venae cavae*; the left one of *fissura ligamenti teretis* and *fissura ligamenti venosi*.
- ***Ligamentum venae cavae*** is a short fibrous band stretching across *pars hepatica venae cavae inferioris* when it courses through *sulcus venae cavae hepatis* to fix the vein within the groove.
- ***Angulus ileocaecalis*** is an acute angle formed between the walls of the terminal ileum and caecum.

Systema respiratorium

- ***Columella*** is a term with different meanings: it can be the only auditory ossicle in the middle ear of amphibians,

reptiles and birds; it can be the artificial prosthesis (such as autografts from cortical bone) placed into the human middle ear instead of missing/disabled auditory ossicles; or it can be the narrow external surface of *pars cutanea septi nasi*, which is a commonly used term in plastic and reconstructive surgery.

- **Recessus apicis nasi** is a small pouch of *vestibulum nasi* protruding ventrally into *apex nasi*.
- **Pons nasi** (nasal bridge) is a clinical term used to define a saddle-shaped area including *radix nasi* and the lateral aspects of the nose, situated between *glabella* and the inferior margin of *ossa nasalia* and extending laterally to *angulus oculi medialis* of both sides.
- **Lamella basilaris** describes the developmental base of both definitive and rudimentary nasal conchae. The clinically most important is **lamella basilaris conchae nasalis mediae** (basal lamella; “ground lamella”) separating *cellulae ethmoidales anteriores et posteriores* which feature different drainage patterns.
- **Recessus frontalis** is a space in *meatus nasi medius*, more exactly the superior (the most ventral and the most cranial) part of *infundibulum ethmoidale*. Cranially, it narrows into *apertura sinus frontalis*, the entrance into *sinus frontalis*. Its medial wall is formed by *concha nasalis media*, the lateral wall mainly by *lamina orbitalis ossis ethmoidalis* and the posterior wall by *bulla ethmoidalis*. The obsolete terms, “ductus nasofrontalis” and “canalis nasofrontalis” are used for *recessus frontalis* or *apertura sinus frontalis* or for both and, to avoid further terminological confusion, both should be abandoned.
- **Recessus terminalis** is a variable recess of *infundibulum ethmoidale*, protruding ventrally from the point of *apertura sinus frontalis*. This variation appears due to anomalous insertion of a vertical bony lamella, *processus uncinatus ossis ethmoidalis*. In this case, the insertion turns laterally and is located on *lamina orbitalis ossis ethmoidalis*. *Recessus frontalis* is thus separated from *infundibulum ethmoidale*.
- **Sinus lateralis** (of Grünwald) is another variable space present in case of small (low) *bulla ethmoidalis*. Usually, *bulla ethmoidalis* reaches the roof of *cellulae ethmoidales anteriores* as a frontally oriented plate, forming the posterior wall of *recessus frontalis*. When *bulla ethmoidalis* is low, *recessus frontalis* directly communicates with *sinus lateralis*, a space above *bulla ethmoidalis*, medially bordered by *concha nasalis media*, laterally by *lamina orbitalis ossis ethmoidalis*, and dorsally by *lamella basilaris conchae nasalis mediae*. *Sinus lateralis* can be divided into the ventral **recessus suprabullosus** above *bulla ethmoidalis* and the dorsal **recessus retrobullosus** (if the sinus extends dorsally behind the posterior wall of the bulla) [24,25].

- **Cellulae ethmoidales supraorbitales** (clinically also termed “suprabullar cells”) are variant air cells, belonging to *cellulae ethmoidales anteriores*. They originate immediately behind *recessus frontalis* and extends over the orbit due to an extensive pneumatization of *pars orbitalis ossis frontalis*.
- Both diarthroses (synovial joints) of the larynx, *articulatio cricothyroidea et articulatio cricoarytenoidea*, contain constant thick and large **plicae synoviales** [26-28].
- **Tonsilla laryngea** is an accumulation of small lymphatic nodules located on the posterior aspect of the epiglottis and mainly in *ventriculus laryngis*.
- **Commissura anterior laryngis** (ligament of Broyles) is the midline area of *rima glottidis*, a site of convergence of the paired *ligamentum vestibulare*, *ligamentum vocale*, and *pars thyroepiglottica musculi thyroarytenoidei*. Its tendinous structure provides the anterior attachment for *ligamenta vocalia*. **Commissura posterior laryngis** is the mucosal surface ventral to *cartilago cricoidea* in between *cartilagine arytenoideae*. Both commissures separate the upper *glottis* and the lower *cavitas infraglottica* and they are continuous with specific areas of *ligamenta vocalia*, termed **maculae flavae**. These spots are uniquely composed in the body of fibroblasts, elastic fibers, collagen fibers and ground substance, and are likened to a shock absorber connecting the cartilage at either end of *ligamenta vocalia* [29].
- There are grooves and furrows on two out of three lung surfaces, formed by the adjacent structures (better visible on a lung from cadaver) and some of them are missing in the TA (Figures 1 and 2):
 - *Facies costalis* features **impressiones costarum**.
 - *Facies mediastinalis* of both lungs contains **sulcus arteriae subclaviae** at *apex pulmonis*, and the adjacent *margo anterior* of both lungs features **impressio costae primae**.

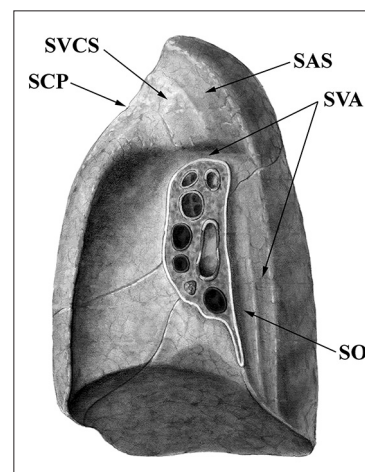


FIGURE 1. Medial view of the right lung. SAS: Sulcus arteriae subclaviae; SCP: Sulcus costae primae; SO: Sulcus oesophagus; SVA: Sulcus venae azygoi; SVCS: Sulcus venae cavae superioris.

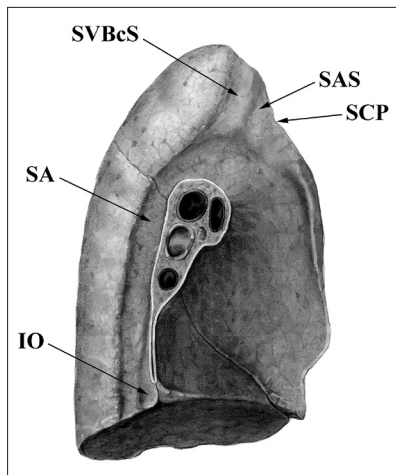


FIGURE 2. Medial view of the right lung. IO: Impressio oesophagea; SA: Sulcus aortae; SAS: Sulcus arteriae subclaviae; SCP: Sulcus costae primae; SVBcS: Sulcus venae brachiocephalicae sinistrae.

- On the left lung, **sulcus venae brachiocephalicae sinistrae** is located at *apex pulmonis*, and behind *hilum pulmonis* there is a vertical deep groove (**sulcus aorticus**) and caudally next to it a shallow shorter depression (**impressio oesophagea**).
- On the right lung, **sulcus venae cavae superioris** is located at *apex pulmonis*, and behind *hilum pulmonis*, there is a vertical groove (**sulcus venae azygoi**) and next to it **sulcus oesophagus**.

These grooves and impressions are present as surface unevennesses of the lungs representing a direct connection between the vessels, bones, and organs and the lungs, and can change their shape during breathing. However, they get stable after embalming and are well visible on cadaverous lungs. That is why we recommend new terminology for these structures.

- *Bronchi segmentales* are further divided into several levels of *arbor bronchialis* in a dichotomic way. They lack their specific denominations, although they may be approached by a flexible bronchoscope. They are labeled by bronchoscopists using letters to differentiate the dorsal (larger) and the ventral (smaller) bronchi of the fourth, fifth, and sixth level of the tree. These bronchi should be denominated only in general, using the general term “ordo” (order, level). Based on the proposed rule, examples are provided below (bronchoscopic labels are stated in the parentheses):
 - Fourth level: **Bronchus subsegmentalis ordinis quartae anterior** (b) **et posterior** (a).
 - Fifth level: **Bronchus subsegmentalis ordinis quintae anterior** (ii) **et posterior** (i).
 - Sixth level: **Bronchus subsegmentalis ordinis sextae anterior** (β) **et posterior** (α).
- The projection of medial parietal pleural borders extends from *cupula pleurae* to *fossa supraclavicularis minor*

behind *articulatio sternocostalis secunda* and forms triangular **area interpleuralis superior**. Then, it descends along the *linea sternalis* to the fourth rib and here diverges behind *articulatio sternocostalis sexta* (on the right) and behind the junction of the sixth rib and its cartilage (on the left) forming the triangular **area interpleuralis inferior**.

Cavitas thoracis

- **Mesopneumonium** (obsolete term “isthmus pleurae”) is the pleural reflection surrounding *radix pulmonis*, including the caudally extending *ligamentum pulmonale* as *pleura parietalis* becomes continuous with *pleura visceralis*.
- **Recessus retrooesophageus dexter et sinister** belong to smaller recesses of pleura, formed by reflections of *pleura mediastinalis* behind the esophagus and in front of *aorta thoracica*, occupied by a small part of the lung. In radiographic imaging, these recesses contribute to the retrocardiac space visible on the thorax radiograph. **Recessus infracardiaca** is a small recess of the pleura sometimes extending beneath *vena cava inferior*.
- **Processus subcostalis recessus costodiaphragmatici cavitatis pleuralis** often extends below the level of the twelfth rib which is clinically relevant during renal surgical procedures.

Systema urinarium

- *Fascia renalis* is enveloping both the kidney and suprarenal gland. It forms a single layer lateral to these organs, merging with *fascia transversalis*, but medially it splits into an anterior sheet termed **lamina prerenalis fasciae renalis** (fascia of Gerota) and a posterior sheet termed **lamina retrorenalis fasciae renalis** (fascia of Zuckerkandl). They continue separately in front and behind, respectively, the large vessels and their branches/tributaries to merge with the contralateral laminae to form the unilayered *fascia renalis* laterally.
- The ureter is narrowed at three different places: first as **constrictio renalis** (clinically “isthmus ureteris”) between *pelvis renalis* and *pars abdominalis ureteris*; second as **constrictio iliaca** when crossing *vasa iliaca communia* on the left side or *vasa iliaca externa* on the left side into the lesser pelvis (i.e. between its *pars abdominalis* and *pars pelvica*); and third as **constrictio vesicalis** in its *pars intramuralis* passing through the wall of the urinary bladder.
- A filled urinary bladder heads ventrocranially with its **vertex vesicae urinariae** (which is a transient structure unlike *apex vesicae urinariae*) above the attachment

of *apex vesicae urinariae* to *ligamentum umbilicale medianum*. In such case, the peritoneum forms in the midline an unpaired fossa of varying depth (dependent of the filling of the urinary bladder) between *apex vesicae urinariae* and the anterior abdominal wall, termed **recessus supravesicalis**. This recess often contains small intestine loops.

- **Plica ureterica vesicae urinariae** is a fine fold of the urinary bladder mucosa elevated by *pars intramuralis ureteris* right above *ostium ureteris*.
- **Curvatura subpubica** is the first bend of the male urethra, concave upward, located at the transition of its *pars intermedia* and its *pars spongiosa*, and it is impossible to straighten. **Curvatura prepunica** is the second bend of the male urethra, concave downward, located approximately in the middle of *pars spongiosa* and it straightens during erection.
- **Papilla urethralis** is a mild elevation in *vestibulum vaginae* at *ostium externum urethrae feminae*.

Systema genitalia

- **Adnexa** is a clinical term used for a complex of the ovary and the uterine tube.
- **Canalis isthmi uteri** is a narrow cavity of the most caudal part of *corpus uteri* having a bit different histological structure, differing from both the cranial *cavitas uteri* and the caudal *canalis cervicis*.
- **Canalis vaginalis** is a hollow space along the whole length of the vagina.
- **Septum vesicovaginale** is a connective tissue layer between the urinary bladder and the anterior vaginal wall, a part of *lamina genitalis fasciae pelvis visceralis* [2], containing the smooth muscle fibers of *musculus vesicovaginalis*.
- The upper part of the anterior vaginal wall is in close contact with the urinary bladder (separated by *septum vesicovaginale*), and at the cranial end of *columna rugarum anterior rugae vaginales* are flattened and border **area trigonalis vaginae** (of Pawlik), corresponding to the smooth *trigonum vesicae* in the urinary bladder.
- **Sulcus coronarius penis** (“balanopreputial groove”) is a retroglandular circular groove behind *glans penis* at the level of *collum penis* where the inner layer of prepuce begins.
- **Ligamentum scrotale** (which is already a term in the TE) is a remnant of the embryonic *gubernaculum testis*, securing *extremitas inferior testis* to the most caudal part of the scrotum, tethering it in place and limiting the degree of testis movements within the scrotum.
- **Diaphragma urogenitale** (excluded from the TA in 1998) is descriptively and didactically a very useful term, so the term should be reintroduced in the TA.

- **Apertura pelvis inferior** is the two-plane pelvic outlet, composed of the ventral *trigonum urogenitale*, bounded by the *symphysis pubica* ventrally and *rami ischiopubici* laterally; and of the dorsal *trigonum anale* extending from *tubera ischiadica* dorsally to *apex ossis coccygis*. Both triangles form an obtuse angle to each other.
- **Nervus cavernosus penis major** is an autonomic nerve which courses forward along *dorsum penis*, joins *nervus dorsalis penis*, and supplies *corpora cavernosa penis*. **Nervi cavernosi penis minores** perforate the fibrous cover of penis near *radix penis*. Similar nerves are present in the female as well: **nervus cavernosus clitoridis major et nervi cavernosi clitoridis minores** [30].

Cavitas abdominis

- **Cavitas peritonealis** is divided by *mesocolon transversum* into the cranial **pars supramesocolica** (or **compartimentum supramesocolicum**) and the caudal **pars inframesocolica** (or **compartimentum inframesocolicum**). The latter is subdivided by *radix mesenterii* into **sinus mesentericus dexter et sinister** (or **compartimentum inframesocolicum dextrum et sinistrum**).
- **Spatium extraperitoneale** is in the TA composed of *spatium retroperitoneale*, *spatium retropubicum* (of Retzius) and *spatium retroinguinale* (of Borgros). However, the extraperitoneal space in the lesser pelvis between the urinary bladder and the uterovaginal complex and between the latter and the rectum, as well as between all these organs and the bony pelvic wall deserves its own common term – **spatium subperitoneale**. The space between the posterior aspect of the anterior abdominal wall and the anterior parietal peritoneum should also be termed – **spatium preperitoneale**.
- **Radix mesocoli transversi** is the origin of *mesocolon transversum* from the posterior parietal peritoneum, extending from *flexura coli dextra* under the right lobe of the liver, passing over the right kidney, *pars descendens duodeni*, pancreas, and left kidney to *flexura coli sinistra* under the spleen.
- **Radix mesocoli sigmoidei** is the origin of *mesocolon sigmoideum* from the posterior parietal peritoneum, extending from the caudal end of *colon descendens* and from the inner border of *musculus psoas major*. It crosses the left ureter, left *vasa testicularia/ovarica* and *bifurcatio aortae* reaching the third sacral vertebra.
- **Omentum minus** can be divided into three parts in relation to the organs (*ligamentum hepatooesophageum*, *ligamentum hepatogastricum*, and *ligamentum hepatoduodenale*) and into two parts with regard to its thickness. It

is thinner in the middle part and on the left (**pars flaccida**) and sometimes perforated in those two parts, and it is thicker, denser, and tight in the upper part (**pars condensata**). Its thickness is based mainly on adipose tissue content.

- The caudal margin of *omentum majus* which is actually the fold between its anterior and posterior layer can be called **apex omenti majoris**.
- **Recessus hepaticus bursae omentalis** (of Spigel) is a small pouch of *cavitas peritonealis* and its *bursa omentalis* along *vena cava inferior* and *lobus caudatus hepatis*, immediately left to *foramen omentale*.
- **Recessus splenorenalis** (“recessus splenopancreaticus”) is a space behind *ligamentum splenorenale*, it means behind *vasa splenica* and behind and under *cauda pancreatis* and in front of *lamina anterior fasciae renalis* (covering the left kidney and left suprarenal gland and a space lateral to them filled with *corpus adiposum pararenale*).
- **Plica splenoomentalis** (“plica gastroomentalis”; “plica lienooementalis”; “fold of Morgenstern”; and “criminal fold”) is a variant fold located between the inferior margin of the spleen and *omentum majus* at *flexura coli sinistra* from which it is separated by *ligamentum splenocolicum*.
- *Fascia umbilicalis* (of Richet) is a part of *fascia extra-peritonealis* (its superior part is continuous with *fascia transversalis* as well) and covers the umbilicus from the dorsal (internal) side. It adheres to *peritoneum parietale* and forms a shallow depression, which can be termed as **fossa umbilicalis profunda**. The caudal margin of *fascia umbilicalis* is more distinct, and a small peritoneal pouch can be present here – **recessus umbilicalis**.
- **Fascia retropancreatica** (“fascia of Treitz”; “membrana retropancreatica”) is a fusion fascia which has been partially modified by mechanical stresses between tissues during development^[31] when the retroperitoneal organs are covered by *lamina anterior fasciae renalis* and the pancreas by peritoneum. During the 6th–12th week of the intrauterine life the pancreas becomes fixed dorsally due to rotation of the mesentery, then the peritoneum changes into a fusion fascia in the area of *bursa omentalis*. The fusion fascia is located behind majority of the pancreas and *vasa splenica* and in front of *vena renalis sinistra* and the left suprarenal gland. The right part behind *caput pancreatis* and adjacent majority of duodenum was originally described by Treitz in 1853 as “fascia retroduodenopancreatica” [32]. The fusion fascia due to the gut rotation is the fascia located behind *colon ascendens et descendens*, as described by Toldt, and should be termed **fascia retrocolica** (“fascia of Toldt”) [33,34].
- **Plica vesicalis transversa** is a temporary peritoneal fold, visible only above the empty urinary bladder,

dividing *fossa paravesicalis* into two parts, **fossa paravesicalis anterior et posterior**.

- **Plica ductus deferentis** is a fine peritoneal fold elevated by *pars pelvica ductus deferentis*, stretching from *anulus inguinalis profundus* medially to the urinary bladder and bordering laterally *fossa paravesicalis*.
- **Plica ureterica peritonei** is a gentle peritoneal fold in males in a place where *peritoneum parietale* passes up and over the ureter on each side of the posterior part of the urinary bladder.
- During pregnancy the ovary is shifted cranially, and after the delivery, it does not return to its original site (*fossa ovarica*) but drops a bit dorsally into **fossa subovarica** (of Claudius). This fossa is bordered ventrally by *plica ureterica peritonei* (and *vasa iliaca interna*), dorsally by *peritoneum parietale* covering *facies pelvica ossis sacri*, and mediocaudally by *plica rectouterina*.
- **Plica sacrogenitalis** is a peritoneal fold extending dorsally from the sides of the urinary bladder in males or of the uterus in females, passing lateral to the rectum to reach *facies pelvica ossis sacri*. It forms the lateral boundaries of *excavatio rectovesicalis* in males or *excavatio rectouterina* in females.
- **Fossa femoralis** is a depression of *peritoneum parietale* mediocaudal to *fossa inguinalis lateralis*, separated from it by the medial end of *ligamentum inguinale* and overlying *anulus femoralis*.

Others

- **Articulatio uncovertebralis** (of Luschka) is a paired small synovial joint formed secondarily between *processus uncinatus faciei superioris corporis vertebrae* of the superior cervical vertebra and *facies inferior corporis vertebrae* of the inferior cervical vertebra (except for the atlas).
- In humans, a synarthrosis connecting the right and left halves of the mandible which fuse and form a synostosis within the 1st year of life is called *symphysis mandibulae* in the TA. However, based on a study performed by Prieth *et al.* [35], in the Week 15 of the fetal life, a syndesmosis between the bony mandibular halves develops and is consistent throughout all later stages. At the lingual side, “symphyseal chondriole” (islets of Meckel) could be identified in the Week 22, but not later on. That is why this structure should be called **syndesmosis mandibulae**.
- *Raphe pterygomandibularis* should be completed with the non-preferred synonym – **raphe buccopharyngea**.
- **Linea alba cervicis** is a midline vertical fibrous connection of the infrahyoid muscles, namely between *musculi sternohyoidei* of both sides in the upper part and between *musculi sternothyroidei* of both sides in the lower part. It

can be considered as a thickened part of *lamina pretrachealis fasciae cervicalis*.

- **Cupula diaphragmatica** is a Latin term for the dome of the diaphragm, corresponding to the muscular part of the diaphragm (mainly its *pars costalis*) dorsal to its *centrum tendineum*. This part is responsible for the total shape of the diaphragm as well as for its excursions during respiration. It consists of **fornix diaphragmatis dexter et sinister**.
- **Facies superior et inferior diaphragmatis** are two surfaces of the diaphragm, the upper one facing *cavitas thoracica* and covered with **fascia diaphragmatica superior** (part of *fascia thoracica parietalis*), the lower one facing *cavitas abdominis* and covered with **fascia diaphragmatica inferior** (part of *fascia abdominis parietalis*).
- **Spatium retroadductorium** (“space of Guiot”) is a gap between *musculus interosseus dorsalis primus* (*manus*) and *musculus adductor pollicis*. *Vasa radialis* enter this space through a slit between the two heads of *musculus interosseus dorsalis primus*.
- There are two bony structures located on the lateral aspect of *fossa intercondylaris (femoris)* [Figure 3]. **Crista supracondylaris lateralis** is a proximodistal bony ridge bordering ventrally the whole attachment of *ligamentum cruciatum anterius*. **Crista bifurcata lateralis** is a ventrodorsal bony ridge coursing dorsally from the previous crest and separating the insertional areas of two fascicles of the above-mentioned ligament – **fasciculus ventromedialis et dorsolateralis** (*ligamenti cruciati anterioris*) [12,36].
- Small branches supplying the fine structures of the retroperitoneum (such as ureter, *nodi lymphoidei lumbales*, adipose tissue, sympathetic plexuses, and ganglia) related to large vessels of the abdomen, emanating from

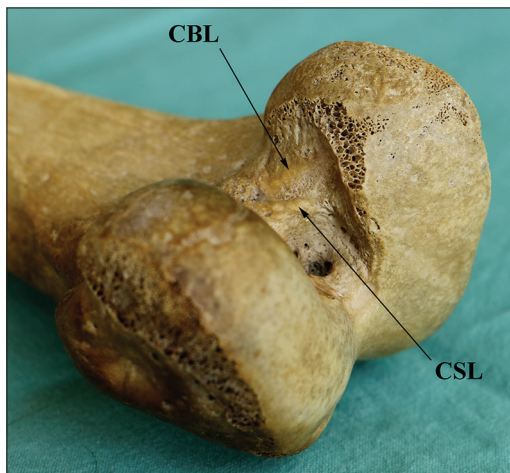


FIGURE 3. Dorsal view of the distal part of the femur, centered at the lateral wall of fossa intercondylaris. CBL: Crista bifurcata lateralis; CSL: Crista supracondylaris lateralis.

arteria renalis, *arteria renalis accessoria*, *arteria testicularis/ovarica*, *arteria iliaca communis*, or directly from *aorta abdominalis* can be termed **rami retroperitoneales anteriores** as they emerge from the anterior aspect of *aorta abdominalis*. Their accompanying veins entering the anterior aspect of *vena cava inferior* (or its tributaries) can be similarly called *venae retroperitoneales anteriores* [9,37,38].

- The terms for contact surfaces should be consistent concerning all the organs of the human body. Based on this rule, the terms for contact surfaces of the spleen located on its *facies visceralis* should be changed from *facies renalis*, *facies gastrica*, *facies colica* and variable **facies pancreatica** to **impressio renalis, gastrica, and colica et pancreatica (splenis)**, following the corresponding terms in English [39].
- *Nervus auriculotemporalis* bifurcates after leaving *nervus mandibularis* within *fossa infratemporalis*, forms a loop around *arteria meningea media*, and both branches merge again. This nerve loop can be termed **ansa nervi auriculotemporalis**.
- *Ramus meningeus nervi mandibularis* courses together with *vasa meningea media* within the *sulcus arteriae meningeae mediae* and then it branches into **ramus frontalis** and **ramus parietalis**, following the homonymous branches of *arteria meningea media* within *sulci arteriosi ossis parietalis* to supply the meninges.
- **Circulus tonsillaris** is a term for a fine network of four type of fibers – *rami tonsillares nervi glossopharyngei*, branches from *plexus pharyngeus* (containing fibers from *nervus vagus* and *truncus sympathicus*) and *rami tonsillares nervorum palatinorum minorium*, as already mentioned by Carl Samuel Andersch [40].
- *Cavum trigeminale* (of Meckel) is a space formed by two layers of *dura mater cranialis*, evaginated from *tentorium cerebelli* at *apex partis petrosae ossis temporalis*, containing *ganglion trigeminale* (of Gasser). It is the only term containing the word “cavum” and should be changed to **cavitas trigeminalis** to be consistent throughout the whole body.
- **Haustra digiti** are distances between digital creases of fingers, measured from the lateral view. We can classify them as **hastrum digiti proximale, medium et distale** in relation to the corresponding phalanges.

DISCUSSION

The rationale behind the initiative to revise and strictly follow a unique list of anatomical terms in a form of a worldwide-approved nomenclature can be exemplified with an article concerning the surface landmarks of the abdominal

wall [41]. Boselli et al.^[41] proposed a standardization of terminology related to surface landmarks and borders of the abdominal cavity. It is an excellent article, but the used terminology is inconsistent; for example, “xiphoid appendix” or “ensiform apophyses” was used instead of xiphoid process, “axillary cavity” instead of axilla or axillary fossa, “inguinal arc” instead of groin, “xiphopubic line” instead of “anterior median line,” “ribcage” instead of “thoracic cage,” and “media axillary line” instead of midaxillary line. Such incoherency can cause misunderstanding and confusion, and does not lead to consistent use of anatomical nomenclature. Therefore, it is necessary to discuss proposed changes and extensions of the terminology very thoroughly in public as well as during the peer review process before publishing. In addition, it is essential to consistently follow the rules and terms provided in the latest version of the anatomical nomenclature, the TA 1998, and in its second edition from 2011 [13,14].

In some cases, anatomical terms are not precise. For example, *epigastrium* (*regio epigastrica*) is the cranial third of the anterior abdominal region, *hypogastrium* (*regio hypogastrica*) is its caudal third. The vessels termed *arteria epigastrica inferior* and *arteria epigastrica superficialis* are rather located in the caudal part, within *hypogastrium*, and thus it is not accurate to name them “epigastric.” However, these terms are widely used in the literature, so further discussion is required to determine if it is more precise to use the adjective “*hypogastricus*” instead of “*epigastricus*.” It is worth mentioning here that “*arteria hypogastrica*” was the official term for *arteria iliaca interna* in the *lenaiensia Nomina Anatomica*, until 1935 [42,43].

Consistent use of the nomenclature is also important from the educational point of view, as well as understanding of the basics of Latin grammar and the meaning of Latin and Greek words within a sentence [44-51].

In recent years, the correct use of anatomical terminology has received increased attention from the scientific community and become a subject of considerable debate. Several articles [1-12] have provided a review of current progress in this field with a focus on the use of anatomical terminology in clinical practice, giving explanations of why it is important to use precise, appropriate and valid anatomical terms in everyday communication between physicians from all branches of medicine [46-69].

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The authors declare no conflict of interests.

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