Surg Radiol Anat (2016) 38:757–765
DOI 10.1007/s00276-016-1627-8

ORIGINAL ARTICLE

Contribution to the anatomical nomenclature concerning general anatomy and anatomical variations

David Kachlik[1,2] · Vladimir Musil[3] · Vaclav Baca[2]

Received: 6 November 2015 / Accepted: 12 January 2016 / Published online: 5 March 2016

Abstract Nomenclature of the general and variant anatomy belongs to the most neglected parts of the Latin anatomical nomenclature in Terminologia Anatomica. Although many important small structures are included in Terminologia Anatomica, when describing and teaching particular anatomy of any part of the human body, the general terms are necessary, such as planes, lines and flexion grooves. Moreover, Terminologia Anatomica contains only 149 terms of variant structures, enlisted in the parentheses to differentiate them from constant ones. They are only a rather representative selection and some more should be added, both from the educational and clinical point of view. The authors present some terms, completed with their definitions or explanations concerning the general and variant anatomy to evoke broader discussion on this topic which should issue in incorporation of proposed terms (or their equivalents) into the Terminologia Anatomica.

Keywords Anatomical terminology · Anatomical nomenclature · General anatomy · Anatomical variations

✉ Vladimir Musil
vladimir.musil@lf3.cuni.cz

[1] Department of Anatomy, Second Faculty of Medicine, Charles University in Prague, V Úvalu 84, 150 06 Prague 5, Czech Republic

[2] Department of Health Care Studies, College of Polytechnics Jihlava, Jihlava, Czech Republic

[3] Centre of Scientific Information, Third Faculty of Medicine, Charles University in Prague, Ruská 87, 100 00 Prague 10, Czech Republic

Introduction

A basic tool of understanding the anatomy is its terminology and nomenclature that have to be precise, concise, worldwide accepted and acknowledged, simple and clear. It allows unconfused communication between specialists and excludes possible misunderstanding, misinterpretation and potential errors. Terminology is defined as a system of terms used in the certain scientific field. On the contrary, nomenclature covering the terms created within the scope of terminology, is a normalized system (systematized list) of exactly defined terms—standardized anatomical terms—arranged according to specific classification principles. Nomenclature is approved by the official commission or organ of the certain scientific field and usually worldwide used and accepted by the professional community.

The anatomical terminology dates back to ancient Greece and Rome, more than two thousand five hundred years ago. The influence of Arabian anatomists and language was totally removed by Vesalius, except of the term *venae saphenae*. The meaning of the term is very interesting—in Greek saphenes means obviously visible and in Arabic al-safin means hidden. The Greek terms refers to the appearance of varicose superficial veins of the lower limb, on the contrary the Arabian one describes the natural appearance of the superficial veins in comparison to those of the upper limb.

The end of the nineteenth century culminated in the first anatomical nomenclature which replaced many synonyms describing different structures with one (exceptionally two) term—Basiliensia Nomina Anatomica [36, 47]. Till 1955 there was not a full consensus in the Latin anatomical nomenclature and finally the Parisiensia Nomina Anatomica (PNA) started the new era with one worldwide fully

Table 1 List of newly proposed term for incorporation into the Terminologia Anatomica both in Latin and in English

Latin term	English term
(***Arcus axillaris***)	(Axillary arch)
(***Arteria brachialis accessoria***)	(Accessory brachial artery)
(***Arteria brachioulnaris***)	(Brachioulnar artery)
(***Arteria brachioulnoradialis***)	(Brachioulnoradial artery)
(***Arteria brachiomediana superficialis***)	(Superficial brachiomedian artery)
(***Arteria brachioulnoradialis superficialis***)	(Superficial brachioulnoradial artery)
(***Arteria brachioulnaris superficialis***)	(Superficial brachioulnar artery)
(***Arteria brachialis superficialis***)	(Superficial brachial artery)
(***Arteria brachioradialis superficialis***)	(Superficial brachioradial artery)
Articulatio composita ossea et osseofibrosa	Compound and complex joint
(***Arteria cilioretinalis***)	(Cilioretinal artery)
(***Arteria subclavia dextra aberrans***)	(Aberrant right subclavian artery)
Caput accessorium	Accessory head
Conjugata interspinosa	Interspinous conjugate
Conjugata intercristalis	Intercristal conjugate
Conjugata intertrochanterica	Intertrochanteric conjugate
Compartimentum supratentoriale et infratentoriale	Supratentorial and infratentorial compartment
Dorsum manus; *Regio dorsalis manus*	Dorsum of hand
Extensio proximalis venae saphenae parvae	Proximal extension of small saphenous vein
(***Fabella***)	(Fabella)
Faciecula	Facet
Faciecula medialis*	Medial facet
Faciecula lateralis*	Lateral facet
Faciecula scaphoidea**	Scaphoid facet
Faciecula scaphoidea**	Lunate facet
Fasciculus vasonervosus	Neurovascular bundle
Fossa epigastrica	Epigastric fossa
Fossa umbilicalis superficialis	Superficial umbilical fossa
Fossa umbilicalis profunda	Deep umbilical fossa
Fossa lumbalis lateralis	Lateral lumbar fossa
Jugulum; Fossa jugularis suprasternalis	Jugulum; Suprasternal jugular fossa
Linea carpalis palmaris proximalis	Proximal palmar carpal line
Linea carpalis palmaris distalis	Distal palmar carpal line
Linea xiphosternalis	Xiphosternal line
Linea subcostalis	Subcostal line
Linea transpylorica	Transpyloric line
Linea interspinosa	Interspinous line
Linea intercristalis	Intercristal line
Linea costoarticularis	Costo-articular
Linea axilloumbilicalis	Axillo-umbilical line
Linea spinoumbilicalis	Spino-umbilical line
Mesogastrium	Mesogastrium
Musculus abductor digiti minimi manus	Abductor digiti minimi of hand
Musculus abductor digiti minimi pedis	Abductor digiti minimi of foot
(***Musculus dorsoepitrochlearis***)	(Dorso-epitrochlear muscle)
(***Musculus thoracoepitrochlearis***)	(Thoraco-epitrochlear muscle)
(***Musculus pectoralis quartus***)	(Fourth pectoralis muscle)
Papilla umbilicalis	Umbilical papilla
Regio sublingualis	Sublingual region
Regio hyoidea	Hyoid region

Table 1 continued

Latin term	English term
Regio infraclavicularis	Infraclavicular region
Sulcus inguinalis	Inguinal groove
Sulcus popliteus	Popliteal groove
Sulcus tendinis musculi poplitei	Groove for popliteus muscle tendon
Sulcus inframammarius/Plica inframammaria	Inframammary groove/fold
(***Truncus profundocircumflexus posterior***)	(Posterior profundocircumflex trunk)
(***Tuberculum deltoideum***)	(Deltoid tubercle)

Variant anatomy terms are stated within the parentheses

* Daughter term of *Facies articularis tibialis superior* and of *Facies articularis patellae*

** Daughter term of *Facies articularis carpalis*

accepted Latin nomenclature [15]. Several revisions followed (2nd–6th) and the up-to-now last revision of the Latin anatomical nomenclature was issued by the Federative Committee on Anatomical Terminology (FCAT) and then approved by the International Federation of Associations of Anatomists (IFAA) in 1997 and published in 1998, denominated the Terminologia Anatomica (TA) [10, 22]. The period of last 17 years from the issue of TA and present time has showed several weak points, discrepancies and main insufficiently rich segments [12, 16, 22]. Last year we celebrated the 120 years anniversary of the BNA and 60 years anniversary of PNA and it can and should be the right reason to further ameliorate the TA.

The aim of this article is to draw attention to discrepancies, mistakes, inaccuracies and insufficiencies of the current version of the Latin anatomical nomenclature, to ameliorate and correct it and to propose some extensions in the field of general and variant anatomy.

Body

Based on our experience with the Terminologia Anatomica in fields of education (of both systemic and topographic anatomy) and clinical medicine (teaching of clinical anatomy and courses for young physicians in endoscopy), we decided to provoke a wider discussion on this topic. From 2009, the Programme on Anatomical Terminology (FIPAT), a successor of FCAT, is very active in this field, but this volunteer huge activity stays without any publicity and advertisement. The effort of FIPAT led to the free access of TA at: http://www.unifr.ch/ifaa; and specific FIPAT commissions dealing with certain topics can be addressed by any morphologist who feel interest and would like to be involved, at http://www.ifaa.net/index.php/fipat/change-fipat/fipat-discussion-forum.

But, we feel the necessity to discuss it in wider morphological community and that is why we dare to propose some terms in the general and variant anatomy. The proposals are usually not supported with citations while the authors consider them as anatomically clear and well known, often stated in fundamental anatomical or clinical textbook and atlases. The official terms of the TA, used in this article, are written in Italics; the unofficial, obsolete or incorrect terms are in usual font and with quotation marks. The suggested changes and proposals for new edition are written in bold Italics (see Table 1).

To demonstrate the difference in the development of the anatomical nomenclature during last decades (between PNA and TA), we can focus on two specific regions, the central nervous system and the skeletal system (bones). The difference in the chapter Nervous system is 333/1947 (484 % increase) and in the chapter Bones 847/993 (17 % increase). Of course, this discrepancy reflects the enormous boom of scientific research of the brain and relative deep knowledge of the skeletal system anatomy, but indeed it does not correlate with the real state. This discrepancy reveals the weakest point of the TA, missing terms of detailed systemic anatomy, topographic anatomy and clinical anatomy and a low number of terms of variant anatomy.

Several points concerning the inconsistencies of TA were already discussed in our previous papers [15, 22], but it is necessary to highlight the most striking ones, concerning the upper and lower limb structures. The terms containing the adjective ***pudendus*** should not be called "pudendalis", the terms containing the adjective ***iliacus*** should not be called "ilicus". The only one synonym from the pair *fibularis-peroneus* should be preferred—***fibularis***; similarly only one synonym from the pair *collum-cervix* should be preferred as defined: the term ***collum*** should be used for the bones only, the term ***cervix*** for all other structures (neck of body, neck of organs and related structures). *Dorsum pedis* has an alternative term *regio dorsalis pedis*, similarly the *dorsum manus* (A01.2.07.021) should be completed with the term ***regio dorsalis manus***. Skin creases of palm were totally missing in the TA and their terms were proposed as whole [22], e.g. ***linea***

carpalis palmaris proximalis et distalis for two close lines at the border of wrist and forearm.

A problem of identical terms for similar structures located in different regions of the human body is solved by a clever system of the TA. Each structure when listed under a mother term can be extended with adding the genitive of the mother term behind the term itself, e.g. *epicondylus medialis* located on the humerus and on the femur can be easily differentiated into the *epicondylus medialis humeri* and *epicondylus lateralis humeri*. But, in case of the *musculus abductor digiti minimi* describing two different muscles, one on the upper limb (A04.6.02.062) and the other on the lower limb (A04.7.02.063), it should be distinguished by their denomination following their position in the body while there are stated only under the mother term *Musculi membri superioris/inferioris*—***musculus abductor digiti minimi manus*** and ***musculus abductor digiti minimi pedis*** (as already stated by Lobo in 2011 [31]).

Facet is a well-established anatomical term in English, but it lacks its Latin counterpart in the TA. Sometimes it is applied for the whole articular surface (*facies articularis* in Latin), but sometimes only to its part (no Latin term). Facets of composed articular surfaces, which are separated with a crest (or some other bony structure), and situated in a bit different planes (with a various degree of angle) should be termed with a diminutive of the term *facies*—***faciecula***. *Facies articularis tibialis superior* is composed of two facets for *condylus medialis femoris et condylus lateralis femoris*, i.e. of oval shaped ***faciecula medialis*** and of round shaped ***faciecula lateralis***; *facies articularis carpalis (radii)* consisting of the ***faciecula scaphoidea*** for the *os scaphoideum* and ***faciecula lunata*** for the *os lunatum*; *facies articularis patellae* comprising the smaller ***faciecula medialis*** and larger ***faciecula lateralis*** [22].

Clinicians sometimes use terms different from the anatomical nomenclature, but some of them have no synonyms in the TA. These discrepancies can be solved by a close cooperation of anatomist and FIPAT with clinicians and their scientific societies. The pilot field already producing good results is phlebology. International Union of Phlebologists issued (in cooperation with IFAA and FICAT), two consensus documents extending the anatomical nomenclature of superficial and deep venous systems of the lower limb in 2002 [3, 23–25], and that of the pelvic venous system [4, 26, 45]. But, not every change was precise and perfect as can be proved on the term *extensio cranialis venae saphenae parvae* (introduced instead of "vena femoropoplitea"). The adjective *cranialis* is inaccurate because it determines the superior direction in the trunk and head, but not in the limbs (the precise term should be ***extensio proximalis venae saphenae parvae***). This complex term was first mentioned (in English) in 2003 by Georgiev without any further terminological remarks [11].

Another concept, introduced by the IUP proposal regarding the veins of the lower limbs [1, 2, 17, 18] introduced the innovative concept of a three-layered architecture of the venous system of the lower limbs (deep, saphenous and superficial veins). This three-layered model was recently proposed for the upper limb as well [46].

All the other branches of medicine are not so active and many clinical terms used everyday should be incorporated in TA. One term has to be kept in mind and explained in detail repetitively: the "perforator". In clinical medicine, it is used to determine two different structures, either a *vena perforans*, which connects the superficial and deep venous system of a limb and perforates the fascia (its clinical relevance consists in the venous reflux and treatment of varices of lower limbs); or an arterial perforator feeding an angiosome (its clinical relevance consists in usage as a pedicle for various types of flaps in reconstructive surgery). However, they may not be mixed with the *arteria perforans prima, secunda et tertia* of thigh (branches of *arteria profunda femoris*), or with the *ramus perforans arteriae fibularis* located in the distal part of the leg. This tricky part of the terminology is officially only half-processed. The nomenclature of the venous perforators (*venae perforantes*) was codified and published in 2005 [4], but the nomenclature of the arterial perforators does not exist at all.

The following terms are proposed to be incorporated into the TA. Few of them have been proposed (marked with asterisk) in our previous article or in articles published by other authors, usually aimed only to the structure involved. They are stated only to summarize the missing and neglected structures, and it is useful to mention them. If the anatomy of the structure is well known or it is mentioned in any edition of the Gray's anatomy, the authors do not consider necessary to add a citation. To be short and consistent, only terms from the chapter *Anatomia generalis* are discussed.

Nomenclature concerning general anatomy

The chapter misses several terms, especially those concerning the anatomical regions, lines and flexion grooves. ***Sulcus inguinalis****** is a flexion groove formed superficially to the *ligamentum inguinale* and serves as a border between *regio inguinalis* and *regio femoris anterior* and as the ventral border between the abdomen and lower limb. The popliteal flexion groove is located on the posterior aspect of the *fossa poplitea*. But, in Latin it is necessary to distinguish it from the *sulcus popliteus* which is a bony groove on the *condylus lateralis femoris*. The judicious solution

can be to apply the term ***sulcus popliteus*** to the flexion groove to be first consistent with other flexion grooves and second due to more frequent usage of this term generally. The bony groove (A02.5.04.026) on the *condylus lateralis femoris* serving for the origin of the *musculus popliteus* can be then termed as ***sulcus tendinis musculi poplitei***, following the example of, e.g. *sulcus tendinis musculi fibularis*.

A general term describing a neurovascular bundle, composed of a nerve accompanied by an artery and one or two veins, can be ***fasciculus*** **vasonervosus**. Such bundle is usually veiled in a common fibrous sheath, either distinct (e.g. *vagina carotica, vagina femoralis*) or discrete. Such bundle can contain either homonymous structures (e.g. *nervus obturatorius et vasa obturatoria*) or heteronymous ones (e.g. *nervus fibularis profundus et vasa tibialia anteriora*). The interior space of the skull—*cavitas cranii*—is divided by an incomplete septum—*tentorium cerebelli*—into two spaces, which can be termed *compartimentum supratentoriale et infratentoriale*. This division is useful not only from the anatomical point of view, but also from the pathological one due to different incidence of brain tumours in childhood (located mainly infratentorially) and adulthood (located mainly supratentorially). It should be practical for anatomy education to distinguish between the compound and complex joint in the TA. Now, both terms are summarized under the term *articulatio composita* (complex joint). The compound (composite) joint is a type of synovial joint in which more than two bones are involved (there are three or more articulation surfaces), the complex joint is a type of synovial joint in which at least two bones as well as an articular disc or meniscus are involved. But, there are no Latin terms to differentiate them, as, e.g. ***articulatio composita ossea et osseofibrosa***.

Some basic descriptive anatomical regions are missing, for example:

- on the neck
  - ***regio sublingualis*** (between *musculus mylohyoideus* and lingual mucosa)
  - ***regio hyoidea*** (in the extent of hyoid bone)
  - ***regio infraclavicularis*** (below clavicle)
  - ***jugulum*** **(*fossa jugularis suprasternalis*)** which is a large, visible dip on surface of the lower third of *regio cervicalis anterior*, at the superior border of the *manubrium sterni*, between the origins of both *musculi sternocleidomastoidei*.
- on the abdomen
  - ***fossa epigastrica*** is a depression, visible on surface in the midline just below the sternum.
  - to complete the terms *epigastrium* and *hypogastrium*, **mesogastrium** should be added for a region comprising the unpaired *regio umbilicalis* and paired *regio lateralis.*
  - a depression of skin in *regio umbilicalis* in the extent of underlying *anulus umbilicalis* can be termed ***fossa umbilicalis superficialis*** or if protruding from the surface, as ***papilla umbilicalis***. Its internal counterpart, depression of parietal peritoneum can be termed ***fossa umbilicalis profunda*** in corresponding way.
- on the back
  - a sagittally symmetrical dimple just superior to *crena analis* is located directly superficial to *articulatio sacroiliaca*. It is formed by *retinacula cutis*, attached to *spina iliaca posterior superior* and is often called fossa of Venus and should be termed ***fossa lumbalis lateralis***.

The lines are important arbitrary structures which are very useful in locating the deeply situated structures and finding the corresponding spots on the body surface:

- ***sulcus inframammarius*** or ***plica inframammaria*** describes the caudal boundary of breast (the difference between *sulcus* and *plica* depends on the prominence of this feature).
- transverse lines encompass:
  - ***linea xiphosternalis*** courses through the *symphysis xiphosternalis* serving to determine the approximate position of the diaphragm vault (i.e. the deep border between thorax and abdomen)
  - ***linea subcostalis*** between *tubercula costoabdominalia*
  - ***linea transpylorica*** (of Addison) is projection of a plane, located halfway between *incisura jugularis sterni* and cranial border of *symphysis pubica* which is in most cases defined by following points: the pylorus of stomach, the tips of *cartilagines costales nonae* (ninth costal cartilages) and the caudal margin of *vertebra lumbalis prima*
  - ***linea interspinosa*** between the *spinae iliacae superiores anteriores*
  - ***linea intercristalis*** between the tips of *cristae iliacae*.

The last two can serve to measure the outer pelvic dimensions for obstetrical purposes and in that case can be denominated as ***conjugata interspinosa*** and ***conjugata intercristalis***; similarly, ***conjugata intertrochanterica*** can be added as a distance between the outer margins of both *trochanteres majores*.

- oblique lines include:
  - ***linea costoarticularis*** between *articulatio sternoclavicularis* and the tip of *costa undecima* (eleventh rib)
  - ***linea axilloumbilicalis dextra*** from the apex of the right axilla to the umbilicus (serves for determining of *punctum pancreaticum* (of Desjardin), located 6–7 cm cranially to the umbilicus for projection of *papilla duodeni major*)
  - ***linea spinoumbilicalis dextra*** (of Monro) between umbilicus and *spina iliaca anterior superior dextra* (serves for determining of the beginning of *appendix vermiformis,* located 6–7 cm from the spine).

Nomenclature concerning anatomical variations

A very important part of both the education and research in anatomy as well as concerning the relevance in the clinical medicine is the variant anatomy. Anomalies and abnormalities of the human body which are not considered as serious defects of the development that means that they do not impair the function, are considered as variants (variable/variant structures). The TA contains 149 terms of variant structures enlisted in the parentheses to differentiate them from constant ones. The TA contents are only a rather representative selection, some more should be added, both from the educational and clinical point of view. Of course, not every variant can be a part of the TA and a separate nomenclature on the anatomical variants should be taken into account. There is a list of few relevant ones: ***caput accessorium*** is a common term for any accessory head of the limb muscles, e.g. *musculus biceps brachii, musculus triceps brachii, musculus pronator teres*, etc. ***Arteria cilioretinalis****** is a variant artery, branching from *arteria ciliaris posterior brevis* and exiting the *discus nervi optici* independently on *arteria centralis retinae*, usually on its lateral (temporal) side. It serves as an additional supply to the retina and mainly to the *macula lutea* from choroidal circulation, its supplies the whole thickness of the retina and its incidence is about 10–30 % of cases [32]. It can spare central vision and *macula lutea* in case of the occlusion of *arteria centralis retinae*.

The arterial supply of the kidney is very often doubled. It this case it is necessary to distinguish the accessory and aberrant arteries. In general, an accessory artery is a doubled artery supplying the same organ and having the same source vessel (a very close origin spot and entry point of the organ); an aberrant artery is an artery supplying the same organ, but coursing differently and originating from a different source vessels (not a very close or different origin spot and entry point of the organ). Accessory aberrant artery expresses both these characteristics. *Arteria renalis accessoria* is a branch of the *aorta abdominalis* and enter the *hilum renale* to supply usually one segment independently. *Arteria renalis accessoria aberrans* is a branch of the *aorta abdominalis* as well, but in enters the *polus inferior/superior ("polar artery").* The incidence of the *arteria renalis accessoria* is reported in many studies, but the average number is approximately 28 % [7, 44].

Arteria subclavia dextra aberrans is the *arteria subclavia dextra* branching as the last branch from the *arcus aorta*e, left to the origin of the *arteria subclavia sinistra*, and coursing across the midline to the right side. It may run not only between the oesophagus and the vertebral column (hence termed the retro-oesophageal right subclavian artery/RRESA/ in clinical medicine and found in about 80 % of such cases), but also between the trachea and the oesophagus (in 15 %) or even in front of the trachea (5 %). In two first cases it can compress the oesophagus and may cause swallowing problems known as dysphagia lusoria, that is why in positive clinical symptoms the vessel can be also termed arteria lusoria [8, 30, 39, 41].

Truncus profundocircumflexus posterior is a short common trunk, for the *arteria profunda brachii* and *arteria circumflexa humeri posterior*, coursing below the fused insertional tendon of the *musculus teres major et musculus latissimus dorsi*; its incidence is about 9 % [27, 29]. It has to be distinguished from similar trunks of the lower limb arteries—*truncus profundocircumflexus medialis et lateralis*, giving the *arteria profunda femoris* and the *arteria circumflexa femoris medialis*, or *lateralis*, respectively.

Tuberculum deltoideum* is a variable tuberosity on the ventrocranial surface of *extremitas acromialis claviculae*, serving as an insertion point for *pars clavicularis musculi deltoidei*. ***Arcus axillaris*** (of Langer) is a variant muscular or fibromuscular slip extending from *musculus latissimus dorsi* to the tendons, muscles or fasciae of the proximal part of the humerus. Its incidence is less than in 10 % of cases [40]. Frequently is the *arcus axillaris* joined by another variant, ***musculus pectoralis quartus***, usually originating near the costochondral junction of the fifth and sixth ribs, coursing laterally along the border of *musculus pectoralis major* (separately from it), crossing the axilla and inserting on or near the deep surface of the tendon of *musculus pectoralis major* [2]. Another variant, ***musculus thoracoepitrochlearis*** ("musculus chondroepitrochlearis; musculus costoepitrochlearis; musculus chondrohumeralis") can originate from different spots of the thoracic wall (*musculus pectoralis major*, costal cartilages, *aponeurosis musculi obliquii externi abdominis*), crossing the axilla, and inserting to different spots as well (*septum intermusculare brachii mediale, epicondylus medialis humeri, fascia brachii, facies ventromedialis humeri*). The incidence is

very low (less than 30 cases in last 200 years) and the clinical manifestation various (from movement reduction to entrapment of the *nervus ulnaris*) [33]. Similar variant can occur on the dorsomedial aspect, termed ***musculus dorsoepitrochlearis*** ("musculus latissimocondylaris, musculus latissimocondyloideus; musculus coracocondylaris; musculus coracocondyloideus; musculus glenotricipitalis; musculus triceps accessorius; caput quartum/quintum musculi tricipitis brachii") originating from the ventrocaudal border of the *musculus latissimus dorsi*, crossing the axilla, and inserting to very different spots (*septum intermusculare brachii mediale, epicondylus medialis humeri, epicondylus lateralis humeri, facies ventrolateralis humeri, olecranon, caput longum musculi tricipitis brachii, fascia brachii, fascia antebrachii*). The incidence is higher, reported in 2–5 % of cases [1, 13, 38].

Fabella is a small sesamoid bone embedded within the lateral margin of tendon of *caput laterale musculi gastrocnemii* behind the *condylus lateralis femoris*, present in humans as cartilage in 50–90 %, but as X-ray contrast bone in only 10 % of cases. And finally, as an example of a group of the related variants, the upper limb arterial trunks are discussed. The only one included in the TA is the *arteria brachioradialis*. Its subtype, the ***arteria brachioradialis superficialis*** is the most frequent variant of the upper limb arterial trunks (14 %). The nomenclature of these variants was proposed in English by Rodríguez-Niedeführ et al. [43]. The Latin terms have been applied only in individual articles, e.g. ***arteria brachialis superficialis, arteria brachialis accessoria, arteria brachioulnaris et brachioulnaris superficialis, arteria brachiomediana superficialis***, ***arteria brachioulnoradialis et brachioulnoradialis superficialis***, etc. [5, 6, 14, 17–21, 28, 37].

Discussion

The terminology and nomenclature are an ever-lasting problem, but thanks to the effort of all the commissions working from 1895 the goal is approached consistently. The officially valid Latin anatomical nomenclature is a gold standard in the description of any morphological structure or unit. Unfortunately, we have no such standard in our main communication language—the English. Although the TA contains a list of English terms, it is a mere list of the most used synonyms and not a valid and obligatory list of official English anatomical nomenclature. This state causes an infestation of both anatomical and clinical literature with many synonyms—old, obsolete, inexact, redundant, abundant—which can be a source of confusion not only for students, laymen and non-English native speakers, but also for the medical specialists. The hugest goal to be achieved is to convince the AAA, AACA, BACA, ANZACA, IFAA and other scientific societies to solve this problem [34, 35].

As for the Latin anatomical nomenclature, few articles have been published on its general aspects and some more on individual structures and their denomination—for details, see our previous work [22].

The anatomical terminology features some differences in systemic, topographic and clinical anatomy. That of the systemic anatomy is principally identical with the anatomical nomenclature, of course there are synonyms and obsolete terms often used, e.g. "epiphysis" or "conarium" for *glandula pinealis*, the problem which can be traced back to history as proved by Eycleshymer [9]. The topographic anatomy is a "Cinderella" among the subfields of the anatomy concerning the amount of terms incorporated into the TA. Many terms denominating anatomical canals and triangles, especially in the limbs, are missing, e.g. *canalis pronatorius, canalis cubitalis, canalis supinatorius, trigonum humerotricipitale, trigonum omotricipitale*, etc. The clinical anatomy terminology often uses terms which are not even mentioned in anatomical textbooks or atlases, but are of significant clinical relevance and belong to the basic knowledge of the specialist in the involved medical branch, e.*g. retinaculum femoris anterius, mediale et laterale* (of Weitbrecht), the synovial folds of the articular capsule of *articulatio coxae*, or *tuberculum vastoadductorium** ("tuberculum innominatum"), a projecting distal end of the *trochanter major femoris*, serving for the origin of the *musculus vastus medialis* and for the insertion of the *musculus gluteus medius*. Further derivation into the clinical terminology concerns, e.g. the dysphagia lusoria, mentioned above, or the nutcracker syndrome as a clinical manifestation of the nutcracker phenomenon which denomination comes from the X-ray image of the compression of the left renal vein between the abdominal aorta and superior mesenteric artery [both arteries appear to be a nutcracker crushing a nut (the vein)]. A more anatomically appropriate term can be the renal vein entrapment syndrome or mesoaortic entrapment/compression of the left renal vein [42].

There is an imposing question whether the anatomists are able to persuade clinicians to pay attention to the anatomical nomenclature, to adhere to it and accept active role in its amelioration and extension. One of the remedies can be a list of clinical synonyms listed in the TA, but still only one term should be approved as the official one for oral and written usage. This way of arrangement can serve both for the students and young physicians who are not well oriented in the specific medical field and its detailed anatomy as well as for the information retrieval specialists.

The variant anatomy is a special large subfield which terminology and nomenclature belong among the most neglected ones. Many variant structures possess more

synonyms and any terminological rules have been neither proposed nor officially approved. 149 terms is a choice made by FCAT in 1998, but no rule of this choice is mentioned in the preface, although we can suppose that these structures are the most common variants and the most striking ones, e.g. *sutura frontalis persistens*, *costa cervicalis, musculus psoas minor, ductus thyroglossalis*, *diverticulum ilei, lobus pyramidalis glandulae thyroideae*, etc. This topic goes far beyond the intention and extent of this article, but in future deep attention should be paid to propose rules for the codification of variant anatomical nomenclature.

The last, but not the least part of any nomenclature is eponyms. They have not been considered as a part of the official Latin anatomical nomenclature since 1955 (PNA), except those, converted into true Latin terms. The TA contains a list of 362 eponyms at the index chapter only serving for better orientation in searching for the proper term. Although the consensus documents of the venous structures of the lower limb and pelvis terminology proposed three eponyms ("vena Giacomini", "venae perforantes Cocketti", "plexus Santorini") to be an integrated part of the nomenclature, to be consistent with general rule, all these should be replaced with their Latin equivalents within the body of the TA [3, 23, 24, 26, 47]. Preferred eponyms should be listed only in the index (or special appendix) and each structure should bear firstly its Latin non-eponymic term. This state is not kept in case of "vena Giacomini" which completely lacks its Latin term.

Conclusion

The TA should become a powerful tool in communication not only between all anatomists around the world, but also between the anatomists and clinicians. To reach this aim, two activities are necessary to be started. First, every anatomist should with her/his knowledge and results of the research contribute to amelioration of the TA. Second, an extensive advertisement and discussion should be evoked between anatomists and clinicians to meet the needs of both the theoretical science and the practical use and relevance of the terms. Otherwise the TA will be a mere list of arbitrary terms reflected only by official authorities and keen anatomists and journal editors without broader impact on the medical community.

Acknowledgments The authors thank Miroslava Plecitá for help in obtaining the cited articles. The study was supported by the Charles University, Project PRVOUK # 33.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest and no financial interests.

References

1. Bergman RA, Afifi AK, Miyauchi R (2015) Opus II: Cardiovascular system: arteries: upper limb. In: Illustrated encyclopedia of human anatomic variation; 1992–2004. http://www.anatomyatlases.org/AnatomicVariants/MuscularSystem/Alphabetical/MuscleListing.shtml. Accessed Dec 2015
2. Bonastre V, Rodríguez-Niedenführ M, Choi D, Sañudo JR (2002) Coexistence of a pectoralis quartus muscle and an unusual axillary arch: case report and review. Clin Anat 15:366–370
3. Caggiati A, Bergan JJ, Gloviczki P, Eklof B, Allegra C, Partsch H (2005) Nomenclature of the veins of the lower limb: extensions, refinements, and clinical application. J Vasc Surg 41:719–724
4. Caggiati A, Bergan JJ, Gloviczki P, Jantet G, Wendell-Smith CCP, Partsch H (2002) Nomenclature of the veins of the lower limbs: an international interdisciplinary consensus statement. J Vasc Surg 36:416–422. doi:10.1067/mva.2002.125847
5. Casal D, Pais D, Toscano T, Bilhim T, Rodrigues L, Figueiredo I, Aradio S, Angélica-Almeida M, Goyri-O'Neill J (2012) A rare variant of the ulnar artery with important clinical implications: a case report. BMC Res Notes 5:660. doi:10.1186/1756-0500-5-660
6. Chakravarthi KK, Siddaraju KS, Venumadhav N, Sharma A, Kumar N (2014) Anatomical variations of brachial artery—its morphology, embryogenesis and clinical implications. J Clin Diagn Res 8:AC17–AC20. doi:10.7860/JCDR/2014/10418.5308
7. Daescu E, Jianu AM, Motoc A, Niculescu MC, Rusu MC (2010) The renal polar arteries—anatomical considerations. Med Evol 16:11–15
8. de Araújo G, Junqueira Bizzi JW, Muller J, Cavazzola LT (2015) "Dysphagia lusoria"—right subclavian retroesophageal artery causing intermitent esophageal compression and eventual dysphagia—a case report and literature review. Int J Surg Case Rep 10:32–34
9. Eycleshymer CE (1917) Anatomical names: especially the Basle Nomina Anatomica ("BNA"). William Wood & Company, New York
10. FCAT (1998) Terminologia anatomica. Thieme Verlag, Stuttgart
11. Georgiev M, Myers KA, Belcaro G (2003) The thigh extension of the lesser saphenous vein: from Giacomini's observations to ultrasound scan imaging. J Vasc Surg 37:558–563
12. Gobée OP, Jansma D, DeRuiter MC (2011) Anatomical terms info: heading for an online solution to the anatomical synonym problem hurdles in data-reuse from the Terminologia Anatomica and the foundational model of anatomy and potentials for future development. Clin Anat 24(7):817–830. doi:10.1002/ca.21185
13. Haninec P, Tomás R, Kaiser R, Cihák R (2009) Development and clinical significance of the musculus dorsoepitrochlearis in men. Clin Anat 22:481–488
14. Hong T, Qiuhong D, Haipeng C (2010) Brachioradial arteries with anastomotic arteries connecting to brachial arteries bilaterally. Hell J Cardiol 51:358–361
15. Kachlik D, Baca V, Bozdechova I, Cech P, Musil V (2008) Anatomical terminology and nomenclature: past, presence and highlights. Surg Radiol Anat 30:459–466. doi:10.1007/s00276-008-0357-y
16. Kachlik D, Bozdechova I, Cech P, Musil V, Baca V (2009) Mistakes in the usage of anatomical terminology in clinical practice. Biomed Pap 153:157–162
17. Kachlik D, Hajek P, Konarik M, Krchov M, Baca V (2015) Coincidence of superficial brachiomedian artery and bitendinous palmaris longus—a case report. Surg Radiol Anat. doi:10.1007/s00276-015-1512-x
18. Kachlik D, Konarik M, Baca V (2011) Vascular patterns of upper limb: an anatomical study with accent on superficial brachial artery. Bosn J Basic Med Sci 11:4–10

19. Kachlik D, Konarik M, Hajek P (2011) A case of a double variant of the arterial system in the upper extremity: arteria brachialis accessoria et Arteria comitans nervi mediani. Arch Biol Sci 63:641–648. doi:10.2298/ABS1103641K
20. Kachlik D, Konarik M, Riedlova J, Baca V (2015) Arteria brachiomediana revisited. Bosn J Basic Med Sci, in press
21. Kachlik D, Konarik M, Urban M, Baca V (2011) Accessory brachial artery: a case report, embryological background and clinical relevance. Asian Biomed 5:151–155. doi:10.5372/1905-7415.0501.019
22. Kachlik D, Musil V, Baca V (2015) Terminologia Anatomica after 17 years: inconsistencies, mistakes and new proposals. Ann Anat 201:8–16. doi:10.1016/j.aanat.2015.04.006
23. Kachlik D, Pechacek V, Baca V, Musil V (2010) The superficial venous system of the lower extremity—new nomenclature. Phlebology 25:113–123. doi:10.1258/phleb.2009.009046
24. Kachlik D, Pechacek V, Musil V, Baca V (2010) Information on the changes in the revised anatomical nomenclature of the lower limb veins. Biomed Pap 154:1–6
25. Kachlik D, Pechacek V, Musil V, Baca V (2010) The venous system of the pelvis—new nomenclature. Phlebology 25:162–173. doi:10.1258/phleb.2010.010006
26. Kachlik D, Pechacek V, Musil V, Baca V (2012) The deep venous system of the lower extremity—new nomenclature. Phlebology 27:48–58. doi:10.1258/phleb.2011.010081
27. Konarik M, Kachlik D, Baca V (2014) A coincidental variation of the axillary artery: the brachioradial artery and the aberrant posterior humeral circumflex artery passing under the tendon of the latissimus dorsi muscle. Bosn J Basic Med Sci 14:239–243. doi:10.17305/bjbms.2014.4.31
28. Konarik M, Knize J, Baca V, Kachlik D (2009) Superficial brachioradial artery (radial artery originating from the axillary artery): a case-report and its embryological background. Folia Morphol (Warsz) 68:174–178
29. Konarik M, Knize J, Baca V, Kachlik D (2009) The posterior circumflex humeral artery turning under the tendon of the latissimus dorsi: a case report. Eur J Anat 13:91–95
30. Kopp R, Wizgall I, Kreuzer E, Meimarakis G, Weidenhagen R, Kühnl A, Conrad C, Jauch KW, Lauterjung L (2007) Surgical and endovascular treatment of symptomatic aberrant right subclavian artery (arteria lusoria). Vascular 15:84–91
31. Lobo SW, Menezes RG (2011) Abductor digiti minimi: why is the name the same for both hand and foot muscles? Clin Anat 24:273–274. doi:10.1002/ca.21105
32. Lorentzen SE (1970) Incidence of cilioretinal arteries. Acta Ophthalmol (Copenh) 48:518–524
33. Loukas M, Louis RG Jr, Kwiatkowska M (2005) Chondroepitrochlearis muscle, a case report and a suggested revision of the current nomenclature. Surg Radiol Anat 27:354–356
34. Martin BD, Thorpe D, Barnes R, Deleon M, Hill D (2009) Frequency in usage of FCAT-approved anatomical terms by North American anatomists. Anat Sci Educ 2:94–106. doi:10.1002/ase.83
35. Martin BD, Thorpe D, Merenda V, Finch B, Anderson-Smith W, Consiglio-Lahti Z (2010) Contrast in usage of FCAT-approved anatomical terminology between members of two anatomy associations in North America. Anat Sci Educ 3:25–32. doi:10.1002/ase.114
36. Musil V, Suchomel Z, Malinova P, Stingl J, Vlcek M, Vacha M (2015) The history of Latin terminology of human skeletal muscles (from Vesalius to the present). Surg Radiol Anat 37:33–41. doi:10.1007/s00276-014-1305-7
37. Natsis K, Papadopoulou AL, Paraskevas G, Totlis T, Tsikaras P (2006) High origin of a superficial ulnar artery arising from the axillary artery: anatomy, embryology, clinical significance and a review of the literature. Folia Morphol (Warsz) 65:400–405
38. Natsis K, Totlis T, Vlasis K, Sofidis G, Lazaridis N, Tsitouridis I (2012) Dorsoepitrochlearis muscle: an unknown cause of shoulder motion limitation and axilla deformity. J Orthop Sci 17:186–188
39. Natsis K, Tsitouridis I, Didagelos M, Fillipidis A, Vlasis K, Tsikaras P (2015) Anatomical variations in the branches of the human aortic arch in 633 angiographies: clinical significance and literature review. Surg Radiol Anat 31:319–323
40. Pai MM, Rajanigandha Prabhu LV, Shetty P, Narayana K (2006) Axillary arch (Of Langer): incidence, innervation, importance. Online J Health Allied Sci 1:1–4
41. Polguj M, Chrzanowski Ł, Kasprzak JD, Stefańczyk L, Topol M, Majos A (2014) The Aberrant Right Subclavian Artery (Arteria Lusoria): the morphological and clinical aspects of one of the most important variations—a systematic study of 141 reports. The Sci World J 2014:292734. doi:10.1155/2014/292734
42. Polguj M, Topol M, Majos A (2013) An unusual case of left venous renal entrapment syndrome—a new type of nutcracker phenomenon? Surg Rad Anat 35:263–267
43. Rodríguez-Niedenführ M, Vázquez T, Parkin IG, Sañudo JR (2003) Arterial patterns of the human upper limb: update of anatomical variations and embryological development. Eur J Anat 7:21–28
44. Satyapal KS, Haffejee AA, Singh B, Ramsaroop L, Robbs JV, Kalideen JM (2001) Additional renal arteries: incidence and morphometry. Surg Radiol Anat 23:33–38
45. Thiagarajah R, Venkatanarasimha N, Freeman S (2011) Use of the term "superficial femoral vein" in ultrasound. J Clin Ultrasound 39:32–34. doi:10.1002/jcu.20747
46. Tourani SS, Taylor GI, Ashton MW (2014) Understanding the three-dimensional anatomy of the superficial lymphatics of the limbs. Plast Reconstr Surg 134:1065–1074
47. Woerdeman MW (1957) Nomina anatomica parisienssia (1955) et BNA (1895). Ossthoek, Utrecht