

Pořízková, Kateřina

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KATEŘINA POŘÍZKOVÁ
(LANGUAGE CENTRE, MASARYK UNIVERSITY, BRNO)

URACHUS IN MEDICINE: WHAT IS THE MOTIVATION OF THIS TERM?

*It is generally assumed that technical terminology reflects the memory of a scientific branch and via its development it becomes, as a rule, more precise. One of the peculiarities of such terminology from the semantic point of view is the relation between the original meaning of technical terms and their present-day pragmatic interpretation. This article focuses on the medical term *urachus* and its original motivation in comparison with incorrect etymological interpretation in contemporary medical lexica. The research is based on excerpts of the semantic usage of the *urachus* and its typical collocations found in treatises of Ancient Greek authors.*

Keywords: *Urachus*, Medical Collocation Terms, Medical Terminology

The aim of this paper is to clarify the motivation of the medical term *urachus*, which is currently used in two fields of medicine. In embryology, it is used to denote the link between the extraembryonic pouch called allantois and the cranial part *sinus urogenitalis* – a structure involved in the development of the urinary bladder, which is fully closed before the birth of the child and its remnant in people after birth is called *ligamentum umbilicale medianum*. Another field which uses this term is clinical medicine. Specifically, paediatric surgery uses the two-word term *urachus persistens* for a medical condition when the *urachus* does not fully close and a fistula is created between the urinary bladder and skin; cysts may also be present. This paper was motivated above all by the inaccurate translations of the term *urachus* in some renowned medical publications, which are probably related to a faulty etymological interpretation.

As regards the general concepts of term and terminology, this paper is based mainly on the works by I. Bozděchová (2009) and F. Čermák (2010). For the purposes of this paper, term means a lexical unit (lexeme), which

represents an unambiguous, semantically precise and clearly defined name for an object in a specific discipline. For terms consisting of more words, the name *collocation term* is used (in accordance with Bozděchová's conception¹). Furthermore, the paper consistently distinguishes *terminology*, as a set of terms used in a specific field, and *nomenclature*, that is, codified and systematically organised terms within a field. Medicine is a discipline in which this distinction can be easily illustrated, because some – especially theoretical – fields have binding terms (anatomical, histological, embryological nomenclature), while others (e.g. in the clinical area) take advantage of platforms, the usage of which is ambiguous both within and outside the particular field and on many levels, including the international level (clinical terminology). If a term is called motivated in this paper, it means that the meaning of the appellation may be fully or partially derived from its form.²

The term *urachus* is established in the embryological nomenclature³ within the urinary system (*systema urinarium*) and may also be found in the subsystem of the urinary bladder (*vesica urinaria*). This connection might suggest that from the etymological point of view, *urachus* is connected with the Greek expression τὸ οὔρον (meaning “urine”). The Canadian anatomist A.H Skinner, for example, explains this term in *The Origin of Medical Terms* (1961) as arising from the words τὸ οὔρον (“urine”) and ἔχειν (“to have, to hold”). However, such interpretation contradicts the interpretations offered by the etymological dictionaries of Ancient Greek. H. Frisk (1970) derives the origin of the word *urachus* from οὐρά + -αχός, meaning “projecting tip” or “point”, such as of the heart, eyebrows, or a stalk (similarly P. Chantraine: 1968-). E. Marcovecchio (1993) also points out the implausibility of the interpretations of some modern etymological dictionaries, which connect the term *urachus* with the words οὔρον and χέω, and is more supportive of the interpretations by H. Frisk and P. Chantrain.

In the Ancient literature written in Greek,⁴ altogether 25 instances of this word may be found, and the Ancient authors interpret its meaning in different ways:

¹ BOZDĚCHOVÁ (2009: 11, 189).

² This study is concerned with semasiological and onomasiological motivation. More details about types of motivation may be found in FILIPEČ – ČERMÁK (1985).

³ *Terminologia Embryologica: International Anatomical Terminology*. (FIPAT, 2013).

⁴ The texts of Ancient Greek authors used in this article were taken from *Thesaurus Linguae Graecae (A Digital Library of Greek Literature)*. [Database online] 2001. Irvine: University of California. Available from URL: <http://www.phil.muni.cz/wlap/>.

a) it is a foetal organ connected with the urinary bladder; in this meaning, which basically corresponds with the current conception of this word in embryology, it is most often used by Galen, who describes *urachus* in the embryo as a link between the urinary bladder (κύστις) and the allantoic sac (άλλαντοειδής χιτών). It lies in the middle among four cavities (άγγεϊα) in the navel (όμφαλός) and its expansion gives rise to the hymen (*De uteri dissectione*, 2, 907, 6–13):

οὐδὲ γάρ οὐδὲ ἄλλο τί ἐστὶν ὁ ὀμφαλός ἀλλ' ἢ τὰ τέτταρα ἄγγεϊα, μέσον αὐτῶν ἔχοντα τὸν οὐραχόν. οὗτος δὲ ἐστὶν ἀρχὴ τοῦ ἄλλαντοειδοῦς χιτῶνος, ὃν ἐπικεῖσθαι κατὰ τὰ ἐξέχοντα τοῦ ἐλέγομεν. συντέρηταί τε εἰς τὸν πυθμένα τῆς κύστεως τοῦ ἐμβρύου εὐρεῖ καὶ ἀξιολόγῳ πόρῳ, ὥστε εἶναι ἔνωσιν τῇ κύστει πρὸς τὸν ἄλλαντοειδῆ χιτῶνα διὰ τοῦ οὐραχοῦ, μεταξύ ἄμφοιν κειμένου. καθ' ὃ δὲ πρῶτον ἀνευρνομένου τοῦ οὐραχοῦ ἀποφύεται ὁ ὕμην,...

Galen defines the *urachus* in a similar way in *De usu partium* (4, 231, 5–10): “there are four cavities in the navel (άγγεϊα), which are represented by two arteries (ἀρτηρία) and two veins (φλέβες). In the middle among them is the *urachus*; that is how the anatomists usually describe the way (πόρος) from the base (πυθμῆν) of the urinary bladder, through which the urine flows to the allantoic sac (άλλαντοειδής ὕμην)”:

Τέτταρα τοίνυν ἐστὶ τὰ προειρημένα κατὰ τὸν ὀμφαλὸν ἄγγεϊα, δύο μὲν ἀρτηρία, δύο δὲ φλέβες, μέσον ἐαυτῶν ἔχοντα τὸν οὐραχόν· οὕτω γὰρ ὀνομάζειν ἔθος τοῖς ἀνατομικοῖς τὸν ἐκ τοῦ πυθμένος τῆς κύστεως πόρον ἐξοχετεύοντα τὸ οὖρον εἰς τὸν ὀλίγον ἔμπροσθεν εἰρημένον ὕμηνον τὸν ἄλλαντοειδῆ.

In another part of the same treatise (*De usu partium*, 4, 240, 7–12) Galen⁵ mentions straightness of the *urachus* in comparison with curvation of neck

⁵ See also Galen, *De fetuum formatione libellus* 4, 657, 4–9: ...καὶ τούτου πάνυ πολλὰκις αὐταῖς συμβάντος, εἰς δύο μὲν ἀρτηρίας, δύο δὲ φλέβας ἢ πάντων τῶν κατὰ μέρος ἀγγείων κεφαλαιοῦται σύνοδος, ὧν ἐν τῷ μεταξύ γεννᾶται τις πόρος εἰς τὸν πυθμένα τῆς κύστεως τοῦ κυουμένου συντετημένος, ὃν οἱ δεινοὶ περὶ τὰς ἀνατομὰς ὀνόμασαν οὐραχόν... Also Galen, *De libris propriis liber*, 19, 26, 5; Pseudo-Galenus *Definitiones medicae* 19, 454, 16). The medical Pseudo-Galenic treatises contain a further explanations: ...καὶ ἀπὸ τῶν νεύρων νεῦρον ἐν συνελθόντα ἀποτελεῖ τὸν οὐραχόν, ὃς ἐμβάλλει εἰς τοῦ ἐμβρύου τὸν ὀμφαλόν... (*Introductio seu medicus*, 14, 719, 17); ...ἐκ τε τοῦ γόνου καὶ τοῦ παρὰ τῆς μητρὸς ἐπιρρέοντος αἵματος διὰ τοῦ οὐραχοῦ ἢ σύστασις γίνεται τοῦ τικτομένου... *Ibidem*, 14, 696, 11); ...τό τε γὰρ μηκῶνιον καλούμενον περίττωμα [ὄν] ἐξ ὅλης τῆς τοῦ ἐμβρύου τροφῆς ἐστὶν καὶ τὸ ἐν τῷ οὐραχῷ ὑγρόν. (*An animal sit quod est in utero*, 19, 176, 5). Furthermore see Ruphus Medicus, *De corporis humani appellationibus*, 232, 2; Orbasius, *Collectiones medicae (libri incerti)* 15, 9, 3; Aetius Medicus, *Iatricorum liber XVI* 3, 45; Theophilus Protospatharius, *De corporis humani fabrica libri quinque* 5, 19, 28.

of the urinary bladder and the fact that *urachus* is not externally controlled by any muscle that would prevent accidental outflow of excess liquid. In other words, he does not link *urachus* with urine:

σκολιὸς μὲν γὰρ ἰκανῶς ὁ τῆς κύστεως αὐχὴν, εὐθύς δ' ἀκριβῶς ὁ οὐραχός,...., μὴ δ' οὐδεὶς ἐξῶθεν περιβέβληται τῷ οὐραχῷ φύλαξ τῆς ἀκαίρου τῶν περιττωμάτων ἐκροῆς,...

Two synonymous terms denoting the anatomical structure in question are used by Soranus from Ephesus. Besides the term *urachus*, which is „used by anatomists,” Soranus mentions the name οὐρητικόν (i.e. urine–draining) and he uses it to describe the fifth cavity of the navel, which grows from the base of the urinary bladder and, allegedly, serves to drain the urine of the embryo to the chorion (amniotic sac membrane); after birth, the urine is removed through the urethra (*Gynaeciorum libri IV*, 1.57.5.2):⁶

τὸ δὲ πέμπτον ἀγγεῖον, ὅπερ οὐρητικὸν οὕτως ὀνομάζομεν, πρὸς τῶν ἀνατομικῶν οὐραχὸς καλεῖται, ὃς τῷ πυθμένι τῆς κύστεως ἐμπέφυκεν. λέγεται καὶ διὰ τούτου τὸ οὖρον τοῦ ἐμβρύου τὴν παρακομιδὴν λαμβάνειν εἰς τὸ χόριον, ἣ δὲ διὰ τῆς οὐρήθρας ἀπούρησις μετὰ τὴν ἀπότηξιν γίνεται.

b) the word *urachus* refers to the apex of the heart; Hippocrates mentions *urachus* in this sense in connection with the comparative description of heart chambers: he characterises the right heart chamber (which is located more to the left when viewed from the front) as a wider cavity which does not form the apex of the heart, but juts out to form the *urachus* (*De corde*, 4, 2–8):⁷

Καὶ δύο γαστέρας [ἡ καρδίη] ἔχει διακεκριμένας ἐν ἐνὶ περιβόλῳ, τὴν μὲν ἔνθα, τὴν δὲ ἔνθα· οὐδὲν δὲ εἰκόασιν ἀλλήλησιν· ἡ μὲν γὰρ ἐν τοῖσι δεξιοῖσιν ἐπὶ στόμα κέεται ὀμιλέουσα τῇ ἐτέρῃ [φλεβί], ἡ δὲ δεξιῇ φημί τῶν ἐν λαιοῖς· ἡ γὰρ πᾶσα καρδίη τουτέοισι τὴν ἔδρην ἐμπεποιήται· ἀτὰρ ἦδε καὶ πάμπαν εὐρυκοίλιος καὶ λαγαρωτέρη πολλῶ τῆς ἐτέρης, οὐδὲ τῆς καρδίας νέμεται τὴν ἐσχατιὴν, ἀλλ' ἐγκαταλείπει τὸν οὐραχὸν στερεὸν, καὶ ἔστιν ὡσπερ ἐξῶθεν προσεραμμένη. Ἡ δὲ ἐτέρη κέεται ὑπένερθεν μὲν μάλιστα, καὶ κατ' ἰθυωρίην μάλιστα μὲν μαζῶ ἀριστερῶ, ὅση καὶ διασημαίνει τὸ ἄλμα.

c) the word *urachus* also refers to the stem or stalk; for example, Claudius Aelianus in his *De natura animalium* (6, 43, 23–29) explains, in connection with the way of getting food, how ants obtain fruit from the plants – the ant leaders climb up a stalk erected by the younger ants, bite off the stem (i.e. *urachus*) and the fruit then falls down for the rest of the colony:

⁶ Cf. Soranus: *Gynaeciorum libri IV* 2.11.5.2.

⁷ See also Aretaeus Medicus, *De causis et signis acutorum morborum*, 1, 8.

οἱ δὲ μύρμηκες προιόντες ὥσπερ οὖν ἐπισιτίσασθαι, τοῖς μεγίστοις ἔπονται· οἱ δὲ ἄγουσι στρατηγῶν δίκην. καὶ ἐς τὰ λήια ἐλθόντες οἱ μὲν ἔτι νεαροὶ τὴν καλὰμην ὑφεςτᾶσιν, οἱ δὲ ἡγεμόνες ἀνέρπουσιν, καὶ τοὺς καλουμένους οὐραχοὺς τῶν καρπίμων διατραγόντες τῷ δῆμῳ τῷ κάτω ρίπτουσιν·

- d) *urachus* is the point of a weapon.⁸ Apollodorus of Damascus describes in his *Polioretica* (148, 3–8) a weapon called *trypanon*, which is used to tear down the wall more quickly. This weapon has an *urachus* at both ends (tips):

ἔστω δὲ τὰ τρύπανα μοχλοὶ δακτυλῖοι τὸ πάχος, οἷς κατ' ἄκρον λεπίς σιδηρᾷ προσηλούσθω, τὸ πλάτος δακτύλων ἰβ, τὸ ὕψος ἡ οὐραχὸν μέσον ἔχουσα. κατὰ δὲ τὸ ἕτερον ἄκρον κύλινδρος ἐγκείσθω ξύλινος μεσόστενος, ... ἐχέτω δὲ καὶ ἄλλον οὐραχὸν ὑπὲρ τὸν κύλινδρον, ὃς ἀναστραφήσεται ἐν πτελίδι προσάγοντος αὐτὴν κανόνος καὶ ἀκολουθοῦντος αἰεὶ τῷ τρυπωμένῳ.

- e) the word *urachus* is used as an appellation of the hairs inside the blossom of the Cretan Thyme (*Thymbra capitata*). When describing the blossom of this flower, Dioscorides Pedanius (*De materia medica*, 4, 177, 1–3)⁹ mentions tiny outgrowths which look like hairs:

ἄνθος ἐστὶ θύμου τοῦ σκληροτέρου καὶ θύμβρα εὐικότος· ἐστὶ δὲ κεφάλια λεπτά, κοῦφα, οὐραχοὺς ἔχοντα ὡς τρίχας.

- f) Liddell-Scott (1996) also mention the outer ends of the eyebrows¹⁰ as another meaning of the word *urachus*.

Based on these written sources, the semantic usage of the word *urachus* in Ancient Greek literature may be summed up in the following overview:

	foetal organ connected with bladder	apex of the heart	plant stem or stalk	point of a weapon (drill, border, spear or arrow)	hairs in the flower of Cretan Thyme (<i>Thymbra capitata</i>)	outer ends of the eyebrows
<i>urachus</i>	15	2	2	3	2	1

⁸ See also Paulus Medicus, *Epitome medicae libri septem*, 6, 88, 2, 17. Cf. Apollonius Sophista, *Lexicon Homericum* 125, 1: ὁ οὐραχὸς τοῦ δόρατος.

⁹ See also Oribasius, *Collectiones medicae* 11, ε, 11, 2. Cf. Choerilus: *Fragmenta epica*, Fragment 21, 1.

¹⁰ PMed in Archiv für Papyrusforschung, 1900–, 4, 271.

The table above shows that the term *urachus* in Ancient Greek literature is most often used to denote the embryonic anatomic structure – cavity connecting the base of the urinary bladder with the amniotic sac (Galen 5×, Pseudo-Galen 4×, Soranus 2×, Aetius 1×, Oribasius 1×, Theophilus 1×, Rufus 1×). However, it is obvious that none of the writers is the author of the term *urachus* in this sense of the word; they often mention that it is a technical term used by the anatomists.

The first written record of the term *urachus* in connection with medicine is the treatise *De corde* by Hippocrates; however, he uses it as a name of the anatomic structure in the lower part of the heart (*apex cordis*). Hippocrates does not mention *urachus* as a foetal organ.

The most numerous records of the usage of the word *urachus* can be found in the written sources of the 1st and 2nd century A.D., which also capture a wide range of semantic nuances of this word. However, the original etymological motivation of the word is obvious in all cases: *urachus* is used to describe a projection or an end which corresponds (by its shape or location) with the meaning of the Ancient Greek οὐρά (“tail, rear”). In many of the instances, there is no connection with urine; also in case of the most common usage – as the appellation of the embryonic pouch – it is not defined just as a link for the removal of urine, but also more exactly (from the point of view of modern embryology) as the canal for the waste material after digestion (τὰ περιττώματα).

Therefore, from the point of view of the interpretation of the term in medical usage, it is a metaphorical name which reflects the location of the structure and not its physiological function. The translations common in dictionaries of medical terminology (German *Harngang*,¹¹ English *urinary canal of foetus*¹²) are inaccurate and usually ignore the usage of the term in embryological nomenclature.

Furthermore, looking at the typical collocations of the word *urachus* in current authentic medical records in the clinical area,¹³ we come to the conclusion that it is most often used in the following collocation terms:

- a) *urachus persistens*
- b) *urachus persistens et cystis urachi perivesicalis*
- c) *urachus et vasa umbilicalia persistentes*

¹¹ Roche *Lexicon Medizin* (2003).

¹² SKINNER (1961).

¹³ The terms are taken from the electronic system of medical records of the Clinic of Paediatric Surgery of the teaching Thomayer’s Hospital in Prague in the period between 1st January 2011 and 31st December 2012.

d) *urachus et arteria umbilicalis persistentes*

In all cases, the word *urachus* is used in context in connection with the adjective *persistens* to describe a medical condition. In this collocation term, the meaning is clearly determined, denoting a persistent structure in the patient (i.e. from the embryological stage of development). The name does not reflect the pathological process as such. Even though such collocation term is semantically clear, the word *urachus* is still inaccurately translated and falsely interpreted¹⁴ in a number of dictionaries of medical terminology. A more precise interpretation of the word would be a channel or duct of the urinary bladder. The problematic situation may be explained by the so-called “dead metaphor”:¹⁵ the original figurative expression is now incomprehensible and in the process of interpreting the etymology of the word it is easily confused because of the formal similarity of word stems (Greek οὔρον and οὐρά).

Conclusion

This paper was aimed at the research of the original motivation of the Greek word *urachus*. The research concentrated on the authors of ancient literary sources who wrote in Greek; overall, 25 instances of the word were found. The common feature in all cases was the original motivation of the word arising from similarity in shape or localisation (tail, rear) and the etymological interpretation linking the word with the Greek word οὔρον was found to be unsubstantiated. Another study aimed at the development of this term on a wider diachronic scale – that is, a complex study which would include also the history of the clinical collocation term *urachus persistens* – would be a useful addition to the research of this term.

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¹⁴ See also KÁBRT, JAN – KÁBRT, JAN jr. (2004).

¹⁵ ENGLISH (2003).

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RESUMÉ

Termínem *urachus* je v embryologii označován kanálek spojující močový měchýř přes pupečník s alantoidním plodovým obalem. Pokud se *urachus* po narození člověka zcela neuzavře, dochází k patologickému jevu, pro nějž se v lékařském prostředí uplatňuje kolokační termín *urachus persistens*. Ačkoli je výklad původu výrazu *urachus* v etymologických slovnících klasické řečtiny jednoznačný (spojitost s οὐρά), běžně se v renomovaných slovnících lékařské terminologie setkáváme s vysvětlením, že se jedná o kompozitní tvar z řeckého slova οὐρον. V článku autorka objasňuje motivovanost tohoto termínu na základě komparativní analýzy sémantického uplatnění tohoto výrazu u řecky píšících antických autorů.

porizkova.katerina@gmail.com