Nerve and arterial supply to the hand in Vesalius's *De Humani Corporis Fabrica*

Keith Denkler · Max Austin Norman

Published online: 10 February 2012
© American Association for Hand Surgery 2012

Abstract

Background Belgian anatomist Andreas Vesalius, in his groundbreaking medical atlas *De Humani Corporis Fabrica*, 1543, committed to paper two anatomical errors relating to the vascular and nervous system of the hand. In the diagrams, he depicts a highly irregular symmetrical sensory innervation of the median and ulnar nerves. He also fails to mention or illustrate the deep or superficial palmar arches.

Keywords Hand anatomy · Medical history · Palmar arch · Ulnar nerve · Vesalius

Sir Astley Cooper declared, “The best surgeon, like the best general, is he who makes the fewest mistakes.” Generals, however, have maps to guide them, whereas surgeons, without a knowledge anatomy, are blind. The publication in 1543 of *De Humani Corporis Fabrica* by the Belgian anatomist Andreas Vesalius was the first accurate map of human anatomy [17]. Vesalius’s seven-part work was published in Latin centuries ago and was never translated into English until 2009, when the first and only complete English rendition was finished. This landmark publication was the combined work of an anatomist John Carman, and Latinist

William Richardson, who went through the original texts and drawings page-by-page, updating terminology, and taking into consideration current usage [18, 19, 22–24].

Vesalius did make errors—how couldn’t he? In around 2 and a half years, aged only 25 or 27, he composed a monumental work of over 400,000 words, touching upon virtually every aspect of human anatomy with a characteristic incisiveness, and, at times, morbid wit [11]. Vesalius even touches upon the highly illegal but, unfortunately, equally necessary skill of “body snatching.” He cogently describes how bodies might need to be dissected quickly in order to prevent authorities, or church, from claiming them. Vesalius’s work ranged from the presentation of novel findings, to the refutation of contemporary medical dogma, and commentary on the work of the famed Greek anatomist Galen of Pergamum; all presented in impeccable and stylish Latin, forming a distinctly Vesalian pedagogical method [11]. Yet even though Vesalius wrote the text, artistic license was largely beyond his control. The artists that illustrated and engraved the work—a masterpiece of woodcutting and book design—are unknown, although it is highly probable that an artist, or several, of Titian’s school were responsible [6], perhaps working from drawings or sketches done by Vesalius himself. Of interest to hand surgeons are the illustrations of nerve and artery supply (Figs. 1 and 2) to the hand from volume III [20]. Vesalius described the innervation of the hand as symmetrical, a very uncommon clinical and anatomic finding: “The offshoot of the fifth [or ulnar] nerve divides into three branches, of which the first divides in two and travels to the outer side of the little finger, the second also divides in two and travels to the outer area of the ring finger, and the third, without diving, merges into the outer side of the outer area of the middle finger” [21]. Vesalius mentioned in his text the more common possibility: “More than once I have observed that the outer side of the inner

K. Denkler (✉)
275 Magnolia Ave.,
Larkspur, CA 9439, USA
e-mail: kdenklermd@hotmail.com

K. Denkler
University of California, San Francisco,
San Francisco, CA, USA

M. A. Norman
65 Trellis,
Dr. San Rafael, CA 94903, USA
e-mail: maxnorman@comcast.net

Fig. 1 In the frontal view of the full nervous system, the symmetrical distribution of the sensory nerves to the hand may be seen

Fig. 2 A close-up of Fig. 1 shows the nerves to the hand divided along the middle ray

Fig. 3 The Berrettini branch seen in Plate XII of the drawings by Berrettini in 1618. Berrettini is also called Pietro da Cortona

Fig. 4 A full view of the vascular system to the upper extremity shows no palmar connections between the radial and ulnar arteries

area of the middle finger and the inner side of the ring finger receive twigs from the third nerve, in which case the fifth nerve sends only two offshoots to the inner region of the little finger and one to the inner area of the ring finger" [21]. This description is the currently accepted palmar sensory innervation pattern of the ulnar nerve [7, 10], which Stopford, in studies of injured patients, found to occur 79% of the time [14, 16]. In only 3% of cases did Stopford find the

situation as illustrated by Vesalius, with sensation of the ulnar nerve extending to the middle of the middle finger [16]. The anatomist Linell corroborated Stopford's findings: He found a similarly rare distribution of the ulnar nerve to the middle finger [8]. Meals and Shaner [10] dissected 50 cadaver palms to demonstrate a small communicating branch between the median and ulnar nerves of the palm in 80% of cases. Bas and Kleinert [1] also investigated these

small interconnections between the ulnar and median nerves in the palm, known as the Berrettini branch [9, 15] since the eponymous artists description of this anatomical feature in a book published postmortem in 1741 [3] and 1788 [2] (Fig. 3). However, Berrettini showed an interconnection between the ulnar and median nerves and not the linear symmetry as illustrated in Vesalius.

Vesalius's portrayal of the hand's vascular intricacies is unique, for his drawings show neither the superficial nor the deep palmar arches (Figs. 4 and 5). Coleman and Anson, in their 1961 study of 650 cadavers, reported a complete superficial arch in 78.5% of the specimens and a deep palmar arch in 97% of them, rendering a body without either extremely rare [4]. Gellman et al. found no patients with absence of both arterial arches [5].

To Renaissance anatomists, the hand was of particular importance as both an object of beauty and as evidence of man's God-given superiority over all other denizens of the natural world. Many interpret this conception of the hand as "divine creation" as a vestige of Aristotelian philosophy perpetuated by the ancient anatomist Galen, whose status in the eyes of most of Vesalius's contemporaries approached that of a deity. Aristotle wrote in *De partibus animalum* that "man received hands because he was most intelligent. For the hands are an instrument, and nature, like an intelligent person, always distributes instruments according to the recipients' ability to use them...Nature adds the lesser to the greater and more important, not the other way around" [12].

It is interesting to note that Vesalius chose for his portrait, shown in the frontispiece of *De Humani Corporis Fabrica*, (Fig. 6) to depict himself in dissection of the superficial and deep flexor tendons of the arm, which he described as "a peculiar and rare occurrence...due to the marvelous labor of the supreme Creator of the world" [13]. We wish in that vein, to provide with this paper, another look at the neuro-vascular system of the hand in this remarkable work.

Fig. 5 A close-up of the vascular system to the hand shows no superficial or deep palmar arches

Fig. 6 The frontispiece of *De Humani Corporis Fabrica* showing Vesalius cradling the upper extremity which he admired "due to the marvelous labor of the supreme Creator of the world" [13]

Conflicts of Interest I have nothing financial to disclose personally in any way and I receive no benefits in any way. The goal is to put these photos and thoughts of our history in front of hand surgeons. Max Norman, my coauthor is 17 years old. His father published the English translation of the book and would receive royalties on its sale. Max receives no royalties or compensation for the book.

References

1. Bas H, Kleinert JM. Anatomic variations in sensory innervation of the hand and digits. *J Hand Surg Am*. 1999;24(6):1171–84.
2. Berrettini P, F Petraglia, *Tabulae Anatomicae*. 2 ed. 1788, Rome: Venanti Monaldini.
3. Berrettini P, *Tabulae anatomicae*. 1741, Rome.
4. Coleman SS, Anson BJ. Arterial patterns in the hand based upon a study of 650 specimens. *Surg Gynecol Obstet*. 1961;113:409–24.
5. Gellman H, et al. Arterial patterns of the deep and superficial palmar arches. *Clin Orthop Relat Res*. 2001;383:41–6.
6. Hazard J. Jan Stephan Van Calcar, a valuable and unrecognized collaborator of Vesalius. *Hist Sci Med*. 1996;30(4):471–80.
7. Laroy V, Spaans F, Reulen J. The sensory innervation pattern of the fingers. *J Neurol*. 1998;245(5):294–8.
8. Linell EA. The distribution of nerves in the upper limb, with reference to variabilities and their clinical significance. *J Anat*. 1921;55(Pt 2–3):79–112.

9. Meals RA, Calkins ER (1991) Anomalous innervation of the upper extremity, in operative nerve repair and reconstruction, R.H. Gelberman, Editor. Lippincott: Philadelphia. p. 197–204.
10. Meals RA, Shaner M. Variations in digital sensory patterns: a study of the ulnar nerve-median nerve palmar communicating branch. *J Hand Surg Am.* 1983;8(4):411–4.
11. O'Malley CD. Andreas Vesalius of Brussels, 1514–1564. Berkeley: University of California Press; 1964. p. 1–112.
12. Schupbach W. The paradox of Rembrandt's 'Anatomy of Dr. Tulp'. *Med Hist Suppl.* 1982;2:57–8.
13. Schupbach W. The paradox of Rembrandt's 'Anatomy of Dr. Tulp'. *Med Hist Suppl.* 1982;2:18.
14. Seddon HJ. Surgical disorders of the peripheral nerves. Edinburgh: Churchill Livingstone; 1972. p. 206.
15. Stancic MF, Micovic V, Potocnjak M. The anatomy of the Berrettini branch: implications for carpal tunnel release. *J Neurosurg.* 1999;91(6):1027–30.
16. Stopford JS. The variation in distribution of the cutaneous nerves of the hand and digits. *J Anat.* 1918;53(Pt 1):14–25.
17. Vesalius A. *De humani corporis fabrica libri septem.* 1543; Basileae Bruxelles,. 659
18. Vesalius A, Richardson WF, Carman JB (1999) On the fabric of the human body. Book II, The ligaments and muscles : a translation of *De humani corporis fabrica libri septem.* Norman anatomy series. San Francisco: Norman. xxix, 490 p.
19. Vesalius A, Richardson WF, Carman JB (2002) On the fabric of the human body. Book III, The veins and arteries. Book IV, The nerves : a translation of *De humani corporis fabrica libri septem.* Norman anatomy series. Novato: Norman. xxxi, 286 p.
20. Vesalius A, Richardson WF, Carman JB (2002) On the fabric of the human body. Book III, The veins and arteries. Book IV, The nerves: a translation of *De humana corporis fabrica libri septem.* Norman anatomy series no. 3. San Anselmo: Norman xxxi, 286 p.
21. Vesalius A, Richardson WF, Carman JB (2002) On the fabric of the human body. Book III, The veins and arteries. Book IV, The nerves: a translation of *De humani corporis fabrica libri septem.* Norman anatomy series. Novato: Norman 245.
22. Vesalius A, Richardson WF, Carman JB (2007) On the fabric of the human body. Book V, The organs of nutrition and generation : a translation of *De humani corporis fabrica libri septem.* Norman anatomy series. Novato: Norman xvii, 257 p.
23. Vesalius A, Richardson WF, Carman JB (2009) On the fabric of the human body. Book VI, The heart and associated organs. Book VII, The brain: a translation of *De humani corporis fabrica libri septem.* Norman anatomy series. Novato: Norman. xix, 413 p.
24. Vesalius A, Richardson WF (1998) On the fabric of the human body. Book I, Bones and cartilages. Norman orthopedic series. San Francisco: Norman. lxii, 416