IJAE
Vol. 124, n. 1: 1-4, 2019
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

Research Article - Human Anatomy Case Report

Aberrant innervation of the lateral abdominal muscles by direct branch of L4 nerve

Cameron Schmidt[1], Vlad Voin[1,*], Joe Iwanaga[1], Marios Loukas[2], Rod J. Oskouian[3], R. Shane Tubbs[1]

[1] Seattle Science Foundation, Seattle, WA
[2] St. George's University School of Medicine, Grenada, West Indies
[3] Swedish Neuroscience Institute, Seattle, WA

Abstract

Surgical approache through the posterior abdominal wall used for nephrectomy or other access to contents of the retroperitoneal space requires to be cognizant of the regional nerve supply to the posterolateral abdominal wall muscles. We herein report a, to our knowledge, previously undescribed direct branch from the L4 spinal nerve that formed a plexus with regional nerves to then innervate the lateral abdominal wall musculature. Such a nerve variant should be considered by the surgeon who operates this region.

Key words

Anatomy, posterior abdominal wall, lumbar plexus, oblique muscles.

Introduction

Muscles of the abdominal wall serve a number of roles, including flexion and rotation of the trunk, abdominal protection, and forced expiration (Urquhart et al., 2005). The lateral abdominal wall is composed of three paired muscles: the external oblique (EO), internal oblique (IO), and transversus abdominis (TrA). These three muscle overlie one another in the lateral abdomen and become aponeurotic medially (Hebbard et al., 2010).

These muscles traditionally receive innervation from spinal nerves T6 – L1 (Yang et al., 2003; Rozen et al., 2008; Hebbard et al., 2010). We report a cadaveric dissection where L4 was found to be innervating muscles of the anterolateral abdomen. We believe this variation to be previously unreported in the literature.

Case Report

During routine dissection of the posterior abdominal wall via a posterior approach, a large, direct branch of the L4 spinal nerve was found to travel laterally and innervate the lateral abdominal wall muscles (Figs. 1 and 2). The specimen was from an 84-year-old male died from heart failure. The branch had a horizontal course and distally joined into a neural plexus formed by T12-L2 spinal nerves. A lateral branch from L3 was not observed. The branch from L4 was approximately 5 cm in length and 1.2

* Corresponding author. E-mail: vvoin@outlook.com

http://www.fupress.com/ijae
DOI: 10.13128/IJAE-25465

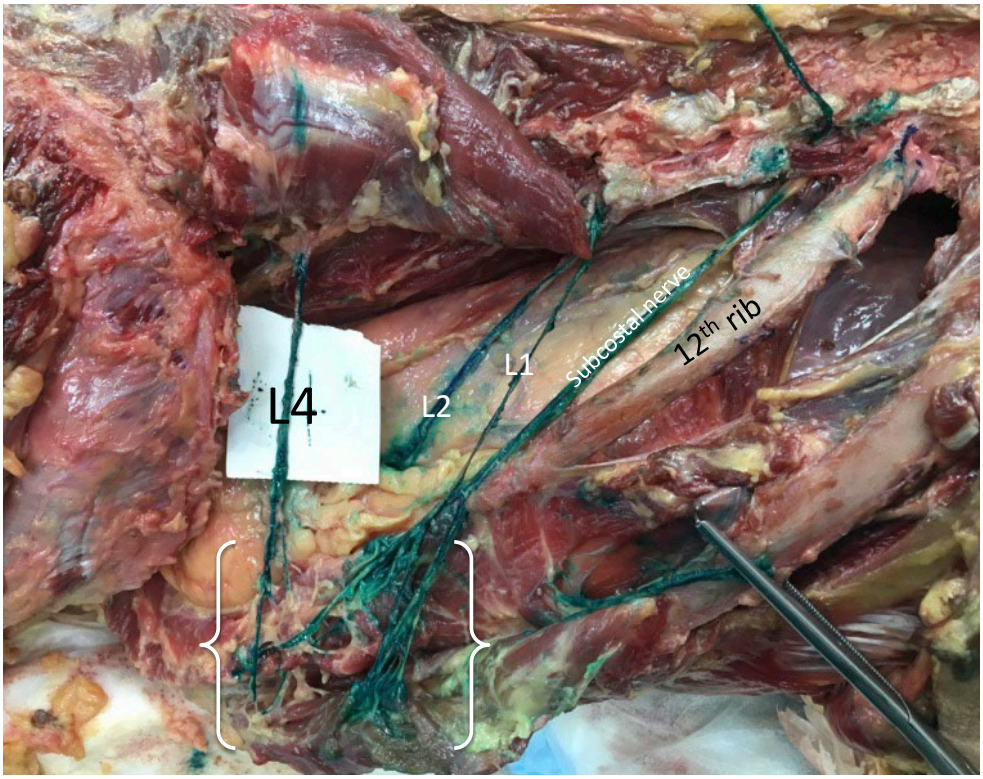

Figure 1. Posterior dissection of the right lumbar region. The subcostal nerve is seen just inferior to the 12th rib. L1 and L2 are seen coursing over the dissector tool. The L4 branch is seen at the arrow.

mm in diameter. The plexus created by it and contributions from T12-L2 formed just distal to the tip of the rib and provided branches to the EO, IO, and TrA muscles. The L4 branch did not innervate any other muscle or structure in this region. No other grossly visible anatomical variations were identified in this specimen. Particularly, no direct L4 branch to the lateral abdominal wall muscles was found on the left side.

Discussion

Strongest and most superficial, the EO arises from attachments at the lower margins of ribs 4 through 12 travelling in an infero-anterior direction (Yang et al., 2003; Urquhart et al., 2005). Upper and middle fibers, interdigitating with the serratus anterior, terminate in the anterior aponeurosis, while lower fibers, interdigitating with the latissimus dorsi muscle, attach at the iliac crest (Yang et al., 2003). A smaller and thinner muscle, the IO, lies deep to the EO, arising from the iliopectineal arch (Yang et al., 2003). Above the iliac crest, fascicles of the IO are oriented superomedially, while taking on a horizontal orientation below the iliac crest. Posterior fibers of the IO travel in

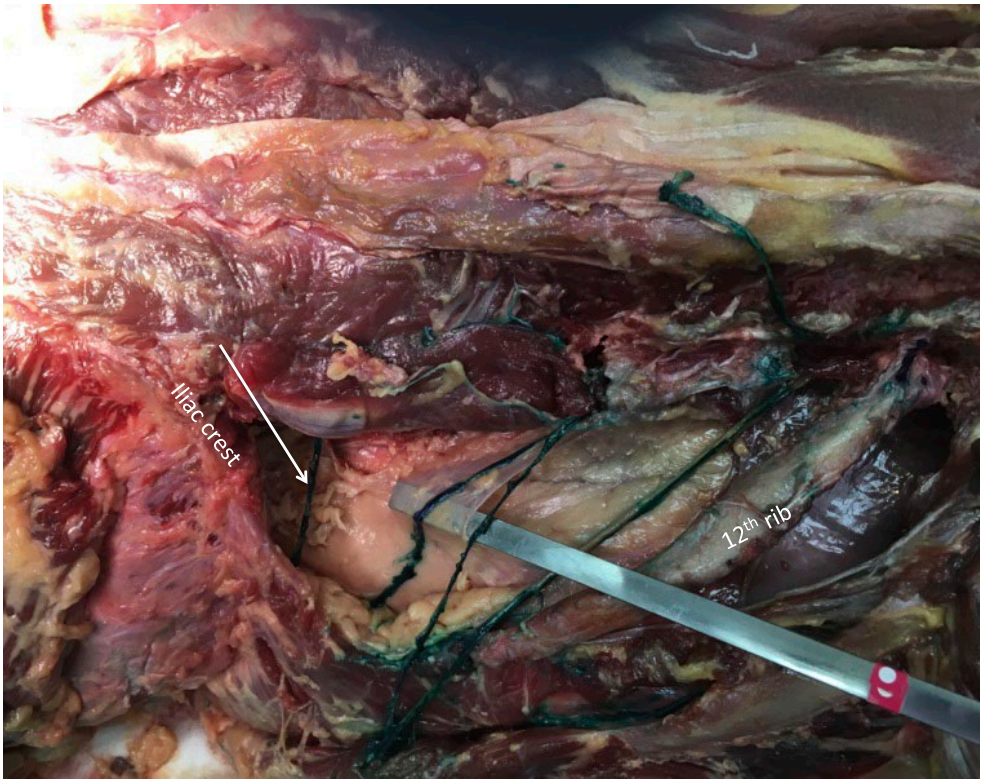

Figure 2. Closer view of Figure 1. Note the nerve plexus (brackets) formed between T12-L2 and the L4 nerve contributions.

a superior-anterior direction to insert on the lower 3 or 4 ribs. Still other fibers travel in an anterior direction becoming aponeurotic medially (Yang et al., 2003). The deepest and thinnest of the anterolateral abdominal muscles is the TrA.

The lateral abdominal wall receives segmental innervation from ventral rami of the lower six thoracic spinal nerves, including the intercostal nerves (T7-11) and subcostal nerve (T12), as well as the iliohypogastric and ilioinguinal nerves, derived from the ventral rami of L1 (Duchateau et al., 1988; Yang et al., 2003; Rozen et al., 2008). T7-L1 all run together with their associated blood vessels in a tissue plane between the IO and TrA, the transversus abdominis plane (TAP) (Davies et al., 1932; Rozen et al., 2008; Jankovic et al., 2009; Hebbard et al., 2010; Sviggum et al., 2012). T6-9 enter the TAP between the anterior axillary line and the midline, progressing anteriorly (Rozen et al., 2008). Sensory nerves branch laterally out of the plane in cutaneous terminal branches (Sviggum et al.. 2012). Within the lateral abdominal wall, each muscle and skin segment is innervated by at least two spinal nerves (Davies et al., 1932).

Any surgeon operating in this abdominal region should be aware of this possible variation. The TAP is of clinical relevance, given its importance in abdominal anesthetic procedures. The posterior TAP block involves the injection of local anesthetic

into the TAP in the lateral abdominal wall (Rozen et al., 2008; Jankovic et al., 2009; Hebbard et al., 2010). The TAP block represents one of a number of abdominal trunk blocks, including the ilioinguinal-iliopypogastric and rectus sheath block, used for pain control after abdominal surgery (Sviggum et al., 2012). In addition, the neuroanatomy of this region holds importance in abdominal wall flaps (Yang et al. 2003; Rozen et al. 2008). Oblique muscle flaps are used for a number of purposes, but frequently play a role in reconstructive surgery of the breast (Tansatit et al. 2006). The identification of all intramuscular neurovasculature is important in avoiding damage, which can lead to denervation, with additional complications including herniation, abdominal wall weakness, and abdominal bulges.

In conclusion, in the present paper we report what is believed to be the first case of lateral abdominal wall innervation by L4. As the quadratus lumborum muscle is also innervated by L4, such a variant innervation of the oblique muscles might suggest a common embryological muscle origin.

Conflict of Interest:

The authors declare that they have no conflict of interest.

References

Davies F., Gladstone R.J., Stibbe E.P. (1932). The anatomy of the intercostal nerves." J. Anat. 66: 323-333.

Duchateau J., Declety A., Lejour M. (1988). Innervation of the rectus abdominis muscle: implications for rectus flaps. Plast. Reconstr. Surg. 82: 223-228.

Hebbard P.D., Barrington M.J., Vasey C. (2010). Ultrasound-guided continuous oblique subcostal transversus abdominis plane blockade: description of anatomy and clinical technique. Reg. Anesth. Pain Med. 35: 436-441.

Jankovic Z.B., du Feu F.M., McConnell P. (2009). An anatomical study of the transversus abdominis plane block: location of the lumbar triangle of Petit and adjacent nerves. Anesth. Analg. 109: 981-955.

Rozen W.M., Tran T.M., Ashton M.W., Barrington M.J., Ivanusic J.J., Taylor G.I. (2008). Refining the course of the thoracolumbar nerves: a new understanding of the innervation of the anterior abdominal wall. Clin. Anat. 21: 325-333.

Sviggum H.P., Niesen A.D., Sites B.D., Dilger J.A. (2012). Trunk blocks 101: transversus abdominis plane, ilioinguinal-iliohypogastric, and rectus sheath blocks. Int. Anesthesiol. Clin. 50: 74-92.

Tansatit T., Chokrungvaranont P., Sanguansit P., Wanidchaphloi S. (2006). Neurovascular anatomy of the deep inferior epigastric perforator flap for breast reconstruction. J. Med. Assoc. Thai 89: 1630-1640.

Urquhart D.M., Barker P.J., Hodges P.W., Story I.H., Briggs C.A. (2005). Regional morphology of the transversus abdominis and obliquus internus and externus abdominis muscles. Clin. Biomech. (Bristol, Avon) 20: 233-241.

Yang D., Morris S.F., Geddes C.R., Tang M. (2003). Neurovascular territories of the external and internal oblique muscles. Plast. Reconstr. Surg. 112: 1591-1595.