ISSN 0008-3194 (p)/ISSN 1715-6181 (e)/2026/254–258/$2.00/©JCCA 2026

Rare anatomical variant of a duplicate renal vein traversing through the L1 vertebral body in a U.S. Veteran presenting with spine pain: an imaging case review

Alex V. Pham, DC, MS, ATC[1]
Kevin W. Meyer, DC[2]
Patrick J. Battaglia, DC[3]
William H. Borman, PhD[3]
Clinton J. Daniels, DC, MS[2,3]

In this imaging case review, we provide an account of a rare anatomical variant that was discovered incidentally during a routine computed tomography (CT) scan and subsequently confirmed with magnetic resonance imaging (MRI). This case marks the first description of a duplicated renal vein traversing through a lumbar vertebral body, an unusual anatomical phenomenon that has not been previously reported in the medical literature.

(JCCA. 2026;70(2):254-258)

KEY WORDS: low back pain, chiropractic, case report, vascular anomaly, renal vein, vertebral body

Variante anatomique rare d'une veine rénale dupliquée traversant le corps vertébral de L1 chez un vétéran américain présentant des douleurs rachidiennes: étude de cas d'imagerie

Dans cette étude de cas d'imagerie, nous décrivons une variante anatomique rare découverte fortuitement lors d'une tomodensitométrie (TDM) de routine, puis confirmée par imagerie par résonance magnétique (IRM). Il s'agit de la première description d'une veine rénale dupliquée traversant un corps vertébral lombaire, phénomène anatomique inhabituel qui n'avait encore jamais été signalé dans la littérature médicale.

(JACC. 2026;70(2):254-258)

MOTS CLÉS: lombalgie, chiropratique, rapport de cas, anomalie vasculaire, veine rénale, corps vertébral

[1] VA Puget Sound Health Care System, Seattle, WA, USA
[2] VA Puget Sound Health Care System, American Lake, WA, USA
[3] University of Western States, Portland, OR, USA

Corresponding author: Alex Pham, VA Puget Sound Health Care System, Seattle, WA, USA
E-mail: alex.pham3@va.gov

Conflicts of Interest:
The authors have no disclaimers, competing interests, or sources of support or funding to report in the preparation of this manuscript.
The involved patient provided consent for case publication.

Case presentation

A 60-year-old male veteran was referred to the VA Puget Sound chiropractic clinic by their neurologist for evaluation of chronic low back pain (LBP) secondary to military service, along with a secondary complaint of intermittent bilateral anterior thigh pain. His medical history was significant for Parkinson's disease, diagnosed two years earlier, and his body mass index (BMI) was 31.7. The patient rated their chief complaint impact on Pain, Enjoyment of Life, and General Activity (PEG) with scores of 6/10, 8/10, and 7/10, respectively. Walking was described as aggravating his LBP but was not limited due to pain.

A review of the patient imaging records revealed a well-corticated curvilinear lucency in the L1 vertebral body that appeared to contain a duplicated left renal vein on lumbar computed tomography (CT) scan (Figures 1 and 2). Lumbar magnetic resonance imaging (MRI) was conspicuous for a probable venous lake with a prominent draining vein again associated with the L1 vertebral body (Figure 3). On examination, the neurological assessment was significant for sway during Romberg test, observation of bilateral hand tremors, and diminished sensation of the plantar surface of the right foot, which was attributed to a prior foot surgery. Lower extremity muscle stretch reflexes and myotomes were intact bilaterally. Lumbar range of motion (ROM) was minimally reduced with flexion and reproduced his chief complaint of LBP. ROM was also markedly decreased with lumbar extension. Additionally, lumbopelvic orthopedic tests (i.e., passive straight leg raise, prone hip internal/external rotation, and prone sacroiliac extension) localized pain to the lumbar spine without radiation.

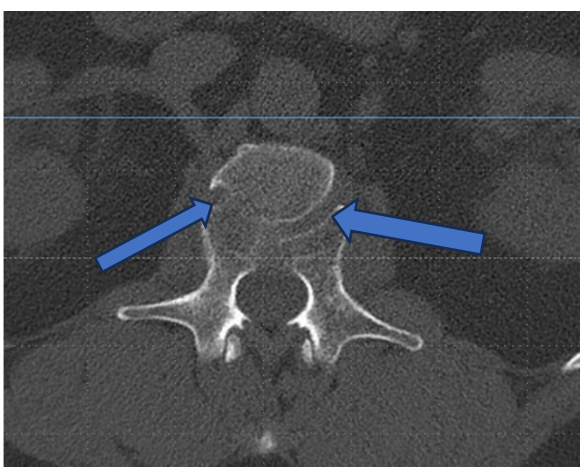

Figure 1.
Axial non-contrast CT images in bone window demonstrating a well-corticated intraosseous channel within the L1 vertebral body (indicated with arrows).

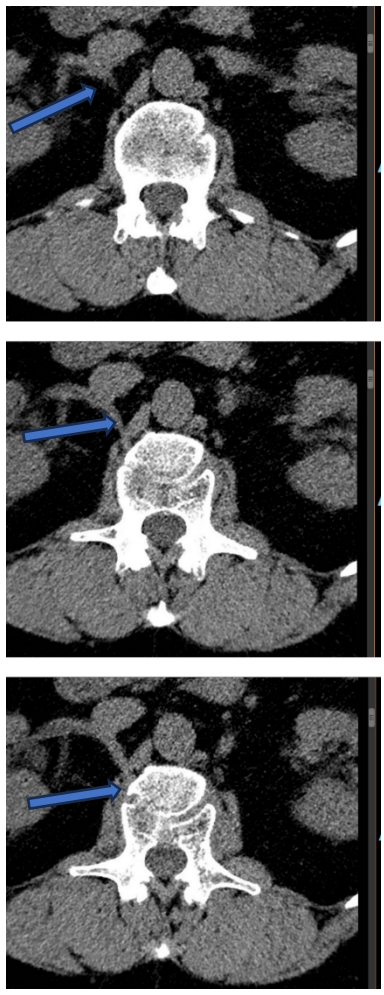

Figure 2.
Sequential axial non-contrast CT images of the lumbar spine and abdomen in soft-tissue window. Arrows indicate probable duplicate left renal vein.

The patient was diagnosed with mechanical non-specific lumbar pain and a trial of chiropractic care with a combination of thoracic high-velocity low-amplitude (HVLA) spinal manipulation, lumbar flexion-distraction manipulation, myofascial release, and exercise prescription was completed. The patient was treated for five visits over four months, with a resolution of his chief complaint, and the patient was transitioned to an as-needed care plan. No adverse events occurred.

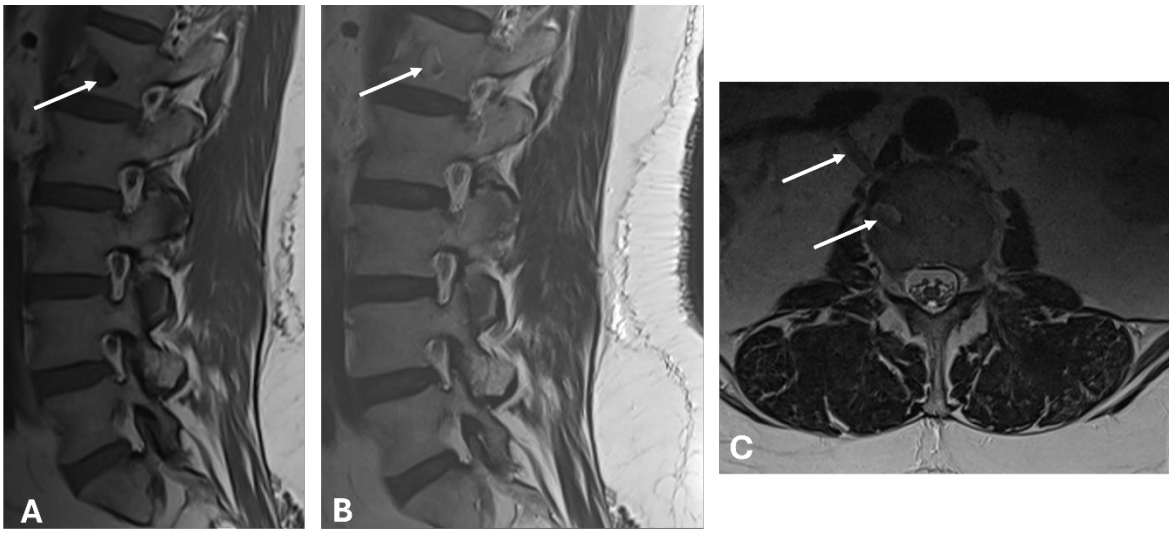

Figure 3.
Sagittal T1-weighted (A), T2-weighted (B), and Axial T2-weighted (C) magnetic resonance images (MRI) of the lumbar spine. Note the vascular structure coursing through the vertebral body (arrow) is hypo-intense on T1 and hyper-intense with areas of mixed low-intensity on T2-weighting, consistent with slow venous flow.

Discussion

Anatomical variants are not uncommon and are often discovered incidentally on diagnostic imaging.[1] In typical embryonic development, renal veins form in weeks 6-8 from an anastomosis between supracardinal veins and subcardinal veins at the level of L1-L2 vertebrae.[2] Initially, each renal vein forms from this anastomosis as a dorsal and ventral limb. The dorsal limb typically degenerates and the ventral limb typically persists as the definitive renal vein. The definitive left renal vein typically traverses anterior to the abdominal aorta and lumbar vertebrae, where it connects to the inferior vena cava. Renal developmental variations are common[3] and may include the renal vein traveling posterior to the abdominal aorta and/or duplicating into multiple veins. The developmental interpretation of such variants is generally attributed to variability in the original supracardinal-subcardinal anastomosis and/or persistence of the dorsal limb of the fetal renal vein.[4] A meta-analysis of pooled data from surgical reports, imaging, and cadaveric studies by Hostiuc *et al*. described posterior traversing renal vein, also known as a retro-aortic renal vein, as estimated to be present in 3% of individuals.[3] A reported 16.7% of individuals have duplicated renal veins, and 3.5% have circumaortic renal veins (one vein traverses anteriorly to the aorta and one posteriorly). Anomalies of the renal vein, which originate during the embryologic stage of development, have an estimated prevalence ranging from 0.3% to 16.6%, occurring more commonly on the right side than the left.[3,5,6] To our knowledge, this report is the first to describe a duplicated renal vein that traverses through a vertebral body.

The duplicated left renal vein traversing the L1 vertebral body in this case was likely temporally associated with the developmental processes of vertebrae formation. The first appearance of a segmental pattern in vertebrates is segmentation of paraxial mesoderm into somites in weeks 3-4 of development.[7] At that time, intersegmental blood vessels pass through the cleft between sequential somites. Subsequently in weeks 5-6, the somite sclerotomes recombine to fuse the caudal half of one somite with the cranial half of the next successive caudal somite to begin forming definitive vertebrae via endochondral ossification.[7] As definitive vertebrae form, intersegmental blood vessels are associated with each developing vertebral body which forms at each original inter-somite cleft. Although presumably very rare and not previously described, the potential temporal overlap in renal vein development and vertebral body resegmentation creates

a developmental opportunity for a persistent dorsal limb of the left renal vein to be enveloped by the endochondral ossification of the L1 vertebral body as described here. The duplicate left renal vein anastomoses with the L1 basivertebral vein within the L1 vertebral body (Figure 1).

Despite the incidental nature of finding these variations, they can be clinically important and may present a potential contraindication to manual therapies. Melka *et al*. similarly reported a vascular anomaly, with a vertebral artery tortuosity that resulted in cervical vertebral body erosion mimicking neck pain.[8] The anomaly in our case appeared to be incidental without significantly impacting the clinical presentation of the patient. While vascular injuries associated with spinal manipulation are very rare,[9,10] the unique presentation of this renal vein warranted consideration of venous compression syndromes (e.g., Nutcracker syndrome) and exercising caution with manual therapies.[11]

Chiropractic clinical practice guidelines recommend an individualized approach to risk assessment.[12–14] We opted not to pursue high-velocity, low-amplitude spinal manipulation to the lumbar region due to the known presence of the anomaly. Flexion-distraction manipulation,[15] myofascial manual therapy, and exercise were applied to the lumbar region without adverse event. While it appears to be unlikely that duplicated renal veins pose a direct safety concern to manual therapy providers, the clinical implications are not well understood, and we felt the vessel traversing a vertebral body warranted extra caution. The key imaging features and etiologies of this condition are presented in Table 1.

Table 1.
Key imaging features and proposed etiologies of duplicate renal vein.

Key Imaging Features
• Well-corticated curvilinear lucency within the L1 vertebral body identified on CT
• Duplicated left renal vein traversing the L1 vertebral body
• Communication with the basivertebral venous system within the L1 vertebral body
• T1 hypointense and predominantly T2 hyperintense signal characteristics on MRI, consistent with slow venous flow
• Absence of destructive osseous changes or marrow replacement
Proposed Etiologies
• Persistence of the dorsal embryonic limb of the left renal vein
• Variability in the supracardinal–subcardinal venous anastomosis
• Temporal overlap between renal vein development and vertebral resegmentation
• Envelopment of a persistent venous structure during endochondral ossification of the developing L1 vertebral body

Key Messages
• A duplicated left renal vein traversing the L1 vertebral body represents an exceedingly rare anatomical variant.
• To our knowledge, this is the first reported description of an intraosseous duplicated renal vein within a lumbar vertebral body.
• CT and MRI demonstrated imaging findings consistent with a benign congenital vascular anomaly.
• The anomaly may reflect persistence of embryonic venous structures during vertebral body development.
• Recognition of vascular variants is important for diagnostic interpretation and may influence procedural or manual therapy decision-making.

References

1. O'Sullivan JW, Muntinga T, Grigg S, Ioannidis JPA. Prevalence and outcomes of incidental imaging findings: umbrella review. BMJ. 2018;361:k2387. doi:10.1136/bmj.k2387
2. Pandya VK, Patel AS, Sutariya HC, Gandhi SP. Evaluation of renal vascular anatomy in live renal donors: Role of multi detector computed tomography. Urol Ann. 2016;8(3):270-276. doi:10.4103/0974-7796.184898
3. Hostiuc S, Rusu MC, Negoi I, Dorobanțu B, Grigoriu M. Anatomical variants of renal veins: a meta-analysis of prevalence. Sci Rep. 2019;9(1):10802. doi:10.1038/s41598-019-47280-8
4. Kyung DS, Lee JH, Shin DY, Kim DK, Choi IJ. The double retro-aortic left renal vein. Anat Cell Biol. 2012;45(4):282-284. doi:10.5115/acb.2012.45.4.282
5. Walker A, Slim N, Nicholson M, Brassett C. Configuration of the extra-renal venous system in relation to the left renal vein: a cadaveric study and new proposed classification. Surg J R Coll Surg Edinb Irel. 2020;18(6):349-353. doi:10.1016/j.surge.2020.01.001
6. Kennealey PT, Saidi RF, Markmann JF, Ko DSC, Kawai T, Yeh H. Duplicated Inferior Vena Cava—Something to Consider in the Evaluation of a Living-Donor Renal Transplant. Dial Transplant. 2009;38(10):420-422. doi:10.1002/dat.20363
7. Tanaka T, Uhthoff HK. Significance of resegmentation in the pathogenesis of vertebral body malformation. Acta Orthop Scand. 1981;52(3):331-338. doi:10.3109/17453678109050111
8. Melka HA, Rivera-Melo H, Jordan S, Hwang H, Whedon J. Cervical Vertebral Body Erosion Due to Vascular Abnormality: a case report. J Chiropr Med. 2020;19(1):65-69. doi:10.1016/j.jcm.2019.10.002
9. Whedon JM, Mackenzie TA, Phillips RB, Lurie JD. Risk of Traumatic Injury Associated with Chiropractic Spinal Manipulation in Medicare Part B Beneficiaries Aged 66–99. Spine. 2015;40(4):264-270. doi:10.1097/BRS.0000000000000725
10. Whedon JM, Petersen CL, Schoellkopf WJ, Haldeman S, MacKenzie TA, Lurie JD. The association between cervical artery dissection and spinal manipulation among US adults. Eur Spine J. 2023;32(10):3497-3504. doi:10.1007/s00586-023-07844-9
11. Gulleroglu K, Gulleroglu B, Baskin E. Nutcracker syndrome. World J Nephrol. 2014;3(4):277-281. doi:10.5527/wjn.v3.i4.277
12. Hawk C, Whalen W, Farabaugh RJ, et al. Best Practices for Chiropractic Management of Patients with Chronic Musculoskeletal Pain: A Clinical Practice Guideline. J Altern Complement Med N Y N. 2020;26(10):884-901. doi:10.1089/acm.2020.0181
13. Hawk C, Amorin-Woods L, Evans MW, et al. The Role of Chiropractic Care in Providing Health Promotion and Clinical Preventive Services for Adult Patients with Musculoskeletal Pain: A Clinical Practice Guideline. J Altern Complement Med. 2021;27(10):850-867. doi:10.1089/acm.2021.0184
14. Whalen WM, Hawk C, Farabaugh RJ, et al. Best Practices for Chiropractic Management of Adult Patients With Mechanical Low Back Pain: A Clinical Practice Guideline for Chiropractors in the United States. J Manipulative Physiol Ther. 2022;45(8):551-565. doi:10.1016/j.jmpt.2023.04.010
15. Cambron JA, Gudavalli MR, Hedeker D, et al. One-year follow-up of a randomized clinical trial comparing flexion distraction with an exercise program for chronic low-back pain. J Altern Complement Med N Y N. 2006;12(7):659-668. doi:10.1089/acm.2006.12.659