ORIGINAL ARTICLE

Ultrasound-Guided Superior Hypogastric Plexus Block: A Cadaveric Feasibility Study with Fluoroscopic Confirmation

Michael Gofeld, MD; Chuan-Whei Lee, MBChB
Department of Anesthesia, St Michael's Hospital, University of Toronto, Toronto, Canada

■ **Abstract:** Plancarte first described a fluoroscopy-guided superior hypogastric plexus block to manage pelvic pain in 1990. Modifications have since been described using different imaging modalities. Ultrasound-guided approach has been described in a clinical outcome study. However, the accuracy of an ultrasound-guided method has never been validated by alternative imaging. We conducted an experiment aiming to develop ultrasound-guided superior hypogastric plexus block using human cadavers in the supine position. Final needle position and spread of a radiopaque contrast was verified by fluoroscopy, a standard imaging tool. The needle approach to the L5 vertebral body was performed in the short axis as has been recommended. Injection of radiopaque contrast revealed unilateral and cephalad spread to the L5/S1 disk. Additional transabdominal long-axis scanning of the lumbosacral segment was and the needle trajectory was modified to aim for the apex of the L5/S1 disk. Bilateral spread was achieved by strict midline placement of the needle tip and real-time observation of injection. The modified ultrasound-guided technique resulted in a similar spread of injectate as the traditional fluoroscopy-guided technique that in a clinical scenario would offer complete block of the superior hypogastric plexus. ■

Address for correspondence and reprint requests to: Michael Gofeld, MD, Department of Anesthesia, St Michael's Hospital, University of Toronto, 30 Bond Street, Toronto, Ontario M5B 1W8 Canada. E-mail: michael.gofeld@utoronto.ca.

Submitted: September 4, 2015; Revision accepted: December 2, 2015
DOI. 10.1111/papr.12437

Pain Practice, Volume 17, Issue 2, 2017 192–196

Key Words: pelvic pain, sympathetic chain, ultrasound-guided, superior hypogastric plexus

INTRODUCTION

The superior hypogastric plexus is a retroperitoneal autonomic nervous system structure that lies anterior to the caudal third of the L5 and the cephalad third of the S1 vertebral bodies[1]. It includes sympathetic visceral efferents to the pelvic organs from the aortic and lumbar plexi and parasympathetic branches from the sacral outflow tracts[2]. Sensory afferents are passing to the dorsal spinal column visceral pathway along the sympathetic fibers without connection in the ganglia. Blockade of the superior hypogastric plexus to manage pelvic pain was first described by Plancarte et al.[3] in 1990 as the fluoroscopy-guided, posterior, 2-needle technique, targeting anterior to the L5 vertebral body. Since then, other techniques using different imaging modalities have been described, including the first ultrasound-guided technique described by Mishra et al.[4] in 2008. The accuracy of an ultrasound-guided method has never been confirmed by an alternative imaging. We present the development of a fluoroscopy-controlled ultrasound-guided, anterior approach using a single needle for the blockade of the superior hypogastric plexus.

METHODS

The main outcome of the study was to confirm feasibility and accuracy of the ultrasound-guided superior

hypogastric block. The study was designed as a feasibility cadaveric experiment. The study procedure was performed entirely under ultrasound guidance and fluoroscopy was used to confirm the accuracy of needle tip location and spread of the radiopaque contrast.

Eight unembalmed cadavers donated to the University of Washington Willed Body Program were used. No Institutional Review Board approval was required since the personal health data, excluding biometrics, of the deceased were not disclosed to investigators. Specimens were placed in the supine position. Initially, the methodology originally described by Mishra et al.[4] was utilized. The injections were performed using the C6 curvilinear transducer and S-Series ultrasound system (SonoSite, Bothell, WA, USA). Identification of the aorta and its bifurcation was difficult due to postmortem collapse of the vessels. Instead, the anterior inferior surface of the L5 vertebral body was approached as described in the original and subsequent publications.[4,5] Injection of 5 mL of iohexol 240 mgI/mL was performed. In the first 2 experiments, the anteroposterior fluoroscopy revealed spread of the contrast agent mainly at the anterior surface of the L5 vertebra without significant extension toward the S1 vertebra. In addition, it was mostly unilateral in the second experiment (Figure 1). In order to improve the technique and eliminate potential errors with identification of the vertebral level, the subsequent 6 experiments included a midline sagittal sonography from the umbilicus caudally. It consistently helped to localize the L5/S1 intervertebral disk. At that point the transducer was rotated axially and an injection was performed utilizing the in-plane approach (Figure 2) aiming to the most anterior portion of the disk that was considered the midline. After the needle tip reached the anterior longitudinal ligament, 5 mL of the contrast was injected. Pattern of the injectate flow was detected. If injection of the first 2.5 mL resulted in a unilateral flow of the anechoic fluid, the needle was gently repositioned 1 cm toward the contralateral side, and the rest of the contrast was injected to assure bilateral spread. No more than one additional reposition was required. Fluoroscopy was used to confirm final position of the needle and contrast appearance relative to the lumbosacral spine (Figure 3; Supplementary online only video [insert link]).

Figure 1. Needle tip is placed anterior surface of L5 vertebral body. Contrast spread confined to the L5 and mainly unilateral.

RESULTS

When performed as the originally described, the injectate spread was unilateral and localized anterior to the L5 vertebral body in 2 cadavers as verified with fluoroscopy. Subsequently, the technique was modified to include an additional longitudinal scanning and mapping of the L5/S1 intervertebral disk, rotation of the probe to the short axis with in-plane needle approach to just anterior to the L5/S1 disk and careful identification of bilateral spread of injectate. The modification resulted in the consistent, reproducible, bilateral injectate spread toward the S1 vertebral body in the following six experiments. The injectate spread was similar to a pattern that is typically obtained with the fluoroscopically guided posterior transdiscal approach.

DISCUSSION

Since Plancarte et al. described a fluoroscopic-guided, two-needle, posterior technique in 1990[3], a single-needle techniques[4,6–10], posterior transdiscal[9–11] and anterior[4,7,8] approaches utilizing fluoroscopy[8–10], computed tomography[6,11], and ultrasound guidance[4,5] have been developed. Mishra et al.[4] described an ultrasound-guided superior hypogastric plexus block in 2008, using an anterior approach targeting the most anterior portion of the L5 vertebral body. They clinically validated the ultrasound-guided technique in a prospective, randomized control trial of 54 patients with advanced gynecological malignancy against oral morphine alone[12]. However, the accuracy of the ultrasound-guided superior hypogastric plexus block was not compared to another validated image-guided technique.

We have challenged this originally described technique by confirming the injectate spread with fluoroscopy. The spread of injectate was unsatisfactory due to unilateral and cephalad extent relatively to the L5/S1 disk. Following an additional sagittal scanning, the

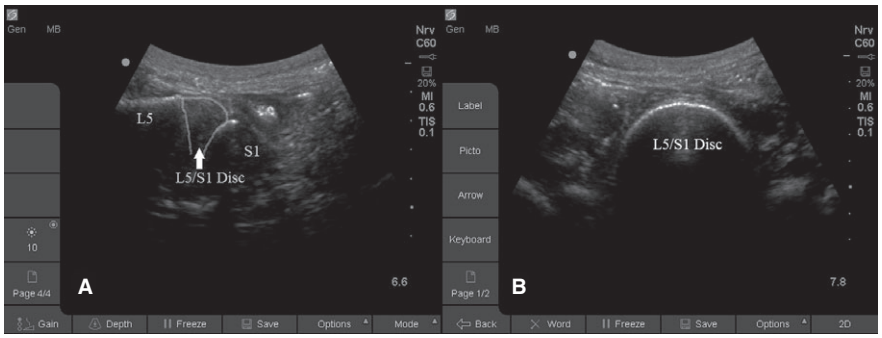

Figure 2. Ultrasound image centered to L5/S1 intervertebral disk. A. Midline long axis. B. Short axis.

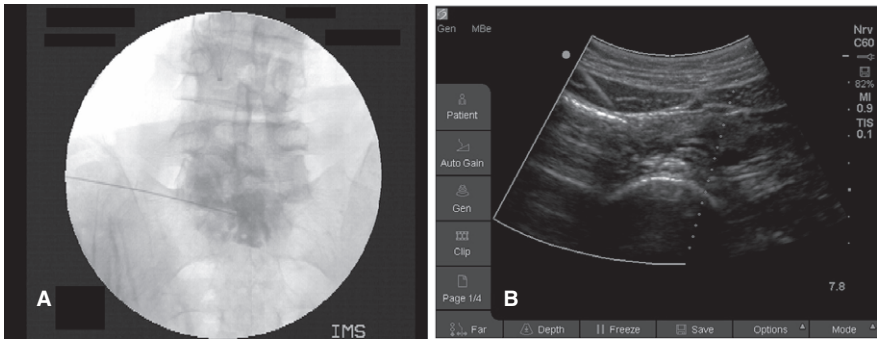

Figure 3. Injection performed at the level of L5/S1 disk. A. Fluoroscopic confirmation of the midline needle placement and L5/S1 prevertebral spread of contrast agent. B. Corresponding ultrasound image (short axis).

needle trajectory was changed and it was directed toward the most anterior ventral aspect of the L5/S1 disk. Identification of a unilateral distribution was corrected by manipulation of the needle tip under dynamic ultrasound guidance to ensure the contralateral spread. This modification resulted in a consistent bilateral injectate spread in both cephalad and caudad directions. The bilateral spread is highly desirable in case of pelvic cancer pain where a suboptimal accuracy may result in inadequate pain relief.[13] Radiological picture of the needle tip position and the injectate spread was similar to the typically obtained with the fluoroscopically guided posterior transdiscal approach,[9,10] which in a clinical scenario should result in a complete block of the superior hypogastric plexus.

Selection of the L5/S1 disk as the target for the modified ultrasound technique provided a more reliable target compared to the most anterior portion of the L5 vertebral body. Mishra et al. relied on the aortic bifurcation as a landmark to localize the L5 vertebral body.[4] However, cadaveric studies show variability in the aortic bifurcation relatively to the lumbar vertebral spine. It may correspond to any vertebral level from L3 to S1.[14] Recently, Deswal et al. found that the aortic bifurcation was seen at L4 in 64% and the L4/5 disk in 16% of the cadavers.[15] The aortic bifurcation can occur above L4 in between 8% and 14% of cadavers.[15,16] The originally described technique targeted the "most anterior portion" of L5 vertebral body. However, depending on the acoustic window, the most anterior portion may be in the superior, middle, or inferior third of the L5 vertebral body, thereby introducing variability in the needle placement. Combined, these 2 factors may result in a cephalad or unilateral spread of the injectate.

Posterior fluoroscopic-guided transdiscal approaches were described by Erdine et al.[9] in 2003 and Turker et al.[10] in 2005. Both techniques used the anterior border of the L5/S1 disk as the preferred target. The transdiscal technique has been validated against the original method in studies that have highlighted the ease and speed of technique and safety, similar reductions in the visual analogue pain scores and morphine consumption.[17,18] The transdiscal approach has also been used as a rescue method for those who failed to obtain pain relief when the original 2-needle technique was used.[19] However, the transdiscal method carries the risk of discitis, disk rupture, or disk herniation although no cases have been reported in the literature.[9,10,17,18] The modified ultrasound technique circumvents the need to penetrate the L5/S1 disk by approaching it anteriorly, thus decreasing this risk, while still allowing for a fluoroscopically validated target.

Limitations of the present study are that the technique was performed on cadavers and the number of

experiments was limited. The main goal of the study was to evaluate and improve the previously published method and to make practical recommendations based on anatomy and imaging. Further studies to clinically validate the efficacy of this technique for patients with pelvic pain may be required.

Based on the previously published recommendations[4] and the results of this experimental work, the suggested technique is as following:

1. Ask patient to empty bladder prior to the procedure.
2. Administer prophylactic antibiotics.
3. Place patient supine with the slight Trendelenburg to displace bowels cephalad.
4. Use a curvilinear low-frequency ultrasound transducer.
5. Perform long-axis scanning to map out L5/S1 disk.
6. Once L5/S1 disk identified, rotate transducer to the short axis.
7. Introduce needle in-plane targeting anterior surface of the L5/S1 disk.
8. Ensure strict midline placement of needle tip.
9. Inject 10 mL of analgesic or neurolytic solution. Real-time observation of injectate to ensure bilateral spread. If unilateral spread is identified, then the needle tip should be manipulated to ensure bilateral spread.
10. Alternatively, half of the solution can be delivered unilaterally, and then, the needle tip manipulated to deliver the remaining solution contralaterally.
11. Withdraw the needle and apply adhesive dressing to cover the injection site.

ACKNOWLEDGEMENTS

The authors thank the University of Washington Willed Body program for the support and Drs. K. Montgomery and J. Lee for the technical assistance. SonoSite, Inc. provided the US machine for the laboratory as a loan.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Video S1. In-plane insertion of the block needle towards apex of the L5/S1 intervertebral disc.

Video S2. Injection of the contrast agent is performed. The fluid spread over the disc is visible.

REFERENCES

1. Paraskevas G, Tsitsopoulos P, Papaziogas B, et al. Variability in superior hypogastric plexus morphology and its clinical applications: a cadaveric study. *Surg Radiol Anat*. 2008;30:481–488.

2. Plancarte R, Guajardo-Rosas J, Guillen-Nunez R. Superior hypogastric plexus block and ganglion impar (Walther). *Tech Reg Anesth Pain Manag*. 2005;9:86–90.

3. Plancarte R, Amescua C, Patt RB, et al. Superior hypogastric plexus block for pelvic cancer pain. *Anesthesiology*. 1990;73:236–239.

4. Mishra S, Bhatnagar S, Gupta D, et al. Anterior ultrasound-guided superior hypogastric plexus neurolysis in pelvic cancer pain. *Anaesth Intensive Care*. 2008;36:732–735.

5. Domingo-Rufes T, Bong DA, Mayoral V, et al. Ultrasound-guided pain interventions in the pelvis and sacral spine. *Tech Reg Anesth Pain Manag*. 2013;17:107–130.

6. Waldman S, Wilson W, Kreps R. Superior hypogastric plexus block using a single needle and computed tomography guidance: description of a modified technique. *Reg Anesth*. 1991;16:286–287.

7. Michalek P, Dutka J. Computer tomography-guided anterior approach to the superior hypogastric plexus for noncancer pelvic pain: a report of two cases. *Clin J Pain*. 2005;21:553–556.

8. Kanazi G, Perkins F, Thakur R, et al. New technique for superior hypogastric plexus block. *Reg Anesth Pain Med*. 1999;24:473–476.

9. Erdine S, Yucel A, Celik M, et al. Trandiscal approach for hypogastric plexus block. *Reg Anesth Pain Med*. 2003;28:304–308.

10. Turker G, Basagan-Mogot E, Gurbet A, et al. A new technique for superior hypogastric plexus block; the posteromedian transdiscal approach. *Tohoku J Exp Med*. 2005;206:277–281.

11. Dooley J, Beadles C, Ho KY, et al. Computed tomography-guided bilateral transdiscal superior hypogastric plexus neurolysis. *Pain Med*. 2008;9:345–347.

12. Mishra S, Bhatnagar S, Rana SPS, et al. Efficacy of the anterior ultrasound-guided superior hypogastric plexus neurolysis in pelvic cancer in advanced gynaecological cancer patients. *Pain Med*. 2013;14:837–842.

13. Plancarte R, de Leon-Casasola OA, El-Helaly M, et al. Neurolytic superior hypogastric plexus block for chronic pelvic pain associated with cancer. *Reg Anesth*. 1997;22:562–568.

14. Pirro N, Ciampi D, Champsaur P, et al. The anatomical relationship of the iliocava junction to the lumbrosacral spine and the aortic bifurcation. *Surg Radiological Anat*. 2005;27:137–141.

15. Deswal A, Tamang BK, Bala A. Study of aortic-common iliac bifurcation and its clinical significance. *J Clin Diagn Res*. 2014;8:AC06–AC08.

16. Karahara N, Tomita K, Baba H. Cadaveric vascular anatomy for total en bloc vertebral spondylectomy in malignant tumours. *Spine*. 1996;21:1401–1407.

17. Gamal G, Helaly M, Labib Y. Superior hypogastric block: transdiscal versus classic posterior approach in pelvic cancer pain. *Clin J Pain*. 2006;22:544–547.

18. Ghoneim A, Mansour S. Comparative study between computed tomography guided superior hypogastric plexus block and the classic posterior approach: a prospective randomized study. *Saudi J Anaesth*. 2014;8:378–383.

19. Nabil D, Eissa A. Evaluation of posteromedial transdiscal superior hypogastric block after failure of the classic approach. *Clin J Pain*. 2010;26:694–697.