

Research Article

Inferior Hypogastric Plexus Block Affects Sacral Nerves and the Superior Hypogastric Plexus

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Background. The inferior hypogastric plexus mediates pain sensation through the sympathetic chain for the lower abdominal and pelvic viscera and is thought to be a major structure involved in numerous pelvic and perineal pain syndromes and conditions. **Objectives.** The objective of this study was to demonstrate the structures affected by an inferior hypogastric plexus blockade utilizing the transsacral approach. **Study Design.** This is an observational study of fresh cadaver subjects. **Setting.** The cadaver injections and dissections were performed at the Department of Forensic Sciences and Insurance Medicine, Semmelweis University, Budapest, Hungary after obtaining institutional review board approval. **Methods.** 5 fresh cadavers underwent inferior hypogastric plexus blockade with radiographic contrast and methylene blue dye injection by the transsacral fluoroscopic technique described by Schultz followed by dissection of the pelvic and perineal structures to localize distribution of the indicator dye. Radiographs demonstrating correct needle localization by contrast spread in the specific tissue plane and photographs of the dye distribution after cadaver dissection were recorded for each subject. **Results.** In all cadavers the dye spread to the posterior surface of the rectum and the superior hypogastric plexus. The dye also demonstrated distribution to the anterior sacral nerve roots of S1, 2, and 3 with bilateral spread in 3 cadavers and ipsilateral spread in 2 of them. **Limitations.** The small number of cadaver specimens in this study limits the results and generalization of their clinical significance. **Conclusions.** Inferior hypogastric plexus blockade by a transsacral approach results in distribution of dye to the anterior sacral nerve roots and superior hypogastric plexus as demonstrated by dye spread in freshly dissected cadavers and not by local anesthetic spread to other pelvic and perineal viscera.

1. Background

The inferior hypogastric plexus (IHP) is the caudal component of the sympathetic chain and is composed of both adrenergic and cholinergic nerve fibers. Morphologically the IHP is a symmetrical, flat, rectangular, sagittal structure, and its nerve branches form a net of nerve endings surrounding the pelvic organs, rectum, bladder, and vagina. In females, the IHP is a triangular structure with its base positioned anteriorly to its afferent sacral nerve roots, its inferior edge stretching anteriorly from the fourth sacral root to the point of entry of the distal ureter into the broad ligament, and its cranial edge is parallel to the course of the posterior edge of the hypogastric artery [1]. In males, the IHP is situated in a subperitoneal fibro-fatty plane at the intersection of the terminal ureter and the vas deferens

and courses postero-laterally in the vicinity of the seminal vesicle [2]. Communicating branches of the plexus or any of its afferents and efferents with the pudendal nerves have been observed and this may explain both incomplete relief of sympathetically mediated pelvic pain after blockade of the IHP and partial preservation of function if the IHP or its branches have been resected during pelvic surgery. The sympathetic component of the IHP mediates nociceptive sensations from the pelvic viscera through sacral afferents also known as pelvic splanchnic nerves or erector nerves of Eckhardt. The efferent branches form three groups of nerves and these are the superior rectal plexus, the vesical plexus, and the inferior rectal plexus. In females, these are further defined as the uterovaginal plexus of Frankenhausen and the vesicovaginal plexus. In males, the prostatovesical plexus has been described and identified [2]. The sacral roots

receive afferent fibers from the IHP. The afferent fibers most frequently originate from the sacral nerve roots S3 or S4 (60%), some arise from S2 (40%), occasionally S5 (20%), and have not been described for S1 [1].

Pelvic visceral pain can arise from various causes. The pelvic and perineal areas, as well as the lower abdominal contents transmit pain sensation through the sympathetic pathways of the IHP to the sacral afferent roots and nerve blockade of this structure relieves the sympathetically mediated component of pain originating from these viscera. Cancerous and noncancerous chronic pain of the anorectal, vesical, genital, or perineal organs, sympathetically mediated pelvic pain, lower pelvic endometriosis, pelvic malignancy, vulvodynia, colorectal radiation-induced tenesmus and enteritis, proctalgia fugax, acute herpes zoster, and postherpetic neuralgia involving sacral dermatomes are some of the conditions that can be treated with an inferior hypogastric plexus blockade [3–5]. Chronic pelvic pain (CPP) is defined as recurrent or constant pain in the lower abdomen of at least 6 months duration [6, 7]. Those patients failing to receive adequate relief from superior hypogastric blockade for CPP and other abdominal conditions have benefitted from blockade of the IHP [4].

There are several techniques for blockade of the superior hypogastric plexus. The traditional approach is insertion of the needle in an oblique paravertebral direction anterior to the vertebral body of L5. An alternative technique that is reported to be safer and easier is the transdiscal approach through the L5-S1 intervertebral disc. The transsacral approach for blockade of the IHP is performed by placing a 22 gauge spinal needle through the posterior sacral foramen under fluoroscopic guidance and guiding it through the corresponding anterior sacral foramen and confirming needle tip placement on the anterior sacral surface with contrast dye, followed by local anesthetic injection for diagnostic or therapeutic purposes. The sacral foramen most easily visible under fluoroscopy is selected for this technique and the level of the S2 dorsal foramen is the most commonly accessed point [3]. A transverse coccygeal IHP block technique has been described and is reported to be associated with a lower incidence of transient paresthesias, nerve damage, vascular penetration, rectal puncture, hematoma, and infection [4].

2. Objectives

To identify the anatomic structures affected by an inferior hypogastric block using the transsacral fluoroscopic guided technique described by Schultz and to test the hypothesis that analgesia attributable to an inferior hypogastric block is due to anesthesia of the anterior sacral nerve roots at positions S1, 2 and 3 rather than elimination of sympathetically mediated pain through the inferior hypogastric plexus.

3. Method

This is an observational study using fresh nonembalmed cadavers for injection and dissection of the inferior hypogastric plexus and adjoining anatomic regions of the pelvis.

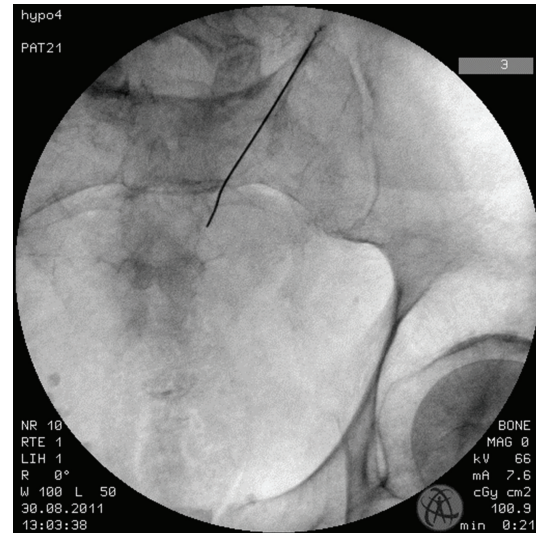


FIGURE 1: Transsacral placement of needle through S2 foramen (AP view).

Five fresh, nonembalmed cadavers were included in this study. The cadavers were procured, injected, and dissected at the Department of Forensic Sciences and Insurance Medicine, Semmelweis University. Institutional review board approval was obtained for this study from Semmelweis University.

The inferior hypogastric plexus blockade was performed on each cadaver using the transsacral fluoroscopic guidance technique described by Schultz. The cadaver was placed prone on the fluoroscopic table and an anteroposterior view with slight cephalad tilt and lateral rotation was used to visualize the sacral foramen at the S2 level. A 22 gauge spinal needle was introduced postero-anteriorly through the S2 foramen and guided to the anterior/ventral surface of the sacrum with fluoroscopic monitoring (Figure 1). Correct needle position was confirmed by verification of contrast dye spread in a cephalocaudal direction along the presacral plane by injection of 5 mL of Omnipaque solution. Inferior hypogastric plexus blockade was then simulated by injection of 10 mL of methylene blue in a 1:50 dilution through the needle located at the presacral position (Figure 2). Insertion of the needle using a more horizontal direction angle through the sacral foramina places the needle tip closer to the midline while remaining within the presacral region. The cadavers were then dissected to expose the pelvic contents and map and record the region of spread of the dye solution in the area.

4. Results

In all 5 cadavers the distribution of methylene blue dye was present on the posterior surface of the rectum (Figure 4). Diffusion of indicator dye to the anterior and lateral regions of the rectum or to any of the other pelvic viscera was absent in all the specimens studied (Figure 5).

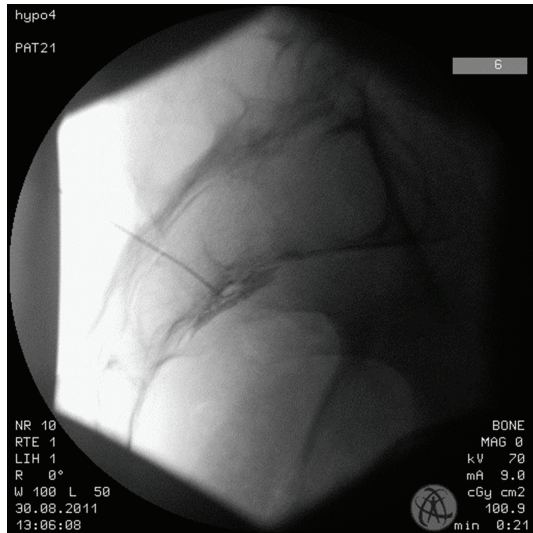


FIGURE 2: Needle confirmation of placement with contrast dye spreading along the presacral plane (lateral view).

In three of the cadavers the needle was located more proximal to the midline point and spread of methylene blue dye was found to occur in a bilateral distribution within a distance of 1-2 cm from the needle position.

The anterior sacral nerve roots of S1 to S3 were invariably affected as demonstrated by spread of methylene blue to these areas in all of the cadavers. Three cadavers demonstrated bilateral diffusion of methylene blue along the anterior nerve roots of S1 to S3 on the ipsilateral side of injection and S2, S3 on the contralateral side. The remaining two cadavers had ipsilateral staining of the S-3 anterior nerve root and this correlated with the needle tip appearing more lateral from the midline position on fluoroscopic imaging. All cadavers had blue staining of the superior hypogastric plexus located on the anterior surface of the L5-S1 disc space and sacral promontory (Figure 3).

5. Discussion

Inferior hypogastric plexus blockade provides analgesia for conditions in which sympathetically mediated pain is thought to be the main contributing factor. These cadaveric injections and dissections demonstrate that the transsacral technique causes local anesthetic distribution to the anterior surface of the sacrum, posterior surface of the rectum, and the anterior sacral nerve roots at levels S1, S2, and S3, but not to the other pelvic organs surrounded by the inferior hypogastric plexus.

The small number of cadaver specimens and the lack of imaging while performing the same injection technique on live human subjects to reproduce the same results may introduce sampling error into these observations and limit any generalizations or correlation to clinical results. The limited number of cadaver specimens did not allow observations on the spread of dye with relation to exact needle localization from the midline, range of volume

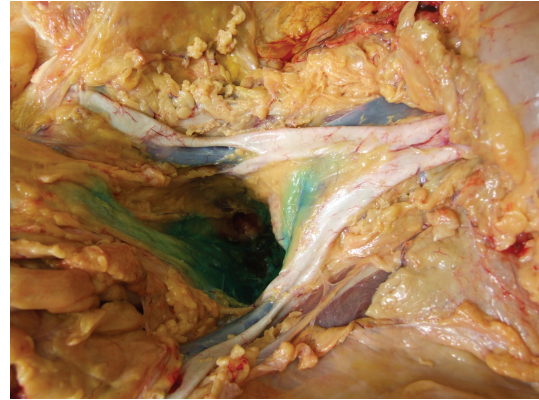


FIGURE 3: Methylene blue dye staining the sacral promontory at the L5-S1 level.

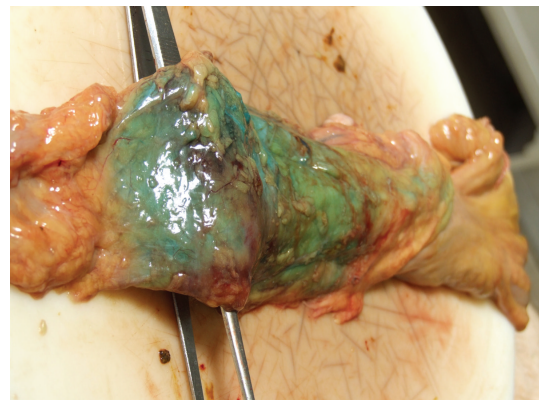


FIGURE 4: Methylene blue staining of the posterior rectal wall.

injected, needle bevel orientation and if any of these factors influence bilateral contrast distribution.

Patient analgesia achieved with this blockade is most likely the result of anesthetizing the S1, 2, and 3 anterior sacral nerve roots and the superior hypogastric plexus, but not the inferior hypogastric plexus. The fact that methylene blue dye spread to these specific sacral nerve roots confirms the anatomic distribution of the sacral afferents to the IHP at the S2 and S3 levels. Spread of methylene blue dye to the S1 level on the ipsilateral side of injection is likely related to the proximity of the needle tip and volume of injectate near this nerve root and would explain the greater level of transient sacral nerve blockade on the injected side in patients receiving IHP blockade. The transsacral injection technique described consistently involved the superior hypogastric plexus as demonstrated by uniform distribution of dye to the sacral promontory in all subjects. This would make the transsacral approach an alternative, although a technically more challenging method to perform nerve blockade of the superior hypogastric plexus on account of the narrow and obliquely angled bony window that the needle must be placed through to reach the presacral plane. The lack of dye diffusion to the contralateral side of injection or spread to roots above or below S3 in the two cadavers could explain the 73% success rate for achieving analgesia in

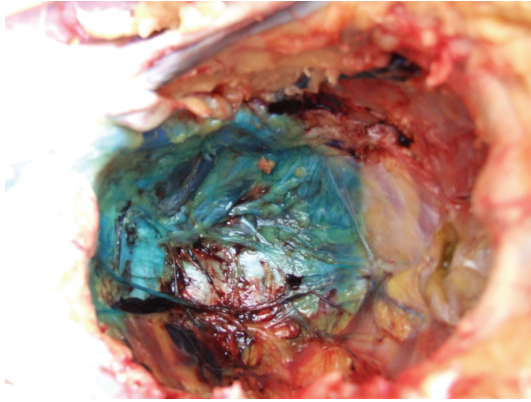


FIGURE 5: Lack of distribution of methylene blue dye to structures other than the posterior rectal wall.

patients receiving an IHP nerve block [3, 8]. Success rates for IHP nerve blockade may be increased by positioning the needle tip closer to the midline point using a more horizontal angle of approach as it is advanced anteromedially through the foramina. Performing a bilateral procedure in those cases where the midline cannot be reached with the needle tip, or increasing the volume of therapeutic agent injected also would increase the success rates for analgesia with this technique [9, 10].

Superior hypogastric plexus blockade is currently done by a variety of techniques that are technically difficult to perform. The traditional Plancarte approach uses two posteriorly placed needles but this may prove technically challenging to perform because of the possible obstruction of needle passage by the bony margins of the iliac crest and transverse process of L5 [11]. Other techniques for blockade of the superior hypogastric plexus include the computed tomographic guided single needle posterior approach described by Waldman et al., the fluoroscopically guided anterior approach proposed by Kanazi et al., a paramedian transdiscal approach as mentioned by Erdine et al., and the variant posteromedian transdiscal approach reported by Turker et al. [8, 12–14]. The transsacral approach to the IHP described in this study reduces the risk of injury to anterior structures such as small bowel, bladder, and common iliac artery, and also reduces the risk of infection related to traversing through bowel from the anterior approach. The transsacral technique also avoids the risk of discitis that can occur in up to 2% of patients from the posterior and paramedian transdiscal approaches to the superior hypogastric plexus [8]. The transsacral approach does cause transient sacral nerve paresthesias in 5% of patients, responsible for sensory and motor innervation of the pelvic floor structures, and one must exercise caution if using this technique for injection of neurolytic agents such as phenol, but no persistent paresthesia or nerve injury has been reported [3]. There is significant risk of discitis, cauda equine nerve injury, and postdural puncture headache in the setting of a superior hypogastric plexus block using the transdiscal approach, although these have not been frequently reported [15].

6. Conclusions

Blockade of the IHP by a transsacral approach as simulated by dye distribution following injection and dissection in cadavers in this study demonstrated dye diffusion along the dorsal rectal wall and anterior sacral surface in all subjects and absence of spread to any other pelvic viscera. The dye spread to the superior hypogastric plexus in all cadavers. Distribution of dye along the ipsilateral anterior sacral nerve roots at S1, 2, and 3 and bilateral diffusion of dye was present in 3 of the 5 subjects in which the needle tip was located closer to the midline on imaging. Clinical correlation with regards to failure of IHP blockade in some patients due to either lack of contralateral spread of therapeutic agent due to the needle tip being positioned too far laterally from the midline, the needle bevel not being correctly oriented or inadequate volume of local anesthetic injected could be attained by further cadaveric studies into these variables. The use of the transsacral approach as an alternative technique for superior hypogastric plexus blockade is proposed although transient paresthesias of the sacral nerves have been observed in 5% of patients. Further studies into these two observations would assist in further validating this technique.

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