SYMPATHETIC BLOCKS AND THEIR ROLE IN MANAGEMENT AND DIAGNOSIS OF CHRONIC PAIN SYNDROMES

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Overview

Activity of the sympathetic efferents and their role in the pathology of chronic pain syndromes has been well described in the literature. In such classic conditions as complex regional pain syndromes, peripheral vascular disease, central pain, injury to the brachial plexus, lumbosacral plexus or conditions like trigeminal neuralgia or post herpetic neuralgia have all been felt to have an element of sympathetic maintained pain as their underlying etiology. The sympathetic contribution to these conditions can differ in the magnitude of involvement. Patients clinically presenting with anyone of the above chronic painful conditions can have elements of sympathetic maintained pain as well as sympathetic independent pain. Although this area is controversial, with respect to pathology of central and peripheral processing of painful stimuli, a generalization can be made. That investigation into the role of sympathetic maintained pain can have a profound effect on the successful diagnosis and treatment of many chronic pain syndromes. If it is determined, that sympathetic contribution to the patient's chronic pain syndrome is significant, then this would direct a different algorithmic approach to treatment. Failure to make this determination early on often underlies diagnostic and treatment failures in chronic pain syndromes.

Neuroanatomy of the Sympathetic Nervous System

The peripheral portion of the sympathetic nervous system consists of two portions. The paravertebral portion consists of two chains that extend from the base of the skull to the lower portion of the coccyx. The second portion consists of several major prevertebral plexuses that enervate the abdominal and thoracic contents including the aorta and its large visceral branches such as cardiac, celiac, and hypogastric plexuses. In the sacral area, the two sympathetic chains gradually merge and are fused in location just anterior to the sacrococcygeal ligament and forms the ganglion impar or Walther's ganglion.

General Anatomic Location of the above described sympathetic ganglia
Regarding the role of diagnostic sympathetic blocks in the treatment of chronic pain syndromes, not only are they useful for diagnosis of sympathetic pain but they also can be used as a prognostic indicator for consideration of neurolytic ablations in the treatment of sympathetic maintained pain.

General diagnostic considerations for sympathetic blocks should address the following concerns:

- Attempt to find location and sources of the pain generator
- Contributions of somatic vs. visceral origins of pain into the thoracic or abdominal regions
- Contributions of sympathetic vs. somatic pain in peripheral structures
- Attempt to identify sources of referred pain
- Delineation of exact levels of nociceptive afferent input
- Identification of central pain syndromes
- Role of the musculoskeletal system as etiology of pain with respect to painful spasm vs. fixed contracture

**Performance of Sympathetic Blocks**

The following section will described in detail the technique of sympathetic blocks covering the above anatomical locations. The following blocks will be described: cervical and thoracic ganglia (which enervates the brain meninges, eye, ear, tongue, pharynx, larynx, glands and skin of the head, neck and upper extremity), celiac plexus (which enervates the majority of the GI tract from distal esophagus to mid transverse colon), lumbar sympathetic ganglia, hypogastric plexus (which enervates descending and sigmoid colon, rectum, vaginal fundus, bladder, prostate, prostatic urethra, testes, seminal vesicles, uterus and ovaries), ganglion impar (which enervates perineum, distal rectum and anus, penis, and vulva and distal third of the vagina).

**Stellate Ganglion Block**

The stellate ganglion also called the cervicothoracic ganglion, results from the fusion of the inferior cervical and the first thoracic sympathetic ganglia. The classic approach to the stellate ganglion block involves contacting the transverse process of C6, (Chassaignac’s tubercle), and injecting a test dose before delivering the full volume.

**Indications**

Stellate ganglion blocks are used primarily for treatment of vascular insufficiency of the upper extremity and face, and painful syndromes such as CRPS 1 and 2 and neuropathic states such as acute herpes zoster infection or post-herpetic neuralgia.

**Technique**

The patient is placed supine. In some individuals, it may be necessary to place a towel to extend the neck. Before beginning, temperature strips should be placed on both sides of the face or bilateral upper extremities to assess sympathetic interruption. Using aseptic technique, the paratracheal area is prepped and the tissues of the neck are retracted laterally using two fingers. Using a 22-gauge needle, the skin is entered and the needle is advanced to contact the lateral tubercle of C6. After contact with the tubercle and after negative aspiration, 0.25 cc is given and 15 seconds are allowed to elapse to rule out intravascular or subarachnoid entry. The remaining volume is then given in 3 cc aliquots with aspiration performed between each volume. Typically, stellate ganglion blocks are performed using 10 to 12 cc of low concentration local anesthetics, (1% Xylocaine or 0.25% bupivacaine). This block may be performed using a short extension tubing to facilitate stable positioning of the needle during performance of this procedure. However, this approach requires the use of two people. Some authors recommend using the C7 approach, however, there is increased risks primarily due to being in proximity to the vertebral artery and brachial plexus sheath. However, this may increase the success rate since its location is closer to the stellate ganglion.
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Side Effects and Complications
Common side effects for this block include blockade to the recurrent laryngeal nerve affecting swallowing, hoarseness, blockade of cervical sympathetic nerves causing Horner’s syndrome (ptosis, miosis, and enophthalmos) and nasal congestion. Complications related to this block include pneumothorax, subarachnoid or epidural block if the needle is located near the dural cuff, vertebral artery injection causing either convulsions and or immediate loss of consciousness, laceration of the thoracic duct if performed on the left side, esophageal puncture and infection. In some patients spread of the local anesthetic solution can be inhibited by presence of the first rib or fascial structures. In this situation, approach to sympathetic blockade of the upper extremity can be accessed via the second thoracic vertebrae approach.

Second Thoracic Vertebrae Approach to Sympathectomy of the Upper Extremity
Utilizing the posterior approach to this block, either sympathetic interruption to the upper extremity can be accomplished or a neurolytic technique can be employed using alcohol or phenol.

Technique
The procedure is performed with the patient lying in a prone position. A pillow is placed under the chest to allow cervical flexion. Under fluoroscopy, AP and lateral views are obtained of the thoracic vertebrae with identification of the T2-T3 interspace. A point 2 cm. off the midline at the mid portion of the interspace was marked. At this point a 22-gauge 3.5-inch needle with a depth marker in place is inserted 30 degrees and angled slightly towards the midline. When the needle contacts the lamina, the marker is placed 1 to 1.5 cm above the skin. The needle is withdrawn one-half its length and redirected perpendicular to all skin planes. If the needle contacts the lamina again, it is withdrawn halfway and the overlying skin is pulled more laterally until the needle tip passes just lateral to the lamina and is reinserted to the depth indicated by the marker. Proper needle tip placement is confirmed using 1 ml of Omnipaque 180 contrast. Three ml of local anesthetic is then given after negative aspiration.

Side Effects and Complications
Pneumothorax is the most common complication associated with the thoracic approach to sympathetic blockade. Careful needle advancement and knowledge of anatomy can prevent this. Occasionally patients will cough during injection of the medication and they should not be misconstrued as occurrence of a pneumothorax. This may be due to pleural irritation. As with any invasive procedure there are vascular as well as neurological complications that can occur with this procedure.
**Celiac Plexus Block**

The celiac plexus is the largest of the prevertebral plexuses in the body. There is a right and left portion of the ganglia. They are typically located anterior to the crura of the diaphragm due to the aorta. This ganglion extends in front of the lower half of the body of the T12 vertebrae and the entire first lumbar vertebrae.

The ganglia are composed of terminal portions of the greater, the lesser, and the least splanchnic nerves. Due to the extensive system of ganglia, that the celiac plexus receives input from, this major plexus enervates all of the abdominal viscera from the distal esophagus to the splenic flexure of the colon.

**Indications**

Celiac plexus block is indicated primarily for the relief of pain generated from the abdominal viscera. Primarily, this sympathetic block is used either as a diagnostic modality or it may be employed for neurolytic purposes either for malignant or benign abdominal or pancreatic pain.

**Technique**

There are three approaches to the performance of this block. The posterior approach is the one most commonly employed. However, some prefer the transaortic approach or the bilateral splanchnic approach. There is also an anterior approach described via the epigastrium.

The patient is placed prone on the fluoroscopic table and pillows may be necessary under the abdomen. Landmarks are a line drawn over the midline at the level of the lumbar vertebrae. A second line is made 8 to 10 cm from the midline and the point where this second line crosses the last rib is the site of needle insertion. A straight line from this insertion site to the midline corresponds to the level of the second lumbar vertebra. A line 30-degree cephalad to this is directed toward the L1 vertebra. The patient is placed in the prone position, with a pillow under the abdomen to decrease the lumbar lordosis. The needle is inserted at the above-described site and angled toward the L1 vertebra, which is approximately 30 degrees cephalad to the line connecting the needle entry site to the side of the L2 vertebra. A 6 inch (15 cm) 20-gauge needle is inserted, with depth markers in place, at an angle of 40 to 45 degrees to the plane that is perpendicular to all planes of the skin. Once the needle contacts the body of the L1 vertebra, the needle marker is adjusted 1 to 2 cm from the skin. The needle is then withdrawn two thirds of the way out and reinserted at a 30-degree angle to the plane that is perpendicular to all planes of the skin. The needle is then advanced until the needle marker touches the skin or the needle passes 1 to 2 cm beyond the vertebral body of the L1 vertebra. After negative aspiration, the patient is given approximately 5 ml of water-soluble contrast media; if the dye pattern is acceptable then 20 to 25 ml of 1% Xylocaine or 0.25% bupivacaine is then administered. The identical procedure is then repeated on the opposite side. The location of the ganglia on the left is lower than the right. The left ganglion is injected first. The target for the needle tip for the left ganglia should be the middle to the lower third of the first lumbar vertebral body. The target for the needle tip for the right ganglia should approximate the middle third of the first lumbar vertebral body. Both sides should receive identical volumes of local anesthetic.
Side Effects and Complications
Complications encountered during celiac plexus block can involve orthostatic hypotension, spinal or epidural injection, somatic nerve injection, paralysis, kidney laceration, pneumothorax, loss of rectal or bladder function, aortic puncture with dissection, abdominal visceral injury, or thrombosis of the superior or hepatic arteries. Acute paralysis is the most serious potential complication of celiac plexus block. In addition to inadvertent spinal or epidural injection, there have been episodes of paresis thought to be due to traumatic injury to the Artery of Adamkiewicz. Anterior spinal artery syndrome consisting of loss of motor function and partial or total loss of sensory function has also been described.

Lumbar Paravertebral Sympathetic Block
This sympathetic chain in the lumbar region lies in the anterolateral portion of the bodies of the L2 and L3 vertebral bodies. This block is performed to enhance vasodilation to the lower extremities or to confirm an element of sympathetic maintained pain to the lower extremities.

Technique
The major landmarks to be used as guides include the line drawn in the midline overlying the lumbar vertebrae and a second line which is parallel and 8 to 10 cm lateral to this first line. The point where this parallel line crosses the last rib is usually adjacent to the body of L2. It is recommended that this block be performed as a single needle technique at the L3 level (upper third of the body of L3). This approach should prevent possible neuralgia in the distribution of the genitofemoral nerve and injury to the kidney. Insertion of the needle 8 to 10 cm from the midline enables the needle to reach the anterolateral angle of the vertebral body. This approach positions the needle closer to the sympathetic chain and away from the somatic nerve roots.

The patient is placed in the prone position with a pillow under the abdomen. A 6 inch 20 gauge needle is inserted, with depth markers, across from the body of L3 under fluoroscopy at an angle that is 40 to 45 degrees to the plane that is perpendicular to all planes of the skin. The needle is directed toward the upper half of the body of L3. On contact with the body of L3, the needle marker is placed 1 to 2 cm above the skin (depending on the patient’s size). The needle is then withdrawn two thirds of the way out and reinserted at a 30-degree angle to the plane that is perpendicular to all planes of the skin. The needle is then advanced until the depth markers touch the skin or until the needle reaches the anterolateral border of L3.
Correct needle placement is confirmed by injection of 3 to 5 ml of nonionic contrast media. The dye should track in the fascial plane and not outline muscles or appear intravascular. 15 to 20 ml of local anesthetic is then injected using frequent aspiration. Either 0.5 to 1.0 % lidocaine or 0.25% bupivacaine may be used.

Proper dye pattern is indicated in the above radiograph. In addition, appropriate temperature monitoring should be conducted on both lower extremities both before performance of the block as well as after the block.

If this block is performed for neurolytic purposes then both L2 and L3 ganglia are injected using no more than 2 ml of either 6% to 10 % phenol or 100% alcohol.

Side Effects and Complications
Complications of lumbar paravertebral sympathetic block include bleeding from the great vessels, trauma to the ureters, infection, hypotension, inadvertent epidural or spinal injection, intravascular injection, or damage to the nerve roots. Since the genitofemoral nerve is in the area of the third lumbar vertebrae any paresthesias produced in this distribution indicate that needle placement is too low and should be repositioned.

**Superior Hypogastric Block**
The superior hypogastric plexus enervates the pelvic viscera as well as the descending portion of the colon from the splenic flexure. Chronic pelvic pain secondary to cancer or benign conditions may be
relieved by sympathetic block of this plexus. This ganglion is in the retroperitoneal portion of the pelvis. The ganglion is typically found extending from the fifth lumbar vertebral body to the upper portion of the first sacral vertebrae.

**Technique**

Patients are placed in the prone position on the fluoroscopic table. A pillow may be necessary under the abdomen to relieve the lumbar lordosis. The L4-L5 intervertebral space is located and skin anesthesia is placed bilaterally five to seven cm off the midline caudad to the level of the L4-L5 junction. Typically, 6-inch needles are used employing either 20 or 22 gauge sizes. The bevels are directed 45 degrees mesiad and 30 degrees caudad. The target point for the needle tips are in the anterolateral portion of the L5-S1 intervertebral space. Needle placement is confirmed by the injection of three to five ml of water-soluble contrast media. After negative aspiration, a diagnostic block is performed using 8 to 10 ml of the local anesthetic of choice, typically in a sympathetic concentration like 0.125 percent or 0.25 percent bupivacaine. A neurolytic block may be also be indicated in this is performed with six to 10 percent phenol in sterile water.

**Side Effects and Complications**

Currently there are no reported complications experienced from performance of this block. However, negative aspiration should be performed and the occurrence of any paresthesias dictates a change in needle placement.

**Ganglia Impar block**

The terminal portion of the sympathetic ganglia resides in the area of the coccyx. This anatomy results from the fusion of the two bilateral chains. As they fuse anterior to the sacrococcygeal junction, they form the ganglion impar, a.k.a. Walthers ganglion. This ganglion is a single retro-peritoneal structure that lies in front of these bony structures. The ganglion impar is responsible for innervation of perineal structures including the distal rectum, anus, distal urethra, vulva, and distal vagina.

**Technique**

The patient is placed on the procedure table in the prone position. A standard 22 gauge, 3.5-inch spinal needle is used. Using the transsacrococcygeal technique, the needle is advanced directly through the sacroccocygeal ligament under fluoroscopic guidance using loss of resistance. After visual localization of the needle tip anterior to the bony structures, contrast is used to show spread along the ventral side of the coccyx. If performing a diagnostic block, five to eight ml of local anesthetic is used. For neurolytic block's 2 to 3 ml of 6% to 10 percent phenol is used.
Summary

The above described interventional sympathetic nerve blocks are associated with significant risks. As with any invasive technique standard precautions are to be employed to insure patient safety. These include intravenous access, use of full monitoring and the availability of resuscitative equipment.

References

- Cueto A, DeRosayro A, Rutter, T; Mullin V: T2 Sympatheitc Block II for Sympathetically Maintined Pain.