Peripheral Sympathetic Blocks

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stellate ganglion block

Anatomy: The cervical sympathetic trunk contains three interconnected ganglia: the superior, middle, and inferior cervical ganglia. In 80% of people the lowest cervical ganglion is fused with the first thoracic ganglion to form the cervicothoracic (stellate) ganglion. If not connected, the first thoracic ganglion is labeled as the stellate ganglion. The cervical ganglia receive preganglionic fibers from the lateral gray column of the spinal cord; the myelinated preganglionic cell axons originate from the anterolateral horn of the spinal cord. The nerve fibers emerge from the upper thoracic spinal cord through the ventral spinal root, joining the spinal nerves at the start of the ventral rami. They leave the spinal nerve through the white rami communicantes, which enter the corresponding thoracic ganglia, through which they ascend into the neck. The preganglionic fibers for the head and neck emerge from the upper five thoracic spinal nerves (mainly the upper three), ascending in the sympathetic trunk to synapse in the cervical ganglia. The preganglionic fibers supplying the upper limb originate from the upper thoracic segment, probably T2–T6, ascend via the sympathetic trunk to synapse in the cervicothoracic ganglion, where postganglionic fibers pass to the brachial plexus. The white ramus to the cervicothoracic ganglion contains most of the preganglionic fibers for the head and neck; these ascend the trunk to the superior cervical ganglion from which postganglionic branches supply vasoconstrictor and sudomotor nerves to the face and neck, secretory fibers to the salivary glands, dilator pupillae, and nonstriated muscle in the eyelid and orbitalis. Blockade of this ramus leads to ptosis, miosis, enophthalmos, and loss of sweating of the face and neck (Horner’s syndrome). The cervicothoracic ganglion sends gray rami communicantes to the seventh and eighth cervical and first thoracic nerves and gives off a cardiac branch, branches to nearby vessels, and sometimes a branch to the vagus nerve. To achieve successful sympathetic denervation of the head and neck, one should block the stellate ganglion because all preganglionic nerves either synapse or pass through the ganglion on their way to the more cephalad ganglia. Blood vessels of the upper limb beyond the first part of the axillary artery receive their sympathetic supply via branches of the adjacent brachial plexus. The first and second (and occasionally the third) intercostal nerves may be interconnected by postganglionic fibers from their gray rami; these fibers provide another pathway by which postganglionic nerves pass from the upper thoracic ganglia to the brachial plexus. These anomalous pathways have been termed Kunze’s nerves and are implicated in cases of inadequate relief of sympathetic mediated pain despite evidences of cervical ganglia block.

The cervical sympathetic chain lies anterior to the prevertebral fascia which is the fascia enclosing the prevertebral muscle. It is enclosed within the lateral aspect of the alar fascia (the thin layer of fascia immediately anterior to the prevertebral fascia which separates the cervical sympathetic chain from the retropharyngeal space). It is medial to the carotid space. The carotid sheath is connected to the alar fascia by a variable mesothelium-like fascia. The fascial plane enclosing the cervical sympathetic chain may be in direct communication with several spaces including the space in front of the scalenus anterior muscle, the brachial plexus, spinal nerve roots, the prevertebral portion of the vertebral artery, and between the endothoracic fascia and the thoracic wall muscle at the T1–T2 level. These communications may explain some of the side effects of stellate ganglion block. In the upper thorax the thoracic sympathetic chain lies lateral to the longus colli muscle and posterior to the endothoracic fascia, which is the inferior continuation of the prevertebral fascia.

The cervicothoracic ganglion lies on or just lateral to the longus colli muscle between the base of the seventh cervical transverse process and the neck of the first rib (which is posterior to the ganglion), the vertebral vessels are anterior, and the nerve roots that contribute to the inferior portion of the brachial plexus are posterior to the ganglion. The vertebral artery, which originates from the subclavian artery, passes over the ganglion and enters the vertebral foramen, posterior to the anterior tubercle of C6.
Effects of Stellate Ganglion Block: The effects of stellate ganglion block are secondary to neural inhibition in its sphere of innervation, including increased blood flow as a result of peripheral vasodilation. Brain blood volume may increase. The increase in blood flow can be reversed by prostaglandin (PGE1) infusion. In left-stellate ganglion block has been shown to increase heart rate and blood pressure and to activate the sympathetic neural outflow to the skeletal muscle with no deleterious effect on the left ventricular function. In left-sided block the QTc interval and the QTc dispersion interval is decreased. Although the autonomic innervation of sinus node is mainly through the right stellate ganglion, blockade of the right stellate ganglion may attenuate both sympathetic and parasympathetic activities resulting in inconsistent changes in the RR interval and corrected QT interval. Stellate ganglion block may increase the retinal venous blood velocity without changing the retinal vessel diameter. The intraocular pressure on the blocked side may decrease and the ocular oxygen tension and ocular temperature may increase. The tympanic temperature may drop significantly 5 minutes after a stellate ganglion block and the decrease in temperature may persist for more than 30 minutes. Stellate ganglion block may modulate the immune system, although neural blockade alone cannot completely explain the effects of the block on the immune and endocrine systems. Other mechanisms of action besides vasodilatation have been suggested including the regulation of melatonin secretion by the pineal gland. Plasma melatonin levels are suppressed triggering the recovery of a physiological melatonin rhythm. Since the rhythm of melatonin secretion influences many organs, recovery of its rhythm restores various physiological biorhythms.

Clinical Indications for Cervicothoracic Ganglion Block: The therapeutic efficacy of stellate ganglion block has not been tested by randomized, controlled clinical trials and some of its clinical indications are based largely on anecdotal cases. The clinical indications for stellate ganglion block in Japan are broader than in the USA or Europe. It is not only used for diseases of the head, neck, and upper extremity, but also in systemic diseases. Although there may be grounds for the extensive clinical indications, the evidences have been insufficient to support the routine use of stellate ganglion blocks in these conditions. Moreover, there are other alternatives that are efficacious and yield immediate results.

The common indications of stellate ganglion block include complex regional pain syndrome (CRPS), acute pain of herpes zoster, postherpetic neuralgia, and acute and chronic vasculopathies of the head, neck, and upper extremity.

Other reported clinical indications include the following:

- Head: migraine, tension headache, cluster headache, temporal arteritis, cerebral angiospasm, cerebral thrombosis.
- Face: Bell's palsy, Hunt's syndrome, atypical facial hair, mastiatory muscle syndrome, temporomandibular artheros.
- Eye: retinal vascular occlusion, retinal pigment degeneration, uveitis, optic neuritis, macular edema, corneal herpes, corneal ulcer, allergic conjunctivitis.
- Ear, nose, throat: allergic rhinitis, nasal polyps, acute or chronic sinusitis, sudden deafness, Meniere's disease, benign paroxysmal position vertigo.
- Circulatory system: myocardial infarction, angina pectoris, sinus tachycardia, neurocirculatory asthenia.

Technique: An intravenous line is started and standard resuscitative equipment must be readily accessible. The patient is placed in the supine position with the head slightly lifted forward and tilted backwards to straighten the esophagus and move it away from the transverse processes. The mouth is slightly opened to relax the neck muscles. The cricoid cartilage is palpated to discern the level of the C6 transverse process. Identification of the skin crease just caudal to thyroid level may be helpful as it is found to cross the C6 transverse process level in 71% of cases. The Chassaignac's tubercle at C6 is identified. In most individuals the tubercle is located approximately 3 cm cephalad to the sternoclavicular joint at the medial border of the sternocleidomastoid muscle. The trachea and carotid pulse are palpated by the insertion of two fingers between the sternocleidomastoid muscle and the trachea (Fig. 80-1). The carotid artery is retracted laterally away from the needle entry site. A 22-gauge, short-beveled 4 to 5 cm needle is advanced downward, perpendicular to the table plane, until it touches bone and then withdrawn approximately 2 mm to avoid injection into the periosteum. The needle is in contact with either the C6 tubercle or the junction between the C6 vertebral body and the tubercle. The C6 tubercle is covered by the prevertebral fascia whereas the longus colli muscle is located at the lateral aspect of the body of the vertebra and the medial aspect of the transverse process. Injection into the substance of the longus colli muscle may result in a spread pattern that is often localized to the course of the muscle. Injection anterior to the C6 tubercle places the majority of solution anterior to the stellate ganglion. The solution may reach the ganglion especially when the drug travels in a caudal direction to the thoracic level. Therefore, sympathetic denervation of the upper extremity after C6 parastrachael injection is a complex phenomenon not entirely explained by bulk contact of local anesthetic with the stellate ganglion. This has led many investigators to refer to this type of block as a cervicothoracic sympathetic block.

Careful aspiration must be performed prior to any injection. An initial test dose of 0.5 to 1 mL must be injected slowly since intravascular injection of less than 1 mL of local anesthetic results in loss of consciousness and seizure activity. Computed tomography, magnetic resonance imaging, ultrasound, radionuclide tracers, and fluoroscopy may be used to confirm correct needle placement. Fluoroscopy is the most practical method. After 1 to 2 mL of contrast material is injected, spread of the contrast is characteristically seen. If contrast medium is not easily visualized, improper placement including intravascular, intrathecal, epidural, or intrapleural should be suspected.

The choice of medication and the volume of the solution vary according to the preference of the physician. Volumes of 5 to 20 mL have been used. A larger volume is suggested when a sympathetic block to the arm is required. However, larger volumes (20 mL) are associated with an increased incidence of recurrent laryngeal nerve block. Due to the high vascularity at the injection site, the plasma local anesthetic levels may
be higher than after other types of nerve blocks. Opioids, including fentanyl and morphine, and clonidine have been used alone or in combination with local anesthetics.

**Alternative Approaches**

**C7 ANTERIOR APPROACH:** This approach is similar to the C6 anterior approach. However, C7 has a vestigial tubercle so the C6 tubercle should be identified first and the C7 transverse process can be located one fingerbreadth caudally. In this approach less volume is needed to achieve a sympathetic blockade. The approach has some disadvantages including increased incidence of vertebral artery puncture since the artery lies anterior to the C7 transverse process and increased risk of pneumothorax since the dome of the lung lies in close proximity to the injection site.

**POSTERIOR THORACIC APPROACH:** A posterior approach to the thoracic sympathetic chain has been described. It is most frequently done with imaging guidance such as fluoroscopy or computed tomography. The needle is inserted 2 to 4 cm lateral to the upper thoracic (T1, T2, or T3) spinous process adjacent to the body of the vertebra. A 22-gauge, 8 to 10 cm needle is used. The lamina is contacted then the needle is moved laterally off the lamina, parallel to the sagittal plane, until it passes through the costotransverse ligament at a depth of 2 cm beyond the lamina. The block can be done with the loss-of-resistance technique or a contrast material is injected to document spread in the area.

**Side Effects and Complications:** Cervical ganglion block causes ptosis, miosis, nasal congestion, and warmth of the face. Recurrent laryngeal nerve block results in hoarseness, subjective feeling of lump in the throat, or subjective shortness of breath. Phrenic nerve block may lead to respiratory difficulty in patients with preexisting lung disease.

Intravascular injection of the local anesthetic may lead to loss of consciousness, apnea, hypotension, and seizures. Intravascular injection of air may result in cerebral air embolism. A transient locked-in syndrome with hemodynamic instability, eyelid movements, apnea, and motor paralysis has been reported. Brachial plexus block is secondary to the needle being inserted too posterior or from the spread of the medication along the prevertebral fascia. Intrathecal, subdural, or epidural injection may require respiratory assistance. Puncture of the pleura results in pneumothorax. The risk of pneumothorax is increased with the C7 approach. Myoclonus of the hand and arm, persistent cough, sinus arrest, intercostal neuralgia, and migraine have all been reported. Contralateral spread of the drug may occur from the injection of large volumes of the local anesthetic. Bleeding and hematoma formation cause tracheal compression and airway compromise and may require emergency tracheostomy. Properly performed, stellate ganglion block is a safe and easy procedure. Complications are rare, with an incidence of 0.17%; these occur early and are of short duration. Full resuscitative equipment should always be available when stellate ganglion block is performed.
LUMBAR PARAVERTEBRAL SYMPATHETIC BLOCK

Anatomy: The sympathetic chain lies along the anterolateral surface of the lumbar vertebral bodies, the psoas muscle and fascia separating the sympathetic nerves from the somatic nerves. The lumbar sympathetic chain contains pre- and post-ganglionic fibers to the pelvis and lower extremities. The location of the sympathetic ganglia on the vertebra at the level of the second and third lumbar vertebral bodies, where the sympathetic innervation of the lower extremities mostly originates from, was studied in cadavers. The ganglia were most frequently found at the level of the lower third of the second lumbar vertebra, at the L2–L3 interspace, and at the upper third of the third lumbar vertebra. Therefore, the best site for placement of the tip of the needle is the anterolateral surface of the lower third of the second vertebral body or at the upper third of the third vertebral body. The segmental artery and vein pass along the midportion of the lumbar vertebral body in a tunnel under the dense fascia. Solutions injected at the mid-vertebral level may pass posteriorly in this tunnel to the epidural space. Crossover of the sympathetic fibers to the other side has been described.

Indications: Lumbar sympathetic blocks are performed to determine the degree of sympathetic-mediated pain in a patient with acute or chronic pain, as prognostic or therapeutic blocks in patients with sympathetic mediated pain, for the improvement of blood flow in patients with vascular insufficiency of their lower extremities, and for the management of neuralgic pain associated with peripheral nerve injuries such as those following trauma or limb amputation.

Technique: The patient is placed prone with a pillow underneath the lower abdomen to reduce lumbar lordosis. Blind insertion of the needle has been described. However, radiologic confirmation is preferable because of variability of the body habitus, the uncertainty of the vertebral level of insertion, and to confirm correct placement of the needle tip. The earlier techniques involve injections at the L2, L3, and L4 vertebrae. More recent techniques described the use of a single needle. In the technique of Hatangdi and Boss the midline is marked and the tip of the twelfth rib palpated on the side to be injected. The site of insertion of the needle is 2 to 3 cm below and medial to the tip of the twelfth rib, opposite the body of L3 (Fig. 80-2). A 5- to 7-inch, 22-gauge needle is inserted 8 to 10 cm from the midline, at a 30° to 45° angle, lateral to the spinous process, to reach the anterolateral aspect of the vertebra. Correct placement of the needle is confirmed by the injection of 2 to 3 mL of nonionic contrast that shows a linear spread of the dye along the anterolateral aspect of the vertebral bodies (Fig. 80-3). A volume of 15 to 20 mL of local anesthetic is then injected. Some authors first identify the psoas muscle by injecting 0.5 to 1 mL of dye, visualizing the "psoas stripe," then advancing the needle until it is anterior to the psoas muscle. For neurolytic blocks, a two-needle technique is recommended, one needle at L2 and the other needle at L3. The injection of 2 to 4 mL of 6% phenol at each site allows better control of the spread of the neurolytic agent, in contrast to an injection of 6 to 10 mL of phenol at one site. Some investigators recommend confirmation of correct needle placement by demonstration of a temperature increase after injection of a small volume of local anesthetic, before the phenol is injected. A volume of 1 mL of air or local anesthetic is injected before the needle is removed to prevent depositing the neurolytic solution on the somatic nerves during removal of the needle. The patient is kept on the side for 15 to 30 minutes to prevent the phenol from spreading laterally toward the genitofemoral nerve or posteriorly between the slips of origin of the psoas major muscle and along the fibrous tunnel occupied by the rami communicantes, toward the somatic nerve roots. The patient is then turned supine and instructed not to raise his/her head for at least 1 hour.

FIGURE 80-2. Single-needle technique of lumbar sympathetic blockade. X is the site of the needle insertion.

FIGURE 80-3. Linear spread of the dye along the anterolateral aspect of the vertebral body.
Insertion of the needle at 10 cm from the midline is the preferred site by some investigators. Insertion of the needle closer to the midline takes the needle path close to the somatic nerve roots. The more lateral the needle insertion the closer is the tip of the needle to the sympathetic chain. There is also less risk of piercing the roots of the lumbar plexus or encountering the transverse process.

Complications of lumbar paravertebral sympathetic block include bleeding from puncture of the lumbar vessels or the aorta, hematoma, infection, orthostatic hypotension, perforation of the abdominal viscera, transient backache and stiffness, epidural or subarachnoid blockade, lumbar plexus block, and segmental nerve injury. There is a 5% to 40% incidence of postblock neuralgia but this is usually of limited duration. The genitofemoral nerve passes below L3 so injection at L4 is not advisable.

Radiofrequency Lumbar Sympathectomy: Roccò described the use of radiofrequency (RF) sympathectomy to relieve the pain of sympathetic maintained pain, i.e., CRPS type I.22 The site of RF sympatheolysis was slightly cephalad to the middle of the L3 vertebra; contrast material was injected to confirm the correct placement of the needle. Reproduction of the pain, spread of the dye, rapidity of temperature rise in the leg, and increase in the pulse amplitude were useful guides to appropriate placement of the needle tip. The needle tip was heated to 80°C and the temperature maintained for 90 seconds. Of the 20 patients who had RF sympathectomy, 5 continued to have pain relief 5 months to 3 years after the last RF procedure while 15 had temporary relief or no relief at all. Roccò concluded that despite the early sympathetic blockade, as confirmed by a warm foot, long-lasting relief with RF sympathectomy was difficult to obtain.22

MONITORING THE ADEQUACY OF SYMPATHETIC BLOCKADE

Successful stellate ganglion block denervates the upper cervical segments to produce Horner's syndrome that includes ptosis, miosis, and anhidrosis. Other signs include unilateral nasal stuffiness (Guttman's sign), hyperemia of the sympathetic membrane, and warmth of the face. The presence of Horner's syndrome signifies cephalic sympathetic blockade and does not imply sympathetic denervation of the arm.23 If the block is used to treat the shoulder or upper limb, additional signs are needed to determine sympathetic blockade in the area. Complete block is reliably detected when a test of adrenergic fiber activity (thermography, plethysmography, laser Doppler flowmetry) is combined with a test of sympathetic cholinergic (sudomotor) fiber activity (sweat test, sympathetic galvanic response).

Increase in skin temperature is the most commonly used clinical sign of sympathetic blockade. Commonly, skin temperature is measured by using adhesive thermocouple probes that are placed distally to the extremity being monitored. For continuous skin temperature measurements, thermocouple devices are placed bilaterally. It is important to allow the patient some time to accommodate to the room temperature before the first temperature measurements are taken. If an infrared thermography unit is used, an average sensitivity to skin temperature changes is about 0.1°C. Another qualitative thermography technique is liquid crystal thermography, with reported sensitivity of about 0.8°C. Different investigators considered different increases in skin temperature as signifying effective sympathetic blockade. After a stellate ganglion block, skin temperature increases of 1.5°C, 3.8°C, and 7.5°C have been considered as signifying successful sympathetic blockade. A mean increase of 3°C was noted after a lumbar paravertebral sympathetic block.27 Hogan et al. recommended that the ipsilateral temperature increase should exceed that of the contralateral side to indicate successful sympathetic blockade. Stevens et al. found that a temperature increase that was 2°C higher than the contralateral extremity signified complete sympathetic blockade in most patients but it was not sufficient to guarantee a complete sympathetic block in all their patients.28 The magnitude of temperature increases after complete sympathetic blockade depends on the baseline values; greater increases are noted in patients with lower preblock temperatures.29 With vasodilation, the skin temperature will approximate core body temperature. Since the upper limit of skin temperature in the fingers and toes is 35 to 36°C,30 patients other than those with organic peripheral vascular disease can approach 35 to 36°C as a limit of complete sympathetic blockade.39 Patients whose baseline skin temperatures are low because of vasoconstriction (those with late-stage CRPS) will have large increases after complete sympathetic blockade. A patient who has vasodilation of the involved extremity, someone with early-stage CRPS, cannot be expected to have a large temperature increase. The absolute change in temperature of the affected extremity is greater if temperature is measured more distally (e.g., index finger rather than upper arm).

Laser Doppler flowmetry is a sensitive method to evaluate skin blood flow and to detect the presence of sympathetic blockade. Most of the devices available today have a low-power laser source and flexible fiberoptic light guides, which deliver laser light to the skin. When light is reflected from the moving red blood cells, the device has a shift in frequency that can then be analyzed in real time. Some investigators consider a 50% or greater increase in the skin blood flow to signify successful sympathetic block.31

Blood flow can be determined accurately by using plethysmographic methods such as venous-occlusion plethysmography. A transducer is placed on the finger to measure the change of the finger volume over time, or the whole foot or hand is placed in a water bath that is attached to the transducer. Rapid inflation of the venous tourniquet around the finger allows arterial blood to enter the finger but prevents venous blood to leave. The finger's rate of volume increase is measured using the volume transducer and typical plethysmographic trace is produced. The slope first rapidly increases then reaches a plateau phase when enough blood has entered the finger to equalize the venous and tourniquet pressures. After successful sympathetic block of the extremity, there is a marked increase of the upward slope because of a significant increase in the pulse wave. Investigators found a better correlation of the blood flow measured by volume plethysmography with skin surface temperature gradients than blood flow measurements by laser Doppler flowmetry.31

Abolition of sweating and of the sympathogalvanic response (SGR) are among the standard tests of complete sympathetic blockade.32–34 The older starch iodine test is messy and cumbersome while the newer sweat tests, the cobalt blue and the ninhydrin sweat tests, are easier to perform. Benzon et al. have modified the preparation of the two sweat tests. For the cobalt
blue filter paper, 0.5 M CoCl₂ in 70% ethanol is used while 2% ninhydrin in 70% ethanol with 1 mL of 4 M acetate buffer (pH 5.5) per 100 mL solution is utilized for the ninhydrin filter paper. Seventy percent ethanol is used because it dries up rapidly and does not require heating of the filter paper. The solutions (cobalt blue or ninhydrin) are applied evenly on a Whatman No. 1 filter paper at 2 mL/100 cm². The papers are dried at room temperature and stored in a desiccator. The sweat tests are performed in the following manner. The patient's fingers or toes are wiped dry and the cobalt blue- or ninhydrin-impregnated filter paper is taped on them. A transparent tape is used so the change in color of the cobalt blue paper secondary to sweating can be seen. Sweating is signified by a change in color of the cobalt blue filter paper from blue to pink and the appearance of purple dots in the ninhydrin filter paper. Unfortunately, the cobalt blue and ninhydrin sweat tests are not available commercially.

The SGR can be recorded using a regular ECG machine. The right arm and left arm leads of the ECG are placed on the dorsum and palm of the hand (or dorsum and sole of the foot), the other leads are placed on the contralateral extremity, and the lead selector switch turned to lead I. The stimulus can be a deep breath, pinprick, or loud noise. The response consists of an upward or downward deflection of the ECG tracing; it can be monophasic or biphasic. Partial sympathetic block reduces the response while complete block abolishes it, i.e., the tracing is a straight line (Fig. 80-4). The SGR has several shortcomings including marked variations in the responses of patients to the different stimuli and difficulty in obtaining a satisfactory recording under clinical conditions. There is also a rapid habituation to the stimuli used, i.e., the patient has no SGR in the absence of a sympathetic block after several SGR recordings with the same stimulus.

The two sweat tests are more reliable than the SGR in predicting complete sympathetic blockade. The sensitivities of the sweat tests and the SGR were found to be 90%. The specificity of the SGR was 95% compared to 100% for the sweat tests; their accuracy was 74% and 95%, respectively. Since these tests are rarely used clinically, temperature increases to 35 or 36°C can be considered as signifying complete sympathetic blockade.

Relief of pain does not imply complete sympathetic blockade since patients with chronic pain may exhibit complete pain relief after partial sympathetic blockade. Partial pain relief, on the other hand, signifies one of two things. The patient's pain may be due to causes other than sympathetic-mediated pain (e.g., combined somatic sensory- and sympathetic-mediated pain or combined sympathetic-mediated and central pain) or the sympathetic blockade may be partial. A sign of complete sympathetic blockade is therefore necessary in these instances. It is also valuable after surgical or chemical sympathectomy to demonstrate complete sympathetic interruption and to correlate recurrence of pain with sympathetic recovery.

KEY POINTS

- The cervicothoracic ganglion lies on or just lateral to the longus colli muscle between the base of the seventh cervical transverse process and the neck of the first rib. The vertebral vessels are anterior and the nerve roots that contribute to the inferior portion of the brachial plexus are posterior to the ganglion.

- The intravascular injection of a small volume (1 mL) of local anesthetic may result in convulsion. This is secondary to injection of the local anesthetic into the vertebral artery.

- The appearance of Horner's syndrome does not signify sympathetic blockade of the upper extremity. Signs of sympathetic blockade of the arm must be documented.

- The lumbar sympathetic ganglia are most frequently found at the lower third of the L2, the L2-L3 interspace, and at the upper third of L3. Therefore, the best site for placement of the needle is at the anterolateral surface of the lower third of L2 or at the upper third L3. The genitofemoral nerve passes below L3 so injection at L4 is not advisable when chemical neurolytic block is performed.

- Increase in skin temperature is the most commonly used clinical sign of sympathetic blockade. The magnitude of temperature increases after complete sympathetic blockade depends on the baseline values. Greater increases are noted in patients with lower preblock temperatures. Since the upper limit of skin temperature in the fingers and toes is 35 to 36°C, patients without organic peripheral vascular
disease can approach 35 to 36°C as a sign of complete sympathetic blockade.

- Abolition of sweating and of the SGR are the standard tests of complete sympathetic blockade. The two sweat tests are more reliable than the SGR in predicting complete sympathetic blockade. Since these tests are rarely used clinically, temperature increases to 35 or 36°C can be considered as signifying complete sympathetic blockade.

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