Sympathetic Nervous System Blocks for the Treatment of Cancer Pain

17

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Introduction

The anatomist Galen first described the sympathetic nervous system (SNS) in the second century AD. However, a more complete anatomical description of the iconic paravertebral chains would be delineated by the Oxford scholar Thomas Willis in his remarkable book *De Cerebri Anatome* (1664 AD). Experimentally, the French scientist Francois Pourfour du Petit (1664–1741 AD) is credited with transecting the superior cervical chain in a dog which resulted in what would later be known as Horner's triad [1]. This experiment appears to be the first purposeful SNS block that would be easily understood by the modern physician. In 1948, Dargent published the first major case series assessing the role of the SNS in cancer pain by evaluating percutaneous cocaine sympathetic blocks and surgical sympathectomies [2].

The autonomic nervous system is comprised of the sympathetic nervous system, parasympathetic nervous system, and enteric nervous system. Anatomically, the SNS is composed of both pre- and postganglionic neurons. The soma of preganglionic sympathetic neurons is located in the intermediolateral column of the spinal cord from T1 to L2. These neurons then leave the spinal canal as myelinated neurons on the ventral nerve root and travel to the thoracic paravertebral ganglia. These are paired ganglia on the anterolateral surface of the vertebrae. Embryologically, paired ganglia are formed for every vertebral level, but during development sequential ganglia can fuse, particularly in the cervical region. Preganglionic neurons can synapse at the same paravertebral ganglion level that they enter, or they can ascend or descend before synapsing. Postganglionic neurons with their soma in the paravertebral ganglia then track toward their target organs (Fig. 17.1). Alternatively, some presynaptic neurons pass through the paravertebral ganglia forming splanchnic nerves. These nerves synapse in prevertebral ganglia which unlike the paravertebral ganglion are not paired. Postganglionic neurons with their soma in the prevertebral ganglia then track toward their target organs (Fig. 17.1).

Thoracic, abdominal, and pelvic sympathetic nerves are generally paired with visceral afferent nerves which both track along visceral vascular supplies. The visceral afferent nerves, like somatic afferent nerves, have their soma in the dorsal root ganglia (DRG) with synaptic connections in lamina I, II outer, V, and X of the spinal cord dorsal horn. In addition, synaptic connections are also made in the intermediolateral column and on ventral motor neurons for coordination of complex visceral reflexes. Ascending spinal pathways for this lamina are principally contained in the anterolateral pathways and in the dorsal columns [3].

The role of the sympathetic nervous system in pain has a relatively recent history. Several conditions, most notably being complex regional pain syndrome, can have strong sympathetic components in the initiation and maintenance of the pain. The diagnosis of sympathetically mediated pain is generally made by associating pain with other signs of sympathetic dysregulation such as vasomotor changes, edema, tremor, and trophic changes of the affected body region [4, 5].

It is likely that several mechanisms underlie the development and maintenance of sympathetically mediated pain. Following nerve injury, nociceptors in the periphery become sensitized to direct norepinephrine application or sympathetic stimulation [6] providing a peripheral mechanism for efferent-afferent coupling. Peripheral nerve injury also triggers sympathetic efferents to sprout into the DRG and form

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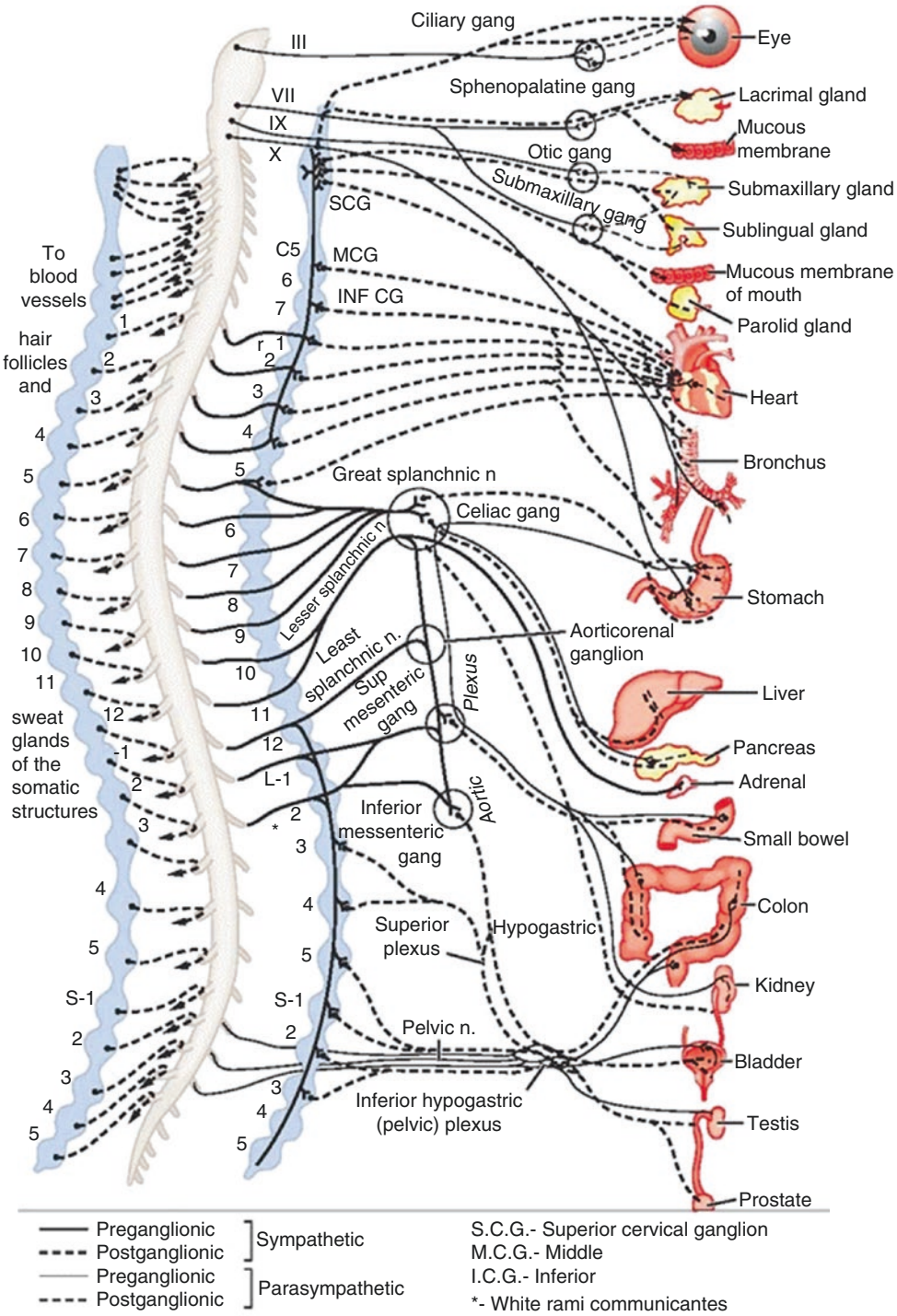

Fig. 17.1 Schematic of the peripheral sympathetic nervous system. Sympathetic fibers exit the spinal cord from T1 to L2 and enter the paravertebral chain (blue column to the right of the spinal cord). These fibers can either synapse at the same level or ascend along the paravertebral chain before synapsing at a higher level. Alternatively, some fibers pass through the paravertebral ganglia and form the splanchnic nerves before synapsing in the prevertebral ganglia. Target organs of post-sympathetic efferents are indicated on the right side of the figure. (Adapted from Griffin et al. [75] with permission from Wolters Kluwer)

"baskets" around large diameter afferent neuron providing a DRG mechanism for efferent-afferent coupling [7]. Finally, much work has also occurred in recent years regarding the role of nerve growth factor (NGF) in animal models of cancer pain. These studies have shown that NGF released by inflammatory cells near an osseous tumor can sensitize primary afferent neurons and lead to sprouting and neuroma formation of both sensory afferent and sympathetic efferent fibers [8] providing a neuroanatomical underpinning for how the sympathetic nervous system may be involved in osseous cancer pain.

The SNS can be blocked at the level of the ganglia or anywhere along a sympathetic pathway. This chapter will concentrate on the seven major sympathetic blocks commonly performed in clinical practice for the treatment of cancer pain.

Sphenopalatine Ganglion Block

Anatomy

The sphenopalatine ganglion (SPG) also known as the pterygopalatine ganglion is the most cephalad sympathetic pathway for which diagnostic and therapeutic blocks are commonly performed. The ganglion is also the largest group of neurons outside the cranial cavity. It is primarily a parasympathetic ganglion that also contains sensory and sympathetic fibers. The postganglionic sympathetic fibers that course through the sphenopalatine ganglion originate in the superior cervical ganglia. These nerves initially travel through the carotid artery plexus and then through the deep petrosal and vidian nerves before reaching the sphenopalatine ganglion in the pterygopalatine fossa. These postganglionic fibers provide sympathetic innervation to the lacrimal glands as well as nasal and palatine mucosa. Importantly, sensory afferent fibers from the maxillary nerve also pass through the sphenopalatine ganglia [9, 10].

Indications

The primary indications for the sphenopalatine block are sphenopalatine neuralgia, trigeminal neuralgia, headache (migraine and cluster), and atypical facial pain. In addition, publications have documented the effect of the block for cancer pain involving the tongue and floor of the mouth [9–11].

Evidence

The evidence for the effectiveness of the sphenopalatine ganglion block is derived from multiple case series that mainly emphasized headache, sphenopalatine neuralgia, and atypical facial pain. For example, Sanders and colleagues studied 56 patients with episodic and 10 patients with chronic cluster headaches. They all underwent radiofrequency ablation of the sphenopalatine ganglion, and 60% of the episodic and 30% of the chronic patients had total pain relief at a mean follow-up of 29 months [12]. Additionally, Narouze and colleagues performed infrazygomatic SPG radiofrequency ablation (RFA) on 15 people with chronic cluster headache and showed a significant reduction in mean attack intensity and frequency [13]. Puig and colleagues performed repeated chemical neurolysis of the SPG on eight patients with sphenopalatine neuralgia. The patients reported on average 90% pain relief with an average duration of pain relief of 9.5 months [14]. Finally, a study by Bayer and colleagues followed 30 patients with chronic face and head pain. The patients were evaluated 4–52 months after radiofrequency ablation of the SPG, resulting in 21% of patients reporting complete pain relief and 65% reporting mild to moderate relief [15].

The evidence for the SPG block in the treatment of cancer pain is specifically limited to a few small case series. Prasanna and colleagues reported ten patients with cancer of the tongue or floor of the mouth that reported significant pain relief with repeated transnasal SPG blocks [16]. In addition, another case report documented excellent pain relief in a patient with buccal mucosa cancer with significant extension into the maxilla and mandible following both diagnostic and neurolytic transnasal SPG blocks [17].

Intranasal Technique

The patient is placed supine on the procedure table. Long cotton tip applicators are then soaked in local anesthetic (commonly 4% viscous lidocaine). These applicators are then inserted through the nares and are slowly advanced to the back of the nasal pharynx. A second applicator is then advanced through the same nare, and the tip is seated immediately superior and lateral to the first applicator. These applicators are left in place for 30–60 min. The sphenopalatine ganglion is near the lateral nasal mucosa and can be blocked by diffusion of the local anesthetic through the mucosa. If additional local anesthetic is necessary, newly soaked applicators can replace the initial applicators, or local anesthetic can be trickled down the shafts of the initial applicators [9–11].

Infrazygomatic Fluoroscopic Technique

This technique can be used for diagnostic blockade and should be employed prior to SPG neurolysis. One should consider obtaining intravenous access since the patient may require sedation for successful completion of this procedure. The patient is placed supine with the head slightly turned away from the physician. Then, lateral fluoroscopic guidance is used to align the ipsilateral and contralateral mandibles. The pterygopalatine fossa is a vase-shaped structure that can be visualized under the ipsilateral zygomatic arch and posterior to the maxillary sinus. Cephalad tilt of the C-arm frequently helps visualization. Next, anesthetize the skin and subcutaneous tissues over the fossa but anterior to the mandibular rami using a 25-gauge 1.5-inch needle. Then, insert a 22-gauge 3.5-inch spinal needle under the zygoma and in the coronoid notch, and advance toward the middle of the pterygopalatine fossa. This will likely be

in a medial, cephalad, and slightly posterior trajectory. Alternate between anteroposterior and lateral views as the spinal needle is advanced toward the middle turbinate on AP view. Note that the sinus bones are exceptionally thin and easily penetrated by a needle. A reasonable argument can be made for use of blunt needles for this reason. The final position is determined in the AP view with the needle tip adjacent to the nasal mucosa. After negative aspiration, inject 0.5 ml of contrast solution to verify appropriate needle position in the fossa and to ensure that there is no vascular or intranasal spread of contrast. Then, 2 ml of 0.25% bupivacaine should be injected into the fossa. The needle can then be removed [9, 10, 18] (Fig. 17.2).

Neurolysis of the ganglia can be performed following a positive diagnostic block using either radiofrequency ablation or chemical neurolysis. For radiofrequency ablation, a 10-cm needle with a 5-mm active tip is inserted using the infrazygomatic approach as previously described. Use sensory stimulation at 50–100 Hz and 0.1–1 V to elicit paresthesia at the root of the nose. If paresthesia is felt in the upper teeth, the needle needs to be redirected inferior and medial [9]. Following appropriate needle position confirmation, inject 1–2 ml of local anesthetic. Radiofrequency ablation can be performed at 80 °C for 90 s. Alternatively, pulsed radiofrequency modulation can be performed at 42 °C for 120 s. When considering chemical neurolysis, it is critically important to inject contrast to evaluate for vascular uptake and to identify the extent of neurolytic solution spread [9–11].

Side Effects and Complications

The sphenopalatine block and neurolysis is a relatively advanced procedure that should only be performed by physicians well trained in the technical aspects of the block and potential complications. Blocking the ganglion will commonly result in ipsilateral tearing due to unopposed parasympathetic activity. Infection is possible if sterile technique is compromised or if the nasal mucosa is breeched by penetrating the lateral aspect of the nasal wall. Bleeding and hematoma are certainly considerations given the maxillary artery and vascular plexus is near the ganglion. Dysesthesia of the palate, maxilla, and oropharynx has been reported following radiofrequency ablation. Damage to the globe is possible if the needle is advanced through the inferior orbital fissure. Finally, a bradycardic reflex can occur during RFA that occasionally requires pharmacologic therapy during the procedure [9, 10, 18].

Stellate Ganglion Block

Anatomy

The stellate ganglion is commonly formed by the fusion of the inferior cervical and first thoracic sympathetic ganglia. The structure is anatomically located anterior to the neck of the first rib and C7 transverse process. The sympathetic chain proceeding through this critical structure supplies the

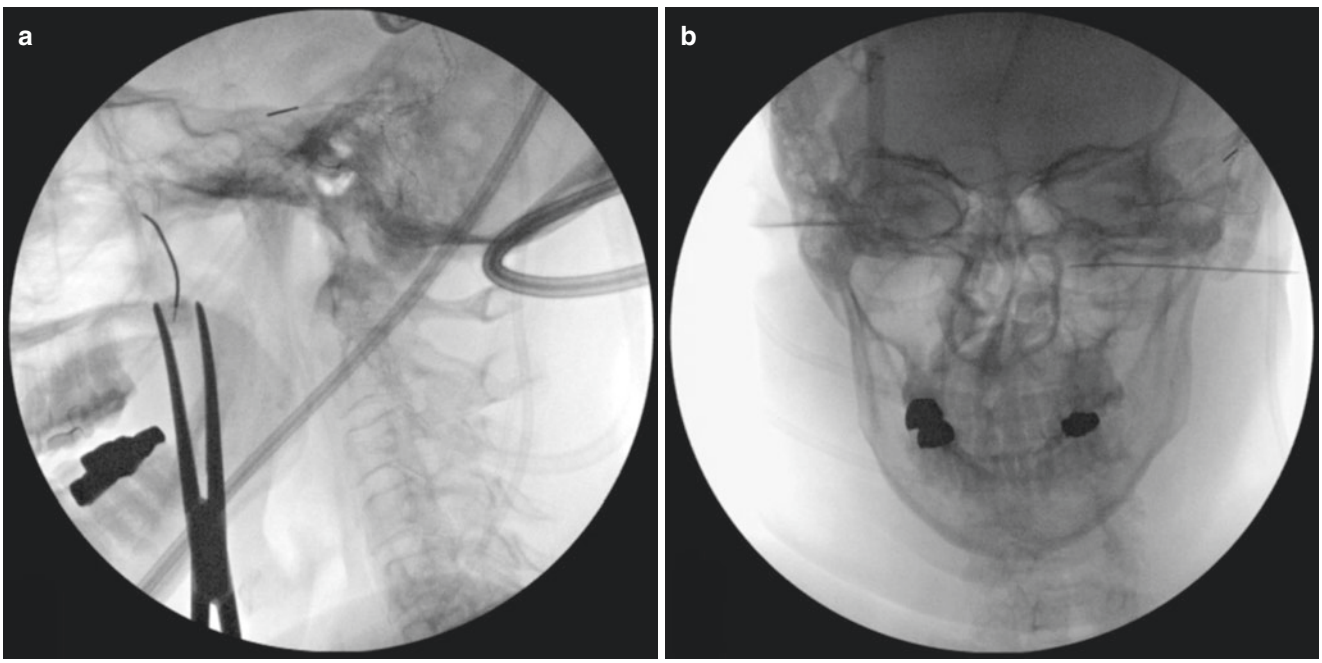

Fig. 17.2 Infrazygomatic sphenopalatine block. (**a**) Lateral view demonstrating the needle tip in the sphenopalatine foramen which is shaped like a vase. (**b**) AP view demonstrating the needle tip is immediately lateral to the lateral wall of the maxillary sinus

sympathetic innervation to the ipsilateral head, neck, and upper extremity. The stellate ganglion block is frequently performed at the C6 vertebral level, although some practitioners perform it at C7 or T1 levels. The C6 location is rostral to the actual ganglion but helps avoid inadvertent contact with both the apex of the lung and unprotected portion of the vertebral artery as it travels through the transverse foramen of the cervical vertebrae. At the level of C6, the cervical sympathetic chain is posterior to the carotid artery and jugular vein, anterior to the C6 transverse process and longus colli muscle, lateral to the thyroid and esophagus, and medial to the anterior scalene muscle and vertebral artery.

Indications

The three most commonly recognized indications for the stellate ganglion block (SGB) are vascular insufficiency, hyperhidrosis, and sympathetically mediated pain (SMP) syndromes affecting the face or upper extremity. As mentioned previously, SGB can be used to diagnose and treat a variety of sympathetically mediated pain disorders affecting the head, neck, or upper extremity. These include CRPS and herpetic neuralgia. In terms of cancer-related pain, SGB may be effective for regional pain associated with a solid tumor, upper extremity pain due to superior sulcus lung tumors, postmastectomy pain syndrome, brachial plexopathy, and postradiation neuritis. The SGB has also been described for treating post-traumatic stress disorder in addition to hot flashes and nighttime awakenings frequently present in breast cancer survivors.

Evidence

Studies investigating the efficacy of the SGB have predominantly focused on patients with CRPS and acute herpetic neuralgia. When used to treat CRPS, SGB is thought to be more effective when performed closer to onset of symptoms [19, 20]. In 2013, Kastler and colleagues reported on a series of patients with type I CRPS that underwent CT-guided radiofrequency neurolysis or block. Patients who underwent neurolysis were more likely to have greater than 50% pain relief at 2 years than patients who underwent block alone (68% versus 21%) [21]. A cadaver study examining the ideal volume compared 5, 10, and 20 ml injections and found the most favorable spread with 5 ml [22]. Although not performed at our center, chemical neurolysis of the stellate ganglion has also been described in the literature. Arter and colleagues reported no serious complications in a series of over 150 SGB with 3% phenol [23].

Several studies have evaluated the effectiveness of the SGB on trigeminal and cervical acute herpetic neuralgia [24]. In 2012, Makharita and colleagues reported a randomized, placebo-controlled study investigating the effect of early stellate ganglion blockade for facial pain from acute herpes zoster on the subsequent development of postherpetic neuralgia. They concluded that early SGB performed within 2 weeks of rash onset can rapidly relieve acute pain from herpes zoster with a possible reduction in the incidence of postherpetic neuralgia [25].

The SGB has been utilized for the treatment of several cancer-associated pain syndromes. In 2002, Noguchi and colleagues reported that SGB relieved trigeminal neuralgia caused by a cerebellopontine angle tumor [26]. Lipov and colleagues reported a prospective pilot study of 13 breast cancer survivors who underwent SGB for the treatment of hot flashes and night awakenings. They found that one or two SGB very effectively reduced the incidence of hot flashes and night awakenings for up to a year. Interestingly, the authors noted the projection of stellate ganglion efferents to the hypothalamus, a critical center in thermoregulation [27, 28].

In 2004, an oblique fluoroscopic technique was published by Abdi and colleagues [29]. Subsequently, a prospective study compared the classical anterior and oblique block techniques in 50 patients with postmastectomy pain syndrome. They found that both block procedures decreased pain scores, daily morphine consumption, areas of allodynia, and patient satisfaction for up to 3 months after the last block. However, the authors reported higher incidence of side effects with the classic anterior approach than with the oblique approach [30].

Anterior Paratracheal Fluoroscopic Technique

Always obtain verified intravenous access prior to performing this procedure due to risks of hemodynamic and neurological complications. Heart rate, blood pressure, and pulse oximetry monitors should be applied. The patient is positioned supine on the fluoroscopic table with the neck slightly extended and the head slightly turned away from the physician. Use PA fluoroscopic imaging to identify the uncinate process of the C6 vertebral body. Slight caudal tilt may enhance visualization. Anesthetize skin over the uncinate process using a 25-gauge 1.5-inch needle. Next, laterally retract the ipsilateral carotid artery to prevent inadvertent vascular puncture. A 25-gauge spinal needle is then inserted through the skin and advanced toward the C6 transverse process immediately inferior to the uncinate process. This process should be performed while maintaining lateral retraction on the carotid artery, and needle advancement should be performed using coaxial technique. After the needle contacts the C6 transverse process, the needle should be withdrawn several millimeters to prevent injection into the longus colli muscle. Following negative

aspiration, 1–2 ml of contrast should be injected under live fluoroscopic imaging to demonstrate the lack intravascular injection and to ensure appropriate spread of contrast along the muscle. Next, slowly inject 0.5 ml of 0.25% bupivacaine and wait at least 1 min to ensure lack of vascular injection. Then slowly inject an additional 4.5 ml of 0.25% bupivacaine. The needle is removed. In our practice, we commonly add 25 mcg of clonidine to the injection mixture.

Neurolysis of the stellate ganglion has been reported following positive diagnostic blockade using both radiofrequency ablation and chemical neurolysis. In our clinical practice, we do not perform neurolysis of this ganglion due to the proximity to critical vascular and neurological structures. Several reports have documented stellate ganglion radiofrequency ablation using the technique previously described. Sensory stimulation for paresthesias should be undertaken at 50–100 Hz and 0.1–1.5 V. Motor testing to identify the phrenic nerve and recurrent laryngeal nerve should be carried out at 2 Hz and 0.1–1.5 V. A small volume of local anesthetic and particulate (or non-particulate depending on a practitioner's concern of vascular uptake in the cervical region) steroid is injected after negative aspiration. Radiofrequency ablation is then typically performed at 60 °C for 60 s.

Oblique Fluoroscopic Technique

An alternative technique uses an oblique approach to avoid the major vascular structures of the neck. Again, IV access and cardiorespiratory monitors should be used while performing the block. With the patient in the supine position, the C6 vertebrae are visualized using PA fluoroscopy. The fluoroscope is then tilted obliquely until the neuroforamen are visualized. The skin overlying the junction of the C6 uncinate and transverse process is anesthetized with local anesthetic using a 25-gauge 1.5-inch needle. A 25-gauge spinal needle is then inserted through the skin and advanced toward the junction between the C6 uncinate and transverse processes. After appropriate needle placement, the procedure is like the standard PA procedure (Fig. 17.3).

Ultrasound-Guided Technique

Ultrasound has gained considerable standing in the past decade for the performance of blocks. Ultrasound-guided SGB has the unique advantage of allowing the physician to directly visualize and avoid critical vascular and neural structures in the neck. Prior to beginning the block, intravenous access and cardiorespiratory monitors are applied, and the patient is placed supine on the procedure table with the neck slightly extended and head turned away from the physician. The cricoid cartilage is then palpated to identify the C6 vertebral level. Using sterile technique, a high-frequency linear ultrasound probe is placed in the transverse position at the level of the cricoid cartilage. The neck is then scanned medial to lateral to identify the trachea, esophagus, thyroid, carotid artery, jugular vein, C6 transverse process, longus colli muscle, anterior scalene, brachial plexus, and middle scalene muscles. The sympathetic chain usually lies posterior (deep) to the carotid artery and anterior to the longus colli muscle. The block is performed using an in-plane needle placement technique from either the medial or lateral aspect of the probe. The lateral approach is preferred at our institution. For this technique, the skin lateral to the probe is anesthetized with local anesthetic using a 25-gauge 1.5-inch needle. Using an in-plane technique, an echogenic needle is inserted through the skin immediately superior to the brachial plexus. The needle is then advanced toward the sympathetic chain being careful not to contact the brachial plexus, jugular vein, or carotid artery. The final needle position should be posterior to the carotid artery and superior to the longus colli muscle. Following negative aspiration, 0.5 ml of 0.25% bupivacaine is injected. After 1 min with no neurological symptoms, the remaining 4.5 ml of 0.25% bupivacaine can be injected. The needle can then be removed. Unlike the fluoroscopic technique, no contrast is utilized during the ultrasound procedure because the vascular structures can be directly visualized and avoided (Fig. 17.4).

Side Effects and Complications

The stellate ganglion block is an advanced procedure regardless of technique utilized and should only be performed by physicians appropriately trained in the technique and potential complications. Following the block, ipsilateral Horner's syndrome with ptosis, miosis, and occasionally enophthalmos and conjunctival injection is expected and indicative of a successful block. This block should be avoided in patients with significant pulmonary disease, since phrenic nerve block is a frequent side effect. In addition, patients should be instructed not to eat or drink anything for several hours after the block since recurrent laryngeal nerve block is also a common side effect. Rarely, branches of the brachial plexus will inadvertently be blocked due to proximity of the plexus. This block is also associated with several significant complications such as pneumothorax, vascular injury, epidural or intrathecal injections, cardiovascular collapse due to sudden loss of sympathetic tone, seizure related to arterial injection of local anesthetic, and disruption of the vertebral artery causing thrombus, dissection, or infarction. Inadvertent puncture of the cervical esophagus is possible when performing the procedure, particularly on the left side. A rare delayed complication is retropharyngeal hematoma which can cause complete airway obstruction [31]. These complications highlight the necessity of appropriate intravenous access, cardiopulmonary monitoring, and rapidly available ACLS support.

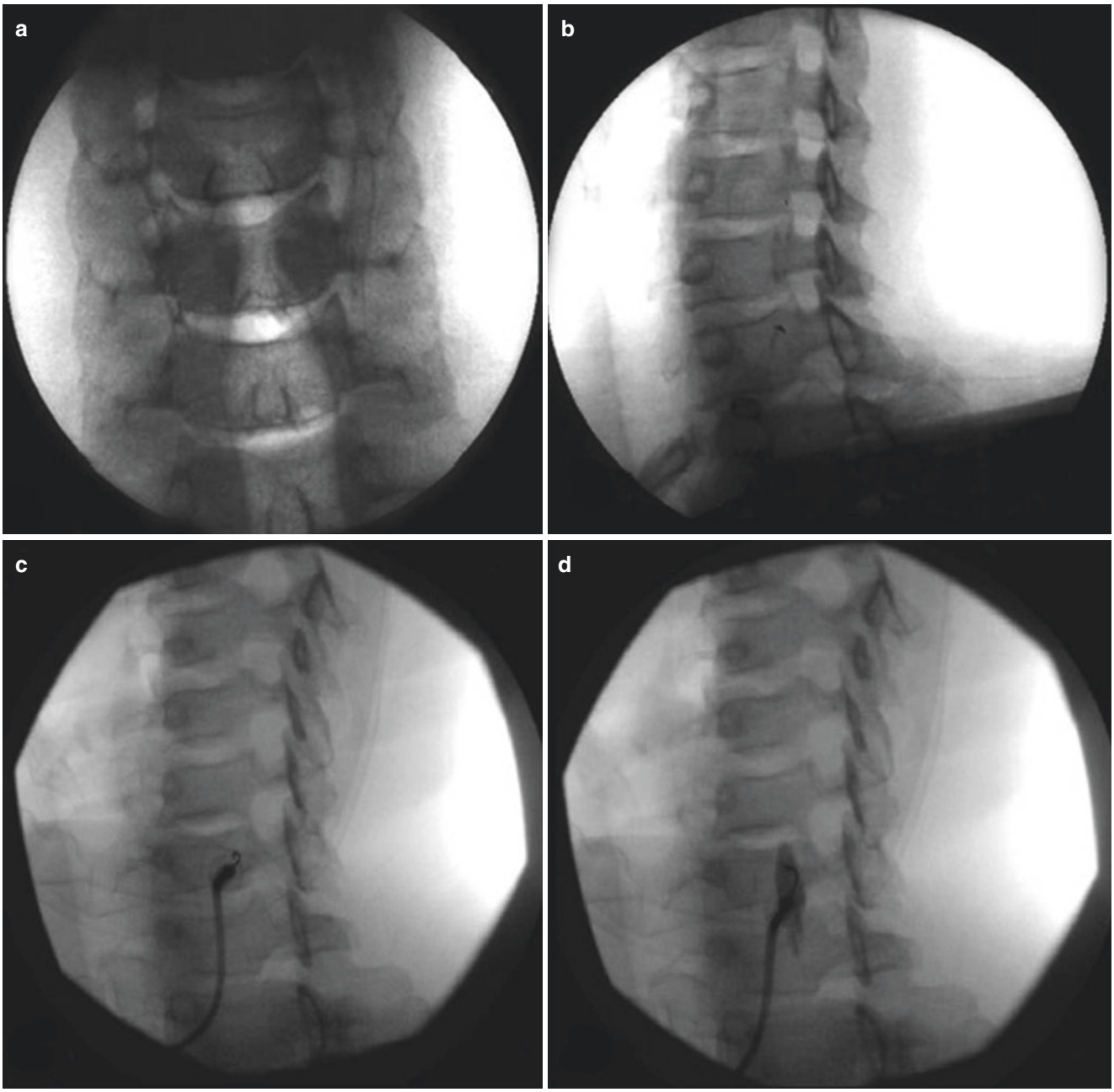

Fig. 17.3 Oblique stellate ganglion block. (**a**) AP fluoroscopic view with caudal tilt to square the end plates. (**b**) Oblique view demonstrating a clear view of the neuroforamen. (**c**) The needle is placed at the base of the uncinate process. (**d**) Appropriate contrast spread. (Adapted from Abdi et al. [29] with permission from the American Society of International Pain Physicians)

Thoracic Sympathetic Ganglion Blocks

Anatomy

The thoracic sympathetic ganglia provide sympathetic innervation to the upper extremities, chest wall, and upper abdominal wall. The superior thoracic sympathetic ganglia often fuse with the inferior cervical ganglia to form the stellate ganglia. Although these ganglia do provide passage for the majority of the upper extremity sympathetic fibers, at least 20% of people have significant contributions from the T2 and T3 thoracic sympathetic ganglia. The fibers from these ganglia are commonly referred to as Kuntz nerves. Failure to block these fibers may lead to lack of success with the SGB when targeting sympathetic fibers to the upper extremity. Since preganglionic neurons of the upper extremity typically

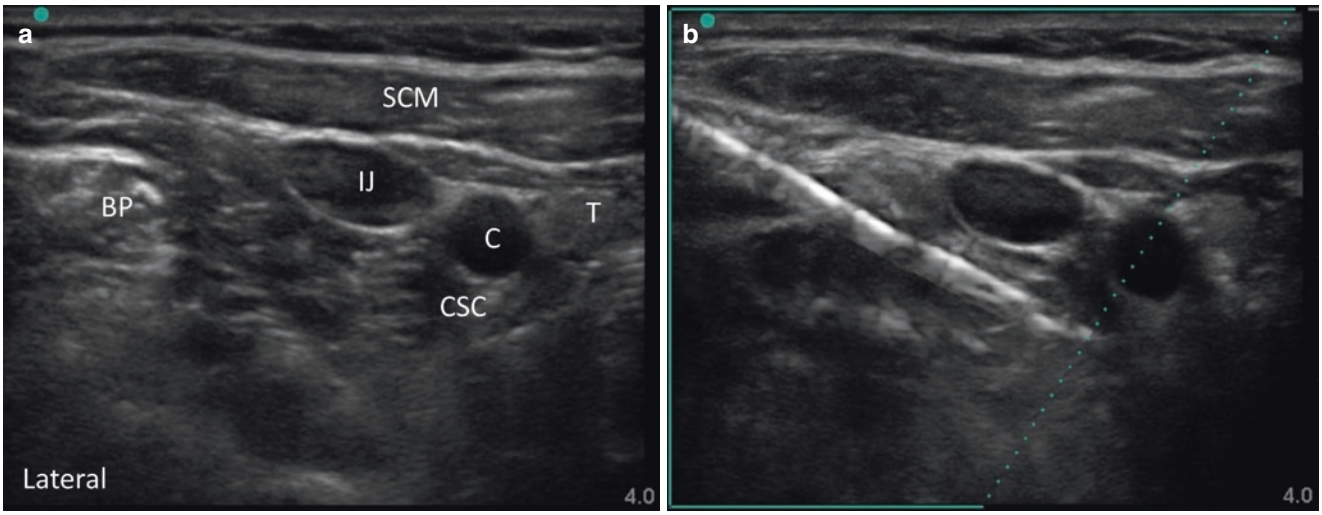

Fig. 17.4 Ultrasound-guided stellate ganglion block (lateral approach). (**a**) Transverse ultrasound view at the level of the cricoid cartilage demonstrating the brachial plexus (BP), sternocleidomastoid (SCM), thyroid (T), internal jugular (IJ) vein, carotid artery (C), and cervical sympathetic chain (CSC). (**b**) Similar image after lateral in-plane needle placement above the brachial plexus with the final needle tip position at cervical sympathetic chain deep to the carotid artery

originate from T2 to T8 and ascend to the T3, T2, stellate, and middle cervical ganglia, blockade of the upper thoracic ganglia should ensure complete blockade of the sympathetic innervation to the upper extremity [32].

The T2 and T3 sympathetic ganglia lie on the lateral aspect of their respective vertebral bodies approximately halfway between the anterior and posterior longitudinal lines. The ganglia are several millimeters superior to the cranio-caudal midpoint of the vertebrae as well. Of note, the ganglia are in relatively close approximation to the parietal pleura and intercostal nerves [33].

Indications

The indications for the upper thoracic sympathetic ganglia block are similar to those for the stellate ganglion block. These indications are vascular insufficiency, hyperhidrosis, and SMP syndromes. The most common of the sympathetically mediated pain syndromes is complex regional pain syndrome of the upper extremity. This technique has also been reported for the diagnosis and treatment of phantom breast pain, acute herpes zoster, angina pectoris, and refractory polymorphic tachycardia [34].

Evidence

Few studies have investigated the effectiveness of thoracic sympathetic ganglion blockade or ablation. A retrospective analysis of CT-guided interventions in 293 patients with intractable neuropathic pain reported that continuous infusion of ropivacaine or chemical neurolysis produced significant reductions in patient reported pain [35]. Another study reported sustained relief of sympathetically mediated pain for greater than 1 year following thoracic sympathetic ganglia thermal radiofrequency ablation [36]. In general, it has been reported that thoracic sympathetic blocks are more likely to be effective if performed within 1 year of pain onset [34].

Fluoroscopic T2–T3 Technique

Always obtain verified intravenous access prior to performing this procedure due to risks of hemodynamic and neurological complications. Cardiopulmonary monitors should be applied. The patient is positioned prone on a fluoroscopic table. AP fluoroscopy is used to identify the T2 vertebral body, and the end plates are squared. Oblique the C-arm approximately 20° to the ipsilateral side. Anesthetize the skin immediately lateral to the T2 vertebral body just caudal to the second rib. Using coaxial technique, a 22-gauge spinal needle is then inserted through the skin immediately lateral to the T2 vertebral body. The needle is advanced using frequent oblique and lateral imaging. The needle should closely approximate the T2 vertebral body during the entire procedure. The final needle position is halfway between the anterior and posterior longitudinal lines for the vertebrae and slightly superior to the cranial caudal axis of the vertebrae. Inject 2 ml of contrast solution to verify appropriate ventral spread along the sympathetic chain. If the contrast follows the dome of the lung, this indicates that the parietal pleura has been breached and the needle should be redirected medially. For a diagnostic block, 6–8 ml of 0.25% bupivacaine is

injected. The needle is then withdrawn, and the patient is taken to the recovery room where a chest X-ray is obtained to evaluate for pneumothorax [32].

Chemical neurolysis is not commonly performed by many physicians due to the proximity of the thoracic nerve roots. Instead, radiofrequency ablation is more commonly used. The neuroablation procedure is usually technically similar to diagnostic blockade except that an additional needle is placed at the T3 vertebral level to completely capture sympathetic fibers from T2 and T3. Applying thermal energy also requires the use of specialized curved thermal RF cannulas (usually with 10 mm active lesioning tips). It is important to perform both sensory (50 Hz up to 1 V) and motor testing (2 Hz up to 2 V) to ensure that the lesion area will not encompass the thoracic nerve root. Prior to lesioning, a small volume of local anesthetic is injected. The lesion is typically performed at 80 °C for 90 s (Fig. 17.5) [32].

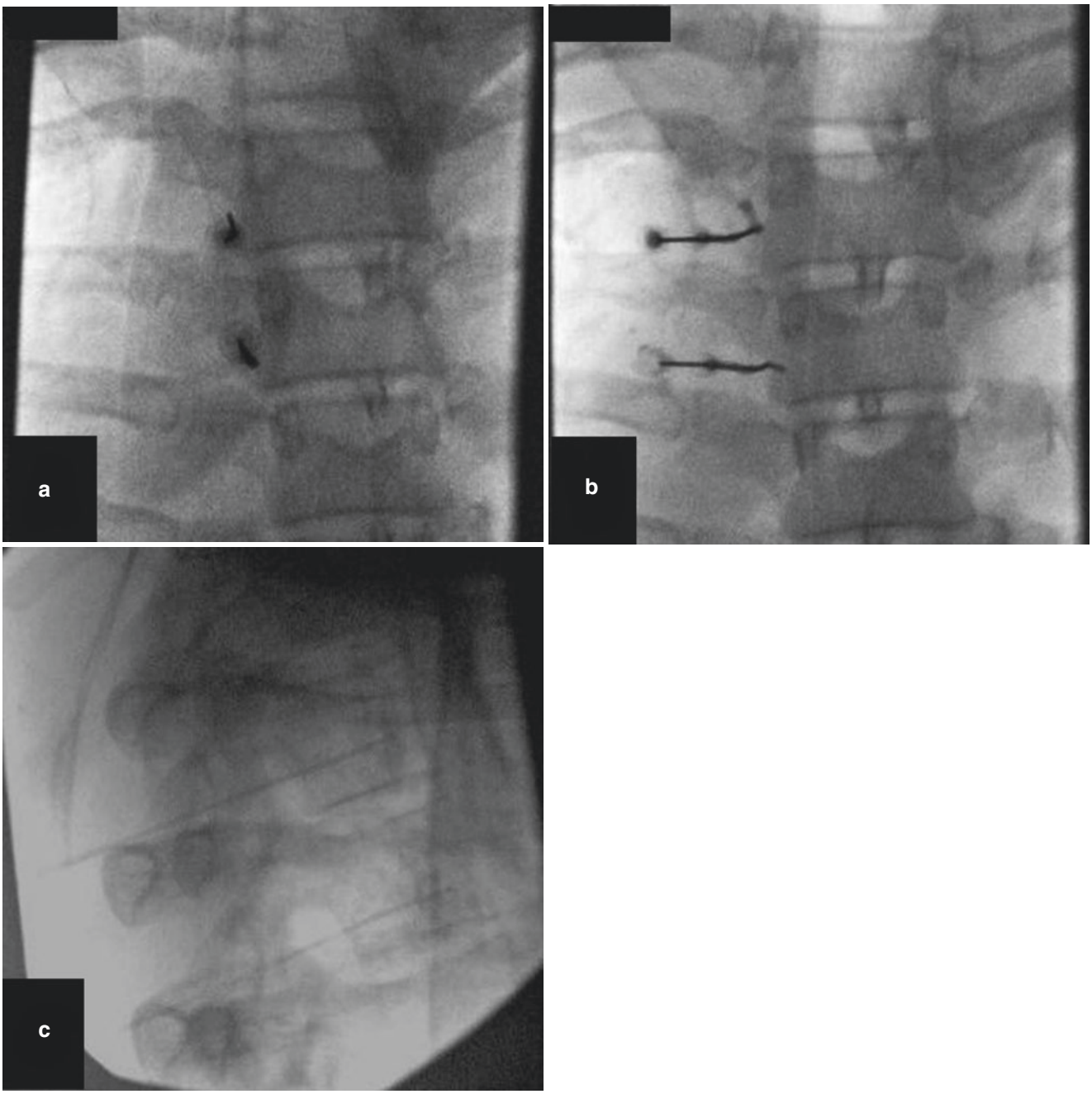

Fig. 17.5 Thoracic sympathetic ganglion block. (**a**) Using a 20° ipsilateral oblique view, the needles are placed and advanced immediately inferior to the transverse process along the vertebral body. Final needle placement in the AP (**b**) and lateral (**c**) views. (Images courtesy of Miles Day, M.D., Department of Anesthesiology and Pain Management, Texas Tech University Health Sciences Center, Lubbock, Texas)

Side Effects and Complications

The thoracic sympathetic block is an advanced procedure and should only be performed by physicians appropriately trained in the technique and potential complications. Similar to the stellate ganglion block, ipsilateral Horner's syndrome is an expected side effect. Rarely, branches of the brachial plexus will inadvertently be blocked due to variable contribution of the intercostal nerves to the brachial plexus. The most common complication is pneumothorax which is documented to occur in 1.8–2.4% of cases performed by experienced practitioners [32, 36]. This complication highlights the importance of the post-procedural chest X-ray to evaluate for pneumothorax and the need to inform patients of the possible delayed development of a pneumothorax. Less common complications include sudden cardiovascular collapse due to blockade of cardiac sympathetic fibers, epidural or intrathecal injection, intercostal nerve injury, and local anesthetic toxicity. These complications again highlight the necessity of appropriate intravenous access, cardiopulmonary monitoring, and rapidly available ACLS support.

Celiac Plexus and Splanchnic Nerve Block

Anatomy

Although many presynaptic sympathetic neurons synapse in the paravertebral ganglia, a portion of them bypass the ganglia as splanchnic nerves. Instead, these presynaptic sympathetic fibers synapse at unique prevertebral ganglia that typically lie anterior to the aorta. The greater splanchnic nerve is derived from the medial branches of the fifth through ninth thoracic sympathetic ganglia. These nerves descend obliquely, perforating the diaphragm before terminating in the celiac ganglion [37]. The lesser splanchnic nerves are formed from the ninth and tenth thoracic ganglia and terminate in the aorticorenal ganglion. The least splanchnic nerve is highly variable and generally originates from the 11th and 12th thoracic ganglia and synapses in the renal plexus [37].

The celiac plexus is the best known of the prevertebral ganglia, and it surrounds the celiac artery which is usually located at the L1 vertebral level. The plexus is an important pathway for sympathetic efferent and visceral afferent nerves innervating the pancreas, liver, gallbladder, spleen, distal esophagus, stomach, adrenals, kidneys, small intestine, and large intestine to the splenic flexure.

Indications

The celiac plexus block is one of the oldest sympathetic blocks having been first described in 1914 by Max Kappis for the management of abdominal pain [38]. Today the block is used most commonly for the treatment of intra-abdominal cancer pain, most commonly pain associated with pancreatic cancer. The technique is commonly carried out using a neurolytic technique with alcohol or phenol solutions. The procedure has been described using many different techniques including anatomical landmark, fluoroscopy, CT guidance (posterior or anterior), abdominal ultrasound, and endoscopic ultrasound-guided approaches. The selection of technique frequently depends on locally available technology and physician expertise.

The terms neurolytic celiac plexus block (NCPB) and neurolytic splanchnic nerve block are commonly and inappropriately used as synonyms. The NCPB is a transcrural technique that targets the prevertebral synaptic ganglion. Conversely, the neurolytic splanchnic nerve block is a retrocrural technique that specifically targets the splanchnic nerves before they pierce the diaphragm and synapse in the celiac ganglion. Some practitioners choose the splanchnic nerve neurolysis over a true celiac plexus neurolysis because it avoids penetration of the diaphragm and its clinical success is less likely to be influenced by intra-abdominal tumor burden around the prevertebral celiac plexus.

Evidence

The first high-quality double-blind randomized controlled trial was performed by Lillemoe and colleagues in 1993. This study evaluated intraoperative chemical splanchnicectomy with 50% alcohol ($N = 65$) versus a placebo injection of saline ($N = 72$) in patients with histologically proven unresectable pancreatic cancer. The chemical splanchnicectomy group reported decreased pain scores for up to 6 months. Interestingly, the chemical splanchnicectomy group had improved survival compared to the saline group [39].

Mercadante performed a prospective randomized controlled trial on 20 patients with pancreatic cancer comparing the effectiveness of neurolytic celiac plexus block (NCPB) versus oral analgesics. Though the study did not find statistically significant differences in pain scores between the two groups, the NCPB group consumed significantly less opioids [40]. In addition, Kawamata and colleagues conducted a randomized prospective study to evaluate the effectiveness of NCPB versus NSAID and morphine treatment in 21 pancreatic cancer patients. They reported lower pain scores for the first 4 weeks in the NCPB group with reduced morphine consumption to 7 weeks [41].

Polati and colleagues conducted a double-blind randomized controlled trialed comparing neurolytic celiac plexus blocks ($N = 12$) with pharmacologic therapy ($N = 12$). Short-term pain relief was superior in the neurolytic celiac plexus block group, although long-term relief was not different between the groups. Opioid consumption was also noted to be lower in the neurolytic celiac plexus block group [42]. Similarly, Zhang and colleagues in an unblinded randomized

controlled study investigated the efficacy of CT-guided NCPB compared with pharmacological therapy in 56 patients. The authors demonstrated a significant decrease in pain score for 2 weeks and a decreased in opioid consumption for 90 days in the NCPB group [43].

In 2004, Wong and colleagues performed a prospective double-blind randomized controlled trial that examined the effect of NCPB versus a sham injection on pain relief, quality of life, and survival in 100 patients with unresectable pancreatic cancer. The patients were followed weekly for at least 1 year or until death. Neurolytic celiac plexus block produced superior analgesia to the sham procedure, although both groups reported significant pain reduction out to 24 weeks. Despite changes in pain, the NCPB showed no effect on opioid consumption, quality of life, or survival [44].

Wyse and colleagues in a prospective double-blind randomized controlled trial studied the effect of endoscopic ultrasound-guided celiac plexus neurolysis for newly diagnosed inoperable pancreatic cancer. This study determined that the endoscopic technique also resulted in decreased pain burden and possibly decreased morphine consumption over 3 months [45].

In 2011, Arcidiacono and colleagues published a meta-analysis at the Cochrane Collaboration evaluating the effectiveness of NCPB on pain reduction and opioid utilization. The analysis used many of the studies already described in this section and reported a significant and highly homogenous reduction in pain at 4 weeks. This effect was not maintained at 8 weeks with a significant increase in heterogeneity. Opioid utilization was significantly decreased at both 4 and 8 weeks [46].

Since the clinical effectiveness of NCPB tends to wane with time, repeat NCPB are occasionally performed. McGreevy and colleagues reported that repeat NCPB have a lower chance of achieving 50% pain relief than the initial block (67% vs. 29%) and that the mean duration of pain relief is decreased for the second block (3.4 months vs. 1.6 months) [47]. In addition, anatomical distortions caused by adenopathy or tumor around the frontal plane quadrants of the celiac axis can have significant impact on the effectiveness of the NCPB. De Cicco and colleagues published two reports evaluating the effect of anatomic distortions on contrast spread and pain relief. When contrast spreads to all four quadrants around the celiac axis, the chance of prolonged pain relief is quite high. However, when two or fewer quadrants demonstrate contrast spread, the chance of prolonged pain relief is very low [48, 49].

Fluoroscopic Celiac Plexus or Splanchnic Nerve Block

Always obtain verified intravenous access prior to performing this procedure due to high likelihood of significant hemodynamic changes. If appropriate, infuse 500–1000 ml of crystalloid prior to the procedure to increase cardiac preload. Cardiopulmonary monitors should be applied. The patient is positioned prone on a fluoroscopic table. The patient may require sedation to lie on their abdomen for an extended period. Visualize the T12 and L1 vertebral body in an AP fluoroscopic view and square the end plates. Next, oblique the C-arm approximately 20–30° ipsilateral until the T12 transverse process is encompassed within the lateral border of the vertebral body. Anesthetize the skin and subcutaneous tissues immediately lateral to the vertebral body and inferior to the rib head in this view with 1% lidocaine using a 25-gauge 1.5-inch needle. For the splanchnic nerve block, the needle insertion site is immediately superior to the 12th rib and just lateral to the vertebral body. For the celiac plexus block, the needle insertion site is at the superolateral border of the L1 vertebrae in the oblique view. Curved tip 5–7-inch 22-gauge spinal needles are commonly used for this procedure. For the splanchnic nerve block, the needle trajectory has a slight angulation toward the T12 vertebral body. In either case, alternate between oblique and lateral views as the spinal needle is advanced. Once periosteum is contacted, the spinal needle is then "walked" along the lateral edge of the vertebra. For the splanchnic nerve block, final needle position is at the anterior edge of the T12 vertebral body in the lateral view (Fig. 17.6).

For the celiac plexus block, the needle trajectory is truly coaxial along the lateral border of the L1 vertebral body. The left side needle should be placed at the location of the aorta, which can be mapped from a prior CT scan of the patient's abdomen. Alternate between oblique and lateral views every few centimeters as the spinal needle is advanced. After the anterior edge of the vertebral body is reached in the lateral view, it is advanced under constant aspiration. If blood is aspirated, a transaortic technique can be performed by advancing until blood can no longer be aspirated. The final needle position is 2–3 cm anterior to the vertebral body in the lateral view and medial to the pedicle in the AP view. This should allow for injection of contrast and neurolytic anterior to the aorta.

After determination of the final needle position, inject 0.5–1 ml of contrast solution through each needle to verify appropriate anterolateral spread along the vertebral body for the splanchnic nerve block and preaortic spread for the celiac plexus block. Then, after negative aspiration for blood, inject 10 ml of 0.25% bupivacaine through each needle. The needles are then removed.

For chemical neurolysis, after contrast spread is verified, 10 ml of 1% lidocaine (or 2% chloroprocaine) is injected through each needle. After 10–12 min, hip flexion motor testing is then performed to verify that the local anesthetic did not track posterior to the nerve roots or spinal cord. If motor function remains intact, 6–10 ml (usually higher volumes are chosen for the transcrural

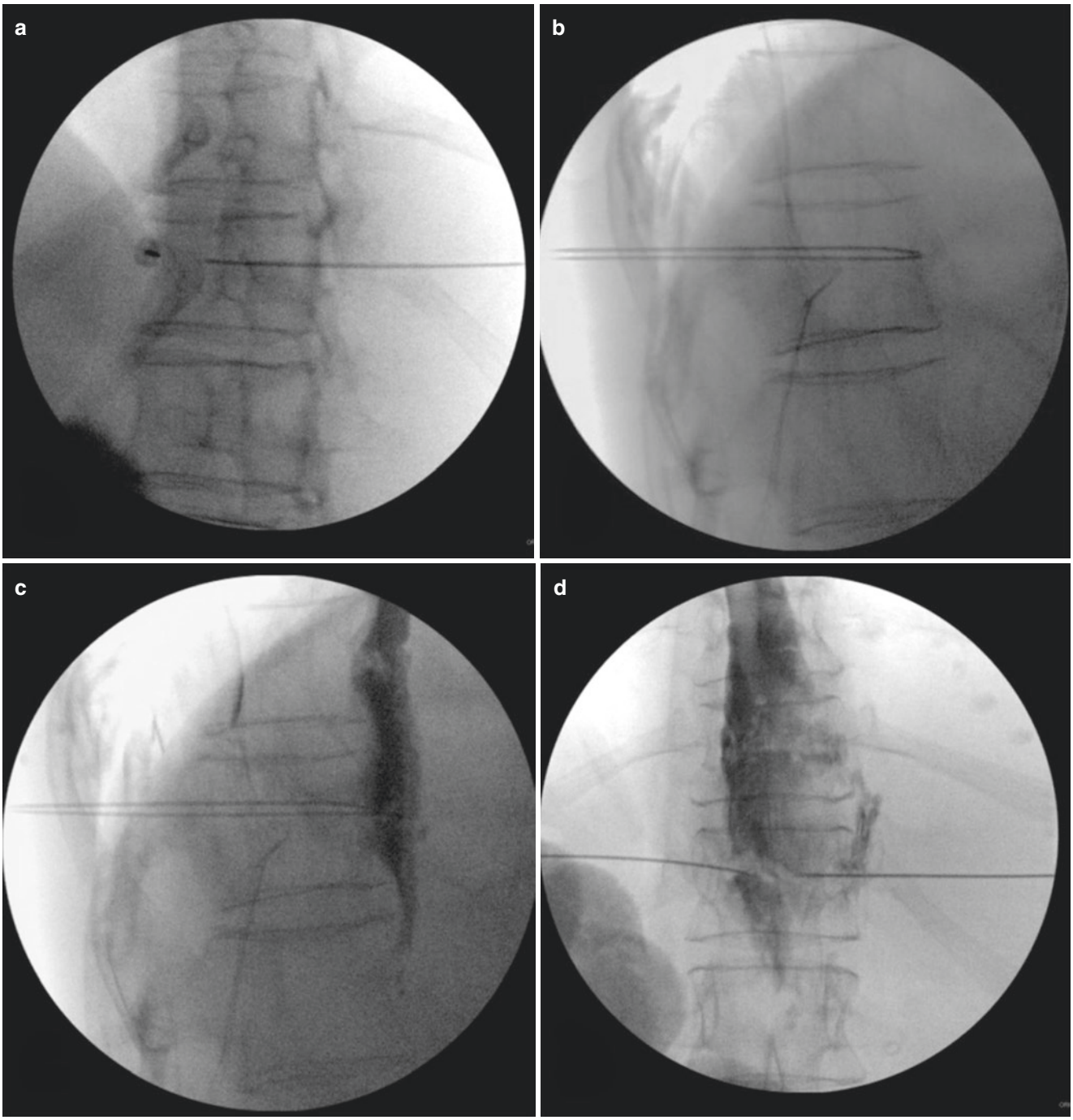

Fig. 17.6 Splanchnic nerve block. (**a**) In an oblique view, the needle is placed superior to the head of the 12th rib immediately lateral to the vertebral body (a similar contralateral needle was already placed). (**b**) Final needle position at the anterior border of the T12 vertebral body. Appropriate prevertebral contrast spread in the lateral (**c**) and AP (**d**) views

approach) of 98% alcohol or 6–10% phenol per side is then injected slowly in 1 ml increments over the course of 5–10 min. The spinal needles should be flushed with saline or local anesthetic solution prior to removal to prevent posterior tracking of alcohol. Many practitioners also inject non-particulate steroid during the flush procedure to reduce the chance of chemical neuritis (Fig. 17.6).

Computed Tomography (CT)-Guided Celiac Plexus and Splanchnic Nerve Block: Posterior Approach

Following placement of verified intravenous access and cardiopulmonary monitors similar to the fluoroscopic approach, the patient is positioned prone on the CT scanner table.

Sequential 5 mm slices are then obtained from T11-L1 to locate the celiac artery and other vasculature in relationship to the lung and soft tissue structures. Planned pathways to the retrocrural space using two needles or the transcrural space using one or two needles are commonly mapped prior to needle placement using the CT image viewer tools. A radiopaque measurement grid taped to the patient or a sterile ruler can be further used to identify specific needle entry sites in the axial and sagittal planes. Typical entry points are no greater than 7 cm from midline. After anesthetizing all entry sites with local anesthetic, 5- or 7-inch 22-g spinal needles are then directed using intermittent CT guidance toward their respective targets. The needles should pass medial to the kidneys and either anterior to the aorta for the transcrural (celiac plexus block) technique or lateral to the aorta and behind the diaphragm when utilizing the retrocrural (splanchnic nerve block) technique. Repeat imaging should be obtained every 1–2 cm while attempting to keep the needle shaft in the current CT axial plane. Following negative aspiration, a small volume of contrast is injected. The contrast should spread bilaterally around the anterior surface of the aorta using the transcrural approach and through the retrocrural space when using the retrocrural approach. If adequate spread of contrast along both sides of the aorta is not appreciable when targeting the transcrural space, an identically placed needle should be placed on the contralateral side. Two needles are almost always required for the retrocrural technique in that the aorta typically prevents spread of injected material to the contralateral side. But in general, lower volumes are typically required for the retrocrural approach given that the splanchnic nerves lie within this confined space. Following confirmation of bilateral contrast spread, 10–30 ml of 0.25% bupivacaine divided among one or two needles can be injected when performing a diagnostic block. When planning neurolysis, 5 ml of 1% lidocaine is first injected through each needle. After performing a neurological test and waiting 10–12 min, 5–15 ml of 50–100% alcohol is subsequently slowly injected through each needle when using a two-needle technique. If a single-needle transcrural approach is utilized, up to 20–40 ml of neurolytic agent can be given in total. The needles are then flushed and removed similar to the fluoroscopic approach (Fig. 17.7).

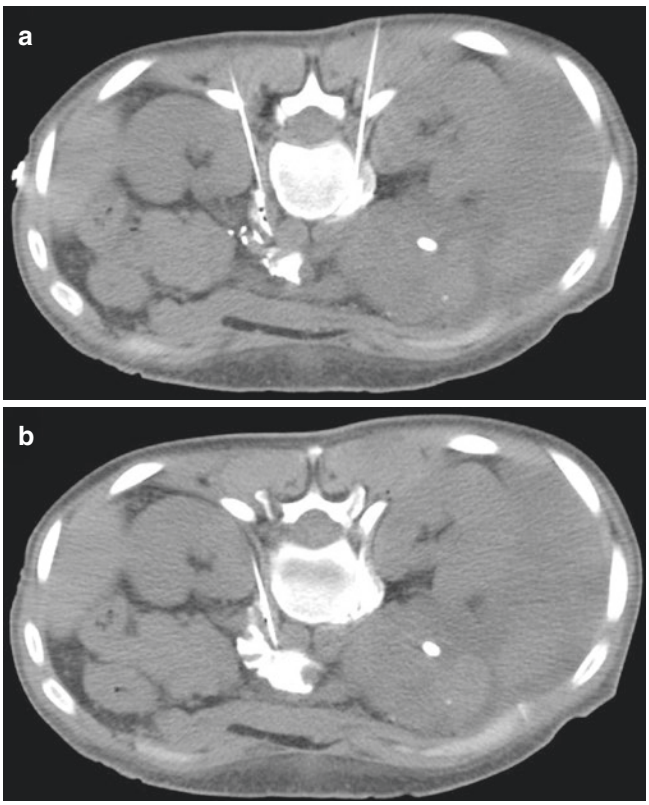

Fig. 17.7 Celiac plexus block (CT guided). (**a**) In a prone position, the right needle tip is placed at the anterolateral aspect of the L1 vertebral body with appropriate contrast spread. (**b**) The left needle tip is placed near the celiac artery branch point from the abdominal aorta. Contrast shows an appropriate preaortic spread. (Images courtesy of Vinay Puttanniah, M.D., Department of Anesthesiology and Critical Care Medicine, Memorial Sloan Kettering Cancer Center, New York, New York)

Side Effects and Complications

Hypotension is a common side effect following CPB and may be symptomatic. This effect is due to vasodilation and pooling of blood within the splanchnic vasculature and is generally responsive to the infusion of crystalloid. The patient should be monitored after the procedure with vital signs obtained at regular intervals. Orthostatic hypotension is generally transient but has been reported up to 1 week [43]. Diarrhea is another common side effect due to the unopposed parasympathetic tone with the blockade of the sympathetic fibers. For this reason, this procedure should not be performed in patients with known or suspected bowel obstruction due to the risk of bowel perforation. The most common significant complication is pneumothorax due to the inadvertent puncture of the parietal pleura during needle placement. The reported incidence of pneumothorax is 1–2% [50–52]. The risk for this complication increases with more cephalad needle placements. As such, immediate ACLS should be available whenever this procedure is performed. Additional reported side effects include hemorrhage due to patient coagulopathy or aortic puncture, aortic wall dissection [53], hematuria from renal puncture, and hemorrhagic gastritis [54]. The most feared complications of this procedure are neurological, ranging from local chemical neuritis to paralysis. Although less severe, hip flexor paresis or paralysis can occur from unintentional lumbar plexus neurolysis in the psoas compartment. Spinal paralysis can be caused by

posterior tracking of the neurolytic agent toward spinal cord or vasospasm of the anterior spinal vasculature. In a large retrospective series of 2730 NCPB procedures performed in the late 1980s under radiographic guidance, 4 events of paralysis were reported for an incidence of 1:683 [55].

Lumbar Sympathetic Block

Anatomy

The lumbar sympathetic chain is a series of paired ganglia anterolateral to the L2-L4 vertebral bodies. The preganglionic neurons that synapse in these ganglia arise from the T11-L2 region of the spinal cord [56]. These ganglia are responsible for the majority of the sympathetic innervation to the lower extremities.

Indications

The lumbar sympathetic block (LSB) is used for both diagnostic and therapeutic purposes. It is primarily indicated for sympathetically mediated pain involving the lower extremities. Pain conditions that have been treated by lumbar sympathetic block include complex regional pain syndrome, peripheral vascular disease, postherpetic neuralgia, diabetic neuropathy, phantom limb pain, and groin and testicular pain. Cancer-specific diagnoses for which this block has been utilized include tumor-related lumbosacral neuropathy, postradiation plexopathy [5], and tumor-related bladder spasms [57].

Evidence

Most of the evidence demonstrating the efficacy of lumbar sympathetic blockade is from patients with CRPS. In 1994, Cameron and colleagues studied 29 patients with CRPS involving the lower extremity following total knee replacement. They found 45% of the patients had complete pain relief with the intervention [58]. Another study by Rocco and colleagues assessed the effectiveness of lumbar sympathetic chain radiofrequency ablation in 20 patients with CRPS. Of the 18 patients who completed treatment, 14 demonstrated some degree of response, with 5 patients reporting complete resolution of pain [59]. More recently, Manjunath and colleagues conducted a randomized controlled trial of 20 patients comparing radiofrequency ablation versus phenol for CRPS involving the lower extremities. The study found no significant difference between the two methods of neurolysis [60]. Finally, Carroll and colleagues reported the use of botulinum toxin A along with bupivacaine in LSB for the treatment of CRPS. They found that the addition of botulinum toxin A significantly increased the duration of effect of the block from 10 to 71 days [61].

The utilization of LSB for cancer-related pain has not been widely published. In 2011, Gulati and colleagues reported the use of an LSB at L4 for the treatment of malignancy-related bladder spasms. The three patients reported had bladder spasms caused by local tumor progression, metastatic tumor infiltration, and/or intravesicular chemotherapy. All three patients had significant pain reduction following the procedure [57].

Fluoroscopic Lumbar Sympathetic Block

Consider obtaining intravenous access before proceeding. It is possible for patients to become hypotensive after during the procedure. Cardiopulmonary monitors are applied. The patient is placed in the prone position. A pillow may be placed underneath the patient's abdomen to reduce lumbar lordosis. Identify the L2 vertebral body using AP fluoroscopy, and square the end plates using a caudal tilt of the C-arm. This block can be performed anywhere from the inferior aspect of L2 to the superior aspect of L4. Oblique the C-arm approximately 20–30° ipsilateral until the lateral tip of the transverse process is encompassed within the L2 vertebral body. Anesthetize the skin and subcutaneous tissues over the inferior portion of the lateral border of the L2 vertebral body using a 25-gauge 1.5-inch needle. A 22-gauge spinal needle is then inserted through the skin slightly lateral to the lateral border of the L2 body. Using coaxial technique, the needle is advanced toward the lateral border of the vertebral body. The lateral border of the vertebral body should then be contacted, and the needle is "walked off" the body using lateral fluoroscopic imaging. The final needle position should lie within the anterior 1/3 of the vertebral body in the lateral fluoroscopic view. After negative aspiration, inject 0.5–1 ml of contrast solution to verify appropriate ventral spread along the anterolateral aspect of vertebral body and not in the psoas muscle. Blockade is then typically achieved using 10 ml of 0.25% bupivacaine injected in 2 ml increments through each needle (Fig. 17.8).

Lumbar sympathetic chain neurolysis can be accomplished using either radiofrequency ablation (RFA) or chemical neurolysis. For chemical neurolysis, needles are placed at the L2, L3, and L4 spinal levels like the technique described for the L2 needle placement. Following negative aspiration for blood and appropriate contrast spread, 2 ml of 2% chloroprocaine is injected slowly through each needle. After waiting approximately 10 min, perform a hip flexion motor testing to ensure the local anesthetic did not spread to the motor nerves. If motor strength is still intact, then slowly inject 2 ml of 50–98% alcohol or 6% phenol through each needle.

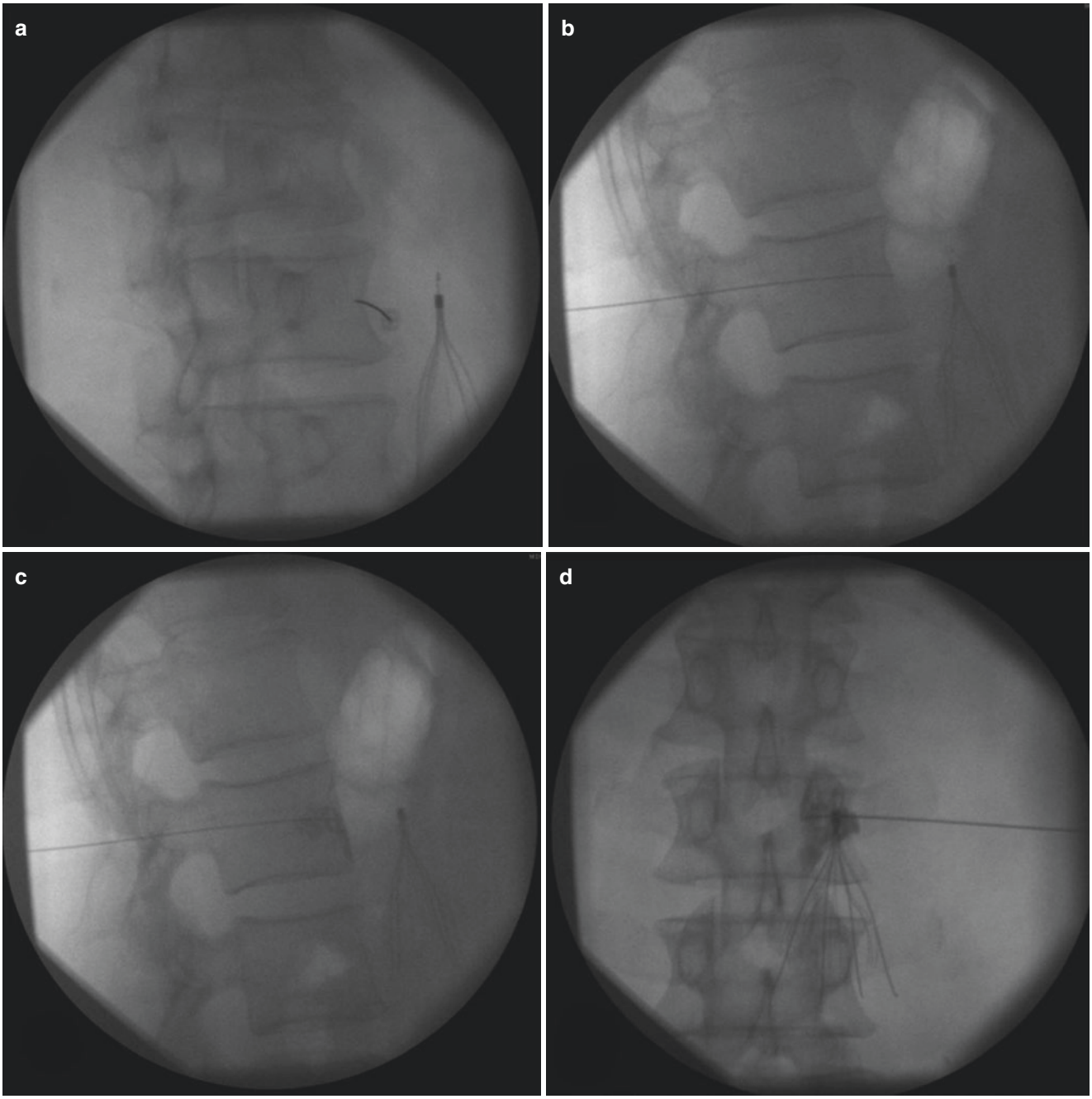

Fig. 17.8 Lumbar sympathetic block. (**a**) The needle is placed and advanced immediately lateral to the L2 vertebral body in an oblique view. (**b**) Final needle position at the anterior border of the L2 vertebral body. Appropriate prevertebral contrast spread in the lateral (**c**) and AP (**d**) views

For RFA, 15-cm RFA needles with 10-mm active tips are placed over the anterolateral aspect of the L2, L3, and L4 vertebral bodies. Sensory testing should be conducted and generally results in difficult to localize back and abdominal pain. Motor testing should also be performed with 2 Hz up to 3 V to ensure the needle tip is an appropriate distance from critical motor structures. No lower extremity movement is expected with motor testing at this site. 1 ml of 2% lidocaine is then injected followed by lesioning at 80 °C for 90 s. Non-particulate steroids are frequently injected following RFA prior to needle removal.

Side Effects and Complications

The most common side effect for this procedure is hypotension. Patients should be monitored carefully post-procedure with vital signs obtained at regular intervals. In addition, the

temperature of the lower extremity on the ipsilateral side of the performed block may increase secondary to increased blood flow. Some practitioners use a temperature increase of 2 °C as an indication of a successful block. Genitofemoral neuralgia can occur from direct mechanical injury to the genitofemoral nerve which presents as pain in the groin and anterior thigh. A recent publication also reported permanent lesioning of the lateral femoral cutaneous nerve after low-volume chemical neurolysis with alcohol [62]. Hemorrhage is always possible given proximity to major vascular structures. Hematuria can occur from placement of the needle through the kidney and is normally self-limited. Finally, neuroablative procedures carry the added possible complications of chemical neuritis, femoral nerve neurolysis, and paralysis with mechanisms like those described in the neurolytic celiac plexus block section.

Superior Hypogastric Plexus Block

Anatomy

The superior hypogastric plexus is a collection of retroperitoneal sympathetic fibers that are anterior to the L5 and S1 vertebral bodies. These fibers then continue to the inferior hypogastric plexus at the S2 to S4 levels where they receive additional parasympathetic inputs. Visceral afferent and sympathetic efferent nerves in the superior hypogastric plexus innervate the prostate, bladder, uterus, ovaries, proximal vagina, and rectum.

Indications

Indications for the superior hypogastric plexus block (SHPB) include pain originating from the pelvic viscera, gynecologic disorders, endometriosis, adhesions, interstitial cystitis, irritable bowel syndrome, and malignancies in the pelvic viscera. Diagnostic blocks may be effective in determining the pelvic pain generator. Neurolytic blocks are frequently used for pelvic tumor-related pain.

Evidence

Numerous reports exist regarding the effectiveness of SHPB for the management of pelvic pain associated with cancer. Plancarte and colleagues reported a significant decrease in pain scores after SHPB for patients with cervical, prostate, and bladder cancer pain [63]. De Leon and colleagues reported that 69% of patients had significant pain reduction with superior hypogastric plexus neurolysis for pelvic pain arising from gynecologic, colorectal, or urinary cancer [64]. Plancarte and colleagues later reported the largest cohort of superior hypogastric neurolysis in 227 patients with gynecological, colorectal, or genitourinary cancer. The neurolytic procedure reduced pain by 50% for greater than 1 month in 72% of patients who responded to a diagnostic block and 51% of all patients that enrolled in the study. In addition, mean opioid use decreased by 40% [65]. Predictors of successful pain reduction following superior hypogastric plexus neurolysis included increased age and bladder cancer [66].

The transdiscal approach is an alternative to the classical paravertebral superior SHPB. Erdine and colleagues performed the transdiscal block on 20 patients with pelvic pain due to cancer. Sixty percent had significant pain relief and decreased daily analgesic requirements for up to 3 months [67]. A formal comparison of the two block techniques demonstrated equivalence in pain reduction, with decreased time to perform the transdiscal approach [68]. The transdiscal approach may be particularly helpful as a rescue technique if the classical approach is not possible due to anatomic limitations such as large transverse processes or iliac crests [69].

Fluoroscopic Technique

The patient is placed prone on the fluoroscopy table. Place a pillow underneath the patient's iliac crest to decrease lumbar lordosis. Locate the S1 sacral segment and square the superior end plate using cranial tilt. Turn oblique approximately 20–30 ipsilateral to the side of needle placement. The ideal trajectory will be inferior to the L5 transverse process, medial to the iliac crest, and lateral to the lateral aspect of the vertebral body in this view. It is frequently necessary to adjust the degree of oblique tilt to obtain the clearest view. Anesthetize the skin and soft tissues over the proposed trajectory. Insert a curved tip 5- or 7-inch 22-gauge spinal needle immediately lateral to the lateral border of the L5 vertebral body. Advance the needle along this path using a slight medial deviation. Once the vertebral body is contacted, turn to a lateral view, and slowly walk the needle to the anterior portion of the L5 vertebral body. The ideal position is along the inferior aspect of the L5 or superior aspect of the S1 body on lateral imaging. This technique frequently requires bilateral needle placement. Inject 1–2 ml of contrast solution to verify appropriate prevertebral along the sacral promontory in both AP and lateral images.

A transdiscal approach can also be used for this block and frequently only requires one needle placement. We frequently provide prophylactic antibiotics prior to a transdiscal procedure. This approach uses a similar initial fluoroscopic view with careful attention to "squaring" off the superior S1 end

plate. The fluoroscope is then turned oblique 15–25°. The needle entry point is like L5-S1 discography, immediately lateral to the sacral ala over the disc. A 22-gauge 7-cm spinal needle is inserted through the skin and advanced through the disc. Once in the disc, use lateral guidance to advance the needle until the needle tip has exited the disc. Inject 3 ml of contrast solution to verify appropriate prevertebral along the sacral promontory in both AP and lateral images (Fig. 17.9).

After appropriate contrast spread and negative aspiration for blood, 8–10 ml of 0.25% bupivacaine is slowly injected through each needle for the block. For neurolysis, first inject 8 ml of 1% lidocaine (or 2% chloroprocaine) through each needle. We routinely wait 10–12 min and repeat motor testing (ankle plantar and dorsiflexion). If motor function is intact, slowly inject 5–8 ml of 98% alcohol or 6% phenol in 1 ml aliquots over 5 min. The needles are then flushed with

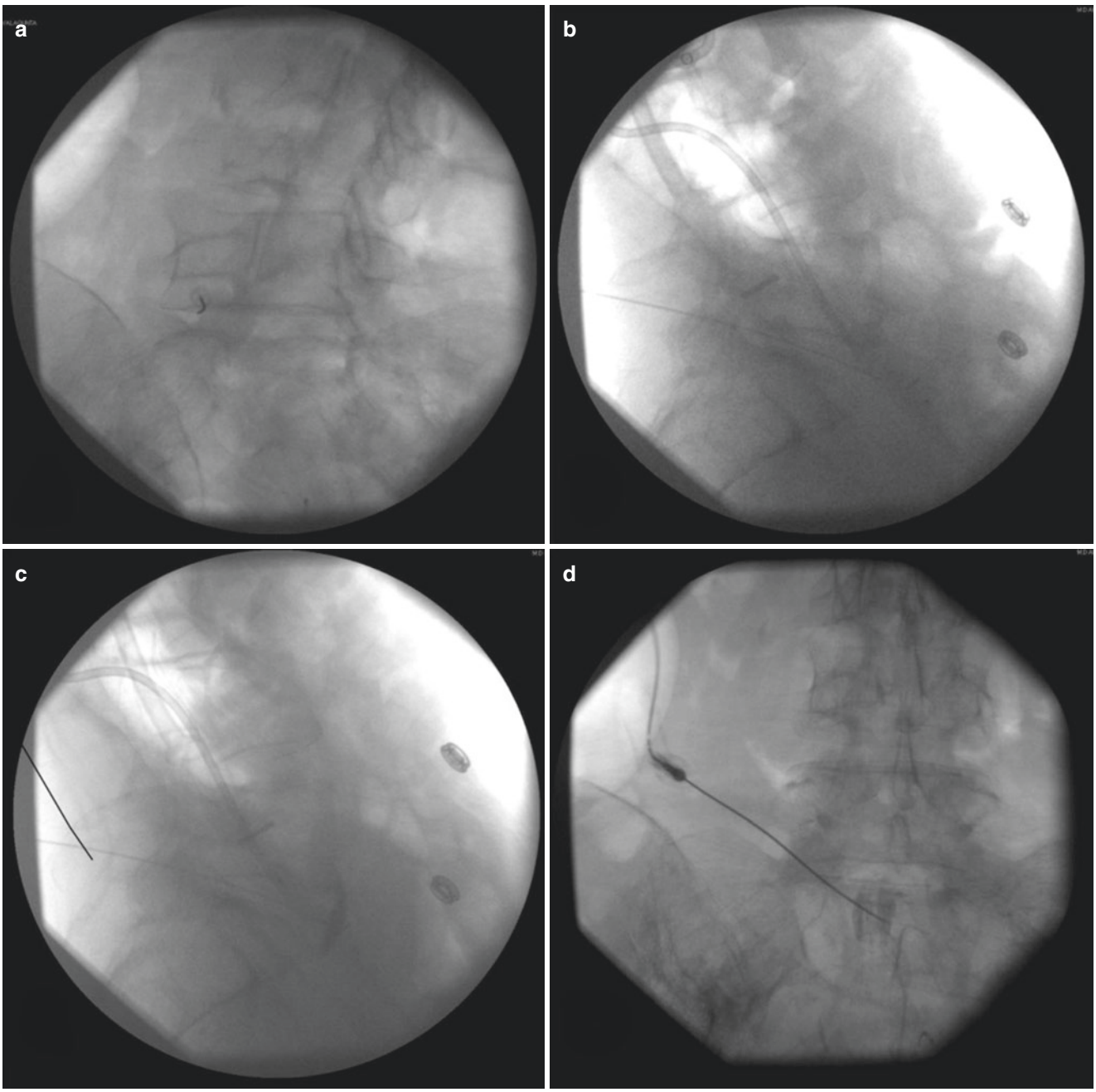

Fig. 17.9 Superior hypogastric plexus block (transdiscal approach). Cranial tilt is used to visualize the L5-S1 intervertebral disc. (**a**) Following 20–30° of oblique angulation, the needle is placed and advanced immediately lateral to the sacral ala through the L5-S1 disc. (**b**) Final needle position immediately anterior the disc. Appropriate contrast spread over the sacral promontory in the lateral (**c**) and AP (**d**) views

local anesthetic and steroid and are then removed. Care must be taken to flush the needles prior to removing them because the path of the needle is near the L5 spinal nerve.

Side Effects and Complications

Due to the plexus location directly posterior to the iliac vessel bifurcation, inadvertent intravascular injection of medications with resultant systemic toxicity is possible. Additionally, strict sterile technique should be used when performing the transdiscal technique in conjunction with intravenous prophylactic antibiotics (such as cefazolin) to help prevent the development of discitis. Since the L5 nerve root is commonly in the path of needle placement for this block, the patient should be awake while the needle is advanced past the neuroforamen. Needle repositioning is frequently needed during the procedure to avoid contacting the L5 spinal nerve. Finally, rare painful sacral neuritis has been observed in our clinical practice and is thought to be related to tracking of neurolytic agent along the sacral nerve roots.

Ganglion Impar Block

Anatomy

The ganglion impar (ganglion of Walther) is the most caudal ganglion of the sympathetic chain. It is a solitary midline ganglion formed from the union of bilateral paravertebral ganglia. The structure is located anterior to the inferior sacral or superior coccygeal segments in the retrorectal space. The ganglion contains sympathetic, parasympathetic, and visceral afferent fibers innervating the distal rectum, anus, perineum, vulva, distal vagina, and distal urethra.

Indications

The ganglion impar block is usually performed in patients with pelvic and perineal pain from the rectum, anus, vagina, and vulva. For tumor-related pain, neurolysis of this ganglion is a commonly employed practice. Local anesthetic blockade and radiofrequency ablation have also been used to relieve chronic pain from coccydynia.

Evidence

Several small case reports have been published evaluating the role of the procedure in treating pelvic and perineal pain due to cancer. The original technique for blocking the impar ganglion was published in abstract form by Plancarte and colleagues in 1990 [70]. In the study, 16 patients underwent the block and over half reported having complete relief of previous pain symptoms. Similar pain reduction has been reported in other small case series [71, 72].

The commonly used transarticular approach was described in 1998 by Swafford and colleagues [73]. In this report, 20 patients with perineal pain all reported at least 50% pain relief, with 5 patients reporting complete relief. A more recent prospective study from 2005 by Reig and colleagues looked at radiofrequency ablation for noncancer-related perineal pain. The group found that all 13 patients receiving the treatment had an average decrease in their pain score by 50% [74].

Fluoroscopic Technique

The patient is placed prone on the fluoroscopic table. Lateral fluoroscopic imaging is used to identify the interspace between the last sacral segment and the first coccygeal segment using a metallic pointer. Holding the pointer in place, an AP image is then obtained ensuring the entry point is midline on the sacrum. The site is then anesthetized with local anesthetic. A 22- or 25-gauge 2-inch spinal needle is inserted through the skin and advanced through the sacrococcygeal ligament in the lateral view. The needle tip is advanced several millimeters past the anterior border of the sacrum. Following negative aspiration for blood, 0.5 ml of contrast solution is injected to verify presacral spread in the lateral view. AP imaging is used to confirm midline spread of the contrast. For the block 5 ml of 0.25% bupivacaine is injected and the needle is withdrawn. For chemical neurolysis, 3–4 ml of 1% lidocaine is injected, and after 7–10 min, 3–4 ml of 50–98% alcohol or 6% phenol is then injected. The needle is then flushed and removed. Many practitioners inject a small amount of steroid to help prevent neuritis. For radiofrequency ablation, a 5-mm active tip RFA needle is placed as described above with only the active tip anterior to the sacrum. Motor and sensory testing are typically performed. Radiofrequency ablation is then performed at 80 °C for 90 s (Fig. 17.10).

Side Effects and Complications

Significant complications from this block are relatively rare. Inadvertent puncture of the rectum with the needle can occur. The risk for this complication increases as the size of a pelvic tumor increases. In neutropenic patients, this can result in a presacral abscess. In addition, rectal fistula formation is possible. Finally, the injectate can track anterior to the sacrum and adversely affect the sacral nerve roots and parasympathetic nerves.

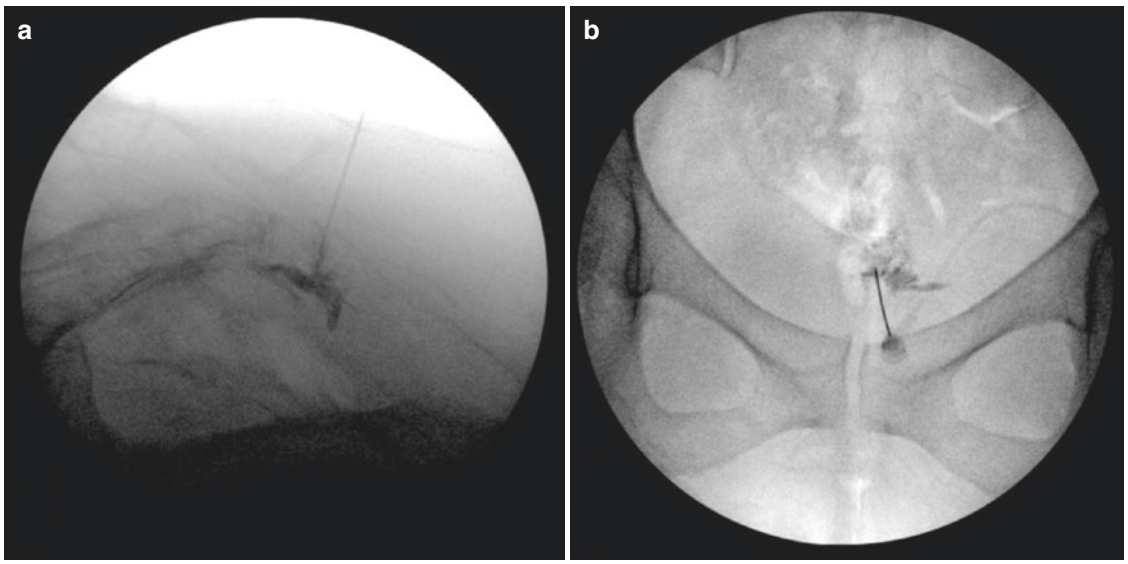

Fig. 17.10 Impar ganglion block. Initial approach in the lateral view between coccygeal segments. The final needle position is immediately anterior to the segments. Appropriate pre-coccygeal contrast spread in the lateral (**a**) and AP (**b**) views

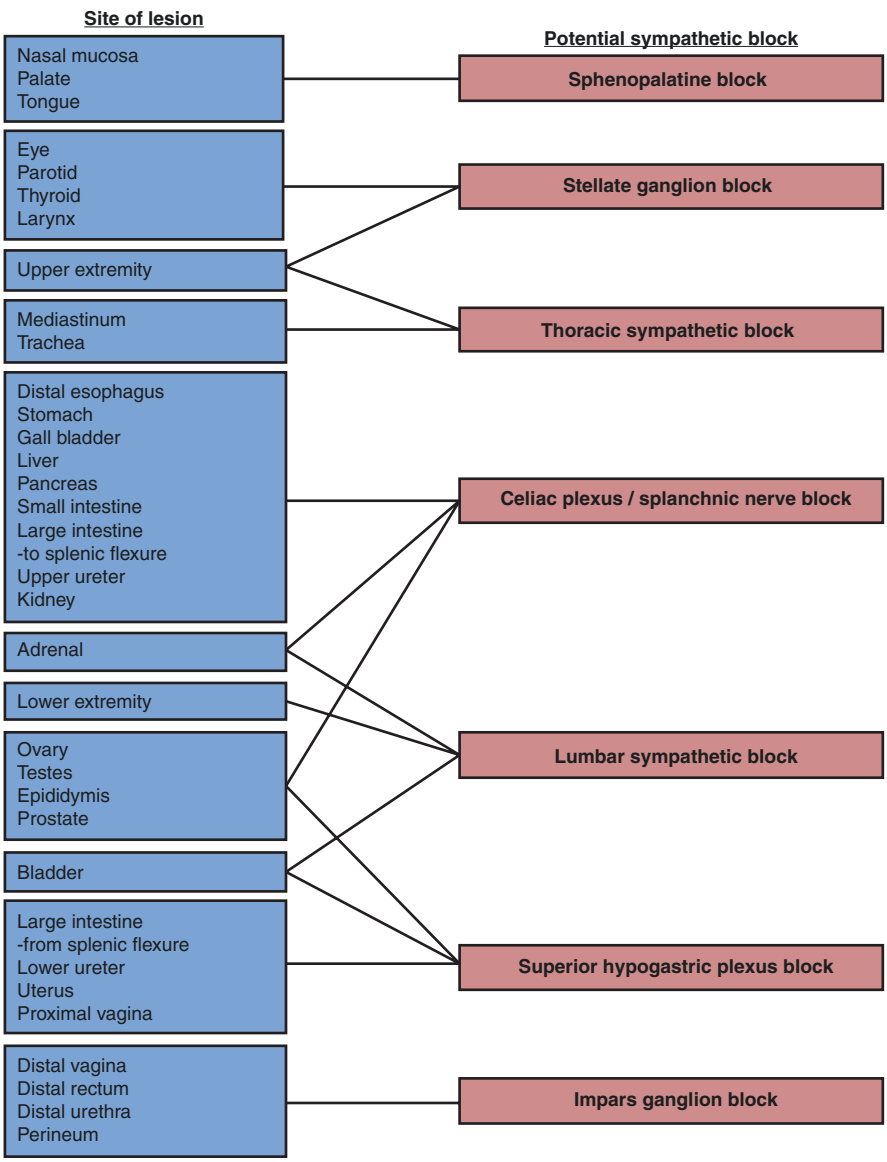

Fig. 17.11 Potential sympathetic blocks based on the anatomical site of lesion or injury

Conclusion

Blocks of the sympathetic nervous system are some of the oldest and most reported interventional pain techniques. These blocks have been shown to be effective in treating sympathetically mediated pain syndromes in addition to malignant visceral pain. Determination of the appropriate sympathetic block can be challenging due to the diffuse nature of both sympathetic and visceral innervations. Figure 17.11 was constructed to assist interventional pain physicians in choosing the most appropriate sympathetic block based on the anatomical location of the tumor or cancer treatment.

Although several randomized controlled trials have been conducted for the celiac plexus block, few high-quality studies have been performed for the other techniques outlined in this chapter. Future directions for the field of interventional cancer pain medicine should aim to include more high-quality prospective studies examining the benefit of these procedures in the context of cancer-related pain.

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