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CT-guided percutaneous neurolytic celiac plexus block technique

P. J. Wang, M. Y. Shang, Z. Qian, C. W. Shao, J. H. Wang, X. H. Zhao

Department of Radiology, Tongji Hospital Affiliated to Tongji University, Shanghai 200065, China

Abstract

Up to now, the studies in the world have demonstrated that CT-guided percutaneous neurolytic celiac plexus block (PNCPB) is an invaluable therapeutic modality in the treatment of refractory abdominal pain caused by cancer. Its efficacy of pain relief varied in reported studies. The main technical considerations which would affect the analgesic effects on abdominal pain included the patients' cooperation, needle entry approaches, combined use of blocking approaches, localization of the target area, dosage of the blocker, and so on. A success of PNCPB depends greatly on close cooperation with patients. The patient should be educated about the purpose and steps of the procedure, and trained of breathing in and breathing hold. The needle entry can be divided into the posterior approach and the anterior approach. The former one is the most commonly used in clinical practice, but the latter one is rarely used except in the cases that the posterior approach becomes technically difficult. Bilateral multiple blocking of celiac plexus and splanchnic nerves is often required to achieve optimal analgesia. The needle entry site, insertion course, and depth should be preselected and simulated on CT monitor prior to the procedure in order to ensure an accurate and safe celiac plexus block. The magnitude of analgesic effect is closely related to the degree of degeneration and necrosis of the celiac plexus. Maximally filling with blocker in the retropancreatic space is an indication of sufficient blocking. We also provided an overview of indications and contraindications, preoperative preparations, complications and its treatment of PNCPB.

Key words: Celiac plexus—Blocking agent—CT-guidance—Abdominal pain—Cancer

Correspondence to: P. J. Wang; *email:* Tongjipjwang@vip.sina.com

Computed tomography (CT)-guided percutaneous neurolytic celiac plexus block (PNCPB) is an invaluable therapeutic modality in the treatment of refractory abdominal pains caused by cancer. PNCPB, used to directly block the sympathetic afferent nerve pathway from the viscera, was first introduced in 1914 by Kappis et al. It was initially performed through a puncture according to the bony landmarks on the body surface. This technique was then abandoned because of inaccurate puncture localization and blind distribution of the neurolytic agent. Since the 1970s, more accurate PNCPB methods were developed based on various guiding techniques, such as X-ray fluoroscopy, ultrasound and CT. With X-ray fluoroscopy, the anatomic structure is anteroposteriorly or transversely overlapped with poor density resolution. Thus, it is difficult to distinguish among the pancreas, blood vessels, tumors and lymph node metastases, resulting in inaccuracy of the injection site and puncturing route. In addition, X-ray fluoroscopy is unable to display the diffusion of the neurolytic agent clearly. So this guiding technique is no longer used. Using ultrasound to guide the procedure has several advantages. Firstly, it can clearly delineate the abdominal aorta, the celiac artery and the superior mesenteric artery. Secondly, neurolytic agent (such as ethanol) diffusion can be observed clearly without using any contrast medium. And thirdly, the technique is low in cost and simple to follow. The disadvantages of the ultrasound-guided PNCPB technique are: firstly, ultrasound is not able to display the pancreas and other retroperitoneal structures as clearly as CT; secondly, the anatomic display varies from one operator of the ultrasound to another depending on their skills and experience. These limitations restrict a universal use of ultrasound as a guiding tool for PNCPB. In recent years, CT-guided PNCPB has become a popular technique, in which a puncture can be accurately made into the celiac plexus with a fine needle. An appropriate amount of a neurolytic agent is injected through the

needle to obliterate the sympathetic ganglia, cut off the nerve pathway and interrupt the pain reflex arc to achieve the purpose of analgesia. Many clinical results have shown the advantages of using CT-guided PNCPB: firstly, CT is a cross-section imaging system which avoids anatomic structures anteroposterior or transverse overlapping. Secondly, CT has a high density resolution, and is able to clearly display the retroperitoneal anatomic structures including the pancreas, the abdominal aorta, the celiac artery and the superior mesenteric artery, as well as the number, size and location of a tumor/metastasized retroperitoneal lymph nodes, which are important information for a successful PNCPB. Thirdly, an optimal puncture site and needle course can be simulated and selected, and the angle and the depth of needle insertion can be measured on a CT screen before the actual procedure, thus providing needed data for a more accurate procedure. Fourthly, CT is able to display the exact location of the needle tip relative to the surrounding structures, thus ensuring the accurate controlling of the whole procedure and avoiding possible damage to vital organs. Fifthly, CT is also able to accurately display the range of neurolytic agent (such as ethanol) diffusion, and allow the operator to decide whether the amount of ethanol injected is sufficient as well as to detect whether there is any leakage into the peritoneal cavity. And finally, CT fluoroscopy developed in recent years offers real-time images making PNCPB even more accurate and easier to perform. Above all, these benefits of CT-guidance have rendered PNCPB to be one of the most effective modalities for eliminating or relieving refractory abdominal pains caused by later stage cancer and is gaining universal acceptance [1–4].

Indication and contraindication

Indication

Percutaneous neurolytic celiac plexus block (PNCPB) is indicated for chronic refractory pains, caused by pathological changes of the viscera, governed by the celiac plexus, especially refractory and persistent abdominal pain caused by cancers such as pancreatic cancer, gastric cancer, esophageal cancer, metastatic liver cancer, gallbladder cancer, cholangiocarcinoma and other malignancies associated with retroperitoneal lymph node metastasis. PNCPB could also provide opportunities for continuing transcatheter hepatic arterial chemoembolization for liver carcinomas in patients with intolerable pain, although this application is uncommon.

Contraindication

Pains caused by cancerous involvement of the trunk such as the skeleton, muscle and abdominal wall should not be managed by PNCPB. Abnormalities of bleeding and clotting time are relative contraindications for PNCPB. In the case of patients with abdominal aortic aneurysm, severe calcification and mural thrombosis of abdominal aorta, the selection of a needle route for PNCPB should avoid a transaortic approach.

Preoperative preparations

1. The patient should be fully informed of every detail of the therapeutic course to relieve him/her of any suspicion or fear regarding the procedure in order to attain the patient's cooperation. An informed consensus should be obtained prior to the procedure, including benefits and potential risks of and alternatives to the procedure.
2. The patient should be instructed to do breathing exercise, learning to hold his/her breath under a fully relaxed condition or after inhalation, and maintain each breath-holding state in a consistent manner.
3. Bleeding time, clotting time, prothrombin time and platelet count should be tested before the operation to avoid hemorrhage during the procedure.
4. Analgesic and sedative measures are administrated before the operation in order to prevent interference with the effective evaluation of the neurolytic agent.
5. An intravenous access should be established prior to the procedure. For those patients whose constitution is extremely poor and whose blood pressure is relatively low, fluid replacement is necessary to prevent possible hypotensive reaction during the procedure, both before and during the operation.
6. Rescue measures should be well prepared preoperatively in order to deal with various emergencies such as severe allergic reaction and bleeding during the procedure.

Administration and dosage of the neurolytic blocking agent

Ethanol or phenol can be used as a neurolytic blocking agent. Ethanol is able to degenerate endoneural lipoprotein and mucin, as well as the celiac plexus by extracting cholesterol, phospholipid and cerebroside from the neurolemma, thereby causing analgesic effects. The mechanism of relieving pains caused by malignancies is directly blocking the sympathetic afferent nerve pathway from the viscera. The commonly used concentration of ethanol is between 50% and 100%. Previous studies have shown that greater than 50% ethanol is required to achieve irreversible damage to neurons and nerve fibers. The degree of the damage is independent of the concentration of ethanol provided greater than 50%, but is associated with the distribution in the celiac plexus. To reduce the pain from

ethanol injection and to facilitate observation of the distribution of the neurolytic blocking agent in the celiac plexus, a long-acting narcotic and an iodinated contrast medium are often added in the ethanol [5]. The commonly used neurolytic blocking agent is usually a mixture of absolute ethanol, bupivacaine and a contrast medium at a ratio of 6:3:1. The amount of the neurolytic blocking agent depends on the tolerance of the patient and the diffusion of the neurolytic blocking agent around the celiac artery, averaging from 30 to 60 mL. If phenol is to be used, its concentration should be at the range of 3–20%. Phenol has a higher affinity to the blood vessels than ethanol and is more readily gathered around the major vessels. However, a large amount of phenol is toxic and irritable. Also phenol is harder to be injected or to be mixed with the contrast medium due to its high viscosity. For these reasons, phenol is less frequently used in clinical practice than ethanol.

Anatomy of the celiac plexus

The celiac plexus is the largest visceral plexus, located at the level of T12–L1 around the celiac artery and the root of superior mesenteric artery. It is mainly composed of celiac, superior mesenteric and aortorenal ganglions, splanchnic nerve from thoracic sympathetic trunk, and abdominal branches of posterior trunk of vagus. Celiac ganglions may vary in size (between 1.5 and 4.5 cm with a mean of 2.7 cm in diameter) and number (between 1 and 5), distributing in the retroperitoneal cavity before T12/L1 intervertebral spaces and the middle part of L2 vertebra. The celiac artery is the anatomic marker for locating the celiac plexus. On CT cross-sectional image of this level, the portal vein, the celiac artery, the superior mesenteric/splenic artery or vein as well as pancreas should be identified anterior to the celiac plexus, to which left side the left crus of diaphragm and the left adrenal gland lie next and to which right side the right crus of diaphragm and the inferior vena cava lie next. The Adamkiewicz artery is an important anatomic structure around the celiac plexus. It supplies blood to the lower 2/3 segment of the anterior spinal artery and is also the largest blood supplying artery of the lumbar spinal cord. It enters the vertebral canal through the T8–L3 intervertebral foramens in about 78% cases.

Needle entry

The needle entry site, the insertion course and the blocking point should be appropriately selected under CT guidance so as to ensure the accuracy of the puncturing, enhance the analgesic effect and reduce morbidity. The following are some widely used approaches of needle entry:

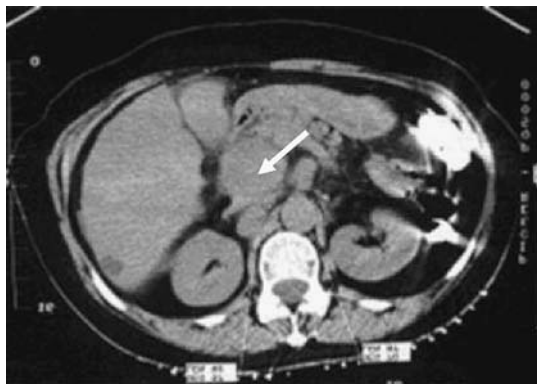

Fig. 1. Pancreatic head cancer invading the eliac plexus (*arrow*). Localization railing is pasted on the body surface of CT scanning range, on which the appropriate puncture point and route of needle insertion are simulated, and the angle and depth are measured.

The posterior approach

CT-guided paravertebral entry

This is the most commonly used approach in clinical practice primarily for bilateral blocks in the area of the anterior- or posterior-crus of the diaphragm.

1. Bilateral blocking anterior to the crus of the diaphragm: This is the most frequently used technique for celiac plexus block. The patient is laid in a prone or side recumbent position. The localization railing is attached to the body surface centered at the level of T12–L1. CT scanning is performed to display various visceral organs, vessels, crus of diaphragm and the tumor within the T12–L1 level. The image slice between the celiac artery and the root of superior mesenteric artery is considered to be the optimal image for the procedure guidance. The puncture site is usually selected at the paravertebral region. The needle tip should be placed anterior to crus of the diaphragm and posterior to the pancreas, and around the celiac artery and the root of superior mesenteric artery. The rib and transverse process should be avoided in the course of the needle entry. Selection of the puncture site and the route of the needle entry are then simulated and the angle and the depth of needle entry are measured on the CT display (Fig. 1). Skin of the puncture site is routinely sterilized, covered with a sterile drape. Under localized anesthesia, a 22–24 G Chiba puncture needle is inserted step by step as planned on the simulation. When CT scanning assures that the needle tip reaches around the celiac artery and the root of the superior mesenteric artery, and the area anterior to the diaphragm and posterior to the pancreas (Fig. 2), 5 mL mixture of the contrast medium and localized anesthetic (1:4) is injected. The CT scanning is re-performed to document distribution

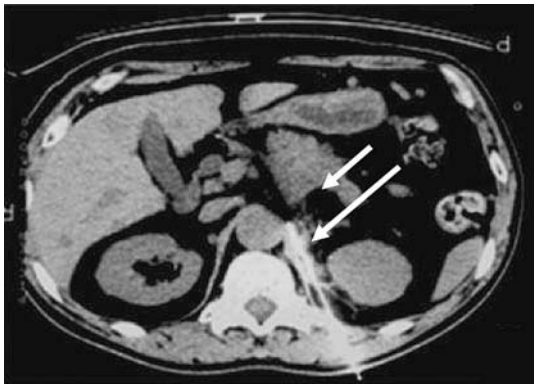

Fig. 2. Pancreatic cancer invading the celiac plexus (*shorter arrow*). The puncture needle is entered paravertebrally from the back with the tip located anterior to the left crus of diaphragm (*longer arrow*).

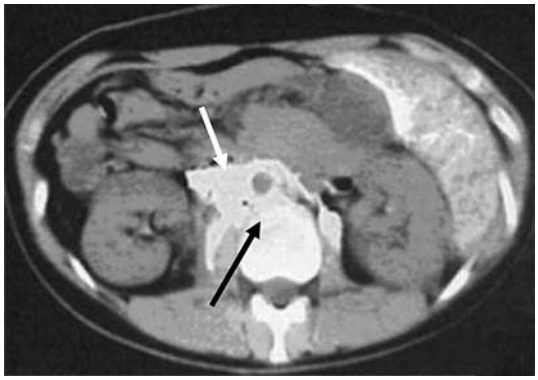

Fig. 4. Bilateral block anterior to (*white shorter arrow*) and posterior to (*black longer arrow*) the crus is used, where ethanol (mixed with high density contrast material) diffuses well in postpancreatic and postcrus spaces.

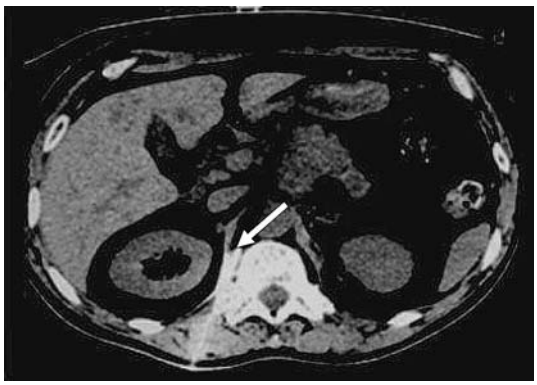

Fig. 3. The puncture needle is entered paravertebrally from the back with the tip located posterior to the right crus of diaphragm for blocking splanchnic nerves (*arrow*).

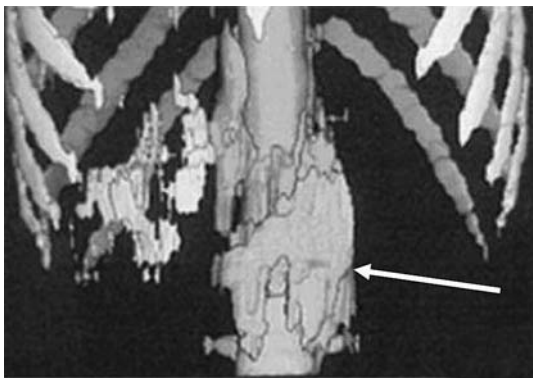

Fig. 5. A 3-D CT reconstruction image shows that ethanol (mixed with high density contrast material) diffuses well pre- and paravertebrally (*arrow*).

of the contrast medium for 10 min. If the neurolytic blocking agent mixture is found to diffuse satisfactorily in the retropancreatic space anterior to the crus of the diaphragm, and the patient has no complaints of numbness and motor dysfunction of the lower extremities and feels that abdominal pain is being relieved, 25–30 mL neurolytic blocking agent is injected through the needle, followed by injection of 2–5 mL normal saline or a local narcotic to prevent the neurolytic blocking agent in the needle from flowing out while withdrawn. Such leakage could cause a burning pain in the puncture route.

2. Bilateral blocking posterior to crus of diaphragm: This technique is mainly indicated for blocking the splachnical nerve. It should be done bilaterally in a separate puncture, and is usually used in coupling with the bilateral blocking anterior to the crus of diaphragm to enhance the analgesic effect. The needle tip is separately placed in the postcrus space bilaterally (Fig. 3), and 5–10 mL neurolytic blocking agent is injected at each side (Figs. 4, 5).

CT-guided trans-intervertebral disc blocking

This approach is applied to the patients in whom the paravertebral approach is difficult to be performed because the optimal needle entry route is blocked by the transverse processes or ribs [6–8] The preprocedural preparations are the same as those for the paravertebral approach. When the needle tip travels through the intervertebral disc and passes through the anterior longitudinal ligament, the operator will feel a sense of breakthrough. When the tip reaches around the celiac artery, before the crus of diaphragm and behind the pancreas 25–30 mL neurolytic blocking agent is then injected. This technique has several advantages. Firstly, the needle tip reaches before the vertebral body through the intervertebral disc, thus avoiding potential damage to the liver, kidney, gut and pancreas. Secondly, It avoids reflux of the neurolytic blocking agent to the intervertebral foramen and/or lumbar and back muscle group, thus preventing injury to the spinal cord. This method does have some disadvantages as well. Firstly, passage of

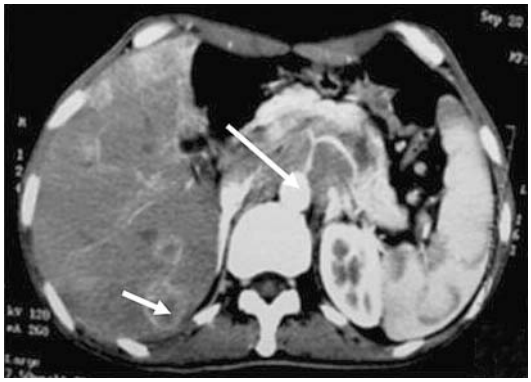

Fig. 6. A case of gastric cancer associated with liver metastatic lesions (*shorter arrow*) and enlarged retroperitoneal lymph nodes (*longer arrow*) where the postpancreatic space is fully occupied by metastatic lymph nodes in which the celiac plexus is enveloped.

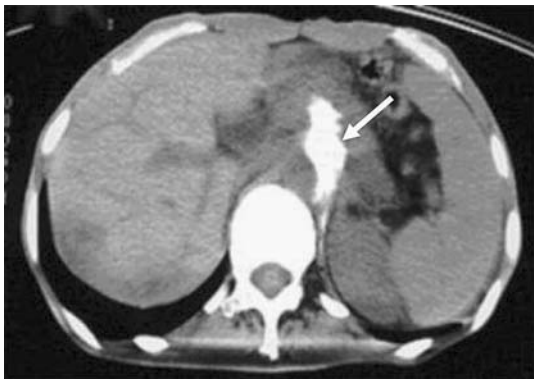

Fig. 7. The puncture needle is directly inserted into the lymph node, into which ethanol (mixed with high density contrast material) is pushed by force and in which ethanol diffuses well (*arrow*).

the needle through the intervertebral disc may cause injury to and degeneration of the disc. Secondly, it is difficult to perform in patients with severe degeneration of the thoracic and lumbar intervertebral disc. In addition, it is likely to penetrate the abdominal aorta potentially causing a retroperitoneal hematoma.

CT-guided trans-abdominal aorta blocking

First of all, CT scanning is performed to outline the exact location of the abdominal aorta and the celiac artery and the superior mesenteric artery. When the needle tip penetrates the posterior wall of the abdominal aorta, the operator may fell the entering of empty space and arterial return can be found from the needle. Then the needle is washed with a small amount of normal saline. When the needle is further advanced and breaks through the anterior wall of the abdominal aorta, the operator may have a breakthrough sense again. If no air or blood is drawn back, 3–4 mL contrast medium is injected and its diffusion is to be observed. If the contrast medium diffuses well in the postpancreatic space before the abdominal aorta, PNCPB is feasible. The advantages of this method is that: firstly, the neurolytic blocking agent can block bilateral celiac plexus with a single (mostly left) injection; secondly, the neurolytic blocking agent will not easily flow into the intervertebral foramen thus reducing the possibility of causing injury to the spinal cord. The disadvantages of this method are that as the abdominal aorta is broken through twice or more during the puncturing, hematoma and iatrogenic vascular injury are likely in patients with hypertension or clotting problems.

CT-guided direct puncture of the tumor

In the cases where the retropancreatic space is almost completely occupied by pancreatic tumors or fused metastatic lymph nodes with the celiac plexus enveloped inside it is difficult for the blocking agent to diffuse or penetrate the celiac plexus encased by the mass. This can greatly diminish the analgesic effect. In addition, ethanol only has superficial contact with the edges of the tumors or the metastasized lymph nodes and is unable to penetrate inside the tumor and exert a therapeutic effect on the mass. Over the time with an increasingly growing mass, abdominal pain will get worse. To solve this problem, we used a new method that the needle was penetrated directly into the mass and the neurolytic blocking agent was pushed in by force to diffuse in the mass. If the mass was large, multiple points of injection were employed so that ethanol could diffuse completely and homogenously in the mass, achieving two therapeutic purposes: ablating the mass and necrotizing the celiac plexus. We have used this technique in 96 cases of extensive metastatic lymphadenopathy in the postpancreatic space and three cases of large pancreatic tumors, where the masses shrank remarkably and became necrotized after treatment (Figs. 6, 7, 8). The analgesic effective rate was 100%. There were no significant complications in this group.

The anterior approach

As this approach may cause injury to the visceral organs, it has rarely been used except in the cases where the posterior approach becomes technically difficult. The patient is in a supine position. Under CT guidance, the needle is inserted through the anterior abdominal wall vertically and passes through the stomach and pancreas to the retropancreatic space anterior to the crus of diaphragm. When the needle tip reaches the adjacency of the celiac artery and the root of superior mesenteric artery, 25–30 mL neurolytic blocking agent is injected (Figs. 9, 10, 11). The advantages of this method are: firstly, it is

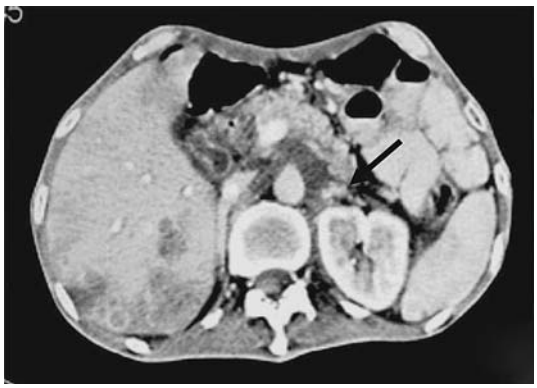

Fig. 8. Posttreatment CT checkup shows that the enlarge lymph node is evidently necrotic and shrunk (*arrow*).

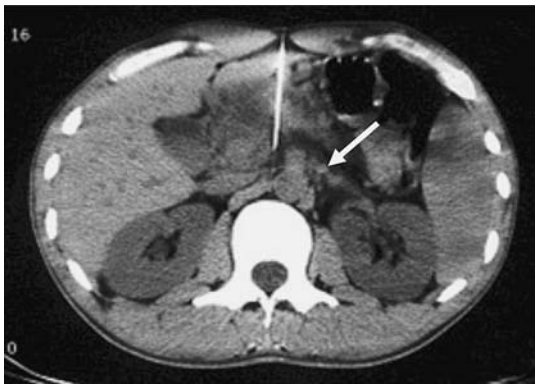

Fig. 10. The puncture needle is inserted vertically into the anterior abdomen under CT guidance with the tip located beside the celiac artery (*arrow*).

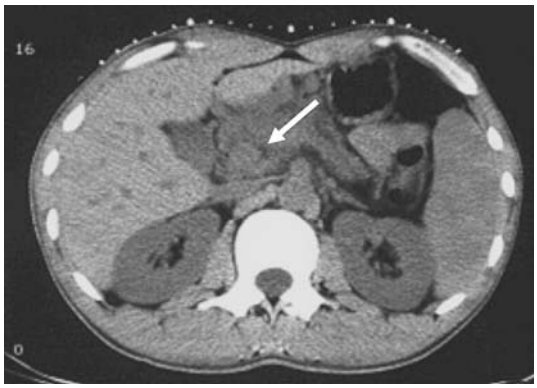

Fig. 9. Pancreatic cancer invades the celiac plexus (*arrow*). The patient assumes a prone position with the apposition railing pasted on the abdominal surface for anterior approach of celiac plexus block.

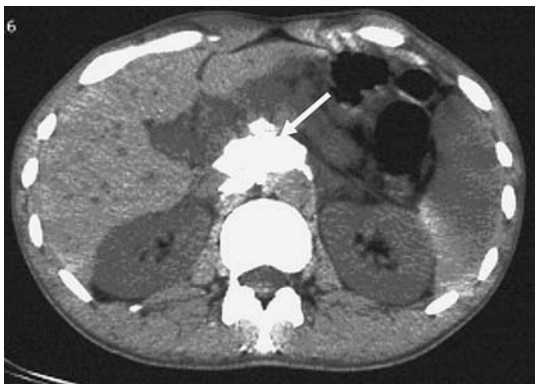

Fig. 11. Postblock CT scan shows that the postpancreatic space is full of ethanol (mixed with high density contrast material (*arrow*).

simple to perform; secondly, the supine position is more acceptable to the patient; and finally, it minimizes the risks of the kidney and spinal cord. However, there are still possibilities of causing gastric perforation [9], pancreatic fistula and chemical peritonitis with the method when the needle passes through the stomach, gut, liver and pancreas.

Postoperational treatment

The patient should be advised to rest in bed for 12 h after the procedure. During this period of time, blood pressure, heart beat rate and other vital signs should be monitored on hourly basis. Movement and sensation of the lower extremities as well as the amount of discharge should also be checked. For 1–2 days after the procedure, a daily 500–1000 mL fluid should be given intravenously. Vitamin K or FFP (fresh frozen plasma) may be given to the patients who are at the risk of bleeding. Prophylactic antibiotics may be used. If any complication occurs, appropriate measures and treatment should be immediately executed.

Efficacy and technical considerations

Relatively good therapeutic outcomes have been reported with the different guiding techniques and needle entry approaches [10–12]. In a randomized double-blind trial on the analgesic effects of PNCPB and narcotic analgesics on upper abdominal pain caused by pancreatic cancer, Polati et al. [13] reported that pain was relieved immediately after treatment in the PNCPB group. Although the long-term outcomes were not significantly different between the two approaches, the PNCPB group was associated with a decreased dosage of the analgesic used and less drug-related adverse effects such as constipation, nausea and vomiting. Complications in the PNCPB group were transient diarrhea and hypotension. In 20 patients treated by Mercadante [14], 10 patients underwent PNCPB and the remaining 10 patients were treated with medical management as control. Both groups were given drugs to ensure analgesia. In the first 2 weeks after the procedure, the dosage of the analgesic used in the PNCPB group was significantly lower than that of the medical group; in 2–4 weeks, it was reduced

to one-third of what was used in the control group; and after 1 month to death, it was the half of that of the control group. The difference was significant between the two groups. In another the double-blind comparative study on the analgesic effects of alcohol versus saline in 130 patients treated with PNCPB, alcohol injection resulted in a significantly better outcome with regards to pain relief, mood states, and the quality of life compared with saline injection [11]. In our 392 patients with cancerous abdominal pain who underwent PNCPB, the effective rate for analgesic was achieved 100%, 98% and 91% at 1, 2 and 3 months after the procedure, respectively. These high effective rates for analgesic may have been the results of the combined use of multiple blocking techniques, which could optimize the analgesic effects on abdominal pains from a variety of malignancies.

There are several technical considerations that may affect the outcome [14–16]. Based on the literature review and our experience the following technical considerations should be taken into account in terms of achieving clinical goals:

1. Cooperation from the patient: A success of PNCPB depends greatly on the close cooperation with the patient. Sufficient communication with the patient should be conducted before the procedure, informing the patient of the therapeutic steps and relieving their suspicion and fear. Breathing exercise should be arranged before the procedure, teaching the patient how to breathe homogenously and consistently without great fluctuation as well as how to hold his/her breath. After the procedure is started, the patient should be immobilized to ensure a precise needle insertion as planned on the simulation.
2. Needle entry: Needle entry and insertion should be preselected. After the entry angle and depth are determined, needle puncture is performed step-by-step under CT guidance. Any direction deviation should be corrected in time to ensure that the needle tip reaches the designed position safely and accurately. One-step insertion to the target area should be avoided as it could accidentally cause iatrogenic injuries to the adjacent organs due to a deviation of the needle course. CT fluoroscopy can be an invaluable modality to facilitate precise needle insertion done step by step under CT guidance.
3. Localization of the target area: In either the posterior approach or the anterior approach, accurate localization is essential for the successful blocking. As the celiac plexus cannot be directly displayed on the CT screen, the operator should get familiar with its anatomic location and make use of the celiac artery and the root of superior mesenteric artery at the T12–L1 level as the anatomic land markers for localizing the celiac plexus. The entry site, course, angle and depth of inserting the needle should be simulated on the CT screen prior to the procedure to ensure an accurate localization and puncture.
4. Combined use of blocking approaches: The analgesic mechanism of PNCPB is blocking the conduction pathway of the splanchnic nerve and interrupting the pain reflex arc. Whether the blocking agent is sufficiently diffused is the key factor affecting the analgesic outcome [10–12, 17]. Unilateral blocking is usually not adequate for ethanol diffusion in most cases. Single blocking anterior to crus of the diaphragm is unable to obliterate the splanchnic nerve posterior to the crus. Therefore, bilateral multiple blocking of celiac plexus (anterior to crus of diaphragm) and splanchnic nerves (posterior to crus of diaphragm) is beneficial to obtaining the most optimal blocking effect.
5. Dosage of the blocking agent: The analgesic effect is closely related to the degree of degeneration and necrosis of the celiac plexus. If the amount of the blocking agent is insufficient, the celiac plexus cannot be degenerated and necrotized completely. Only when the amount of the blocking agent is sufficient, the celiac plexus can maximize degeneration and necrosis of the celiac plexus. In principle, the blocking agent should be diffused in the retropancreatic space completely after the therapy. The total amount of the blocking agent usually ranges between 30 and 60 mL.
6. Blocking of needle inserting into the mass: when the celiac plexus is encased by the pancreatic tumor or a confluence of metastatic lymphadenopathy, the retropancreatic space near the celiac plexus could become very small or even disappear. It is therefore difficult for the blocking agent to be diffused into the celiac plexus or infiltrate into the mass for satisfactory celiac plexus obliteration. For this reason, it is necessary to directly puncture the mass for the blocking agent delivery. The blocker can be injected at divided doses through multiple intra-mass injections to facilitate maximal diffusion in the mass. This not only produces a good analgesic effect, but also directly ablates the tumor and the enlarged lymph nodes. In patients who have a relatively large tumor or who poorly tolerate ethanol, a single session of PNCPB may not be adequate and multiple sessions may be required to achieve the palliative goals [18].
7. Early intervention: The more advanced the tumor is, the less analgesic effects of PNCPB would be achieved. This is because when neoplasm extensively spreads, it not only involves the celiac plexus, but also invades other nerve pathways including the afferent and efferent nerve systems, which also become sources of the pain. Early intervention can achieve the optimal analgesic effects as the celiac plexus is usually not encased by the tumor. Therefore, an early application of PNCPB may generate longer analgesic effects before patients develop an addiction to the analgesics.

8. Psychotherapy: Pain is a symptom resulting from many factors including psychological, emotional and physical factors. Appropriate psychological therapy should not be neglected. Celiac plexus block, if aided with psychological therapy, would enhance palliative effects.

Complications

CT-guided PNCPB is a relatively safe-adjuvant analgesic method. As long as the location of the injection is correct, a fine needle (20–22 G) is used and the protocol is strictly followed, no serious complications would occur. On review of the literature, some complications may be associated with PNCPB [13, 19–21].

1. Procedure-related pain: Ganglion blocking by ethanol may induce abdominal and thoracodorsal burning pain or pain radiating to the shoulder. When a substantial amount of ethanol is injected, patients may experience pain. At this time, CT scanning should be performed to verify whether the needle tip is at the right position in order to prevent the blocking agent from leaking into adjacent organs or tissues causing pain. In order to minimize discomfort and irritating pain caused by ethanol, the use of 0.5% bupivacaine (a long-acting anesthetic) is recommended prior to ethanol injection. Once injection of blocking agent is completed, the needle should be flashed with 0.2 mL of normal saline or 1% lidocaine to eliminate possible ethanol leak from the needle into back muscles or the peritoneal cavity during the withdrawal. Such leakage could cause pain. Decreased excitability of the sympathetic nerve and increased excitability of parasympathetic nerve after PNCPB may induce constipation or intestinal spasm, which could cause obstructive pain. Preoperative bowel preparation may minimize or prevent them from occurring. Oral analgesic may be taken to relief some postoperative pain.
2. Diarrhea: The mechanism of diarrhea after PNCPB is not completely understood, but is probably due in part to blockage of the intestinal sympathetic efferent nerve fibers or a lack of control over the excitability of the parasympathetic nerve. Chronic diarrhea is a rare situation, and deemed to be associated with continuous nerve injury by the blocking agent. Ischia et al. [22] suggested that the amount of the blocking agent was the main causative factor for diarrhea. Conventional treatment is less effective. Some studies report that the use of sandostatin and atropine may benefit the management of this complication.
3. Orthostatic hypotension: It has been reported that 10–52% of patients may develop orthostatic hypotension after PNCPB. The mechanism of orthostatic hypotension is the visceral vasodilation causing relatively low blood volume and low cardiac output due to decreased tone of the sympathetic nerve and decreased control over excitability of the parasympathetic nerve after celiac plexus block. The patient should be advised to lie supine for 20 min and then lie in a prone position for another 20 min immediately after the procedure. The patient should also avoid rising up swiftly. If orthostatic hypotension occurs and the diastolic pressure drops below 2.67 kPa the patient should be laid flat and be given fluid intravenously, with push injection if necessary.
4. Chemical peritonitis: Chemical peritonitis is usually caused by a blocking agent leak resulting mainly from an improper location or migration of the needle tip during the procedure. Ethanol leak into the peritoneal cavity could cause severe chemical peritonitis. Repeated puncture with anterior approach could amplify the risks of peritonitis due to the possible injury to the pancreas and/or stomach. Therefore, the needle tip must be positioned accurately. If patients suddenly experience pain during the procedure, injection of the blocking agent should be halted immediately and position of the needle tip needs to be checked on CT.
5. Paralysis: Although rarely seen, Paralysis is the most severe procedure-related complication with PNCPB. In a study on 2730 patients receiving PNCPB, Davies et al. [23] found only 4 (0.15%) patients developed paralysis after the procedure. Three of these patients lost anal and bladder sphincter function, due to the injury to the spinal cord. It was believed that the injury had probably been caused by the needle tip migration and unintended injection of the agent into the spinal artery through the posterior approach. A direct injection of ethanol into the spinal artery could lead to vascular spasm and spinal ischemia. Another possible mechanism is when the needle passed through the lumbar intervertebral space, the lumbar sympathetic chain, plexus, nerve network were injured. Direct injection of ethanol into the subarachnoid space or dissemination from the nerve root to the subarachnoid space could also be a reason for paralysis.
6. Arterial dissection: Arterial dissection is also a complication which cannot be ignored. Some researchers believed that migration from the original needle tip position during the procedure could scratch the arterial wall and induce an arterial entry, which is one of the causes for arterial dissection. Anatomic change caused by the tumor growth, volumetric change caused by the blocking agent injection and excess respiratory movement can invariably alter the needle tip position.Other complications have been sporadically reported, including local hematoma, pleurisy, transient hematuria, pericarditis, intervertebral disc injury, local tissue necrosis (lysis of striated muscle), monoplegia accompanied with dysfunction of anal and bladder sphincters, pneumothorax, sexual impotence, formation of retroperitoneal abscess [24].

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