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CT-Guided Celiac Plexus Block for Intractable Abdominal Pain

Treatment of intractable abdominal pain due to inoperable intraabdominal malignancy is important, and the ineffectiveness of pharmacological agents has led many investigators to recommend chemical neurolysis of the celiac ganglions as a treatment. The author describes the technique and results of celiac plexus neurolysis under CT-guidance with various approach routes, including anterior, posterior and transaortic routes. Twenty-eight patients, ranging in age from 36 to 82 years, have been treated with this procedure. All had inoperable or recurred intraabdominal malignancies and suffered from intractable upper abdominal pain and/or back pain. The author performed the procedure using absolute alcohol by an anterior approach (n=18), posterior approach (n=6) and transaortic approach (n=4). Pain was rated according to a visual analog scale before and after the procedure to gauge treatment success. No major complications occurred. Mild hypotension occurred in five patients (18%) and transient diarrhea in six patients (21%). Twenty-one (75%) of the 28 patients had some relief of pain and 17 of these patients (61%) had good relief of pain after the procedure. The results support that CT-guided celiac plexus block with alcohol is a safe and effective means of pain control in patients with intraabdominal malignancy.

Key Words: *Anesthesia; Celiac Plexus; Tomography, X-ray Computed; Abdominal Pain; Radiology, Interventional*

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INTRODUCTION

Neurolysis of the celiac ganglion is an efficient method in the management of pain in patients suffering from upper abdominal malignancies, such as pancreatic cancer, bile duct cancer, gastric cancer and primary liver neoplasm (1-9). The percutaneous celiac plexus block technique was first described by Kappis (1) in 1919 and subsequently refined by several authors (2-4) to improve results and avoid complications. Most authors have described and evaluated the procedure performed via a posterior approach, sometimes with fluoroscopic guidance. However, conventional posterior approach for celiac plexus block sometimes cannot be used in patients whose anatomical relationship of the retroperitoneal organs is distorted by cancer growth or by a previously performed operation. In addition, complications such as paraplegia, pneumothorax, and liver or kidney puncture can occur (4-6).

Recently, radiologic guidance such as CT or ultrasound has been shown to be fundamental in improving the quality and reproducibility of the neurolytic procedure and in making it safer and more effective (7-17). Various approaches for the positioning of the needle have been described with CT or ultrasound guidance in an attempt to increase success rates, reduce morbidity, and enhance technical accuracy (11-17). Although such attempts have generally been successful, nonuniformity of techniques has led to variability of those results.

The purpose of this study is to report my experience using CT as a guidance in performing celiac plexus block with various approach routes, including anterior, posterior and transaortic route, and also, to examine the safety and efficacy of this technique in relieving intractable abdominal pain due to upper abdominal malignancies.

MATERIALS AND METHODS

Selection of patients

Patients were carefully screened before the procedure to assess the source of abdominal pain. All patients suffered from chronic upper abdominal pain regarded as of celiac ganglion origin, for which pharmacologic treatment proved either ineffective or limited by side effects. Patients with moderate degrees of pain that could be relieved by several daily doses of oral narcotics were gen-

erally not included as candidates for this procedure. All patients had normal prothrombin and thromboplastin times.

Celiac plexus blocks were performed in 16 women and 12 men ranging in age from 36 to 82 years old (mean, 65 years) from May 1995 to December 1998. All patients had abdominal cancer; 10 patients had pancreatic cancer, eight had gastric cancer, five had bile duct cancer, three had liver cancer, one had right colon cancer and one had renal cell carcinoma. Besides to primary cancer, five of them had extensive hepatic metastases and three had peritoneal metastases. In order to evaluate treatment results better, each patient was asked to judge the intensity of pain before and after the procedure, using a 0-to 10-cm visual analog scale (VAS) (18). Based on a 10-cm line, the left extremity represented "no pain at all" (score 0) and the right one represented "unbearable pain" (score 10). The distance from score 0 to the point indicated by the patient, rounded off to the nearest whole number of centimeters, expressed the pain score. We judged the pain relief after block as excellent when the reduction of the score on the VAS was >7, good when it was 5-6, fair when it was 3-4 and poor when it was <3.

Technique

We preferred to use the 21-gauge Chiba needle (Cook, Bloomington, IN, U.S.A.) but the procedure could be adequately performed with either 18- or 22-guage needles. Neurolytic blockade of the celiac plexus was carried out with absolute ethanol. 15 mL of absolute alcohol was injected through each needle in two-needle approach or 30 mL was injected through one needle if a single-needle approach was used. This can be mixed with either lidocaine to reduce pain or contrast material to permit visualization.

Preparation included the administration of intravenous fluids to attenuate the hypotension associated with neural blockade and it also included an evaluation for coagulopathy in those patients who had undergone antiblastic therapy or have a history of significant hepatic malfunction. Preliminary CT scans of thin sections (5-mm thick at 5-mm intervals) were obtained through the upper part of the abdomen, and the celiac and superior mesenteric arteries were identified. After skin anesthesia, a single or two 20-guage, 15-cm long Chiba needles were advanced at the predetermined path and depth.

When the needle tip was shown to be in the appropriate position on CT scan, the stylet was removed, then after careful suction to exclude needle presence within a vascular lumen, 5 mL of 2% lidocaine (Kwang-Myung, Seoul, Korea) mixed with contrast medium was injected through each needle (Fig. 1). Injection of local anesthetic mixed with contrast medium almost always preceded that of alcohol to reduce the pain of either ganglion neurolysis or retroperitoneal tissue necrosis and to assess spread around the aorta. The injected contrast material flowed freely without resistance from the tip of the needle into the retroperitoneal space around the celiac and superior mesenteric vessels and around the aorta (Fig.

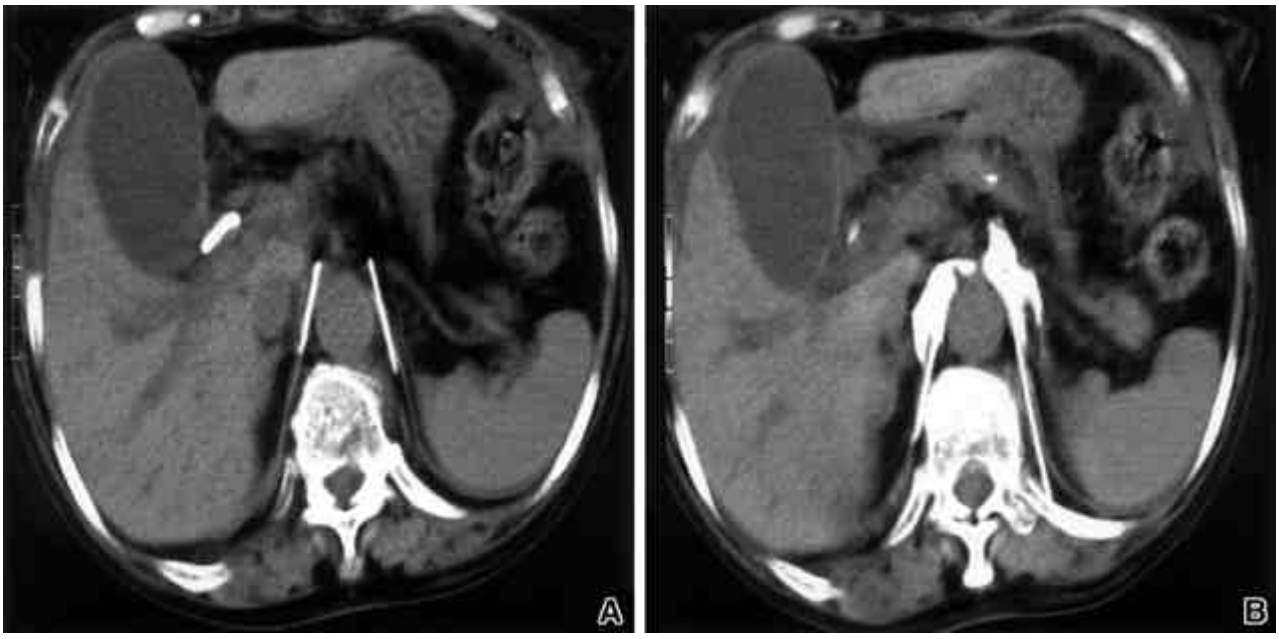

Fig. 1. Two needle transcrural technique. A: The needle tips are positioned transcrurally just lateral to the aorta. B: Spread of contrast material anterior to the crura indicates correct needle position for alcohol injection.

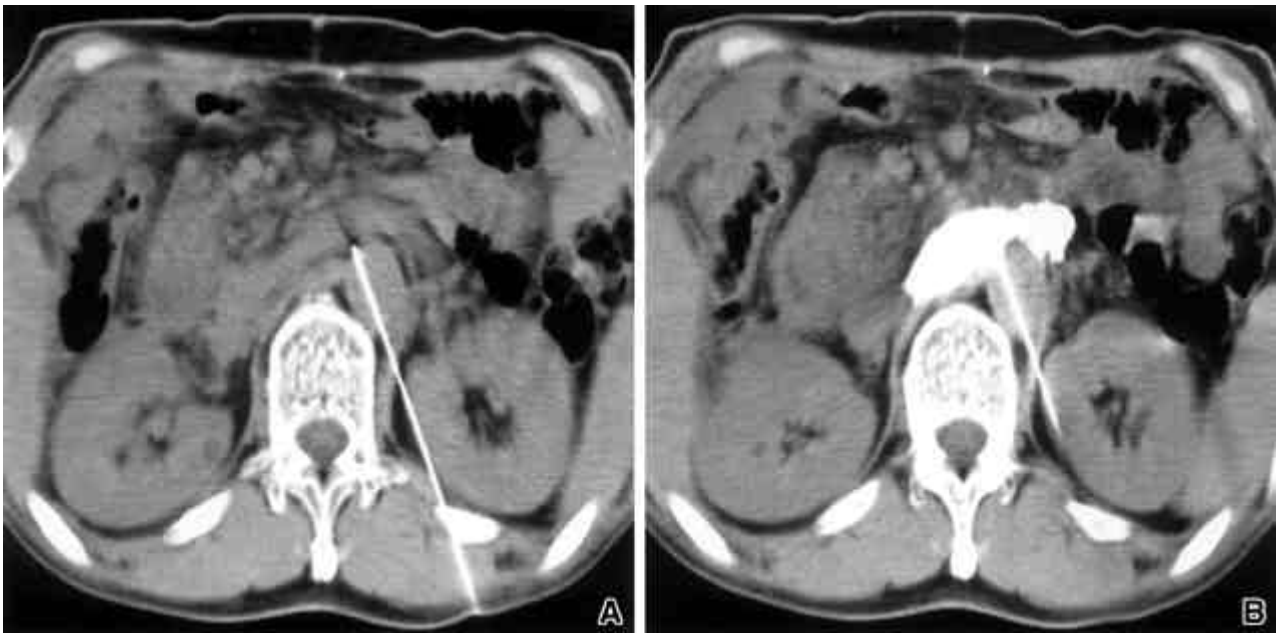

Fig. 2. Single-needle transaortic technique. Axial CT scan at the L1-vertebral level, the patient lying prone, shows placement of needle transaortically into the preaortic space (A) and pre-aortic spread of contrast agent (B).

2B). After the injection of contrast material showed that the needles were in the correct position, 15 mL-30 mL of absolute alcohol was injected. Before the needles were removed, 5 mL of saline was injected through each needle to prevent alcohol from tracking back along the needle path. Immediately after needle withdrawal, serial CT scans were obtained above and below the injection site up to the lower and upper limits of neurolytic solution spread.

Three kinds of approach to reach the celiac plexus were used in this study and the selection of the approach was done rather arbitrarily: transcrural approach (n=6) (Fig. 1), single needle transaortic approach (n=4) (Fig. 2) and anterior approach (n=18) (Fig. 3). For two-needle transcrural technique, placement of needle tips was directed to anterior and caudal to the diaphragmatic crura (Fig. 3A). In cases that used single-needle transaortic technique, a needle was advanced to penetrate both walls of the aorta and to rest in the preaortic nerve network of the celiac plexus (Fig. 2A). One or two needles were placed just anterior to the aorta between the roots of the celiac and the superior mesenteric arteries, or just cephalad to the root of the celiac artery or just lateral to the celiac artery in the anterior approach (Fig. 3A & C).

RESULTS

There was no technical failure, serious side effects or complication related to the procedure. CT was capable of accurately demonstrating the location of the needle tip and also, alcohol spread following injection (Fig. 2B, 3B & D). Detection of the abnormal needle location by CT permitted removal prior to alcohol injection and probably prevented any serious complications that would have resulted from an alcohol injection into the spinal canal. Transient hypotension, however, occurred in five patients (18%) as a result of vasodilatation of the splanchnic vascular bed and pooling of blood within the splanchnic vessels. Transient diarrhea occurred in six patients (21%) as a result of unopposed parasympathetic activity, but this did not last for more than 48-72 hr. On the basis of the patients' charts, we found no clinical suspicion of retroperitoneal abscess or pancreatitis during any of the patients' hospital stay.

The pre-block VAS values ranged from 7 to 10 (mean: 9). Pain relief was assessed one week following the neurolytic procedure and scored subjectively by the patient on a 0-10 scale. The result of pain relief based on the reduction of the score on the VAS were as follows: excellent (n=6), good (n=11), fair (n=4) and poor (n=7). Twenty-one (75%) of the 28 patients had some relief of pain and 17 of these patients (61%) had good to excellent relief of pain. Little or no significant benefit was noted in the seven patients. Five of them were in the terminal period of their disease course, and three had extensive involvement of the omentum and peritoneum and two had involvement of the liver by tumor. Eight of 10 patients (80%) with pancreatic cancer and 13 of 18 patients (72%) with other intraabdominal malignan-

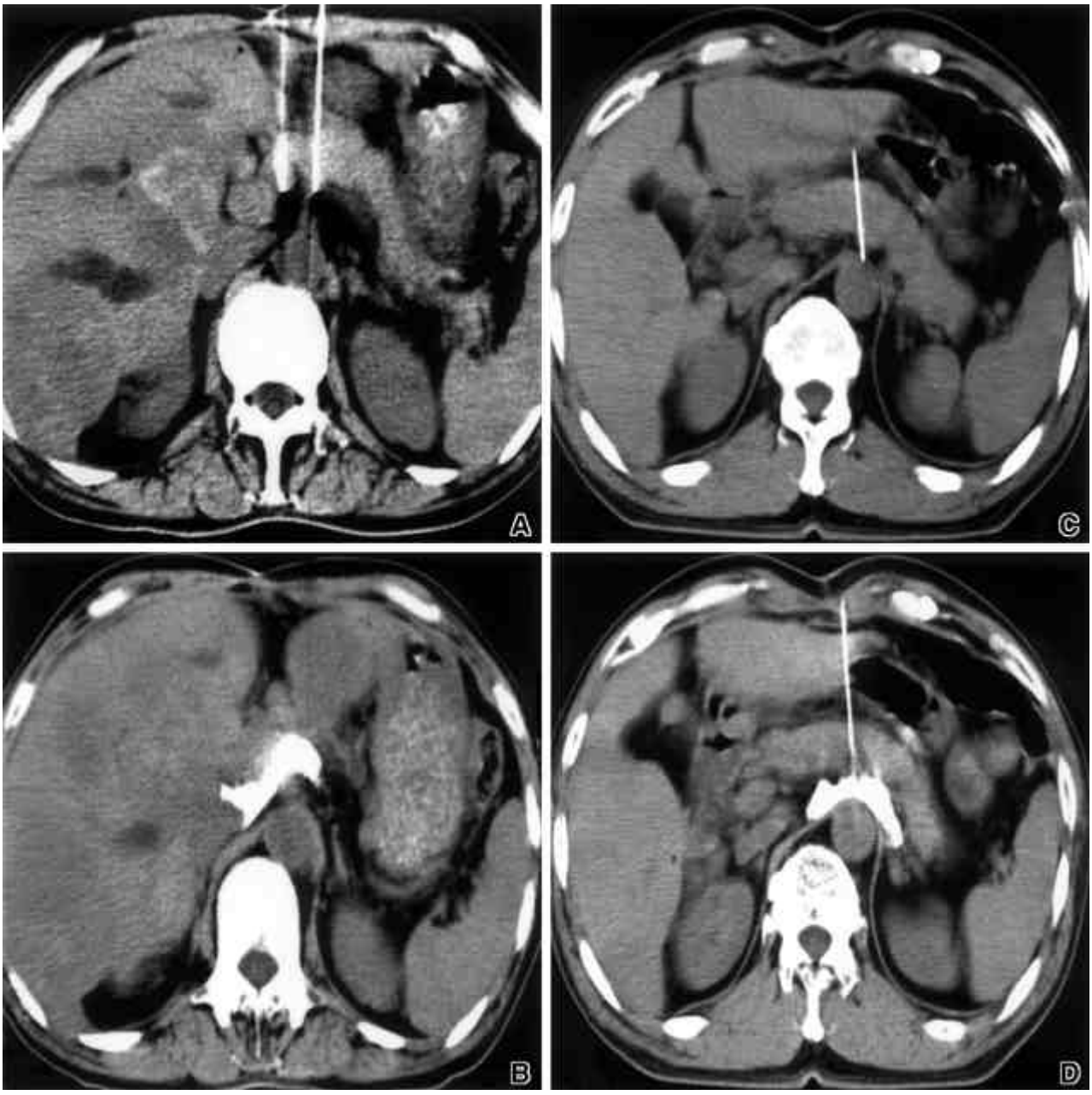

Fig. 3. Anterior approaches. Two needle technique: CT scan shows two 15-cm, 21-guage Chiba needles, one on each side of the superior mesenteric artery (A), and contrast material diffusing around the superior mesenteric artery and aorta from both needle tips (B). Single needle technique: CT scan shows tip of needle is placed anterior to the aorta between the celiac axis and superior mesenteric artery (C), and spread of the contrast material around the aorta (D).

cies had fair to excellent pain relief. There was no statistically significant difference in pain relief between the patients with pancreatic cancer and patients with other malignancies ($p>0.05$).

DISCUSSION

Treatment of inoperable upper abdominal cancer pain is of paramount importance. The ineffectiveness of pharmacological agents has led many investigators to recommend chemical neurolysis of celiac ganglions for pain control (17). Chemical neurolysis of celiac ganglions and splanchnic nerve is currently an extremely effective procedure that blocks transmission and achieves significant or complete alleviation of deep visceral pain. The terms 'celiac plexus block' and 'splanchnic nerve block' often are used synonymously, but the celiac plexus and

splanchnic nerves are anatomically and regionally distinct structures (16).

To perform neurolysis safely and get good results, radiologist must first have a good understanding of the anatomical relationship of the celiac ganglion and its surrounding structures, which determine the safest possible percutaneous pathway. Most of the sympathetic efferent fibers to the abdominal viscera originate in the thoracic spinal cord and reach the abdominal viscera through the thoracic splanchnic nerves and celiac plexus. The thoracic splanchnic nerves lie cephalad to the diaphragm, anterior to the lower thoracic vertebral bodies. The celiac plexus lies just caudad to the diaphragm, at the level of the first lumbar spine but may be found from T12 to L2. It is a dense network of sympathetic nerve fibers coursing along the anterior surface of the upper abdominal aorta and the origin of the celiac artery, consisting of the right and left celiac ganglia and a dense interconnecting network of nerve fibers. The celiac plexus serves as a relay station for visceral afferent nerve fibers that carry pain sensation from all abdominal and most pelvic viscera such as pancreas, liver, gallbladder, stomach, renal pelvis, ureter and intestine proximal to the transverse colon (8).

Celiac plexus block has been performed by an anterior or posterior approach employing either laparotomy, fluoroscopic, CT, or sonographic guidance (4, 11, 16, 17). In this study, three different kinds of approach were used to get needle tips to celiac plexus. Each approach had its own merits and demerits compared to others. Two-needle transcrural approach permitted the spread of injected solutions anterior to the aorta, where the celiac plexus is most concentrated, and minimizes the risk of somatic nerve root blocks. Single-needle transaortic technique, despite concerns regarding the potential for aortic trauma and subsequent occult retroperitoneal hemorrhage with its transaortic approach to celiac plexus block, may, in fact, be safer than the classic two-needle posterior approach (3). However, posterior approaches such as transcrural and transaortic approach couldn't be used for those terminally ill patients who are unable to tolerate the prone position and those who required meticulous monitoring and good ventilation. The anterior approach necessarily involves the passage of a fine needle through the liver, stomach, intestine, vessels and pancreas. Surprisingly, however, it is associated with very low rates of complication (1, 4, 5). This approach would offer several advantages over the posterior approach, including shorter procedure time, less discomfort to the patient, no necessity of prone position, and a reduced risk of neurologic complications (8, 11). Potential disadvantages of the anterior approach to celiac plexus block include the risks of infection, abscess, hemorrhage and fistula formation. However, these complications were not observed clinically in any of my patients.

The reported positive results of celiac plexus chemical neurolysis have rather varied, ranging from 60% to 85% of cases for the visceral pain, which is caused from upper malignancies or benign disease such as chronic pancreatitis (1-17). Recent improvement in the procedure, such as its performance under fluoroscopic or CT or US guidance, have increased the percentages of positive results obtained in different studies, although nonuniformity of techniques has led to variability of those results (10-17, 19-22). We used a 0- to 10-cm VAS for the objective quantification of pain relief. In many previous reports (1-9), vague terms such as "good" and "success" were commonly used without any objective definition. While pain quantification is generally difficult, it is believed that VAS may be a reasonable attempt. In this study of inoperable, upper abdominal malignancies, 21 (78%) patients had some relief of pain but little or no significant benefit was noted in the seven patients. Failure to get positive results of the procedure may be related to alternative pain pathways from extensive tumor involvement, anatomic variations, or inability to access the neurolytic agent to the celiac plexus because of tumor or scar tissue encasing the aorta.

Celiac plexus blocks have been significantly less successful in patients with pain associated with disease or conditions other than carcinoma of the pancreas (19, 20). This study demonstrated, however, no statistically significant difference in pain relief between patients with pancreatic cancer and with other malignancies (80% vs. 72%). The reason for this is not clear — presumably the advanced stage of the pancreatic cancer may affect the spread of the neurolytic solution. The procedures were performed in their advanced stage, therefore the celiac area could be infiltrated or compressed by tumor.

Complications of the celiac plexus block include local pain, hypotension, diarrhea, renal injury, pneumothorax, peritonitis, retroperitoneal hematoma, and neurologic sequelae (8, 16). Hypotension and diarrhea are presumably caused by splanchnic vasodilatation (16). Because of irritation from injected alcohol, some patients may experience severe but temporary abdominal pain. Paraplegia may occur in about 1% of patients undergoing the classic posterior block technique with or without fluoroscopic guidance (3-5, 16, 19). The likelihood of complications such as pneumothorax and renal injury, which are related with traumatic injury of the organs that are adjacent to celiac plexus, or are in the path of needle, can be further reduced by the use of CT guidance. In the present group of patients, complications were relatively mild, with mild hypotension and transient diarrhea. No patient had long-term sequelae, and no patient had neurologic symptoms.

In this study, CT allowed the physician to clearly identify the clinically relevant anatomy, including the crura of the diaphragm, aorta, vena cava and kidneys, ensuring accurate precrural needle placement (Fig. 3A & B). Observation of the spread of contrast medium as described here enabled the physician to know exactly where the injectate was deposited, providing an added margin of patient safety in comparison with "fluoroscopic" or "blind" techniques. Therefore, we believe that CT might provide the safest way to perform the procedure at present time. In addition, recent advances in CT scanner that provide improved image acquisition speed and higher resolution will continue to make CT guidance a more attractive option for celiac plexus block. However, technologic development of ultrasound machines such as high-resolution ultrasound, and three-dimensional image reconstruction makes it play a role in the evolution of the anterior approach.

There were several limitations in this study. First, the lack of comparison groups is a significant limitation, particularly in view of the findings that placebo effects, widely recognized in drug studies. Thus a certain proportion of the success rates in this study could be due to placebo effect. Second, there were too small number of cases that used transcrural and transaortic approaches to compare advantages and drawbacks of each technique. Third, the short period of follow-up due to advanced stage of their malignant disease, along with the fact that many patients were lost to follow-up once they leave the hospital, hampered evaluation of the incidence and duration of pain relief.

In summary, CT-guided celiac plexus neurolysis appears to provide patients with safe and effective relief for pain unresponsive to conventional medical treatment.

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