

## An Improved Technique for Alcohol Neurolysis of the Celiac Plexus

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Neurolysis of the celiac plexus is performed to relieve intractable pain caused by carcinoma of the pancreas, liver, gall bladder, or stomach; and of upper abdominal metastases of tumors having more distant origins.<sup>1-4</sup> It is also occasionally effective in controlling the pain of chronic pancreatitis. However, complications such as paralysis and dysesthesias may result from the spread of neurolytic solutions from the site of injection. As recently recommended by Moore *et al.*,<sup>5</sup> I have used the CT scanner for all cases of alcohol celiac plexus block to determine both the position of the needle tips and the spread of neurolytic solution. A posterior spread of neurolytic solution toward the lumbar plexus was noticed when the solution was injected using previously described techniques.<sup>5</sup> This observation prompted an investigation of alternative methods of celiac block. In this report such a modification of the classic technique is described.

## METHODS

Eleven patients with chronic upper abdominal pain underwent a diagnostic celiac block with 25 ml of 0.25 per cent bupivacaine, which was injected through each of two needles inserted according to the technique described by Moore.<sup>6</sup> The group included six patients with either primary or metastatic upper abdominal carcinoma, three patients with chronic pancreatitis (one patient three months status-post Whipple procedure), one patient with longstanding Crohn's disease, and one with diabetic sympathetic neuropathy. One to three days after diagnostic block produced significant relief of pain for the duration of local anesthetic effect (6-10 h), the patients were brought to the CT scanning suite and sedated with incremental intravenous doses of fentanyl and diazepam. In the prone position, CT scans were performed to locate

the celiac artery as it leaves the aorta. If retroperitoneal metastases or surgical clips obscured the view of the celiac artery, a site for needle insertion was chosen at the level of the L1 vertebral body. Further sedation was then induced with an intravenous drip of methohexital.

In the first five patients, 20-gauge, 5-in needles were inserted according to the technique described by Moore.<sup>6</sup> Using a point of entry no greater than 7 cm lateral to the midline, along the caudad margin of the twelfth rib, needles were directed anteromedially and slightly cephalad, so that their tips rested 1.5 cm anterolateral to the vertebral body of L1. Repeat CT scans were then made to verify needle position medial to renal parenchyma and behind the aorta and diaphragmatic crura.

The next six patients received injections using the following modified technique as follows (fig. 1). Using the initial CT scan, the most probable location of the celiac ganglia was determined by locating the celiac artery around which the celiac ganglia lay clustered. Measurements were then taken at this level to determine a straight-line path between the skin and the location of the celiac plexus which would avoid vertebral body, renal parenchyma and major vascular strictures. Of necessity, the needles would pass through both diaphragmatic crura below the level of lung parenchyma. The plane of needle insertion most commonly lay at L1, but when the celiac artery was found to lie at a higher location, insertion of the needle was made between the eleventh and twelfth rib if lung parenchyma was not in evidence, or below the margin of the twelfth rib and directed slightly cephalad if higher insertion would result in impaling the lung. Regardless, both needles would, of necessity, pass through the diaphragmatic crura so that their tips would lie at the predicted location of the celiac ganglia.

In practice, the left needle was inserted about 4 cm lateral to the midline, and the tip was localized immediately adjacent to the anterolateral wall of the aorta. The point of insertion of the right needle was considerably more variable. In placing the needle tip between the vena cava and aorta immediately anterior to the diaphragmatic crus, it was necessary to take a point of entry anywhere from 5-10 cm lateral to the midline, constrained by the vertebral body medially and the renal

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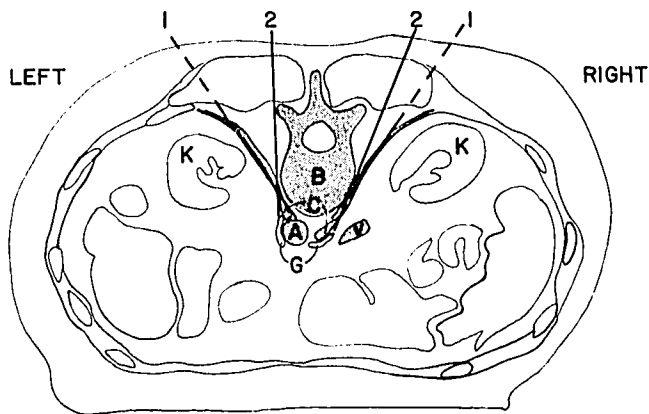


FIG. 1. Schematic diagram of needle position using classic (1) and transcrural (2) approaches to the celiac plexus. The plane of the scan is at the L1 level, and the dotted portion of lines indicating needles inserted according to classic technique represents the portion of the needle below the plane of the scan. Note that with both techniques needles usually pass through some portion of the diaphragm, but that with the classic technique the tips rest posterior to the diaphragm. With the transcrural technique, the tips rest anterior to the diaphragm, adjacent to the celiac ganglia. A, aorta; B, vertebral body; C, diaphragmatic crus; G, celiac ganglia; K, kidney; V, vena cava.

parenchyma laterally. A final depth of 11–15 cm was required to reach the location of the celiac plexus. As before, repeat CT scans were performed to verify needle position.

Neurolysis was accomplished with the injection of a solution consisting of 25 ml absolute alcohol; 18 ml 0.75 per cent bupivacaine, and 7 ml of 60 per cent (Conray® 60) iohalamate meglumine.<sup>5</sup> In the group injected according to the classic technique, 25 ml was injected through each needle, as recommended by Moore *et al.*<sup>5</sup> When the modified technique was used, from 10 to 20 ml was injected through each needle. The needle was then cleared with 0.5 ml air, and CT scans were obtained to determine the spread of neurolytic solution.

All patients were then taken to the recovery room and their condition followed until they were awake and alert. Patients were then returned to the ward, where strict bed rest was imposed for 12 h. If, after this, orthostatic blood pressure measurement showed a fall in systolic blood pressure of less than 30 torr and there was no dizziness, the patient was allowed to ambulate. Pain often increased for several days after the block due to the irritant effects of alcohol on retroperitoneal musculature.

### RESULTS

The spread of neurolytic solution using the classic and transcrural techniques can be compared in figures 2 and 3. Alcohol (with contrast material) is found over a wide area in the retroaortic space. Of note is the presence of alcohol at the site of the celiac plexus with the transcrural

technique, but not with the classic technique. When injected classically, alcohol lies only posterior to the diaphragm at the level of the celiac ganglia.

I had previously observed that when the classic technique was used, alcohol occasionally spread posteriorly along the diaphragm, towards the psoas compartment containing the lumbar plexus. In this study, when 50 ml was injected as advocated by Moore, such spread occurred in two of five patients (fig. 4). One patient with apparently normal spread of alcohol noted numbness of the left hip for approximately six weeks. With the transcrural technique, no such posterior spread occurred.

Of the group injected using the classic technique, three patients (with carcinomas) had excellent relief of upper abdominal pain, one patient (with chronic pancreatitis) had moderate relief, and one (with chronic pancreatitis) had no relief when evaluated at one month after block.

Of the group injected using the transcrural technique, four patients (two with carcinomas, one patient with chronic pancreatitis, and one with diabetic neuropathy) had excellent relief; two patients (one patient with carcinomatosis and one with Crohn's disease) had minimal relief of pain.

### DISCUSSION

In 1919, Kappis† described a technique by which the splanchnic nerves of the upper abdomen could be anesthetized using a percutaneous injection. This technique, more fully investigated by Moore,<sup>6</sup> has been used with minimal modification ever since. However, every published report warns of the danger of major nerve damage following neurolysis. Jones<sup>2</sup> advocates using roentgenographic techniques to verify needle position before injection of alcohol, while Bridenbaugh *et al.*<sup>3</sup> believe that such radiographic techniques do not significantly alter the incidence of complications. With the infrequent use of celiac neurolysis, statistical data on complications are rare. In a series of 100 neurolytic celiac plexus blocks over an 8-year period, Thompson *et al.*<sup>4</sup> found only one patient with neurologic sequelae.

Using the CT scanner with the classic technique, Moore's<sup>6</sup> observation that solution spreads primarily cephalad was confirmed: up to 12 cm or more cephalad from the needle tips and only 3–5 cm caudad. He has suggested that optimum results are obtained when the neurolytic solution completely encircles the aorta,‡ as the celiac plexus lies anterolateral to it. However, when us-

† Kappis M: Sensibilität und lokale Anästhesie im chirurgischen Gebiet der Bauchhöhle mit besonderer Berücksichtigung der Splanchnicusanästhesie. *Brun's Beiträge zur klin Chirurgie* CXV:161–175, 1919.

‡ Moore DC: Personal communication.



FIG. 2. CT scans demonstrating the spread of 50 ml of neurolytic solution injected using the classic technique. Fig. 2A. A scan 8 cm above the level of the celiac artery (T10) shows the first evidence of encirclement of the aorta with neurolytic solution (arrows), as recommended by Moore. FIG. 2B. Note that at the level of the celiac artery, at T12 in this patient, no preaortic contrast is seen, and, therefore, no neurolytic solution can be expected to rest among the celiac ganglia. Asterisks represent the position of needle tips before they were obscured by contrast.

ing the classic technique, the neurolytic solution is not observed anterior to the aorta at the level of the celiac ganglia, *i.e.*, from T12 to L2. Thus, this confirms that relief occurs from neurolysis of the greater and lesser splanchnic nerves as they approach the celiac plexus, and *not* by neurolysis of the plexus itself.

The celiac ganglia lie in variable locations adjacent to the celiac artery, anterior and lateral to the aorta.<sup>7</sup> Ganglia that are cephalad to the celiac artery are sep-

arated from the aorta by the crura of the diaphragm.<sup>8</sup> The branches of the splanchnic nerves that form the plexus arrive after perforating the crura. When found lateral and inferior to the celiac artery, the plexus may or may not be separated from the aorta by slips of muscle or loose areolar tissue. In any case, the crura of the diaphragm, where loosely bound to aortic adventitia along their inferior margins, form an anatomic barrier to flow of fluid from a prevertebral, retroaortic site of

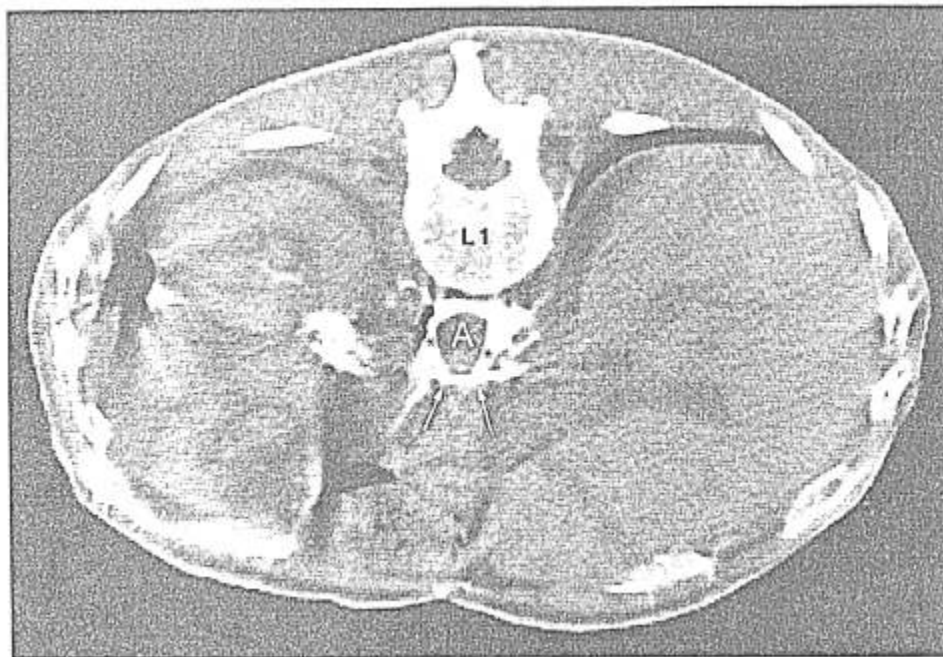


FIG. 3. Spread of 40 ml of neurolytic solution injected using the transcrural technique. This scan at L1 is 1 cm above the level of the celiac artery and needle tips. Asterisks represent position of needle tips relative to aorta and diaphragm as they would be seen in a scan 1 cm lower. Note the presence of pre-aortic contrast material (arrows) at the predicted location of the celiac ganglia. This is not seen in a scan at the level of the plexus using the classic technique (fig. 2B).

injection to the celiac plexus itself. Indeed, for ganglionic destruction to take place when using the classic technique, the solution must spread caudad, escape from underneath the crura of the diaphragm as they divide at the celiac artery, and then return cephalad to reach the ganglia as they lie anterolateral to the artery and crura. Contrary to Moore's theory that this is a part of the mechanism of action of the classic technique of celiac plexus block,<sup>5</sup> it was observed that such spread does *not* occur.

If, instead, the crura are pierced by the needle and injection is made immediately lateral to the aorta, the solution can be expected to reach the plexus directly, requiring smaller volumes. Preaortic spread of alcohol, as advocated by Moore *et al.*,<sup>5</sup> then occurs at the level of the ganglia instead of above them. The use of smaller volumes would reduce the possibility that solution would spread to the psoas compartment and the lumbar plexus. Although a posterior spread of alcohol occurred in two of five patients when 50 ml were injected using the classic

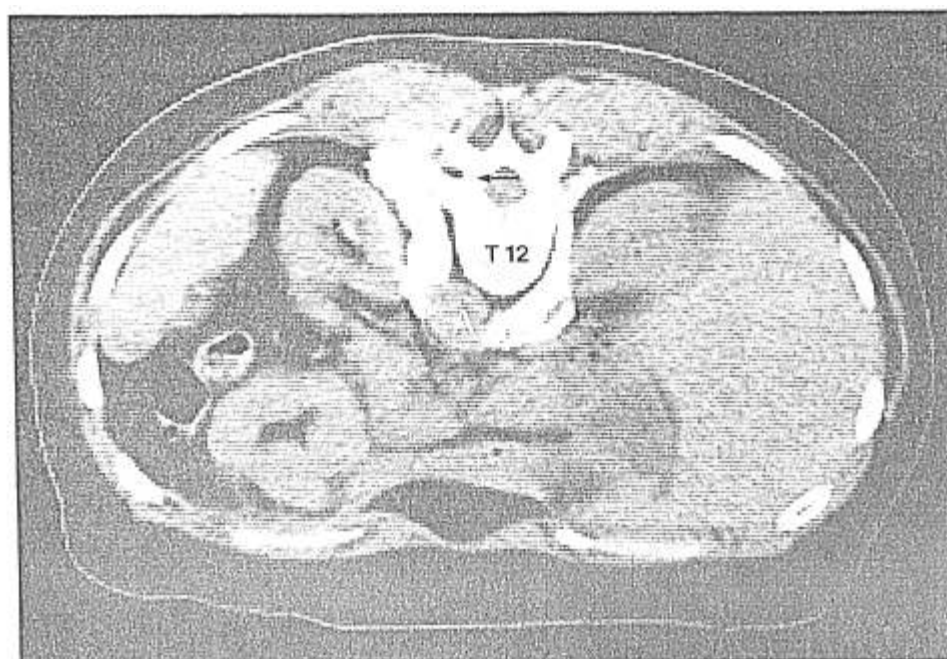


FIG. 4. CT scan at L1 showing the posterior spread of 50 ml of neurolytic solution injected using the classic technique. Note the proximity of alcohol to the area of the lumbar plexus (white arrows). The black arrow indicates the location of the intervertebral foramen through which nerves of the lumbar plexus pass. No complications occurred in this patient.

technique, no posterior spread was seen in six patients when the transcrural technique was used.

Boas,<sup>9</sup> in a technique using fluoroscopy, was the first to note the difference between transcrural *celiac* block and retrocrural *splanchnic* block. However, the precise needle positioning relative to soft tissue landmarks, necessary to ensure proper placement of the tips at the location of the celiac ganglia, was not described, and the necessarily asymmetric insertion of the left and right needles was not noted. While the difference in soft tissue definition between fluoroscopic and computed tomographic radiography is perhaps a minor additional advantage, it is one which may assume great importance when considering the proximity of the thoracic duct, aortic wall, inferior vena cava, and renal parenchyma to the site of injection of a tissue-destructive substance. In addition, tumor enlargement may significantly alter the anatomic relationship of soft tissue structures. The use of CT scans to delineate this anatomy may increase the incidence of successful blockade.

The transcrural path of the needle is the essential alteration of Moore's technique.<sup>5</sup> This technique requires the use of computed tomography for determining needle depth and avoiding perforation of the aorta or vena cava,

and, therefore, cannot be recommended as the method for routine blockade of the celiac plexus. The classic technique has worked well, and is still used for surgery and diagnostic blockade prior to neurolysis.

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## Tracheomegaly

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Tracheomegaly, or tracheobronchiomegaly, is a rare syndrome consisting of marked dilatation of the trachea and major bronchi usually due to a congenital defect of the elastic and muscle fibers of the tracheo-bronchial tree. The diagnosis follows roentgenological investigation and is associated frequently with chronic respiratory infection and partial airway obstruction. Most of the symptoms usually appear during childhood.<sup>1,2</sup>

In this report we present a case of adult onset tracheomegaly, probably secondary to intensive radiotherapy. This entity is of importance to anesthesiologists because of a predisposition to aspiration pneumonitis

during general endotracheal anesthesia and to tracheal trauma by endotracheal tubes, suction catheters, and tracheal instrumentation.

#### REPORT OF A CASE

A 67-year-old man developed carcinoma of the base of the tongue approximately three years ago, and this was managed with a series of 37 radiotherapy treatments to his neck area. Although his cancer was controlled adequately, he developed radionecrosis of the mandible. A hemimandibulectomy was scheduled under general anesthesia. He was a heavy smoker with a chronic cough associated with production of copious purulent sputum and chronic pulmonary parenchymal changes as evidenced by both auscultation findings and chest radiographs (fig. 1). Pulmonary function tests were not obtained, but  $pH_a$  was 7.43,  $Pa_{CO_2}$  36 mmHg, and  $Pa_{O_2}$  98 mmHg on room air. There were no other significant positive findings except emaciated appearance (weight 58 kg) due to the associated anorexia from the carcinoma.

Anesthesia was induced with 0.4 mg intravenous atropine, 3.0 mg *d*-tubocurarine, 150 mg thiopental, 5 mg diazepam, and 80 mg succinylcholine. The trachea was intubated with an 8.5-mm nasal endotracheal tube. Anesthesia was maintained with nitrous oxide, and halothane and ventilation was controlled. Besides the initial dose of succinylcholine, no other muscle relaxants were used. After securing

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