

# Celiac Plexus Block

## Injectate Spread and Pain Relief in Patients with Regional Anatomic Distortions

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**Background:** The success of the neurolytic celiac plexus block, despite different approaches and methods used, depends on adequate spread of the injectate in the celiac area. This retrospective study was conducted to evaluate the patterns of alcohol spread and pain relief in patients with cancer or therapy-related anatomic distortion of the celiac area.

**Methods:** From 177 cancer patients who underwent computed tomography (CT)-guided single-needle neurolytic celiac plexus block *via* an anterior approach, a radiologist, blind to the aim of the study, retrospectively selected 105 patients with abnormal anatomy of the celiac area as judged by CT images obtained before the block. To evaluate CT patterns of neurolytic (mixed with contrast) spread, the celiac area was divided on the frontal plane into four quadrants: upper right and left and lower right and left, as related to the celiac artery. Results were expressed as the number of quadrants into which contrast spread, *i.e.*, four, three, two, or one quadrants with contrast. The patterns of contrast spread according to the number of quadrants with anatomic distortion were analyzed. Patient assessment by visual analog scale was reviewed to evaluate the degree of pain relief. Pain relief 30 days after block was considered long-lasting. Pain relief at 30 days after block was analyzed according to the number of quadrants with contrast.

**Results:** Overall, four, three, two, and one quadrants with contrast were observed in 9 (8%), 21 (20%), 49 (47%), and 26 (25%) patients, respectively. An inverse correlation was observed between the number of quadrants with anatomic distortion and the number of quadrants with contrast ( $P < 0.001$ ). Long-lasting pain relief was noticed in nine of nine patients (100%; 95% confidence interval, 66–100) with contrast in four quadrants, and in 10 of 21 patients (48%; 95% confidence interval, 26–70) with contrast in 3 quadrants ( $P < 0.01$ ). None of the 75 patients with contrast in two quadrants or one quadrant experienced long-lasting pain relief.

**Conclusions:** These findings suggest that, using the single-needle anterior approach, the neurolytic spread in the celiac area is highly hampered by the regional anatomic alterations. It also appears that only a complete (four quadrants) neurolytic spread in the celiac area can guarantee long-lasting analgesia, and that this picture may be obtained in a very limited fraction of patients with regional anatomic alterations.

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NEUROLYTIC celiac plexus block (NCPB) is commonly considered effective to control pain caused by pancreatic and other primary or metastatic cancer of the upper abdominal viscera.<sup>1</sup> However, recent reviews of the efficacy of NCPB have reached conflicting conclusions. Some investigators affirm the efficacy of NCPB for pancreatic cancer pain,<sup>2</sup> but others believe that its effectiveness is not yet proven.<sup>3</sup> Recently, it has been emphasized that only a complete spread of the neurolytic solution in the celiac area seems to guarantee long-lasting analgesia, and that an incomplete spread may occur even when the celiac area seems free from regional anatomic distortions.<sup>4</sup> Furthermore, regardless of the technique used to improve the spread of the injectate in the plexus area, failures are common due to regional infiltration by cancer tissue and anatomy distortion by either previous surgery or radiation therapy-induced fibrosis.<sup>5-9</sup>

The present study, which stems from a prior investigation of our group,<sup>4</sup> was conducted to retrospectively evaluate the patterns of neurolytic spread in patients with cancer or therapy-related anatomic distortions of the celiac area, as judged by computed tomography (CT). The patterns of injectate spread in relation to the anatomic distortions and analgesic results according to the different patterns of injectate spread are analyzed and discussed.

## Materials and Methods

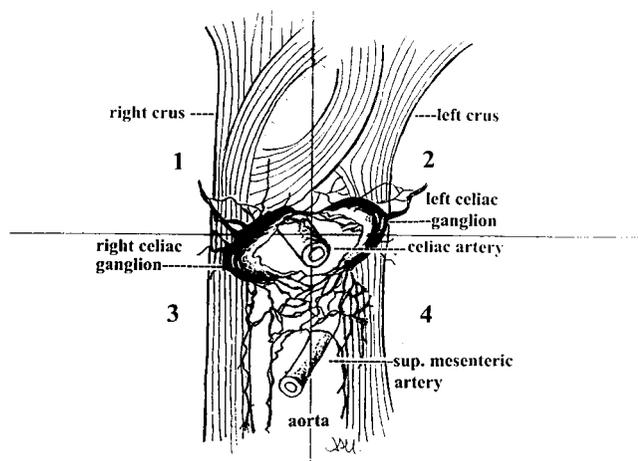
Between 1989 and 1996, after obtaining approval from the Institutional Review Board at the National Cancer Institute, Aviano, Italy, 177 cancer patients with upper abdominal pain, regarded as of celiac ganglion origin and for which pharmacologic treatment proved either ineffective or limited by side effects, underwent CT-guided single-needle NCPB *via* an anterior approach. All patients gave written informed consent before the procedure. The hospital charts of these patients were reviewed, and a radiologist who was blinded to the aim of the study selected 105 patients whose celiac area was compressed or infiltrated by tumor or distorted by previous surgery or radiation therapy. Preblock patient characteristics, diseases, and therapies are shown in table 1.

**Table 1. Patient Characteristics, Cancer Diseases, and Therapy**

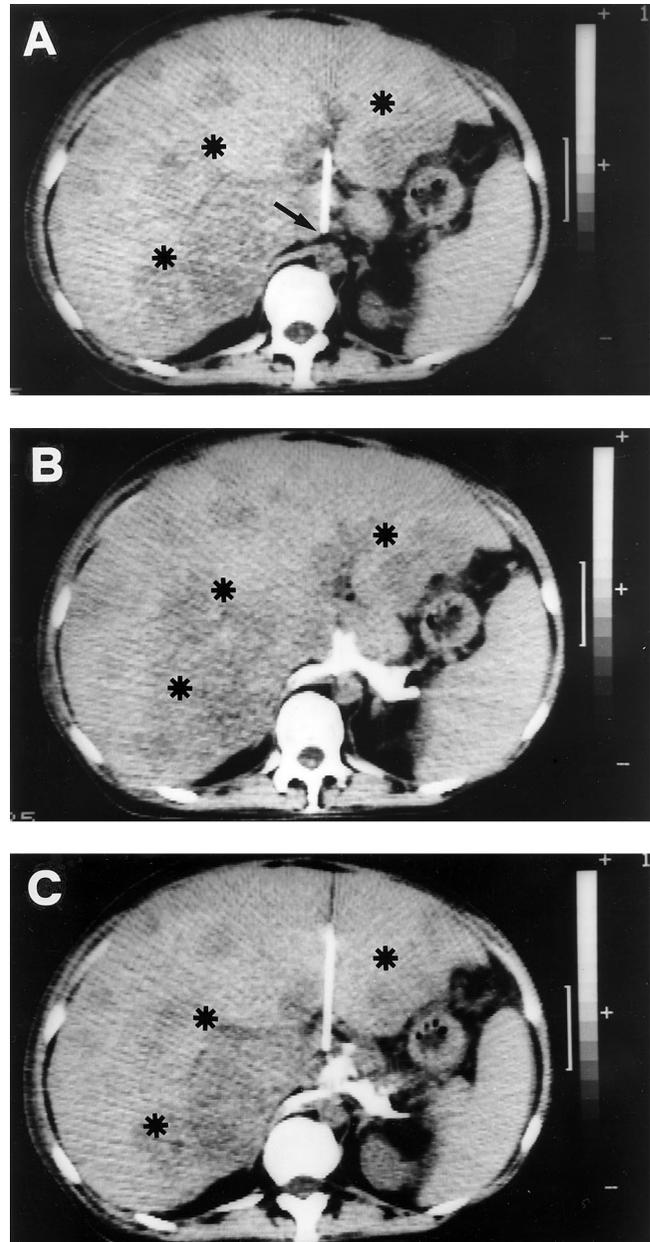
Age (yr) [median (range)]	57 (27–80)
Sex (M/F)	76/29
Cancer diseases	
Pancreas	77
Stomach	14
Liver	7
Colon	4
Other	3
Previous therapies	
CDP	16
CDP and RT	10
Biliary derivation	11
Surgical exploration	7
RT	9
CT	13

CDP = cephalopancreaticoduodenectomy; RT = radiotherapy; CT = chemotherapy.

The block technique was performed as previously described.<sup>4</sup> In addition, when a large anatomic alteration of the celiac area was present, the needle path was chosen to reach the part of the celiac area free from alteration. CT scans were taken during all phases of the block. In particular, after needle withdrawal, serial CT scans were obtained above and below the injection site up to the lower and upper limits of neurolytic solution (30 ml mixed with contrast) spread. Alcohol spread evaluation was based on the presence of the contrast medium around the anterolateral wall of the aorta, anterior to the crura of the diaphragm, from above the celiac artery to the superior mesenteric artery. To evaluate CT patterns of neurolytic spread, this area (celiac area) was divided, on the frontal plane, into four nearly equal quadrants: upper right and left and lower right and left, defined by a horizontal line passing just caudad to the root of the celiac artery and by a vertical line at the midline of the central wall of the aorta (fig. 1). Results were expressed as the number of quadrants into which the contrast



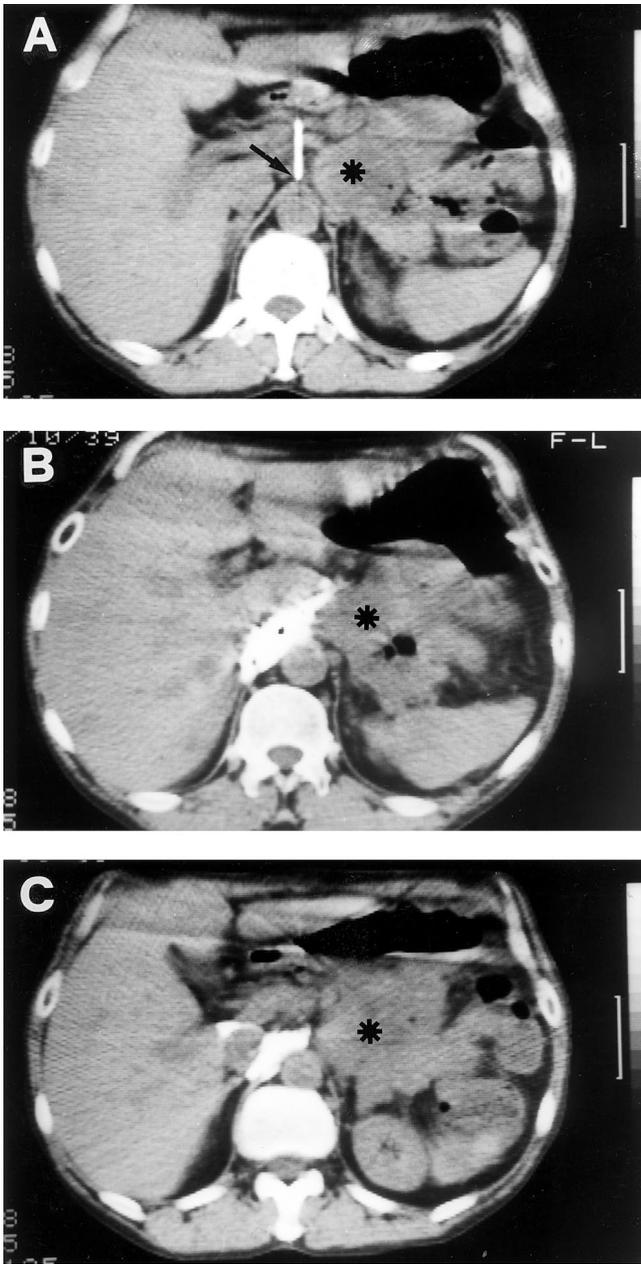
**Fig. 1.** The division of the celiac area into four quadrants: two upper (quadrants 1 and 2) and two lower (quadrants 3 and 4) in relation to the celiac artery (see text).



**Fig. 2.** Computed tomographic scans show (A) the needle tip (arrow) between the celiac and the superior mesenteric arteries and the right side of the celiac area (quadrant 3 of fig. 1) compressed by liver (asterisks); (B) the preaortic bilateral contrast spread cephalad and (C) caudad to the celiac artery. This pattern is consistent with four quadrants with contrast (quadrants 1, 2, 3, and 4 of fig. 1).

spread, *i.e.*, four quadrants with contrast (fig. 2); three quadrants with contrast; two quadrants with contrast, both superior or inferior, or both unilateral, right or left quadrants (fig. 3); and one quadrant with contrast. The same four-quadrant scheme was adopted to evaluate CT patterns of anatomic distortion. The patterns of contrast spread according to the number of quadrants with anatomic distortion were analyzed.

Patients assessments by visual analog scale (VAS), obtained 24 h before and 30 days after block, were re-



**Fig. 3.** Computed tomographic scans show (A) the needle tip (arrow) cephalad to the celiac artery and (B) the preaortic unilateral contrast spread cephalad and (C) caudad to the celiac artery. The left side of the celiac area (quadrant 2 and 4 of fig. 1) is compressed-infiltrated by a tumor mass (asterisk). This pattern is consistent with two quadrants with contrast (quadrants 1 and 3 of fig. 1).

viewed to evaluate the pain degree. Criteria for VAS scores evaluation were as previously reported.<sup>4</sup> Because the mean preblock VAS value was 8 (table 2), we judged the pain relief after block as good when the score on the VAS was less than 5 and poor when it was 5 or more. Pain relief still good 30 days after block was judged as long-lasting. Pain relief at 30 days after block according to the number of quadrants with contrast was analyzed. The evaluation of pain relief was completed up until 30

**Table 2. VAS Pain Scores according to the Patterns of Contrast Spread in the Celiac Area**

No. of Quadrants with Contrast	No. of Patients	VAS Score	
		24 h before Block	30 days after Block
4	9	8 ± 1	4 ± 1*
3	21	8 ± 1	6 ± 2*†
2	49	8 ± 1	8 ± 1*†
1	26	8 ± 1	8 ± 1*†

The values of Visual Analog Scale (VAS) pain score are expressed as mean ± SD.

\* Four quadrants versus three, two, and one,  $P < 0.001$  (Student *t* test). † Three quadrants versus two and one,  $P < 0.01$  (Student *t* test).

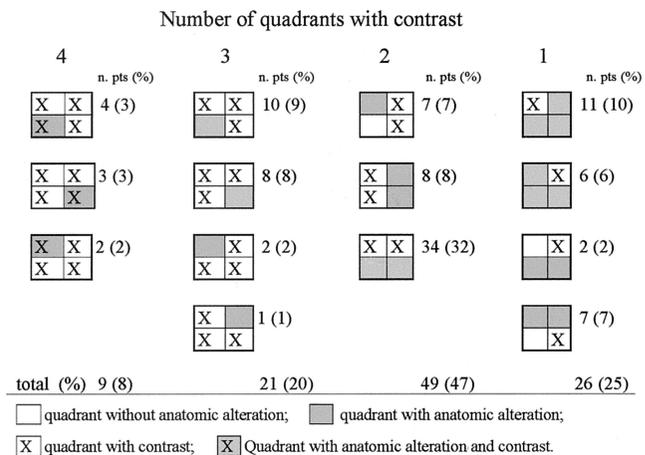
days after block because complete medical records of all patients were available only until that time.

**Statistical Analysis**

The chi-square test and Fisher exact test were used for comparison of proportions in independent groups. Spearman rank correlation was used to evaluate differences between ranked groups (Spearman's rank correlation coefficient =  $r_s$ ).<sup>10</sup> Data shown as mean values ± SD were analyzed by the Student *t* test.<sup>10</sup> A significant difference was accepted at  $P < 0.05$ .

**Results**

The anatomic alterations of the celiac area caused by primary or metastatic cancer were as follows: a regional infiltration or compression in 58 (55%) and in 20 (19%) patients, respectively. In the remaining 27 patients, the regional distortions were a consequence of a cephalopancreaticoduodenectomy in 13 (12%) instances, of a cephalopancreaticoduodenectomy plus radiotherapy in 9 (9%), and of radiotherapy alone in 5 (5%) patients. The patterns of contrast spread expressed as the number of quadrants with contrast are shown in figure 4. Overall,



**Fig. 4.** Patterns of contrast spread in the celiac area (see fig. 1) of the 105 patients with regional anatomic alterations.

**Table 3. Patterns of Contrast Spread according to the Patterns of Anatomic Alterations**

	No. of Quadrants with Anatomic Alterations* [No. of Patients (%)]		
	1	2	3
No. of quadrants with contrast spread			
1		9 (18)	17 (100)
2	7 (19)	42 (82)	
3	21 (57)		
4	9 (24)		
Total	37 (35)	51 (49)	17 (16)

\* Spearman correlation coefficient:  $r = -0.87$ ;  $P < 0.001$ .

four, three, two, and one quadrants with contrast were observed in 9 (8%), 21 (20%), 49 (47%), and 26 (25%) patients, respectively. In only 9 of 105 patients (8%) did the contrast enter the quadrant with anatomic alteration (fig. 4). A significant inverse correlation was observed between the number of quadrants with anatomic alterations and the number of quadrants with contrast ( $P < 0.001$ ; table 3). In 16 of 105 patients (15%), the contrast did not enter the quadrants free from anatomic distortion (fig. 4).

Table 2 shows VAS pain scores according to the number of quadrants with contrast. Thirty days after block, significant differences in VAS scores, depending on number of quadrants with contrast, were observed (table 2). A significant difference in long-lasting pain relief was noted between patients with contrast in four quadrants (9 of 9, 100%; 95% confidence interval, 66–100) and those with contrast in three quadrants (10 of 21, 48%; 95% confidence interval, 26–70) (Fisher exact test:  $P < 0.01$ ). No association between relative location of the three different quadrants with contrast and pain relief degree was observed (data not shown). None of the 75 patients with contrast in two or one quadrant experienced long-lasting pain relief.

## Discussion

Several techniques of NCPB are used. The percutaneous bilateral posterior approach (classic retrocrural) has been the most widely used.<sup>11,12</sup> In the past two decades, several variations in technique have been introduced, including the transcrural<sup>13,14</sup> or single-needle transaortic<sup>5,15</sup> technique and the single-needle anterior approach.<sup>4,16–21</sup>

The goal of any technique is to get better analgesia by trying to locate the optimal needle position to improve the spread of the injectate to the plexus area. In fact, as has been recently demonstrated in a selected group of patients whose celiac area was free from anatomic alterations, only a complete (four quadrants) spread of the neurolytic solution in the celiac area can guarantee long-

lasting analgesia.<sup>4</sup> Conversely, irregular or partial injectate spread are common to any technique because of regional distortions by cancer or previous therapies.<sup>5–9</sup> Because the NCPB is mainly performed to control pain related to pancreatic cancer, which at the time of presentation had already metastasized in more than 50% of the patients,<sup>22</sup> it is unlikely that, at the time of the block, in such patients the celiac area could be free from alterations caused by cancer or previous regional therapies. Therefore, a complete spread of the neurolytic agent may be very difficult to achieve in a large part of these patients.

In the present study, only 9 of 105 patients (8%) with alterations of the celiac area experienced a complete neurolytic spread. In the remaining 96 patients (92%), the regional anatomic distortions completely hampered the spread of the neurolytic solution (fig. 3). The nine patients with complete injectate spread had only one quadrant altered by either compression (7 patients) or tumor infiltration (2 patients). Because the injected volume was 30 ml in all patients, the way by which the neurolytic solution entered the altered quadrant of these 9 patients is unknown. Maybe a different pressure imposed by adjacent organs may have directed fluids to low-pressure areas (fig. 2), or an unexpected favorable texture and grain of the infiltrating tissue may have not prevented the spread of the injectate. Conversely, as previously suggested,<sup>4</sup> this study confirmed that in some patients (16 of 105, 15%), an incomplete spread of the injected solution occurs even when the celiac area seems free from regional anatomic distortions, and that such lack of spread mainly involves the lower quadrants (fig. 4).

As far as pain relief according to the number of quadrants with contrast is concerned, the results confirmed our previous findings.<sup>4</sup> The complete spread of the alcohol in the celiac area ensures long-lasting pain relief. Only a fraction of patients with three quadrants with contrast will experience long-lasting analgesia. Poor or no pain relief should be expected when the neurolytic spread constitutes only a part, either right or left, superior or inferior, of the celiac area.

Because in the present study a single-needle technique was used, a wider neurolytic spread in the celiac area cannot be excluded when different techniques, *i.e.*, those based on two-needle bilateral posterior (transcrural) or anterior approach, are used. However, because of the better preservation of the retrocrural structure in patients with upper abdominal malignancy, the retrocrural splanchnic nerve neurolysis may represent a more reasonable alternative to NCPB when the celiac area is largely affected by anatomic distortions.<sup>7–9</sup>

Our data suggest that, when a single-needle precrucal approach is chosen, the neurolytic spread in the celiac area is highly hampered by the regional anatomic alterations. It also appears that only a complete (four quad-

rants) neurolytic spread in the celiac area can guarantee long-lasting analgesia, and that this picture may be obtained in a limited fraction of patients when regional anatomic alterations are present. Therefore, the decision to perform the NCPB to control pain caused by cancer of the upper abdominal viscera must be based on the anatomic conditions of the celiac area in each patient to avoid anticipated failures.

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