

# EUS-guided celiac plexus neurolysis/block

Narendra S. Choudhary, Rajesh Puri

Institute of Digestive and Hepatobiliary Sciences Medanta, The Medicity, Gurgaon, Haryana, India

## Abstract

Refractory chronic abdominal pain as a result of inoperable pancreatic cancer or chronic pancreatitis poses a formidable challenge and can be effectively relieved with celiac axis block or celiac plexus neurolysis (CPN). Percutaneous celiac plexus block (CPB) or computed tomography (CT)-guidance using anterior or posterior approaches has some limitations. However, endoultrasound (EUS)-guided CPB has evolved itself as an effective and safe procedure for management of refractory abdominal pain. The EUS offers advantages, which include accurate anatomic imaging, real-time monitoring of injection, and anterior approach, which avoids neurologic complications. The CPN can be combined with staging and fine-needle aspiration cytology (FNAC) of a malignancy in the same session. The present review discusses anatomic details of celiac axis block, procedure-related details, complications, contraindications, comparison to other modalities, and results of various studies and author's experience of EUS guided CPB/neurolysis.

## Key words

Celiac plexus, computed tomography, endoscopic ultrasound, neurolysis

## Introduction

In 1914, Max Kappis used splanchnic nerve blocks for surgical anesthesia.<sup>[1]</sup> Initially, celiac plexus block (CPB) was performed using posterior approach that was associated with risk of neurological complications, and hence, was replaced by anterior approach. Currently, celiac axis block or neurolysis is used for management of refractory pain secondary to inoperable pancreatic cancer or chronic pancreatitis.<sup>[2-5]</sup> The celiac plexus innervates the liver, gallbladder, biliary tract, pancreas, spleen, adrenal glands, kidneys, mesentery, and the small and large bowel proximal to the transverse colon.<sup>[2]</sup> CPB refers to temporary inhibition of the celiac plexus with the help of bupivacaine and corticosteroid injections in patients with benign pancreatic diseases such as chronic pancreatitis. Celiac plexus neurolysis (CPN) refers to the ablation of the plexus (chemical splanchnicectomy which ablates the afferent

nerve fibers that transmit pain from intra-abdominal viscera), and is often achieved with alcohol or phenol administered with a local anesthetic.<sup>[6]</sup> CPN using alcohol is not routinely used in benign diseases as there is risk of retroperitoneal fibrosis, which would render any subsequent pancreatic surgery more difficult. Anterior approach under computed tomography (CT)- or ultrasound-guidance has been used to avoid neurological complications.<sup>[7,8]</sup> Endoultrasound (EUS)-guided celiac axis block/neurolysis has several advantages over other modalities. EUS uses anterior approach, thus, it avoids neurological complications and relative proximity of the celiac ganglia to the posterior gastric wall ensures an accurate passage of the needle into the ganglia, thereby minimizing the risk of complications and increasing effectiveness of block.<sup>[5,6]</sup> Comparison of various celiac axis approaches is shown in Table 1.

## Anatomy of Celiac Plexus

Celiac 'plexus' (ganglia and interconnecting fibers) is the largest plexus of sympathetic nervous system located in upper abdomen; it comprises of preganglionic sympathetic efferent nerve fibers derived from the greater splanchnic (T5-T9), lesser splanchnic (T10-T11), and least splanchnic (T12) nerves; preganglionic parasympathetic efferent fibers (from posterior trunk of the vagus nerve) and the visceral afferent fibers (for nociceptive stimuli) from the upper abdominal viscera. The

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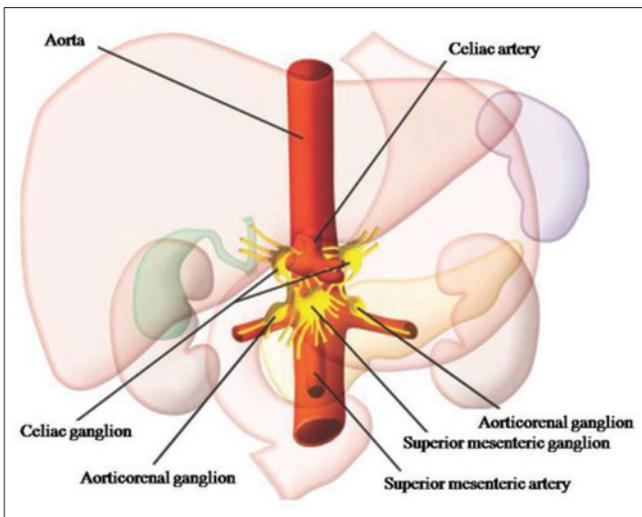
### Address for correspondence:

Dr. Rajesh Puri, Associate Director, Therapeutic Endoscopist and Endosonologist, Institute of Digestive and Hepatobiliary Sciences, Medanta, The Medicity, Gurgaon - 122 001, Haryana, India. E-mail: purirajesh69@gmail.com

celiac plexus innervates the liver, gallbladder, biliary tract, pancreas, spleen, adrenal glands, kidneys, mesentery, and the small and large bowel proximal to the transverse colon. The celiac plexus lies within retroperitoneal space posterior to the stomach and pancreas embedded in loose areolar tissue, close to the celiac axis anterolateral to aorta at the level of first lumbar vertebra, just inferior to origin of celiac artery as shown in Figure 1 and is separated from vertebral column by crus of diaphragm.<sup>[2,4,9-12]</sup> There is considerable variability in size (0.5-4.5 cm), number (1-5), and position (T12-L1 disc space to middle of L2 - vertebral body). Zhang *et al.*, reported that 94% of the celiac ganglia are located at the level of T12 or L1.<sup>[10]</sup>

### EUS-Guided CPB/CPN-Procedure

The procedure is done under deep sedation. Patients on antiplatelet/anticoagulant drugs need to stop them to allow normalization of hemostasis. The patient is given intravenous fluids to prevent risk of hypotension that may arise from splanchnic blood pooling due to unopposed parasympathetic action after CPB/neurolysis. The procedure is performed with a curvilinear array EUS scope. The EUS under endoscopic view is passed into the proximal stomach, just distal to the gastroesophageal junction and along the posterior wall of the stomach, the aorta and the celiac axis (first vessel arising from the aorta below the diaphragm) are identified.<sup>[13,14]</sup> The celiac plexus is identified as a hypoechoic, oblong, or lobulated structures, often with irregular edges, containing hyperechoic foci or strands, anterolateral to the origin of the celiac artery.<sup>[15-17]</sup> After identification of base of celiac trunk, a EUS fine-needle aspiration (FNA) needle is passed through the biopsy channel and secured to the Luer-Lock assembly. This needle is advanced under real-time EUS imaging through the posterior wall of the stomach adjacent and anterior to the lateral aspect of the aorta at the level of celiac trunk origin. An aspiration test is done to rule out vessel puncture before injection. For neurolysis, 5-10 mL



**Figure 1:** Morphologic and functional anatomy of the celiac plexus (adapted from reference 2)

of a local analgesic bupivacaine (0.25%) is injected followed by 10-20 mL of a neurolytic agent (98% dehydrated ethanol), which will produce an echogenic cloud; for plexus blocks, 20 mL of 0.25% bupivacaine is injected followed by 80 mg of triamcinolone. Alternatively, half amount may be injected to each side of celiac trunk. Our center uses EUS-FNA cytology (FNAC) needle having multiple side holes for CPN/CPB (Echotip; Cook Endoscopy, WinstonCook™); these multiple side holes ensure uniform distribution of neurolytic agents; however, there are no studies comparing one needle with another.

Contraindications of procedure<sup>[4,18]</sup> are summarized in Table 2. Relative contraindications include altered anatomy interfering in obtaining adequate access or a history of multiple prior CPBs in patients with chronic pancreatitis. There are no guidelines regarding hemostasis for undertaking CPB/CPN, but at our center we follow same recommendations as outlined for EUS-guided FNAC. These include stopping all antiplatelet and anticoagulants except aspirin 7 days prior to the procedure

**Table 1: Comparison of various techniques for celiac plexus block/neurolysis (adapted from reference 2)**

Technique	Advantages	Disadvantages
Fluoroscopy	Easily available	Anatomic details are not seen Radiations are involved
Ultrasonography	Easily available Vascular structures are identifiable Diffusion of neurolytic agent may be seen without contrast medium	Not good for retro-peritoneum Operator dependent
CT	Retroperitoneal structures are identifiable May show celiac plexus Shows exact location of the needle tip and surrounding structures Shows diffusion of neurolytic agents	Radiations are involved
EUS	Shows proximity to celiac plexus Anatomic details well imaged Real-time monitoring of neurolytic injection Anterior approach avoids neurologic complications Allows staging, FNAC and/or biopsy	Operator dependent Invasive Snowstorm effect may hinder visualization of the celiac plexus

CT=Computerized tomography, EUS=Endoultrasound, FNAC=Fine-needle aspiration cytology

**Table 2: Contraindications of celiac plexus block or neurolysis**

- Patients with coagulopathy
- Local/intra-abdominal infection and sepsis
- Bowel obstruction
- Patients on disulfiram therapy for alcohol abuse
- Patients with physical dependence and drug seeking behavior
- Thrombocytopenia (platelets <50,000)
- An uncooperative patient

and to ensure a platelet count of >50,000 and international normalized ratio (INR) <1.5.<sup>[19]</sup>

## Results of EUS-Guided CPB/CPN and Comparison to Other Modalities

Table 3 summarizes the results of various studies using EUS-guided CPN/CPB and their comparison to CT- and fluoroscopic-guided CPN/CPB.<sup>[20-30]</sup> In a systemic review of EUS-guided CPN of 17 studies for relief of pain; eight studies involved 283 patients of pancreatic cancer and nine studies with 376 patients of chronic pancreatitis. The review concluded that pain relief occurred in 80.12% (95% confidence interval (CI) =74.47-85.22) and in 59.45% (95% CI = 54.51-64.30) for pancreatic cancer and chronic pancreatitis, respectively.<sup>[31]</sup> In general, EUS guided CPN/CPB is safe and more effective than other modalities of CPB.<sup>[27,29]</sup>

A total of 62 patients underwent EUS-guided CPB/CPN at our center; of them 17 patients with chronic pancreatitis underwent CPB and 45 patients with pancreatic cancer and a few with gallbladder cancer underwent CPN for palliation of intractable pain. Eleven patients (17.7%) had no improvement in pain. The narcotic requirement

decreased in the remaining 51 patients (82.3%) and relief lasted for 8-12 weeks in majority of these patients. There were no serious procedure-related complications in any of these patients.

## Complications

In the posterior approach era, major complications were neurological such as monoplegia and anal and bladder sphincter dysfunction due to puncture of spinal artery resulting in spinal ischemia. Other complications included backache, pneumothorax, and retroperitoneal abscess.<sup>[2,7]</sup> The common complications of EUS-guided celiac axis block/neurolysis are immediate pain, orthostatic hypotension (due to loss of sympathetic tone and splanchnic vasodilatation), and transient diarrhea.<sup>[14,18,32]</sup> The potential risk of hypotension can be reduced by administering 500 ml saline before the procedure and 500 ml saline after procedure at a rate of 100 ml per hour. A large series of 189 EUS-CPB and 31 EUS-CPN procedures which were performed in 128 and 30 patients, respectively, reported four complications (asymptomatic hypotension, retroperitoneal abscess, and severe self-limited pain in two patients).<sup>[33]</sup> Uncommon complications of celiac plexus include chronic diarrhea,<sup>[34]</sup> gastroparesis,<sup>[35]</sup> retroperitoneal hemorrhage, peripancreatic abscess formation,<sup>[36]</sup> and stomach rupture<sup>[37]</sup> (after repeated injections).

**Table 3: Results of endoultrasound-guided celiac plexus block (CPB)/celiac plexus neurolysis (CPN)**

Author (year)	N, modality	Results	Comments
Wiechowska-Kozłowska <sup>[20]</sup> 2012	29, CPN	86% improved at 1-2 weeks	Improvement of pain in 76% of patients after 2-3 months
LeBlanc <i>et al.</i> , <sup>[21]</sup> 2011	29 in 1 injection and 21 in 2 injections, CPN	74% (69 vs 81%, <i>P</i> =NS)	Median duration of pain relief in the 1-injection and 2-injection groups: 11 and 14 weeks ( <i>P</i> =NS)
Ascunce <i>et al.</i> , <sup>[22]</sup> 2011	64, CPN	50% at 1 week	Visualization of celiac ganglia was best predictor of response (odds ratio 15.7; <i>P</i> <0.001) Tumors located outside the head of the pancreas and higher baseline pain level were weakly associated with a good response
Wyse <i>et al.</i> , <sup>[23]</sup> 2011	40 CPN, 48 analgesics	EUS-CPN group had less pain and narcotic requirement	Used CPN at diagnosis of inoperable pancreatic cancer
Iwata <i>et al.</i> , <sup>[24]</sup> 2011	47, CPN	Pain relief 68.1%	Multivariate analysis: Direct invasion of celiac plexus and distribution of ethanol only on the left side of the celiac artery were negative predictors
Gunaratnam <i>et al.</i> , <sup>[25]</sup> 2001	58, CPN	78% patients had decline in pain scores	
Sakamoto <i>et al.</i> , <sup>[26]</sup> 2010	34 CPN vs 33 broad plexus neurolysis (including SMA)	BPN superior for pain control	Better neurolytic spread in BPN group (as seen by CT)
Santosh <i>et al.</i> , <sup>[27]</sup> 2009	27 CPB vs 29 fluoroscopic-guided CPB	70 vs 30% improvement	EUS-CPB more effective than fluoroscopic technique
Gress <i>et al.</i> , <sup>[28]</sup> 2001	90, CPB	55% had improvement in pain score	26% had persistent benefit beyond 12 weeks, 10% had persistent benefit at 24 weeks; less response in <45 years of age or previous pancreatic surgery for chronic pancreatitis EUS-guided block cost effective compared to CT-guided block
Gress <i>et al.</i> , <sup>[29]</sup> 1999	18 CPB (10 EUS-guided)	50 (EUS group) vs 25% (CT group)	EUS group less cost and more persistent benefit (40% at 8 week and by 30% at 24 week) than CT group
Wiersema and Wiersema, <sup>[30]</sup> 1996	30 CPN (25 carcinoma pancreas)	79-88% of patients had persistent improvement in their pain score	Median follow-up 10 weeks

EUS=Endoultrasound, SMA=Superior mesenteric artery, NS=Not significant, BPN=Broad plexus neurolysis, CT=Computed tomography

## Conclusions

CPN should be considered in patients with upper abdominal cancer where pain is not adequately controlled with analgesics or significant opioid-induced side effects are present.<sup>[38]</sup> CPB is used to provide temporary relief in chronic pancreatitis patients with significant pain to decrease dose of narcotics.<sup>[39]</sup> EUS-guided CPN is a safe and useful modality for relief of intractable pain in patients with inoperable pancreatic cancer and chronic pancreatitis.

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