ORIGINAL ARTICLE

Percutaneous ultrasound-guided celiac plexus neurolysis in advanced upper abdominal cancer pain

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KEYWORDS
Celiac plexus neurolysis (CPN);
Visual analog scale (VAS);
Hepatocellular carcinoma (HCC);
Endoscopic ultrasound (EUS)

Abstract
Background: The alleviation of suffering in cancer patients is universally acknowledged as a cardinal goal of medical care. Celiac plexuses neurolysis is an effective technique in decreasing pain severity in patients suffering from upper abdominal cancer as it decreases analgesic requirements.

Objective: This study aims to evaluate the efficacy of ultrasound-guided celiac plexus neurolysis (CPN) in controlling pain in patients with upper abdominal cancer pain.

Materials & Methods: Ultrasound-guided CPN was done for 21 adult patients suffering from upper abdominal cancer pain using ethanol (50%) as a neurolytic agent. Visual analog scale (VAS) score was used to assess the degree of pain relief immediately after injection at 1 week, 1 month and 3 months post-neurolysis.

Results: Marked decrease of pain severity in all patients was noted as a sharp fall of the VAS score in the 1st day after CPN with relatively stationary course for 3 months. Baseline VAS score was 9.1 ± 0.85. One day after CPN, pain severity decreased markedly to 1.4 ± 0.71. One week after CPN the decrease in pain severity was maintained at the same level 1.6 ± 0.89. One month after CPN the decrease in pain severity maintained at the same level 2 ± 0.79. 3 months after CPN, pain severity decreased significantly to 2.3 ± 1.02.

Conclusion: Ultrasound-guided CPN is an effective method for reducing pain of upper abdominal cancer.

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1. Introduction

The celiac plexus is a dense network of autonomic nerves that lies anterior to the aorta and the crus of the diaphragm at L1 level (1). Methods to administer neurolytic agents to the celiac ganglion included surgery, CT-guided injection, percutaneous ultrasonography, fluoroscopy or endoscopic ultrasonography-guided (EUS) approaches (2). The main disadvantages for the use of CT and fluoroscopy are that it does not provide real time imaging, it carries the risk of exposure to hazards of radiation, it is time-consuming, and expensive and the use of endoscopic ultrasound requires special equipment and formal training in gastroenterology (3). Ultrasound (US) is a
real-time technique in interventional pain management as it allows the identification of soft tissues, vessels, and nerves, without exposing patients or medical personnel to radiation.

2. Materials and methods

2.1. Subjects

The study was done in specialized private centers in Cairo during the period from November 2013 to December 2014. The study was carried out on 21 adult patients suffering from abdominal pain due to upper abdominal cancer (Table 1). The technique was successfully performed in 20 patients of whom 18 (90%) were males and 2 (10%) were females with mean age 55.7 ± 4.83 (Table 2) via paramedian needle entry technique (95.2%). Only one case failed (4.8%) due to colonic distension obscuring the celiac trunk. CT-guided CPN was successfully done for this patient via anterior approach technique.

Inclusion criteria
- Abdominal pain due to upper abdominal cancer.
- Pain not controlled by WHO analgesic step ladder.
- Patients suffering from side effects of analgesic drugs.

Exclusion criteria
- Patient refusal.
- Patients with coagulopathy.
- Patients with colonic gas distension.

2.2. Methods

All patients were subjected to history taking, general examination, abdominal ultrasound, CT abdomen, chest X-ray, coagulation profile, stoppage of pain medications overnight, training on breath holding, informing about complications and hospital stay time.

This procedure was done with the patient in the supine position while fasting for 8 h. IV cannula size 18 G was inserted and all patients received an intravenous ringer solution of 1000 ml. Standard monitors were used including automatic cuff blood pressure, pulse oximeter, ECG. Baseline values for mean arterial blood pressure, heart rate, and oxygen saturation were taken. A 3–5 MHz convex transducer was applied over epigastric area to define the common celiac trunk at its origin from the aorta and at its division into hepatic and splenic branches. After sterilization, subcutaneous anesthesia with Lidocaine 2% was done and a 22-gauge Chiba needle was introduced into the epigastrium via paramedian approach to the transversely placed ultrasound transducer. Under sonographic guidance, the tip of the needle was advanced into the right lateral or the left lateral area of the celiac trunk (unilateral or bilateral). Once the tip of the needle was correctly positioned, suction was applied to confirm that the needle tip is not inside a blood vessel, and a “prognostic block” performed by injecting a local anesthetic (9 ml of Lidocaine 2%) for the enforcement of a diagnostic celiac plexus block. 10 min after successful prognostic block, 15 ml of 50% ethanol was injected under US guidance. Ethanol appears echogenic in ultrasound. Maximum filling of the retro pancreatic space with ethanol is an indication of sufficient neurolysis. Before the needle was removed, 3 ml of Lidocaine 2% was injected to diminish irritation by ethanol. The patient stayed at the hospital for 4 h under surveillance.

Patients were asked to grade the pain using the visual analog scale (VAS) score (Fig. 1) for assessment of the degree of pain relief. The assessment ranges from 0 (no pain) to 10 (severe pain). VAS was scored immediately after injection, 1 week, 1 month and 3 months post-neurolysis. Analgesic requirements and complications were documented.

Complications observed were postural hypotension and transient diarrhea.

2.3. Statistical methods

Statistical analysis was done by personal computer and statistical package SPSS version 11. Two types of statistics were done: descriptive statistics: e.g. percentage (%), mean (x), standard deviation (SD) and range. Analytic statistics: e.g. P-value of < 0.05 was considered statistically significant.

3. Results

Marked decrease in pain severity in all patients was noted as a sharp fall of the VAS score in the 1st day after CPN with relatively stationary course for 3 months. Baseline VAS score was 9.1 ± 0.85. One day after CPN, pain severity decreased markedly to 1.4 ± 0.71, one week after CPN the decrease in pain severity maintained at the same level 1.6 ± 0.89 (Fig. 3), one month after CPN the decrease in pain severity maintained at

![Pain Scale](image-url)
the same level $2 \pm 0.79$ and 3 months after CPN pain severity still decreased significantly to $2.3 \pm 1.02$ (Fig. 4). The decrease in pain severity at its average before and at different sequences after CPN recorded highly significant statistical difference $P$ value < 0.001 (Table 3) (Fig. 2).

According to analgesic drug consumption, it decreased significantly for three months after CPN. After one week, all patients stopped opioids and 3 patients (15%) continued on NSAIDS. While after three months, 8 patients (40%) continued on NSAIDS and 3 patients only (15%) took opioids again but with lesser dose than the preblock doses (Table 4).

No major complications occurred, however local irritant pain occurred in 12 patients (60%), hypotension occurred after CPN in 4 patients (20%) who all responded to I.V fluid therapy while diarrhea occurred in 10 patients (50%) after CPN and all responded to I.V fluid therapy & Diosmectite sachets (Table 5).

4. Discussion

Celiac plexus neurolysis is an interventional technique utilized for the treatment of abdomino-visceral pain from upper abdominal cancer. In gastrointestinal (GI) malignancies, compression, invasion, or distension of visceral structures results in a poorly localized noxious pain. All systemic analgesics (opioid and nonopioid) may fail to provide adequate control of cancer pain. Celiac plexus neurolysis (CPN) can be employed for pain originating from the liver, pancreas & upper GI malignancies.

In this study, we used US-guided technique which was used by several studies as Bhatnagar et al. (4) who performed celiac plexus neurolysis under US guidance and stated that it offers many advantages over the other procedures proposed as it allows observation of the entire procedure on a video monitor in real time. The US-guided procedure exposes neither patient nor physician to unnecessary radiation, and is also less time-consuming.

Gofeld (5) performed CPN under US guidance with similar conclusion. Siddaiah and Sardesai (6) mentioned that US-guided CPN is simple, inexpensive and (in contrast to the EUS-guided CPN) does not require special equipment or formal training in gastroenterology. Marcy et al. (7) concluded that ultrasound guidance is safe and effective and should be attempted for celiac plexus block whenever possible it almost completely eliminates the risk of inadvertent injection of ethanold into vascular or intradural structures. Wang et al. (8) said that the disadvantages of the ultrasound-guided CPN technique are as follows: 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.

As regards anterior approach we found it more comfortable with patient in the supine position. That comes in agreement with Bhatnagar et al. (3) who performed CPN through anterior approach and stated that patient is more comfortable because this is understandable in the terminally ill patients where the goal of the interventional palliation is a simple technique with minimal discomfort. Marcy et al. (7) performed anterior celiac plexus block and proposed that the anterior approach to percutaneous celiac ganglia is an easy, less invasive and safely performed procedure with a high success rate. Akhan et al. (9) stated that the major advantage of the anterior approach is the reduced risk of neurologic complications because the tip of the needle is anterior to the spinal arteries and spinal canal. Narouze and Gruber (1) believed that the most important advantage of the anterior approach is decreasing or even eliminating the potential risk of paraplegia with CPN.

Approaches and methods used to place the needle are either single midline, single unilateral or bilateral para median on
both sides of celiac trunk. In the present study we used single
unilateral approach in 90% of patients, while bilateral
approach was done in 10% of patient as pain was not relieved
by single approach. A similar study reported that bilateral nee-
dles might be placed if there is not a satisfactory pain relief
using the unilateral approach by Rana et al. (10). A previous
study that performed CPN utilizing ultrasound-guided CPN
with bilateral paramedian needle entry technique showed high
success by Bhatnagar et al. (4) while another study stated that
bilateral CPN is more effective and is safe than central CPN by
Sahai et al. (11). Few complications, and overall good success
rate were reported in Caratozzolo et al. (12). Fugere and Lewis
(13) stated that with the same approach smaller dose of
neurolytic agent was required.

For CPN, 50–100% Alcohol or Phenol 10% concentration
was utilized. Phenol has the advantage of being painless with a
similar effectiveness; however, it has high viscosity & short
duration of block. Ethanol has longer duration of block, but
more painful. 20–50 mL of ethanol in concentrations of
50–100% is the most commonly used neurolytic agent in
clinical practice (14). In our study, US-guided CPN was done
with injection of 15–30 mL of 50% ethanol. There was good
pain relief for 3 months for all patients. Bhatnagar et al. (3)
performed US-guided CPN for 20 patients with 15–20 mL of
50% ethanol injected bilaterally. They reported successful
CPN for all patients with good pain relief for 2 months.
Romanelli et al. (15) injected 15–40 mL of 50% Alcohol unilat-
erally. Pain was relieved in 92% (totally 61%, partially 31%)
of patients, and unchanged in 8%. However, Marcy et al. (7)
performed celiac plexus block (30 mL ethanol 99%) with pain
relief obtained in 79% of the patients which is less than our
results. As regards the technical success rate; in our study,
the technical success rate was 95.2%. US-guided CPN failed
in 1 patient (4.8%) due to marked colonic distension obscuring
the celiac trunk. Bhatnagar et al. (3) performed US-guided
CPN for 22 patients with technical success rate 91%. Marcy
et al. (7) performed celiac plexus block under CT and
ultrasound-guidance anterior approach single midline injec-
tion. The technical success rate was 100% for CT guidance
and 93% for ultrasound guidance.

Fig. 3(c–f)  After ultrasound-guided CPN was done: (c) Color Doppler study showing the celiac trunk. (d) The needle (yellow arrow) was
introduced through the left hepatic lobe. (e) Then, the needle crossed the hepatic artery (yellow arrow) till it reached the right celiac
ganglion. (f) Ethanol injection into the right celiac ganglion that appeared echogenic. There is difference in echogenicity between the right
(yellow arrow) and left (blue arrow) celiac ganglions. Right ganglion neurolysis was done using 12 mL Lidocaine 2% and 15 mL ethanol
50%. Pain degree after CPN (By VAS); immediately after CPN: 3/10, 1 week after CPN: 1/10, 1 month after CPN: 2/10 and 3 months
after CPN: 2/10. Analgesic requirements after CPN: 2 days after CPN: the patient had stopped Morphin. Only, Tramadol tablet was taken
once daily for 5 months.
Fig. 4(a–c) Male patient, 64 years old, with cancer tail of pancreas and multiple hepatic deposits. CT scan (a) Shows hypodense poorly-enhancing pancreatic tail mass (yellow arrow) with multiple hepatic deposits (blue arrows). (b) Multiple hepatic deposits (blue arrows). (c) Shows the celiac trunk (yellow arrow). Analgesics: Tramadol tablets twice daily, Morphin tablet once daily and Nalophene ampule once daily. Pain degree by VAS (Before CPN): 10/10.

Fig. 4(d–f) After ultrasound-guided CPN was done: (d) Color Doppler shows the celiac trunk (yellow arrow). (e) The needle crosses the left hepatic lobe toward the right celiac ganglion (yellow arrow). (f) Ethanol spread at the right celiac ganglion that appears echogenic (yellow arrow). Right ganglion neurolysis was done using 12 mL Lidocaine 2% and 15 mL ethanol 50%. Pain degree after CPN (By VAS); immediately after CPN: 2/10, 1 week after CPN: 1/10, 1 month after CPN: 1/10 and 3 months after CPN: 3/10. Analgesic requirements after CPN: 3 days after CPN, the patient had stopped opioids. Only, Paramol tablets were taken twice daily for 4 months.

Table 3 Pre- and post-intervention VAS score. Baseline VAS, pain degree before CPN; D1, one day after CPN; W1, one week after CPN; M1, one month after CPN; M3, three months after CPN.

<table>
<thead>
<tr>
<th>Score ± SD</th>
<th>Parameter</th>
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<tbody>
<tr>
<td>9.1 ± 0.85</td>
<td>Baseline VAS</td>
</tr>
<tr>
<td>1.4 ± 0.71</td>
<td>D1 VAS</td>
</tr>
<tr>
<td>1.6 ± 0.89</td>
<td>W1 VAS</td>
</tr>
<tr>
<td>2 ± 0.79</td>
<td>M1 VAS</td>
</tr>
<tr>
<td>2.3 ± 1.02</td>
<td>M3 VAS</td>
</tr>
<tr>
<td>&lt; 0.001</td>
<td>P value</td>
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</tbody>
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In our study the degree of pain relief was significantly decreased in their VAS score and opioid consumption. These results were similar to Bhatnagar et al. (3) who performed US-guided CPN. They reported VAS score at the preblock stage 9.10 ± 0.85. One day after CPN, VAS score markedly decreased to 1.2 ± 1.02. 2 months after CPN, pain scores had decreased to 2.10 ± 0.79 ($P < 0.001$). Marcy et al. (7) also performed US-guided CPN with the preblock VAS score 9.4 ± 0.7. They stated that the VAS score decreased sharply to 1.3 ± 0.8 at the 1st day after neurolysis. 3 months later, VAS score was 3.9 ± 1.2.

No major complications were recorded in our study similar to Bhatnagar et al. (3) who stated that; hypotension occurred in 15% of patients, diarrhea occurred in 55% of patients, and pain at site of injection in 85% of his group of study and we
come in agreement with Alshab et al. (16) who reported that transient diarrhea occurred in 65%, hypotension occurred in 52% and local pain at the injection site occurred in 40%.

5. Conclusion

Ultrasound-guided celiac plexus neurolysis technique is a safe effective procedure in decreasing pain severity in patients suffering from upper abdominal cancer with no major complications and high success rates.

Conflict of interest

The authors declare that there are no conflicts of interest.

References