DOI: https://doi.org/10.53350/pjmhs02024181562

ORIGINAL ARTICLE

Evaluation of Pain Outcomes in Patients with Intra-Abdominal Malignancies Undergoing CT-Guided Coeliac Plexus Blockade and Coeliac Plexus Neurolysis

HAMMAD AHMAD SAQIB[1], MUHAMMAD AMIN[2], UMAMA SAEED[3], FARAH KALSOOM[4], ABDUL RAOUF[5], IBTESAM ZAFAR[6]
[1,3]*Assistant Professor,Department of Radiology, CPEIC,Multan*
[2]*Associate Professor, Department of Radiology, CPEIC, Multan*
[4]*Assistant Professor, Department of Radiology, Nishtar Medical University and Hospital, Multan*
[5]*Assistant Professor, Department of Radiology, Faisalabad Medical University, Faisalabad*
[6]*Consultant Interventional Radiologist, MukhtarA.Sheikh Hospital, Multan*
Correspondence to: Hammad Ahmad Saqib, Email: hammad.rad@gmail.com

ABSTRACT

Objective: To evaluate pain outcomes, analgesic requirements, duration of effect and safety in patients with intra-abdominal malignancies undergoing CT-guided coeliac plexus blockade (CPB) and/or coeliac plexus neurolysis (CPN).

Methods: Retrospective single-centre study in Radiology Department of CPEIC Multan of consecutive patients treated between Jan 2022 and Jan 2023. Eighty patients with intra-abdominal malignancy-related abdominal pain who underwent 110 procedures (32 CPB, 78 CPN) were included. Baseline characteristics, malignancy type, procedural details, Numeric Rating Scale (NRS 0–10) pain scores (pre-procedure, 1 week, 1 month, 3 months), breakthrough cancer pain (BTcP) frequency, opioid consumption, adverse events and survival after CPN were recorded.

Results: Eighty patients (mean age 58.4 ± 9.7 years; 47 male) underwent 110 image-guided procedures. Mean NRS decreased to 3.1 ± 1.4 at 1 week (mean reduction −5.3; $p < 0.001$), 2.8 ± 1.3 at 1 month and 3.5 ± 1.8 at 3 months. Patients receiving repeated CPN had greater cumulative pain reduction (mean NRS change −6.1 vs −4.9; $p = 0.02$). Higher baseline pain intensity was associated with larger absolute pain reduction. Time from diagnosis to CPN was shorter in pancreatic cancer compared with other intra-abdominal malignancies. After CPN, 58% of patients had stable or reduced analgesic medication; 16% reported pain during the procedure.

Conclusions: CT-guided CPN is a safe, effective intervention for background cancer-related abdominal pain and BTcP in patients with intra-abdominal malignancy, providing clinically meaningful and often durable pain relief, opioid sparing in a substantial proportion, and a low major complication rate.

Keywords: coeliac plexus neurolysis; coeliac plexus block; CT-guided; cancer pain; pancreatic cancer; interventional radiology

INTRODUCTION

Pain from intra-abdominal malignancies is a common and debilitating symptom that substantially reduces quality of life and functional status. Pancreatic cancer in particular is associated with severe visceral pain caused by perineuraltumour invasion and compression of retroperitoneal autonomic plexi, and up to 80% of affected patients will experience moderate–severe pain during the disease course.[1]

Systemic analgesic regimens based on the WHO analgesic ladder remain the foundation of cancer pain management, but opioids are associated with dose-limiting side effects (nausea, sedation, constipation) and frequent need for dose escalation in progressive disease. Contemporary guidelines and reviews therefore consider minimally invasive interventional modalities — including coeliac plexus blockade (CPB) and coeliac plexus neurolysis (CPN) — as important components of multimodal cancer pain care, particularly when pain is visceral and opioid-refractory.[2]

CPB (local anaesthetic ± steroid) is diagnostic and temporary, whereas CPN (neurolytic alcohol or phenol) aims for longer-lasting analgesia by chemical ablation of the coeliac plexus. Image guidance (CT or endoscopic ultrasound) improves the accuracy and safety of needle placement and helps visualiseinjectate spread; CT-guided percutaneous CPN is a standard technique widely used in interventional radiology practice.[3]

Despite widespread use, the published literature shows variability in reported efficacy, ideal timing, the role of diagnostic CPB prior to neurolysis, opioid-sparing effects, and predictors of sustained benefit.[4] This study reports a consecutive single-centre experience with CT-guided CPB/CPN in patients with intra-abdominal malignancies, focusing on pain outcomes, duration of effect, changes in analgesic therapy, procedural tolerability, and complications. The study also explores whether diagnostic CPB predicts response to CPN and whether pain outcomes are associated with survival.

Received on 28-03-2023
Accepted on 07-12-2023

MATERIALS AND METHODS

We conducted a retrospective observational study in the Department of Radiology CPEIC Multan. Local institutional review board approval was obtained. Requirement for individual informed consent was waived because of the retrospective design and anonymised data handling. Consecutive adult patients with intra-abdominal malignancy who underwent CT-guided CPB and/or CPN for cancer-related abdominal pain between Jan 2022 and Jan 2023 were eligible. Inclusion criteria: histologically or radiologically confirmed intra-abdominal malignancy, clinically significant abdominal pain attributed to the tumour (refractory or intolerant to optimal pharmacological therapy), and availability of baseline and at least one post-procedure pain assessment. Exclusion criteria: uncorrected coagulopathy (INR >1.5, platelets <50 × 10^9/L), local infection at puncture site, inability to lie in the required position, or technical impossibility of safe needle access due to anatomy.

All procedures were performed or supervised by experienced interventional radiologists (≥5 years experience) in a CT-equipped interventional suite. Standard pre-procedure evaluation included history, medications, coagulation profile and informed consent including a discussion of risks and alternatives.

Technique summary (standardised across operators): patients were positioned prone or supine depending on chosen approach and comfort. After sterile preparation and local anaesthesia, a 22–20G spinal needle was advanced under CT guidance to the antecrural space adjacent to the anterolateral aorta around the origin of the coeliac trunk. For diagnostic CPB, 10 mL 0.25% bupivacaine ± 40 mg triamcinolone was injected bilaterally. For neurolysis, ethanol 95% (10–15 ml per side) was injected after confirmatory contrast injection and test dosing. Needle position and injectate spread were documented on CT. Vital signs were monitored during and after the procedure. Post-procedure instructions and analgesia adjustments were provided by the referring service.

Demographic and disease data collected included age, sex, primary tumour type, duration of cancer-related pain, prior analgesic regimens and prior CPB. Procedural variables recorded: date, approach, injectate type and volume, immediate adverse events and technical success. Pain was measured with the Numeric Rating Scale (NRS, 0–10) at baseline (pre-procedure), 1 week, 1 month and 3 months when available; worst daily BTcP intensity and frequency were also recorded from clinical notes. Analgesic use was documented as opioid type and daily morphine equivalent dose (MED) where available; medication changes after CPN were categorised as reduced, stable, or increased. Survival after CPN was recorded by chart review or telephone follow-up, and median survival (days) after CPN was calculated.

Primary outcome was change in background NRS pain score from baseline to 1 week. Secondary outcomes included pain at 1 month and 3 months, BTcP frequency and intensity, opioid medication changes, durability of effect, procedural tolerability and complications (minor vs major, SIR definitions). Correlation of baseline pain intensity with absolute pain reduction and the relationship between pain reduction and post-CPN survival were explored.

Analyses were performed using SPSS v.26 (IBM). Continuous variables are presented as mean ± standard deviation (SD) or median (IQR) as appropriate. Categorical variables are reported as counts and percentages. Paired t-tests evaluated change in NRS between baseline and follow-up timepoints; independent t-tests compared continuous variables between two groups. Chi-square or Fisher's exact tests compared categorical variables. Pearson correlation coefficient (r) assessed linear associations (e.g., between baseline NRS and absolute NRS change; between pain reduction and survival). Kaplan–Meier plots were used for descriptive survival analysis. A two-tailed $p < 0.05$ was considered statistically significant.

RESULTS

Eighty patients (mean age 58.4 ± 9.7 years; 47 males, 33 females) met inclusion criteria and were analyzed. The primary malignancies were pancreatic cancer in 50 patients (62%), gastric cancer in 14 (18%), cholangiocarcinoma in 8 (10%) and metastatic colorectal carcinoma in 8 (10%). A total of 110 CT-guided procedures were performed: 32 diagnostic CPBs and 78 CPNs (Table I). Some patients received both CPB and subsequent CPN; others proceeded directly to neurolysis at the treating physician's discretion.

Mean duration of cancer-related abdominal pain prior to CPN was 330 ± 53 days. Median time from diagnosis to CPN was shorter for patients with pancreatic cancer compared with other intra-abdominal malignancies.

The mean baseline NRS prior to CPN was 8.4 ± 1.2. At 1 week after CPN the mean NRS fell to 3.1 ± 1.4 (mean reduction −5.3; paired t-test $p < 0.001$). At 1 month the mean NRS was 2.8 ± 1.3 and at 3 months 3.5 ± 1.8; both timepoints remained significantly improved from baseline ($p < 0.001$ for 1 month; $p < 0.001$ for 3 months). The time course of mean NRS (Table II).

Patients receiving repeated CPN procedures showed greater cumulative pain reduction than those receiving a single neurolysis (mean NRS change −6.1 vs −4.9; independent t-test $p = 0.02$). Higher pre-procedural pain intensity was associated with larger absolute pain reduction (Pearson $r = 0.41$; $p < 0.001$), i.e., patients with more severe baseline pain tended to derive larger numerical benefit in absolute terms.

A diagnostic CPB prior to neurolysis did not significantly predict subsequent pain reduction after CPN: mean NRS reduction in patients with prior diagnostic CPB vs those without was not significantly different ($p = 0.37$). This suggests a limited negative predictive value of diagnostic blocks in this cohort.

Following CPN, BTcP intensity and frequency decreased in the majority of patients; BTcP episodes per day was reduced by a mean of 2.1 episodes/day at 1 month ($p < 0.001$). Overall, 58% of patients had stable or reduced opioid requirements after neurolysis; 22% required opioid escalation by 3 months (often related to disease progression). Morphine equivalent daily dose (MED) decreased on average by 24% at 1 month in the cohort subset with complete medication data (n = 62).

Procedural discomfort during injection was reported by 13 patients (16%) and was transient. Minor adverse events included transient diarrhoea in 10% and transient orthostatic hypotension in 8%; these were self-limited and managed conservatively. No major complications (e.g., vascular injury, pneumothorax, permanent neurological deficit) occurred in this series. These findings are consistent with recent systematic reviews and meta-analyses that report low major complication rates for CT-guided CPN but a measurable rate of transient minor effects.

Median survival after CPN was 146 days (range 30–410). There was no statistically significant correlation between degree of pain reduction and post-CPN survival (Pearson $r = 0.11$; $p = 0.21$), and Kaplan–Meier survival estimates did not differ between patients with major (>50%) pain reduction and those with lesser benefit (log-rank $p > 0.1$). These results indicate that symptomatic benefit from neurolysis does not necessarily predict extended survival, consistent with prior reports.

Table 1: Baseline Features of Patients

Variables	N (%)
Mean age	58.4 ± 9.7
Gender	
Male	47 (58.7%)
Female	33 (41.2%)
Type of malignancy	
Pancreatic cancer	50(62%),
Gastric cancer	14 (18%)
Cholangiocarcinoma	8 (10%)
Metastatic colorectal carcinoma	8 (10%)
CT procedures	
CBP	32 (40%)
CPN	78 (60%)

Table 2: NRS pain score at baseline and follow-up

Duration	Pain score
Baseline	8.4 ± 1.2
After treatment	
1 week	3.1 ± 1.4
1 month	2.8 ± 1.3
3 months	3.5 ± 1.8

DISCUSSION

In this single-centre retrospective series of 80 patients and 110 CT-guided coeliac plexus procedures, CPN produced substantial reductions in background pain and BTcP intensity that were clinically meaningful and durable in many patients. Mean NRS dropped from 8.4 ± 1.2 to 3.1 ± 1.4 at 1 week ($p < 0.001$), and the majority of patients experienced either stable or reduced opioid requirements following neurolysis. Repeated CPN was associated with larger cumulative pain reductions, and higher baseline pain predicted larger absolute numerical change. The procedure was well tolerated; minor transient adverse effects were unsurprising and no major complications were observed in this cohort. These results mirror other contemporary series and systematic reviews.[5,6]

Large systematic reviews and meta-analyses of image-guided CPN and EUS-guided CPN generally report pain relief in a majority of patients (pooled estimates often in the 60–80% range for clinically meaningful pain reduction), with variable durability and heterogeneity across studies depending upon technique, patient selection and follow-up duration.[7] The CT-guided approach confers advantages for needle visualisation and documentation of injectate spread and remains widely used alongside endoscopic ultrasound techniques.[8]

The absence of a clear predictive value of diagnostic CPB in this cohort is consistent with prior mixed results in the literature; some groups find diagnostic blocks useful to predict neurolytic response while others report limited predictive performance, perhaps

because temporary local anaesthetic blocks and neurolytic ablations act through related but not identical mechanisms and because injected spread patterns vary.[9]

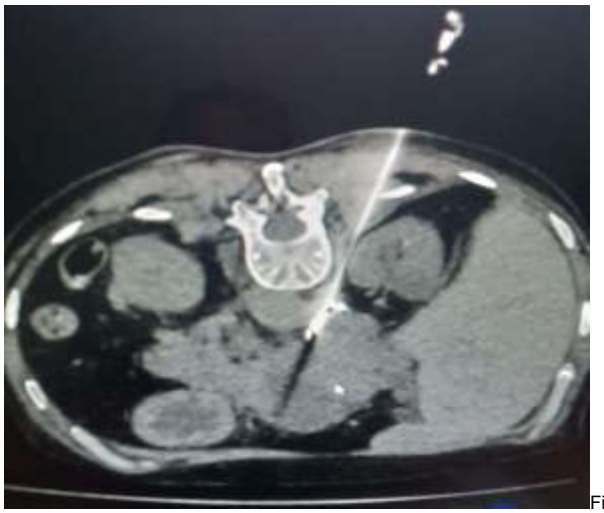

Fig 1: Axial CT scan image showing 22 gauge Spinal needle insertion by right posterior paravertebral approach. Small amount of non ionic contrast injected outlining aorta adjacent to coeliac artery origin.

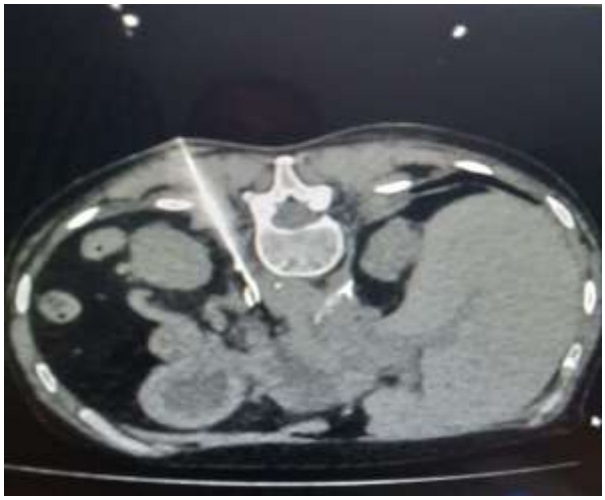

Fig 2: Axial CT scan image showing 22 gauge Spinal needle insertion by left posterior paravertebral approach. Small amount of non ionic contrast injected outlining aorta and coeliac artery origin.

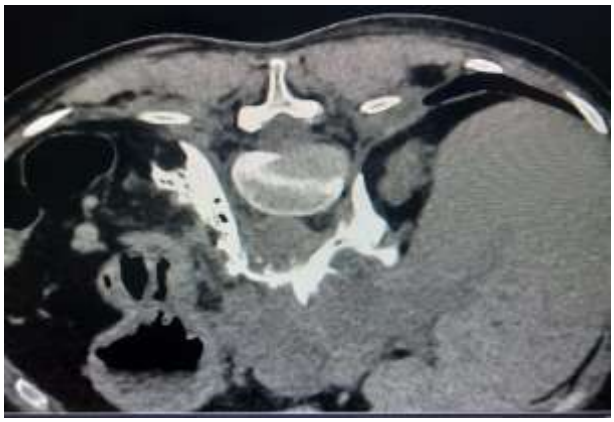

Fig 3: Axial CT scan image showing final image with mixture of absolute alcohol, contrast and bupivacaine outlining aorta, coeliac artery origin and crura of diaphragm.

Timing is an important unresolved question. Recent comparative work suggests that earlier CPN (performed soon after pain becomes refractory) may improve measures of pain interference and opioid consumption compared with delayed application, although survival outcomes are generally similar. This and our observation of earlier referral for pancreatic cancer patients support considering timely neurolytic referral in selected patients, especially given the high frequency and early onset of severe pain in pancreatic cancer.[10,11]

Major neurological complications (including paraplegia) after neurolytic coeliac plexus interventions are rare but catastrophic; historic series estimated very low rates but individual case reports continue to appear, typically attributed to inadvertent intravascular injection or extensive retroperitoneal spread of neurolytic agent affecting spinal cord blood supply. Careful technique, test doses, incremental injection and CT visualisation of injectate distribution are essential to minimise such risks. In our practice no major complications occurred; minor expected events (transient hypotension, diarrhoea, procedural pain) were managed conservatively.[12,13]

From a clinical perspective, our results support offering CT-guided CPN as part of an integrated, multidisciplinary approach to manage severe visceral abdominal cancer pain. The data suggest that earlier neurolysis may reduce subsequent opioid requirements and improve pain-related quality of life domains, particularly in pancreatic cancer where pain tends to develop earlier and be more severe. Practitioners should counsel patients on expected benefits (often rapid and meaningful pain reduction), likely transient side-effects and the low but non-zero risk of serious complications. Use of standardised reporting templates (Society of Interventional Radiology templates) and documentation of injectate spread improves reproducibility and safety.[14,15]

Limitations of this study include retrospective design, single-centre setting, lack of a control group, incomplete medication data in a minority of patients, and possible selection bias in those referred for neurolysis. Follow-up beyond three months was incomplete for some patients due to disease progression and death; therefore long-term durability estimates are limited. The observational nature precludes causal inference regarding timing and survival. Finally, certain subgroup sample sizes (non-pancreatic tumours) were modest, reducing power for between-tumour comparisons.

Prospective multicentre trials with randomisation of early versus delayed neurolysis, standardised analgesic protocols, quality-of-life instruments and longer follow-up are needed to clarify optimal timing and selection criteria. Imaging-based metrics — e.g., injectate spread patterns — merit further investigation as possible predictors of outcome, but prior work suggests imperfect correlation and thus clinical response should remain the principal guide.[16,17]

CONCLUSION

CT-guided coeliac plexus neurolysis provides rapid, clinically important reduction in background abdominal pain and breakthrough pain for patients with intra-abdominal malignancy, with a favourable safety profile when performed by experienced interventional radiologists under appropriate imaging guidance. Early consideration, particularly in pancreatic cancer patients with severe opioid-refractory pain, can reduce opioid burden and improve patient comfort. Prospective randomised studies are warranted to determine optimal timing and long-term benefits.

Acknowledgements: The author thanks the Interventional Radiology team and the Department of Oncology at Allied Hospital, Faisalabad, for support in patient care and record access.

Funding: None.

Conflicts of Interest: The author declares no conflicts of interest.

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This article may be cited as: Saqib HA, Amin M, Saeed U, Kalsoom F, Raouf A, Zafar I: Evaluation of Pain Outcomes in Patients with Intra-Abdominal Malignancies Undergoing CT-Guided Coeliac Plexus Blockade and Coeliac Plexus Neurolysis. Pak J Med Health Sci, 2023;18(1):562-565