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# Interventional treatments of splanchnic nerve blockade for various indications and their outcomes: A retrospective study

Emel Guler[1], Ece Yanik[2], Onur Bulut[2], Hilmi Gunuc[3], Didem Akcali[1], Nurten Inan[1]

[1]Gazi University, Faculty of Medicine, Department of Anesthesiology and Reanimation, Division of Pain Medicine, Ankara, Türkiye
[2]Gazi University, Faculty of Medicine, Department of Neurology Division of Pain Medicine, Ankara, Türkiye
[3]Isparta City Hospital, Department of Algology, Isparta, Türkiye

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**Abstract**

Splanchnic nerve blockade is employed in the treatment of abdominal pain, resistant to medical management due to various etiologies, particularly in cases involving pancreatic cancer and pancreatitis. Different techniques are utilized during the procedure, with radiofrequency ablation (RFA) and neurolysis using neurolytic agents being the two most frequently used methods. We retrospectively examined the effects of RFA and the combination of RFA with a neurolytic agent on pain scores. A total of 15 patients (10 males, 5 females) diagnosed with pancreatic cancer (11 cases), metastatic cancer (1 case), and chronic pancreatitis (3 cases) underwent splanchnic nerve block procedures. Of these, one patient received phenol, five patients underwent RFA, and nine patients were treated with a combination of RFA and phenol. The pre-procedural pain score was 8.93±1.22, while the one-month post-procedure pain score was 4.47±2.06 (p=.001). There was no statistically significant difference in pain score reduction among the different procedures (p>.05). Splanchnic nerve block techniques yielded a significant reduction in pain scores across various diagnoses. However, uncertainties persist regarding the preferred treatment methods. Notably, the addition of phenol to RFA treatment did not result in a difference in pain score reduction when compared to RFA alone.

**Keywords:** Splanchnic block, radiofrequency ablation treatment, phenol treatment, pain

## Introduction

Abdominal pain can be caused by various pathologies. Among patients admitted for chronic abdominal pain, the most commonly encountered conditions in pain management practice are pancreatitis, pancreatic cancer, gastric cancer, hepatobiliary system cancers, and abdominal metastases. Medical agents are preferred in the initial treatment; however, interventional treatment methods are utilized, especially in cases of pain resistant to medical therapy. The sympathetic innervation of the abdominal organs is provided by fibers originating from the anterolateral horn of the spinal cord, which synapse with the celiac plexus. These fibers arise from the thoracic segments T5-T12 and the ventral roots, together forming the greater, lesser, and least splanchnic nerves, contributing to the sympathetic innervation of the celiac plexus. These splanchnic nerves are localized on both sides of the spine. Their primary functions include providing autonomic control of the abdominal and pelvic organs, transmitting pain signals, and regulating the function of these organs. The blockage of these nerves is defined as splanchnic nerve blockade [1]. The increasing utilization of this blockade technique can be attributed to its well-defined anatomical boundaries, its localization resembling a closed triangle in the retrocrural area, and the minimal impact on adjacent organs during treatment procedures [2].

The technique of percutaneous injection for blocking the celiac plexus and splanchnic nerve was first introduced by Max Kappin in 1914. In 1957, Robert R. Jones described neurolysis in these two blocks. The role of neurolysis in managing pain resulting from gastrointestinal malignancies was first identified by Bridenbaugh [3]. During the neurolysis procedure, various

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**Corresponding Author:** Emel Guler, Gazi University, Faculty of Medicine, Department of Anesthesiology and Reanimation, Division of Pain Medicine, Ankara, Türkiye
Email: emelguler@gazi.edu.tr

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agents such as phenol and alcohol are used [2,4]. Radiofrequency ablation (RFA) is another treatment method commonly used alongside neurolysis [5]. Neurolytic block involves the deliberate degeneration of targeted nerve fibers through the application of chemicals or by heating with needles, resulting in disruption of signal transmission in the nerves. Neurolysis specifically refers to the physical destruction of neurons by placing a needle near the nerve and injecting neurodestructive chemicals. This procedure induces denervation, which blocks visceral pain transmission, making it a widely utilized method in clinical practice for the managing various pathologies [6].

The aim of our study is to evaluate the short-term efficacy of splanchnic nerve block treatment, utilizing the radiofrequency ablation technique and neurolytic agents, in the management of medication therapy-resistant abdominal pain resulting from various pathologies, such as cancer-related pain and chronic pancreatitis.

## Material and Methods

This study retrospectively evaluated patients who presented to our clinic due to medical treatment-resistant abdominal pain and underwent splanchnic block treatment at a tertiary healthcare facility between 01/01/2023 and 31/08/2024. The study commenced after obtaining approval from the ethics committee (Decision No: 2024-1933). Patients with different diagnoses (cancer, pancreatitis, metastatic cancer of unknown primary) who received neurolytic agents, RFA, or both as blocking techniques were included. The existing files of these patients were reviewed, and their age, height, and weight, body mass index (BMI) were recorded, along with pain scores evaluated before the procedure and one month post-procedure. The BMI was calculated using the formula: weight in kilograms (kg) divided by height in meters squared ($m^2$) [7]. Pain intensity was assessed using the Numeric Rating Scale for pain (NRS).

NRS: This scale is utilized to measure and monitor pain intensity. It consists of a line 10 centimeters long marked with numbers from 0 to 10. Measurements range from 0 to 10 (0=no pain, 10=most severe pain). Patients were asked to mark the point on this line corresponding to the intensity of the pain they were experiencing.

All procedures were performed under sedation, with the patient positioned prone and monitored. After obtaining antero-posterior images of the T11 and T12 vertebral bodies using fluoroscopy, the angle was adjusted to visualize both the pleural shadow and diaphragm shadow, allowing for the identification of the point where the rib and vertebra join. Following the administration of 2% lidocaine for local anesthetic infiltration, the procedure was initiated. During needle advancement, contact with the bone was ensured, and the target point was reached through repeated fluoroscopic imaging (anteroposterior and lateral). After confirming adequate contrast distribution and nonvascularization by contrast administration, the procedure was completed (Figure 1a and 1b).

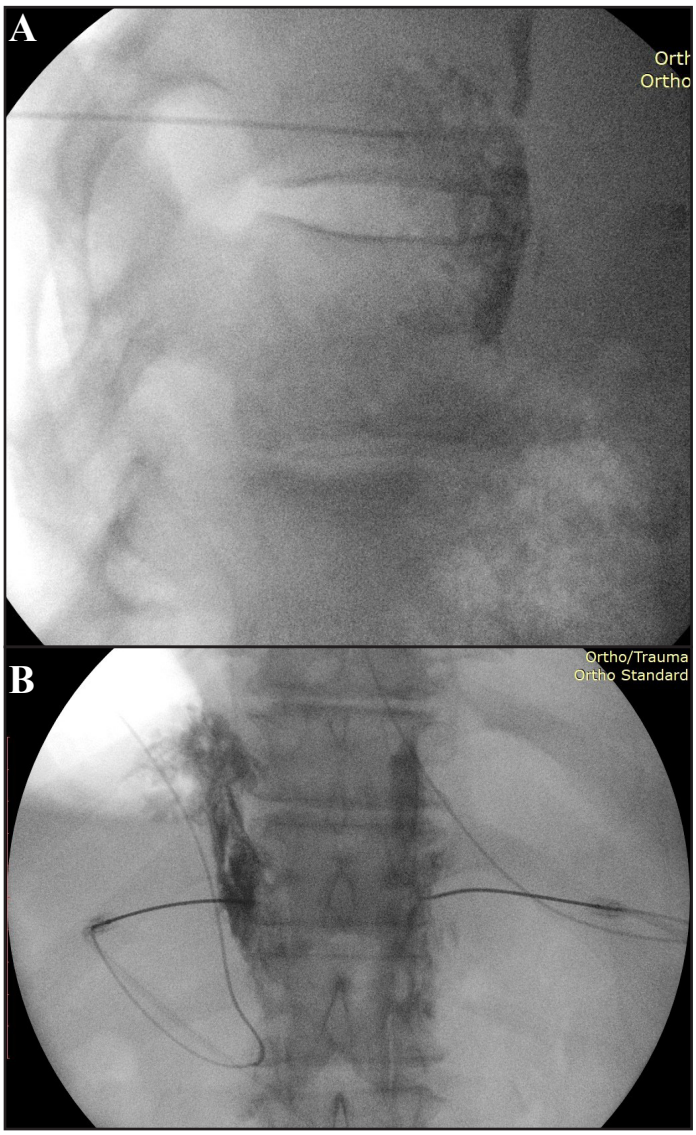


**Figure 1.** Splanknic block lateral view and antero-posterior view

In patients undergoing RFA, radiofrequency needles (top-neuropole RF needle, 21-gauge, sharp curved, 100-150 mm in length, with a 10 mm active tip) were used during the procedure. The motor and sensory stimulation tests were performed using frequencies of 2 Hz (up to 2 V) and 50-100 Hz (up to 1 V), respectively. The presence of a sensation in the epigastric region during sensory stimulation and the absence of any contraction of the intercostal muscles during motor stimulation indicated proper localization of the needle. Consequently, a lesion was produced at 80°C for 90 seconds [8]. For neurolysis, a 5 mL solution of 6% phenol was used [9]. Before the neurolysis procedure, all patients were administered a mixture of 2 mL of 0.5% bupivacaine, 2 mL of 8 mg dexamethasone, and 6 mL of 0.9% NaCl (totaling 10 mL), with 5 mL administered to each splanchnic area. The procedure was not performed in patients with coagulation disorders, local infections at the injection site, sepsis, allergies to contrast agents, those who were pregnant, or in cases where cooperation could not be established due to psychiatric conditions. After the procedure,

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patients were monitored for complications that might arise from sympathetic blocks, such as hypotension, diarrhea, or colicky pain. No complications were observed in the patients.

### Statistical Analyses

Statistical analyses were performed using SPSS version 25 software. Initially, descriptive statistical methods (mean, standard deviation, frequency, minimum-maximum, percentage) were employed to summarize the data. Due to the small sample size, normality tests for continuous variables were conducted using the Shapiro-Wilk Test. The results indicated that the data did not meet the criteria for normality. Consequently, non-parametric tests were applied. The Wilcoxon Signed-Rank Test was used to examine differences between two related groups for continuous or ordinal variables. For comparisons of two independent samples, the Mann-Whitney Test was utilized. A significance level of .05 was set for all tests conducted.

## Results

The gender, diagnosis, demographic data, disease durations, and pre- and post-procedure pain scores of the patients included in the study are presented in Tables 1 and 2.

**Table 1.** Distribution of gender, diagnosis, and treatment groups of the patients

| | | | |
|---|---|---|---|
| **Gender n (%)** | | **Male** | **Female** |
| | | 10 (66.7) | 5 (33.3) |
| **Diagnosis n (%)** | **Pancreatic cancer** | **Metastatic cancer** | **Chronic pancreatitis** |
| | 11 (73.3) | 1 (6.7) | 3 (20) |
| **Treatment type n (%)** | **Phenol** | **RFA** | **Phenol+RFA** |
| | 1 (6.7) | 5 (33.3) | 9 (60) |

RFA: radiofrequency ablation

**Table 2.** Basic statistics of age, BMI, duration, and NRS values before and after the patients' procedure

| Variable (n) | Minimum | Maximum | Mean | Standart deviation |
|---|---|---|---|---|
| **Age (15)** | 30.00 | 79.00 | 57.20 | 13.21 |
| **BMI (15)** | 17.90 | 27.80 | 22.63 | 3.23 |
| **Duration (month) (15)** | 1.00 | 12.00 | 5.73 | 4.43 |
| **Pre-procedure NRS (15)** | 6.00 | 10.00 | 8.93 | 1.22 |
| **Post- procedure NRS (15)** | 2.00 | 9.00 | 4.47 | 2.07 |

BMI: body mass index, NRS: numerical rating scale for pain

The difference between the pre- and post-procedure NRS scores for all subjects, including those with different diagnoses and treatments, was analyzed using the dependent sample Wilcoxon Test due to the non-normal distribution of the data. As shown in Table 3, there is a significant difference between the pre- and post-procedure NRS scores ($p<.05$). The post-procedure NRS scores decreased significantly compared to the pre-procedure scores.

**Table 3.** Results of the difference test for pre- and post-procedure NRS averages

| Variable (n) | Mean (sd) | p value |
|---|---|---|
| **Pre-procedure NRS (15)** | 8. 93 (1.22) | .001 |
| **Post- procedure NRS (15)** | 4. 47 (2.06) | |

NRS: numerical rating scale for pain, sd: Standart deviation

In Table 4, the results of the Wilcoxon test, obtained after excluding the patients who underwent the phenol procedure, are presented. It is observed that both pre- and post-procedure NRS scores have decreased for all patients. A significant difference was found between the pre- and post-procedure NRS scores ($p<.05$), with the post-procedure NRS score showing a significant reduction.

**Table 4.** Results of the difference test for pre- and post-procedure NRS scores after excluding patients who underwent the phenol procedure

| Variable (n) | Mean (sd) | p value |
|---|---|---|
| **Pre-procedure NRS (14)** | 9.00 (1.24) | .001 |
| **Post- procedure NRS (14)** | 4.57 (2.10) | |

NRS: numerical rating scale for pain, sd: Standart deviation

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Due to the inclusion of a patient who underwent the phenol procedure, the Mann-Whitney U Test was applied to investigate the differences in pre- and post-procedural NRS scores among patients who underwent either of the remaining two procedures, given the non-normality of the data.

According to the results obtained (Table 5), a significant difference was found in the pre-procedure NRS scores based on the type of procedure performed ($p<.05$), while no significant difference was observed in the post-procedure NRS scores ($p>.05$). The pre-procedure NRS score for patients undergoing the phenol+RFA procedure was higher compared to those undergoing only the radiofrequency procedure.

**Table 5.** Test results for the differences in pre- and post-procedure NRS scores according to the procedures performed

| Procedure (n) | RFA (5) | Phenol+RFA (9) | p value |
|---|---|---|---|
| **Pre-procedure NRS mean (sd)** | 8.00 (1.41) | 9.55 (2.10) | .042 |
| **Post- procedure NRS mean (sd)** | 3.60 (0.55) | 5.11 (2.47) | .438 |

NRS: numerical rating scale for pain, sd: standart deviation, RFA: radiofrequency ablation

Similarly, due to the inclusion of a patient diagnosed with metastatic cancer, the Mann-Whitney Test was applied to investigate the differences in pre- and post-procedural NRS scores among patients with other diagnoses, given the non-normality of the data. According to the results obtained (Table 6), no significant differences were found in the pre- and post-procedure NRS scores between patients diagnosed with pancreatic cancer and chronic pancreatitis ($p>.05$).

**Table 6.** Test results for the differences in pre- and post-procedure NRS scores according to diagnosis

| Diagnosis (n) | Pancreatic cancer (11) | Chronic pancreatitis (3) | P value |
|---|---|---|---|
| **Pre-procedure NRS mean (sd)** | 9.18 (1.33) | 8.00 (0) | .222 |
| **Post- procedure NRS mean (sd)** | 4.36 (2.11) | 3.67 (0.58) | .667 |

NRS: numerical rating scale for pain, sd: standart deviation

## Discussion

In managing medically resistant abdominal pain, splanchnic nerve block is commonly preferred, particularly for oncology patients. However, there is a limited number of studies in the literature addressing the treatment of pain caused by chronic pancreatitis. Our study was observed that both RFA and RFA combined with phenol neurolysis resulted in a statistically significant reduction in pain scores in patients with abdominal pain due to medication-resistant pancreatic cancer and chronic pancreatitis. Comparison of the therapeutic methods used did not reveal a statistically significant difference in pain scores. The phenol treatment was applied to a patient diagnosed with pancreatic cancer, and a notable decrease in pain intensity was recorded post-procedure. On the other hand, RFA combined with phenol treatment was applied to a patient with metastatic cancer of unknown primary origin, but no significant reduction in pain scores was observed in this patient. This was interpreted as a lack of expected response due to the patient's extensive abdominal metastases.

A review assessing the effectiveness of RFA in treating abdominal pain syndromes examined two prospective cohort studies involving patients with pancreatic cancer, one retrospective observational case study, one randomized clinical trial, and two case studies. In all of these studies, pain scores for a total of 80 patients were recorded and monitored at various times before and after the procedure. The findings indicated a statistically significant reduction in pain scores in 78 patients. Additionally, a retrospective study involving 10 patients with abdominal pain due to chronic pancreatitis was included in the same review, highlighting findings such as reduced analgesic consumption, increased daily activities, and improvements in mood [10]. In our study, a statistically significant reduction in pain scores was observed in the group receiving both RFA and combined treatment.

In a case report, a patient previously diagnosed with chronic pancreatitis and subsequently diagnosed with pancreatic cancer underwent bilateral RFA. To facilitate the patient's compliance with the procedure and to reduce pain, an erector spinae plane block was performed prior to the RFA, which was carried out at the thoracic 11-12 levels. Notable reductions in pain scores were observed during follow-up [11]. In our study, RFA treatment was performed in patients diagnosed with chronic pancreatitis, and the results indicated a statistically significant reduction in pain scores. Notably, phenol treatment was not administered to these patients.

Jumah et al. performed bilateral RFA on a 50-year-old male patient diagnosed with pancreatic cancer, employing a temperature of 80 degrees Celsius for a duration of 90 seconds, followed by neurolysis using 8 ml of 100% ethyl alcohol mixed with 2 ml of contrast agent in both splanchnic areas equally.

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This procedure resulted in a significant reduction in the patient's pain scores [12]. Similarly, our study achieved a statistically significant decrease in pain scores among patients subjected to the combined treatment protocol. We opted to use phenol in smaller volumes instead of alcohol. Additionally, a similar reduction in pain scores was noted in the group receiving RFA alone.

In a retrospective study involving data from 99 patients, alcohol was administered as a neurolytic agent to 28 patients, while phenol was administered to 71 patients. The study included patients diagnosed not only with pancreatic cancer but also with upper abdominal cancers (such as esophageal, duodenal, and hepatobiliary cancers) and abdominal metastases. Follow-up assessments conducted over one month revealed a statistically significant reduction in pain scores, with no significant differences observed in the effects of the two agents on pain. These findings underscore the effectiveness and safety of splanchnic neurolytic block [13].

In another case report, a 63-year-old patient diagnosed with pancreatic cancer underwent a 5 ml injection of 10% phenol via a transdiscal approach at the thoracic 8-9 and thoracic 11-12 levels under fluoroscopic guidance. During a two-week follow-up period, a reduction in pain intensity was noted. The researchers indicated that they preferred this technique to achieve denervation of more splanchnic nerve fibers while using a smaller volüme [14]. This is one of the key reasons for the use of phenol as a neurolytic agent.

In the study conducted by Amr et al., 60 patients diagnosed with abdominal cancer were examined. Of these patients, 30 received RFA treatment, while the other 30 underwent neurolysis with alcohol. During a three-month follow-up, complications, pain scores, opioid consumption, and quality of life were evaluated post-procedure. The results indicated that patients treated with alcohol experienced statistically significant higher rates of complications, such as paresthesia, while those who underwent RFA experienced more colicky pain. Furthermore, it was determined that the RFA procedure performed at the thoracic 10 and 11 levels was more effective in reducing pain, as assessed by VAS scores and opioid consumption, compared to the single-level (T11) alcohol application [15].

Our literature review indicates that various application techniques are used in treatments utilizing splanchnic nerve block; however, studies comparing these techniques are notably limited [16-18]. An important finding in our study is the lack of a significant difference in pain reduction between the two applied techniques.

Several limitations exist in our study. Firstly, our sample size is relatively small. Secondly, the follow-up periods for patients are short-term. Additionally, the retrospective design of the study, the lack of a prospective nature, and the inclusion of patients with different diagnoses constitute other constraints.

## Conclusion

The importance of addressing pain resulting from cancer itself or occurring during its treatment is emphasized as a significant health issue. It is crucial for clinicians to apply appropriate treatment methods at the right time and with suitable procedures for pain [19]. In particular, the choice of method to tackle medically resistant pain, when implemented at the appropriate time and with the correct technique, is likely to yield positive outcomes for both patients and physicians. Our study has compared treatment methods for which a similar study is absent in the literature. This investigation demonstrates that splanchnic nerve block therapy administered to patients diagnosed with cancer and chronic pancreatitis can achieve significant reductions in pain scores. Especially in cases of severe pain that lead to a striking increase in opioid dosages, timely decision-making regarding the block can result in considerable improvements in patients' quality of life and functional capacity. The results of our study highlight the need for randomized controlled prospective studies employing different treatment protocols.

**Conflict of Interests**
*The authors declare that there is no conflict of interest in the study.*

**Financial Disclosure**
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**Ethical Approval**
*This study received ethical approval from the Local Ethical Committee of the Gazi University Rectorate Ethics Commission (Approval number: 2024 - 1933, date: 10.12.2024).*

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