

Observational Assessment

Effectiveness of Splanchnic Nerve Neurolysis for Targeting Location of Cancer Pain: Using the Pain Drawing as an Outcome Variable

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The effectiveness of splanchnic nerve neurolysis (SNN) for cancer-related abdominal pain has been investigated using numeric pain intensity rating as an outcome variable. The outcome variable in this study used the grid method for obtaining a targeted pain drawing score on 60 patients with pain from pancreatic or gastro-intestinal primary cancers or metastatic disease to the abdominal region. Results demonstrate excellent inter-rater agreement (intra-class correlation [ICC] coefficient at pre-SNN = 0.97 and ICC at within one month post-SNN = 0.98) for the grid method of scoring the pain drawing and demonstrate psychometric generalizability among patients with cancer-related pain. Using the Wilcoxon signed rank test and associated effect sizes, results show significant improvement in dispersion of pain following SNN. Effect sizes for the difference in pre-SNN to 2 post-SNN time points were higher for the pain drawing than for pain intensity rating. Specifically, the effect size difference from pre- to within one month post-SNN was $r = 0.42$ for pain drawing versus $r = 0.23$ for pain intensity rating. Based on a smaller subset of patients who were seen within 1 – 6 months following SNN, the effect size difference from pre-SNN was $r = 0.46$ for pain drawing versus $r = 0.00$ for pain intensity rating. Collectively, these data support the use of the pain drawing as a reliable outcome measure among patients with cancer pain for procedures such as SNN that target specific location and dispersion of pain.

Key words: Cancer pain, pain drawing, splanchnic block

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Pain associated with cancer is prevalent in approximately 60% of patients on anticancer treatment or with advanced disease (1). Up to 40% of patients have pain that may be undertreated (2). Although the incidence of many cancers is stable or declining, the incidence of pancreatic cancer is increasing (3). Seventy-five percent of patients with pancreatic cancer have pain upon diagnosis, and over 90% have pain in advanced stages, with abdominal pain being a chief symptom (4).

Splanchnic nerve neurolysis (SNN) selectively disrupts nerve pathways that travel through the celiac plexus and is used to manage cancer-related supraumbilical abdominal pain and back pain with a shared etiology. These locations of pain often occur with pancreatic, gastric, esophageal, biliary, hepatic, small intestine, and portions of the large intestine cancers in addition to metastatic disease to the upper abdomen (5).

Using pain intensity score as the primary outcome, a Cochrane review of 6 studies reported a modest decrease in pain after celiac plexus neurolysis (CPN) yet noted that CPN produced less adverse effects than opioid medication (6-7). Another study among patients with supraumbilical pain from mixed cancer diagnoses found improvement in pain intensity one month after

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SNN (8). Improvement was not associated with a reduction of opioid use (7-8).

Reliance on pain intensity can result in miscommunication between the physician and patients and may adversely affect treatment (2). Pain drawings that describe pain location and dispersion are an important complement to other defining features of pain (intensity and quality) (9-11). Pain drawings may be particularly useful for evaluating the effectiveness of a procedure that targets a specific location, thereby reducing the possible confounding impact of general malaise or body pain in places other than the targeted location.

When a standardized method [penalty point system (12), visual inspection (13), body region documentation (14), grid method (15), automated computer scoring of either spatial-anatomical distribution (16-17), or number of pixels assigned to each pain sensation (18)] is used for scoring pain drawings, data can be quantified and assessed to determine psychometric properties of pain drawings. Inter-rater reliability for the body region scoring method has been reported using the intra-class correlation coefficient (ICC = 0.925) (14), yet has not yet been assessed for the grid scoring method. Regardless of the scoring method used, test-retest repeatability and intra-rater reliability have been demonstrated most often among patients with low back pain (19). A low, yet still significant, correlation (0.28) has been found between pain drawings and ratings of pain intensity (20). This finding is suggestive of validity as both indicators of pain inform part of the pain experience with some overlap. The usefulness of pain drawings has been demonstrated by their role in clinical decision-making (21). Specifically, in patients with low back and/or radicular pain, pain drawings helped determine disc pathology which was associated with good surgical treatment outcomes.

Given the existing evidence of psychometric support, it was our expectation that pain drawings scored with the grid method would yield reliable data (inter-rater agreement) for the current investigation of the effectiveness of SNN to reduce supraumbilical and possible shared pain pathway back pain among patients with cancer.

METHODS

Inclusion and Exclusion Criteria

A chart review of operating and procedure room schedules was conducted to identify patients who had SNN from July 15, 2007, to July 14, 2010. A HIPAA

compliant database of 99 patients was created on Filemaker Pro version 9 (22). Of that database, 35 patients were excluded due to missing pain drawings, 3 were excluded because their diagnosis did not fit our cancer diagnosis criterion, and one was excluded because of invalid data. A total of 60 patients had pain drawings at pre-SNN and within one month following SNN. Thirteen of those patients had an additional pain drawing at 1 – 6 months following their SNN.

Technique

SNN was performed with patients in the prone position. Fluoroscopic guidance was used to identify the T12 or L1 vertebral bodies. The skin overlying these regions was then anesthetized with lidocaine. Using an oblique approach, 22 gauge spinal needles were inserted bilaterally and guided laterally along either the T12 or L1 vertebral bodies until the needle tips were situated at the anterolateral margin of the respective vertebral bodies. Following confirmation of needle position with contrast injection, a test dose of ~10 mL of 2% chlorprocaine was injected through each needle. After the motor function of the lower extremities was assessed and determined to be intact, approximately 8 mL of either 6% phenol or 98% alcohol was slowly injected through each needle.

Demographic and Illness Variables

The patients (30 women; 30 men) had an average and median age of 59 (SD = 10.24 years; range = 27 – 77 years). All patients in this study had active cancer, with 73% of patients having been treated with chemotherapy and 35% having been treated by radiotherapy. Half of the sample had a primary pancreatic cancer, with others having different primary gastrointestinal cancers or metastatic disease to the abdominal area.

Prior to the SNN, 56 of the 60 patients in the sample had complete records of their daily dose of opioids. Of those 56, 96% of patients were on opioid therapy. The median morphine equivalent daily dose (MEDD) prior to SNN was 180.00, (M = 237.88 mg; SD = 227.22; range = 0.00 – 1020.00). Within one month after the SNN, 52 of the 60 patients had accurate records of their daily dose of opioids. Of those 52, 90% were on opioid therapy. The median MEDD after SNN was 120.00 mg (M = 188.59; SD = 195.53; range = 0.00 – 900.00).

Study Measures

Upon arrival to the MD Anderson Cancer Center Pain Management Clinic at the different time points

(pre-SNN, which was the same day as SNN; within one month after the SNN at the time of a follow-up clinic appointment; and between one and 6 months after the SNN at the time of a follow-up clinic appointment), patients shaded in areas of pain on a pain drawing, provided opioid use information, and also provided usual (in past week) 11-point (range 0 – 10, where 0 = no pain and 10 = worst imaginable pain) intensity ratings on the Brief Pain Inventory (23).

The grid method based on Gatchel and colleagues' work (15,24) was used for scoring pain drawings in this study, the only difference being that our grid did not extend out of the body. Also, due to the usage of a different pain drawing, there was a square for each hallux as opposed to a single square for both the halluces. For scoring, a transparency consisting of a body grid of 108 squares on the anterior view and 108 squares on the posterior view was overlaid on the computer screen showing the pain drawing.

Consensus of 3 physicians, who are board certified in pain medicine, identified a total of 10 squares on the pain drawings relating directly to the areas targeted by SNN. These 10 squares were labeled on the grid template and were used to calculate the targeted pain drawing scores that were used in this study (Fig. 1). Each pain drawing in the electronic medical record was enlarged to match the body outline on the transparency. All marked squares were counted regardless of how small the mark was. Boxes with a marking were labeled with a 1, and those without a marking were labeled with a 0. Circles were treated as if the entire circle was filled in. Xs were treated like typical shading with all boxes containing part of the X mark counted. Obvious markings used to only emphasize pain were disregarded. The targeted grid score was the sum of number of grids marked.

Each pain drawing was independently scored by 2 second-year medical students who had been closely su-

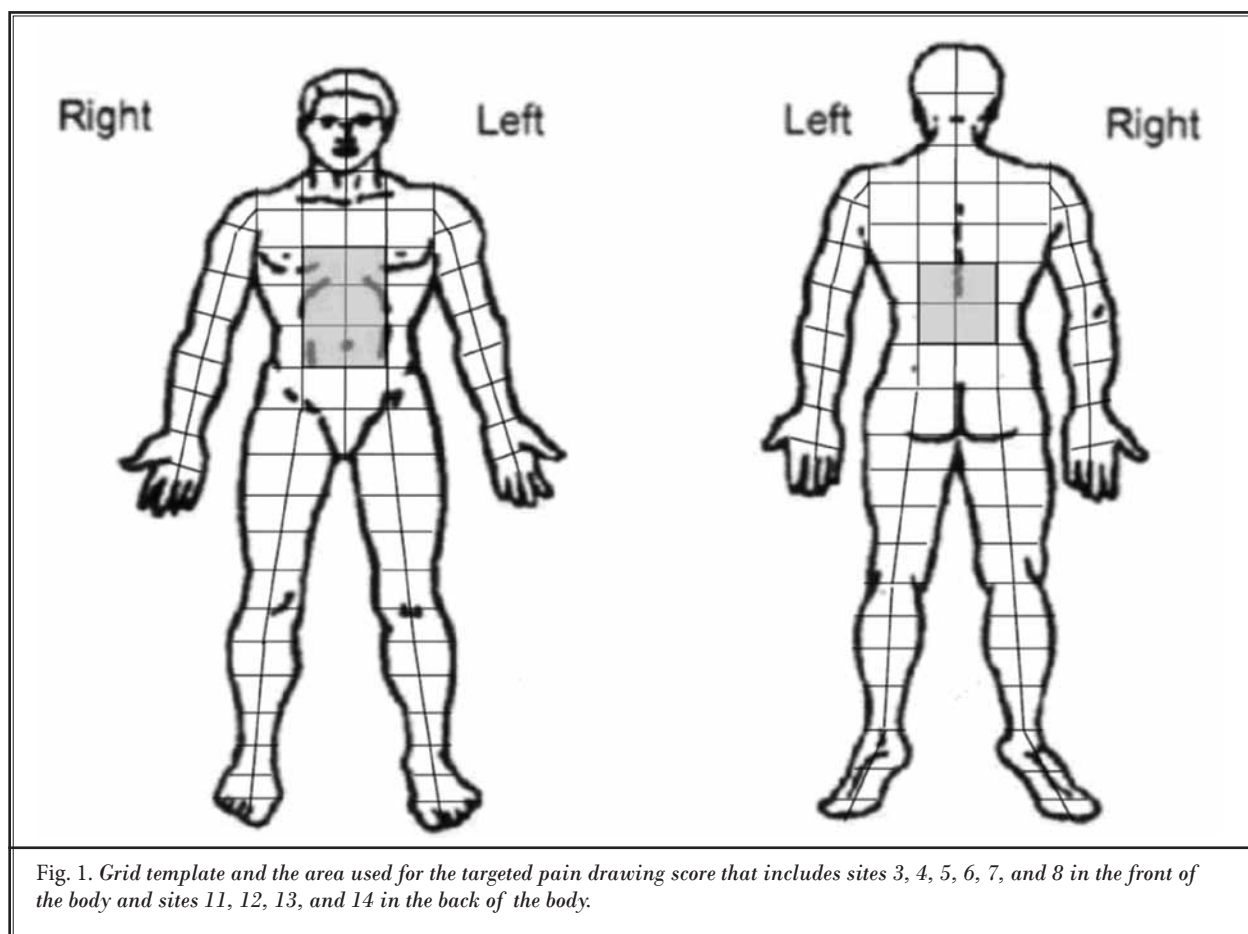


Fig. 1. Grid template and the area used for the targeted pain drawing score that includes sites 3, 4, 5, 6, 7, and 8 in the front of the body and sites 11, 12, 13, and 14 in the back of the body.

Table 1. Percentage pain dispersion reduction from pre- to post-SNN. Pain dispersion reduction within one month post-SNN.

Percentage range	Front region of targeted area (N = 60)	Back region of targeted area (N = 60)	Total targeted area (N = 60)
< 0%	14 (23.33%)	9 (15%)	12 (20%)
0 – 9%	12 (20%)	22 (36.67%)	9 (15%)
10 – 19%	1 (1.67%)	0	2 (3.33%)
20 – 29%	5 (8.33%)	2 (3.33%)	8 (13.33)
30 – 39%	4 (6.67%)	0	5 (8.33%)
≥ 40%	24 (40%)	27 (45%)	24 (40%)

Table 2. Pain dispersion reduction within 1 – 6 month post-SNN.

Percentage range	Front region of targeted area (N = 13)	Back region of targeted area (N = 13)	Total targeted area (N = 13)
< 0%	2 (15.38%)	3 (23.08%)	2 (15.38)
0 – 9%	0	7 (53.85)	0
10 – 19%	0	0	0
20 – 29%	1 (7.69%)	0	1 (7.69%)
30 – 39%	2 (15.38%)	0	1 (7.69%)
> 40%	8 (61.54%)	3 (23.08%)	9 (69.23%)
Missing	47	47	47

pervised and trained to use the grid method of scoring pain drawings by pain medicine faculty and fellows. Any discrepancies in the independent scorings were marked and re-evaluated until a consensus was reached.

Statistical Analysis

ICC was used to determine the inter-rater agreement for the 2 medical students on the pain drawings. Descriptive statistics on targeted pain drawing scores and pain intensity ratings at the 3 time points are in Tables 1 and 2. Wilcoxon signed rank test and associated effect sizes were used to evaluate the difference between pre- and post-SNN targeted pain drawing scores. Statistical software SAS 9.3 (SAS, Cary, NC) and S-Plus 8.2 (TIBCO Software Inc., Palo Alto, CA) were used for all statistical analysis (25,26).

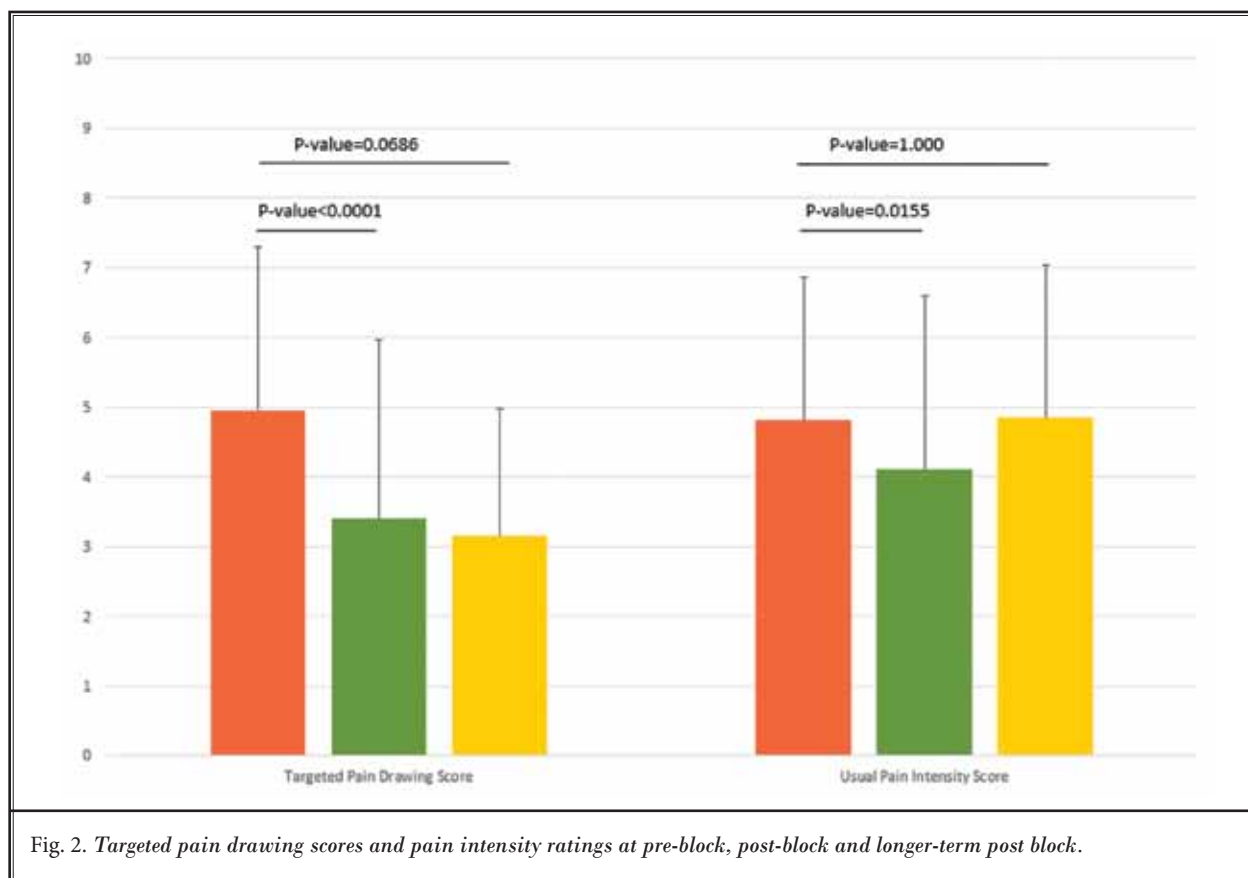
RESULTS

Based on the 60 pre-SNN targeted pain drawing scores, the 2 raters had agreement on 44 (73.3%) of their independent ratings. Of the 16 disagreements, there were only 2 instances in which the raters' scores differed by more than one pain square. The maximum amount of disparity between the 2 raters for a given patient was 2 pain squares. Rater 1 gave a higher score

than Rater 2 in 14 out of the 16 cases where there were different scores. ICC was 0.97.

Based on the 60 post-SNN targeted pain drawing scores, the 2 raters had agreement on 51 (85%) of their independent ratings. Of the 9 disagreements, there were 3 instances in which the raters' scores differed by more than one pain square. The maximum amount of disparity between the 2 raters for a given patient was 2 pain squares. Rater 1 gave a higher score than Rater 2 in 8 out of the 9 cases where there were different scores. ICC was 0.98.

The targeted pain drawing scores and the usual pain intensity ratings at pre-block, post-block, and long-term post-block are described in Fig. 2. The Wilcoxon signed rank associated effect size for the difference between the pre- and one month post-SNN targeted pain drawing scores (pre-SNN median = 5, mean = 4.95, range = 1 – 10; within one month post-SNN median = 3.5, mean = 3.40, range = 0 – 9) was $r = 0.42$. The effect size for the difference between pre- and within 1 – 6 month post-SNN targeted pain drawing scores (1 – 6 month post SNN median = 3, mean = 3.15, range = 0 – 6) was $r = 0.46$. The effect sizes for the pain drawings pre- to post-SNN differences were higher than those for usual pain intensity. Specifically, the effect size for



the difference between pre- to within one month post-SNN pain intensity ratings (pre-SNN median = 5, mean = 4.81, range = 2 – 10; one month post-SNN median = 4, mean = 4.10, range = 0 – 10) was $r = 0.23$ and the effect size for difference between pre- to 1 – 6 month post-SNN pain intensity ratings (1 – 6 month post SNN median = 5, mean = 4.75, range = 1 – 8) was $r = 0.00$. The percentage breakdown of patients who had decreased dispersion in the targeted area of pain following SNN is in Table 1 and 2.

Discussion

The patients in our sample had supraumbilical abdominal and referred back pain as the result of pancreatic or gastrointestinal primary cancer or metastatic disease to the abdominal region. Their cancer was active, and the large majority had been treated with chemotherapy and radiation therapy. Almost all of the patients were on high dose opioid therapy at the time of the SNN and continued opioid use after SNN. Other studies have demonstrated improvement in pain intensity ratings following SNN. What had not been

investigated previously was the extent of improvement in a specific location and dispersion of the pain that is targeted by SNN. To do this, we used the pain drawing as an outcome indicator.

Before evaluating the effectiveness of SNN on specific pain location and dispersion, we assessed psychometric properties of an outcome measure, namely the pain drawing score at a specific target: the supraumbilical and corresponding back region of the body. The literature provided psychometric support for reliably using pain drawings on patients who have low back pain. The psychometric evidence found in previous studies (14,19) generalized to the grid method of scoring the pain drawing and to our sample of patients with supraumbilical cancer-related pain. Specifically, we expected and found high inter-rater agreement for targeted pain drawings.

We also observed stylistic differences between our raters, with one rater scoring patients' markings on the pain drawing slightly higher than the other rater. Although our training clearly took the position that any marking on the grid would require a score, we learned

that the light and angle that the drawing was scored impacted the rating. Most previous studies have used non-professional raters (11,13,27), whereas both of our raters were second year medical students. Stylistic differences between professionals and non-professionals and differences among disciplines are not well understood. Future psychometric studies on the pain drawing could address these potential issues as well as investigation of validity coefficients. Although other studies had reported the correlation of pain drawing scores with pain intensity ratings (20,21), we did not investigate this relation because our pain drawing scores were based on a specific region of the body, whereas pain intensity ratings were based on the whole body. Should future studies of psychometric properties of the pain drawings be done, it would be very useful to understand the overlap between targeted pain drawing scores and targeted pain intensity ratings. Some degree of overlap would be evidence of validity for both measures.

Previous studies had demonstrated the effectiveness of SNN for reducing pain intensity among patients with pain from pancreatic cancers (4-6,8). Using pain intensity ratings as an outcome of a targeted block like SNN has the limitation of being potentially confounded by multiple locations of pain and by overall feelings of malaise that are commonly experienced by patients with chronic and cancer-related pain. The extent of reduction of targeted pain dispersion following SNN had not been investigated prior to this study. Our findings showed 80% of patients had some reduction in the targeted dispersion of pain following SNN. The effect size for reduction of pain dispersion following SNN was larger than the effect size for reduction in

pain intensity. Although based on only 13 patients, our assessment of pre-block to 1 – 6 month post-SNN approached significance, whereas usual pain intensity ratings improvements were not discernable. Given the subjectivity of indicators of pain intensity and dispersion, it appears useful to include both of them for investigating procedures such as SNN. An additional suggestion is to have patients rate their pain intensity on the different regions of the pain drawing. This strategy would afford investigation of a targeted dispersion of pain along with pain intensity of the specific region.

Pain drawings have previously demonstrated their role in predicting surgical treatment outcomes in the context of low back pain and lumbosacral radiculopathy (21,28). The current study is unique because it is the first to use pain drawings in evaluating the effectiveness of interventional pain procedures. Specifically, it evaluated the effectiveness of SNN for cancer-related abdominal and back pain. The utility of pain diagrams as an assessment tool for supraumbilical pain lends support for the generalizability of the process for additional parts of the body. Together, this work provides a significant advancement to the pain literature, and clinical effectiveness studies in particular, since almost all previous pain studies have relied on patient-reported global pain scores. This process has numerous confounds, namely the lack of site specificity for the pain and the ability of generalized malaise to alter total pain scores. We argue that the inclusion of pain drawings and site-specific pain ratings are an important technical advancement that should be considered in future effectiveness studies in the pain field.

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