ACUTE PAIN SECTION

Original Research Article
Judging Pain Sensitivity with Subcutaneous Lidocaine Injections

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Abstract

Objective. Pain perception is affected by psychological, social, medical, and environmental conditions, and contributes to the patient's treatment satisfaction and response. Better understanding of pain perception will likely improve pain assessment and treatment selection. The objective of this study was to define a range of verbal and nonverbal pain responses to a clinical stimulus in a clinical population.

Design. Subjects were 165 patients with chronic pain conditions. The patients were scheduled for elective interventional pain procedures on the lumbar spine including lumbar interlaminar epidural steroid injections, lumbar transforaminal steroid injections, lumbar facet injections, lumbar medial branch nerve blocks, radiofrequency ablation of lumbar medial branch nerves, and lumbar discography.

Intervention. Prior to the procedure, subjects rated anxiety on a numerical rating scale (NRS) from 0 (no anxiety) to 3 (extreme anxiety), and received standardized subcutaneous injections of lidocaine (using 25-G needle to infiltrate 2 cc 1% lidocaine) as local anesthesia. Following the lidocaine injection, pain was rated on an NRS scale. Body movement detected during the injection was rated by an independent observer and recorded as none, less than 1 in., and more than 1 in. Body movement was defined as torso moving away from original prone position.

Results. Patients were 37% men and 63% women, with average age of 53 years. The range of pain intensity responses fell within a normal curve ($P < 0.01$), with average pain intensity of 4.9 (standard deviation = 2.7). Patients with more body movement reported higher pain ($P < 0.01$). Anxiety predicted pain intensity ratings ($P < 0.01$). Use of opioids did not predict pain intensity, body movement, or anxiety.

Conclusion. This study shows normal distribution of verbal pain response to a clinical pain stimulus in a clinical population. Body movement and anxiety correlated with verbal pain intensity ratings. Subcutaneous injections of lidocaine may be a useful model for exploration of pain sensitivity in a clinical population.

Key Words. Chronic Pain; Pain Sensitivity; Pain Intensity; Painful Clinical Stimulus; Behavioral Movement

Introduction

Pain perception is subjective and affected by various factors involving psychological, social, medical, and environmental conditions [1]. The patient's perception and judgment of pain often influences decisions about when to seek treatment, the acceptability of diagnostic and treatment modalities, treatment response and treatment satisfaction. In order to provide an accurate assessment of pain and appropriate treatment, it is imperative for physicians to understand the patient's pain perception [2]. While we agree on the importance of assessment of pain

perception, there's no accepted objective method of obtaining information regarding pain sensitivity in the practice of pain management.

Providers are required to make complex decisions about the pain perception described by the patient. A model of pain judgment recently proposed by Tait and colleagues [3] posits that providers receive clues from a variety of sources (e.g., patient presentation, race/ethnicity, gender, mood, medical evidence) to arrive at symptom certainty. Symptom certainty is the degree to which reported symptoms result in straightforward clinical decisions, even in the presence of a complex clinical condition. When providers are less certain about the patient's report of symptoms, clinical decision-making is more ambiguous and patients may be vulnerable to undertreatment. [3] Research shows that physicians prefer objective information (e.g., conclusive diagnostic tests) in decision-making over the absence of detailed information [4].

One source of information that may contribute to a provider's sense of symptom certainty is a judgment of the patient's sensitivity to pain. The study of pain sensitivity is described as a critical step in the prevention, evaluation, and treatment of chronic pain. Individual differences in pain sensitivity may be related to the type of stimulus given, heritability, and/or environmental effects [5]. Pain sensitivity is generally studied in experimental settings with healthy volunteers [6]. Few studies have used a clinical stimulus in a clinical population to assess pain sensitivity. The purpose of this study was to describe the range of pain responses to subcutaneous lidocaine injections in patients with low back pain and to determine the association with anxiety and body movement.

Methods

The study was approved by our hospital's Institutional Review Board, Division of Human Subjects Protection. Participants were recruited using a convenience sample of patients in an outpatient pain center associated with a large urban medical school. Subjects were patients scheduled for an elective lumbar spine injection procedure their lower back pain and lower extremity pain. Participants had to be at least 18 years old with pain duration of greater than 6 months, and have the ability to give verbal consent. Subjects were excluded if they had an active infection at site of injection, known hypersensitivity to lidocaine, were pregnant, and/or were unable to rate pain intensity due to cognitive impairment.

Prior to their scheduled procedure, demographic information and appropriate consent were obtained. Participants' age, gender, race, employment status, intake of pain medications, comorbidities, and smoking and drinking habits were obtained through a self-report questionnaire. While in the holding area, subjects were asked to rate their anxiety level using a 4-point numerical rating scale (NRS, 0–3) ranging from calm to extremely anxious. No preoperative medications were administered prior to lidocaine injection.

Patients were shown how to report pain intensity using an NRS (0–10) with anchors at zero ("no pain") and 10 ("the worst pain imaginable"). They were informed that they would be asked to rate the pain of the lidocaine injection immediately following the injection. Prior to their injection, standard monitors were attached including blood pressure, a pulse oximeter, and an electrocardiogram. Patients were placed in a prone position for the procedure then instructed about the needle insertion and local anesthetic injection, which was described as a "pinch and burn" sensation. The lumbar area was prepped and draped in sterile fashion. Skin and subcutaneous tissue were infiltrated with 1% lidocaine as local anesthesia for the procedures. The injections were standardized with infiltrating 2 cc 1% lidocaine using a 25-G needle over a period of 2 minutes. To control variability, only one investigator, who was not involved in the injection procedure, was designated to watch each subject closely for any movement. Body movement was defined as the torso moving away from the original prone position. Body movement detected during the injection was recorded as none, less than 1 in., and more than 1 in. After the injections, patients were asked to rate pain intensity from 0–10 using the NRS. There was no deviation from standard of care, except for the patients' verbalization of the amount of pain experienced.

Subjects

Subjects were 165 patients with chronic pain conditions scheduled for an elective interventional pain procedure on the lumbar spine. The average age of the participants was 52 years (range 23–87). Sixty-three percent (63%) were women and 37% were men. Forty-seven percent (47%) were employed, while 39% were unemployed and 14% were disabled. Participants were Caucasian (62%), African American (30%), Hispanic (5%), Asian (2%), and other (1%). Daily opioid doses were converted using the equianalgesic opioid conversion chart in Table 1. Equianalgesic opioid doses were divided into categories consistent with Cohen et al.'s [7] groupings. Percentages of the sample falling into these groups is shown in Table 2.

Table 1 Opioid equianalgesic table

Medication	Equianalgesic PO Dose
Morphine	30 mg
Oxycodone	20 mg
Hydromorphone	6 mg
Meperidine	300 mg
Methadone	4 mg
Oxymorphone	10 mg
Hydrocodone	30 mg
Codeine	200 mg
Propoxyphene	200 mg
Transdermal Fentanyl	12.5 mcg/h

PO = per os.

Table 2 Scaled conversion of daily opioid dose

Oral Morphine Equivalents (mg/d)	Percent of Sample
0	40.6
1–29	26.7
30–89	20.1
90–179	4.2
180–299	6.7
≥399	1.8

Results

Patients were 37% men and 63% women, with an average age of 53 years. The average pain intensity rating following subcutaneous injection was 4.9 (standard deviation = 2.7). A one-sample Kolmogorov–Smirnov test found that the distribution of pain intensity in the sample was normal (Z = 1.842. $P < 0.01$). A graph of the distribution is shown in Figure 1.

Bivariate Pearson product moment correlations were computed for pain intensity and morphine equivalence, as well as for gender and race, as both of these variables have been associated with increased sensitivity to pain [8]. None of these variables were significantly correlated. Twenty-two percent (22%) of participants took opioid medication prior to the procedure. No significant differences in bivariate correlations of the variables listed above were found for this subset of participants.

Regression analyses were conducted to answer the question of whether ratings of anxiety and body movement predicted pain intensity perception. Anxiety and body movement were entered into the model in a stepwise fashion. Results revealed that both movement and anxiety ratings predicted pain intensity. Higher pain
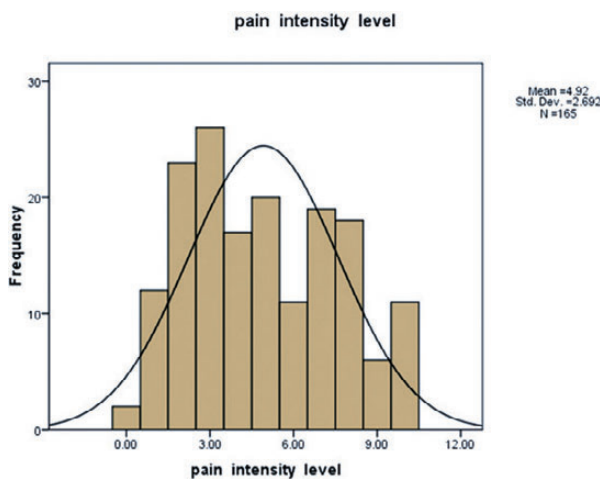
ratings were associated with greater body movement ($P \leq 0.01$, Figure 2) and higher ratings of anxiety prior to the procedure ($P \leq 0.01$, Figure 3). Thirteen percent (13%) of the variance in pain intensity was associated with body movement and an additional 18% was associated with anxiety.

Analysis of variance was used to test whether there were differences in pain intensity ratings for individuals who were taking opioids and those who were not. Individuals were divided up into three groups based on their morphine equivalence: no morphine (40.6% of the sample), morphine equivalence between 1 and 89 mg (46.7% of the sample), and morphine equivalence between 90 and greater than 300 (12.7% of the sample). Analysis of variance found no differences between these groups on pain intensity, anxiety, body movement, gender, or race.
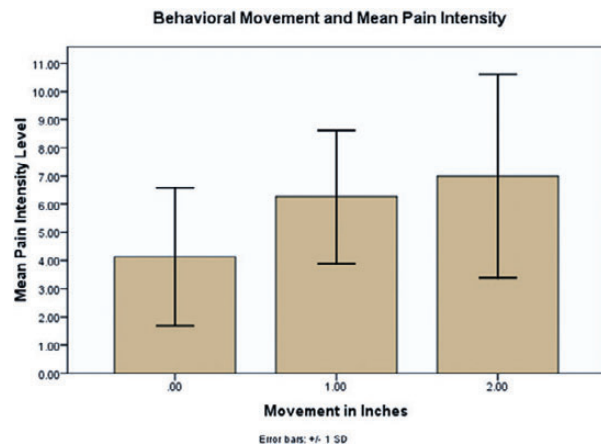
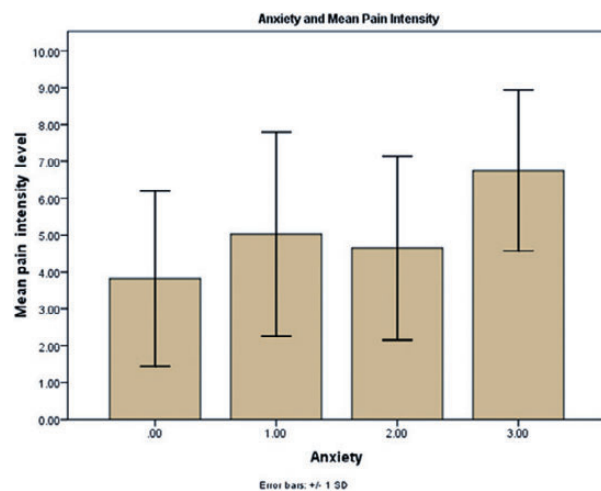

Figure 2 Behavioral movement and mean pain intensity.

Figure 1 Distribution of pain intensity ratings.

Figure 3 Anxiety and mean pain intensity.

Discussion

A limited number of studies have investigated pain sensitivity in patients with chronic low back pain (CLBP). Giesecke et al. [9] applied an experimental pain stimulus to a neutral site (thumbnail) to assess pressure-pain threshold in patients with CLBP and fibromyalgia. Compared with healthy controls, patients with CLBP or fibromyalgia experienced more pain and had more extensive neuronal activation in pain-related cortical areas during functional magnetic resonance imaging. The investigators describe these results as consistent with evidence of augmented central pain processing in patients with idiopathic CLBP.

Cohen et al. [7] used subcutaneous lidocaine injections as a clinical stimulus in patients with chronic pain taking opioid analgesics to study pain perception. They found that higher opioid doses, duration of treatment, and gender were positively correlated with ratings of pain intensity and unpleasantness. They proposed subcutaneous lidocaine injections as a potential model of a relevant clinical pain stimulus in a clinical population that could be used to study opioid-induced hyperalgesia.

We used a lidocaine injection as a clinical stimulus to assess pain sensitivity in patients with low back pain. Ratings of pain intensity were normally distributed in our study, with an average pain rating of 4.9 on a 0–10 NRS. Therefore, pain sensitivity may be normally distributed in this population. An alternative hypothesis is that individual differences may have accounted for the wide distribution of pain scores, as it is impossible to determine whether the same pathophysical conditions existed even for individuals with similar diagnoses. Experimental research on pain would argue for the latter explanation, as these experiments are precisely controlled and wide variations of pain ratings are found between and within various chronic, acute, and experimental conditions [5].

Individual differences in pain sensitivity have been found for individuals of different ethnicities in pain range (tolerance threshold) for heat, cold, and ischemic pain [7]. Woodrow et al. [10] examined race differences in pain tolerance to mechanical pressure. Their study showed that Caucasians have the highest pain tolerance, African Americans the second highest, and Asian Americans the lowest. Gender differences were found following lidocaine injection for individuals with low back pain [7]. In a study on morphine requirements for postoperative pain, it was found that female patients had higher pain scores and morphine requirements [11]. Additionally, Maffiuletti et al. [12] observed that sensory threshold was lower in women than in men after electrical stimulation.

Contrary to these findings, we did not find differences in pain sensitivity for ethnicity or gender in this study. The absence of significance for gender or ethnicity could have been due to a variety of factors. One of the factors may be that we did not measure pain range in an experimental fashion and perhaps would have found differences had tolerance and threshold been tested.

Pain intensity ratings in our study were predicted by higher anxiety and more body movement. The relationship between pain and anxiety are consistent with prior research on the association between higher anxiety and higher self-reported pain sensitivity [13]. Literature has shown that anxiety and depression are associated with higher pain levels [14]. Emotional responses of anxiety and depression have an impact on the overall pain experience and are important for an accurate assessment of pain, which provides the foundation of a successful treatment plan [15].

Our study showed that more body movement during the injection was associated with higher pain ratings. This result may be explained by the instinctual and natural response of the body to withdraw from the source of pain as an attempt to eliminate the noxious stimulus. Response to lidocaine injections, especially body movement, is a frequent clinical marker of pain sensitivity. Individuals who move significantly may be said to have "jumped off the table." Behavioral observation, including body movement, is an important tool for overall pain assessment. Although it is more formally used in nonverbal patients [16], it is informally used by pain physicians to assess and treat pain.

In this study, opioid dose did not correlate with pain intensity as described by Cohen et al. [7] in a study that used lidocaine injections as a standardized clinical stimulus for low back pain and compared patients on a steady regimen of opioids with a control group of volunteers who took no analgesics. We feel this discrepancy might be due to the fact that our study was designed to determine whether pain intensity after lidociaine injections was normally distributed in patients with low back pain. Therefore, we used a cross-sectional design vs a control group design. Additionally, most of the patients recruited for our study only took minimal amount of opioid medication.

There were other limitations to this study. The baseline pain information and a record of whether participants had previous injections were not collected. These factors could have influenced pain and anxiety ratings. Although these data may have added clinical information, we were more interested in the rating of the pain for the acute affect of the lidocaine injection in this specific patient population. We did not collect information on participants' use of non-opioid analgesics, which could have introduced variability in pain ratings. However, the acute affect of the injection would have been expected to be felt over and above stable long-term doses of non-opioid analgesics. Future studies could take these factors into consideration in study design. The findings of our study are important in the documentation of clinical phenomena observed by clinicians.

Recent literature shows the importance of studying pain sensitivity both empirically and clinically. Accurate

assessment of pain and knowledge of pain sensitivity is critical in making appropriate diagnoses and choosing treatment. Pain sensitivity can also potentially confound clinical trials [5]. Quantitative sensory testing (QST), a psychophysical method of determining thresholds or stimulus response curves for sensory processing under normal or pathological conditions, has been proposed to understand pain sensitivity in clinical populations and aid in clinical tasks, such as drug profiling [6]. However, QST has primarily been applied in neuropathic pain conditions. It also requires significant training, expenditure and expertise to deliver [13].

Understanding pain sensitivity is important for appropriate diagnosis and treatment in chronic pain. We demonstrated a normal distribution in pain response in a clinical population to subcutaneous lidocaine injections. Therefore, subcutaneous lidocaine injections may be a reasonable clinical stimulus that can be used in a clinical population to answer questions about pain sensitivity. Future research should focus on determining whether subcutaneous lidocaine injections can be a useful tool in exploring opioid-induced hyperalgesia, as suggested by Cohen et al. [7], and in measuring pain sensitivity in patients with low back pain. Future research should also focus on the clinical relevance of using this methodology to understand the patient's pain perception so that we can more accurately predict the patient's response and tailor interventions.

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