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Prolongation of Lumbar Facet Joint Nerve Block Duration with 10% Lidocaine Neurolysis: A Retrospective Cohort Study

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Background: Neural blockade of the facet medial branch/L5 dorsal rami with local anesthetic with or without corticosteroid has been used to both diagnose and treat low back pain. Higher concentration lidocaine has been shown to be neurolytic in multiple in vivo, in vitro, and some clinical studies. This may make 10% lidocaine a possible neurolytic agent to prolong pain relief from facet blocks.

Objective: Compare neurolytic effects of 10% lidocaine to prolong pain relief compared to bupivacaine/methylprednisolone (BM) in facet medial branch/L5 dorsal rami blocks (MBB).

Methods: Retrospective review of 77 patients who received a 10% lidocaine MBB from after short term relief from MBB with BM. Comparison was made in visual analog scale (VAS) and duration of relief using Wilcoxon signed rank matched pairs test.

Results: There was no significant difference between baseline median VAS prior to MBB with BM and 10% lidocaine and median days VAS recorded post each MBB ((*P* = 0.477). Median VAS immediately after BM MBB (17.5 mm) was not significantly different than after 10% Lidocaine MBB) of 18 mm (*P* = 0.341). Median duration of relief with 10% lidocaine was greater at 14 days versus BM at 3.5 days (*P* = 0.001). There was no significant correlation between the volume of 10% lidocaine at each level and performance measures: % change VAS post lidocaine MBB (*P*= 0.529), duration lidocaine MBB (*P* = 935), VAS pre-RFTC (*P* = 0.683).

Limitation: Retrospective, small study.

Conclusion: Ten percent lidocaine was moderately effective neurolytic agent with longer duration than BM.

Key words: Lidocaine, facet joint, neurolysis, low back pain

Low back pain is a common ailment with one month prevalence of 23.2% and can become chronic in 65% of those patients at one year (1,2). The facet joints have been recognized as a common source of low back pain (3-7). Even with the advent of diagnostic imaging, delineating the source of pain has been shown to be difficult given the high rates of false-positive findings seen in plain-view radiography (X-rays), computed tomography (CT), magnetic resonance imaging (MRI), bone scans, and single photon computed tomography (SPECT) imaging (8-11). Physical examination has not proven to be a reliable tool for diagnosis either (12). Neural blockade of the medial branches of the dorsal rami innervating the facet joints has been used for diagnostic purposes in multiple studies (3-5,13-16). Some studies have reported the therapeutic value of facet medial branch/L5 dorsal ramus block (MBB) with pain relief beyond the duration expected from local anesthetic with or without corticosteroids (3-5,13-16). There has been a general consensus that 2 diagnostic MBB should be performed to decrease the rate of false positives (3-5). Those patients with short-term relief with diagnostic blockade typically proceeded to radiofrequency thermocoagulation (RFTC) to achieve long-term pain relief although a significant percentage

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of patients may not respond to ablation therapy despite positive response to diagnostic blockade (17-20). Typical local anesthetics used for MBB include lidocaine and bupivacaine with mean duration of action lasting 2 to 8 hours, respectively. The addition of corticosteroid to the injectate has the theoretical advantage of inhibition of C-fiber transmission and therefore may prolong blockade, but not without the typical side effects of corticosteroids (21). Lidocaine has been shown to be neurotoxic in multiple in vitro (cell) and in vivo (animal) studies (22-34). Ready et al (25) reported persistent neurological deficit and major histological changes starting at 8% concentration when injected intrathecally in rabbits, but not below this concentration. Literature on clinical use of higher concentration lidocaine for chronic pain was limited to a few small case series. Choi et al (35) reported 3 cases of patients who had several months of pain relief with peripheral nerve blocks using 5% lidocaine with 7.5% dextrose. Their study was problematic given the concentration used was less than the 8% concentration seen in the animal study by Ready et al (25). In humans, lower concentration 5% lidocaine did not show consistent neurolytic effect in the context of transient neurologic symptoms (TNS) in spinal anesthesia (36-37). The author presented histologic evidence of the neurolytic effect of perineural injections of 10% lidocaine in a canine sciatic nerve with no accompanying gross changes in the surrounding muscle and connective tissue (38). The same author demonstrated prolonged headache relief with blockades using 10% lidocaine versus 0.5% bupivacaine/methylprednisolone (BM) of the greater occipital nerve (39). Han et al (40) also demonstrated the neurolytic effects of 10% lidocaine with pain relief of up to 172 days after blockade of the trigeminal nerve. Lee reported an abstract case series of 25 patients with a variety of neuropathic pain, including postherpetic neuralgia, trigeminal neuralgia, and post-operative neuralgia, receiving pain relief for 4 weeks to 6 months with 10% lidocaine (41). Our present study tests the hypothesis that lidocaine greater than 8% concentration can be an alternative neurolytic agent in the prolongation of low back pain relief for short term responders to MBB performed with standard BM blocking agent in a retrospective study.

METHODS

After Institutional Review Board (IRB) at Henry Ford Hospital (Detroit, MI) approval, a retrospective chart review was performed on all patients at Henry Ford Hospital Pain Clinic, Columbus Center (Novi, MI) who received 10% lidocaine MBB from January 2015 to December 2016. It had been a general practice in our pain clinic to perform lumbar MBB with 10% lidocaine if patient had relief of at least 8 hours of ≥ 50% decrease in visual analog score (VAS) with the first MBB using BM. All patients were at least 18 years old with greater than 3 months of low back that did not radiate below the knee and positive MRI or CT imaging for facet arthropathy without evidence of significant stenosis. Physical exam findings were positive for pain reproduction with extension/lateral bending, negative for any neurologic deficits, and negative straight leg raise sign. The levels to be injected were determined after correlation with imaging and physical exam findings. The MBB were performed after obtaining informed consent and using standard technique: fluoroscopic guidance using a 22- or 25-gauge Quincke spinal needle, which was guided to the junction of the superior articular process and its pedicle/ transverse process. After confirmation of needle position on anterior/posterior (AP) and lateral view, 0.1 mL of isovue m-300 or gadolinium contrast dye was injected to confirm correct position. After which, each site was injected with 1 mL of a solution containing 9 mL of preservative free 0.5% bupivacaine and 40 mg methylprednisolone (4.5 mg bupivacaine/4mg methylprednisolone/level). Each patient had an intravenous (IV) line placed prior to the procedure and was given 1-2 mg of midazolam for sedation. The American Society of Anesthesiologists (ASA) standard monitoring for monitored anesthesia care was applied: pulse oximetry, heart rate, electrocardiogram (ECG), and carbon dioxide monitoring. The patients were then given pain diaries in order to monitor and record their pain every 2 hours for the first day, then once a day for the next 5 days. They would return for the second MBB at 1-2 months from the initial procedure. If they received at least 8 hours of pain relief ≥ 50% decrease in VAS, but less than 1 month, the same procedure was performed with 10% lidocaine. Of note, the patients were given the same amount of IV sedation for both BM and 10% lidocaine blocks to reduce any confounding factors. The preservative free 10% lidocaine was compounded by Health Dimensions Compounding Pharmacy (Farmington, MI). At the time of the second MBB, each patient was asked about the duration of pain relief ≥ 50% and their VAS at the moment of follow-up. The maximum total volume of 10% lidocaine that could be injected for the procedure was based on 80% of the maximum dose (4 mg/kg)

with the total volume divided evenly among the levels of MBB performed. The volume of 10% lidocaine used at each level, however, was limited to not exceed 1 mL at each level to decrease the chance of spreading to surrounding structures. The patients were asked to notify the performing physician if they noted any signs of local anesthetic toxicity. The patients were given pain diaries as before and returned for follow-up in 1-2 months for possible RFTC. As before, patients were asked about the duration of pain relief ≥ 50% and their VAS at the moment of follow-up. Demographic data including age, gender, number of levels performed, whether unilateral or bilateral, and volume of lidocaine at each level were recorded. Comparison were made between (VAS pre-BM MBB) versus (VAS pre-lidocaine MBB), (VAS post-BM MBB) versus (VAS post-lidocaine MBB) , (% change VAS post-BM MBB) versus (% change VAS post-lidocaine MBB), (duration BM MBB) versus (duration lidocaine MBB), (VAS pre-BM MBB) versus (VAS pre-RFTC), (days post- BM MBB that lidocaine performed) versus (days post lidocaine RFTC performed). Volume of lidocaine used at each level was correlated with (% change VAS post-lidocaine MBB), (duration lidocaine MBB), and (VAS post-lidocaine MBB). Matched-pairs signed-rank Wilcoxon test was used to assess the difference between the variables considered. The data was not normally distributed, which necessitated the use of a nonparametric test as well as nonparametric Spearman correction in the analysis.

RESULTS

During the 2-year time period of the study, a total of 352 patient had MBB performed. Of those, 188 did not have 50% relief, and 59 were lost to follow-up. Twenty-eight still had ≥ 50% relief on 1-2 months follow-up, so they did not receive confirmatory second MBBs. A total of 77 patients had < 1-2 months of relief therefore, they had 10% lidocaine MBB performed. Of the patients in the study, 56% were men, 44% women, and the median age was 64 (Table 1). 57.1% had unilateral blocks with median number of 3 levels performed and the median volume of 10% lidocaine used per level was 0.75 mL (Table 1). Median (VAS pre- BM MBB) was 70 mm (mean: 67.3/SD: 17) and median (VAS pre-lidocaine MBB) was 70 mm (mean: 66/SD: 16.8) with no significant difference between the baseline pain before each injection (*P* = 0.477) (Table 2). The median (days post-BM MBB lidocaine performed) of 30 (mean: 41.8/SD: 35.4) was marginally shorter than median (days post lidocaine RFTC performed), which was 38 (mean 59.8/SD: 60.2) (*P* =0.008). Median (VAS post BM MBB) was 17.5 (mean 18.8 /SD: 12.4 mm), which was not significantly different than median (VAS post Lidocaine MBB), which was 18 (mean: 21.6 /SD: 17.3 mm) (*P* = 0.341) (Table 2). Both groups had reported a decrease in VAS post blockade on follow-up with median (% change VAS post-BM MBB) of -77.1% (mean: -72.5/SD: 16.2) versus (% change VAS post-lidocaine MBB) of -75% (mean: 68.3/SD: 21.6) with no significant difference between both groups (*P* = -0.029) (Table 2). There was, however, significant greater mean duration of pain relief ≥ 50% reported by patients who received lidocaine MBB versus BM MBB. Median duration of relief with lidocaine was 14 days (mean: 28.9/SD: 40.1) versus duration of relief with

Table 1. Patient demographics.

Gender		Median Age	Location		Median Number of Levels	Median Volume per Level
Men	Women	64	Unilateral	Bilateral	3	0.75
56% (n = 43)	44% (n = 34)		57.1% (n = 44)	42.9% (n = 33)		

Table 2. Comparison of VAS, change in VAS, and duration of pain relief after MBB with BM versus 10% lidocaine.

	Median VAS (mm) (mean/SD)	Median Change VAS (%) (mean/SD)	Median Duration of Relief (Days) (mean/SD)
Pre-BM MBB	70 (67.3/SD = 17)		
Pre-Lidocaine MBB	70 (66/SD = 16.8)		
P-Value	0.477		
Post-BM MBB	17.5 (18.8/SD = 12.4)	-77.1 (-72.5/SD = 16.2)	3.5 (10.7/SD = 16.7)
Post-Lidocaine MBB	18 (21.6/SD = 17.3)	-75 (-68.3/SD = 21.6)	14 (28.9/SD = 40.1)
P-Value	0.341	0.029	0.001

BM MBB was 3.5 days (mean 10.7/SD: 16.7) (*P* = 0.001) (Table 2). There was no significant correlation between the volume of 10% lidocaine at each level and performance measures of blockade: % change VAS post lidocaine MBB (*P* = 0.529), duration lidocaine MBB (*P* = 0.935), VAS pre-RFTC (*P* = 0.683).

DISCUSSION

Duration Bupivacaine with or without Corticosteroid vs. 10% Lidocaine

Based on the limited literature, the duration of response to MBB appeared in some cases to be longer than expected with the procedure having both diagnostic and therapeutic effect. Manchikanti et al (15) published a randomized trial of patients who received either bupivacaine, bupivacaine with Sarapin (High Chemical Company, Levittown, PA), or bupivacaine with corticosteroid. The average duration was prolonged beyond what would be expected from local anesthetic /corticosteroid effect. The authors reported durations of 12.5 weeks in the bupivacaine nonsteroid group versus 14.8 weeks in the steroid group. Rocha et al (42) performed saline MBB and those who had no relief immediately underwent repeat block with 2% lidocaine. Of the 54 patients who responded to lidocaine and not saline with > 50% decrease in VAS, 36 (67%) maintained pain improvement after 3 months. Pampati et al (16) performed MBB first with 1% lidocaine and the second with 0.25% bupivacaine. No significant differences were noted with mean pain relief of 3.6 to 3.8 weeks with the first diagnostic block with lidocaine and of 5.9 to 6.9 weeks with confirmatory bupivacaine block. In the present study, the average duration of relief with bupivacaine was still longer than expected for just local anesthetic effect of 8 hours with median duration of 3.5 days (mean: 10.5). The mechanism of prolonged relief with local anesthetics had been speculated in multiple studies, including suppression of nociceptive discharge, axonal transport inhibition, sympathetic blockage, desensitization, and anti-inflammatory effects (43-48). This can also be seen in fact that the absolute VAS on follow-up after 10% lidocaine was significantly less than baseline VAS even after 1 month. The literature was mixed on the additive effect of corticosteroids as mentioned in the previously mentioned study by Manchikanti et al (13). Besides the obvious anti-inflammatory action, corticosteroids have been shown to directly inhibit C-fibers and GABA (21,49). The prospect of false positives has always challenged the veracity of diagnostic nerve blocks and is always a question mark especially in those who undergo a single block. Prevalence and false positivity rates with dual injections using ≥ 50% decrease in VAS has described in multiple studies with prevalence reported to be 15-61% and with false positive rates of 17-66% (15,50-54). In our study, 10% lidocaine MBB used had the disadvantage of being the second MBB, but the present study had a low false positive rate of only 5.1% (n = 4) received < 50% relief with 10% lidocaine. One limitation to this study is the nonstandard use of IV versed for sedation for both MBB performed with 10% lidocaine and BM. Manchikanti studied the effect of sedation with fentanyl or versed on diagnostic accuracy of MBB and found minimal effect when 80% relief was used as cut off for diagnosis. The effect of sedation became more significant when 50% reduction was used as diagnostic criteria as was used in the present study, however, both BM and 10% lidocaine groups were given sedation, which may decrease the effect sedation as a confounding factor (55-56).

Lidocaine as a Neurolytic Agent

Most animal studies used concentrations of 5% or less to study neurotoxicity since this is the most common clinically used concentration (23-34). Previous studies used direct intraneural injection, intrathecal injection, desheathed nerves, and cell cultures (23-34). Only Kalichman et al (23) injected lidocaine perineurally by piercing the connective tissue separating the neural tissue from overlying muscle rat sciatic nerves. They reported endoneurial edema, collapsed myelin sheaths, and axonal degeneration. However, this study used 3% lidocaine, a lower concentration than seen in previous studies. Although animal models had shown evidence of neurotoxicity at clinically used concentrations of 5% or less, evidence of neurotoxicity in humans at these concentrations appeared to be much less than expected and inconsistent . This had been well documented in the use intrathecal lidocaine for spinal anesthesia and the phenomenon of TNS. Keld et al (37) compared 5% lidocaine versus 0.5% bupivacaine and found lidocaine caused TNS in only 26% of patients. The reason only a small percentage of patients have transient neurologic deficits may be explained by the study by Ready et al (25) who reported prolonged neurologic deficit and profound histologic changes after intrathecal injection in rabbits

occurred only at lidocaine concentrations ≥ 8% which was compatible with the previously mentioned clinical experience in humans. Ten percent lidocaine in our study allowed local concentrations ≥ 8% despite the requirement to inject contrast beforehand to exclude vascular and neural uptake.

Duration of 10% Lidocaine vs. RFTC

RFTC has been performed to prolong pain relief after positive response from facet MBB. Civelek et al (57) reported pain relief in 90% of RFTC patients and 69% relief with facet MBB at 12 months. Dobrogowski et al (58) reported 60% RFTC patients with pain relief at 6 months. Son et al (59) reported a mean duration of 10.9 months of > 50% pain relief in 85% of patient. Previous clinical studies with higher concentration lidocaine were limited but did note prolongation of relief close to relief with RFTC although a direct comparison had not been performed. Choi et al (35) reported 3 cases of patients who had months of relief with peripheral nerve blocks of using 5% lidocaine with 7.5 dextrose. A previous study by Kim et al (38) demonstrated prolonged headache pain relief with greater occipital nerve blockade using 10% lidocaine versus BM (148.05 days versus 6.33 day). Han et al (40) also demonstrated the clinical neurolytic effects of 10% lidocaine with pain relief 3-172 days after blockade of the trigeminal nerve. Lee (41) reported a duration of relief of 4 weeks to 6 months. The duration of ≥ 50% pain relief with 10% lidocaine, although significantly longer than with BM, was less than the relief reported by previously mentioned studies on RFTC or previous 10% lidocaine studies. However, the absolute level of pain (VAS) after 10% lidocaine prior to RFTC was significantly less than baseline pain level prior to any treatment indicating continued prolongation of relief with 10% lidocaine although below the ≥ 50% pain reduction threshold. One explanation could be the anatomy and the difference in needle placement in RFTC versus MBB. The medial branch is covered by the mamillo-accessory ligament which runs from the mammillary process to the accessory process of vertebrae, which encloses the medial arch of the dorsal rami in an osseofibrous tunnel. RFTC is usually performed with the electrode slipping anteriorly allowing direct contact with the medial branch. The MBB is performed short of this target relying on local spread of local anesthetic. In the animal study by Kim et al (39), neurolysis was noted on direct perineural contact to the neural tissue. This direct contact may be easier in the blockade of other peripheral nerves blocked in the previously mentioned 10% lidocaine studies given the lesser amount of surrounding soft tissue and larger volumes of 10% lidocaine used. There is no data comparing lesion size between RFTC and MBB. Data concerning lesion size from neurolytics for MBB is limited to one study by Dreyfuss et al (60) who tracked contrast spread on fluoroscopy and CT scan after MBB and found consistent spread to the medial branch but the size of the spread was not quantified. The size of lesions from RFTC has been well studied by Cosman et al (61) and Provenzano et al (62). Cosman reported lesion size was dependent on tip gauge, tip length, temperature and duration. A typical 20-gauge, RTFC probe with 10 mm active tip was found to produce lesion 6.2 mm in width and 12 mm in length. Provenzano reported that lesion size can be increased by injecting lidocaine or saline.

Complications of 10% Lidocaine

Besides the known cardiac and central nervous system toxicity with lidocaine which was controlled in our study by dose and image guidance, review of literature did not indicate significant soft tissue injury with lidocaine unlike other neurolytic agents such as phenol and alcohol. Two case reports have been published in the ophthalmology literature with cases of ptosis and diplopia after lidocaine injection for retro-orbital nerve blocks causing what is presumed to be due to ocular muscle necrosis, but not proven by biopsy (63-64). Kim et al (38) in their canine sciatic nerve study reported no gross changes seen in surrounding soft tissue. There is also theoretical concern regarding the possible spread of a neurolytic agent in close proximity to exiting spinal nerve roots. To reduce the risk of any complications due to this cause, contrast was injected with fluoroscopic imaging to ensure lack of epidural and vascular uptake with limitation of volume at each level of 1 mL of 10% lidocaine. The limiting of the volume of the neurolytic agent further to standard 0.5 mL may help prevent any unwanted spread. Only one study by Dreyfuss et al (60) addressed the potential spread of injectate toward neural structures other than the target nerve. Their study injected 0.5 mL contrast for MBB in both cadavers and healthy volunteers at the

standard target site and slightly below the site and found spread toward neural structure occurred in 16% of all patients which our study did not see and such high rate of inadvertent neural blockade has not been reported in the literature. They did note one technical point that those patients who did have neural spread were injected in the traditional target area and those who did not were a slightly lower. On subsequent follow-up, they found the same patients who had neural spread did not have it on repeat block if the lower target area was used and bevel oriented down and medially. Our present study used volumes > 0.5 mL used in the study by Dreyfuss, which could degrade the diagnostic value of the MBB performed in our study with BM of 1 mL and 10% lidocaine median volume of 7.5 mL. Neither groups, however, reported clinical evidence of epidural spread. Since both groups received > 0.5 mL of volume, this may be less of a confounding factor.

CONCLUSION

Higher concentrations (10%) of lidocaine appears to be an moderately effective neurolytic agent in lumbar medial branch blocks for chronic low back pain due to lumbar facet arthopathy. The nerve blocks with 10% lidocaine increased he duration of pain relief from MBB when compared with 0.5% BM without complication. However, the duration of relief was shorter in duration than literature reported response to RFTC. It may place a niche role for patients who have relief with MBB but no relief with RFTC. Ten percent lidocaine may also have a substitute role for RFTC especially for patient who have contraindications to RFTC such as pacemaker/defibrillators or RFTC cannot be performed due to technical issues placing the electrode. The study was limited in number and its retrospective nature. Further prospective study with a larger population using alternate placement of blockade needle should be performed.

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