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Comparison of skin traction, pressure, and rapid muscle release with conventional method on intramuscular injection pain: A randomized clinical trial

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Abstract:

BACKGROUND: Intramuscular (IM) injection is one of the causes of anxiety and pain in patients, using new techniques and creating a pleasant experience is of the legal and ethical duties of nurses. We aimed to investigate comparison of skin traction, pressure, and rapid muscle release with conventional method on IM injection pain.

MATERIALS AND METHODS: This clinical trial investigated 28 patients (56 samples) who required Methocarbamol injection. Two 5 cc Methocarbamol were injected for each patient by the conventional and innovative methods. In the innovative technique, after applying skin traction and imposing deep pressure to the muscle, the needle was inserted at a 90° in the muscle and injected after aspiration. However, this deep pressure was not applied in the conventional method. The pain was measured using visual analog scale. STATA software version 12 was used for statically analysis. $P < 0.05$ was considered statistically significant.

RESULTS: The findings showed pain intensity in innovative method and conventional method was 1.17 ± 0.75 and 2.78 ± 1.61, respectively. The difference was statistically significant ($P = 0.001$). The minimum pain intensity in innovative method was 0 and maximum was 4, meanwhile in conventional injection, the lowest and highest pain intensity was 0 and 6 respectively.

CONCLUSION: The results of this study showed that innovative method can be used as a substitute for conventional method to reduce IM injection pain.

Keywords:

Intramuscular injections, pain, pressure, rapid muscle release, skin traction

Introduction

Intramuscular (IM) injection of drugs is widely used and can be performed by a licensed nurse, wherever patients receive care;[1] according to WHO's annual report, 16 million IM injections are done worldwide.[2] Muscles, with a rich source of blood supply and high volume, have the capacity of injecting higher amount of drug and show less sensitivity to drugs with high viscosity and sensitivity, while there are fewer pain receptors in the muscle.[1] Also, IM injection is used, when rapid and stable absorption of the drug is required for a long time.[3] For example, the study by Ghahiri *et al*. on reducing pain after cesarean section, showed a more effective analgesic effect by IM injection of pethidine compared to patient control analgesia, as a new method.[4]

IM injection is one of the causes of anxiety and pain in patients, which causes fear of injection and avoiding repeating this

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painful experience in patients. Since IM injection pain results from damage to the tissue and is one of the most common complications of IM injection, it should not be underestimated.[3,5-7] Although many studies have addressed pharmacological and nonpharmacological methods of IM pain reduction,[6] research continues to find more effective techniques to reduce it.[8] Since applying new techniques of IM injection and creating an enjoyable experience are of the ethical and legal duties of nurses,[5] gaining skill in injection based on most recent studies has long been considered by nursing science.[2] Pain reduction methods include slow injection of the drug,[1,3,9] acupressure,[10] direct skin contact,[11,12] and oral sucrose in neonates,[13,14] the effect of patient's position at the time of injection,[15] topical cold,[16,17] thought deviation,[16,18] use of ShotBlocker,[6,19] use of air locking technique and Z method,[3,7,15,20] use of skin stroke with fingers, use of topical anesthetics such as lidocaine and prilocaine cream[6,21] and Vapocoolant spray,[22] and selection of the appropriate muscle for drug injection.[1,13,23]

Using nonpharmacological methods has attracted the attention of not only nurses, but also patients,[12] but each of the above techniques has some limitations; for example, the use of ice requires preparation and use of topical anesthetics with drugs require cost and time. The use of manual pressure also requires 10 s before injection, and requires access to the tool. Therefore, designing a new method by combination of these methods with the least time and cost will be definitely welcomed by patients and nurses. In the usual method, after selecting the injection site, skin is retracted by the thumb and index finger, and the needle enters the muscle by dart technique at an angle of 90°, and the drug is injected at 1 cc/10 s after aspiration.

The method of applying skin traction, pressure, and rapid muscle release is proposed as a new technique by the researchers. In this method, after detecting the injection site into the dorsogluteal muscle using the thumb and index finger, muscle's skin was retracted[1] and at the same time, deep pressure is imposed with the same two fingers into the muscle and as the needle is inserted, the pressure is removed from the muscle and after aspiration, the drug is injected at 90° at a rate of 1 cc in 10 s. Although ventrogluteal muscle is a safer place for IM injection, since 60% of nurses use dorsogluteal muscle for injection,[20] in this study we chose this muscle for injection. The probable mechanism of this method's effectiveness is the pain reduction or control by Wall and Melzack pain gate theory.[5,8]

Accordingly, the pain transfer from the peripheral fibers can be regulated through the spinal cord to the brain.[8] The posterior branch of spinal cord facilitates or prevents transmission of pain messages as a valve. Normally, this valve is closed and transfers the sense of pressure from the pain site by pressure thick A fibers and hence, reduces the pain,[8,19] because A-beta thick fibers transmit the pain to the posterior horn much faster than narrow A-delta and C fibers and prevent the transfer of pain to the spinal cord and higher centers by blocking the valve.[19] According to this theory, by involving and stimulating more peripheral receptors, pain transmission and perception reduce correspondingly,[10] and we stimulate more receptors by pulling the skin and applying deep pressure to the muscle simultaneous to injection that reduce pain more. The needle penetrates the stretched skin easier and reduces pain.[24]

In IM injection, the needle should be inserted into the body fast, like a dart, and perpendicular, because fast injection is less painful, and the syringe movement damages the tissue[23] and if we want to inject without pressure on the skin by the conventional method, our hand may shake or the needle may not enter the muscle at a constant rate, but in this new method, the muscle is released in throwing manner and injection is done according to the principles mentioned. Muscle relaxation reduces pain,[24] as when the needle entrance is associated with pain, the patient will unconsciously spasm the muscle and will feel the injection of the drug in the muscle more. In this innovative method, we insert the needle without pressure and subsequently the injection pain is minimized. Therefore, the present study aimed to evaluate the effect of applying skin traction, pressure and rapid muscle release on reducing the pain of IM injection compared to conventional injection method.

Materials and Methods

This triple-blind clinical trial had a parallel design to compare the effects of skin traction, pressure, and rapid muscle release on the intensity of IM injection pain. This study was performed on 28 patients aged 16–60 years with low back pain who required methocarbamol injection. For each patient, two conventional and innovative injections were randomly assigned to both dorsogluteal muscles. Patients who referred to the Emergency Department of Vasei Hospital, Sabzevar, Iran, affiliated with Sabzevar University of Medical Sciences, from February to March 2018.

The participants of this study were 28 patients (56 samples), the two hip muscles were randomly divided into two groups; in other words, each group consisted of 28 samples. Inclusion criteria for sample selection were age of 16–60, no communication (auditory, visual, speech) problems and common language, having same volume of dorsogluteal muscles of the patient and having written consent, having two healthy muscles and no

sensory problems, and the exclusion criteria included scarring, redness, bruising, sensitivity, and stiffness at the injection site, history of injection in the past 2 weeks, neuropathy, severe pain due to a disease and severe fear of injection, people with body mass index below 15 and over 35, drug use, with a history of diabetes.

Samples were selected by convenient sampling. Then, the two dorsogluteal muscles of the patient was randomized into two groups of experimental (innovative injection method: Skin traction, pressure, and rapid muscle release) and control (conventional injection method). The random allocation method was performed by coin flipping (heads and tails) and in the first patient, the conventional method will be randomly used for injection to in the right dorsogluteal muscle and the innovative method injected in the left dorsogluteal muscle, and the sequence changed for every other patient, so that the next person would receive the injection in the right muscle by the innovative method and in the left muscle by the standard injection method.

Data were collected using a questionnaire. The first part of the questionnaire included demographic data (age, sex, weight, height, educational level, marital status, and occupation) and the second part contained the visual analog scale (VAS) for measurement of injection pain intensity. VAS scale is commonly used in various studies to measure pain. Participants in the study indicated their pain intensity on a horizontal line from 0 to 10: 0 indicating no pain, and 10 the worst pain imagined. According to available studies, VAS is a valid, reliable, and repeatable tool for pain assessment. To determine the content validity of the demographic information questionnaire, which included 15 questionnaire of demographic information and history of patients' disease and activity, ten faculty members of nursing were consulted and its content validity was confirmed.

At the beginning of the study, the aim and benefits of the study were explained to all patients. It was explained to them that the drug prescribed (Methocarbamol) was 10 cc, and in the conventional injection method, it is injected into two equal parts of 5 cc in two similar syringes and injected into the two hip muscles. In addition, the patient was told that in this injection method, when the patient lies on the abdomen (prone position), two injection methods were randomly done in each of the two hip muscles, and then the intensity of the pain felt by the patient was examined immediately after each injection.

All injections of this study were done by one person (SM; the first author, a female nurse) and the pain was assessed by the researcher assistant. The study was triple blind, so that the patient and the nurse, who evaluated the pain, and the statistical analyst were not aware of the injection method in each of the patient's muscles, and each patient received both injections. In the conventional injection method, hand pressure was not applied and after pulling the skin between the thumb and index fingers, the needle was inserted in a dart manner at a 90° after aspiration, at 1 cc in 10 s, and the innovative injection method (skin traction, pressure, and rapid muscle release): after applying traction and deep pressure with the needle entry at 90°, the muscle was quickly released and the drug was injected after aspiration at 1 cc in 10 s. In this method, in fact, the muscle release causes the needle to enter, and moved inactively by the dominant hand and the main role of removing the pressure from the muscle by the nondominant hand (Video 1). All injections were performed using a 5-cc syringe with a needle of 22 mm and an air locking technique with tenth of a cc. Alcohol-impregnated cotton was used to sterilize the injection site and no gaps were considered between the two injections, except for the completion of the pain assessment questionnaire.

The sample size was calculated using G*Power software, according to the study by Moharreri *et al*.[23] The mean difference before and after pain was 10 with standard deviation of 14.1 and the number of samples required for the study with 95% confidence level, 95% test power, and effect size of 0.719 was estimated at 28.

To describe the quantitative variables, mean and standard deviation, and to report qualitative variables, frequency and percentage were used. To compare mean pain intensity, Mann–Whitney U-test was used. Data analysis was performed using STATA software version 12 (*Stata Statistical Software: Release 12*. College Station, Texas: StataCorp LP.), and $P < 0.05$ was considered as statistically significant.

This research was approved by the Ethics Committee of Sabzevar University of Medical School (ethical code: IR. MEDSAB. REC.1395.141). The study protocol was registered in the clinical trial registration website (IRCT20171231038155N1). Injection was performed after obtaining written informed consent and description of the study goals for patients, and participants were assured that they could leave the study at any stage they did not wish to continue their participation. All patients filled out the informed consent form.

Results

28 patients were included in this study. Of these, 16 patients (57.14%) were female and 12 patients (42.86%) were male. In this study, 5 patients (17.86%) were single and 23 (82.14%) were married. Also, 21 participants in this study were high school graduate

and undergraduate (75%) and 7 (25%) had a bachelor's degree. The patients' age ranged from 16 and 60 years old with a mean of 39.32 ± 11.39 years. The frequency of pain intensity in the innovative injection group (skin traction, pressure, and rapid muscle release) showed a significant decrease, so that in the innovative injection method (skin traction, pressure, and rapid muscle release), the minimum pain was 0 and maximum was 4 with a mean and standard deviation of 0.75 ± 1.17. In conventional injection, the lowest and highest pain intensity was 0 and 6 with a mean and standard deviation of 2.78 ± 1.61, respectively, so the difference was statistically significant (P = 0.001) showed that this method can be effective in reducing IM injection pain [Tables 1 and 2].

Discussion

The present study aimed to compare the effects of skin traction, pressure, and rapid muscle release with the standard injection method to reduce muscle pain. Analysis of the results showed that this innovative method (skin traction, pressure, and rapid muscle release) can cause significant pain relief. There was a significant difference between mean and standard deviation of the present study with other techniques in other studies; in this study, the mean and standard deviation of the intervention group were 0.75 ± 1.17 and the pain range was 0–4; however, in a study by Moharreri *et al*. who examined the effect of manual pressure on the injection site and the pain intensity induced by IM injection was reported 3.50 ± 0.96.[23] In the study of Barnhill *et al*. who followed the same objectives, the mean and standard deviation was 13.8 ± 13.6 and the pain ranged from 0 to 57 of 100 mm,[8] and in the study of Öztürk *et al*., the observed mean and standard deviation was 3.17 ± 1.95 and the pain ranged from 0 to 8 in the intervention group.[5]

Table 1: Mean and standard deviation of pain severity in two groups of injections (conventional and innovative methods)

Pain	Group					*P*
	Frequency	Mean	Minimum pain	Maximum pain	SD	
After injection						
Intervention	28	0.75	0	4	1.17	0.001
Control	28	2.78	0	6	1.61	

SD=Standard deviation

Table 2: Frequency of pain intensity in two groups of injections (conventional and innovative methods)

Pain intensity	Conventional method, *n* (%)	Innovative method, *n* (%)
No pain (0)	1 (3.57)	17 (60.71)
Mild (1-2)	11 (39.29)	9 (32.14)
Intermediate (3-4)	12 (42.86)	2 (7.14)
Severe (5-6)	4 (14.29)	0
Very severe (7-8)	0	0
Intolerable (9-10)	0	0

This method was superior as it had several differences with similar studies, which has been associated with the involvement and stimulation of more pain receptors through skin traction and deep muscle pressure, and reduced pain more, according to Wall and Melzack theory.[10] On the other hand, the needle penetrates the skin more easily and reduces pain,[24] and because the injection is less painful and the movement of the syringe causes damage to the tissue,[25] with this innovative method, the muscle is released by throwing method and injection can be performed in dart method, without hand shaking, and irregular movements of the syringe will be prevented, as the needle is inserted into the muscle inactively. By this technique, the needle will be inserted with completely no pain and muscle spasm and consequently, the injection pain will reduce to minimum, as muscle relaxation reduces pain.[24]

Because in each muscle, a certain drug volume should be injected and the highest injectable volume in dorsogluteal muscle is not more than 5 cc,[1] Methocarbamol can cause the greatest pain due to its high volume and viscosity. Therefore, using this drug with a significant reduction in mean and standard deviation of pain can be an evidence for the effectiveness of this method. Also, other benefits of this study included the simultaneous use of case and control, which can control the individual, social, cultural, and economic differences affecting pain. While in other studies, two groups have been considered to compare the effect of the proposed method. For example, in the study of Barnhill *et al*., 93 samples were selected and a single injection method was used on each patient,[8] or in the study of Öztürk *et al*., 123 samples were selected and pressure was applied to 48 samples, and not applied in the rest of samples.[5] Although many techniques have been proposed to reduce IM injection pain, among all nonpharmacological methods, using hands to touch or massage is one of the oldest and most effective methods,[1] for example, Öztürk *et al*.,[5] Moharreri *et al*.,[23] Barnhill *et al*.,[8] and Taddio *et al*.[26] proved that manual pressure is an effective method for reducing IM injection pain, and we changed the use of this method, spent the least amount of time, did not use any tools, and did not impose extra costs and the use of this method resulted in a dramatic reduction in IM injection pain. It should also be noted that this procedure will not result in any side effects. As management of IM injection pain is a nursing task, it is essential to acquire the skills in performing this common technique as it will increase patient's satisfaction, which is the main goal of the health professionals.

Because one of the causes of pain at the injection site is the firmness of the muscle[2] and induction of relaxation to the muscle reduces pain. By this innovative technique, the needle will be inserted completely painless. Meanwhile the patient will have no muscle spasm. Therefore, it will prevent tightening the injection site. And subsequently the injection pain will be reduced to a minimum.

Study limitations

The limitations of this study included small sample size and variation, thus, it is suggested that the effect of this method be studied on larger number of samples and different age groups of neonates, children, and the elderly; and since the ventrogluteal muscle is a safe injection site, due to being far from vessels and nerves, it is also recommended that future studies investigate IM injection on other muscles. Perhaps, it is worth mentioning that obtaining the skill required for this technique may be one of the limitations of using this method. One of the strengths of this study was studying two muscles of one person with a similar drug, dose, and volume and expression of pain intensity at one time by one patient.

Conclusion

Based on the results of the present study, applying skin traction, pressure, and rapid muscle release significantly reduced pain during IM injections, and it is recommended that future studies focus on the impact of this innovative technique in different age groups and larger samples, in order to replace this effective method with conventional methods.

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Conflicts of interest

There are no conflicts of interest.

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