Original Research Article

The Effect of Training on the "V" and "G" Techniques Used in the Ventrogluteal Site and Injection Application to This Site on the Knowledge Level of Nurses

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Abstract

Introduction: It is stated in the literature that nurses know the importance of the VG site, but they do not prefer it due to the difficulty of defining the site anatomically. In addition, it was emphasized that nurses should be informed about the current literature in order to increase the rate of use in this site.
Aim: The study was carried out to examine the nurses' knowledge of the ventrogluteal site and the "V" and "G" techniques used in intramuscular injection to this site and the effectiveness of the training provided in this context.
Materials and methods: The sample of this descriptive and quasi-experimental study consisted of 217 nurses working in two state hospitals. A data collection form was applied to the nurses in the whole hospital group, and the training was carried out in a single hospital group of nurses.The research was conducted as a semi-experimental study in a single group.
Results: When the pre-test knowledge score average (9.43 ± 4.49) and the post-test knowledge score average (10.96 ± 2.98) applied to the group that was trained about the ventrogluteal site and the 'V' and 'G' technique used in injection application to this site, it was observed that there was an increase in the correct response rates. The difference between the pre-test and post-test average scores was found to be statistically significant ($p<.05$). It was observed that most of the participants (65.4%) did not use the VG area and methods in the application of intramuscular injection.The knowledge score

averages of those who would prefer to apply injection to the VG area in the clinic (9.60 ± 2.85) were found to be higher than those who did not (6.87 ± 4.03).

Conclusion: It has been observed that the rate of attending the in-service training or congress / symposium for the VG region of the nurses is low, and it has been found that the average knowledge points after the training increased. It was found that the nurses' knowledge about the ventrogluteal area changed positively after the training. It is recommended that knowledge and skills on intramuscular injection are developed and kept up-to-date with in-service training programs.

Key words

Intramuscular Injection, Ventrogluteal Zone, Training.

Introduction

In intramuscular (IM) injection, which is one of the parenteral drug administrations, the drug is delivered to the deep muscle tissue [1]. IM injection application started to be applied in the late 1960s with the administration of antibiotics intramuscularly and became a routine part of nursing practices [2]. Intramuscular injections are one of the most commonly used injection methods [3,4]. Due to the presence of more veins in the muscles, drugs are absorbed faster through the IM way than the subcutaneous way. However, there are many risks associated with intramuscular injection. For this reason, nurses should know well the anatomical structure of the application site and make the site selection very well [5]. World Health Organization (WHO) reports that about 16 billion injection applications has been made each year and 90% of these injections have been applied for the purpose of treatment [6].

Nurses do not receive any other training after their basic training that teaches the IM injection technique, and it is reported that they use very different methods in the preparation and administration of drugs [7]. Dorsogluteal (DG) site is the most frequently used site in IM injection application. The most important complication that may develop after injection to the DG site is sciatic nerve damage. Needle hitting the sciatic nerve; injection application to this area is not recommended because pain, drop foot and leg may cause temporary or permanent paralysis [2,8]. Injury to the sciatic nerve in IM injection has been known for many years and emerges as a global malpractice problem [9]. Studies have emphasized that intramuscular injections applied to the DG area cause sciatic nerve neuropathy the most (31.2%), especially in elderly individuals, weak patients, IM injection has high morbidity and injection-related secondary sciatic nerve neuropathies have a poor prognosis [10]. It is stated that the reason for the widespread use of the DG site in the clinic is that it is easily accessible, it has a larger muscle structure and it will cause less pain, as well as the belief that patients will prefer this site [11]. WHO reports that safety precautions generally have not been followed at the injection applications in many countries in the last decade [6].

According to the results of evidence-based studies conducted in recent years, the ventrogluteal (VG) injection site is considered to be the safest injection site [2,12]. There are some important points that should be known in the use of the VG site in IM injection, these are; the correct technique, the knowledge of anatomy to accurately identify the IM injection site, physiology knowledge to prevent complications that may develop during the application and patient evaluation. Body mass index, gender, and age can directly affect subcutaneous adipose tissue and gluteal muscle thickness. In addition to a good knowledge of anatomy and physiology, the selection of the injection site should be made correctly. When the appropriate technique is not used during IM injection in drug applications and the injection site is not determined correctly, some complications may arise [13-15].

The VG area, also called the anterolateral (lateral hip) site, includes the gluteus medius and gluteus minimus muscles. It is recommended to be used as the first choice in IM injection because the risk of sciatic nerve damage is low, it allows for safe location determination because the bone structures are palpated, it can be performed in the supine, prone, lateral positions, and the gluteal muscles in the site are thick, and the subcutaneous and adipose tissue is thin. In IM injection, ventrogluteal (V) method and geometric (G) method are used to determine the injection point of the VG region [16]. The easiest method used in determining the ventrogluteal site is the "V method". In this method, if the nurse will use the left lateral hip of the patient, s/he places his/her right hand, if s/he will use the right lateral hip, s/he places his/her left hand on the large thoracic of the femur, points his/her thumb towards the groin, puts the index finger on the spinailiaca anterior superior, opens the middle finger towards the crista iliaca posterior superior and forms a "V" zone. The injection site is the middle of the "V" created [17]. In the "G" method, by considering the bony protrusions, a triangle is formed by drawing an imaginary line from the greater trochanter to the iliac tubercle crystal, from there to the anterior superior iliac spina, then from the greater thoracic to the anterior superior iliac spina. Then, median lines are created at the center of the triangle for each corner of the triangle. The injection site is the center of these median lines drawn (Dogu 2016; Kara et al.2015). Recently, researchers compared the areas identified by these two methods with an ultrasound examination for blood vessels and nerves [18].

In a study conducted to compare the dorsogluteal (DG) and ventrogluteal (VG) sites in terms of pain intensity and satisfaction levels after injection, it was stated that less pain was felt in the VG area and the satisfaction level in the VG site was higher than the DG [19]. Absence of large blood vessels and nerves, VG site which is away from the bony tissue is safer for injection and causes less pain, however, nurses in Turkey tend to use DG site as the first choice [20].

It is stated in the literature that nurses know the importance of the VG site, but they do not prefer it due to the difficulty of defining the site anatomically. In addition, it was emphasized that nurses should be informed about the current literature in order to increase the rate of use in this site. Studies show that nurses need in-service training [21].In the literature search, there is no study that reveals the knowledge of nurses about the use of "V" and "G" techniques used in the correct determination of the VG site. The data obtained from this study will enable the evaluation of nurses' level of knowledge on this subject and will direct the in-service training to be conducted on this subject.

Materials and methods

Purpose of the Study

This research was designed to examine the knowledge levels of nurses about the V and G method used in the correct determination of the VG site and the injection area on this site, and to provide training.

Research Questions

- Is there a difference before and after the training in the knowledge levels of the nurses regarding the use of the VG site in IM injection practice?
- Is there a difference before and after the training in the knowledge levels of the nurses regarding the V and G techniques with respect to the use of the VG site in IM injection practice?

Type of the Study

The study was carried out descriptively and quasi-experimentally in order to evaluate the effectiveness of the training on the nurses' application of injections to the VG site and knowledge scores of the V and G technique.

Research Place and Features

The research was conducted with nurses working in inpatient, intensive care and emergency services in a university hospital and a state hospital.

Population and Sample of the Research

Research population consists of a total of 595 nurses working in health practice and research hospital located in a province in the Mediterranean region of Turkey and a state hospital in the same province. Power analysis was used to determine the number of samples. According to this; It was planned to recruit 202 nurses from 2 hospitals for a study with $\alpha = 0.05$ significance level and $\beta = 0.20$ with a strength of 0.80. After calculating the sample size according to the size of the hospitals with the stratified sampling method, 51 nurses from the state hospital (36 nurses were sufficient for the sampling in this hospital, 51 nurses were included with voluntary participation) and 166 nurses from the university hospital were included in the sample. The nurses to be included in the sampling were determined using the simple random sampling method.

Data Collection Tools

The data collection form consists of two parts. The pre-application of the data collection forms was made with 10 nurses who were excluded from the sample. Five faculty members who are experts in the field of nursing were informed about the content validity of the questions. Necessary changes were made in the data collection form in line with the opinions of experts and pre-application.

1. Nurse Recognition Form

It covered 12 questions about the introductory characteristics of nurses and their current practice in the VG site.

2. Knowledge Evaluation Form

It was collected with a questionnaire prepared by the researcher in line with the literature [1,13,22,23]. There are 20 recommendations for determining the level of knowledge regarding the administration of IM injection to the ventrogluteal site.

Implementation of the Research

In the first stage, data collection forms were applied to all participants. In the second stage, the group to be trained was trained using the presentation method and training materials. The knowledge scores of the nurses before and after the training were determined by the researcher using a questionnaire with a proposition consisting of 20 questions created in line with the literature. The research was applied between 10.01.2019 and 10.06.2019.

The training booklet and program were prepared by the researcher using the literature [1,13,22,23]. The content of the training booklet includes IM injection, IM injection sites, determination of the injection site, injection application method, IM injection to the VG site with V and G technique, and unexpected results related to IM injection. In the booklet used in the education and in the presentation, the IM injection process steps are explained with colored pictures and photographs. Training booklets were distributed to the nurses. During the training, applied training was carried out by one of the researchers in the form of a demonstration.

Collection of Data

One of the researchers conducted one-to-one interviews with the nurses working in the clinics before the training application, and all questionnaires were applied. The training program was conducted in a single session with 51 nurses who agreed to participate in the training. One month after the training, the 20-question knowledge test was applied again.

Data Analysis

Statistical analysis was performed using SPSS software for the evaluation of the data obtained from the research (Version 23.0, SPSS Inc., Chicago, IL, USA). Number, percentage, average ± standard deviation were used to evaluate the data. The fit of the studied variables to the normal distribution was accepted as a result of the shao method, which accepts that the kurtosis-skewness ± 3 indicates the normal distribution [24]. In the examination of the relationships, the independent sample t test was used to examine the differences of variables with 2 categories according to continuous data, and the One Way Anova test was used to compare variables with

more than 2 categories with continuous data. Paired Sample t test was used to compare the averages obtained from the pre-test and post-test measurements. Statistically p <0.05 was considered significant.

If continuous variables were normal, they were described as the mean ± standard deviation (kurtosis and skew ± 3), and continuous variables were normal, they were described as the mean ± standard deviation. Comparisons between groups were applied using Independent Sample t test, Paired Sample t test, One Way Anova test were used for the data normally distributed. Values of $p < 0.05$ were considered statistically.

The Ethical Aspect of the Research

Necessary institutional permissions were obtained for the application of the research. In addition, ethical permission was obtained from the Clinical Research Ethics Committee of a state university (Date: 16/05/2018, Number: 20) and the participants were informed about the study and the verbal and written consents of the nurses who agreed to participate in the study were obtained voluntarily. The Helsinki Declaration was complied with at every stage of the study.

Limitations of the Research

Operating room nurses and nurses working in polyclinics were not included in the study. In addition, the inability to apply the training program to the nurses working in the university hospital due to their workload is among the limitations of the study.

Results

The distribution of responses given by nurses to demographic, study and information questions is shown in **Table - 1**. It was determined that 58.1% of the participants were between the ages of 26-35, most of them (61.8%) were women, and nearly half (48.8%) had been nursing for 5-9 years. It was observed that the education level was mostly (58.0%) undergraduate and above, 76.5% worked in university hospitals and 67.7% worked in inpatient services. The rate of those who think they have sufficient knowledge about ventrogluteal injection is 52.5% and 71.4% stated that they got the knowledge about VG injection from the education they received in the university curriculum. While the rate of those who thought that the safest area for intramuscular injection was the DG site was 62.2%, the rate of those who stated that the most reliable method used in VG was the "V" technique was 65.4%. 65.4% of the participants do not use the VG site and methods in intramuscular injection and 57.6% stated that they would not accept it if it was decided to use the VG site in the clinic.

The distribution of the knowledge levels of the venterogluteal site injection and the responses of the nurses to the V and G methods used in determining the site are given in **Table - 2**. Propositions 1. (67.3%), 2. (71.9%) and 3. (53.0%) articles were the articles with the most correct answers. It was observed that the proposition with the most wrong answers (50.7%) was the 5th article. Again, it was found that the answers given to the 11th article (61.8%) were mostly wrong (**Table - 2**).

Table - 3 shows the knowledge levels of the injection applied to the VG site and the distribution of the responses of the nurses to the V and G methods used in determining the site before and after the training. When the answers were examined, the items with the highest rate of correct answers were found to be 1. (80.4% before training, 92.2% after training), 2. (78.4% before training, 98.0% after training) and 16. (23.5% before training, after training 76.5%) (**Table - 3**).

When the pre-test knowledge score average (9.43 ± 4.49) and post-test knowledge score average (10.96 ± 2.98) applied to the training group was examined, it was observed that the rate of correct answers increased (**Table - 4**). The difference between the pre-test and post-test average scores was found to be statistically significant (**Table - 4**) ($p<.05$).

Table – 1: Introductory characteristics of nurses and their responses to information questions (n=217).

Demographic and working characteristics	**n**	**%**
Age (Year) (min-max: 18-45)		
18-25	48	22.1
26-35	126	58.1
36 and over	43	19.8
Gender		
Female	134	61.8
Male	83	38.2
Working time (min-max: 1-19)		
1-4	45	20.7
5-9	106	48.8
10-14	46	21.2
15-19	20	9.2
Level of Education		
High School	52	24.0
Associate Degree	39	18.0
Bachelor's Degree and Higher	126	58.0
Hospital Worked		
State	51	23.5
University	166	76.5
Clinic Served		
Inpatient service	147	67.7
Intensive care	23	10.6
Emergency Services	47	21.7

Having sufficient information		
Yes	114	52.5
No	103	47.5
Training status for the VG region		
In-service training	30	13.8
Congress / symposium	12	5.5
University curriculum	155	71.4
I haven't received any education	20	9.2
The safest site for IM injection		
Dorsogluteal	135	62.2
Ventrogluteal	42	19.4
VastusLateralis	26	12.0
Rectus Femoris	14	6.5
The easiest method for VG site detection		
V method	142	65.4
G method	29	13.4
I have no information	46	21.2
VG site and frequency of using methods in site detection		
1-3 per day	51	23.5
4-10 per day	10	4.6
11 and more per day	14	6.5
I don't use	142	65.4
The acceptance of the decision regarding the use of the VG site in the clinic		
Yes	92	42.4
No	125	57.6

Table – 2: The knowledge levels of the injection into the ventrogluteal region and the distribution of the responses of the nurses to the V and G methods used in determining the region(n = 217).

Propositions	**Yes**		**No**		**I do not know**	
	n	**%**	**n**	**%**	**n**	**%**
1.Theventrogluteal region includes the gluteus medius and gluteus minimus muscles. (Yes)	146	67.3	10	4.6	61	28.1
2.Theventrogluteal site is safe for injection as it is far from large blood vessels and nerves. (Yes)	156	71.9	32	14.7	29	13.4
3.It is difficult for the needle to reach the muscle because the subcutaneous fat tissue in the ventrogluteal region is thick. (No)	62	28.6	115	53.0	40	18.4
4.The most common complication in the ventrogluteal region is sciatic nerve damage. (No)	67	30.9	98	45.2	52	24.0
5.Complications such as fibrosis, nerve damage, abscess, tissue necrosis, pain due to injection in the ventrogluteal site are not observed. (Yes)	41	18.9	110	50.7	66	30.4
6.VG site is not recommended for the application of irritating and oily solutions. (No)	96	44.2	36	16.6	85	39.2

7.For injection in the ventrogluteal site, the patient can be supine, prone, or lying on his/her side. (Yes)	112	51.6	48	22.1	57	26.3
8.Theventrogluteal site is determined using imaginary lines, and the dorsogluteal site is determined by palpating the bony structures. (No)	93	42.9	65	30.0	59	27.2
9.To determine the ventrogluteal injection site, the nurse should use the right hand on the patient's right hip and the left hand on the left hip. (No)	75	34.6	81	37.3	61	28.1
10.Ventrogluteal injection site can be safely performed on children older than 12 months**..**(Yes)	58	26.7	92	42.4	67	30.9
11th.Using the V method in defining the ventrogluteal site injection site for a more successful IM injection is more reliable than the G method. (No)	134	61.8	17	7.8	66	30.4
12.Using the ventrogluteal site for IM injection causes excessive pain in the patient. (No)	62	28.6	69	31.8	86	39.6
13.In the "V method" used in the determination of the ventrogluteal site, the detection of the injection site may be difficult in obese patients due to the absence of the greater trochanter. (Yes)	113	52.1	24	11.1	80	36.9
14.There is a G (geometric) method to determine the ventrogluteal site injection point. (Yes)	109	50.2	34	15.7	74	34.1
15.It can be thought that the size of the nurse's hand in the V method to determine the injection point of the ventrogluteal site may cause errors, especially in children. (Yes)	96	44.2	33	15.2	88	40.6
16.In the "V method" used in the determination of the ventrogluteal site, the determination of the injection site is used only in adults. (No)	105	48.4	45	20.7	67	30.9
17.The "V method" used in the detection of the ventrogluteal injection site is recommended only in children, as the ventrogluteal muscle is well developed. (No)	39	18.0	82	37.8	96	44.2
18.The "G method" used in the determination of the ventrogluteal injection site is recommended for children. (Yes)	42	19.4	51	23.5	124	57.1
19.In the "V method" used in the determination of the ventrogluteal site, the nurse places the lower part of the palm to the greater trochanter of the femur to determine the injection area. (Yes)	105	48.4	31	14.3	81	37.3
20.In the "G method" used in the determination of the ventrogluteal site, the nurse places the lower part of the palm to the greater trochanter of the femur to determine the injection site. The injection site is the region below the iliac crest and above the imaginary cross line that connects the posterior superior iliac spine with the greater trochanter of the femur. (Yes)	92	42.4	46	21.2	79	36.4

Table – 3: Comparison of Proposition Answers of Nurses Before and After Training (n=51).

Propositions	Before			After		
	Yes	No	I do not know	Yes	No	I do not know
	%	%	%	%	%	%
1.The ventroglutealregionincludesthegluteusmediusandgluteus minimusmuscles.	80.4	3.9	15.7	92.2	0.0	7.8
2.The ventrogluteal site is safeforinjection as it is far fromlargebloodvesselsandnerves.	78.4	5.9	15.7	98.0	0.0	2.0
3.It is difficultfortheneedletoreachthemusclebecausethesubcutaneousfattissue in theventroglutealregion is thick.	25.5	54.9	19.6	41.2	54.9	3.9
4.The mostcommoncomplication in theventrogluteal site is sciaticnervedamage.	23.5	52.9	23.5	17.6	70.6	11.8
5.Complications such as fibrosis, nervedamage, abscess, tissuenecrosis, painduetoinjection in theventrogluteal site are not observed.	21.6	56.9	21.6	35.3	58.8	5.9
6.VG site is not recommendedfortheapplication of irritatingandoilysolutions.	41.2	31.4	27.5	35.3	47.1	17.6
7.For injection in theventrogluteal site, thepatient can be supine, prone, orlying on his/her side.	54.9	23.5	21.6	90.2	3.9	3.9
8.The ventrogluteal site is determinedusingimaginarylines, andthedorsogluteal site is determinedbypalpatingthebonystructures.	51.0	25.5	23.5	64.7	21.6	13.7
9.To determinetheventroglutealinjection site, thenurseshouldusetherighthand on thepatient'srighthipandthelefthand on thelefthip.	58.8	21.6	19.6	13.7	68.6	17.6
10.Ventrogluteal injection site can be safelyperformed on childrenolderthan 12 months.**.**	25.5	43.1	31.4	70.6	17.6	11.8
11th.Using the V method in definingtheventrogluteal site injection site for a moresuccessful IM injection is morereliablethanthe G method.	62.7	2.0	35.3	25.5	21.6	52.9
12.Using theventrogluteal site for IM injectioncausesexcessivepain in thepatient.	21.6	52.9	25.5	0.0	98.0	2.0
13.In the "V method" used in thedetermination of theventrogluteal site, thedetection of theinjection site may be difficult in obesepatientsduetotheabsence of thegreatertrochanter.	66.7	5.9	27.5	92.2	3.9	3.9
14.There is a G (geometric) methodtodeterminetheventrogluteal site injectionpoint.	60.8	9.8	29.4	80.4	3.9	15.7
15.It can be thoughtthatthe size of thenurse'shand in the V methodtodeterminetheinjectionpoint of	52.9	19.6	27.5	84.3	0.0	15.7

theventrogluteal site maycauseerrors, especially in children.						
16.In the "V method" used in thedetermination of theventrogluteal site, thedetermination of theinjection site is usedonly in adults.	52.9	23.5	23.5	13.7	76.5	9.8
17.The "V method" used in thedetection of theventroglutealinjection site is recommendedonly in children, as theventroglutealmuscle is welldeveloped.	23.5	47.1	29.4	0.0	88.2	11.8
18.The "G method" used in thedetermination of theventroglutealinjection site is recommendedforchildren.	39.2	29.4	31.4	64.7	19.6	15.7
19.In the "V method" used in thedetermination of theventrogluteal site, thenurseplacesthelowerpart of thepalmtothegreatertrochanter of thefemurtodeterminetheinjectionarea.	51.0	23.5	25.5	86.3	3.9	9.8
20.In the "G method" used in thedetermination of theventrogluteal site, thenurseplacesthelowerpart of thepalmtothegreatertrochanter of thefemurtodeterminetheinjection site. Theinjection site is theregionbelowtheiliaccrestandabovetheimaginarycrossli nethatconnectstheposteriorsuperioriliacspinewiththegreat ertrochanter of thefemur.	51.0	19.6	29.4	62.7	33.3	3.9

Table – 4: Comparison of the Total Knowledge Scores of the correct answers given by the nurses to the injection and application methods in the VG site (n: 51).

Pre-test / Post-test	**Mean±SD***	**t**, p**
BeforeEducation	9.43 ± 4.49	-2.179,
AftertheEducation	10.96 ± 2.98	**.034**

*SD: Standard Deviation, **Paired Sample Test

Table – 5: Distribution of Proposition Mean Scores by Demographic Variables (n:217).

DemographicVariables	**Mean±SD***	**P****
Age		
18-25	9.00 ± 2.57	0.189
26-35	7.92 ± 3.69	
36 andover	8.65 ± 4.68	
Gender		
Female	8.05 ± 3.59	.197
Male	8.72 ± 3.90	
Level of Education		
Vocational School of Health	9.07 ± 2.29	0.059
AssociateDegree	8.92 ± 3.91	
Bachelor'sDegreeandHigher	7.80 ± 4.05	
Workingduration		
1-4	7.62 ± 3.51	0.065

5-9	7.98 ± 3.50	
10-14	9.19 ± 4.23	
15-19	9.55 ± 3.59	
Hospitalworked		
State	9.43± 4.49	**0.035**
University	7.96± 3.38	
ClinicServedIn		
Inpatient service	8.41± 3.45	**0.001**
Intensivecare	10.43± 3.14	
Emergency	6.93± 4.25	
Safest Site		
Dorsogluteal	8.09± 4.06	0.242
Ventrogluteal	9.09± 2.76	
VastusLateralis	7.61± 3.27	
RectusFemoris	9.28± 3.17	
Fromwhere is thelatestinformation		
In-service training	6.50± 3.89	**0.004**
Congress / symposium	9.91± 3.87	
Universitycurriculum	8.69± 3.34	
Theeasiestmethodfor VG site detection		
V method	8.29± 3.43	**0.006**
G method	10.17± 2.40	
VG decisionacceptancestatus		
Yes	9.60± 2.85	**0.000**
No	6.87± 4.03	

*** SD: Standard Deviation **p: Independent Sample t test; One Way Anova**

When the distribution of the total proposition score according to demographic variables is examined; nurses working at universities (7.96 ± 3.38) had statistically significantly lower rates of correct answers in the proposal questions compared to those working in a state hospital (9.43 ± 4.49) ($p < .05$). When the correct answer rates in the proposition questions were examined according to the service they worked in, it was found that the total scores of the correct questions (6.93 ± 4.25) of the emergency workers were statistically significantly lower than the inpatient service (8.41 ± 3.45) and the intensive care workers (10.43 ± 3.14) ($p < .05$). When the sources of information regarding the ventrogluteal application site are examined, the highest average belongs to those who obtained information from the congress/ symposium (9.91 ± 3.87), followed by the knowledge score averages of the subjects in the university curriculum (8.69 ± 3.34) and lastly, information obtained through in-service training (6.50 ± 3.89). It was determined that the difference between the knowledge points obtained regarding the sources of information was statistically different ($p < .05$). The knowledge score averages of those who find the G method easy in detecting the VG site (10.17 ± 2.40) are higher than those who find the V method easier (8.29 ± 3.43) ($p < .05$). The knowledge score averages of those who would prefer to apply injection to the VG site in the clinic (9.60 ± 2.85) were found to be higher than those who did not (6.87 ± 4.03).

Discussion

The hip is a common site for intramuscular injection in adults and children, as it has faster absorption rates [25]. When the subcutaneous adipose tissue is too thick in intramuscular (IM)

injection, the drug does not reach the muscle, which may lead to harmful effects and a decrease in drug bioavailability and effectiveness [15]. It is recommended to be used as an injection site because of the excess muscle tissue in the ventrogluteal (VG) site, the thinner subcutaneous tissue, the absence of large blood vessels and nerves, being far from the bone tissue and easy site determination [26]. The changes and developments observed in every field in the world are reflected in the field of health and consequently in nursing. It is an indispensable criterion for nurses to adapt to these changes and developments, to take science as a basis and to base their practices on evidence [27]. In this study, the effect of training on the ventrogluteal site and the V and G techniques used in injection to this site on the knowledge level of nurses was examined.

Considering the distribution of demographic and working characteristics, it was determined that most of the nurses are undergraduate and above. It has been observed that the working period of the majority of the nurses in the profession is between 5-9 years.

In our study, when the answers given to the question we asked to determine the sources of information about VG site injection were examined, it was determined that 71.4% of the nurses acquired the information about VG site injection from the education in the university curriculum. A similar study by Ozturk et al. (2017) showed that 71.11% of nurses did not receive training on intramuscular injection in the ventrogluteal site in basic nursing education [21]. Likewise, Korkmaz, et al. (2018), 61.6% of the nurses stated that they were not given enough information about the use of the ventrogluteal site in nursing education [28]. At this point, a different result from the literature was obtained in our study. Information regarding VG site preferences in IM injection practices in Turkey entered the main textbooks over the past decade [21] and in this context, it might be considered that the differences may have been caused due to the difference between the years of graduation. Within the scope of nursing curriculum, students should be provided with up-to-date information and practices, and nurses should also carefully follow up-to-date scientific knowledge on this subject after graduation and apply it to practice [28].

In order to prevent serious complications that may occur due to IM injection, although, it is extremely important to have injections by experienced nurses who have received sufficient training, up-to-date knowledge, and most of the nurses participating in our study were trained in the university curriculum for VG injection, it was determined in our study that the rate of nurses (52.5%) who think that "they have enough information to make the explanation" is low. It is thought that this situation is caused by the fact that the theoretical knowledge is forgotten due to the fact that the site is not used in practice, and also due to the lack of knowledge and application on this subject. In the study conducted by Su and Bekmezci (2020), it was stated that nurses used the traditional dorsogluteal site (DG) more because of their lack of knowledge and experience about the VG site [26]. In the literature, it is mentioned that training programs can be organized to meet the training needs of nurses, to increase their competence and to improve the use of the ventrogluteal site in intramuscular injection [29]. In our study, it was observed that the knowledge of the use of the VG site changed positively after the training given to nurses.

In parallel with similar studies in the literature [12,27,30,31] in our study, it is also found that nurses' knowledge point averages increased after training compared to pre-training (Before Training: 9.43 ± 4.49, After Training: 10.96 ± 2.98; $P < 0.05$). In this respect, our study supports the conclusion that the trainings planned after graduation are effective in conveying up-to-date information.

In our study, it was seen that 62.2% answered DG site, then 19.4% VG site to the question of the site you find the safest in IM injection. In our

study, the rate of nurses who think that the VG region is reliable is very low. In the study of Eroglu and Cevik (2019), Sari, et al. (2017), it was determined that the site that nurses found the safest for IM injection is the DG site[2,27]. Our study is similar to the literature in this respect. In addition, it is recommended to emphasize more that the ventrogluteal site is safer than other sites in the "Basic Principles and Practices in Nursing" course in the literature [32]. The fact that the VG site is safe and should be the first choice has been a subject mentioned in both textbooks and researches in recent years. However, in clinical practice, the choice of intramuscular injection site often appears to be based on tradition or habit.

The DG site is considered to be the most risky application site for IM injection due to the presence of thicker subcutaneous tissue compared to other sites, the presence of more vessels in the site and the proximity of the sciatic nerve [33]. When the studies conducted on this subject are evaluated, it is seen that nurses commonly use the DG site instead of the VG site for IM injection and/or find it safer [2, 12,14,29,34,35].

In our study, it was observed that 57.6% of the nurses would not accept it if a decision was made regarding the use of the VG site in the clinic. Similarly, inTugrul and Denat's (2014) study, 37.6% of nurses stated that they would not accept the use of VG site in the clinic [14]. Although it is written and recommended in the literature that the VG site is safe, it has been reported that nurses hesitate to apply injections to the VG site and do not want to apply this technique. Studies investigating the reasons why nurses do not use the VG site based on the statements of the nurses have determined that most of the nurses do not have sufficient knowledge and skills about the VG site[2,29]. When asked why nurses did not use the VG site in IM injection application, the most common answers were "I am not used to this site.", "I do not have enough information about the site.", "I don't know how to determine the site." [2,26,36]. In our study, 65.4% of the nurses stated that they did not use the methods for VG site and site detection. It can be thought that the reason why the use of this site is not accepted is the lack of practice and the lack of courage since the method has not been observed enough in practice. Although studies suggest the ventrogluteal site, it is not frequently used by healthcare providers, especially in obese patients [37].

Most of the nurses (71.9%) responded correctly to the statement "Ventrogluteal site is safe for injection since it is far from large blood vessels and nerves" in the knowledge test. In a similar study, most of the nurses (87.0%) gave the correct answer to the statement "The VG site is safe because it is away from large blood vessels and nerves" [2]. However, the other propositions (67.3%) that gave the most correct answer in our study are "The ventrogluteal site includes the gluteus medius and gluteus minimus muscles" (53.0%) "It is difficult for needle to reach the muscle because the subcutaneous adipose tissue in the ventrogluteal region is thick". In the study of Tugrul and Denat (2014), it was observed that nurses 29.4% gave the correct answer to the question "Which muscles are injected in the ventrogluteal region? [14]. This site consists of the gluteus medius and gluteus minimus muscles. The gluteus medius muscle was first described by Hochstetter in 1954 as an injection site; when IM is applied to the ventrogluteal site, medication is given to the gluteus medius muscle. Unlike the gluteus maximus, the gluteus medius is well developed in children and young adults, especially in the period before children learn to walk [13]. Reliability of the injection site for successful intramuscular injection depends on the presence of the target muscle, its sufficient thickness and the sufficiently thin subcutaneous fat layer in this area [25]. This site has a large gluteal muscle thickness and thinnest subcutaneous fat layer, so it prevents injection into the subcutaneous tissue, and is relatively far from the main nerves and blood vessels, and the risk of serious injury is less[38].

The rate of correct responses to the statement "For the detection of the ventrogluteal injection site, the nurse should use the right hand on the

patient's right hip and the left hand on the left hip" is 37.3%. In the study of Sari et al. (2017), the rate of nurses who gave the correct answer to this question was 46.1% [2]. In the study conducted by KacarogluVicdan, et al. (2019), most of the nurses stated that they did not know how to determine the site exactly and that they had difficulty in determining the injection site correctly [31]. In this method, if the nurse will use the patient's left lateral hip, s/he will use his/her right hand, and if s/he will use the right lateral hip, s/he places his/her left hand on the greater thoracic of the femur [39]. Although the results of the studies and our findings were similar, it was observed that most of the nurses had a lack of knowledge in the identification of the site. In addition, it was observed that the rate of correct responses to this statement increased after the training in the educated group (BT: 21.6%, AT: 68.6%).

The rate of correct responses to the statement "Ventrogluteal injection can be applied safely in children older than 12 months" is low (26.7%). The fact that the rate of correct response to this proposition increased significantly after the training in the group given education made us think that the training was effective and created an awareness about the age group in which the method can be applied (BT: 25.5%, AT: 70.6%). In a similar study, 49.7% of nurses gave correct answer to the proposition that the use of the VG muscle is recommended because it develops well in children older than 7 months [2]. In the study by Cerit and Emen (2020), most nurses stated that they do not know for which age group the VG site can be used [29]. In a study by YapucuGunes et al. (2016), it was stated that the muscle in the ventrogluteal site developed sufficiently even in infants aged 1-12 months, and the ventrogluteal site was thicker than anterolateral, especially in children aged 12-36 months [40]. Another study conducted on this subject revealed that the skin thickness of the VG site is suitable for IM injection in children aged 36 months and younger [38]. Studies have report that the VG site should be used as the first choice in babies 0-36 months as in adults, the muscle tissue in the site is developed, and the possibility of administering the drug to the subcutaneous tissue is lowand the risk of complications is low compared to other sites[2, 14, 40,41]. The VG site can be used in adults, children older than seven months and cachectic patients [42]. It is important to know for which age range the site to be used for safe and successful injection applications is suitable.

Half of the nurses responded correctly to the statement "There is a G (geometric) method to determine the ventrogluteal site injection point". The increase in the rate of correct answers to this proposition (BT: 60.8%, AT: 80.4%) after the training in the educated group showed that the education had a positive effect. Meneses and Marques (2007) proposed the geometric method to determine the injection site in the ventrogluteal site for the first time in the literature[43]. Imaginary lines are drawn between the bone ends in the method of determining the ventrogluteal site using "Geometric methods (G method)" by referring to the bone protrusions. It has been reported in the literature that this method has 100% reliability, and it is also mentioned that the use of this method eliminates the variable effect of the clinician's hand size and placement [13,44].

In the "G method" used in the determination of the ventrogluteal site, the nurse places the lower part of the palm to the greater trochanter of the femur to determine the injection site. The rate of correct responses to the statement "The injection site is the site below the iliac crest and above the imaginary cross line that connects the posterior superior iliac spina with the greater trochanter of the femur" is 42.4%. It was observed that the correct answers given to this statement increased in the training group (BT: 51.0, AT: 62.7). In this method, bone protrusions are taken as reference and imaginary lines are drawn between the bone ends to determine the injection point [13].

The rate of correct responses to the statement "The use of the V method in defining the ventrogluteal site injection site for a more

successful IM injection is more reliable than the G method" was low (17%), and it was observed that there was an increase in the rate of correct responses to this proposition after the training in the training group (BT: 2.0%, AT: 21.6%). Considering that this site is not widely used now, it may be natural that there is a lack of information about the methods used to determine the site.

Although the "V" method (traditional method, hand method) is preferred because it is a more widely known method in determining the site, in recent years, the "G" (geometric method) method is emphasized to be safer in the studies comparing blood vessels and nerves through ultrasound in the sites determined by both of the techniques[17,18]. It has been stated that the V method is not adopted by many nurses, and this method is not practical due to the differences in the nurses' hand structure and the patient's body structure [45]. In another study conducted on the reliability of location determination methods in ventrogluteal injection, when the injection site was determined using the G method, the presence of a blood vessel under the site was recorded in 15% of the cases, while the presence of a blood vessel under the injection site in 19.2% of the cases with the V method and it has been statistically stated that the G method is significantly more reliable [13]. In the V method, the use of the hand of the nurse applying the injection to determine the injection site increases the uncertainty of the location selection. Using the G method can increase the confidence and use of the clinicians in the ventrogluteal site. The geometrical ventrogluteal site detection method is less subjective and probably more reliable than the traditional V method for successful intramuscular injection results [44]. At the same time, there is information in the literature that the G method is more reliable than the V method in terms of the presence and thickness of the target muscle in the gluteus medius and that the G method is preferred over the V method in weak individuals for a successful intramuscular injection without the risk of bone contact [25].

It was observed that the rate of correct response to the statement "The size of the nurse's hand in the V method to determine the ventrogluteal site injection point can cause errors, especially in children", increased in the educated group. This result is considered as a positive change. Meneses and Marques (2007) stated that in the traditional ventrogluteal method (V method), there is not always a proportional relationship between the size of the hand of the practitioner and the patient's gluteus muscle, and this will lead to the wrong injection sites [43]. Using the nurse's hand to determine the injection site increases the uncertainty of the injection site, the size of the nurse's hand is thought to cause error, especially in children. However, whether the clinician uses the palm or heel of the hand, and the size of the hand will affect the exact position. When the G method is used to define the ventrogluteal site, it is stated in the literature that there is less individual variability in bilateral total tissue thickness and less inter-individual variability in each of subcutaneous fat, muscle, and total tissue thickness [16,44].

The findings obtained in this study show that the education given by the researcher positively affects the knowledge point average. At the same time, it was thought that the training given by the researcher informs the nurses about the VG site and the V and G technique used in injecting the VG site, and the illustrated training booklets and demonstrations that were distributed after the training guided nurses on the VG site the methods used in determining the VG site, and contributed to their awareness of the current information in the field.In parallel with the changes and developments in the field of health, nurses should base their practices on evidence based on science anddirect their practices.

Since injection practices vary based on evidence, IM injection training is an important issue for current education in both state and health institutions. Participating in a training on the use of the VG site for IM injection is effective in raising the level of knowledge, but its effect on creating behavioral change is limited [35].

Any process that justifies steps in decision making and increases the confidence of clinicians in choosing a gluteal intramuscular injection site will improve the injection outcome and hence health outcomes. However, more research and stricter clinical guidelines are needed to encourage optimal decision making on site selection, particularly with regard to injection safety [15].

Conclusion and Recommendations

In this descriptive and quasi-experimental study in order to evaluate the effectiveness of the training on the V and G technique used in VG site and site determination in IM injection application of nurses, the rate of nurses finding the VG site safe was low, and it was determined that there was an increase in the knowledge scores about the methods. In line with the results obtained from the research, the following recommendations have been made.

1. Organizing in-service trainings in hospitals and teaching the nurses working in the clinic about IM injection to the VG site practically and discussing the effectiveness of the application.
2. Sharing the evidence level study results for the G method, V method and VG site in IM injection with the nurses working in the clinic
3. In order to increase the awareness of the VG site, it is recommended to explain why this site should be preferred for both pre-graduate and post-graduate nursing education.

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