

Original Article

Determining the Knowledge Levels of Nursing Students about Intramuscular Injection

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Abstract

Aim: Evaluating the knowledge levels of nursing students about intramuscular injection (IMI).

Methods: The data of the research were obtained from the nursing students of a foundation university in Gaziantep, Turkey. Questionnaire forms of the study were prepared by the researchers in the light of literature, and the ethics committee approval was taken. One demographic information form and two questionnaire forms about the IMI skill were used, where the first included 15 questions about the theoretical knowledge about the IMI skill and the second 16 questions about the attitude towards IMI application steps (Intramuscular injection). The data were analyzed by percentage and chi-square tests.

Results: The majority of students answered most of the statements about IMI correctly. However, no statistically significant relation was not found upon analyzing the distributions of the correct answers in respect to classes ($p>0.05$). It stood out that all classes attained a high level of correct answer to the statement about the dose amount of IMI applied according to age, and there was a statistically significant relation between the distribution of class and the rate of correct answers ($p<0.05$).

Conclusion: It could be said that the students have enough theoretical knowledge about IMI. It is recommended/The researchers recommend to increase the number of studies on this subject and to emphasize that especially the ventrogluteal area be preferred more in the application of IMI.

Keywords: Nurse, Intramuscular, Injection

Introduction

Nursing education is a profession which involves theoretical and practical teaching-learning experiences, and its primary objective is to raise individuals who can fulfill all their potential (Karadag & Ucan 2006). Education is crucial to increase the accumulation of knowledge of nursing and professionalize the profession. Among theoretical and practical courses of nursing, the course titled “Basic Principles and Applications in Nursing –Fundamentals of Nursing” constitutes the basic scientific background for nursing education. The course Basic Principles and Applications in Nursing aims to teach the basic concepts, principles, rules,

methods and techniques of the patient-centered care (Caliskan & Akgoz 2006).

One of the primary objectives of the course is to prepare the students for the job they will be assigned at the end of the education about drug applications which is an important nursing responsibility with ethical and legal liabilities. The education on drug applications is pivotal, since it is emphasized that one of the important points to reduce and avoid drug application faults is to ensure that nursing students review the education of drug applications and define the fields they regard as inadequate (Caliskan & Akgoz 2006; Potter & Perry 2009).

Intramuscular injection has an important place in drug applications, and the intramuscular injection technique is a method frequently used by nurses.

The IMI injection is a method where a medicine is injected into the deep muscular tissue under the subcutaneous tissue (Potter & Perry 2009). Intramuscular injection must be implemented heedfully. Serious complications may arise if correct techniques are not used. It was found in studies conducted that complications stemming from intramuscular injection are frequently observed and most develop due to the lack of knowledge and improper methods used (Potter & Perry 2009). Potential complications are; abscess, cellulite, tissue necrosis, granuloma, tissue fibrosis and contracture, intravascular injection and hematoma (Potter & Perry 2009; Unal & Kasıkcı 2017). Complications stemming from lack of knowledge and implementation flaws can be prevented with education. Therefore, it is vital to train nurses, who take part in all the drug application phases, about drug applications to prevent drug implementation flaws (Herkreader & Hogan 2007; Berman et al 2012). Taking into consideration the cases due to IMI application faults and the financial and emotional losses thereunto, which could be prevented by a better education each passing year and paying more attention, this study, which analyzes the knowledge levels of nursing students about IMI applications, is essential to avoid possible mistakes in the future.

Objective

The aim of this study was to determine the knowledge levels of nursing students about intramuscular injection (IMI) skills. The questions expected to be answered in this research are as follows;

- What are the theoretical knowledge levels of students included in the study about The IMI skills?
- What are the knowledge levels of students about application phases of IMI?
- Do the students' theoretical knowledge levels and attitudes towards application phases differ by grade?

Method

Design: This is a descriptive study. The data of the study were obtained from a health school between April – May 2015.

Participants and Setting

In this study, the sampling method was not used, but the whole population was accepted as sample. A total of 140 nursing students in a health school in the 2014-2015 academic year fall semester were included in the universe of the research. 73 students who were not absent from school in 2014-2015 and accepted to voluntarily to participate in the survey were included in the research. Moreover, insufficiently filled data collection tools were not taken into consideration.

Data Collection Tools

Demographic information forms prepared by the researchers (Karadag & Ucan, 2006; Potter & Perry, 2009; Unal & Kasıkcı, 2017). in line with the related literature (Yapucu & Bicici et al., 2009; Gulnar & Caliskan 2014; Tugrul & Denat 2014; Sagkal et al., 2014) and 2 questionnaire forms consisting of questions about The IMI skills were used to obtain the data of the research. The first questionnaire form includes 15 questions about the theoretical knowledge level of the IMI skill, whereas the second questionnaire form has 16 questions about the attitude towards IMI application steps.

Data Collection

The data were collected by researchers in a class environment at a suitable time and date for the students. On the days the work was done, students were informed about the research and demographic information and questionnaire forms were applied to students who wished to participate in the survey voluntarily. The students filled the data collection tools individually. There was no time limitation. The average answering time varied between 15-25 minutes.

Ethical Considerations

The approval of the local ethics committee of the relevant university (dated 11.03.2015 and numbered 2015-10) and the written permission of the school of health was taken to conduct the research. The students were informed about the research and their verbal consents were taken. The students were informed not to write their names on the data collection tools and that the data obtained from this work would only be used in the scope of study.

Data Analysis and Evaluation: The data were analyzed using the Statistical Package for the Social Science (SPSS 16.0). Percentage and chi-square tests evaluated the demographic characteristics and distribution of the answers.

Limitations of the Study

The research was conducted in one school only, and the results of the study could not be generalized to all the students who study in the nursing departments. These facts constitute the limitations of this study.

Results

The average age of participating students was 20.89 ± 1.93 . While 41% of participants were moderately successful in the Fundamentals of Nursing course, 15.1% showed a high level of success. While 61.6% of participants were female, 49.3% were first-graders, 52.1% were regular high school graduates, 80.8% chose the Nursing Department willingly and 9.6% were employed.

Of the participating students, 97.3% stated that the gluteus maximus muscle was rich in terms of blood vessels and close to the sciatic nerve, while 93.2% named the gluteus maximus and gluteus medius muscles when asked about the ones used for injection; 87.7% stated that 1.5-4.ml drug was administered at once to the dorsogluteal area and 97,3% that the most crucial complication of IMI applied to the dorsogluteal area was the sciatic nerve injury, thus giving right answers. Of the participating students, 47.9% gave wrong answers to the statement that the dorsogluteal region was only used in adults. When asked whether the dorsogluteal region could be used in children under the age of 3, 21.9% of the students gave wrong answers stating that it was possible. 93.2% stated that they asked the patient to take a deep breath before IMI. 57.5% correctly answered the statement about whether the dorsogluteal area could be used or not for irritant and fatty solutions. A clear majority correctly answered the statements related to designating an injection site for IMI in the dorsogluteal region (Table 1).

Table 2 shows the distribution of students' answers about the application steps of IMI. Only 5.5% of the students stated that they do not change the needle tip after preparing the drug for IMI. It stood out that 69.9% of the participatory

students always use the airlock technique in IMI. It was also found that 80.9% keep the needle inside the tissue for 10 seconds after the injection and that 79.5% always use the DG area for IMI. 45.2% of the students rarely used the ventrogluteal region, while 42.5% never used the laterofemoral region.

Furthermore, the study showed that only 8.2% of the students never used the airlock technique. However, it was reported that 84,9% routinely checked for bleeding during IMI. It stood out that 35.6% of the participators distracted the attention of the patient away during the injection. 41,1% of the students remarked that they never applied ice before the IMI, on the contrary, 37% remarked that they applied massage on the area before and after the IMI to decrease the pain.

Students from all grades correctly answered the statement about the injection area by a majority. Moreover, the rate of correct answers of the 1st and 2nd graders was higher than other grades. But no statistically significant relationship was found when the distribution of correct answers by grades was analyzed ($p>0.05$). It was found that all the grades accepted the sciatic nerve injury as the most vital complication from among the statements about the complications of IMI. One of the remarkable findings is that the statement about the use of the DG region for infants under the age of 3 was mostly answered as being right, thus wrongly answered by all grades. No statistically significant difference was observed when these answers were analyzed by grades ($p>0.05$). All grades scored a high rate of correct answers to the statement about the dose amount in IMI to be applied according to the age, and there was a statistically significant relation between class distribution and the rate of correct answers ($p<0.05$). Again all the grades scored a high rate of correct answers to the statement about the method to divide the region between crista iliaca and coccyx into three to designate the area of the IMI.

Moreover, there was a statistically significant relation between the rate of correct answers to this information and the distribution by grades ($p<0.05$). It stood out that the 1st graders correctly answered at the highest rate the information about providing asepsis before the injection. It was observed that the statements were correctly answered by the the 1st graders at a high rate upon analyzing Table 3 as a whole.

Table 1. The Distribution of the Answers of Students about Intramuscular Application knowledge

| STATEMENTS | TRUE | | FALSE | |
|--|------|------|-------|------|
| | n | % | n | % |
| 1) The dorsogluteal (DG) region is rich in terms of blood vessels and close to the sciatic nerve. | 71 | 97.3 | 2 | 2.7 |
| 2) The gluteus maximus and gluteus medius muscles are used for the injection. | 68 | 93.2 | 5 | 6.8 |
| 3) The amount of medicine to be given to the dorsogluteal region at once is 1.5-4 ml. | 64 | 87.7 | 9 | 12.3 |
| 4) Depending on the thickness of the layer of fat in the region, the drug could be given to the SC. | 54 | 74.0 | 19 | 26.0 |
| 5) The most important complication in the dorsogluteal region is sciatic injury | 71 | 97.3 | 2 | 2.7 |
| 6) The dorsogluteal region is used only in adults. | 38 | 52.1 | 35 | 47.9 |
| 7) The dorsogluteal region should be preferred for children under the age of 3. | 16 | 21.9 | 57 | 78.1 |
| 8) The needful dose for IM drug implementation is 1.5 ml for the ages between 3-6; 1.5-2 ml for the ages between 6-15; and 2-4 ml for the age of 15 and over. | 67 | 91.8 | 6 | 8.2 |
| 9) When the patient is in the prone position, their toes must be turned inward; when the patient lies over, they must bend their upper leg in the flexion position and place the upper leg in front of the lower leg. | 59 | 80.8 | 14 | 19.2 |
| 10) Before the IM injection is applied, the patient is told to breathe deeply. | 68 | 93.2 | 5 | 6.9 |
| 11) DG is not used for irritant and fatty solution applications. | 42 | 57.5 | 31 | 42.5 |
| 12) The injection area, the right/left hip is divided into four equal parts by horizontal and vertical lines. The upper outer part is again divided into four. The best-fit part in the top and outer area should be selected. | 70 | 95.9 | 3 | 4.1 |
| 13) Crista iliaca superior and coccyx should be divided into three after being combined with an imaginary line, the appropriate area should be selected from the remaining one-third area. | 67 | 91.8 | 6 | 8.2 |
| 14) The injection part is wiped out with an antiseptic tampon outwards from the injection area by 5 cm diameter circular movements. | 64 | 87.7 | 9 | 12.3 |
| 15) The injection must be applied after aseptic solution dries up. | 61 | 83.6 | 12 | 16.4 |

Table 2. The Distribution of the Answers of Students about the Application Steps of IMI

| STATEMENTS | ALWAYS | | SOMETIMES | | NEVER | |
|---|--------|------|-----------|------|-------|------|
| | n | % | n | % | n | % |
| 1) I change the needle tip after preparing the drug during intramuscular injection. | 51 | 69.6 | 18 | 24.7 | 4 | 5.5 |
| 2) In the airlock technique, I pull 0.2-0.3 ml air into the syringe after filling it with the drug | 51 | 69.9 | 13 | 17.8 | 9 | 12.3 |
| 3) I ensure the drug is given slowly at a rate of one milliliter every 10 seconds. | 50 | 68.5 | 20 | 27.4 | 3 | 4.1 |
| 4) I ensure the needle is kept inside the tissue for 10 seconds more after the injection. | 59 | 80.9 | 25 | 34.2 | 21 | 28.8 |
| 5) I rapidly draw the needle from the tissue with a single move. | 21 | 28.8 | 8 | 11.0 | 6 | 8.2 |
| 6) I frequently use the dorsogluteal region during intramuscular injection. | 58 | 79.5 | 9 | 12.3 | 6 | 8.2 |
| 7) I usually use the ventrogluteal region while applying the intramuscular injection. | 12 | 16.4 | 33 | 45.2 | 22 | 30.1 |
| 8) I usually use the laterofemoral region while applying the intramuscular region. | 12 | 16.4 | 30 | 41.1 | 31 | 42.5 |
| 9) I use the airlock technique during intramuscular injection. | 41 | 56.2 | 26 | 35.6 | 6 | 8.2 |
| 10) I check for bleeding during intramuscular injection. | 62 | 84.9 | 6 | 8.2 | 5 | 6.8 |
| 11) I arrange the length of the needle according to the patient's condition (in cachectic patients, infants, obese patients, etc.). | 62 | 84.9 | 8 | 11.0 | 3 | 4.1 |
| 12) I apply intramuscular injection with a 90 degree angle | 60 | 82.2 | 8 | 11.0 | 5 | 6.8 |
| 13) I try to distract the attention of the patient away before intramuscular injection. | 17 | 23.3 | 26 | 35.6 | 11 | 15.1 |
| 14) I apply ice before intramuscular injection to reduce the pain. | 17 | 23.3 | 26 | 35.6 | 30 | 41.1 |
| 15) I apply massage to the region to ensure the pain is reduced and drug is absorbed after intramuscular injection. | 27 | 37.0 | 27 | 37.0 | 29 | 39.7 |
| 16) I apply manual pressure to the region before IMI to reduce the pain after injection. | 27 | 37.0 | 25 | 34.2 | 21 | 28.8 |

Table 3. The Distribution of the Answers of Students about Intramuscular Implementation Knowledge by Grades

| Statements | 1 st Grade | | | | 2 nd Grade | | | | 3 rd Grade | | | | 4 th Grade | | | | x ² | p |
|---|-----------------------|------|-------|------|-----------------------|------|-------|------|-----------------------|------|-------|------|-----------------------|------|-------|------|----------------|---|
| | True | | False | | True | | False | | True | | False | | True | | False | | | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | | |
| 1) The dorsogluteal (DG) region is rich in terms of blood vessels and close to the sciatic nerve. | 35 | 97.2 | 1 | 2.8 | 12 | 92.3 | 1 | 7.2 | 3 | 100 | 0 | 0 | 21 | 100 | 0 | 0 | .59 | |
| 2) The gluteus maximus and gluteus medius muscles are used for the injection. | 36 | 100 | 0 | 0 | 11 | 84.6 | 2 | 15.4 | 3 | 100 | 0 | 0 | 18 | 85.7 | 3 | 14.3 | .10 | |
| 3) The amount of medicine to be given to the dorsogluteal region at once is 1.5-4 ml. | 34 | 94.4 | 2 | 5.6 | 10 | 76.9 | 3 | 23.1 | 2 | 66.7 | 1 | 33.3 | 18 | 85.7 | 3 | 14.3 | .23 | |
| 4) Depending on the thickness of the layer of fat in the region, the drug could be given to the SC. | 30 | 83.3 | 6 | 16.7 | 8 | 61.5 | 5 | 38.5 | 3 | 100 | 0 | 0 | 13 | 61.9 | 8 | 38.1 | .14 | |
| 5) The most important complication in the dorsogluteal region is sciatic injury | 36 | 100 | 0 | 0 | 13 | 100 | 0 | 0 | 3 | 100 | 0 | 0 | 19 | 90.5 | 2 | 9.5 | .16 | |
| 6) The dorsogluteal region is used only in adults. | 19 | 52.8 | 17 | 47.2 | 5 | 38.5 | 8 | 61.5 | 2 | 66.7 | 1 | 33.3 | 12 | 57.1 | 9 | 42.9 | .69 | |
| 7) The dorsogluteal region should be preferred for children under the age of 3. | 9 | 25.0 | 27 | 75.0 | 3 | 23.1 | 10 | 76.9 | 0 | 0 | 3 | 100 | 4 | 19.0 | 17 | 81.0 | .76 | |
| 8) The needful dose for IM drug implementation is 1.5 ml for the ages between 3-6; 1.5-2 ml for the ages between 6-15; and 2-4 ml for the age of 15 and over. | 36 | 100 | 0 | 0 | 9 | 69.2 | 4 | 31.8 | 3 | 100 | 0 | 0 | 19 | 90.5 | 2 | 9.5 | .03* | |
| 9) When the patient is in the prone position, their toes must be turned inward; when the patient lies over, they must bend their upper leg in the | 26 | 72.2 | 10 | 27.8 | 11 | 84.6 | 1 | 7.7 | 2 | 66.7 | 1 | 33.3 | 20 | 95.2 | 1 | 4.8 | .09 | |

flexion position and place the upper leg in front of the lower leg.

| | | | | | | | | | | | | | | | | | |
|--|----|------|----|------|----|------|---|------|---|------|---|------|----|------|----|------|-------------|
| 10) Before the IM injection is applied, the patient is told to breathe deeply. | 33 | 91.7 | 3 | 8.3 | 12 | 92.3 | 0 | 0 | 3 | 100 | 0 | 0 | 20 | 95.2 | 1 | 4.8 | .41 |
| 11) DG is not used for irritant and fatty solution applications. | 24 | 66.7 | 12 | 33.3 | 7 | 53.8 | 6 | 46.2 | 2 | 66.7 | 1 | 33.3 | 9 | 42.9 | 12 | 57.1 | .35 |
| 12) The injection area, the right/left hip is divided into four equal parts by horizontal and vertical lines. The upper outer part is again divided into four. The best-fit part in the top and outer area should be selected. | 35 | 97.2 | 1 | 2.8 | 12 | 92.3 | 1 | 7.7 | 3 | 100 | 0 | 0 | 20 | 95.2 | 1 | 4.8 | .86 |
| 13) Crista iliaca superior and coccyx should be divided into three after being combined with an imaginary line, the appropriate area should be selected from the remaining one-third area. | 36 | 100 | 0 | 0 | 11 | 84.6 | 2 | 15.4 | 2 | 66.7 | 1 | 33.3 | 18 | 85.7 | 3 | 14.3 | .05* |
| 14) The injection part is wiped out with an antiseptic tampon outwards from the injection area by 5 cm diameter circular movements. | 32 | 88.9 | 4 | 11.1 | 12 | 92.3 | 1 | 7.7 | 2 | 66.7 | 1 | 33.3 | 18 | 85.7 | 3 | 14.3 | .65 |
| 15) The injection must be applied after aseptic solution dries up. | 32 | 88.9 | 4 | 11.1 | 11 | 84.6 | 2 | 15.4 | 2 | 66.7 | 1 | 33.3 | 16 | 76.2 | 5 | 23.8 | .53 |

Discussion

The IMI a method, which has an important place in drug administrations, is frequently used by nurses (Dinc, 2011; Gunes, Zaybak & Bicici, 2009). IMI is a technique used to inject drug into the deep muscle tissue under the subcutaneous tissue (Dinc, 2011; Hunter, 2008; Nicoll & Hesby, 2002; Potter & Perry, 2009). More than 12 billion drugs are administered via IMI (Nicoll & Hesby 2002). It was observed in studies conducted that complications stemming from IMI are frequent and most of these complications are the result of a lack of knowledge and improper methods used (odger & King 2000; Nicoll & Hesby 2002; Awaidy, Bawikar & Duclos 2006). Indeed, these frequently encountered complications caused by implementation faults and a lack of knowledge could be prevented through education. Therefore, it is of utmost importance to train nurses, who take part in all the steps of drug administration, about drug administration to prevent such flaws (Camiere et al. 2009; Eser et al. 2007; Fontan et al 2003; Kuguoglu et al. 2009; Ozkan et al. 2008; Valentin et al. 2009). According to Taskin et al. (2010), it is a necessity to provide a good basic skills education to nurses during school years.

Students from all grades correctly answered the statement about the DG injection region by a majority. Moreover, the rate of correct answers of the 1st and 2nd graders was higher than other grades. But no statistically significant relationship was found when the distribution of correct answers by grades was analyzed ($p>0.05$). Of the participating students, 97.3% stated that the gluteus maximus muscle was rich in terms of blood vessels and close to the sciatic nerve, while 93.2% named the gluteus maximus and gluteus medius muscles when asked about the ones used for injection.

When asked whether the dorsogluteal region could be used in children under the age of 3, 21.9 % of the students gave wrong answers stating that it was possible. Edeer, Ozdemir et al. (2014) found in their study that 68.7% of the students were aware that the ventrogluteal region was unpreferable for IMI in children under the age of 3 and 79.3% choose the rectus femoris muscle for IMI in the newborn. One of the remarkable findings is that the statement about the use of the DG region for infants under the age of 3 was mostly answered as being right, thus wrongly

answered by all grades. This result hints that the students do not possess a sufficient theoretical knowledge level about the utilization of IMI in age groups.

Of the students, 93.2% stated that they warned the patient to take a deep breath before the injection. During the IMI, taking a deep breath reduces the pain by providing muscle relaxation. According to Kara , although there is a limited number of studies about the subject, it was proven that taking deep breaths relaxed the patient and decreased the pain (Kara 2013; Rodger & King; 2000; Hahn 1991). Additionally, in literature, to provide that the patient takes deep breaths after positioning them is among the steps of IMI (Harkreader et al. 2007; Perry & Potter 2009; Akca Ay 2012; Berman et al 2012). In the light of this information, it could be said that the students had enough knowledge about relaxing the patient and reducing the pain.

Of the participating students, 57.5% stated that the dorsogluteal region cannot be used for irritating and fatty solutions, and thus correctly answered this statement. It is reported in the literature that IMI is particularly used for the injection of the irritant drugs (Harkreader et al. 2007; Perry & Potter 2009; Akca Ay 2012; Berman et al. 2012). The absorption from the dorsogluteal region is slower than the other regions when the pharmacokinetics and pharmacodynamics effects of the drugs are considered (Mittcell & Whitney 2001, King 2003, Diggle & Richards 2007). This slow absorption in the dorsogluteal region can cause drug accumulation in the tissue, and thus toxic effect and overdose (Malkin 2008).

The vast majority of the students correctly answered the statements about how to determine the injection area during IMI implementation to the dorsogluteal region (Table 1). Likewise, it was determined that all the grades scored a high rate of correct answers to the information related to the method of dividing the region between crista iliaca and coccyx into three parts to define the region of IMI. Moreover, a statistically significant relation was recorded between the rate of correct answers to this information and the distribution by the grades ($p<0.05$, Table 3). One of the suggested techniques in literature to determine the correct area during the injection on the dorsogluteal region is to divide the region

between crista iliaca and coccyx into three and to specify 1/3 of the outermost part of this area (Potter & Perry 2009; Herkreader & Hogan 2007; Akca Ay 2008). The reason for specifying the outermost part is to withdraw from the sciatic nerve. Based on the findings, it could be said that the students comprehended this skill in the 1st year theoretically and that the skill became an affective and psychomotor behavior in the next years. Over and above, the statistical significance makes us think that the students comprehended the importance of determining the injection area correctly.

Most of the students correctly answered the statement by stating that 1.5-4 ml of drug is given at once to the dorsogluteal region. Yapucu and Bicici et al., (2009) stated in their research that a large majority of the nurses (72.7%) always considered the suitability of the dose of the drug for the region during the injection. The studies conducted indicated that improper drug dose caused tissue trauma and negatively affected the rate of drug absorption (Engstrom et al. 2000, Potter & Perry 2005).

Only 5.5% of the students did not change the needle tip after preparing the drug for IMI, and 69.9% always used the airlock technique. According to the study by Sagkal, Edeer and Ozdemir et al. (2014), 77.9% of the students changed the needle tip after preparing the drug and 34.5% of the nurses did the same according to the study by Yapucu and Bicici et al., (2009). According to Nicoll and Hesby (2002), the two needle method should be used to minimize ailment during the injection. It was reported in the literature that if the needle is not changed after pulling the drug into the syringe, a blunted needle increases the pain and the glass particles may cause various complications by interacting with the drug when the drug is pulled from the ampoule (Ulusoy & Gorgulu 1996; Engstrom et al. 2000; Potter & Perry 2009). The results of this study which were confirmed by the literature made us consider that the participatory students increased sensibility to this step of the IMI.

It was found that 80.9% of the students kept the needle in the tissue for 10 seconds after the injection. On the other hand, in the study by Nicoll and Hesby, it was determined that only 17.3% of the students did the same. The needle must be withdrawn 10 seconds after the injection to ease the absorption of the drug and to avoid

leaking of the drug ensuring muscle adaptation (Nicoll & Hesby 2002; Potter & Perry 2009). Based on this, it could be considered that a vast majority of the students had sufficient knowledge about this step of IMI.

It was reported that 84.9% of the students always checked for bleeding during IMI. Gulnar and Caliskan (2014) also determined in their study that a large majority of the participating nurses (97.2%) checked for bleeding withdrawing the piston back before injecting the drug. Bleeding control is overemphasized in the literature. The books about "the Fundamentals of Nursing" followed during basic skills education underline bleeding control as one of the major steps of IMI (Karabacak 2010; Harkreder 2012; Akca Ay 2012). Berman, Snyder, Kozier and Erb (2007) stated that the airlock technique reduced tissue trauma and pain during injection preventing drug leak back to the tissue. Another study indicated that the airlock method reduced leakage from the injection area (Quartermaine & Taylor 1995).

The study revealed that all the grades scored a high rate of correct answers to the statement about the dose amount in IMI according to the age, and there was a statistically significant relation between grade and the rate of correct answers ($p < 0.05$). The highest rate of correct answers about providing asepsis before injection belonged to the 1st grades (Table 3).

Taking into consideration the study as a whole, it was observed that the 1st grades scored a high rate of correct answers to the statements. According to the study by Sagkal et al., (2014), 67.3% of the students stated that the maximum dose of drug to be given during injection was 5 ml; and 45.7% stated that the maximum dose of drug to be given to the deltoid muscle is not 3 ml. It is stated in the literature that the dose of drug is 3 ml optimum and 5 ml maximum in IMI, and the maximum dose of drug to be given to the deltoid muscle is 1 ml (Ay & Suzen 2012). As the theoretical knowledge and applications about the basic skills were not examined after the 1st grade, and the competence of these skills of the students from upper grades in practice were not evaluated, these results, which were in parallel with the literature, could stem from the students' performing the requests in line with the information and skills they received during the 1st grade,

The study revealed that 35.6% of the participatory students distracted the attention of the patient away to reduce the pain during injection. It was determined that 41.1% of the students did never apply ice to reduce the pain before IMI, but on the contrary, 37% gave a massage to the area to decrease the pain before and after IMI. Yapucu and Bicici et al., (2009) found in their research that 1.8% of the nurses always reduced the pain of the patient by distracting the attention. Barnhill et al. (1996) remarked that distracting the attention during IMI reduced the pain substantially.

Similarly, Rodger and King stated that distracting the attention of the patient during injection reduced the pain caused by the injection (Rodger & King 2000). Sparks (2001) and Schechter et al. (2007) emphasized that the method to distract the attention is useful to decrease the pain. Taking into consideration the results of the study by Kara (2013), it was observed that IMI applied with the attention distraction method was effective in reducing the pain. Other methods to relieve the pain are ice and massage applications. According to Kara (2013), there are studies in the literature indicating that the local ice application is influential in reducing the pain (Hasanpour et al. 2006; Pamukcu 2008). It could be said that the nursing students do not utilize the local ice application method effectively, despite this application is suggested in the literature and the samples of the present study support it.

It was determined that 79.5% of the participants always used the DG region as the IMI area. 45.2% of the students rarely used the ventrogluteal area, while 42.5% never used the laterofemoral region. It was found that all the grades accepted the sciatic nerve injury as the most vital complication from among the statements about the complications of IMI. Gulnar and Caliskan obtained a similar result. It was found in the study by Gulnar and Caliskan that 85.9% the nurses mostly preferred the dorsogluteal region for IMI and 63.3% never used the ventrogluteal area. Tugrul and Denat (2014) also found in their study that dorsogluteal region was used mostly by nurses for IMI. Sagkal, Edeer, Ozdemir et al. found that 81.2% of the students preferred the dorsogluteal region for IMI in young adults and the reason for this was the farness of the region from the sciatic

nerve. In the same study, 97.3% of the students stated the sciatic nerve injury as the most frequent complication of the injection to the dorsogluteal region. Similarly, in the study by Sagkal et al. students accepted the sciatic nerve injury as the most vital complication of IMI has a lot of risks. Therefore, nurses/student nurses should be aware of the anatomic structure of the region of application and choose the region carefully (Nicoll & Hesby 2002; Small 2004; Potter & Perry 2009). Area selection is important in IMI, as the efficiency of the drug can decrease or increase based on the muscle structure selected (Alannah & Floyd 2007). Denser and greater amounts of drugs must be applied to greater muscles. Furthermore, the body-mass index, muscle development and muscle ratio of the patient should be taken into consideration during the selection of the area. In addition to these, the age, physical condition, muscle and skin structure of the patient should also be taken into consideration (Lala & Lala 2003) The dorsogluteal injection region is frequently preferred for intramuscular injections and used as the traditional injection area. In parallel with various studies in the literature, this study also revealed that students usually chose the dorsogluteal region for IMI.

Conclusion and Recommendations

It could be easily said that a great majority of the students are aware that IMI is an intervention which requires a high rate of attention, sufficient theoretical and application knowledge. It is in evidence that the 1st grade students had a better theoretical knowledge about the application due to the intensive curriculum of the course “Basic Principles and Applications in Nursing” The results hinted that the relative decrease in the evaluation of the basic skills in the higher grades in comparison with the 1st grade had an effect on the results of this study. In parallel with these results, it is recommended that the safer status of the ventrogluteal region compared to the other regions be overemphasized in the “Basic Principles and Applications in Nursing” course; the evaluation related to IMI be increased in the higher grades of nursing education; the evidence-based applications regarding IMI be featured more in the curriculum of the Basic Principles and Applications in Nursing” course; and scientific studies about the theoretical knowledge

and abilities related to IMI be conducted comparing nursing students and clinic nurses.

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