ABSTRACT

Objective: to describe the anatomical measurements of strata ('skin', 'subcutaneous tissue', 'muscle') in the ventrogluteal region in newborns and infants through ultrasonographic images. Method: it is an exploratory and descriptive study, with a quantitative approach, conducted in a university hospital in Maceió/AL/Brazilian Northeast, with 63 children. We used forms with identification data and independent and dependent variables, treated with the Epi-Info statistical program, version Anthro 2007, and linear regression tests. The study had its project approved by the Research Ethics Committee, under the Protocol nº 011490/2010-09. Results: of newborns, 99.9% had not stratum enough to use 25x7mm needle and only 23.3% had stratum for use the 20x5,5mm needle. As for infants, 90,9% had sufficient stratum for the 25x7mm needle and 100% for 20x5,5mm needle. Conclusion: the ventrogluteal region still needs to be further investigated for intramuscular injections in newborns and infants, and this data is a strong indicative for changes in the nursing care practice. Descriptors: Nursing; Intramuscular Injections; Pediatric Nursing.

RESUMO

Objetivo: descrever as medidas dos estratos anátomicos (‘pele’, ‘tecido subcutâneo’, ‘músculo’) da região de ventrólutea em recém-nascidos e lactentes através de imagens ultrassonográficas. Método: estudo descritivo e exploratório, com abordagem quantitativa, realizado em um hospital universitário de Maceió/AL/Nordeste do Brasil, com 63 crianças. Utilizaram-se formulários com dados de identificação e variáveis independentes e dependentes, tratados com o programa estatístico Epi-Info, versão Anthro 2007, e testes de regressão linear. O estudo teve o projeto aprovado pelo Comitê de Ética em Pesquisa, sob o Protocolo nº 011490/2010-09. Resultados: dos recém-nascidos, 99,9% não tinham estrato suficiente para utilização de agulha 25x7mm e apenas 23,3% o tinham para agulha 20x5,5mm. Já os lactentes, 90,9% tinham estrato suficiente para a agulha 25x7mm e 100% para agulha 20x5,5mm. Conclusão: a região ventrólutea ainda precisa ser mais investigada para injeções intramusculares em recém-nascidos e lactentes, sendo este dado um forte indicativo para mudanças na prática assistencial de enfermagem. Descritores: Enfermagem; Injeções Intramusculares; Enfermagem Pediátrica.

RESUMEN

Objetivo: describir las medidas de los estratos anatómicos (piel, tejido subcutáneo y músculo) de la región ventroglútea en recién nacidos y lactantes a través de imágenes ultrasonográficas. Método: estudio descriptivo-exploratorio, cuantitativo, realizado en un hospital universitario de Maceió/AL/Nordeste de Brasil, con 63 niños. Se utilizaron formularios con datos de identificación y variables independientes y dependientes, tratados con el programa estadístico Epi-Info versión Anthro 2007, y tests de regresión lineal. El estudio tuvo el proyecto aprobado por el Comité de Ética en Pesquisa, protocolo nº 011490/2010-09. Resultados: de los recién nacidos, 99,9% no tenían estrato suficiente para utilizar la aguja 25x7mm y apenas 23,3% tenían para aguja 20x5,5mm. Ya los lactantes, 90,9% tenían estrato suficiente para la aguja 25x7mm y 100% para aguja 20x5,5mm. Conclusión: la región ventroglútea todavía precisa ser más investigada para inyecciones intramusculares en recién nacidos y lactantes, siendo este dato un fuerte indicativo para cambios en la práctica asistencial de enfermería. Descritores: Enfermería; Inyecciones Intramusculares; Enfermería Pediátrica.
INTRODUCTION

The intramuscularly (IM) administration of a medicinal drug involves more than the injection of a solution inside of the muscle tissue, but also an assessment about what is the best region and muscle to be selected. Several aspects must be considered in this process, among which, the selection of locations and devices (syringes and needles), besides the patient age.

The locations for the administration of drugs must, unless contraindicated, respect the following order of choice: ventrogluteal region or Hochstetter’s region, dorsogluteal region, anterolateral thigh region and deltoid muscle. Nonetheless, there are still simple issues that bring about doubts and controversies, such as, for example, the most suitable location for IM injections in children, since this group has not yet fully developed its muscle mass.

In care practices in which children require intramuscular medications, it is observed that the application of injections, in most cases, is held in the vastus lateralis thigh region and dorsogluteal. These applications are usually associated with complaints of pain, swelling, fluids return, local paresthesia or even in members.

By considering that, only in the first two months of life, the child is subjected to, at least, five intramuscular injections, the care upon performing this procedure is critical, and is essential having an effective use and application, scientific knowledge about the drug to be administered, the anatomy of the regions, as well as the ability to choose which needle will be used and the best place to be administered. Thus, the best choice must prioritize the location in which there is less risk of possible complications, and the ventrogluteal region, or Hochstetter’s region, is the most recommended for the administration of injectable medications in individuals of any age group, including children.

The ventrogluteal region was firstly studied and described by Hochstetter, in 1955, and has proved to be the safest for IM injections, because it has advantageous characteristics, such as: delimitation of the area with basis on well-defined bone points; region free of major vessels and nerves; more constant layer of adipose tissue; and greater thickness of gluteal muscles. Moreover, the literature has few reports about injuries or complications resulting from this injection type.

METHOD

It is a descriptive and exploratory study, with quantitative design, conducted in sectors like Maternity, Outpatient Unit of Child Care and of Radiology and Images of a university hospital in Maceió/AL/Brazilian Northeast. The population consisted of newborns and infants who had anatomically normal lower limbs, served in these sectors and referred to the Sector of Radiology and Images.

A sample of the voluntary, intentional and accidental type took place by means of prior authorization of the mother/genitor or legal responsible, after signing the Free and Informed Consent Form (FICF). Initially, we showed the research objectives to the responsible, thereby explaining the purposes of the study and noting that, during the survey, there would not be any invasive procedure; that is why we asked them the agreements. The subjects were informed about their freedom to refuse to participate in research or withdraw their consents at any stage of it, without any penalty, and with warranty in relation to the confidentiality of information. Moreover, we asked them to accompany the child until the ultrasonography room.

The study has included patients served in the sector of Maternity and Child Care, in the period from December 2010 to March 2011, and that met the following inclusion criteria: newborns and infants with anatomically normal lower limbs, served/born within the sector of Maternity and Child Care, whose mothers or legal responsible have agreed to the data collection.

The data were collected through a specific form, which contained identification data (independent variables): age, gender, breed, weight, height and BMI, at a first moment. After being referred to the ultrasonography room, the children had their data collected through the examination, the furnished information were: measurement of skin, subcutaneous tissue and striated skeletal muscles, and of anatomical stratum by means of ultrasonographic images. It was necessary to analyze the measurements of anatomical stratum, by comparing them to the 25X7mm needle, which is commonly used for intramuscular injections, and, in that way, check if this region is, indeed, safe for administering IM injections in newborns and infants.
muscle in the gluteus medius and gluteus minimus and in the vastus lateralis thigh region (dependent variables).

The data were organized according to the variables; next, they were organized and treated with the use of statistical resources and, subsequently, analyzed through the Epi-Info program, version Anthro-Plus 2007, which performs statistical tests and proves the obtained data in a universal way, giving accuracy and quality to the study. In this program, the data are compared between the variables (independent x dependent).

For doing comparisons of categorical variables, we used the Kruskal-Wallis Test, which is based on the WHO curves. The data analyzed between the dependent variables (‘skin’, ‘subcutaneous’, ‘muscle’) and independent variables (‘gender’, ‘breed’, ‘height’, ‘weight’) produce a value with a constant p that will be the assessment criteria to determine whether they have or not the same significance. A p value less than 0.05 suggests that the variables are not homogeneous, thus they will present a direct ratio with the analyzed variables.

Moreover, we also used the linear regression tests, which compare the independent and dependent variables. The simple linear regression is a mathematical model to describe the ratio between two variables. The r² is called the coefficient of determination and varies from 0 to 1. It indicates the probability of hitting the value of the variable dependent, having a value of the independent variable. It is noteworthy to highlight that, for Health, values (r²) from 0.2 are already considered good associations.

Due to being a research involving human beings, the project was submitted to the Research Ethics Committee from the Federal University of Alagoas (UFAL) and, subsequently, approved, as Protocol nº 011490/2010-09.

RESULTS

The variables were independently and interrelated analyzed. The independent analysis reached the total sample of 63 children, being 47.61% belonging to the age group of newborns and 52.39% belonging to group of infants. The almost equally split among these age groups enabled the statistical validation of the research, as well as a better visualization of objectives and its scientific evidence for the different age groups.

It was observed that, in the age groups of newborns, two months (11.1%), four months (11.1%), six months (11.1%) and older than one year (11.1%), there is a total of 44.44% of children. This is because, during these months, there is an obligation for vaccines to be administered to the child, according to the immunization schedule of the Brazilian Ministry of Health. There was a predominance of female (63.5%) and mixed color children (49.2%) over white (38.1%) and black children (12.7%). It should be noted that, in determining the color, we took into account the color declared by the mother or legal responsible. We made associations between strata and gender, and strata and breed.

Table 1. Associations between strata and gender (F - female; M - male), and between strata and breed (W - white; M - mixed; B - black). Maceió, AL, 2011.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Skin</th>
<th>Subcutaneous</th>
<th>Muscle</th>
<th>Skin + Subcutaneous</th>
<th>Skin+Muscle + Subcutaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>40</td>
<td>23</td>
<td>40</td>
<td>23</td>
<td>40</td>
</tr>
<tr>
<td>P</td>
<td>1.33</td>
<td>1.43</td>
<td>4.64</td>
<td>4.73</td>
<td>18.79</td>
</tr>
<tr>
<td>Σ</td>
<td>0.28</td>
<td>0.33</td>
<td>3.64</td>
<td>2.92</td>
<td>4.38</td>
</tr>
<tr>
<td></td>
<td>0.21</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03</td>
<td>0.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Breed</th>
<th>Skin</th>
<th>Subcutaneous</th>
<th>Muscle</th>
<th>Skin + Subcutaneous</th>
<th>Skin+Muscle + Subcutaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>24</td>
<td>31</td>
<td>24</td>
<td>31</td>
<td>24</td>
</tr>
<tr>
<td>P</td>
<td>1.37</td>
<td>1.32</td>
<td>3.63</td>
<td>5.08</td>
<td>6.21</td>
</tr>
<tr>
<td>Σ</td>
<td>0.32</td>
<td>0.23</td>
<td>2.73</td>
<td>3.57</td>
<td>3.81</td>
</tr>
<tr>
<td></td>
<td>0.77</td>
<td>0.08</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
</tr>
</tbody>
</table>

In the association between strata and gender, we found a p below than the recommended for the analysis of the dependent variable ‘muscle’ (p=0.03), which demonstrates that the variable ‘gender’ has a ratio with the stratum ‘muscle’, being that, in the studied population, the male gender has a greater muscle stratum, average=21.82, in relation to the female, with average=18.79. In the comparison between strata and declared color, there is a p=0.02 in the dependent variable ‘muscle’, which shows that there is a ratio between the variables ‘color’ and ‘muscle’; the black population has greater muscle stratum, with average of

English/Portuguese

5845
22.72, and the white population has lower stratum, with average of 18.68.

It is also found, in the variable ‘skin+subcutaneous+muscle’, a ratio with the breed, being that the black population has its variable in a greater amount, with average of 30.26. Thus, this stratum shows higher values, in this color; in the white population, it has the dependent variable at its lowest number, with an average of 23.66, with smaller values in this color.

We also made association among anatomical strata and the following variables: age, weight, height and BMI. In order to conduct a better form of analysis, we selected only the results that would provide correlation above 0.36. Thus, below, we will present tables that summarize the distribution of children according to anatomical strata, as well as the association of strata with the respective variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>F Test</th>
<th>P-Value</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.422</td>
<td>0.064</td>
<td>42.9969</td>
<td>0.000000</td>
<td>r^2= 0.41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Association between strata and the variable ‘weight’ (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Association</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Subcutaneous</td>
</tr>
<tr>
<td>X W</td>
</tr>
<tr>
<td>Muscle</td>
</tr>
<tr>
<td>X W</td>
</tr>
<tr>
<td>(Subcutaneous + Skin) X W</td>
</tr>
<tr>
<td>(Subcutaneous + Muscle + Skin) X W</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Association between strata and the variable ‘height’ (H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Association</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Subcutaneous</td>
</tr>
<tr>
<td>X H</td>
</tr>
<tr>
<td>Muscle</td>
</tr>
<tr>
<td>X H</td>
</tr>
<tr>
<td>(Subcutaneous + Skin) X H</td>
</tr>
<tr>
<td>(Subcutaneous + Muscle + Skin) X H</td>
</tr>
</tbody>
</table>

Besides these variables, the dependent variables were compared to the scores of ratio, with the independent variable in accordance with the requirements of the WHO. These scores corroborate the previous findings, as presented below in the variable ‘BMI’.

Table 2. Associations with the independent variable ‘age’, Maceió—AL, 2011.

Table 3. Associations with the independent variable ‘weight’, Maceió—AL, 2011.

Table 4. Associations with the independent variable ‘height’, Maceió—AL, 2011.
By observing all these dependent and independent variables and their scores, we found that the BMI is the best and easiest way to assess the child’s growth. For this research, BMI was the one that better showed a coefficient of correlation with a strong proportion, and it might be one of the best criteria to assess if a child, whether it is a newborn or an infant, can or cannot use the Hochstetter’s region for receiving intramuscular injections.

**DISCUSSION**

We found, through the results, that the sample was relatively homogeneous, with a greater presence of infants in the age groups in which the mandatory vaccinations take place.

After performing the Kruskal-Wallis Test, through analysis between the dependent variables (‘skin’, ‘subcutaneous’, ‘muscle’) and the independent variables (‘gender’, ‘breed’), we realized that there was a $p$ below than recommended for the analysis in the dependent variable ‘muscle’. This means that the variable ‘gender’ has a ratio with the stratum ‘muscle’, being that, in the studied population, the male gender has a higher muscle stratum, which a fact that is mainly resulted from the growth process, as it is influenced by intrinsic (genetic, metabolic, sexual and malformations) and extrinsic factors (environmental). At puberty, for example, growth can reach an average of 9.5 cm/year in males, and 8.3 cm/year, in females. In our age groups, the first year of life is the period in which the human being grows more with respect to time. The differences between genders are usually related to genetic and environmental conditions, but, in general, the male gender has a general constitution larger than the female gender.11-2

Upon discovering a $p=0.02$ in the dependent variable ‘muscle’, we checked that there is a ratio between the variables ‘color’ and ‘muscle’, in which the population of black color has a higher muscle stratum, with average of 22.72, and the white population has a lower stratum, with average of 18.68. We also found in the variable in ‘skin+subcutaneous+muscle’ a ratio with breed, being that, in the black population, this variable is greater, with average of 30.26. Accordingly, in this stratum there are higher values in this color. The white population has the aforementioned dependent variable at its lowest number, with an average of 23.66; with lower values in this color. The specialized literature7 shows that there are some physical differences, besides color, between white and black people, and one of the things is the physical growth, which depending on the environment and their genetic descendants, this growth is more developed, mainly related to the muscular system and skin thickness.

By analyzing associations between anatomical stratum and independent variables, we examined that, in the variable ‘age’, the ration with the strata ‘skin’, ‘subcutaneous’, ‘muscle’ and their associations have strong correlations, which ensures that as age increases, strata and their associations also increase. This proposition was observed in this study and corroborates the assertion that growth is a dynamic and continuous process that takes place from conception to the end of life, and it is expressed by the increased body size.13

With respect to the independent variable, we found that the ratio of the weight with the strata ‘subcutaneous’, ‘muscle’ and their associations, including ‘skin’, has strong correlations with the independent variable, in other words, as the weight increases, the strata and their associations also increase. According to the pediatric literature, the subcutaneous tissue represents and a third of the fat reserves of newborns and infants, and these reserves are directly affected when there are changes in nutritional status, thus they might be reduced or increased. The musculoskeletal tissue in newborns already has a genetically determined number of muscle fibers. With growth, there is an increase in length and in width, and fibers are organized into muscle bundles. This growth is conditioned by nutritional factors and physical exercises. In fact, skin is closely influenced by body composition of the child.
As for the association between the strata and the variable ‘height’, we observed that the same event occurs in height and in cases of other variables. The strata increase as the height increase, since in healthy children, in full growth and development, as time goes by, weight and height and, consequently, their tissues are developed, such as skin, subcutaneous tissue and muscles in general. For newborns, the growth parameter is their weight gain rates, which must be around 25-35 g/day. Moreover, the increase in length of the “first month” is quite variable, but can reach 3 cm.

As for infants, until the age of three months, the growth is mainly influenced by extra-uterine environment and diet. The growth is analyzed with a weight gain ratio of 25 to 30 g/day, and the height with a ratio between 1 to 2 cm/month. The average weight of a newborn is approximately 3.400g. Nevertheless, in most infants, average weight ranges from 2.700g to 4.000g. In the second quarter of life, the average daily gain drops to 15-20 g/day, and in the third half of the first year can reach up to 10 g/day. In general, the child doubles its birth weight between the fifth and sixth month and triples it around its 12 months of age. From the 12 months, the weight gain until the two years of age ranges from 2 to 3 kg/year. With respect to height, newborns are generally conceived with a range from 48 to 53 cm; on average, there is an increase of 15 cm in the first half - and more 10 cm in the second. In the second year of life, this gain should be above 10 cm.11-2

By assessing these variables, it is necessary to cite that, although the ratio between the increase in age, weight and height and the consequent increase of the strata being considered good, it does not guarantee the necessary measurement to intramuscular injections with the 25X7mm needle in the surveyed age groups. That is because, according to the distribution of children in line with the analyzed anatomical strata, from the 63 study participants, 34 (53,95%) showed a total stratum up to 25mm.

Thus, it appears that, in our population, 99,9% of newborns (NB) did not have stratams enough to use 25X7mm needles in the Hochstetter’s region. As for infants, 90,9% had sufficient stratum to use 25X7mm needles in the same region. By comparing these stratams with a second needle, which is frequently used in children in a extent of 20X5,5mm, we found that only 23,3% of newborns had sufficient stratum for use this needle in the Hochstetter’s region. As for infants, 100% could use the 20X5,5mm needle in the Hochstetter’s region.

This finding runs against what many scholars argue15-6, when they say this is the best area of the body for applying injections at all ages, including premature babies. Other authors also claim that the ventrogluteal region (Hochstetter) is indicated for accomplishment of the hepatitis B vaccine (Butang®) in newborns and infants, since the seroconversion rate found in their studies was the same, both in newborns (NB) who took all the three doses in the vastus lateralis region and in those who took them in the ventrogluteal region. In addition, the found reactogenicity had a higher proportion in children who have had the vaccine injected into the vastus lateralis thigh muscle. Such research made use of the 20X5,5mm needle for conducting intramuscular injections in the two regions.17

It is noteworthy to mention that these statistical analyzes are generalists, since they are suitable for everyone, particularly when working with children. It is necessary for the nursing professional to use the ruse of reason and to summarily analyze if the child can receive or not an injection in the Hochstetter’s region. Another independent variable in this study was the BMI, which showed a good indicator to assess the possibility of using or not the Hochstetter’s region in newborns and infants for conducting intramuscular injections. By observing all dependent and independent variables and their scores, we found that the BMI is still the best and easiest way to assess the child's growth For this research, BMI is the one that better showed a coefficient of correlation with a strong proportion, and might be one of the best criteria to assess if a child, whether it is a newborn or an infant, can or cannot use the Hochstetter’s region for receiving intramuscular injections.

With these results, we can say that, in relation the 25X7mm needle, the Hochstetter’s region is still not completely safe to be the best place for conducting intramuscular injections in newborns and infants. Thus, it becomes necessary to carry out a deeper research, with larger population and comparisons with needles of smaller calibers. The Brazilian literature is still scarce of information about the issue at stake.

In spite of having been introduced in practice since 1954, by the Swiss anatomist Von E. Hochstetter, this region is poorly known, explored and used by health professionals, that is why the manuals and protocols that establish the general features
and standardize the techniques for administering vaccines in the network of health services still not included the ventrogluteal part among the places of choice.19

CONCLUSION

There is a necessity to seek new forms of care aimed at efficiency and effectiveness of actions, which are contained in nursing care. The studies on the application of injections are not frequent, but can bring significant contributions to achieve a safer nursing practice.

The ventrogluteal region is a part for long studied and disseminated in academia. In other countries, this region has already been used for more than 20 years as the safest place for conducting intramuscular injections. In Brazil, despite being taught in nursing schools, this location is little used and, very often, understated by nursing staffs, even being proven as the safest region.

By following the national line of surveys focusing this region, we seek to analyze a little explored area, the relationship of this region in children, especially in newborns and infants. According to the data obtained, with respect to the needle 25X7mm, which is mostly used for performing intramuscular injections, newborns should not use the Hochstetter’s region for intramuscular injections, while infants might use it, but with caution. The ideal would be to define what would be the proper age to a child to receive intramuscular injections in the Hochstetter’s region. For this reason, this research was the first step towards a deeper investigation, which might entail in changes to the standard of care practice for many years performed in the nursing scope.

We believe that the evidence of this study might add to the already obtained knowledge in relation to the practice of injections and administration of intramuscular substances, especially because it can support decision makings regarding the choice of the most appropriate location for applying vaccines and medications in children, thereby contributing for reducing injuries, besides enhancing the care quality and the efficiency of the substances in the population at large.

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