Use of vastus lateralis instead of ventrogluteal site for intramuscular injection of anesthetic drug in children: Is it an appropriate option?

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Abstract

Background

Intramuscular injection is a method of systemic administration of drugs with high absorption rate to the circulation. Traditionally gluteal muscle was utilized for IM injection mainly dorsogluteal region. Because of the nearby vital structures including nerves and blood vessels with reported complications, new approaches have applied including Ventrogluteal (VG), Vastus lateralis (VL) and deltoid muscles. Proper selection of the site is essential for successful blood concentration. In children, not all approaches are easy, as they require special and proper control of child movement.

Objectives: to determine and compare the time to sedation and the adverse reactions following the administration of IM injections at the VL and VG sites.

Methods

Forty-seven children aged between 2-6 years were presented for MRI examination under sedation from 1st of January to 31st of August, 2021. They received intramuscular injection of Ketamine 4 mg / kg to provide stability and artifact free images. They were assigned randomly into two groups: The First group received IM injection in the vastus lateralis muscle and the second group in the ventrogluteal region. They were assessed for withdrawal, drug leak, degree of movement and child resistance, bleeding at injection site and time to sleep.

Results

Out of 47 patients, 24 were subjected to vastus lateralis injection and 23 at the ventrogluteal region. The mean age was 4.1±1.6 years and mean weight was 16.6 ±4.1 Kg. Needle withdrawal was seen only in 4 (17.4\%) patients of the VG group with marginal significant statistical difference. Time for sedation was shorter in VL group with less anxiety or resistance during injection.

Conclusion

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Both regions are of great value for anesthetic drug injection however, the vastus lateralis is safer with regard of patient stability during injection process and shorter time for sedation, which is of great importance to the anesthesiologist.

Introduction

Intramuscular injection is an alternative method of systemic administration of drugs with high absorption rate to the circulation (1-3). As with any intervention it is associated with some complications like nerve injury (4). Therefore appropriate site selection and proper injection maneuvers help in reducing such events (5-7). A known practice of aspiration before intramuscular injection is no further recommended (8). Flexion of the hip is a usual reflex that can cause accidental withdrawal of the needle and drug excursion and this should be cautiously observed. Traditionally nurses and medical staff utilized gluteal muscle for intramuscular (IM) injection mainly dorso-gluteal region (9). Because of the nearby structures, including nerves and blood vessels with reported complication, new approaches have been applied and investigated. Many sites were suggested instead of this. Ventrogluteal (VG), Vastus Lateralis (VL), and deltoid muscles are among safe sites (9).

Proper selection of the site is essential for successful blood concentration. Needle injection is stressful to the child and those who were exposed to previous injection may have emotional upset (10, 11). Children presented to supportive investigations as MRI and CT scanning usually exposed to needle injection in laboratory for blood withdraw or for cannulation. These increased the impact over the child. Furthermore, unintentional limb withdrawal during injection can result in needle malposition and deposition of drug into subcutaneous tissue. Most literatures mention intramuscular injection in children for vaccination and some for therapeutic injection of medications. This study was performed to determine and compare the time to sedation and the adverse reactions following the administration of IM injections at the VL and VG sites.

Patients and Methods

The research was conducted between 1st of January and 31st of August including children presented to Basrah University Medical Center for elective magnetic resonant imaging scanning. The participants were randomly assigned into two groups; group VL receive intramuscular injection via vastaus lateralis and group VG those who have the injection through ventrogluteal route. Children who fulfilled the
class I and II criteria of the American Society of Anesthesiologists (ASA) classification system were included in the study. Patients with muscle deformity, limb disability, failure to obtained consent, were considered as exclusion criteria.

All patients were instructed to fast for 4 hours before the examination time. Ketamine is a water-soluble phencyclidine derivative was used as a sedative agent in a dose of 4 mg/Kg body weight as recommended as a sole agent. The vial cover is sterilized with alcohol, the drug is aspirated and a 25 gauge, 25 mm long needle was used for injection. The injection site is decontaminated with antiseptic and administration done by the anesthesiologist who observes the patient. Immediately after injection, notes were documented including any drug leak from injection site, needle withdrawal during the process due to child movement, child resistance to receive the injection, bleeding from the site, and the time required to sleep. Pulse rate, Spo2, and respiratory pattern were monitored for all patients.

The parents were informed about the procedure of administration of IM injections and an informed consent was obtained from the parents before enrolling their children in the study. The Ethics Committee of College of Medicine, University of Basrah, approved the study.

Data were analyzed using Statistical Package for the Social Sciences (SPSS), Version 22, (IBM Corp, Armonk, New York, USA). A P value of <0.050 was considered to be statistically significant.

Results

The total number of children included in the study was 47 patients, 34 (72.3%) of them were boys and 13 (27.7%) were girls. The mean age of the participants was 4.1±1.6 years. The subjects who received the intramuscular (IM) injection at the vastus lateralis muscle was 24 children and form the study group, while those who received the IM injections at Ventro-gluteal muscle represent the comparative group.

No significant differences were noticed between the two groups regarding weight, age, and gender distribution. [Table 1]

| Table 1 General characteristics of the study population |
|---------------------------------|-------------------------------------------------|----------|
| Variable                        | Vastus lateralis (No. 24) | Ventro-gluteal (No.= 23) | P-value  |
| Age (years); Mean ± SD          | 4.3±1.4                        | 3.9±1.8                     | 0.393    |
| Weight (Kg); Mean ± SD         | 16.6±3.8                        | 16.7±4.7                     | 0.927    |
| Boys; No. (%)                  | 17 (70.8)                        | 17 (73.9)                     | 0.999    |

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With injections at the VL and VG sites, no statistically significant difference was found between patients’ resistance to receive the injection (P= 0.114). However, it was seen that with the VL site, none of the patients showed moderate resistance whereas with the VG site, 13% of the patients showed moderate resistance. Likewise, no statistically significant difference was found between the two groups regarding the time to sedation (P=0.114). Nevertheless, it was seen that with the VL site, the mean time required for sedation was slightly shorter. Needle withdrawal was reported only in the VG group (17.4%) with marginal significant level (P=0.05). [Table 2]

Table 2 Comparison of time required for sedation and reactions to injection among the study groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Vastus lateralis Group No. (%)</th>
<th>Ventro-gluteal Group No. (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needle withdrawal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>24 (100.0)</td>
<td>19 (82.6)</td>
<td>0.05</td>
</tr>
<tr>
<td>Yes</td>
<td>0 (0.0)</td>
<td>4 (17.4)</td>
<td></td>
</tr>
<tr>
<td>Leak</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>22 (91.7)</td>
<td>20 (87.0)</td>
<td>0.666</td>
</tr>
<tr>
<td>Yes</td>
<td>2 (8.3)</td>
<td>3 (13.0)</td>
<td></td>
</tr>
<tr>
<td>Bleeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>23 (95.8)</td>
<td>22 (95.7)</td>
<td>0.999</td>
</tr>
<tr>
<td>Yes</td>
<td>1 (4.2)</td>
<td>1 (4.3)</td>
<td></td>
</tr>
<tr>
<td>Resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>21 (87.5)</td>
<td>15 (65.2)</td>
<td>0.114</td>
</tr>
<tr>
<td>Mild</td>
<td>3 (12.5)</td>
<td>5 (21.8)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>0 (0.0)</td>
<td>3 (13.0)</td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time required for sedation (Minutes)</td>
<td>17.7±2.9</td>
<td>18.8±1.5</td>
<td>0.114</td>
</tr>
</tbody>
</table>

Discussion

Because of evidence based researches and improvement of technology, the intramuscular injection technique has alerted throughout the last years (12). The patient’s age, patient's condition, the volume and type of medication, and body measurements should be taken into consideration for determining the intramuscular injection technique, which will be applied to the patient (13). The most appropriate area for intramuscular injection remains controversial (14) therefore; many sites were proposed (9). Existing evidence-based researches and literature endorse the ventrogluteal muscle as being the safer site for IM injection in adults (12,15).
However, IM injection into the gluteal area is not suggested for infants, because the depth of the overlying subcutaneous layer varies and the gluteal area is tiny (14).

The vastus lateralis site has received considerable attention in the literature, and recommended by the Royal College of Pediatricians and Child Health as the preferred site for IM injections for infants and young children due to its ease of access (16,17).

The results of this study showed that the adverse effects associated with vastus lateralis route of IM injection including, needle withdrawal, leakage of drug, and resistance to receive the injection were less than that with ventrogluteal site although the associations were not significant. No previous studies are available about such subject to compare with.

The higher rate of resistance and needle withdrawal in VG than in VL group can be explained by that injection in vastus lateralis can be given in sitting position that makes the vastus lateralis more convenient as it is easily accessible so the child feels more comfortable and less anxious when sitting than lying down or on their sides. In contrast, using VG site needs lying prone or on side which makes the child stressful and show considerable resistance as the procedure requires to maintain a position that allows good relaxation of the gluteal muscles (11,18).

Factors other than the site of injection such as age, sex, and weight cannot be claimed as predisposing factors to such discrepancy in outcome between the two groups since there was no significant difference between the two groups regarding these factors. In addition, the same anesthesiologist performed all the injections, therefore no interpersonal bias can be assumed. One limitation should be considered in this study is that the sample size was small. Further studies using a larger sample size are recommended.

**Conclusion**

Both regions are of great value for anesthetic drug IM injection however, the vastus lateralis is safer with regard of patient stability during injection process and shorter time for sedation, which is of great importance to the anesthesiologist.

**Recommendations**

Knowledge update is essential for medical and nursing staff particularly in interventions. Training of medical and paramedical staff on the new approaches of drug administration is recommended to increase their experiences.
Conflict of interest: Nil

References
