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Pediatric Residents' Dexterity in Performing Lumbar Punctures

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ABSTRACT

Introduction: Lumbar puncture (LP) is a commonly needed procedure in pediatric medicine. In teaching hospitals, it is usually taught to junior residents by senior residents.
Objectives: The goal of this study was to determine the dexterity of pediatrics residents in performing this procedure.
Patients and Methods: All pediatric residents of Shiraz University of Medical Sciences were enrolled in this study. A presumptive case, a 6-year-old patient, suspected of meningitis was presented to them and they were asked to perform lumbar puncture on a manikin while they were observed by two attending physicians. A check list containing 14 items was completed for each participant and finally data were analyzed statistically.
Results: The part of lumbar punctures least considered by pediatric residents was using sedation. There were significant differences between residents of different levels regarding sedating the patients and performing LP. However, there were no significant differences between them in regards to infection control and preparing the patient before starting lumbar puncture. Male and female residents were not different in performing any part of lumbar puncture.
Discussion: Pediatrics residents' dexterity in performing lumbar punctures is not ideal. Many of them do not consider using of sedation prior to performing lumbar punctures. With increasing years of education, their attention to sedation of the patient and their technique of LP improves, but their competence regarding infection control does not. It is necessary for them to learn this procedure by frequent theoretical and practical learning sessions.

Keywords: Lumbar Puncture; Pediatrics; Education; Medical

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Implication for health policy/practice/research/medical education:
Pediatric residents are not expert in performing lumbar punctures. They need more frequent theoretical and practical learning sessions.

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1. Background

Lumbar Puncture (LP) is one of the most commonly encountered painful and at the same time essential procedures in pediatric medicine (1), therefore, it should be taught and practiced early in the education of pediatrics residents (2). Performing LP in a sick child may result in anxiety in parents, patients and the practicing doctor. Failure in obtaining cerebrospinal fluid (CSF), or traumatic LP may lead to unnecessary hospitalization or a prolonged antibiotic course. This procedure is often performed in teaching hospitals by the least experienced physicians (3) and unfortunately, it has been proved that unsuccessful and traumatic LPs are especially common when procedures are performed by these non-expert trainees (4). In many teaching centers, procedural skills are taught to the junior residents by senior residents who are still mastering these skills themselves (2). This type of learning is based on the principle "see one, do one, teach one," and bad habits may be passed from the instructor to learners (2). Little is known about how residents develop competence of performing LP or about the errors they make (4).

2. Objectives

The present study was designed to evaluate the pediatrics residents' experiences of performing LP and to find the pitfalls of the teaching methods at Shiraz University of Medical Sciences, Shiraz, Iran.

3. Patients and Methods

All of the pediatric residents (First to third year of training) studying at Shiraz University of Medical Sciences, were enrolled in this cross sectional study. A presumptive case was presented to them and they were asked to perform LP on a teaching manikin (from Kyoto Kagaku company) while considering all of the necessary stages. The presumptive case was a 6-year-old patient, suspected case of meningitis who had no contraindications for LP. It was assumed that parents' informed written consent was obtained. This procedure was done by all of the residents, one by one, separately, only in the presence of two attending physicians. One of them played the role of an assistant for the resident to give him any necessary material and hold the presumptive patient in proper position. The other physician was observing the resident's functioning and marking a prepared check list. The study on all the residents was performed in just one session. Residents were not informed previously about this study.

The check list consisted of 14 items which were believed to be necessary to perform an accurate LP. The items were as follows:

1) Adequate Preparation (including preparing equipment, putting the patient on decubitus position, determining the site of LP).

2) Sedation (including explaining the procedures to the patient, applying local anesthesia, and general sedation for irritable patients).

3) Considering sterility measures (including hand washing, wearing gloves, disinfecting the site with Betadine, and covering the patient with a drape).

4) Correct technique of performing LP (including correct body angle of the patient, correct angle of the needle with respect to the bed, correct cephalad angle of the needle with respect to the body of the patient).

5) Correct request of laboratory evaluation for the obtained cerebrospinal fluid (gram stain, culture, cell count, protein, sugar).

The residents accessed to Lidocaine-Prilocaine (EMLA) cream, Lidocaine vial, and Midazolam vial for sedation of the patient. The endpoint was considered as success in obtaining CSF fluid from the manikin, providing that the correct steps had been fully followed. Each resident after completing the study, was isolated from other colleagues in a separated room, therefore, they could not transfer their data to others. The results of residents' performances were analyzed using SPSS, version 9.0. The data were compared using Mann-Whitney and Kruskal-Wallis tests. P value less than 0.05 was considered significant.

4. Results

A total of 28 pediatric residents participated in this study (14 males and 14 females). For each participant, a check-list was completed. Table 1 shows the mean, median, maximum and minimum of the scores obtained for each part of the procedures.

Table 1. Comparison of Statistical Parameters of Different Parts of Lumbar Puncture

Statistical	Parts of LP			
	Sedation	Preparation stage	Infection control	Technique of performing
Mean	0.68	1.71	3	1.39
Median	0	2	3	2
Minimum	0	0	2	0
Maximum	3	3	4	3
Total Score	3	3	4	3

As shown in the table, the mean score in sedation part was very low, but the mean scores in other parts were higher. Success in obtaining CSF fluid was influenced by some other external factors (e.g. mechanical problems of the manikin). Therefore, no statistical analysis was done on this issue. *Table 2* reveals the comparative performances of the residents in different years of training, which shows a statistically significant difference in the scores of sedation among residents.

There was a significant difference between residents of the first and second year with respect to procedural competence, but no difference between the residents of second and third year. As illustrated in *Table 2*, there were no statistically significant differences in "preparing stage before LP" and "infection control" among the residents of different years. Five out of 28 participants did not request complete laboratory evaluation. Four of them were first year residents and the other one was second year resident. We also compared the male and female residents using the abovementioned criteria (*Table 3*). There were no statistically significant differences between the residents of different genders.

Table 2. Comparison Between Residents of Three Years About Their Ability to Perform Lumbar Puncture (Based on Kruskal-Wallis Test)

Parts of Lumbar Puncture	Year	Number	Mean Rank, Median	P value
Sedation	1	13	10.77 (0)	0.014
	2	8	14.94 (0.5)	
	3	7	20.93 (1)	
Preparation Stage	1	13	15.81 (2)	0.38
	2	8	11.38 (1.5)	
	3	7	15.64 (2)	
Infection Control	1	13	13.62 (3)	0.35
	2	8	13.06 (3)	
	3	7	17.79 (3)	
Procedure	1	13	10.46 (0)	0.024
	2	8	19 (2)	
	3	7	16.86 (2)	

Table 3. Comparison of Male and Female Residents About Their Ability to Perform Lumbar Puncture (Based on Mann-Whitney Test)

Parts of Lumbar Puncture	Sex	Number	Mean Rank (Median)	P value
Sedation	female	14	17.18 (1)	0.056
	male	14	11.82 (1)	
Preparation Stage	female	14	14.93 (2)	0.765
	male	14	14.07 (2)	
InfectionControl	female	14	13.68 (3)	0.535
	male	14	15.32 (3)	
Procedure	female	14	14.21 (2)	0.839
	male	14	14.79 (2)	

5. Discussion

According to the newest guidelines, a desirable LP procedure contains these parts (5):

Part A, before LP, includes:

1) To explain the procedure for the patient and/or parents.

2) To take history and physical examination to exclude contraindications of LP.

3) To prepare needed equipment and materials.

Part B, during the procedure, includes:

1) Sedation which contains nonpharmacologic techniques, local anesthesia with Lidocaine creams or subcutaneous injections, and intravenous Midazolam in irritable patients.

2) Determining the site of LP.

3) Hand washing and wearing gloves.

4) Proper positioning of the patient.

5) Performing LP using a proper needle which is inserted at a correct angle.

6) Sending specimens urgently to the laboratory for cell count, gram stain, culture, and protein and glucose level.

In the present study, it was revealed that sedation of the patient before LP is the most neglected part of the

procedure by the pediatric residents. Although pediatric procedure textbooks dictate that, "withholding local analgesia for this procedure is strongly discouraged" (6), still incorrect perception of pediatric pain persist among the pediatric residents today. Unfortunately, performing LP on a non-sedated child will decrease the chance of successfulness of the procedure and also cause some physical and psychological problems for the child (4, 7, 8). Previous studies revealed that sedation before LP is considered by pediatric residents less than emergency medicine residents (2), and pain management is done suboptimally before LP procedure (9, 10). Also, it is reported that one of the most important risk factors for dry-tap or traumatized LP, is performing this procedure on a non-sedated patient (3, 9, 11). Our study demonstrates that with increasing years of residency, the residents' attention to sedation increases. Acquiring the knowledge of using sedation before emergency procedures is achievable by theoretical classes as well as proper guidelines (11) and it is not necessary for years to pass to develop this knowledge.

As expected, the residents' skills in performing LP increased with each year of education. The same results have been found in previous studies on internal medicine residents (12), but as it is stated by Taitz J et al. early formal teaching sessions using a pediatric manikin can lead to marked improvement of their abilities to perform LP (13). Simulator-based training in other pediatric procedures is also encouraged (14-17). Five first-year pediatric residents did not know the exact laboratory tests that are necessary for CSF obtained from a patient suspected of having meningitis. This knowledge is also achievable by theoretical classes and proper guidelines. This study also showed that with increasing years of education, pediatric residents' competence did not improve regarding some important points including "infection control measures" and "preparation of circumstances". These two important points can be emphasized in both theoretical and practical courses.

Pediatrics residents' dexterity in performing lumbar punctures is not ideal, and it can lead to failure of the procedure or increasing rate of complications such as infection or psychological problems. It is recommended that theoretical and practical learning sessions be performed annually by attending physicians, and pediatrics residents' dexterity be evaluated regularly.

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Authors' Contribution

Hossein Moravej contributed to the conception and design of the study, analysis and interpretation of data, collection, assembly of raw data, done statistical expertise, final approval of the study and was guarantor of integrity of the entire study. Saeedeh Haghbin contributed to analysis and interpretation of data, collection, assembly of raw data, did statistical expertise, final approval of the study and was guarantor of integrity of the entire study. Seyed Mohsen Dehghani contributed to provision of study material or patients, analysis and interpretation of data, collection, assembly of raw data, and final approval of the study and was guarantor of integrity of the entire study.

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