

Assessment Nurses' Pitfalls of Lumbar Puncture Procedure for Children with Meningitis

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Abstract: Background: Meningitis is an inflammation and swelling of the membranes that cover the brain and spinal cord. It could be fatal or cause serious lasting side effects. It is imperative that pediatric nurses have the knowledge and training related to lumbar puncture to ensure a positive process for child. **Purpose of the study was:** to assess nurses' pitfalls of lumbar puncture procedure for children with meningitis. **Design:** A descriptive design was utilized. Setting, this study was conducted in Shebin El- Kom Fever Hospital in Menoufia Governorate in Egypt. **Sample:** A convenient sample of seventy nurses worked at the previously mentioned setting. All hospitalized children with meningitis were exposed to lumbar puncture procedure throughout the period of data collection were included in the study. Two tools were utilized for data collection, I- A Structured interviewing questionnaire and, II-An Observational checklist. **Results:** It revealed that there were highly statistically significant differences between nurses' pitfalls on pretest Conclusion, most of studied nurses have nursing pitfalls related to lumbar puncture. **Recommendation:** pediatric nurses should update their knowledge and performance through continued nursing education, training, and frequently attending seminars and conferences based on their needs assessment.

Keywords: Lumbar puncture, Meningitis, Nursing Pitfalls, Children,

Introduction

Meningitis is one of the fatal infections occurring in infants and older children. In acute bacterial meningitis, inflammation of the leptomeninges is triggered by bacteria present in the subarachnoid space. Most common pathogens during first two months of life are Groups B and D streptococci, gram-negative enteric bacilli and *Listeria monocytogenes*. While

children aged 2 months to 12 years children are primarily infected by *S. pneumoniae*, *N. meningitidis*, or *H. influenzae* type b. Prior to immunization, Pneumococcal and *H. influenzae* meningitis were common (Gaieski, 2019).

Meningitis is associated with substantial morbidity and mortality, particularly in children, whose morbi-

mortality remains high, it is estimated that each year, more than 1.2 million cases of bacterial meningitis occur all over the world. Meningitis occurs frequently in neonates and can lead to a number of acute, severe complications and long-term disabilities. An early diagnosis of meningitis in children is essential to reduce mortality and to improve outcome (George, Letha & Bai, 2018). Lumbar puncture is currently the best way to confirm the diagnosis. Clinicians are sometimes reluctant to perform an LP, potentially because of concerns regarding the potential risks of adverse events during the procedure (i.e., hypoxia or bradycardia) or further complication. LP was performed by positioning the child in the right lateral decubitus position, maximally flexed at the waist and neck. The spinal needle was inserted in the L-4 to L-5 vertebral interspace (Abdelmowla, Sayed & Elmagd, 2019).

During lumbar puncture procedure, any patients' movement should be avoided to avoid nerve injury, administer prescribed sedation if required and reassurance may be helpful. Patients usually lies in lateral position, move back closed to edge of bed, draw knees toward chest as tight as possible and flex chin onto the chest. Nurses should follow sterile aseptic technique during procedure (Doherty & Forbes, 2018).

After lumbar puncture, nurses assess patients for any complications, lying flat for 4 hours is recommended, patients' vital signs should be measured, if not contraindicated encourage patients to increase fluid intake and observe puncture site for leakage or bleeding (Lenelle et al., 2020).

For minimizing nursing pitfalls of lumbar puncture for children with meningitis, instructional module was

developed on the basis of the interviews about educational needs and a literature review. It was designed to improve nurses' knowledge of meningitis in children and to make good use of nursing interventions when children undergoing lumbar puncture. The teaching materials were developed before initiating the instructional module. Content regarding the definition, causes, predisposing factors, diagnosis, treatment, and nursing care of lumbar puncture was developed in the form of a booklet (Ajani & Moez, 2020).

The most important and significant factor in the survival of children with meningitis is the standard of nursing care provided to meet their requirements. Thus, the nurse must possess abroad knowledge for different methods of care for children with meningitis and practical skills in the application of therapies directed toward solving of the problems that child exposed to invasive procedures (Nguc & Halim, 2020).

Significance of the Study:

Meningitis is a major public health problem needing timely diagnosis, appropriate treatment, prevention and control. Although the United States and other developed countries have seen a decline in pediatric meningitis, also meningitis continues to cause high morbidity and mortality globally (Luksic, Mulic & Falconer, 2015). Meningitis in children takes the form of sporadic cases with a rate of 1.5/100,000 and 20/100,000 population in the developed and developing countries, respectively. A minimum of 890,000 cases are estimated to occur per year in Ethiopia. Among them, 160,000 and 135,000 are disabling and fatal cases, respectively (Tewabe et al., 2018).

The Lumbar puncture (LP) which consequently might leads to significant

morbidity and mortality rates as the number of children who die during 2017 in Egypt has reached 119 children, therefore this study to shed light on pitfalls of nurses during LP procedure by applying instructional module for nursing pitfalls on LP for children with meningitis, also number of infected children who less than fifteen years of meningitis in 2019 has reached 184 children in Shebin El-Kom Fever Hospital in Menoufia Government (Ministry of Health, 2019).

This study was designed in a trial to assess pitfalls during lumbar puncture, as during study Observe nursing pitfalls of lumbar puncture procedure as hand washing before wearing sterile gloves, not explain procedure to child and parents, not place blue paper drape over insertion site, not assess pain after procedure, not monitor child for complication after procedure.

Purpose

The purpose of this study to:

- Assess nurses' knowledge and practices about meningitis and lumbar puncture procedure.
- Assess nurses' pitfalls of lumbar puncture procedure for children with meningitis.

Research Questions:

- Do nurses have an appropriate Knowledge about meningitis
- Do nurses have an appropriate Knowledge about lumbar puncture
- Do nurses perform pitfalls on lumbar puncture for children with meningitis?

Method

This section describes research design, setting, sampling technique, data collection instruments, data collection procedure, pilot study and data analysis.

Research Design:

Descriptive study research design was utilized for this study.

Research Setting:

This study was conducted in Shebin El-Kom Fever Hospital in Menoufia Governorate.

Sampling:-

A convenient sample of 70 nurses employed at the previously mentioned setting. All hospitalized children with meningitis were exposed to lumbar puncture procedure throughout the period of data collection were included in the study. Inclusion criteria for children: Children who had more than one lumbar puncture during data collection period.

Data collection instruments:

In order to achieve the purpose of the study, two instruments were utilized for data collection.

Instrument 1: A Structured interviewing questionnaire

To assess nurse's knowledge related to meningitis, lumbar puncture and nursing care for children with meningitis during lumbar puncture, it was developed by the researcher. It consists of three parts as the following:

- **Part I: Characteristics of Nurses:** It includes age, education level, gender, years of experience and attendance of previous training programs or workshops related meningitis in children.
- **Part II: Characteristics of Children:** It includes age, gender, residence, season of admission, obligatory vaccination, duration of illness, and clinical picture on admission.

▪ **Part III: Nurses' Knowledge**

- **Meningitis:** It includes thirteen open end questions to assess nurses' knowledge about meningitis.
- **Lumbar Puncture Procedure:** It contains ten open end questions to assess nurses' knowledge about lumbar puncture procedure.
- **Nursing Performance** for Children with Meningitis and lumbar puncture: It includes ten open end questions to assess nurses' knowledge about nursing care. The scoring system for this part is: A question was scored as the following, each point of the "correct" answer scored by one score, and zero point to the "incorrect" answer. Total score (100%) of questions were collected and accordingly scores of nurses' knowledge were categorized as follows:
 - Good knowledge scored more than 75% of total score.
 - Average knowledge scored from 50- 75% of total score.
 - Poor Knowledge less than 50% of total score.

Instrument 2:

Nursing Practice Observational Checklist:

To assess nurse's practices before, during, and after lumbar puncture procedure. It developed by the researchers guided by Celik, Ooal & Apiliogullari, (2019), it includes: Nurses' practices before, during, and after lumbar puncture.

The scoring system for this part is: Each step of observational checklist scored as the following: (2) for adequately done, (1) for inadequately done and (0) for not done. The total practice (100%) for study nurses was categorized as the following:

- Satisfactory practice (more than 75% or equal) of total score.
- Unsatisfactory practice (50% to less than 75%) of total score.

Validity:

For validity assurance purpose, instruments were submitted to a jury of five specialists (two professors and one assistant professor in Pediatric Nursing Department and one professor and another assistant professor in Pediatric Medicine Department). To modify any required items of the instruments. All required modifications were done.

Reliability

The reliability of instruments was estimated among 10 participants by using test retest method with two weeks apart between them. Tested to determine the extent to which items in questionnaire were related to each other. Then Cronbach's alpha was calculated between the two score. It was 0.78 which indicates that the instruments were good reliability to meet the objectives of the study.

Ethical Consideration

Ethical written approval was obtained from the Scientific Ethical Committee of Faculty of Nursing, Menoufia University.

A verbal and written approval were obtained from nurses after the investigator explained the purpose, nature and benefits of study to them, their right to withdraw from study at any time.

Studied nurses reassured about confidentiality of data and anonymity was respected, ethics, values, culture and beliefs were respected.

Pilot study

Pilot study was conducted on 7 nurses (10% of studied nurses) to assess the clarity of utilized instruments, after instruments were developed and before

starting the data collection to test the applicability, practicability, consistency, clarity and the feasibility of the study instruments and to estimate the needed time for data collection. No necessary modifications were required for instruments, so the pilot study was included in the total sample.

Procedure:

- 1) A written permission: An official permission to carry out the study was obtained from director of the setting after submitting an official letter from the Dean of the Faculty of Nursing Menoufia University forward to the director of the previously mentioned hospital and explaining the purpose of the study and method of data collection.
- 2) At the beginning of the study, the researcher introduced herself for nurses who participated in the study and explained the purpose and outcomes of study.
- 3) Tools were developed for data collection after a review of past, current, local and international related literature including books, articles, periodicals and magazines to get acquainted with the various aspects of the research problem and to acquire the needed knowledge to conduct the study.
- 4) A Structured interviewing questionnaire was unitized the researcher interview each nurse individually to assess nurses' knowledge and the questionnaire took 20 minutes to complete and filled by investigator during actual nurses' work.

Statistical Analysis:

Data was entered and analyzed by using SPSS (Statistical Package for Social Science) statistical package 22 version on IBM compatible computer.

Graphics were done using Excel program.

Quantitative data were presented by mean (X) and standard deviation (SD). It was analyzed using student t- test and ANOVA (F) test.

Qualitative data were presented in the form of frequency distribution tables, number and percentage. It was analyzed by chi-square (χ^2) test. Repeated Friedman Test (type of Chi square test).

RESULTS

Table (1): Demonstrated total mean score and standard deviation of nurses' knowledge about meningitis and lumbar puncture on pretest, it was found that there were highly statistically significant differences on pretest regarding total mean score and standard deviation of nurses' knowledge about meningitis, lumbar puncture, nursing care about lumbar puncture, and total score of nurses' knowledge as P value (<0.01).

Table (2): Illustrates total mean scores and standard deviation of vital signs nurse s' assessment on pretests, it noted, that there were highly statistically significant differences on pretest regarding total mean and standard deviation of vital signs nurses' assessment as P value (<0.001).

Table (3): Reveals total mean scores of nurses' practice of children health assessment on pretest. As indicated in table, the studied nurses had the highest total mean score and standard deviation assessment of children health on pretest.

Table (4): Illustrates total mean score and standard deviation of number and percentage distribution of nurses' pitfalls before, during and after lumbar puncture on pretest. It revealed that there were highly statistically significant differences between nurses' pitfalls on pretest.

Table (5): shows levels of nurses' practice of lumbar puncture on pretest, it revealed that all of studied nurses have unsatisfactory practices on pre-test.

Figure (1): Distribution of Studied nurses According to their Attendance of Training,

most of them (80%) didn't attended training programs in the field of infectious diseases or meningitis, half of them (50%) had meningitis and infection control and the others had one course about basic life support.

Figure (2, 3) : Show Pearson correlation between total score of

children health status, total score of nurses' knowledge and practices, it showed that there were highly statistically significant positive correlation between total knowledge and total practice as P value (<0.01). Also there was highly statistically significant positive correlation between total knowledge and total score of child status as P value (<0.01). Moreover, there was highly statistically significant positive correlation between total knowledge, practice and total score of child status as P value (<0.01).

Figure (1):Distribution of Studied nurses According to their Attendance of Training Programs in The Field of Infectious Diseases or Meningitis

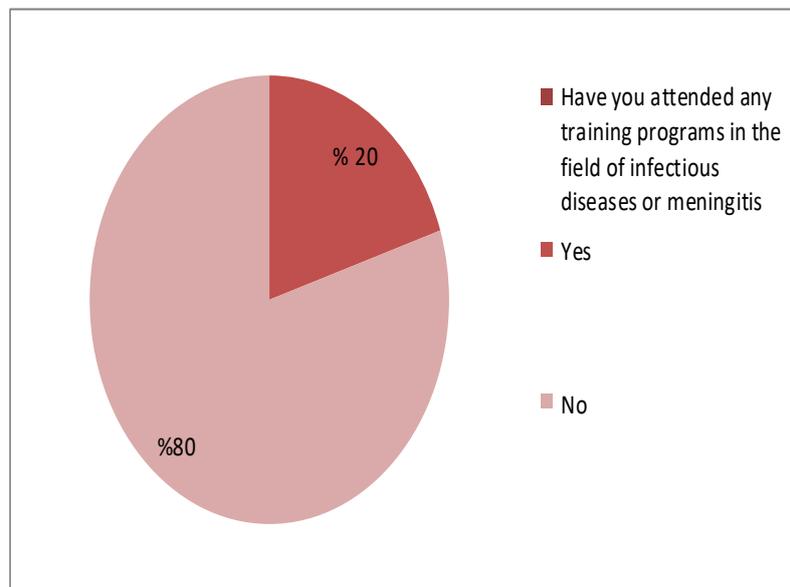


Table (1): Total Mean Score and Standard Deviation of Nurses' Knowledge about Meningitis, Lumbar Puncture and nursing care on pretest.

Items	Pre test X±SD	Anova test	P- value
Meningitis	4.90 ±2.83	248.331	.000**
Lumbar puncture	3.69 ± 3.21	195.164	.000**
Nursing Care about the Lumbar Puncture Procedure	1.91 ±1.92	228.4	.000
Total Score of Nurses' Knowledge	10.50 ±2.83	303.962	.000**

Table (2): Total Mean Scores and Standard Deviation of Vital Signs Nurses' Assessment on Pretest.

X±SD	Pre test	Anova test	P- value
Temperature (Axillary)	6.22 ± 1.58	340.182	.000**
Pulse	4.55 ± 3.64	133.225	.000**
Respiration	3.81 ± 2.14	218.050	.000**
BL P	5.50 ± 2.60	254.889	.000**
Total Score	20.10 ± 9.90	505.506	.000**

Table (3): Total Mean Scores and Standard Deviation of Nurses' Practice regarding Children Health Assessment on Pretest.

X±SD	Pre test	Anova test	P- value
Position for Children	3.95 ± 2.37	430.759	.000**
Fluid balance	2.54 ± 2.55	683.904	.000**
Pain Assessment	0.243 ± 0.69	390.846	.000**

Table (4): Total mean score and Standard Deviation of Nurses' Pitfalls before, during and after Lumbar Puncture on pretest (No: 70).

Items	Pre test X±SD	Anova test	P- value
Before Lumbar Puncture	4.29 ± 0.85	89.78	.000**
General Guidelines for Diagnostic Tests before Lumbar Puncture	6.17 ± 2.21	267.04	.000**
Tray Set-up before Lumbar Puncture	2.20 ± 1.16	55.57	.000
During Lumbar Puncture.	3.84 ± 1.85	63.59	
After Lumbar Puncture	3.31 ± 2.25	25.56	.000**

Table (5): Levels of Nurses' Practices of Lumbar Puncture on pretest (No: 70).

Items	Pre		X ²
	No.70	100%	P1 –value
Unsatisfactory	70	100.00%	140
Satisfactory practice	0	0.00%	.000**

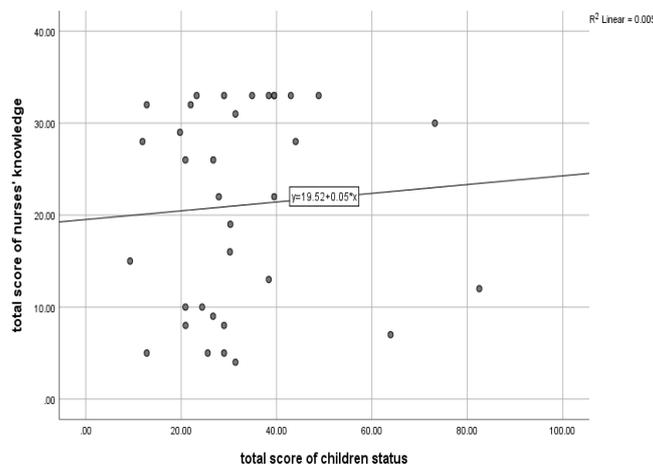


Figure (2): Pearson Correlation between Total Score of Children Health Assessment and Total score of Nurses' Knowledge.

DISCUSSION

Meningitis is a pathology where the quick diagnostic, followed by an effective therapy, impacts the patient's survival and reduction of injuries. Lumbar puncture is a sensitive invasive diagnostic test in which cerebrospinal fluid is extracted for examination and pressure of the cerebrospinal fluid is measured. Nurses should be knowledgeable, skilled and competent to provide high quality care for children. Also, every child want nurses to have a good caring and human attitude, respect them and make them feel with safety and feel comfortable (Obiero et al., 2021).

Therefore, the current study hypothesized that nurses who receive instructional module will have higher level of knowledge regarding their pitfalls of lumber puncture for children with meningitis on post- test than pre-test. Also, children health condition will improve after instructional module for nurses regarding their pitfalls on lumber puncture for children with meningitis.

Regarding characteristics of studied nurses, the results of the current study found that approximately two third of studied nurses aged form 20 to 30 years old. This is elaborate that they are mature enough to tolerate the workload and responsibility of working in a highly specialized area with critically ill children who require meticulous nursing care. This finding was similar to Majd et al. (2020), who study entitled " Evaluation of pre lumbar puncture position on post lumbar puncture headache" concluded that lumbar puncture, is a critical procedure which required skilled nursing assessment of the children's position and status. Moreover, these findings were contradicted with those of Al-Wily (2019), who conducted a study about "Effectiveness of Educational Program on Nurses

knowledge toward Nosocomial Infection at Neonate Intensive Care Unit in Baghdad Hospital" and found that, more than two thirds of the studied nurses aged between 20 to less than 30 years.

In relation to years of experience, it was clear that about one quarter (44.2%) of studied nurses had experience in pediatric nursing for 3 to less than 5years. This result disagreed with Zaki & Hussien (2017), who studied "impact of an educational program on improving nurses' knowledge and practice concerning caring for children with meningitis" and reported that the majority (86.6%) of the studied nurses had years of experience ranged from 5-10 years. It might be due to difference of age of studied sample.

Regarding qualification of studied nurses, current study revealed that more than half (58.6%) of studied nurses had technical nursing institute. This result comes in the line with Elnageeb (2018), who studied " Assessment of Nurses Knowledge Regarding Care Of Child with Meningitis in Soba university hospital (2017 – 2018)" and reported that more than half (59%) of them had Technical Nursing Institute Qualification. This might be due hospital policy regards distribution of newly qualified nurses on critical department.

Also, the result of current study revealed that most (77.1%) of studied nurses were females, such results was in agreed with Atshan & Aburghif (2019), who studied "Effectiveness of an Educational Program on Nurses' Knowledge toward Children with Meningitis at Pediatric Teaching Hospitals in Baghdad City" and reported that more than half of the sample were females. This might be related to lumbar puncture procedure

were scheduled on day shift and usually male nurses took night shifts. Regarding attendance of training program, it was obvious that most (80%) of studied nurses didn't attend training programs. This result agreed with Ahmed, Saad & Khalaf (2019), who reported in a study entitled "Impact of Educational Program About Care of Children With Febrile Convulsion on Nurses Knowledge and Performance" and showed that all of nurses didn't receive training program. Also, this result was supported by Kafli & Bayoumi (2019), and carried out a study entitled "Nurses' Performance towards Care of Neonatal Meningitis: Effect of an Educational Program" who reported that most of studied nurses hadn't previous training regarding infection prevention in neonatal intensive care units. Moreover, these findings were contrary to Hussien et al. (2021), who studied "Effectiveness of Educational Instruction of Nurses Knowledge Regarding Meningitis and Universal Precaution Measures at Selected Department at Minia Fever Hospital" and reported that the most of studied sample had participated in previous training course inside hospital. From the researcher point of view, this might be due to lack of training units in study settings. Regarding nurse's knowledge about meningitis, the results of study illustrated that most of studied nurses had incorrect knowledge regarding definition, method of transmission, incubation period and diagnosis of meningitis on pretest. This result inconsistent with Atshan & Aburghif, (2019), who studied "Effectiveness of an Educational Program on Nurse's Knowledge toward Children with Meningitis at Pediatric Teaching Hospitals in Baghdad City" and mentioned that nurses have good knowledge about definition, method of transmission and diagnosis of

meningitis. From researcher perspectives, effectiveness of instructional module on minimizing nursing pitfalls of lumbar puncture for children with meningitis.

Moreover, this result agreed with Oladele et al., (2020), who studied in a study entitled "Tackling cryptococcal meningitis in Nigeria, one-step at a time; the impact of training" and reported that the most of the studied sample had poor knowledge regarding meningitis. As it was a descriptive study. Also, these results disagree with Attia et al., (2019), who study entitled "The rational clinical examination. Does this adult patient have acute meningitis?" found that nurses' knowledge regarding to meningitis is poor knowledge.

From researcher perspective, poor knowledge on pretest, this might be attributed to nurses abandon reading and neglect updating their professional knowledge. Another possible reason might be the absence of any resources or programs for continued nursing education. Also, might be related work overload.

Regards children health status assessment, the result of current study showed that total mean scores and standard deviation of vital signs nurses' assessment for studied children. This finding was consistent with Jiménez et al.,(2021), who study entitled "Pediatric nursing clinical competences in primary healthcare" concluded that, the specific nursing competencies performed independently in health assessment of patient through the analysis of data exploring nursing competencies performed at workplace. As stated by Chauhan et al. (2020), who carried out a study entitled "Empowering Education: A New Model for In-Service Training of Nursing Staff" concluded that, on-job training and education of nurses

improves their competency and practical skills.

Also, the result was in disagreement with Kafl & Bayoumi, (2019), revealed that the majority of the studied nurses' had competent practices regarding vital signs on post-program implementation with a statistically significant difference.

In relation Pearson correlation between total score of children health status, total score of nurses' knowledge and practices, it showed that there were highly statistically significant positive correlation between total knowledge and total practice as P value (<0.01). This result agreed with Bayomi & Taha (2022), who study entitled "Effect of Self –Learning Package on Nurses' Knowledge and Practice Regarding Arterial Blood Gases Analysis for Critically Ill Patients" found that there was statistically significant positive correlation between studied nurses total knowledge scores and total practice scores throughout phases of self-learning package.

CONCLUSION

Based on the findings of the current study, it is concluded that, studied nurses have an appropriate knowledge about lumbar puncture and have pitfalls related to lumbar puncture.

RECOMMENDATIONS

In the light of the study findings, the following recommendations are suggested.

Recommendation for Nursing Practice

- Continuous job training programs for nurses regarding management of meningitis in children.
- Pediatric nurses should update their knowledge and performance through continued nursing education, training, and frequently

attending seminars and conferences based on their needs assessment

- Continuous evaluation for nurses caring of children with meningitis
- Providing educational guidelines, posters, pamphlets and manuals about meningitis should be available at each nursing station in wards and encourage nurses to get use of them.
- Further studies are recommended on large sample and different setting to accomplish more generalization to study's' results.

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