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A case report on child with pyogenic meningitis

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Abstract

Even though the epidemiology of pediatrics pyogenic meningitis has changed, it is still a feared childhood infection because of substantial morbidity and mortality. It is one differential diagnosis of febrile children with altered mental status and other evidence of neurologic dysfunction. It is a severe, life-threatening infection of the central nervous system. A delay in treatment is associated with poor outcome and should therefore be avoided. And also, up-to-date, scientifically sounded, evidence based and individualized holistic quality nursing care is crucial. This case report is prepared from various evidence-based articles and up-dated guidelines with the aims to aid and facilitate how nurse's approach with pediatric patients presented with pyogenic meningitis.

Introduction

This case study focuses on the biopsychosocial aspects of care given for a pediatric patient who was admitted to University of Gondar Comprehensive Specialized Hospital (UoGCSH), pediatrics main ward wing A bed number 22 with MRN of "++++++" on June 21/2011 E.C. The chief complain of the patient was fever for 04 days and excessive crying for 03 days duration and diagnosed as bacterial (pyogenic) meningitis, based on the diagnosis treated with IV antibiotics and PO anticonvulsant drugs. To safeguard the patient's wellbeing and security (privacy and confidentiality), tried to assign his name and medical registration number as letter "xy" and symbol "++++++" respectively.

Pertinent subjective and objective data were obtained from the historian (biological mother and fathers of the child) and proper physical examination including investigations as well as key patient problems were identified through a holistic assessment by using functional health patterns approach, which is a systematic and standardized approach to data collection and guide for establishing a comprehensive nursing data base.

Functional health patterns enable to determine the following patient aspects of health and human function; health perception – health management pattern (awareness of health and well-being and how health is managed), nutritional – metabolic pattern (food and fluid consumption relative to metabolic need as well as indicators of local nutrient supply), elimination pattern (excretory function of gastrointestinal and urinary), activity – exercise pattern (exercise, activity, leisure and recreation), sleep – rest pattern (sleep, rest and relaxation), cognitive – perceptual pattern (sensory, perceptual and cognitive), self-perception – self-concept pattern (self-concept and perceptions of self (body comfort, image, feeling state)), role – relationship pattern (role engagements and relationships), sexuality – reproductive pattern (age specific concerns), coping – stress tolerance pattern (coping and effectiveness in terms of stress tolerance), value – belief pattern (including spiritual and /or goals that guide choices or decisions) and development and growth patterns (age specific motor, language, personal and social milestones).

NANDA 2018-2020 has been used in the nursing care plan to provide a comprehensive nursing assessment of the patient. Different articles, evidence-based guidelines and textbooks were searched and used to address evidence based biopsychosocial care.

Case description

Baby xy, who is a 22 months old child patient was relatively healthy until 04 days back at when he had fever (febrile to touch) followed by irritable and excessive crying. He was taken to Metema health center and returned home with an unspecified syrup medication. There was no improvement afterwards.

As the historian claimed that, 1and ½ days ago, his symptoms worsened and he experienced seizure with whole body was rigid and loss of consciousness. He also drooled saliva and had up-rolling of the eyes. He was again taken to Metema hospital and given rectal (suppository) medication and referred to UoGCSH for further investigation.

At UoGCSH he was diagnosed with pyogenic meningitis, admitted to main pediatrics ward and treated with ceftriaxone 700 mg IV bid. After midnight he experienced again seizure which was noticed by the historian and duty clinicians, then after he was put on phenytoin 50 mg po bid. Following 03 days ago of medication, seizure subsides.

A few days later, he started experiencing diarrhea. The stool was dark and relatively watery, but it wasn't copious. The frequency was up to 4 times per day with almost 02 days duration. The diarrhea has resolved after 2 days duration. He has no cough and vomiting as well as photophobia.

The patient has been exclusively breast feeding until 06 months. He was breast fed on an average 7 or 8/day (mostly as his need). He did not have feeding interruption. At 6 months, he was started on complementary foods like cow milk and cerifam. He does not experienced diarrhea upon intake of cow milk. He is on breast suckling still now.

The patient is fully vaccinated and Bacillus of Calmette Guerin (BCG) scar on his right upper arm. As historian verbalizes, he pulls to sit at 04 months, sit without support at 6 and ½ months, reach for objects and grasp them at around 4 or 5 months. And also, he smiled in response to face at 2 months, say mama and dada at 10 months. He currently walks alone and runs, uses pen on paper, indicates some desires or needs by pointing (e.g., he points the stethoscope while I examined), plays ball game and feeds self.

He has no history of contact with similar cases. He has fail down history of 01 days back of clinical presentation (fever). He has history of swelling at submandibular area and application of hot iron (as traditional intervention of lymphadenitis, ferentet in Amharic, the local language). He is from a malarious area. He was fumigation history by herbal plants called hareg erasa as a traditional intervention for Mitch (Amharic name). He has no family history of chronic diseases like DM, HTN, HF… etc.

Up on physical examination the patient were well looking, conscious, not in cardio respiratory distress, seems well nourished and no visible dysmorphic features. And also, his vital signs were pulse rate – 103 beat per minute with regular rhythm at right radial, respiratory rate – 27 breath per minute with regular patterns and temperature - 36.7 degree centigrade at axillary. Blood pressure and oxygen saturation was not measured due to lack of instruments.

BF, CBC, RBS, CSF and U/A was done and the result revealed BF = negative, CBC = (Hgb = 12.7 g/dl, Hct = 37.4 %, WBC = 7, 400 cells/mm3, PLT = 43, 000/mm3), RBS = 123 mg/dl, CSF = no cell and U/A = negative.

Discussion

Pyogenic meningitis is a bacterial inflammation of the protective membranes (meninges) covering the brain and spinal cord, mainly leptomeninges i.e. the two innermost layers of the meninges such as pia mater and arachnoid (1)(2)(3). Some common examples of bacterial meningitis are; haemophilus meningitis (caused by haemophilus influenzae type b), meningococcal meningitis (caused by Neisseria meningitidis) and pneumococcal meningitis (caused by streptococcus pneumoniae) (1)(4)(5)(6). It is a severe, life-threatening infection of the central nervous system. Even with appropriate treatment, it is still a feared childhood infection because of substantial morbidity and mortality. It is one differential diagnosis of febrile children with altered mental status and other evidence of neurologic dysfunction (7)(5)(6)(8).

Epidemiology and causes

The epidemiological incidence of pediatrics pyogenic meningitis has changed due routine vaccination; mainly Hib and PCV conjugate vaccine play a great role. As a result, H influenzae, S pneumoniae, and N meningitidis related meningitis is much less common (4)(5)(9)(7).

The causative pathogens of bacterial meningitis depend on the age of the patient and predisposing factors. Different studies showed that the most common pathogens in neonatal meningitis are Streptococcus agalactiae (group B streptococcus, GBS) and Escherichia coli and children beyond the neonatal age H. influenzae type b (in unvaccinated children), N. meningitidis and S. pneumoniae. Most cases occur in children younger than 5 years of age, with the highest risk being in infants aged 2 to 12 months (5)(7)(10)(11) (12)(13)(14).

The common predisposing factors for bacterial meningitis among pediatrics age groups include, being immunocompromised (like HIV infection, not immunized), recent URTI, exposure (close contact) to a case, penetrating head trauma, basal skull fracture and CSF shunt infections. Socioeconomic factors like crowding and poverty may also predispose factors (5)(6)(8)(15).

The incidence of bacterial meningitis disease peaks in winter. A retrospective study of pediatrics with bacterial meningitis in Ethiopia by Ayele et al 2019 revealed that N. meningitidis has high incidence in the second quarter of dry season, April to June (16).

Transmission and pathophysiology

The mode of transmission can be vertical (mother to child) through the birth canal (bacteria from the maternal genital tract colonize the neonate after rupture of membranes, and specific bacteria, such as group b streptococci (GBS), enteric gram-negative rods, and listeria monocytogenes can reach the fetus transplacentally and cause infection) or horizontal (person to person contact) through respiratory tract secretions or droplets. The organisms that cause bacterial meningitis may live in the nose and throat. People of any age can carry them without becoming ill, but they can infect others through coughing or sneezing (5).

Bacteria reach the meninges as a result of direct implantation (infection of the nasopharynx, skull fractures) or the subarachnoid space by hematogenous spread, multiplication in CSF because of inadequate humoral immunity and low bactericidal property. In most cases, meningitis follows invasion of the bloodstream by organisms that have colonized and invaded mucosal surfaces such as the nasal cavity. Once pathogens enter, host inflammatory response is triggered by bacterial cell wall products (like lipoteichoic acid). This response (inflammation) is mediated by the stimulation of macrophage-equivalent brain cells (due to leukocyte migration) that produce inflammatory mediators (cytokines, proteins produced by WBCs; interleukin, tumor necrosis factor, interferons and erythropoietin = increased). This cytokine activation then initiates several processes that ultimately cause damage in the subarachnoid space (increase vascular permeability and BBB impaired i.e., becomes more permeable, leading to vasogenic (increased perfusion) edema, large numbers of white blood cells enter the CSF and release toxic substances causing cytotoxic edema, due to the high protein and cell content, the increased viscosity of the CSF leads to generation of interstitial edema).

The resulting swelling and edema cause wall thrombi and obstruction of flow. And also, results an increase in intracellular sodium and intracellular water. The development of brain edema further compromises cerebral circulation and this effect can result in increased intracranial pressure (ICP) and herniation. Increased ICP together with the lowered blood perfusion often encountered in acute infection, lead to neuronal injury and brain cells apoptosis (8). Increased secretion of antidiuretic hormone (ADH), resulting in the syndrome of inappropriate antidiuretic hormone secretion (SIADH), occurs in most patients with meningitis and causes further retention of free water. These factors contribute to the development of focal or generalized seizures (4)(17)(5).

Clinical presentation and diagnosis

The clinical presentation of pediatrics meningitis patient is age and cause dependent. Neonatal bacterial meningitis has nonspecific presentations and include; poor feeding, lethargy, irritability/shrill cry, respiratory distress (initial presentation), apnea, fever (rare), hypothermia, seizures (group B streptococcal (GBS) compared to E. coli meningitis), bulging fontanelle, pallor, shock and hypoglycemia (5)(8). Clinical presentations with meningitis in children's beyond neonatal age (infants and older children); nuchal (neck) rigidity/stiffness (less frequent in younger infants), joint pain, opisthotonos, bulging fontanelle, convulsions, discomfort looking at bright lights (photophobia), headache, alterations of the sensorium (less frequent in younger infant), irritability, vomiting, fever (less frequent in younger infants, but although some severely ill children present with hypothermia) and meningeal signs.(5) Some studies reported high grade fever (>38oC) is the most common symptom followed by vomiting and neck stiffness (16)(5).

Children with bacterial meningitis may present only with nonspecific
symptoms i.e., the characteristic clinical signs may be absent. In all children with suspected bacterial meningitis, cerebrospinal fluid examination is strongly recommends, unless contraindications for lumbar puncture are present (unstable patients with hypotension or respiratory distress who may not be able to tolerate the procedure, brain abscess, brain tumors or other cause of raised intracranial pressure and infection at the lumbar puncture site) (5)(3)(4).

A definitive diagnosis of meningitis requires examination of cerebrospinal fluid (CSF) via lumbar puncture i.e., the diagnosis of bacterial meningitis cannot be proven without CSF examination. The abnormalities of CSF composition in bacterial meningitis are a pleocytosis (higher than 1000/µL) of mainly polymorphic leukocytes, low glucose concentration, low CSF to blood glucose ratio (a normal CSF glucose level should be higher than two thirds of the serum glucose level; a CSF level lower than 50% of the serum level is suggestive of bacterial meningitis) and elevated protein levels (greater than 50 mg/dL, but it is also elevated by a traumatic lumbar puncture). In patients with very early disease, CSF protein and glucose values may be within the normal range. And also, opening pressures and the color of the CSF (eg, turbid, clear, or bloody) should be determined (3)(4).

In addition to CSF culture, CSF Gram stain and PCR (has additive value in the identification of the pathogen). And also, blood culture before antibiotics treatment are valuable for detection of the causative organism if CSF cultures are negative (pretreatment with antibiotics decreases the yield of CSF culture by 10–20%) or unavailable, e.g. when lumbar puncture is contraindicated (5).

The CSF investigations of procalcitonin values (elevated, > 0.5 ng/ml) in CSF by Konstantinidis et al 2015 and bacterial meningitis characteristics, diagnosis and management by Mehrdadi S et al 2019 also revealed very helpful in distinguishing bacterial meningitis from viral and other noninfectious meningitis diseases (8)(18).

Management (treatment and prevention)

Supportive care is required, depending on the patient's condition, admission to a pediatric intensive care unit (ICU) may be considered. A delay in antibiotic treatment administration is associated with poor outcome and should therefore be avoided i.e., the treatment for meningitis is by the proper and on time application of antibiotics. Whenever lumbar puncture is delayed, empiric treatment must be started immediately on clinical suspicion (even if the diagnosis has not been established) based on age and sensitivity. The drug of choice in neonates (<1 month old) is amoxicillin or ampicillin or penicillin plus cefotaxime or amoxicillin or ampicillin plus an aminoglycosides and for age 1 month to 18 years is cefotaxime or ceftriaxone plus vancomycin or rifampicin (14)(5)(11).

The optimal duration of antibiotic treatment for bacterial meningitis is depending on. For instance, patients in whom no pathogen can be differentiated should be according to the empiric regimen for a minimum duration of 2 weeks. A cohort study of infants < 90 days of age with bacterial meningitis by Ouchenir et al 2017 concluded that if there is evidence for gram-negative meningitis, a third-generation cephalosporin (plus ampicillin for at least one month) can be considered (5)(11).

Some studies and guidelines also recommend adjunctive dexamethasone therapy to decrease hearing loss and neurologic sequelae (decreased inflammation, reduced cerebral edema and ICP and lesser degrees of brain damage). The recommended dexamethasone dose in children with meningitis is 0.15 mg/kg every 6 hours for duration of 2 - 4 days, before or with the first dose of antibiotics in order to prevent the inflammatory response resulting from bacteriolysis by antibiotics (3)(5).

Preventive measures can be chemoprophylaxis (rifampin for 02 days duration, ceftriaxone single dose and ciprofloxacin single dose) and routine childhood immunizations (5)(8).

Outcome (complication, death and prognosis)

Due to overactive inflammation and other mechanisms meningitis can lead to serious long-term consequences. Seizures are a common complication of bacterial meningitis. Persistent seizures, seizures late in the course of disease and focal seizures are more likely to be associated with neurologic sequelae. Other complications that can be seen include the syndrome of inappropriate antidiuretic hormone secretion (SIADH), deafness, subdural effusions and brain abscesses, cortical blindness,

hemiparesis, quadriparesis, muscular hypertonia, ataxia, mental motor retardation, learning disabilities, obstructive hydrocephalus and cerebral atrophy (5)(8)(17).

A retrospective review of children <16 years of age patients with pyogenic meningitis has hyponatremia as a complication and associated with a shorter duration of symptoms before admission, higher CSF white cell counts, and a longer duration of hospitalization. Severe hyponatremia (<125 mmol/l) further associated with the development of systemic complications including shock, multiple organ dysfunction syndromes, respiratory failure requiring mechanical ventilation, and an increase in poor outcome (17).

Bacterial meningitis related mortality and morbidity depend on the infectious agent, the age of the child, the child's general health and the promptness of diagnosis and treatment. Despite improvements in antibiotic and supportive therapy, death and complication rates remain significant. Case control analysis of death and survival factors of bacterial meningitis by Mioramalala et al 2018 and a retrospective study by Wang et al 2019 as well as other study showed that socio - economic factors (number of siblings, overcrowding, time before hospitalization), immunization status, clinical presentation (impaired consciousness, lower white blood cells in blood), antibiotics resistance and meningococcal meningitis are determinant factors for poor outcome (19) (20)(9)(8)(6).

And also, a systemic review of risk factors in predicting prognosis of neonatal meningitis by Mao et al 2018 revealed that seizure, high protein levels in the cerebrospinal fluid (CSF), Low CSF glucose levels, thrombocytopenia, gestational age (GA) <37 weeks and an altered sensorium (coma), the need for ventilation support and leucopenia are predictors of poor prognoses. The study also concluded that a bulging anterior fontanelle, a birth weight <2500 g, early onset meningitis and positive CSF cultures correlated with mortality (21).

Nursing implications for pediatrics bacterial meningitis

The patient with meningitis (in addition to being pediatrics age) is critically ill and requires early recognition as well as immediate intervention to prevent related complication; to accomplish this and deliver quality care the nursing interventions should be collaborative with physicians and other members of the health care team. As a profession being a nurse should have the following implication for meningitis patient's starting from thorough assessment and establishment of proper diagnosis, plan and intervention. Based on the established care plan, the accomplished activities include isolation precautions, keep environmental stimuli at a minimum because most children with meningitis are sensitive to noise, bright lights and other external stimuli, initiation of antimicrobial therapy, maintenance of hydration and ventilation, side-lying position is more often assumed because of nuchal rigidity, assessment for complication with appropriate intervention. Avoid actions that cause pain or increase discomfort, such as lifting the child's head. Prepare the patient for and assist lumbar puncture as well as monitoring of post procedural complications like headache and cerebral herniation. The nurse should also be responsible to encourages the parents to openly discuss their feelings to minimize emotional upset and kept informed of the child's progress and of all procedures, results and treatments.

Evaluation

After thorough assessment of the patient with Gordens functional assessment approach (including investigation), nursing care plan including family support (because parents are upset and concerned about their child's condition) has been established according to NANDA international nursing diagnosis domains. Based on the established care plan, appropriate case based, individualized and up-to-date evidence-based nursing practice has been implemented. Finally, the patients' health function has been improved (determined by physicians and nursing care evaluation) as a result discharged with basic health education about meningitis, when happens, what causes (risk factors), clinical presentations, how spreads, treatment and prevention modalities as well as its complications. And also, family emotional support has been made via reassurance that the natural onset of meningitis is sudden and that they acted responsibly in seeking medical assistance when they did.

Conclusion and recommendation

To deliver holistic quality nursing care (to improve treatment outcome and increase client satisfaction), nursing practice shall be based on up-to-date and scientifically sounded evidence. And also, better to implement case based and individualized (patient centered) nursing care plan according to nursing models and assessment approaches relevant to professional practice like functional health pattern approach.

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