WHO guidelines on meningitis diagnosis, treatment and care

Executive summary

World Health Organization

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Introduction

Meningitis continues to pose a public health threat globally, despite successful efforts to control the disease in several regions of the world. The burden of mortality and morbidity from meningitis, including the risk of neurological and physical sequelae, remains high, particularly in low- and middle-income countries (LMICs) and in settings experiencing large-scale, disruptive epidemics. Furthermore, the financial burden related to meningitis care and aftercare contributes to significant health inequities among the most vulnerable, marginalized and disadvantaged populations.

In 2017, representatives from governments, global health organizations, public health bodies, academia, the private sector and civil society organizations united in a call to action to eliminate meningitis as a public health problem. As a result, the World Health Organization (WHO) together with global partners and experts, coordinated the development of Defeating meningitis by 2030: a global road map, which was approved by the Seventy-third World Health Assembly (resolution WHA73.9). While several causes of meningitis can be prevented by vaccination, the defeating meningitis road map strongly emphasizes the need to improve the clinical management and long-term care of people with meningitis, in an effort to reduce mortality, minimize the incidence of sequelae and disability, mitigate the risk of antimicrobial resistance and improve the quality of life of affected individuals, families and communities.

The WHO guidelines on meningitis diagnosis, treatment and care provide evidence-based, quality-assured recommendations for the clinical management of children over 1 month of age, adolescents and adults with acute, community-acquired meningitis. Due to the similarities in clinical presentation, initial diagnostic approach and treatment strategies, both bacterial and viral causes are considered within the scope of this document.

Target audience

The guidelines provide recommendations applicable worldwide and are primarily intended for health-care professionals working in first or second-level health-care facilities, including emergency, inpatient and outpatient services. Additionally, the guidelines are directed at policy-makers, health-care planners and programme managers operating at national and international levels (e.g. ministries of health, national public health bodies, non-governmental organizations). Since resource-limited settings bear the highest burden of meningitis globally, this document was specifically developed to provide technical guidance suitable for implementation in LMICs.

Methods

As part of Defeating meningitis by 2030: a global road map, these guidelines were prepared by the WHO Department of Mental Health, Brain Health and Substance Use, the Health Emergencies Programme (Department of Epidemic and Pandemic Threat Management) and the Department of Immunization, Vaccines and Biologicals.

The guidelines were developed in accordance with the *WHO handbook for guideline development* and meet international standards for evidence-based guidelines. Conflicts of interest from all individual contributors were declared, assessed and managed in line with WHO procedures. In collaboration with the Guideline Development Group (GDG) and the guideline methodologist, the WHO Steering Group identified priority questions and outcomes to determine the scope

of the guidelines. Overall, 20 guideline questions were formulated using the PICO (population, intervention, comparator, outcome) format, addressing different areas of meningitis diagnosis, treatment and long-term care. For each guideline question, a systematic evidence review was conducted and subsequently used to develop the Evidence-to-Decision frameworks, according to the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.

The GDG formulated the recommendations while considering a range of domains, including the certainty of evidence, the balance between desirable and undesirable effects, values and preferences of intended users, resource requirements and cost-effectiveness, health equity, equality and non-discrimination, feasibility, human rights and sociocultural acceptability.

A strong recommendation was issued when GDG members were confident that the desirable effects of adhering to the recommendation outweighed the undesirable effects. A conditional recommendation was made when GDG members concluded that the desirable effects of adhering to the recommendation probably outweighed the undesirable effects, but they were not confident about the trade-offs or identified specific conditions under which the recommendation applies. When guideline questions addressed the same topic but involved different populations (e.g. children and adults), they were discussed together by the GDG, resulting in single recommendations. The guidelines also include good practice statements, reflecting a consensus within the GDG that the net benefits of adhering to the statement are large and unequivocal, and that the implications of the statement are common sense. The GDG reached unanimous agreement on all the recommendations and ratings.

Summary of recommendations

The recommendations are organized into three sections: A. Diagnosis, B. Treatment and C. Management of sequelae, and are presented along with the remarks in the Summary of Recommendations.

A. Diagnosis

Lumbar puncture

Good practice statement

In individuals with suspected acute meningitis, lumbar puncture should be performed as soon as possible, preferably before the initiation of antimicrobial treatment, unless there are specific contraindications or reasons for deferral.

Cerebrospinal fluid investigations

Strong recommendation for

In individuals with suspected acute meningitis, Gram stain should be performed on cerebrospinal fluid samples.

Strong recommendation. Moderate certainty of evidence.

Strong recommendation for

In individuals with suspected acute meningitis, cerebrospinal fluid investigations should be performed to determine white blood cell count (total and differential), protein concentration, glucose concentration and the cerebrospinal fluid to blood glucose ratio.

Strong recommendation. Moderate certainty of evidence.

Conditional recommendation for

In individuals with suspected acute meningitis, cerebrospinal fluid lactate levels should be considered when antibiotic therapy has not yet been administered.

Conditional recommendation. Moderate certainty of evidence.

Remarks

Cerebrospinal fluid (CSF) Gram stain, white blood cell (WBC) count (total and differential), and protein and glucose concentration have varying sensitivity and specificity. However, none of these tests can be used alone to confirm or rule out a diagnosis of meningitis.

A combined, integrated approach to the interpretation of CSF findings is required to mitigate and minimize the risks associated with the diagnostic performance of individual tests (i.e. risk of false negatives and/or false positives).

The diagnostic yield of these CSF laboratory investigations may decrease when antimicrobial treatment is initiated prior to lumbar puncture.

Normal WBC count and protein concentration may be higher in infants and young children than in older age groups, emphasizing the importance of using age-appropriate threshold values.

When performing a Gram stain on CSF samples, the following results may be observed and inform clinical decision-making:

- Gram-positive diplococci suggest pneumococcal infection.
- Gram-negative diplococci suggest meningococcal infection.
- Gram-negative coccobacilli are consistent with *Haemophilus influenzae* infection.
- Gram-positive bacilli or coccobacilli suggest *Listeria* infection.

Classic CSF characteristics of acute bacterial meningitis caused by pyogenic pathogens include WBC pleocytosis with neutrophilic predominance, low glucose concentration, low CSF-to-serum glucose ratio and high protein concentration.

CSF lactate levels may contribute to differentiating between bacterial and viral meningitis. However, the diagnostic value and clinical applications of CSF lactate are limited after the initiation of antibiotic administration or in the presence of other central nervous system diseases in the differential diagnosis.

The presence of red blood cells in CSF samples should be investigated as it may indicate traumatic lumbar puncture or acute subarachnoid haemorrhage.

Cerebrospinal fluid culture

Good practice statement

In individuals with suspected acute meningitis, cerebrospinal fluid culture and antimicrobial susceptibility testing remain the gold standard for bacterial pathogen identification.

Cerebrospinal fluid molecular testing

Strong recommendation for

In individuals with suspected acute meningitis, PCR-based molecular tests for relevant pathogens should be performed on cerebrospinal fluid samples.

Strong recommendation. Low certainty of evidence.

Remarks

Results of polymerase chain reaction (PCR)-based tests on CSF should be interpreted in the context of clinical presentation (i.e. medical history, symptoms and signs) and additional laboratory findings (e.g. CSF characteristics, Gram stain and culture).

The diagnostic yield of CSF PCR tests for bacterial pathogens may decrease when antimicrobial treatment is initiated prior to lumbar puncture or sample transportation and preservation practices are suboptimal.

CSF culture and antimicrobial susceptibility testing (AST) should not be replaced by PCR and should be routinely performed as the gold standard tests for pathogen identification and characterization of antibiotic resistance profiles. Where resources permit, blood cultures and AST should also be performed in individuals with suspected acute meningitis.

Blood culture

Good practice statement

In individuals with suspected acute meningitis, blood cultures should be obtained as soon as possible, preferably before the initiation of antibiotic therapy.

Blood markers of bacterial infection

Conditional recommendation for

In individuals with suspected acute meningitis, peripheral white blood cell count (total and differential) should be considered where resources allow.

Conditional recommendation. Low certainty of evidence.

Conditional recommendation for

In individuals with suspected acute meningitis, C-reactive protein or procalcitonin should be considered where resources allow.

Conditional recommendation. Moderate certainty of evidence.

Remarks

None of the included peripheral blood tests can be used to confirm or exclude the diagnosis of bacterial meningitis and lumbar puncture should not be deferred or delayed based on their results.

WBC count (absolute and differential), C-reactive protein or procalcitonin should not be performed in isolation and results should be interpreted in the context of clinical presentation (i.e. medical history, symptoms and signs) and CSF characteristics.

Both C-reactive protein and procalcitonin may have a role in differentiating acute bacterial meningitis from other forms of meningitis. Given the lack of evidence comparing C-reactive protein to procalcitonin for the diagnosis of acute bacterial meningitis or regarding the incremental diagnostic value of C-reactive protein and procalcitonin when used in combination, these tests may be used individually.

The decision on whether to choose C-reactive protein or procalcitonin (or both) should be based on resources and local availability. When C-reactive protein is measured, quantitative C-reactive protein assays should be preferred over qualitative assays, since serum levels can be monitored and used as a marker of clinical response to treatment.

Cranial imaging

Strong recommendation against

In individuals with suspected acute meningitis, cranial imaging should not be performed routinely.

Strong recommendation. Very low certainty of evidence.

Strong recommendation for

Where cranial imaging is readily accessible:

Cranial imaging should be performed prior to lumbar puncture to rule out cerebral space-occupying lesions with midline shift, if any of the following features are identified at time of presentation:

- Glasgow Coma Score below 10
- focal neurological signs
- cranial nerve deficits
- papilloedema
- new-onset seizures (in adults)
- severe immunocompromised state.

Strong recommendation. Very low certainty of evidence.

Strong recommendation against

Where cranial imaging is not readily accessible:

Lumbar puncture should be deferred if any of the following features are identified at time of presentation and until they have resolved:

- Glasgow Coma Score below 10
- focal neurological signs
- cranial nerve deficits
- papilloedema
- new-onset seizures (in adults)
- severe immunocompromised state.

Strong recommendation. Very low certainty of evidence.

Strong recommendation for

Treatment should not be delayed for cranial imaging or when lumbar puncture is deferred.

Strong recommendation. Very low certainty of evidence.

Remarks

When lumbar puncture is deferred, blood samples (including blood cultures) should be collected, and antimicrobial treatment started as soon as possible, prior to cranial imaging.

Seizures are a common finding in febrile children suspected of having acute meningitis. New-onset isolated seizures in children do not require cranial imaging prior to lumbar puncture when they occur in the absence of any other at-risk features.

Severe immunocompromised state (e.g. organ transplantation) should warrant lumbar puncture deferral. However, for people living with HIV suspected of having a first episode of cryptococcal meningitis, prompt lumbar puncture with measurement of opening pressure and rapid cryptococcal antigen assay is recommended as the preferred diagnostic approach.

B. Treatment

General management

Good practice statement

Children and adults with suspected acute meningitis should be immediately admitted or urgently transferred to an appropriate health-care facility for further management.

Timing of empiric antimicrobial treatment

Conditional recommendation for

In children and adults presenting with suspected acute meningitis, empiric parenteral antimicrobial treatment before admission or transfer to an appropriate health-care facility should be considered.

Conditional recommendation. Very low certainty of evidence.

Strong recommendation for

In children and adults with suspected acute meningitis admitted to an appropriate health-care facility, empiric intravenous antimicrobial treatment should be administered as early as possible.

Strong recommendation. Very low certainty of evidence.

Remarks

Before admission or transfer to an appropriate health-care facility:

- Parenteral antimicrobial treatment may be beneficial where acute bacterial meningitis is strongly suspected and a clinically significant delay in transfer or referral is considered likely.
- Antimicrobial treatment should be administered intravenously. If intravenous administration is not possible and/or an intravenous line is not secured, intramuscular administration should be pursued.

After admission or transfer to an appropriate health-care facility:

- Intravenous antimicrobial treatment should be given as soon as acute bacterial meningitis is suspected. The "1-hour window" is generally regarded as the golden time period to initiate empiric antibiotic therapy.
- Lumbar puncture, in the absence of contraindications or reasons for deferral, and blood tests should be performed prior to initiating empiric antimicrobial treatment. However, any delay in diagnostic investigations should not delay therapy administration.
- In the absence of contraindications or reasons for deferral, individuals who have received antimicrobial treatment before admission should undergo lumbar puncture as soon as possible once they are admitted in an appropriate health-care facility.
- Adequate clinical monitoring within an appropriate health-care facility is warranted when antimicrobial treatment is administered to an individual with known severe antibiotic allergy.

Empiric antimicrobial treatment regimens

Strong recommendation for

In children and adults with suspected or probable acute bacterial meningitis, intravenous ceftriaxone or cefotaxime should be administered as empiric treatment.

Strong recommendation. Very low certainty of evidence.

Strong recommendation for

In the presence of one or more risk factors for *Listeria monocytogenes* infection (i.e. age over 60 years, pregnancy, immunocompromised state), intravenous ampicillin or amoxicillin should be administered in addition to the initial antimicrobial regimen.

Strong recommendation. Very low certainty of evidence.

Conditional recommendation for

In areas with high prevalence of penicillin or third-generation cephalosporin resistance of *Streptococcus pneumoniae*, intravenous vancomycin should be considered in addition to the initial antimicrobial regimen.

Conditional recommendation. Very low certainty of evidence.

Remarks

Ceftriaxone or cefotaxime are equally recommended as first-line agents for empiric treatment among suspected and probable cases of acute bacterial meningitis. However, intravenous ceftriaxone should be preferred over cefotaxime during meningococcal and pneumococcal disease epidemics.

Ampicillin or amoxicillin should be added to the initial empiric antimicrobial regimen in the presence of any of the following risk factors for *Listeria monocytogenes* infection:

- age over 60 years
- pregnancy
- immunosuppressive therapy
- organ transplantation
- malignancy
- advanced HIV disease
- diabetes mellitus
- end-stage kidney disease
- liver cirrhosis
- alcohol use disease.

Prevalence thresholds to define settings at risk for penicillin or cephalosporin resistance of *Streptococcus pneumoniae* should be defined at the national and/or sub-national level. In areas with known high prevalence of penicillin or cephalosporin resistance of *S. pneumoniae*, intravenous vancomycin would provide adequate antimicrobial coverage against resistant strains. In setting with low tuberculosis burden, rifampicin can be used as an alternative to vancomycin. In settings with high tuberculosis burden, rifampicin can be used only when vancomycin is not readily available or contraindicated.

As soon as a bacterial pathogen is isolated and AST results are known, antibiotic therapy should be reviewed and optimized accordingly.

To mitigate the risk of antimicrobial resistance and ensure appropriate use of second-line antibiotic agents, beta-lactam allergies should be thoroughly investigated before making a treatment decision. Cephalosporins can be safely used in most cases of non-severe penicillin allergy, and vice versa. In cases of previous life-threatening reactions caused by the exposure to beta-lactams, any use of beta-lactams should be avoided.

Conditional recommendation for

In children and adults with suspected or probable acute bacterial meningitis, intravenous chloramphenicol with benzylpenicillin, ampicillin or amoxicillin should only be considered for empiric treatment when ceftriaxone or cefotaxime are not immediately available.

Conditional recommendation. Very low certainty of evidence.

Remarks

In settings with low vaccination coverage for *H. influenzae* type b, intravenous amoxicillin or ampicillin should be preferred over benzylpenicillin for combined empiric treatment (i.e. in association with chloramphenicol).

As soon as a bacterial pathogen is isolated and AST results are known, antibiotic therapy should be reviewed and optimized accordingly.

To mitigate the risk of antimicrobial resistance and ensure appropriate use of second-line antibiotic agents, beta-lactam allergies should be thoroughly investigated before making a treatment decision. In cases of previous life-threatening reactions caused by the exposure to beta-lactams, any use of beta-lactams should be avoided.

Duration of empiric antimicrobial treatment

Conditional recommendation for

In non-epidemic settings, in children and adults with suspected or probable acute bacterial meningitis and no pathogen identification, discontinuation of empiric antibiotic therapy may be considered after 7 days if the person has clinically recovered.

Conditional recommendation. Very low certainty of evidence.

Remarks

All efforts should be made to identify and characterize the causative pathogen on blood and CSF samples through culture and molecular tests (e.g. PCR).

When the pathogen remains unknown, empiric antibiotic therapy can be discontinued after 7 days, provided that the person has clinically recovered. Clinical recovery may be indicated by the presence of *all* of the following for at least 48 hours:

- resolution of fever
- resolution of vital sign abnormalities (blood pressure, heart rate, respiratory rate, oxygen saturation)
- resolution of altered consciousness
- normal mental status.

In the absence of clinical recovery within one week of empiric treatment, antibiotic therapy should be extended and accompanied by an appropriate diagnostic work-up, including a repeat lumbar puncture provided there are no contraindications.

Strong recommendation for

During meningococcal disease epidemics, empiric treatment with parenteral ceftriaxone should be administered for 5 days to children and adults with suspected or probable meningococcal meningitis.

Strong recommendation. Very low certainty of evidence.

Conditional recommendation for

During pneumococcal disease epidemics, empiric treatment with parenteral ceftriaxone for 10 days should be considered for children and adults with suspected or probable pneumococcal meningitis.

Conditional recommendation. Very low certainty of evidence.

Remarks

During meningococcal and pneumococcal disease epidemics, intravenous ceftriaxone is the preferred administration option. If intravenous administration is not immediately feasible, intramuscular ceftriaxone should be given.

During meningococcal and pneumococcal disease epidemics, in the absence of clinical recovery, empiric treatment can be extended, and further diagnostic investigations should be performed.

Post-exposure antimicrobial prophylaxis

Strong recommendation for

In the presence of sporadic disease, antibiotic prophylaxis with single-dose parenteral ceftriaxone or oral ciprofloxacin should be provided to close contacts of laboratory-confirmed cases of meningococcal disease, in accordance with known antimicrobial susceptibility patterns.

Strong recommendation. Very low certainty of evidence.

Strong recommendation for

During large-scale epidemics, antibiotic prophylaxis with single-dose parenteral ceftriaxone or oral ciprofloxacin should be provided to close contacts of clinically suspected cases of meningococcal disease, in accordance with known antimicrobial susceptibility patterns.

Strong recommendation. Very low certainty of evidence.

Conditional recommendation for

Rifampicin should be considered when ceftriaxone or ciprofloxacin cannot be administered.

Conditional recommendation. Very low certainty of evidence.

Remarks

Vaccination remains the primary control intervention against meningococcal disease. All efforts should be undertaken to ensure the highest vaccination coverage in the target population, including routine immunization, mass preventive campaigns and reactive campaigns implemented as part of outbreak response.

Considering the increasing incidence of cases caused by ciprofloxacin-resistant isolates worldwide, the choice of antibiotic should be guided by the antimicrobial susceptibility patterns prevalent within the community and potentially adjusted as necessary based on susceptibility testing results from index cases.

Antibiotic prophylaxis should be provided to close contacts as soon as possible. Administration later than 14 days after case identification likely has limited or no benefit.

Close contacts should be defined based on context-specific considerations and available resources. In the presence of an index case, during the 7 days before symptom onset and until 24 hours after initiation of appropriate antibiotic therapy, people at increased risk of infection include:

- individuals with prolonged exposure while in close proximity (less than 1 metre) to the index case (e.g. household contacts);

- individuals directly exposed to oral secretions of the index case (e.g. via kissing, mouth-to-mouth resuscitation, endotracheal intubation).

In the presence of small-scale outbreaks, antibiotic prophylaxis with single-dose parenteral ceftriaxone or oral ciprofloxacin should be provided to close contacts of laboratory-confirmed or clinically suspected cases of meningococcal disease, depending on available resources.

- If laboratory confirmation is expected to be obtained for all suspected cases, antibiotic prophylaxis should be provided to close contacts of laboratory-confirmed cases.
- If laboratory confirmation is not expected to be obtained for most suspected cases, antibiotic prophylaxis can also be provided to close contacts of strongly suspected cases.

Adjunctive corticosteroids

Strong recommendation for

In non-epidemic settings where lumbar puncture can be performed, intravenous corticosteroids (dexamethasone, hydrocortisone or methylprednisolone) should be initiated with the first dose of antibiotics in children and adults with suspected acute bacterial meningitis.

If cerebrospinal fluid characteristics are not consistent with bacterial meningitis, intravenous corticosteroids should be discontinued.

Strong recommendation. Low certainty of evidence.

Conditional recommendation for

In non-epidemic settings where lumbar puncture cannot be performed, intravenous corticosteroids (dexamethasone, hydrocortisone or methylprednisolone) may be initiated with the first dose of antibiotics when acute bacterial meningitis is strongly suspected in children and adults and no concurrent condition contraindicates their use.

Conditional recommendation. Very low certainty of evidence.

Strong recommendation against

During meningococcal disease epidemics, intravenous corticosteroids (dexamethasone, hydrocortisone or methylprednisolone) should not be routinely used in children and adults with suspected or probable meningococcal meningitis.

Strong recommendation. Very low certainty of evidence.

Strong recommendation for

During pneumococcal disease epidemics, intravenous corticosteroids (dexamethasone, hydrocortisone or methylprednisolone) should be initiated with the first dose of antibiotics in children and adults with suspected or probable pneumococcal meningitis.

Strong recommendation. Very low certainty of evidence.

Remarks

Corticosteroids should be administered intravenously in an inpatient setting.

The beneficial effects of corticosteroids are likely to decrease as the delay in administration increases. Therefore, corticosteroids should be administered with the first dose of antibiotics or as soon as possible after the initial antibiotic dose.

Dexamethasone should be considered the corticosteroid of choice for children and adults. However, the dexamethasone 6-hourly administration schedule can be resource-consuming and its accessibility across different settings is variable. When dexamethasone cannot be administered, intravenous hydrocortisone or methylprednisolone may be used as alternatives, at equivalent dosage and with an appropriate administration schedule.

Upon initial administration, the duration of corticosteroid use should be informed by CSF characteristics and pathogen isolation.

- If CSF characteristics are considered consistent with or suggestive of bacterial meningitis, intravenous corticosteroids should be continued for a maximum duration of 4 days.
- If CSF characteristics are consistent with bacterial meningitis and *S. pneumoniae* or *H. influenzae* type b is detected through culture or molecular testing, intravenous corticosteroids should be continued for a maximum duration of 4 days.
- If CSF characteristics are consistent with bacterial meningitis and a bacterial pathogen other than *S. pneumoniae* or *H. influenzae* type b is detected through culture or molecular testing, intravenous corticosteroids can be discontinued.

Intravenous corticosteroids should not be administered when the benefits do not outweigh the risks.

Corticosteroids should not be administered to individuals with cerebral malaria as their use is associated with prolonged coma resolution times when compared to placebo.

The above recommendations on the use of corticosteroids as adjunctive treatment for suspected acute bacterial meningitis also apply to people living with HIV who are on antiretroviral therapy and have undetectable viral load (less than 50 copies/µl).

Intravenous corticosteroids administered as adjunctive treatment for suspected acute bacterial meningitis in children and adults with advanced HIV disease has not proven to be beneficial in reducing mortality or morbidity.

The recommendations on the use of corticosteroids during meningococcal and pneumococcal disease epidemics are applicable if the causative agent of the epidemic is identified via culture or PCR.

Osmotic agents

Conditional recommendation against

Glycerol should not be used routinely as adjunctive therapy in children and adults with suspected, probable or confirmed acute bacterial meningitis.

Conditional recommendation. Low certainty of evidence.

Remarks

Osmotic agents other than glycerol, such as mannitol, sorbitol and hypertonic saline can be used as a temporary measure for the management of increased intracranial pressure, including in children and adults with bacterial meningitis and signs of impending brain herniation (e.g. rapid change in level of consciousness, hypertension, bradycardia, loss of pupillary reaction).

Interventions with a more durable effect on intracranial pressure (e.g. ventilatory support, decompressive craniectomy) may be required in people with increased intracranial pressure.

Fluid management

Conditional recommendation against

Fluid intake should not be routinely restricted in children and adults with suspected, probable or confirmed acute bacterial meningitis.

Conditional recommendation. Very low certainty of evidence.

Remarks

Maintenance fluids are preferably administered orally or by enteric tube (e.g. nasogastric tube). Among infants and young children, breastfeeding is the ideal method of hydration.

When fluids cannot be administered orally or by enteric tube, isotonic solutions (e.g. Ringer's lactate, normal saline) should be routinely used as maintenance intravenous fluids.

In accordance with clinical judgement, moderate fluid restriction can be implemented in individuals without signs of shock or hypovolemia who present with clinical manifestations suggestive of syndrome of inappropriate antidiuretic hormone secretion (SIADH).

Anti-seizure medicines

Conditional recommendation for

In children and adults with acute symptomatic seizures from meningitis, anti-seizure medicines should be continued for no longer than three months, in the absence of any recurring seizures.

Conditional recommendation. Very low certainty of evidence.

Remarks

The choice of anti-seizure medicines is affected by several factors, including seizure semiology, comorbidities, availability, cost and side-effects. Specific considerations are also in place for older adults, individuals with HIV, people with learning difficulties, and women and girls with childbearing potential.

Recommendations for the diagnosis and management of epilepsy and seizures in children and adults are presented in the WHO mental health Gap Action Programme (mhGAP) guideline for mental, neurological and substance use disorders.

C. Management of sequelae

Clinical assessment

Strong recommendation for

Children and adults with acute meningitis from any cause should be reviewed for sequelae by a health-care provider prior to discharge and at follow-up.

Strong recommendation. Very low certainty of evidence.

Remarks

A clinical assessment at follow-up should be performed at least once within four weeks of discharge.

When sequelae are detected, referral to the appropriate services should be arranged.

When available, psychological support should be offered to both the person with meningitis and their caregivers.

Rehabilitation

Strong recommendation for

In children and adults with sequelae due to acute meningitis from any cause, rehabilitation should be provided as soon as possible.

Strong recommendation. Very low certainty of evidence.

Remarks

The WHO Package of interventions for rehabilitation (PIR) outlines interventions for rehabilitation of 20 health conditions, spanning seven disease areas, including musculoskeletal, neurological, neurodevelopmental and sensory disorders. Interventions are organized into functioning domains, relevant to people with different health conditions, including individuals with sequelae following acute meningitis.

Hearing loss

Strong recommendation for

In children and adults with acute meningitis from any cause, formal audiological screening should be conducted before discharge.

If audiological screening is not possible before discharge, it should be conducted within four weeks of discharge.

Strong recommendation. Very low certainty of evidence.

Remarks

When hearing loss is detected, urgent referral for hearing rehabilitation or evaluation for cochlear implantation should be arranged. This is crucial to prevent the rapid impairment of speech due to the loss of auditory feedback and to avoid cochlear ossification in individuals eligible for cochlear implantation.

Individuals screened before discharge and found to have no hearing loss should undergo a second formal audiological screening test, as a small number may still develop hearing loss at a later stage.

Strong recommendation for

In children and adults with hearing loss from acute meningitis from any cause, hearing rehabilitation should be provided as soon as possible.

Strong recommendation. Very low certainty of evidence.

Remarks

The WHO PIR (Module 6) outlines assessments and interventions for hearing loss. Rehabilitation interventions for hearing impairment include the provision of, and training in, the use of hearing technologies (hearing aids, cochlear implants and middle ear implants), and speech and language therapy to enhance perceptive skills and develop communication and linguistic abilities. Rehabilitation also includes training in the use of sign language and other means of sensory substitution, such as speech reading, use of print on palm or Tadoma signed communication.

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