

Chapter 4

Management of Suspected Brain Infection in the ICU



4.1 Introduction

Suspected brain infections, such as encephalitis and meningitis, are critical conditions that require prompt and precise management in the intensive care unit (ICU). These infections can cause severe neurological damage or death if not treated in a timely and appropriate manner. This chapter outlines the management of suspected brain infections, including bacterial, viral, autoimmune, and atypical causes, and is designed to accompany a flowchart for guiding ICU clinicians (Ref. Algorithm 4.1).

4.2 Initial Assessment

Review Patient History and Perform Neurological Examination

- Patient History: Gather detailed information about recent travel, immunocompromised status, exposure to infectious agents, and prior infections or medications.
- Neurological Examination: Assess for signs of meningeal irritation (e.g., neck stiffness, photophobia, positive Kernig's sign, and Brudzinski's sign), focal neurological deficits (e.g., weakness, speech difficulties), and altered mental status (confusion, lethargy).

Lumbar Puncture (LP)

- Indications and Procedure: Perform LP unless contraindicated (e.g., signs of raised intracranial pressure such as focal deficits or papilledema). LP is crucial for diagnosing central nervous system (CNS) infections, analyzing cerebrospinal fluid (CSF) parameters (e.g., cell count, glucose, protein), and detecting specific pathogens via PCR.

- **Neuroimaging Before LP:** Perform a CT or MRI before LP if there are indications such as focal neurological signs, papilledema, altered consciousness, new onset seizure, or suspicion of increased intracranial pressure. This helps residents avoid unnecessary imaging delays in patients without contraindications.

4.3 Blood Culture

4.3.1 Empirical Antimicrobial Therapy

Critical Time Windows for Therapy

- **Antiviral Treatment:** Initiate intravenous acyclovir (10 mg/kg every 8 h) immediately if HSV encephalitis is suspected, as delays can lead to poor outcomes.
- **Antibacterial Treatment:** Start with ceftriaxone (2 g IV every 12 hours) and vancomycin (15–20 mg/kg IV every 8–12 hours). For patients at risk for *Listeria monocytogenes* (e.g., elderly, immunocompromised), add ampicillin (2 g IV every 4 h).
- **Other Antibiotics:** Consider doxycycline (100 mg IV every 12 hours) for specific bacterial infections (e.g., rickettsial infections) [1].

Antibiotic Stewardship

- Once culture and PCR results are available, de-escalate antibiotics to targeted therapy based on pathogen sensitivity to prevent unnecessary broad-spectrum use and combat antimicrobial resistance.

Adjunct Therapy

- **Corticosteroids:** Administer intravenous dexamethasone (0.15 mg/kg q6h 2–4 days) in cases of suspected bacterial meningitis, especially in pneumococcal meningitis, to reduce mortality and prevent neurological complications. The first dose of steroid should be administered 10–20 min before the first dose of antimicrobial therapy.
- **Intracranial Pressure Management:** Monitor for signs of increased intracranial pressure and manage using hypertonic saline or mannitol. This is especially critical in patients with bacterial or tuberculous meningitis, and HSV encephalitis.

Role of Prophylaxis for Close Contacts

- Chemoprophylaxis: In cases of bacterial meningitis, particularly meningococcal meningitis, consider chemoprophylaxis for close contacts and healthcare workers. Rifampicin or ciprofloxacin may be used, as per local guidelines, for infection control.

4.4 Lumbar Puncture Report and Further Imaging**CSF Analysis**

- White Cell Count: Pleocytosis indicates infection, while normal white cell counts often rule out bacterial or viral meningitis.
- Glucose and Protein Levels: Low CSF glucose is indicative of bacterial or tuberculous meningitis, while elevated protein levels suggest CNS inflammation (Table 4.1).

Pathogen Detection

- Use PCR for rapid identification of viral pathogens and culture for bacterial detection. Perform acid-fast staining and culture if *Mycobacterium tuberculosis* is suspected.

Imaging

- MRI: Perform MRI in cases of suspected encephalitis or to exclude alternative diagnoses. MRI is particularly useful in diagnosing HSV encephalitis and autoimmune encephalitis.

Autoimmune Encephalitis Workup

- Panel and Treatment: If autoimmune encephalitis is suspected, send an autoimmune encephalitis panel. Start high-dose methylprednisolone (1 g IV daily for 3–5 days), followed by oral steroids.
- Further Investigations: Involve a neurologist for specific autoantibody testing and management strategies.

Criteria for Discontinuing Empirical Therapy

- Discontinuation of Therapy: Once CSF PCR results are negative and there is clinical improvement, discontinue antiviral or antibacterial therapy to avoid prolonged and unnecessary treatment.

Table 4.1 Cerebrospinal fluid analysis

Condition	Opening pressure	Appearance	CSF white cell count (WBC)	Predominant cell type	CSF protein level	CSF glucose level	CSF/blood glucose ratio
Normal	12–20 cm CSF	Clear	< 5 cells/ μ L	None	< 0.4 g/L	2.6–4.5 mmol/L	> 0.66
Bacterial meningitis	Raised	Purulent, turbid, cloudy	> 100 cells/ μ L	Neutrophils	Raised	Very low	< 0.36
Viral meningitis	Normal/mildly raised	Clear	5–1000 cells/ μ L	Lymphocytes	Mildly raised	Normal/slightly low	Normal/slightly low
Tuberculous meningitis	Raised	Clear or cloudy	5–100 cells/ μ L	Lymphocytes	Markedly raised	Very low	< 0.36
Fungal meningitis	Raised	Clear or cloudy	5–100 cells/ μ L	Lymphocytes	Raised	Low	Low
HSV encephalitis	Raised	Clear	10–500 cells/ μ L	Lymphocytes	Mildly raised	Normal/slightly low	Normal/slightly low
Autoimmune encephalitis	Normal/mildly raised	Clear	5–100 cells/ μ L	Lymphocytes	Normal/slightly raised	Normal	Normal
Cryptococcal meningitis	Raised	Clear or cloudy	20–200 cells/ μ L	Lymphocytes	Raised	Low	Low

4.5 Specific Treatment Based on LP Findings

Bacterial Meningitis

- Empirical Antibiotics: Begin with ceftriaxone and vancomycin [2]. Adjust therapy based on identified pathogens:
- *Streptococcus pneumoniae*: Continue ceftriaxone or switch to penicillin G (24 million units/day).
- *Neisseria meningitidis*: Penicillin G or ceftriaxone.
- *Listeria monocytogenes*: Ampicillin plus gentamicin.
- Supportive Care: Manage symptoms, including seizures and increased intracranial pressure.

Viral Meningitis

- Supportive Care: Ensure hydration, manage pain, and control fever [3].
- Antiviral Therapy: Initiate acyclovir for suspected or confirmed HSV infections.
- Monitoring: Regular follow-up for recovery.

Tuberculous Meningitis

- Antitubercular Therapy: Begin the RIPE regimen (isoniazid, rifampicin, pyrazinamide, ethambutol). Adjust based on drug susceptibility [4].
- Adjunctive Therapy: Use corticosteroids like dexamethasone to reduce inflammation. Initial adjuvant corticosteroid therapy with dexamethasone or prednisolone tapered over 6–8 weeks.
- Duration: Treatment lasts 9–12 months, depending on disease severity.

Fungal Meningitis

- Cryptococcal Meningitis: Start with Amphotericin B (0.7–1.0 mg/kg IV daily) plus flucytosine, followed by fluconazole maintenance.
- Other Fungal Infections: Treat according to pathogen and susceptibility using antifungals such as voriconazole or itraconazole.

Autoimmune Encephalitis

- Immunotherapy: Administer high-dose corticosteroids and consider IVIG or plasmapheresis for severe cases [5, 6].
- Long-Term Management: Consider rituximab or cyclophosphamide for refractory or chronic cases.

Detailed Management of Specific Subpopulations

- Immunocompromised Patients: Pay special attention to immunocompromised patients (e.g., HIV/AIDS, transplant recipients) who are at higher risk for atypical infections like fungal, tuberculous, or viral meningitis. Adjust treatment based on the specific risks and pathogen involved.

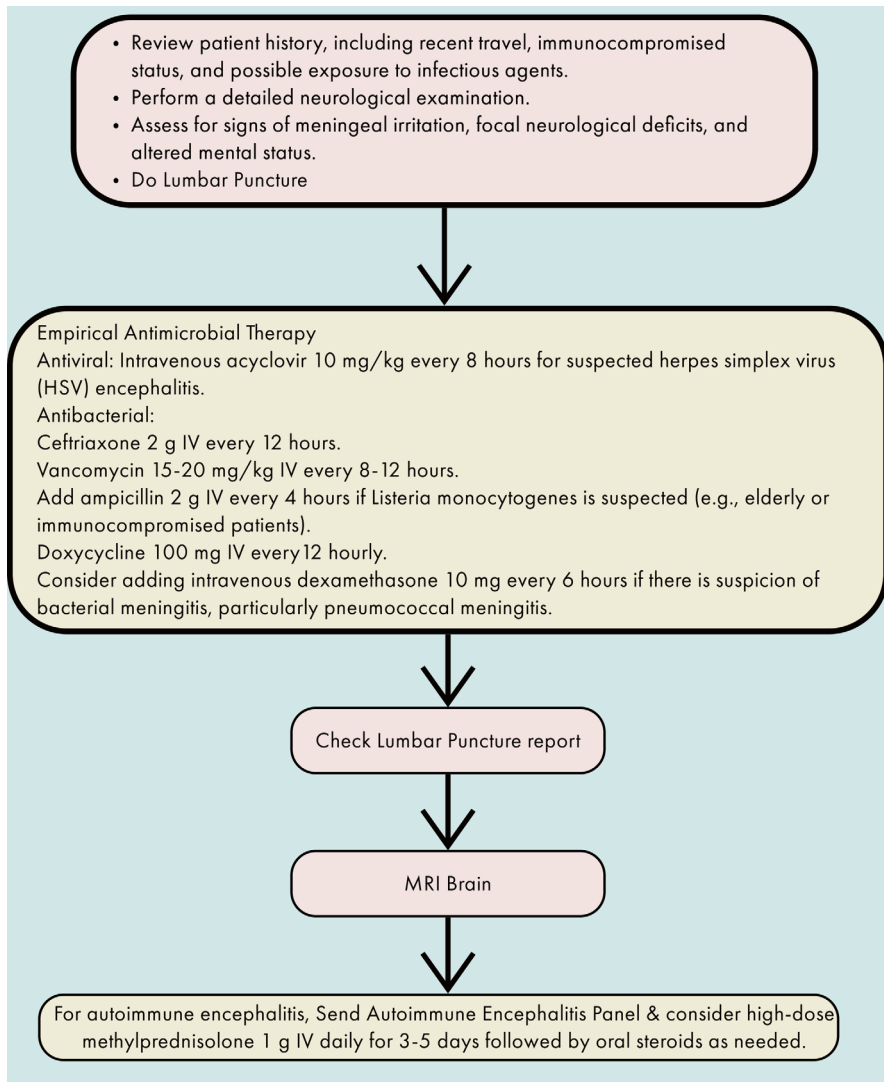
Rehabilitation and Long-Term Follow-Up

- Rehabilitation: Emphasize the importance of rehabilitation and neurocognitive follow-up for patients recovering from severe encephalitis or meningitis, as many may experience long-term neurological or psychological deficits.
- Long-Term Care: Ensure follow-up with neurologists and rehabilitation specialists to monitor recovery, cognitive function, and potential disability.

4.6 Conclusion

Managing suspected brain infections in the ICU requires a structured approach involving prompt empirical therapy, diagnostic testing, and treatment adjustments based on specific pathogens. Lumbar puncture and timely imaging are essential to guide management. Attention to special populations, such as immunocompromised patients, and conditions like autoimmune encephalitis and tuberculosis, is critical to optimizing outcomes. Long-term rehabilitation and follow-up are vital for addressing residual neurological deficits.

Algorithm 4.1: Management of suspected brain infection in the ICU



Bibliography

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