Healthcare-associated ventriculitis

- Heparin-Binding Protein as a Diagnostic Biomarker for Healthcare-Associated Meningitis and Ventriculitis in Pediatric Patients
- Ventriculitis characteristics and outcomes (VELCRO): an international retrospective cohort study
- A risk score to predict mechanical ventilation in patients with healthcare-associated ventriculitis and meningitis (HCAVM)
- The VEntriculostomy-Related Infection Score: An Antibiotic Stewardship Tool in Ventriculostomy-Related Infections
- Intraventricular antibiotics for severe central nervous system infections: a case series
- Utility of cell index in the diagnosis of healthcare-associated ventriculitis and meningitis: an analytical cross-sectional study
- Successful treatment of pan-drug resistant Acinetobacter baumannii meningitis/ventriculitis following craniotomy and external ventricular drainage: a case report
- Cerebrospinal fluid drain infection caused by pandrug-resistant Staphylococcus epidermidis successfully treated with ceftaroline in combination with fosfomycin and vancomycin

AKA Ventriculostomy infection

Iatrogenic ventriculitis is a common complication of external ventricular drain. While the procedure and indications for external ventricular drains (EVD) are highly standardized, the treatment of ventriculitis is not clearly defined.

OBJECTIVE: To depict the treatment of iatrogenic ventriculitis currently performed in German hospitals.

METHODS: A standardized questionnaire consisting of 18 multiple choice questions, each with the ability to provide additional individual answers, covering the diagnosis and treatment of iatrogenic ventriculitis as well as general handling of EVDs, was sent to 121 neurosurgical hospitals registered in the German Society for Neurosurgery (DGNC).

RESULTS: Thirty-three out of 121 hospitals returned the questionnaire. While diagnostics are performed similarly in most hospitals, the treatment varies remarkably. Ten of the 33 (30%) units never applied antibiotics intrathecally and 12 (36%) only in selected (1-20%) cases, while 7 (21%) do this routinely, and the remaining 4 centers vary their treatment. While the targeted systemic therapy after pathogen identification and resistance testing is similar, the choice of empiric antibiotics varies as does the type of drug used for intrathecal therapy. Among the applied systemic antibiotics, vancomycin [n = 23 (70%)] and meropenem [n = 22 (67%)] were the most common, but many others, including ceftriaxone, metronidazol, linezolid, piperacillin/tazobactam, fosfomycin and ceftazidim, are used. There is no standard practice regarding EVD handling. Twelve (36%) hospitals do not replace the EVD after a new diagnosis of ventriculitis, 13 (39%) do so once after the diagnosis, and 8 (24%) regularly switch EVDs after a defined time span (7-20 days), even without signs of infection.

CONCLUSION: Treatment concepts for iatrogenic ventriculitis are very heterogeneous. Thus, there is an urgent need for generating outcome data and defining a standard treatment algorithm with the recently published practice guideline being an important first step [1)].

The agreement between published ventriculostomy related infection (VRI) definitions is moderate to fair. A VRI surveillance definition that better defines contaminants is needed for more homogenous application of surveillance definitions between institutions and better comparison of rates [2)].

Epidemiology

Ventriculostomy-related infection (VRI) is a severe complication of external ventricular drain use, occurring in 5% to 23% of patients [3)].

see also Cerebrospinal fluid infection.

Microbiology

● Unlike organisms that cause acute community-acquired meningitis, those causing neurosurgical procedure-related meningitis are slow to grow on cultures and may require anaerobic media.

● The usual organisms that cause EVD-related infections are either:

○ Organisms that usually colonize the skin, especially the scalp (coagulase-negative Staphylococcus, Staphylococcus aureus, and Propionibacterium acnes).

○ Organisms that can be present in the healthcare environment: S. aureus, both methicillin-sensitive and -resistant, gram-negative bacteria like E. coli, Klebsiella, pseudomonas, and Acinetobacter species, some of which can be multi-drug resistant.

● Infectious organisms can form a polysaccharide layer (biofilm) on the surface of catheters, which increases the resistance to antimicrobials.

Risk factors

Ventriculostomy related infection risk factors

Complications

Ventriculostomy related infection, may be complicated by ventriculitis, meningitis, intracranial abscess, or subdural empyema, significantly prolong hospital stay, increase costs, and often negatively affect the overall prognosis.

Clinical features

1. New headache, nausea, lethargy, and/or change in mental status are suggestive of cerebrospinal fluid (CSF) shunt infection (strong, moderate).

2. Erythema and tenderness over the subcutaneous shunt tubing are suggestive of CSF shunt infection (strong, moderate).

3. Fever, in the absence of another clear source of infection, could be suggestive of CSF shunt infection (weak, low).

4. Symptoms and signs of peritonitis or abdominal tenderness in patients with ventriculoperitoneal shunts, in the absence of another clear etiology, are indicative of CSF shunt infection (strong, moderate).

5. Symptoms and signs of pleuritis in patients with ventriculopleural shunts, in the absence of another clear etiology, are indicative of CSF shunt infection (strong, moderate).

6. Demonstration of bacteremia in a patient with a ventriculoatrial shunt, in the absence of another clear source of bacteremia, is evidence of CSF shunt infection (strong, moderate).

7. Demonstration of glomerulonephritis in a patient with a ventriculoatrial shunt is suggestive of CSF shunt infection (weak, low).

8. New or worsening altered mental status in patients with external ventricular drains is suggestive of infection (weak, low).

9. New fever and increased CSF white blood cell count in patients with external ventricular drains could be suggestive of infection (weak, low).

10. New headache, fever, evidence of meningeal irritation, seizures, and/or worsening mental status are suggestive of ventriculitis or meningitis in the setting of recent trauma or neurosurgery (strong, moderate).

11. Fever, in the absence of another clear source of infection, is suggestive of central nervous system (CNS) infection in the setting of recent head trauma or neurosurgery (weak, low).

12. New fever and drainage from the surgical site in patients with intrathecal infusion pumps are suggestive of wound infection (weak, low).

Diagnosis

13. Abnormalities of CSF cell count, glucose, and/or protein may not be reliable indicators for the presence of infection in patients with healthcare-associated ventriculitis and meningitis (weak, moderate).

14. Normal CSF cell count, glucose, and protein may not reliably exclude infection in patients with healthcare-associated ventriculitis and meningitis (weak, moderate).

15. A negative CSF Gram stain does not exclude the presence of infection, especially in patients who have received previous antimicrobial therapy (strong, moderate).

16. CSF cultures are the most important test to establish the diagnosis of healthcare-associated ventriculitis and meningitis (strong, high).

17. If initial CSF cultures are negative in patients with CSF shunts or drains with suspected infection, it is recommended that cultures be held for at least 10 days in an attempt to identify organisms such

as Propionibacterium acnes (strong, high).

18. If a CSF shunt or drain is removed in patients suspected of having infection, cultures of shunt and drain components are recommended (strong, moderate).

19. If a CSF shunt or drain is removed for indications other than infection, cultures of shunt or drain components are not recommended (strong, moderate).

20. Blood cultures are recommended in patients with suspected ventriculoatrial shunt infections (strong, high).

21. Blood cultures may be considered in patients with ventriculoperitoneal and ventriculopleural shunts (weak, low).

22. Single or multiple positive CSF cultures in patients with CSF pleocytosis and/or hypoglycorrhachia, or an increasing cell count, and clinical symptoms suspicious for ventriculitis or meningitis, is indicative of CSF drain infection (strong, high).

23. CSF and blood cultures in selected patients should be obtained before the administration of antimicrobial therapy; a negative CSF culture in the setting of previous antimicrobial therapy does not exclude healthcare-associated ventriculitis and meningitis (strong, moderate).

24. CSF pleocytosis with a positive culture and symptoms of infection are indicative of a diagnosis of healthcare-associated ventriculitis or meningitis (strong, high).

25. Hypoglycorrhachia and elevated CSF protein concentrations are suggestive of the diagnosis of healthcare-associated ventriculitis or meningitis (weak, low).

26. Growth of an organism that is commonly considered a contaminant (eg, coagulase-negative staphylococcus) in enrichment broth only or on just 1 of multiple cultures in a patient with normal CSF and no fever is not indicative of healthcare-associated ventriculitis or meningitis (strong, low).

27. CSF cultures with multiple organisms from a single sample may be contaminants in patients with no symptoms of infection or CSF pleocytosis (weak, low).

28. CSF cultures that grow Staphylococcus aureus or aerobic gram-negative bacilli are indicative of infection (strong, moderate).

29. CSF cultures that grow a fungal pathogen are indicative of infection (strong, moderate).

30. An elevated CSF lactate or an elevated CSF procalcitonin, or the combination of both, may be useful in the diagnosis of healthcare-associated bacterial ventriculitis and meningitis (weak, moderate).

31. An elevated serum procalcitonin may be useful in differentiating between CSF abnormalities due to surgery or intracranial hemorrhage from those due to bacterial infection (weak, low).

32. Nucleic acid amplification tests, such as polymerase chain reaction, on CSF may both increase the ability to identify a pathogen and decrease the time to making a specific diagnosis (weak, low).

33. Detection of β–D-glucan and galactomannan in CSF may be useful in the diagnosis of fungal ventriculitis and meningitis (strong, moderate).

Neuroimaging

Neuroimaging is recommended in patients with suspected healthcare-associated ventriculitis and meningitis (strong, moderate).

Magnetic resonance imaging with gadolinium enhancement and diffusion-weighted imaging is recommended for detecting abnormalities in patients with healthcare-associated ventriculitis and meningitis (strong, moderate).

In patients with infected ventriculoperitoneal shunts and abdominal symptoms (eg, pain or tenderness), an ultrasound or computed tomography of the abdomen is recommended to detect CSF loculations at the shunt terminus (strong, moderate).

Treatment

see Ventriculitis treatment.

Case series

262 EVDs were included in a study, of which 111 were managed with pre-emptive intrathecal vancomycin (ITV). The infection rate was 2.7% in the vancomycin group and 11.9% in the control group (p<.01). There were no cases of vancomycin-resistant infection in either group.

The use of pre-emptive ITV is associated with a significantly lower EVD infection rate. This compares favourably with those reported in the literature for bactericidal catheters [4].

1)
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