

# A Rare Case of *Klebsiella* Ventriculo-Meningitis Following Head Trauma

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## ABSTRACT

Pyogenic ventriculitis is characterized by ependymal inflammation with the presence of pus in the ventricles. We present a 63-year-old male who sustained head trauma due to a motor vehicle accident and was primarily admitted to another hospital. Since his symptoms persisted despite the first 3 CT scans being insignificant, he was referred to our hospital on day 4. CSF analysis was typical of bacterial meningitis, but CSF and blood cultures were negative. CT head revealed normal findings, except for a minimally displaced right maxillary fracture with hemosinus. Poor progress in the sensorium impelled us to investigate further with a CSF PCR which detected *Klebsiella pneumoniae* and an MRI Brain with contrast, which revealed features of ventriculo-meningitis. Administration of long-term systemic antibiotics resulted in an early recovery. *Streptococcus pneumoniae* is the most commonly implicated pathogen in head trauma-related ventriculitis. Our case, being a *Klebsiella* ventriculo-meningitis, is a rare occurrence in head trauma. We would like to underscore the point that when clinical presentation in head trauma is subtle and non-specific, with minimal microbiological and imaging evidence, an early MRI Brain with contrast coupled with a CSF PCR expedites the diagnosis of a rare cause of ventriculo-meningitis, which has high mortality.

**Keywords:** Computerised tomography; PCR (polymerase chain reaction); Ventriculo-meningitis; Magnetic resonance imaging; *Klebsiella*; Head trauma; Cerebrospinal fluid

## Introduction

The advent of newer antimicrobials, coupled with vaccination has ushered in an era of considerable reduction in central nervous system (CNS) infections. When the cause is post-traumatic, diagnosis can be virtually challenging<sup>[1]</sup>. Pyogenic ventriculitis is distinguished by ependymal inflammation with pus in the ventricles<sup>[2]</sup>. It complicates brain abscess, meningitis, or neurosurgery, requiring long-term systemic antibiotics or surgical intervention, with an estimated mortality of 30% and neurological sequelae

in 60% of cases<sup>[3]</sup>. We present a rare case of *Klebsiella* ventriculo-meningitis in a patient who sustained Head Trauma.

## Case Presentation

A 63-year-old male with type 2 diabetes, presented to the Emergency room (ER) after being referred from a nearby hospital. There was an alleged history of a motor vehicle accident, sustaining only minor skin abrasions. The first computerized tomography (CT) of the brain at the primary hospital was reported to be normal and he was discharged home. The following day, he presented to the same hospital with giddiness and vomiting without neck stiffness. A repeat CT Brain after admission revealed the same findings as the preceding. The subsequent day, he developed high-grade fever with chills along with a decrease in sensorium warranting intubation and mechanical ventilation. CT brain was repeated, which revealed the same findings as the preceding two, following

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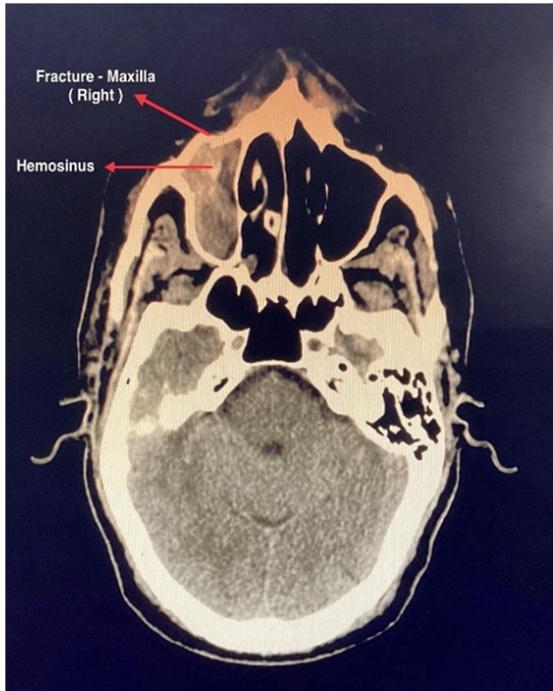
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which he was referred to our hospital. After arrival, he was shifted from the ER to a multi-disciplinary intensive care unit (ICU) after the Trauma CT Protocol. CT Brain revealed a minimally displaced right maxillary fracture with haemosinus (Figure 1).



Admission day CT Head showing evidence of right maxillary fracture with Hemosinus (arrows pointing towards fracture and hem sinus)

**Figure 1: CT Head-Day of Admission**

CT Chest and Abdomen findings were unremarkable. Labs were noteworthy for thrombocytopenia, hyperbilirubinemia, and acute kidney injury (Table 1). The foremost among the differentials were Meningoencephalitis and Tropical fever with Septic Encephalopathy. Meropenem, Vancomycin, and Doxycycline were administered as empirical antibiotics, along with intravenous dexamethasone (10 mg Q6h). CSF was intensely turbid, and the analysis was redolent of bacterial meningitis (Table 2). Cultures couldn't isolate organisms either in CSF or in blood. CSF film array was also reported as negative.

Meanwhile, we received a 48-hour blood culture report from the primary hospital where the patient was initially admitted, revealing a moderate growth of *Klebsiella pneumoniae*. Following this, Vancomycin was stopped, and Polymyxin B was

**Table 1: Laboratory Tests (Day 1 of Admission)**

Test	Value	Reference range
Haemoglobin	12.1 gm/dl	14-18 gm/dl
White blood cell count	9000 cells/cu. mm	4000-11000 cells/cu. mm
Platelet count	93000 cells/ $\mu$ L	1.5- 4.5 lakhs/ $\mu$ L
Sodium	135 meq/L	135-145 meq/L
Potassium	4.2 meq/L	3.6-5.2 meq/L
Creatinine	1.4 mg/dl	0.7-1.3 mg/dl
Blood Urea Nitrogen	25 mg/dl	6-24 mg/dl
Ammonia	38 $\mu$ mol/L	11-32 $\mu$ mol/L
Ionized calcium	1.06 mmol/L	1.16-1.31 mmol/L
Magnesium	1.3 mg/dl	1.7-2.2 mg/dl
Total Bilirubin (Conjugated)	11.2 (9.1) mg/dl	0.1- 1.2 mg/dl
Aspartate aminotransferase	47 U/L	14-20 U/L
Alanine aminotransferase	28 U/L	29-33 U/L
Alkaline Phosphatase	61 IU/L	44- 147 IU/L
Dengue Antigen, IgM	Negative	Negative
Leptospira IgM	Negative	Negative
Scrub Typhus Elisa	Negative	Negative
Rapid Malaria Test	Negative	Negative
Urinalysis- (Pus cells)	1	0-5
Blood Culture	No growth	No growth

$\mu$ L = microliter **fL**= Femtoliter **g/dL**= grams (g) per deciliter (dL) % = percentage **mg/dl**= milligrams/dl **cu.mm**= cubic millimetre **mmol/L**= millimol per litre **meq/L**= milli equivalent/ L **U/L** = Units/L **IU/L**= International units per litre

added because of increased carbapenem resistance in our region. Dengue, Malaria, Scrub typhus, and Leptospira showed negative results and Doxycycline was stopped. MRI Brain with contrast revealed features suggestive of Ventriculitis with meningitis, displaying parenchymal para-ventricular flair hyperintensities as well as mildly dilated ventricles with mild flair hyperintense T2 intermediate signal-dependent fluid in the bilateral occipital horns (Figure 2). Electroencephalogram (EEG) recordings noted findings suggestive of diffuse dysfunction of the brain. CSF polymerase chain reaction (PCR) assay detected *Klebsiella pneumoniae*.

**Table 2: CSF Analysis (Day 1 of Admission)**

CSF	Finding	Reference range
Appearance	Turbid	Clear, Colourless
Cell count	3250 cells/ cu.mm	<5
Cell type	Neutrophils- 94%	Nil
	Lymphocytes- 6%	100% Lymphocytes
Glucose (corresponding GRBS)	77 (314 mg/dl)	> 60% of serum glucose
Proteins	397 mg/dl	15-45 mg/dl
CSF glucose/ Blood glucose ratio	0.24	0.6
CSF Lactate	223 mg/dl	10-25 mg/dl
Gram stain	Negative	Negative
AFB Stain	Negative	Negative
Film Array-Meningitis Panel	Negative	Negative
Bacterial Culture	No growth	No growth



Flair Image of MRI Brain- showing Hyperdensities in the dependent areas of the ventricles- indicative of purulent content. Hyperdensities are also seen in the sulcal spaces of the brain- indicative of inflammation and exudates

**Figure 2: MRI Brain - Flair Image**

His sensorium started to gain ground from day 6 of admission, accompanied by a resolving trend of hyperbilirubinemia, acute kidney injury, and thrombocytopenia, which was also reflected in the CSF analysis on day 6 (Table 3). CSF culture failed to isolate any organism. He was extubated on day 8 and shifted to the High-dependency unit, from where to room by day 13. Meropenem and Polymyxin B were administered for a total duration of 21 days and 14 days respectively. He was discharged home on day 25. At the time of discharge, he remained conscious, obeying, and oriented to person. Nevertheless, he was mildly confused and not oriented to time. He was advised to follow up after 1 month.

**Table 3: CSF Analysis- Day 6 of Admission**

CSF	Finding	Reference range
Appearance	Pale Yellow	Clear, Colourless
Cell count	576 cells/ cu.mm	<5
Cell type	Neutrophils- 58%	100% Lymphocytes
	Lymphocytes- 42%	Lymphocytes
Glucose (corresponding GRBS)	40 (127 mg/dl)	> 60% serum glucose
Proteins	227 mg/dl	15-45 mg/dl
CSF glucose/ Blood glucose ratio	0.31	0.6
CSF Lactate	121 mg/dl	10-25 mg/dl
Gram stain	Negative	Negative
Bacterial Culture	No growth	No growth

### Discussion

Pyogenic ventriculitis is an uncommon infection affecting the ependymal lining of the ventricles of the brain<sup>[4]</sup>. It can complicate meningitis, most notably in the wake of neurosurgical interventions (e.g. shunts), trauma, or CSF leak<sup>[5]</sup>. Thus far, no clear definition for ventriculitis exists, nor any established diagnostic criteria, making the assessment of incidence virtually challenging<sup>[6]</sup>. A retrospective single-centre study found brain abscess (29.6%), primary bacterial meningitis (27.5%), catheter-related ventricular infection (17.3%), neurosurgical site infection (13.3%), or bloodstream infection (12.2%) as the possible etiologies<sup>[3]</sup>. Risk factors for ventriculitis include elderly age (above 60 years) and

immunocompromised status (human immunodeficiency virus, cancer, diabetes, and alcoholism). The present case had the risk factors of advanced age and diabetes.

*Streptococcus pneumoniae* and rarely gram-negative rods are implicated in head trauma-related ventriculitis. In the presence of skull base fracture and persistent CSF leak, oral flora bacteria (*Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Streptococcus pyogenes*) are commonly seen<sup>[7]</sup>. If Ventriculitis occurs due to trauma, the onset can be subtle or even non-specific. The current patient did not present with neck stiffness, which is in tune with the findings of Gronthoud *et al.*<sup>[8]</sup>, who also reported the absence of these signs in their review of patients with ventriculitis. Most of their patients had a positive blood culture, which was also seen in the current case (Positive 48 hour blood culture received from the primary hospital), implying a hematogenous spread of infection.

Ventriculitis, notably, needs prompt and timely identification, given its subtle signs and symptoms, lethal course, and propensity to exist as a potential source of persistent infection. Furthermore, ventriculitis has high mortality and morbidity, as illustrated by a large case series which placed estimated mortality at 30%<sup>[3]</sup>. Early diagnosis is indispensable and CSF microscopy and culture, coupled with imaging form the very essence of evaluation in ventriculitis. The CSF microscopy typically displays elevated proteins (greater than 50mg/dL), low glucose (less than 25mg/dL), pleocytosis (over 10 cells/ $\mu$ L with 50% or more neutrophils), elevated lactate (more than 35 mg/dl) and a positive culture or Gram stain. Molecular testing of the CSF through polymerase chain reaction (PCR) assay, has a turnaround time of less than 48 hours and can detect nucleic acid of various pathogens, even if the microbe is not grown in routine culture or if the patient has been on antibiotics. CSF study in the current case displayed low glucose, high protein, high lactate, neutrophil-predominant leukocytosis, and a negative gram stain and culture. Nonetheless, the CSF PCR assay was positive for *Klebsiella pneumoniae*.

Neuroimaging helps confirm suspected ventriculitis or meningitis and excludes raised intracranial pressure before a lumbar puncture. A CT scan is less sensitive than an MRI, which may lead to a misdiagnosis of intracerebral bleeding<sup>[9]</sup>. Magnetic Resonance Imaging (MRI) with gadolinium contrast

serves as the best imaging modality. Ventriculitis consistently demonstrates ependymal enhancement on T1-weighted images, associated with dilated ventricles and hyperintense T2 signal in the ventricular walls, along with debris in the dependent portions of ventricles on a Gadolinium contrast-enhanced MRI<sup>[10]</sup>. In a case series by Fukui *et al*, ventricular debris was the most characteristic finding seen in 94% of cases, which was irregular in 81% of cases<sup>[11]</sup>. The presence of irregular ventricular debris is specific to pus, distinguishing it from clotted blood.

The present case had all of these features on gadolinium contrast MRI, along with meningeal enhancement, thereby demonstrating features of Ventriculo-meningitis (VM). Antibiotics are the mainstay of treatment<sup>[12]</sup>. The recent Infectious Diseases Society of America (IDSA) guidelines recommend a combination regimen of vancomycin and an antipseudomonal beta-lactam (meropenem, cefepime or ceftazidime) for the initial empirical treatment<sup>[13]</sup>. For the targeted treatment after isolation of a susceptible gram-negative organism, an antipseudomonal beta-lactam is advocated. The recommended duration of antimicrobial therapy is 21 days for Gram-negative VM. In the present case, the patient was empirically treated with a combination of Meropenem and Vancomycin. After the organism's detection, Meropenem was continued for 21 days and Polymyxin B was administered for a total of 14 days. Polymyxin B was added because of increased carbapenem resistance in our region.

## Conclusions

We report a rare case of *Klebsiella* ventriculo-meningitis following head trauma. Though the initial clinical presentation was subtle, CSF analysis showed evidence of bacterial meningitis. However, the CSF Film array, CSF and Blood cultures were negative. MRI Brain with contrast revealed typical features of Ventriculo-meningitis, and CSF PCR detected *Klebsiella pneumoniae*. This prompted us to administer appropriate antibiotics for the optimal duration, resulting in an early recovery of our case.

We would like to draw attention to the importance of considering an early MRI with contrast along with a CSF PCR for head trauma with subtle presentation, minimal CT findings, low microbiological evidence, and poor progress in the sensorium despite empirical antibiotic therapy. This approach significantly expedites the diagnosis and management of a rare cause of a potentially fatal condition such as ventriculo-

meningitis.

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