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Case Report

A case study of post traumatic meningitis after a road traffic accident

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ABSTRACT

In road traffic accident cases one of the main reasons for hospitalization is traumatic brain injury (TBI) with subdural hematomas (SDH). The in-hospital course is further complicated by variety of infections including meningitis. A significant concern in the field of bacterial resistance is the multidrug-resistant strain of *K. pneumoniae*. Due to the dearth of therapeutic options, treating *K. pneumoniae* infections can be difficult and have an adverse impact on morbidity, mortality, and healthcare-related expenses. Here, we present the case of a 34-year-old polytrauma patient who was in good physical health prior to the road traffic accident. The patient sustained right fronto temporo parietal SDH, frontal contusion, frontal bone fracture, multiple facial bone fracture and CSF rhinorrhoea. He underwent bifrontal craniotomy and ACF repair on the following day. His in-hospital course was complicated by *Klebsiella* meningitis. He was discharged from the hospital after 25 days of successful treatment of meningitis. In the present study, effective and satisfactory results were achieved through antibiotic therapy which included Colistin IV and intrathecal, Fosfomycin IV, and Tigecycline IV, for a post-operative *K. pneumoniae* infection. On review day, the CSF analysis had revealed total leucocyte count of 9 and CSF showed no growth.

Keywords: Road traffic accident, CSF rhinorrhoea, *K. pneumoniae*, Meningitis

INTRODUCTION

Poly trauma or multiple traumas is a medical term describing the condition of a person who has been subjected to multiple traumatic injuries. Poly trauma is a major cause of morbidity and mortality in both developed and developing countries.[1] When it comes to the total number of injury-related deaths, road traffic accidents are the leading cause of polytrauma and death. A national automotive sampling system (NASS)-Crashworthiness data system (CDS) analysis of accident cases shown intracranial injuries which causes SDH and to be the third most common traumatic haemorrhage after subarachnoid and intraventricular haemorrhages with high mortality rate.[2]

Cerebrospinal fluid (CSF) leaks are often seen in skull base fractures, which further complicates the surgical management. Leaks of CSF, particularly those with low flow, can go unnoticed at first and not be quickly fixed, which can lead to meningitis. These conditions can worsen the clinical scenarios.[3] Post-traumatic meningitis (PTM) is a significant condition, although head trauma and TBI are intrinsic risk factors.[4] The majority of cases of PTM follow neurosurgical procedures or acute head trauma. Meningitis is a medical emergency that, if left untreated, has a high fatality rate and neurological consequences. However, CSF analysis is the gold standard for diagnosis of meningitis as well as to identify its etiology.

Many healthcare-associated infections, such as meningitis, pneumonia, bloodstream infections, surgical site infections, and liver abscesses, are caused by *K. pneumoniae*.[5] The three distinct forms can be distinguished in the clinical spectrum of *K. pneumoniae*

meningitis as metastatic meningitis, especially from distant liver abscesses, spontaneous meningitis, which typically occurs in elderly patients or those with underlying immunocompromised conditions and post-craniotomy meningitis, which occurs after neurosurgical procedures for brain lesions or head injuries.[6]

Klebsiella species cause infections at multiple sites, including brain, lung, urinary tract, bloodstream, surgical site, and brain. The isolation of multidrug-resistant organisms is increasing day by day in the intensive care unit (ICU) settings and poses a great challenge in treating these patients. *Klebsiella* species include *K. ozaenae, K. rhinoscleroma,* and *K. pneumoniae*, the last of which is an important opportunistic infectious pathogen with major clinical implications.[7] It has a variety of antibiotic resistance mechanisms and is a common pathogen causing hospital-acquired surgical wound infections, digestive tract infections, and community-onset infections, which can cause outbreaks of nosocomial infection.[8] Global drug resistance rate of *K. pneumonia* has reached as high as 70%, and infection-related fatality rate has also reached 40% to 70%.[9]

Reports on surgical patients with bacterial infection says, patients with a *K. pneumoniae* infection have a mortality rate that ranges from 48.5% to 66%, and for adult patients with severe meningitis, that rate is 50% higher.[10] Therefore, recovery depends on early pathogen detection and appropriate and timely treatment. The case report focuses on treating meningitis in a patient who had met with a road accident.

CASE REPORT

A 34 years male was admitted in the emergency following a road traffic accident, reporting polytrauma, subdural haematoma (SDH), multiple bone fracture and CNS rhinorrhoea. Initially he was admitted in outside hospital and was sent to this hospital for further management. His medical history showed no previous infections and no comorbidities.

Physical examination revealed, Temp 98.6°F, PR 80/min, BP 120/80 mmHg, RR 20/min, SPO2 99% on MV, bilateral air entry was adequate, chest examination revealed normal breath sounds and on examination the abdomen was soft. The patient initially underwent neurological evaluation and found the presence of CSF rhinorrhoea, 8 cm long and 7 cm deep laceration on the left side of forehead and also observed with superficial laceration on the left cheek and below the left eyebrow. He was immediately intubated and shifted to ICU.

Blood investigations including CBC, RBS, blood urea, serum creatinine, serum electrolytes, all found within normal limits with neutrophilic leucocytosis. The patient underwent brain MRI scan for further evaluation. Multiple small peripheral areas of restricted diffusion were shown by FLAIR to be hyperintense. The right frontotemporal and bilateral high fronto-parietal blooming areas suggested the possibility of acute haemorrhagic contusions. A grade III diffuse axonal injury change was also possible as the MRI showed multiple small punctate foci of blooming with faint restricted diffusion in the left crus of mid brain, splenium of the corpus callosum, and B/L fronto temporo parietal grey white matter junction. MRI scan details acute subdural haemorrhages observed in the posterior interhemispheric falx of both cerebral hemispheres (Figure 1). Sub-arachnoid and minimal intraventricular haemorrhages also reported in the patient scan.

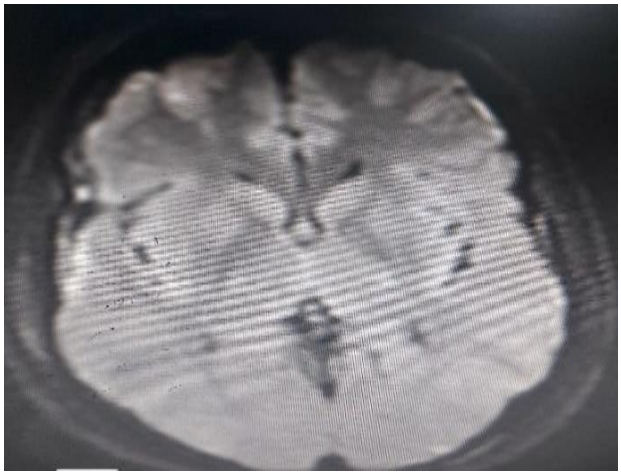


Figure 1: Multiple small peripheral areas of restricted diffusion possible acute haemorrhagic contusions

Subsequent MRI brain scan revealed high grade (III) diffuse axonal injury (Figure 2). To find out any damage happened to the heart during the event a 2D echo was suggested to the patient which revealed Tachycardia (Figure 3). The team of doctors explained the attendees regarding the nature of the polytrauma, the necessity of emergency surgery, and the guarded prognosis.

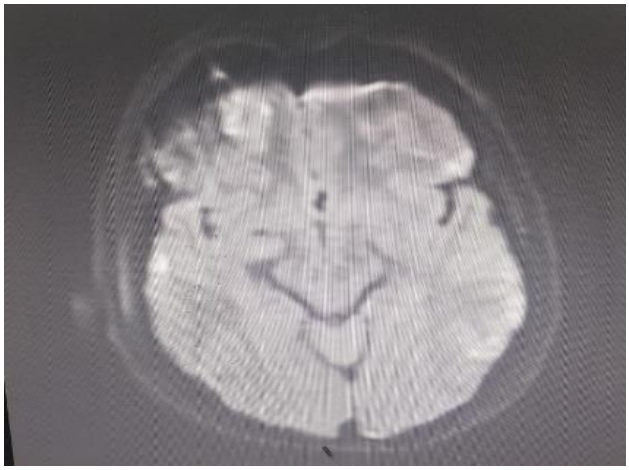
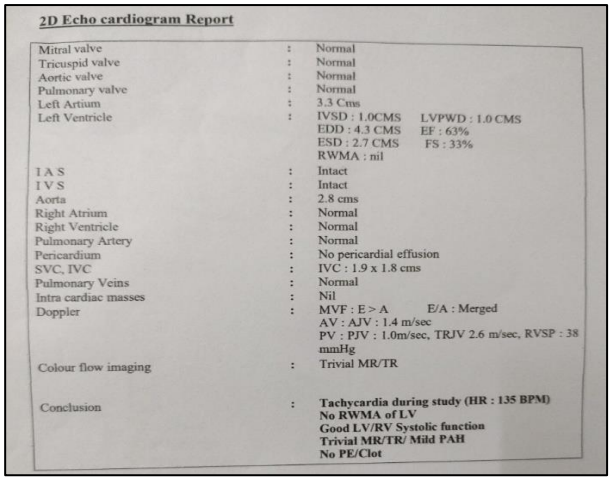


Figure 2: Multiple small punctate foci of blooming likely grade III diffuse axonal injury changes.



2D Echo cardiogram Report

Mitral valve	:	Normal
Tricuspid valve	:	Normal
Aortic valve	:	Normal
Pulmonary valve	:	Normal
Left Artium	:	3.3 Cms
Left Ventricle	:	IVSD : 1.0CMS LVPWD : 1.0 CMS EDD : 4.3 CMS EF : 63% ESD : 2.7 CMS FS : 33% RWMA : nil
I A S	:	Intact
I V S	:	Intact
Aorta	:	2.8 cms
Right Atrium	:	Normal
Right Ventricle	:	Normal
Pulmonary Artery	:	Normal
Pericardium	:	No pericardial effusion
SVC, IVC	:	IVC : 1.9 x 1.8 cms
Pulmonary Veins	:	Normal
Intra cardiac masses	:	Nil
Doppler	:	MVF : E > A E/A : Merged AV : AJV : 1.4 m/sec PV : PJV : 1.0m/sec, TRJV 2.6 m/sec, RVSP : 38 mmHg
Colour flow imaging	:	Trivial MR/TR
Conclusion	:	**Tachycardia during study (HR : 135 BPM)** **No RWMA of LV** **Good LV/RV Systolic function** **Trivial MR/TR/ Mild PAH** **No PE/Clot**

Figure 3: 2D Echo cardiogram showing tachycardia.

During surgery, the patients Hb % is very low, single unit of packed red blood cells was transfused. Under general anaesthesia, the patient underwent bifrontal craniotomy in supine position without head rotation and incision begin anterior to the tragus on each side and curve cranially 2 to 3 cm posterior to the coronal suture. To prevent the brain fluid leakage in the patient, anterior cranial fossa (ACF) repair was also done. Soft tissue repair and open reduction and internal fixation (ORIF) of left zygomatic arch fractures with cutaneous incisions was also done. Tracheostomy is done anticipating prolonged weaning in view of severe traumatic brain injury. Subsequently CT obtained after the surgical procedure did not show any new bleed and the patient was gradually weaned off from ventilator support and shifted to biphasic positive airway pressure (BIPAP), a pressure-controlled ventilation allowing unrestricted spontaneous breathing during the cycle. Proper care was taken for drain and wound healing along regular sterile dressings to prevent the infections.

Later on, fever spikes were reported, the patient underwent a lumbar puncture to collect CSF for analysis. Biochemical analysis of CSF revealed 30000 white blood cells/cumm with 90% of polymorphs, protein of >300 mgs/dL and sugar less than 40 mgs/dL. Red blood cells are also plenty in number. Microscopic examination of CSF shown marked increase in cellularity with neutrophils predominant inflammation depicting neutrophilic pleocytosis and culture shown growth of *K. pneumoniae* (Figure 4).

Isolated *K. pneumonia*, was resistant to meropenem, ceftazidime, cefepime, ciprofloxacin, levofloxacin, gentamicin, amikacin, imipenem, piperacillin and tazobactam, cefoperazone and sulbactam, trimethoprim/ sulfamethoxazole while it showed an intermediate sensitivity to colistin and was sensitive to tigecycline and fosfomycin. A lumbar drain was implanted in order to administer an colistin intrathecally. Post-operative *K. pneumoniae* infection was reduced with antibiotic therapy which included colistin IV, Fosfomycin, tigecycline and patient was further weaned up to BIPAP. Further biochemical analysis of CSF revealed a reduced white blood cells (3000 cells/cumm) with occasional polymorphs. There was no variation in CSF protein level (>300 mgs/dL). Sugar levels increased to 70 mgs/dL. Red blood cells are also plenty in number and culture shown growth of *K. pneumoniae* (Figure 5).

Figure 4: MacConkey agar culture plate with large, mucoid lactose fermenting colonies of *K. pneumoniae*.

When the pus discharge and wound dehiscence were observed in the frontal laceration, collection was identified in CT scan, further investigations and a preoperative aspiration culture were performed. Patient underwent surgical exploration with removal of infected bone flap at the previously operated site and the infected tissue was cleared off. On evacuation, fever spikes were come down and gradually weaned off. Further repetition of lumbar puncture, CSF analysis revealed further reduction in white blood cells (78 cells/ cumm) and culture was negative. Patient was advised to receive limb and chest physiotherapy during the entire course of treatment, and his vital signs were constantly monitored.

Figure 5: Blood agar culture plate with grey, mucoid non hemolytic colonies of *K. pneumoniae*.

After all these procedures, patient was found hemodynamically stable without any fever spikes. With a Glasgow coma scale (GCS) score of E4VTM5 maintaining saturation of 98% on BIPAP and pupils equal sized reacting to light for reasonable time duration. Hence, decided to discharge to rehabilitation center.

Therapeutic intervention

The patient was treated with the recommended antibiotics using, Inj. Meropenem (IV, 2 gm thrice daily for 7 days) later stopped, colistin 9 MU (IV stat), then 4.5 MU (IV twice daily, 14-21 days), intrathecal colistin 5 lakh units (once daily 10 days), Fosfomycin 4 gm (IV, 4 times daily, 21 days), tigecycline (200 mg IV stat), tigecycline (100 mg, IV twice daily, 21 days). IV fluids and a local application of neosporin eye ointment were administered. Proper physiotherapy care was provided to the patient during the course of treatment.

DISCUSSION

Majority of road accident patients die of traumatic shock which is the consequence of poor or absent circulation and the resulting biochemical changes in the body. The surgical intervention within this period of time is the most important reason to improve the survival chances of the polytraumatized patients.

Trauma, causes the majority of leaks, and trauma involving skull base and facial fractures is most likely to cause CSF rhinorrhea, diagnosed by biochemical assay. In the current study, the patient undergoing neurological evaluation with an MRI scan has an evidence of CSF rhinorrhoea. CSF rhinorrhoea, when left untreated, can lead to meningitis and other serious complications.[11] CSF rhinorrhoea is not an uncommon complication of neurosurgical procedures or head trauma.[12] Later presentations are associated with higher complication rates, especially of meningitis which can lead to significant morbidity and mortality.[13] A single institution-based review of 101 traumatic CSF leaks between 1984 and 1998 reported a 27.5% rate of occurrence of meningitis.[14] Present MRI scan also details acute subdural haemorrhages observed in the posterior interhemispheric falx of both cerebral hemispheres due to polytrauma. SDHs are relatively common and occur in about 30% cases of severe head trauma.[15] Following the accident, during the 2D echo study tachycardia was observed and his pulse rate has increased to a maximum of 135 beats/minute. The presence of tachycardia and mild hypertension in the patient were considered signs of sympathetic hyperactivity following brain injury due to head trauma.[16]

Bifrontal craniotomy is one of the most commonly used surgical methods in neurosurgical practice for trauma patients and provides excellent access to the pathology area.[17] In the present case report the patient underwent bifrontal craniotomy, soft tissue repair for polytrauma and tracheostomy for proper aeration. Our result shows that open reduction and internal fixation (ORIF) of left zygomatic arch fractures were done during bifrontal craniotomy. In India the most common cause of zygomatic arch injury was road traffic accidents.[18] In this case surgery was also performed to repair the ACF injury. The vast majority of traumatic ACF injuries resulting in smaller defects of the cranial base itself can be successfully reconstructed using local pedicled peri cranial or Galeal flaps.[19]

After the bifrontal craniotomy, pus discharge and wound dehiscence were found in the patient. Prompt identification is important for preventing worsening dehiscence, infection, and other complications.[20] Frontal sinus complications are challenging to treat and raise morbidity. Leaks of CSF and frontal sinus infections are the most significant of these complications. A crucial issue that the patient and surgeon must address following surgery is CSF leakage.[21] Following these complications, meningitis and intracranial abscesses may occur.[22] In the current investigation, following a bifrontal craniotomy, the patient's CSF culture contained the Gram-negative bacteria *K. pneumoniae*. Acinetobacter, *Klebsiella*, and *P. aeruginosa* are the top three Gram-negative bacteria, typically found in intracranial infections that develop after surgery.[23] Following *Klebsiella* infection, lumbar drain implantation and intrathecal administration of colistin, colistin IV Fosfomycin IV, Tigecycline IV were performed which reduced the infection. Indeed, polymyxin E (colistin) has been considered as a “last resort” antimicrobial to fight *K. pneumoniae* infections, often representing the only antimicrobial to achieve adequate serum levels and minimum inhibitory concentrations (MIC).[24] Drainage and immediate antibiotics administration improves the symptoms in meningitis patients. Studies on analysis of CSF of post-craniotomy and primary meningitis have shown *K. pneumoniae* isolates. These isolates were resistant to cefotaxime and ceftazidime, but were all sensitive to colistin and tigecycline.[25] Studies on surgical site infections in the abdomen lead to the isolation of drug resistant strain of *K. pneumoniae* and demonstrating Fosfomycin susceptibility on an antibiogram which halted the discharge on intravenous administration. Topical medications are being used in an outpatient setting to treat wound dehiscence.[26] Studies on susceptibility of *Klebsiella* spp. to tigecycline and other selected antibiotics shown that over 90% of the *Klebsiella* spp. strains were sensitive to tigecycline.[27] Present case report is in consistent with the results.

The case report shows that the cure of meningitis by using various antibiotics. Appropriate antibiotics along with pharmacokinetic-pharmacodynamic (PKPD) dose compliance were helpful in the meningitis recovery. Patient is discharged and sent to rehabilitation centre for further management. Currently he is responding to commands with a mild deficit in upper limbs (2/5) and lower limb (4/5) because of TBI.

CONCLUSION

One complication that needs to be evaluated right away is post-craniotomy infection in road accident cases. A small percentage of patients may still develop a serious infection even when the procedure was carried out using the proper technique, sterile approach, and sufficient prophylactic antibiotics. This case study demonstrates, patients with meningitis (*K. pneumoniae* infection) can survive, provided they get the right treatment and intervention in right time.

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