Case Report of a V-P Shunt Dependent Child with Shunt Disconnection and Infection with Extended-Spectrum β-Lactamase-Producing *Klebsiella pneumoniae* (ESBL-KP)

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**Abstract**

Shunt malfunction superadded with infection in a shunt dependent child always lead to significant mortality and morbidity. Infections of central nervous system with Extended-Spectrum β-Lactamase-Producing *Klebsiella pneumoniae* (ESBL-KP) are very atypical, only occurs in immunosuppressive state and inappropriate treatment increases mortality and morbidity. Use of central catheter or ‘ommaya reservoir’ is a very good method of C.S.F drainage and intraventricular administration of some antibiotics. Here we report a shunt dependent baby of three and half years with history of recurrent respiratory tract infections, gastroenteritis and UTIs as she presented to us with shunt disconnection and simultaneous meningitis with Extended-Spectrum β-Lactamase-Producing *Klebsiella pneumoniae* (ESBL-KP). This patient was treated with removal of infected shunt, reservoir implantation, parenteral antibiotics and lastly re-introduction of V-P shunt with removal of ‘ommaya reservoir’.

**Keywords:** Ommaya reservoir; Intraventricular administration of antibiotic; Extended-Spectrum β-lactamase-producing *Klebsiella pneumoniae*; Shunt infection and disconnection

**Abbreviations**


**Introduction**

Hydrocephalus occurs when there is excess production or most commonly due to decreased absorption of C.S.F. It may be consequence of aqueductal stenosis, meningitis, intracranial haemorrhage or brain tumour [1]. There are generally two approaches to treat hydrocephalus. The most common treatment is the placement of shunt in the form of ventriculoperitoneal, ventriculo-pleural or verticulo-atrial shunt [2]. The other procedure is Endoscopic Third Ventriculostomy (ETV), involves the surgical creation of an opening in the floor of the third ventricle to enable the passage of CSF into cistern [3,4]. Ventriculoperitoneal shunt is most commonly performed worldwide as a treatment of hydrocephalus [5]. Complications include shunt infection, shunt blockage or disconnection. Intra-abdominal complications include intestinal obstruction, gut perforation, pseudocyst formation [6-8]. Other complications reported in the literature include CSF ascites, inguinal hernia, and intestinal volvulus [9-11]. Infection remains a serious complication of shunt implantation, with a mortality rate ranging from 1.5–22% [12]. Those who survive are at risk intellectual, cognitive, and neurological deficits [13]. Infection has been reported to occur in 5–15% of shunt procedures [14-16]. However, some authors have described lower infection rates ranging from 0.3–5% [17-21].

Many factors have been associated with shunt infection e.g. age of the patient, presence of infections. Most studies of the use of prophylactic antibiotic medications have given inconclusive results, and there has been no definite evidence that prophylactic antimicrobial medications reduce shunt infection rates. Other factors such as timing of the operation (elective/emergency), duration of surgery, number of operations/patient, number of people in the operation room, and length of time during which the shunt material is exposed to the atmosphere have been highlighted as contributing to shunt infection; these may all be included in specific “theatre discipline” [22]. Shunt mechanical complications may occur at any time from in the recovery room immediately after the shunt operation to years late [23]. The most common period for a shunt to fail is at the first 6 months after its insertion. Most
common mechanical complication is the obstruction of CSF shunt flow and the accompanying rise in the cranial pressure. This rise leads most commonly to headache, nausea, vomiting and lethargy. Examination of the site of the shunt equipment implantation may provide confirmatory evidence of the shunt dysfunction [24]. Shunt infection remains as an important, distressing cause of shunt failure. Shunt removal with internal antibiotic treatment (usually with external ventricular drainage) carries the highest shunt infection cure rate and lowest mortality rate [25]. Developmental delay, poor cognitive function, visual and auditory defect may persist after treatment [26-29].

An Ommaya reservoir (Figure 1) is an intraventricular catheter system that can be used for the aspiration of cerebrospinal fluid or for the delivery of drugs (e.g. antibiotic, chemotherapy) into the ventricles. It consists of a catheter in one lateral ventricle attached to a reservoir implanted under the scalp [30-33].

Case Report

Baby “A”, a female child of three and half year was admitted to Bangladesh Medical College Hospital with fever, vomiting, irritability and deteriorating level of consciousness. On examination CCS level was 9 (E1 M5 V3), pupil small reacting, temperature 101°F and rigid neck. Abdomen was soft, non-tender and shunt tube was felt disconnected at the occiput and there was fluid collection around the area of detachment.

She had a history of neonatal pyogenic meningitis (Flavobacterium, sensitive to ciprofloxacin) at the age of 45 days (OFC: 34 cm) and underwent VP shunt surgery due to post meningitic hydrocephalus (OFC: 43 cm). Within 2 month of operation shunt became disconnected and a revision surgery was done. During the growing period parents noticed that the baby unresponsive to sound and was taken to ENT hospital, diagnosed as a case of sensory neural deafness. Another episode of shunt revision for migration of peritoneal end of catheter into the peritoneal cavity was done after ten months of first revision. Since these, she has been receiving treatment several times as case for impetigo, tonsillitis, recurrent pneumonia and UTIs by the pediatricians.

Now this time, investigation showed neutrophilic leukocytosis. CT scan of brain revealed cranial end of shunt tube placed in situ with dilated ventricles and compressed brain matter (Figure 2). X-ray shunt system revealed disconnected shunt distal to the valve (Figure 3). We diagnosed her as a case of “shunt failure”. The baby underwent shunt removal, attempted ETV with Ommaya reservoir placement. During shunt removal the peritoneal end was found to be soiled with faecal matter (Figure 4) and cranial end was stubbornly attached with (?) Choroid Plexus which was dislodged with the help of monopolar cautery. We tried ETV in this session but third ventricular floor was opaque and thickened with hazy CSF and scarred Choroid plexus and aqueduct was stenosed. It was impossible to form a stoma for minimizing intra cranial pressure. We put an Ommaya reservoir through the right frontal burr hole and shunt tube was sent for culture and sensitivity. Post operatively we kept the patient NPO for high suspicion of intestinal perforation. Plain X-ray abdomen erect posture revealed nothing significant throughout the period. Abdomen was soft and non-tender. In the meantime baby was treated with regular 20-30 cc CSF aspiration and 1 mg gentamicin and 5 mg vancomycin in intraventricular route and metronidazole 7.5 mg/kg, 8 hourly in intravenous route. After culture and sensitivity test we stopped all of previous antibiotic and switched to meropenem. As culture of shunt tube was found to be growth of profuse Klebsiella pneumoniae which was which was found sensitive to meropenem, imipenem, amikacin, piperacillin-tazobactam. Baby became apyrexic and neck rigidity resolved soon. After 14 days CSF became clear, it was culture negative and complete blood count became normal baby was stable.

Figure 1: Intraventricular catheter system.

Figure 2: CT scan of brain.
result from congenital blockage, post meningitic state intraventricular hemorrhage or posterior fossa space occupying lesion [39]. We tried endoscopic procedure but circumstances were not favorable.

Extended-spectrum beta-lactamases (ESBLs) producing organisms are capable of hydrolyzing beta lactum antibiotics like ceftriaxone, ceftazidime. They are most commonly found in Klebsiella pneumoniae [40]. Carbapenems (imipenem or meropenem) should be the drug of choice, other beta lactam antibiotics (cefepime) are not suitable as first line antibiotics [41,42].

Conclusions

Repeated respiratory tract infection and other systemic infections in a shunt dependent patient may results shunt infection with rare pathogens. Removal of infected hardware, creating an alternate pathway for CSF drainage and administration of meropenem and intraventricular gentamicin delivered good result. Placement of Ommaya reservoir was very useful for removal of cerebrospinal fluid and introducing intraventricular antibiotics. Finally, shunt surgery should be done by expert hand and unnecessary cutting and reconnecting of shunt tube should be avoided.

References


Discussion

Ventriculoperitoneal shunt associated CNS infection may be caused by overlying skin breakdown, bacteremia due to some systemic disease, colonization of shunt tube during surgery or retrograde infection from distal end of shunt. Patient may present with fever, depressed consciousness, redness over the shunt line, sign of peritonitis [34-36]. In this case, the patient had ESBL-KP shunt infection and retrograde ventriculitis. Infection with ESBL producing organisms needs state of immunosuppression. It may be aggravated by repeated respiratory/urinary tract infections, malignancies, prolonged hospital stay and use of broad spectrum antibiotics [37]. Removal of infected hardware along with antibiotic treatment showed the best result. On the basis of these findings, the authors concluded that the treatment combination of shunt removal, 20 mg/d of intraventricular vancomycin, and systemic antibiotics was both safe and effective for CSF shunt infections [38].

Endoscopic third ventriculostomy (ETV) is currently considered as the best treatment for obstructive hydrocephalus. Obstruction is most frequently at the level of aqueduct. It may

Then we did left side VP shunt (opposite side of previous burr hole) with removal of ommaya reservoir. Post-operative period was uneventful and the baby was discharged after 10 days. After 6 months of surgery baby was doing fine.