

Frequency of Ventriculoperitoneal Shunt Infection in Infants on The Basis of Cerebrospinal Fluid Analysis

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ABSTRACT

Objective: To know the frequency of ventriculoperitoneal shunt infection in infants on the basis of cerebrospinal fluid analysis.

Material and Methods: A cross-sectional study conducted at the LRH Neurosurgery unit, pathology department of KTH Peshawar and department of neurosurgery Gomal Medical College. D.I. Khan, from July 2016 to June 2018. All consecutive patients with suspected ventriculoperitoneal shunt infection were included in the study. The age of the patients was up to one year, irrespective of their gender. Infants with closed fontanelle and previous revision surgery for ventriculoperitoneal shunt were excluded from the study.

Results: Total 204 patients. The age of the patients were under one year (infants). Infected cerebrospinal fluids were observed in 19.1% (39/204) infants. Female infants were slightly more common (51.3%) than male. Majority (64.1%) of the patients was having age less than 6 months.

Conclusion: We conclude from our study that 19.1% of infants with cerebrospinal fluid shunts have infected CSF on laboratory analysis. Most of the infected shunts occur in female infants and in the first half of their age.

Keywords: Hydrocephalus, Infants, Cerebrospinal Fluid, Infected Cerebrospinal Fluids (CSF), Ventriculoperitoneal Shunt, Shunt Infection.

INTRODUCTION

Hydrocephalus is a common neurosurgical entity in the pediatric age group. Infants with hydrocephalus presents with progressive enlargement of the head. They are irritable and also decrease feeding¹. Infants with hydrocephalus are either treated with medicines as acetazolamide and furosemide or surgically². Surgical treatments are endoscopic third ventriculostomy or ventricular shunts. Infants with hydrocephalus are treated most of the time with Ventriculoperitoneal shunts.^{1,3,4}

Infection is the commonest complication of VP shunt.⁵⁻⁹ Almost 30 to 40% of all CSF shunts in pediatric patients fail within 1 year of placement.⁸ Ventriculoperitoneal shunt infection occurs in almost 5-15% of the cases.^{10,11} It is more common during

initial 8 weeks after surgery and the most common cause is *Staphylococcus epidermidis*.¹² Lab analysis of the cerebrospinal fluid of infected shunt patients has a higher white blood cell (WBC) and neutrophil counts, higher protein concentration, and lower glucose levels.¹³

As there is a limited local study on the frequency of ventriculoperitoneal shunt infection in infants evaluated on the basis of cerebrospinal fluid analysis. This study will help us to detect CSF shunt infection earlier and thus treat in time.

MATERIALS AND METHODS

Study Design

It was a cross-section study done at the Lady Reading

Hospital (LRH) Neurosurgery unit, pathology department of KTH Peshawar and department of neurosurgery Gomal Medical College, D.I. Khan from January 2016 to February 2018.

Inclusion Criteria

All consecutive patients with suspected ventriculoperitoneal shunt infection were included in the study. The age of the patients was up to 1 year, irrespective of their gender.

Exclusion Criteria

Infants with closed fontanelle and previous revision surgery for ventriculoperitoneal shunt were excluded from the study.

Data Collection Procedure

Informed consent was taken after ethical committee approval the study. A medical record of the patients, including cerebrospinal fluid (CSF) laboratory reports which was done Cobas 6000 (Roche diagnostics) machine were analyzed. The diagnosis of infected shunt was made if the CSF analysis had higher white blood cell count ($>100/\text{mm}^3$) and a neutrophil count ($> 10\%$), higher protein concentration ($> 200\text{mg/dl}$), and lower glucose levels ($< 50 \text{ mg /dl}$).¹³

Data Analysis

Data analysis was taken through SPSS 22.

RESULTS

Total 204 patients. The age of the patients were under one year (infants). Infected cerebrospinal fluids were observed in 19.1% (39/204) infants. Female infants were slightly more common (51.3%) than male. Majority (64.1%) of the patients was having age less than 6 months.

204 infants who fulfilled the inclusion criteria in the study period.

Gender Distribution

The age of the patients were under 1 year (infants). Female infants were slightly more common (51.3%) than male as given in table 1.

Age Incidence

Majority (64.1%) of the patients was having age less

than 6 months (Table 2).

Table 1: Gender of infants with infected cerebrospinal fluid (CSF) $n = 39$.

| Gender | No of patients | Percentages |
|--------|----------------|-------------|
| Female | 22 | 56.4 |
| Male | 17 | 43.6 |

Table 2: Age distribution in infected CSF infants $n = 39$.

| Age | Number of Patients | %age |
|------------|--------------------|-------|
| < 6 months | 25 | 64.1% |
| > 6 months | 14 | 35.9% |
| Total | 39 | 100% |

Outcome

Infected cerebrospinal fluids were observed in 19.1% (39/204) infants.

DISCUSSION

Ventriculoperitoneal shunt is an important treatment option in infants with hydrocephalus. After shunting some changes in the composition of CSF occurs even if there is no shunt infection. These changes are raised in the WBC ($>5/\text{mm}^3$) and proteins ($> 40 \text{ mg/dl}$). However, in shunt infection these rises in white cell count and proteins are much higher.^{13,14} In our study, we had infected CSF in 19.1% (39/204) cases. Shunt infection varied in different studies.^{15,16} In a study of 7071 children with CSF shunts, the infection rate was 11.7%.¹⁷ In another study of 170 children, the risk of early shunt infection was 5.8%.¹⁹ Kulkarni et al. (2001)³ studied 299 children and reported that 31 (10.4%) had infections of the shunt. In another study of 900 patients, the CSF shunt infection rate was 4.5%.²⁰ In a study of 191 infants, the infection rate was 7.8%.²¹ We have a comparatively higher rate of shunt infection than other studies. This may be because overall post op infection rate is high in our set up than developed countries. Another reason is that most of the parents do not give bath to their babies with shunt. They have the false believe that the shunt gets infected or blocked with bath. This results in poor hygiene and more chances of infection.

The respiratory infection, CSF leak from the wound, low birth weight and revision surgery.^{17,18}

Some studies have reported that CSF shunt infection has a weak association with female gender¹⁷. We have almost the same results. The exact reason for more chances of shunt infection in female gender is not exactly known.

In our study, we observed that infants in the 1st 6 months of life had more chances of shunt infection. Other studies have almost the same results. Pople et al. (1992)²² reported in their study that Ventriculoperitoneal shunt infection was more common (15.7%) in infants with age less than 6 months as compared to older infants (5.6%). This may be because of the immunologic deficiency and residential bacterial flora in this age group²¹. The chances of CSF shunt infection can be reduced in young infants by reducing the skin bacterial flora with chlorhexidine shampoos before surgery and changing the gloves while handling the shunt.²²

CONCLUSION

We conclude from our study that 19.1% of infants with cerebrospinal fluid shunts have infected CSF on laboratory analysis. Most of the infected shunts occur in female infants and in the first half of their age.

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ROLE OF AUTHORS

Safia Rahman, Mumtaz Ali: Study Design.
Seema Sharafat and Zahid Khan: Data Collection and paper writing.
Farooq Azam and Shahid Nawaz: Literature Review.

Additional Information

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Human Subjects: Consent was obtained by all patients/ participants in this study.

Conflicts of Interest:

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

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REFERENCES

1. Kahle KT, Kulkarni AV, Limbrick DD, Warf BC. Hydrocephalus in children. *The Lancet*. 2016; 387 (10020): 788-799.
2. Shinnar S, Gammona K, Bergman jr ED, Epstein M, Freeman JM. Management of hydrocephalus in infancy: Use of acetazolamide and furosemide to avoid cerebrospinal fluid shunts. *The Journal of Pediatrics*, 1985; 107 (1): 31-37.
3. Kulkarni AV, Drake JM and Pasculli ML. Cerebrospinal fluid shunt infection: a prospective study of risk factors. *J of Neurosurgery*, 2001; 94 (2): 0195.
4. Kestle JR. Pediatric hydrocephalus: current management. *Neurol Clin*. 2003; 21: 883-895.
5. Berry JG, Hall MA, Sharma V, Goumnerova L, Slonim AD, Shah SS. A multi-institutional, 5-year analysis of initial and multiple ventricular shunt revisions in children. *Neurosurgery*, 2008; 62: 445-454.
6. Browd SR, Gottfried ON, Ragel BT, Kestle JR. Failure of cerebrospinal fluid shunts: part II: over-drainage, loculation, and abdominal complications. *Pediatr Neurol*. 2006; 34: 171-176.
7. Browd SR, Ragel BT, Gottfried ON, Kestle JR. Failure of cerebrospinal fluid shunts: part I: obstruction and mechanical failure. *Pediatr Neurol*. 2006; 34: 83-92.
8. McGirt MJ, Leveque JC, Wellons JC, III, Villavicencio AT, Hopkins JS, Fuchs HE, et al. Cerebrospinal fluid shunt survival and etiology of failures: a seven-year institutional experience. *Pediatr Neurosurg*. 2002; 36: 248-255.
9. Sainte-Rose C, Piatt J.H, Renier D, Pierre-Kahn A, Hirsch J.F, Hoffman H.J et al. Mechanical Complications in Shunts. *Pediatr Neurosurg*. 1991-92; 17: 2-9.
10. Kontny U, Hofling B, Gutjahr P, Voth D, Schwarz M, Schmitt HJ. CSF shunt infections in children. *Infection*, 1993; 21: 89-92.
11. Horgan MA, Piatt JH Jr. Shaving of the scalp may increase the rate of infection in CSF shunt surgery. *Pediatr Neurosurg*. 1997; 26: 180-4.
12. Mancao M, Miller C, Cochrane B, Hoff C, Sauter K,

- Weber E. Cerebrospinal fluid shunt infections in infants and children in Mobile, Alabama. *Acta Paediatrica*. 2007.
<https://doi.org/10.1111/j.1651-2227.1998.tb01527>.
13. Lan CC, Wong TT, Chen SJ, Liang ML, Tang RB. Early diagnosis of ventriculoperitoneal shunt infections and malfunctions in children with hydrocephalus. *J Microbiol Immunol Infect*. 2003; 36 (1): 47-50.
 14. Noetzel MJ, Baker RP. Shunt fluid examination: risks and benefits in the evaluation of shunt malfunction and infection. <https://doi.org/10.3171/jns.1984.61.2.0328>.
 15. Gardner P, Leipzig T, Phillips P. Infections of central nervous system shunts. *Med Clin North Am*. 1985; 69: 297-314.
 16. Gardner P, Leipzig TJ, Sadigh M. Infections of mechanical cerebrospinal fluid shunts. *Curr Clin Top Infect Dis*. 1988; 9: 185-214.
 17. Simon TD, Hall M, Cambrin JR, Albert E, Jeffries HE, LaFleur B et al. Infection rates following initial cerebrospinal fluid shunt placement across pediatric hospitals in the United States. *J Neurosurg Pediatr*. 2009; 4 (2): 156-165.
 18. Matthew J. McGirt Aimee Zaas Herbert E. Fuchs Timothy M. George Keith Kaye Daniel J. Sexton. Risk Factors for Pediatric Ventriculoperitoneal Shunt Infection and Predictors of Infectious Pathogens. *Clinical Infectious Diseases*, 2003; 36 (7): 858-862.
 19. Amacher AL, Wellington J. Infantile hydrocephalus: long-term results of surgical therapy. *Pediatric Neurosurgery*, 1984 - karger.com.
 20. Ronan A, Hogg GG, Klug GL. Cerebrospinal fluid shunt infections in children. *The Pediatric Infectious Disease Journal*. 1995; 14 (9): 782-786.
 21. Dallacasa P, Dappozzo A, Galassi E, Sandri F, Cocchi G, Masi M. et al. Cerebrospinal fluid shunt infections in infants. *Child's Nervous System*, 1995; 11 (11): 643-649.
 22. Pople IK, Bayston R, Hayward RD. Infection of cerebrospinal fluid shunts in infants: a study of etiological factors. *Journal of Neurosurgery*, 1992; 77 (1): 29-36.

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