

Epidemiological Profile of Children with External Ventricular Drainage

ORIGINAL

Alane Barreto de Almeida Leôncio¹,
Thaís Grilo Moreira Xavier²,
Saionara Lenarda Oliveira Dantas³, Cibério Ladim Macêdo⁴,
Andrea Valente Braga⁵,
Silvia Virginia Pereira do Nascimento Correia⁶,
Thaiany Batista Sarmiento de Oliveira⁷,
Herika Brito Gomes de Farias⁸

- 1 Nurse. Specialist in Pediatrics by the Multidisciplinary Residency Program in Child of Pediatrics Arlinda Marques Complex. *
- 2 Nurse. Tutor/teacher of the Multidisciplinary Residency Program in Child of Pediatrics Arlinda Marques Complex. *
- 3 Pharmaceutical. Specialist in Pediatrics by the Multidisciplinary Residency Program in Child of Pediatrics Arlinda Marques Complex. *
- 4 Pharmaceutical. Tutor/teacher Multidisciplinary Residency Program in Child of Pediatrics Arlinda Marques Complex. *
- 5 Nurse. Nursing resident of the Multidisciplinary Residency Program in Child of Pediatrics Arlinda Marques Complex. *
- 6 Nurse. Nursing resident of the Multidisciplinary Residency Program in Child of Pediatrics Arlinda Marques Complex. *
- 7 Nursing resident of the Multidisciplinary Residency Program in Child of Pediatrics Arlinda Marques Complex. *
- 8 Nurse. Nursing resident of the Multidisciplinary Residency Program in Child of Pediatrics Arlinda Marques Complex. *

*: João Pessoa, Paraíba. Brazil.

Abstract

Objective: tracing the epidemiological profile, focused on infectious aspects, of children undergoing insertion of external ventricular drainage valve for the treatment of hydrocephalus.

Method: A retrospective, documentary and descriptive study of clinical and epidemiological approach with a quantitative analysis of the findings. The sample consisted of 53 children in a pediatric hospital of reference in the state of Paraíba in the period July 2009 to December 2014. For data analysis, non-parametric tests were used, and the chi-square test and Fisher test performed according to the statement.

Results: Among the 53 children who participated in our study, 49.1% (26) died. According to the causes found on the death certificate, 69.2% of the causes of death described relation to infection.

Conclusion: The high rates of CNS infections and other acquired infections, resulting in the deaths of children who underwent insertion of EVD valve, they are the result of a set of facts involving the care of a multidisciplinary team. The high incidence presented in the shunt study showed that changes and system remaining in the patient to a risk factor for infection.

Contact information:

Alane Barreto de Almeida Leôncio.

Address: Rua Professor Maria Lianza, 1104, apt 203, Jardim Cidade Universitária. CEP: 58052-320.

Tel: +55 83 98825-9935.

 alanealmeida@hotmail.com

Keywords

Child Health; External Ventricular Drain; Infection.

Introduction

The neurological disorders in children and adolescents, since it affects the central nervous system (CNS) or Peripheral, has very high prevalence and problems that can lead to death or leave irreparable after-effects, with serious consequences for the physical, intellectual and emotional health of the child and/or adolescents, the social and family environment where they are inserted, making it besides a problem of individual and family health, a public health problem.

Among the diseases in the CNS the most important and frequent, hydrocephalus has its clinical, surgical and social implications in the child's life, and due to various etiologies associated with functional and neuropsychiatric problems attributed to several brain disorders, and represents a significant cause of death. Among the most associated diseases, we highlight the CNS tumors, myelomeningocele and congenital malformations [1].

Hydrocephalus is a pathological condition caused by accumulation of cerebrospinal fluid (CSF) in the intracranial cavity. This accumulation can be caused by disturbances, such as: blocking in its circulation, decrease in the absorption capacity and overproduction. The accumulation of CSF in the ventricles increases the pressure within the intracranial cavity, causes abnormal dilation of the ventricular system and, consequently, enlarges the brain and compresses the cranium [2].

Regarding the treatment, there are several possibilities to be taken. However, neurosurgery has become a common and safe practice, however complex and needs in most cases a more intensified monitoring and admission to the intensive care unit [3]. The improvement of care for this population has been visible in these last few years, however, is still scarce the evaluation of adverse events and of mortality risk factors, where little is known about the possible complications that the child may have [4].

The use of tubes and drains in neurosurgery is closely associated with the history of hydrocephalus.

The use of cerebrospinal fluid drainage valved represented represented great progress, with marked reduction in mortality and morbidity in children with hydrocephalus [5].

Nowadays, after many studies and developments, lead systems used are considered the ideal material for use in this pathology, may be through Ventriculo-peritoneal Derivation (VPD), the Ventriculoatrial Derivation (VAD) or External Ventricular Drain (EVD). The choice of the type and bypass time will be related from the cerebrospinal fluid analysis [6]. The external shunt catheters are essential for the neurosurgical treatment of patients with intracranial hypertension. Besides being quite affordable for most health systems, the installation technique is quite simple, which is the best option to monitor intracranial pressure and act in treatment by cerebrospinal fluid drainage [7, 8].

The use of these derivations in the treatment of hydrocephalus can cause complications that can be infectious, mechanical and functional, and cause neurological injury, death, psychological disorders in patients and families, and increased hospital costs [9].

During the postoperative, the infection of the shunt system is considered an important complication and cause for great concern. The higher the number of times that the child is subjected to system revisions, higher is the risk of infection [10-5]. To reduce the possibility of infection is necessary that some actions are developed during child care, and that include assessment, planning and implementation of care. Being a differentiated population and present particularities, the presence of a trained multidisciplinary team, able to assist them individually and immediately is required [10].

In the leads, infection rates range from 5 to 15%. In internal devices, the highest rates are observed in the initial period after the devices insertion, when they are needed multiple revisions. Already in external devices, generally occur due to colonization of the derivation by the skin microbiota agents, arising through surgery or the postoperative period [11].

Infant Hydrocephalus is the cause of many child deaths, occurring in about 1/5 of patients. According to Kliemann and Rosemberg [5], on average, 80% of these deaths occurred within the first year after entering the derivation where meningitis was the predominant cause in 1/3 of cases. Infectious complications are related to these deaths, implying important consequent financial cost to prolonged hospitalization and use of high-cost medications.

To have a better prognosis of neurological patients, advances in intensive care were implemented in the constant search for quality of care and patient safety. For this, the care aspects should be associated with the prevention of secondary brain injury. The search for quality in health and care for the critical patient arouses great interest in health care providers regarding the role and performance in the care and treatment provided to the population of neurological critical patients [12].

During hospitalization of children, it is noticed that some of them, after inserting the EVD present complications that lead to longer hospitalization, prolonged antibiotic therapy, neuropsychomotor complications, and even death. It is noticed also that some of these complications may be related to failures in the care of the multidisciplinary team, which go from the waiting time for entering the EVD, hospitalization time, to the assistance provided by the staff before, during and postoperative.

Given the above, it is believed that the development of a study describing the epidemiological profile and complications of hospitalization of children who underwent insertion of DVE valve, is important as, it will offer subsidies to identify gaps and breaks in the process to care for. That way, it is expected that this corroborates diagnosis for assistance and provided interventions are better planned and applied, thus contributing to the reduction of complications and iatrogenic, and consequently, risks to children's health, length of stay and reduced public expenses.

This paper aims to trace the epidemiological and infectious profile of children undergoing insertion of external ventricular drainage valve for the treatment of hydrocephalus, identifying the incidence of complications related to these devices.

Method

This is a transversal, longitudinal study, documentary and retrospective descriptive, clinical and epidemiological approach with a quantitative analysis of the research findings, conducted through the medical records of children attending a pediatric reference hospital in the state of Paraíba.

The study population consisted of 281 medical records of children who were accompanied by the neurosurgical team and submitted to shunt catheter insertion in a period from July 2009 to December 2014. Of these, 88 children underwent insertion of EVD. The inclusion criteria for our study, some conditions have been established. Among them, at any time of admission have inserted the catheter EVD, have between one (01) day of life and 16 years 11 months and 29 days and not have infectious condition in the CNS before insertion of the EVD. Patients who did not own diagnosis of hydrocephalus and were admitted to the hospital to perform the insertion of EVD and were transferred to their home units, were excluded.

After application of the inclusion/exclusion criteria, 14 children were not counted in the sample. In addition, 20 children were excluded by performing the DVE insertion procedure and have been transferred to another hospital and can not therefore be accompanied in their clinical course. Thus, the final sample comprised 53 children for insertion of EVD.

The data collection was performed by using the information recorded in the clinical record of these children. For this, the book of registers of neurological surgery from the surgical room were first analyzed and part listed the procedures that had

the description of the inclusion of lead, regardless of type, identified and listed in order of surgeries performed. Subsequently, the location and analysis of medical records identifying the elaborated inclusion and exclusion criteria was performed. Confirmed the presence in the sample of the research, the search for data and completing the collection was performed. Data were entered into an electronic database.

A search of the medical records was performed at the Medical Archive Sector, and as data collection instrument, was used a semi-structured form to assist in the search for information. In this context, variables were discussed as : date of birth, sex, origin, place of residence, date of admission, diagnosis, the first valve insertion date, bypass system complications, infections related to health care, etiology of hydrocephalus, antibiotic therapy, exchange of shunts, cerebrospinal fluid culture results and destination of the patient.

The data were entered into a Microsoft Excel 2013 spreadsheet program, to formation of a database. For quantitative analysis was performed using the Statistical Package for Social Sciences (SPSS) version 2.3 used to preparation of non-parametric tests Pearson chi-square, and when it was not used, Fisher's exact test was chosen test. The significance level used in the study was 5% and in the analysis were also generated choropleth maps and tables of data frequency distribution.

The research was developed respecting the ethical principles of Resolution 466/12, under the approval of the Ethics in Research CAAE: 41533415.4.0000.5177 of the Faculty Santa Emilia de Rodat. The General Direction from the referred Hospital was contacted and signed the Instrument of Consent authorizing the collection of the study data. The Medical Archive Service and researchers signed the consent form to database use, assuming the commitment to preserve the privacy of the data of the participants, that information will be used for the implementation of the project in question

and will only be disclosed in order anonymous, not being used initials or any other information that can identify the research subject.

Results and Discussion

From July 2009 to December 2014, 53 children aged between one (1) day of life and 16 years 11 months and 29 days were hospitalized in the neurosurgery department of the Hospital and used Ventricular External Shunt system during their hospitalization. Among them, 49% were children in female gender and 51% in the male gender. Regarding age, 30.1% presented with aged between 10 and 16 years and 26.4% less than 1 year of age (**Table 1**).

In 2009, the year of implementation of the Hospital Neurology Service, four children were hospitalized to perform EVD insertion procedure. In 2014,

Table 1. Distribution of children hospitalized with a diagnosis of hydrocephalus during the period 2009-2014, according to sex, age and year of admission. João Pessoa, PB, Brazil, 2015.

Variable	N=53	
	N	%
Gender		
Male	27	51.0
Female	26	49.0
Age (years)		
< 1	14	26.4
1 to <5	13	24.6
5 to <10	10	18.9
10 to <17	16	30.1
Year of admission		
2009	4	7.5
2010	7	13.2
2011	10	18.9
2012	7	13.2
2013	11	20.8
2014	14	26.4

Source: Research data

there were 14 (fourteen). Historically, this increase is the result of success in the procedures performed, the quality of service provided by the multidisciplinary team and good service offered by the institution.

In addition, modern diagnostic techniques by image were being improved and developed to assist the therapeutic bases in the diagnosis of diseases. The technology has evolved since the pneumoencephalography introduced in 1918, then with ultrasound, computed tomography and, lastly, nuclear magnetic resonance. The last allows the quantitative and qualitative analyzes of the liquoric flow and its dynamic images [13].

Although we ask ourselves about other possible causes of the increase EVD use in patients who require further investigation in other studies, such as: the increased incidence of serious diseases in the state of Paraíba; patients affected by this disease without proper treatment; migration of patients from other hospitals for the State of reference. (Table 2)

Table 2. Distribution of External Ventricular Drain according to its outcome and exchange of causes. João Pessoa, PB, Brazil, 2015

Variable	N	%
Outcome of the EVD system		
Withdrawal System	17	21.3
Permanence until death	16	19.9
System Exchange	47	58.8
Total	80	100.0
Causes of Exchange		
Routine	29	61.7
Catheter Exposure	5	10.6
Obstruction of the catheter	4	8.5
Catheter Disconnection	3	6.4
Catheter drilling	2	4.2
System Infection	2	4.2
Reattachment	1	2.2
Unknown	1	2.2
Total	47	100.0

Source: Research data

Table 3. Distribution of other hospital infections time to insert, EVD use of time, hospitalization time, number of EVD placed and death. João Pessoa, PB, Brazil, 2015.

Variables	Others infections						p
	Yes		No		Total		
	n	%	n	%	n	%	
Hospitalization time (days)							
Until 15	5	38.5	8	61.5	13	100	0.42
16 to 30	4	28.6	10	71.4	14	100	
31 to 60	11	64.7	6	35.3	17	100	
> 60	8	88.9	1	11.1	9	100	
Number of EVD placed							
Single	12	32.4	25	67.6	37	100	< 0.01*
Multiple	16	100	0	0	16	100	
Death							
Yes	22	84.6	4	15.4	26	100	< 0.01*
No	6	22.2	21	77.8	27	100	

Source: Research data

The descriptions of the use of DLVs are shown in Table 3. The conclusion that the EVD performed in each patient was 21.3% removal of EVD dated known insertion and withdrawal; 19.9% came to death with the inserted EVD and 58.8% performed the valve replacement for various reasons.

Regarding the cause of exchange of EVD, it highlights that 61.7% were replaced due to usage time of routine of EVD or exchange planned for Peritoneal Ventricular Drain. The other exchanges for more significant complications ranged from exposure, obstruction and disconnection of the catheter, with 10.6%, 8.5% and 6.4%, respectively. According Mogrovejo et al. [14] some of the most common complications of derivation systems are the dysfunctions, infections and obstruction.

As the relation of the presence of other acquired infections (pneumonia, pressure ulcers, infection of the bloodstream, urinary tract and surgical site) by the patient and the hospitalization time, in Table 4, it is observed that the frequency of these infections was 28.6% when the time ranged from 16 to 30

Table 4. CNS infection Distribution by hospitalization time to inclusion, EVD use of time, hospitalization time, number of EVD placed and death. João Pessoa, PB, Brazil, 2015.

Variables	CNS infection						p
	Yes		No		Total		
	n	%	n	%	n	%	
Hospitalization time to inclusion (days)							
≤ 3	10	32.3	21	67.7	31	100	0.28
4 to 14	7	38.8	11	61.2	18		
≥ 15	1	25.0	3	75.0	4		
EVD use of time (days)							
Until 18	5	17.8	23	82.2	28	100	0.19
19 to 35	12	63.2	7	36.8	19		
> 35	1	25.0	3	75.0	4		
Hospitalization time (days)							
Until 15	3	23.0	10	77.0	13	100	0.36
16 to 30	3	21.4	11	78.6	14		
31 to 60	7	41.2	10	58.2	17		
> 60	5	55.6	4	44.4	9		
Number of EVD placed							
Single	6	16.2	31	83.8	37	100	< 0.01*
Mutiple	12	75.0	4	25.0	16		
Others infections							
Yes	14	50.0	14	50.0	28	100	< 0.01*
No	4	16.0	21	84.0	25		
Death							
Yes	13	50.0	13	50.0	26	100	0.16
No	5	18.5	22	81.5	27		

Source: Research data.

days. This frequency of infection increased (64.7%) when the hospitalization time ranged from 31 to 60 days, and 89.9% over 60 days. However, this association was not statistically significant.

Hospitalized patients are exposed to acquire the health care associated infections (HAIs), which still appear as a frequent complication. These infections have high costs for health services and reflects a worrying deficiency of quality of care, resulting in increased morbidity and prolonged hospital stay [15, 16].

The placement of multiple EVDs corresponded to 100% infection and EVDs single accounted for

32.4%. It was noted that the death of these patients with PVS and other infection accounted for 84.6% of the sample. The data presented above indicate statistical significance at $p < 0.01$.

As the relationship of CNS infection presence acquired by patients during their hospitalization and hospitalization time to insertion EVD, in Table 5, it is observed that the frequency of these infections was 32.3% when the time was up 3 days of hospitalization for insertion. This frequency of infection increased (38.8%) when the hospitalization time ranged from 4 to 14 days. However, this was not statistically significant. **(Table 4)**

Regarding the time of use of EVD, the infection showed increased 19 to 35 days 63.2%; and up to 18 days only 17.8%. In relation to the hospitalization time 16 to 30 days was observed 21.4% infection; 41.2% 31-60 days and 55.6% over 60 days.

The placement of multiple EVDs corresponded to 75% of infection and EVDs single accounted for 16.2%. For other acquired infections, 50% of children had both associated infections. These data presented showed statistical significance at $p < 0.01$. Therefore, the result brings death of patients who had infection EVD with CNS corresponding to 50.0% of the sample.

Studies show that hospitalization time, multiple exchanges valves and extended stay that EVD represented statistically risk factors for patients who used the system to acquire infection [7-8]. Other studies and care protocols, determine maximum time of 18 days the permanence of these devices, requiring their replacement.

Infections generally weaken hospitalized children, making it more predisposed to acquire infection after insertion valve on CNS. Several factors are associated with this child admission process, where the presence itself of the valve, the system handling, underlying disease, hospitalization time due to EVD and even the need for a central access contributes to the appearance of other infections. Therefore, a child diagnosed with CNS infection

may also have during hospitalization, other associated infections.

Among the 53 children who participated in this study, 49.1% (26) died. According to the causes found on the death certificate, 69.2% of the causes of death described relate to infectious process (sepsis, septicemia, septic shock, meningitis, encephalitis, brain abscess, pneumonia, pelvic abscess), even with the high use rate of potent antibiotics.

A study performed in a hospital in São Paulo corroborates the results found in this study, which identified 15.4% of the deaths were associated with nosocomial infection and is considered the main cause of death in most studied patients [17].

Antibiotic therapy of choice for patients who develop post neurosurgery infection from the suspected condition should be initiated as early as possible. It indicates the use of cefepime, ceftazidime and meropenem, and may be associated with vancomycin until the culture to determine the pathogen and their sensitivities, directing to appropriate antibiotic therapy [18].

The World Health Organization (WHO) [19] considers that 1.4 million infections occur at any time, in both developed countries and under development. It is estimated that about 2 million health care-related infections occur annually in the United States, resulting in an average 75,000 deaths and cost approximately \$ 23 billion. In Brazil, it does not have precise estimates in the absence of systematic information [20].

The WHO also recommends that mortality statistics are presented according items in the death certificate. However, studies have questioned the quality of this information. Observations carried by Turrini and Santo [21], after the repopulation of death certificates, according to medical record information, it was noticed that almost 90.0% of contributing hospital infections could have been identified by this method of collection, if the filling was appropriate.

Some of the limitations of this study are related to their clinical design. Since this is a retrospective study involving observation for a long period of time and with information from medical records, some information was lost and unable to recover, which is directly related to failure to complete the medical records by health professionals.

Conclusions

This study is relevant because the evaluation method provide conditions to meet the reality of the incidence of infection related to health care, with possibilities to devise strategies to improve services, for the promotion and prevention of infections related to child health.

We observed that the infection of the central nervous system, other acquired infections and deaths were highly significant. The high incidence presented in the study proved to be the result of a set of facts involving the care of a multidisciplinary team. It showed that derivation exchanges and system maintenance in the patient represented risk factors for infection.

It is important to highlight the standard precautionary measures such as care in handling the patient during invasive procedures, with antisepsis and hand washing are important and determining factors that can affect the results with reduced prevalence of hospital infection rates.

Considering the importance of the subject at the time and in the context of health assistance provided to the child, it is suggested that further studies be conducted to support the expansion of knowledge not only for the nursing practices, but involving the whole health team.

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