Outcomes of Paediatric Hydrocephalus: Comparative Study between Congenital and Post-Infective Hydrocephalus in Sokoto, Nigeria

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Abstract

Introduction: *Hydrocephalus is the commonest neurosurgical disease among paediatrics; its management is very challenging. Ventriculo-peritoneal shunt is still the main treatment modality but its usage however, has high complications rate and which have continued to cause concern. The study aimed to compare the outcomes of paediatric hydrocephalus following ventriculo-peritoneal shunt insertion between children with congenital and post-infective hydrocephalus.*

Materials And Method: *A prospective cross-sectional study of I42 children, (71 were congenital hydrocephalus while 71 were post-infective hydrocephalus) were included in the study. All patients had ventriculo-peritoneal shunt insertion and followed of the patients were done, reviewed, analysed and compared among the two groups.*

Results: *Patients with congenital hydrocephalus have age range between 2 weeks and 12 months with a mean age of 3.1 ± 3.3 months, most of these patients were less than 12 months of age (93%) and male to female ratio of 1.7:1. While patients with post-infective hydrocephalus have age range of 3 - 12 months with a mean age of 8.0 ± 4.6 months, majority of these patients were less than 12 months of age (67.6%) and male to female ratio of 1:1. The incidence of shunt malfunction and shunt infection is higher among children with post-infective hydrocephalus compared with children with congenital hydrocephalus (malfunction; 18.3% vs 4.3% and infection; 4.2% vs 2.8%). However the difference noted was not statistically significant (malfunction, p = 0.561 vs 0.637; shunt infection, p = 0.623 vs 0.676).*

Conclusion: *The complication rate was higher among patients with post-infective hydrocephalus but was not statistically significant when compared with congenital group*

I. INTRODUCTION

Hydrocephalus is the most frequent neurosurgical problem encountered in the paediatric age group [1]. Hydrocephalus is defined as an active distension of the ventricular system of the brain resulting from inadequate passage of cerebrospinal fluid (CSF) from the sites of production to the point of absorption into the systemic circulation [2], [3]. Paediatric hydrocephalus has incidence of 1 per 2,000 live births and prevalence of 1.2 per 1,000 live births [1], [4]. Hospital based prevalence rate in developing countries is put at 0.092% [5].

Childhood hydrocephalus can be congenital or acquired. It may arise from some disturbances in CSF secretion, flow or absorption. It can also been classified as communicating or non-communicating based on presence or absence of obstruction within the ventricular system.

Hydrocephalus in children, if untreated, causes developmental disorders, mental deficiencies and shortened life expectancy in addition to blindness and other neurological deficits as a result of cerebral injury due to distension of brain tissue [6]. Ventriculo-peritoneal shunting (VPS) for treatment of hydrocephalus in childhood is well established and has altered the outlook of this disease [8]. However, complications related to VPS have continued to cause concern [8], [9]. With present-day standard of care, most patients with hydrocephalus will survive; however, some deaths still occur and complications from treatment among long-term survivors are frequent and often severe [10], [11].

Review of literature from our environment revealed information on the outcome of VPS for hydrocephalus but none has been able to compare the outcomes between congenital and post-infective hydrocephalus. Ventriculo-peritoneal shunting in this region is associated with significant morbidities and complications [12], [13], [14], [15] - [18]. This study aimed to compare outcomes following ventriculo-peritoneal shunting between patients with congenital and post-infective hydrocephalus.

II. METHODOLOGY

A total of 142 patients with diagnosis of paediatric hydrocephalus based on both clinical examinations and radiological investigations (seventy-one patients had congenital and another seventy-one patients had post-infective hydrocephalus) were recruited using systematic point sampling technique. All patients had VPS (medium pressure Chhabra). Only patients with initial VPS were recruited and patients that are older than 2 years, with turbid/xanthochromic/infective cerebrospinal fluid were excluded.

The right Keen's point was used to access the lateral ventricle using ventricular catheter and peritoneal cavity was connected to the ventricular component subcutaneously. The patients were followed up for three (3) months post-shunt insertion and records of anterior fontanelle status, occipitofrontal circumference (OFC), neurological status, shunt site infection, and shunt malfunctions at immediate, six (6) weeks, three (3) month and emergency readmission for shunt revision were documented.

Demographic and clinical data were recorded on proforma. The data were analyzed on computer using statistical package for social science (SPSS) version 20 (SPSS) Inc. Chicago IL, USA and the results were compared between congenital and post-infective hydrocephalus.

III. RESULTS

Patients with congenital hydrocephalus have age range between 2 weeks and 12 months with a mean age of 3.1 ± 3.3 months, most of these patients were less than 12 months of age (93%) and male to female ratio of 1.7:1 as shown in Table 1. While patients with post-infective hydrocephalus have age range of 3 - 12 months with a mean age of 8.0 ± 4.6 months, majority of these patients were less than 12 months of age (67.6%) and male to female ratio of 1:1 as shown in Table 2.

Patients with congenital hydrocephalus presented earlier than those with post-infective hydrocephalus while admission delay was longer among patients with post-infective hydrocephalus and the hospital stay duration was shorter among patients with post-infective hydrocephalus as shown in Table 1 and 2.

The mean of occipitofrontal circumference were 48.2cm, 47.4cm, 44.9cm and 42.9cm, at the time of presentation, immediate post-operative, 6-week and 3-month post-operative among patients with congenital hydrocephalus respectively. While the means among post-infective hydrocephalus were 52cm, 50.9cm, 48.21cm and 51.8cm, at the time of presentation, immediate post-operative, 6-week and 3-month post-operative respectively as shown in Figure 1.

The incidence rate of shunt malfunction is 4.3% among patients with congenital hydrocephalus and 18.3% among patients with post-infective hydrocephalus. The incidence rate of shunt infection is 2.8% and 4.2% among patients with congenital hydrocephalus and post-infective hydrocephalus, respectively, as shown in Table 3.

Table 1: Socio-demographic data of patients with congenital hydrocephalus

M = Male. F = Female, SD = standard deviation

IV. DISCUSSION

Patient morbidity and shunt survival are dependent on post-operative complications whether significant or not. The findings on post-operative complications in this study revealed shunt malfunction 4.3%; shunt infection 2.8% among patients with congenital hydrocephalus and shunt malfunction 18.3%; shunt infection 5.6% among patients with post-infective hydrocephalus. However, the overall shunt malfunction (shunt blockage) rate is 11.3%, which is the leading complication followed by shunt infection rate of 4.2%. In a recent study by Uche, et al, in Enugu, Nigeria, the shunt infection was 8.6%. and also 9.3% in the study by Emejulu & Ugwu in Nnewi, Nigeria [17], [18].

A study by Lee, et al showed a similar complication rate with the current study, shunt blockage in 12.2% of their 246 series of ventriculo-peritoneal shunting in Seoul, South Korea and their infection rate was 4.1% [19]. A higher infection rate (24.6%) was observed in a study done in Kenya.[13] Peacock and Currer found shunt blockage to be 20% in their series of 440 children [20].

Table 1: Socio-demographic data of patients with congenital hydrocephalus

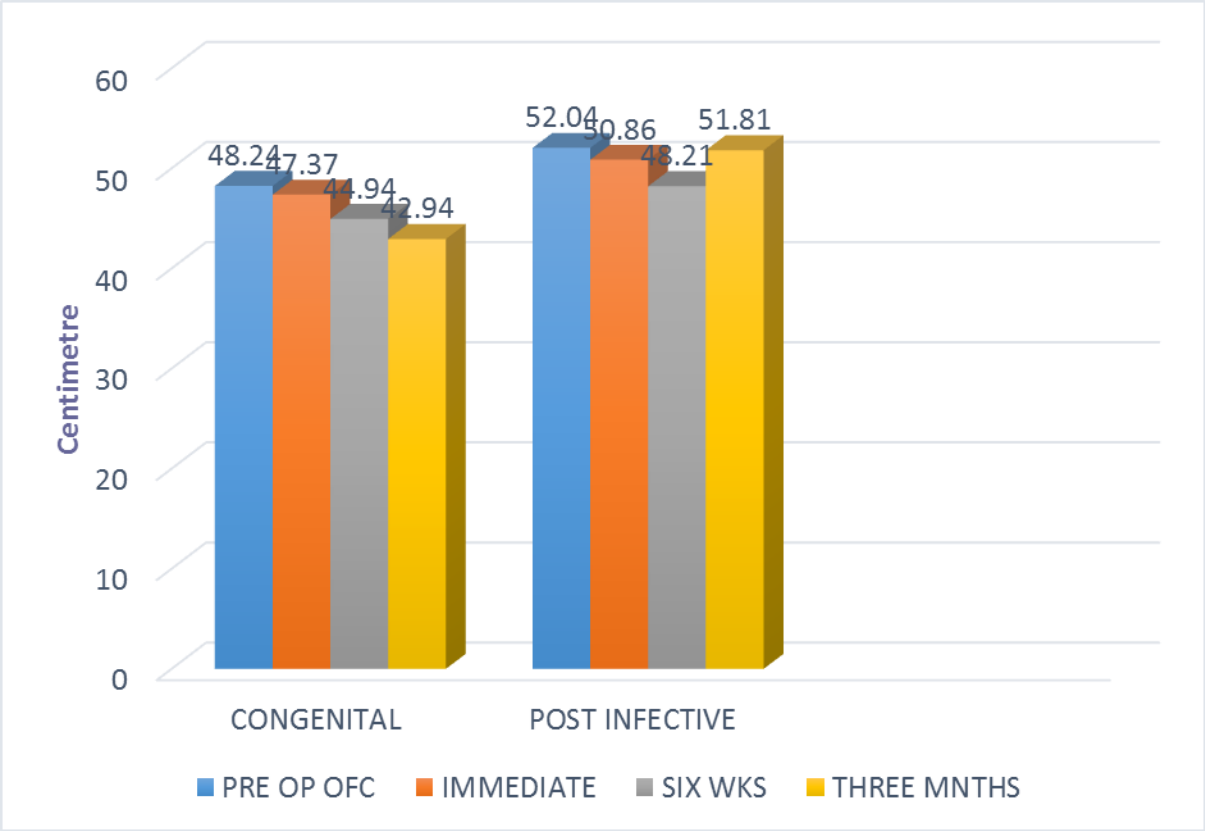
Groups	Age groups (month)/ Frequency (%)	Age at 1st presentation (month) (Mean ± SD)	Admission delay(Day) (Mean ± SD)	Hospital stay (Days) (Mean ± SD)	Sex Frequency (%)
Congenital	<12 66(93) 12 – 24 5(7)	3.03 ± 3.24	42.28 ± 42.76	14.34 ± 4.70	M 45(63.4) F 26(36.6)

M = Male. F = Female, SD = standard deviation

Table 2: Socio-demographic data of patients with post-infective hydrocephalus

Groups	Age groups (months)/ Frequency (%)	Age at 1st presentation (month) (Mean ± SD)	Admission delay(Day) (Mean ± SD)	Hospital stay (Days) (Mean ± SD)	Sex Frequency (%)
Post-infective	<12 48(67.6) 12 – 24 23(32.6)	7.99 ± 4.57	75.64 ± 98.82	11.49 ± 3.68	M 34(47.9) F 37(52.1)

M = Male. F = Female, SD = standard deviation



OFC- occipitofrontal circumference, wks –weeks, mnths- months

Figure 1: Comparative Mean of occipitofrontal circumference (OFC) between patients with congenital and post-infective hydrocephalus

Table 3: Incidence of shunt's malfunction and infection among patients with congenital and post-infective hydrocephalus.

Diagnosis	Variables	
	Shunt Malfunction	Shunt Infection
Congenital	3 (4.2%)	2 (2.8%)
Post infective	13 (18.3%)	4 (5.6%)
Total	16 (11.3%)	6 (4.2%)

Total number for each group = 71

Table 4: Comparative inferential analysis on complications between patients with congenital and post-infective hydrocephalus

Variables	P-value	
	CONGENITAL	POST INFECTIVE
Immediate Post-operative		
Visual loss	0.031	0.003
6-week post-operative		
Visual loss	0.031	0.003
3-month post-operative		
Visual loss	0.031	0.003
Shunt malfunction	0.316	0.421
Emergency re-admission		
Visual loss	0.694	0.542
Shunt infection	0.676	0.623
Shunt malfunction	0.637	0.561

One sample t-test at 95% confidence interval. Significance test $p \leq 0.05$

Infection rate in this study is comparable with figures reported from centres within Nigeria and in the Western World. However, it falls within the wide range of 0.0 - 38.0% that has been reported in the literature [17], [18], [21]. However, shunt infection was the most common complication following ventriculo-peritoneal shunting by recent studies in Nigeria but these findings differ from the current study where shunt malfunction is the most common complication[17], [18]. The main complications observed in the current study are shunt malfunction and shunt infection, which was similar to study by Okoro in Nigeria, though, rare ones like shunt migration and extrusion were also seen[22], [23]. These rare complications reported above could be explained by a longer period of their study.

Also, in this series, most of the patients with shunt infection had shunt malfunction and an assumption that shunt malfunction could have been caused by shunt infection in those patients was considered. Vanachola *et al* observed that shunt malfunction occurred in infected shunts some of which were clinically undetectable. They argue that the incidence of shunt infection might be higher than generally reported and that negative cultures of CSF taps do not exclude shunt infection in malfunctioning shunts [24].

Infection rate is much higher among patients with post-infective hydrocephalus than congenital whatever clinical deterioration of their children to the known illness for which surgery had been performed in the first place and such death is considered shunt related.

hydrocephalus because the former usually requires longer periods of hospitalization and many of them develop other clinical complications such as pneumonia or urinary tract infection which markedly increase the risk of shunt infections [1].

The post-operative timing of shunt complication in this study is 2.20 ± 0.4 months among patients with congenital hydrocephalus and 1.65 ± 0.8 months in the post-infective group. The mean interval from shunt insertion to shunt infection in the current study among congenital group is 1.80 ± 0.45 months and 1.88 ± 0.45 months among post-infective. This finding is similar to the report from earlier study in Nigeria with 1.83 ± 1.25 months interval [23]. According to literature, 70-80% of shunt infections occur within the first post-operative month and 15% occur from the first to the ninth post-operative month [1]. This timing may suggest that most of these infections occur during the surgery itself.**
**The mortality rate in the current study is 4.9% and this is low compared to the study by Uche *et al*, with 21.4% in patients with shunt infection [17]. Kinasha *et al*, showed a higher death rate, where 20% of the deaths were recorded among sixty-two patients that were studied [25]. Despite close follow up, the cause of death could not be ascertained in some of the patients since not all the deaths occurred in the hospital. There is understandable tendency for the mothers to ascribe

Despite higher shunt malfunction and shunt infection observed among post-infective group, there was no statistically significant difference between them and the congenital group (malfunction, $p = 0.561$ vs 0.637; shunt infection, $p = 0.623$ vs 0.676). There was

similar association found between the post-infective and the congenital groups in the development of shunt association [25], [26]. Presence of neural tube defects (NTD's, including spina bifida/myelomeningocele, encephalocele) did not increase the risk of developing a shunt complication in study by Noorani *et al* (p = 0.670) [26]. A previous study by Davis *et al* similarly reported that aetiology of hydrocephalus, age of patient, and presence of an open neural tube defect was not associated with development of shunt infections [27].

V. CONCLUSION

Complications of shunting; infection and malfunction were quite disappointing. These complications necessitated shunt revisions, removal or replacement. The complication rate was higher among patients with post-infective hydrocephalus but was not statistically significant when compared with congenital group and the presentation of shunt complications was early among patients with post-infective hydrocephalus when compared with patients with congenital hydrocephalus.

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Ethical clearance: The research was approved by Ethical committee of our institution.

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complication in the study done by Noorani *et al* (p = 0.71) [22]. Other studies have, similarly, found no such

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