Original Article

Complications of Ventriculoperitoneal Shunts in Children in Dar es Salaam

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Background: From the few reports available, VP shunt surgery in sub- Saharan Africa is associated with significant complications. This study was aimed at establishing the pattern, causes and frequency of complications of VPS in Tanzania.

Methods: Sixty five of the 102 children with hydrocephalus treated with ventriculoperitoneal shunts between January 1996 and January 1999 were studied prospectively. The first follow-up was at 2 weeks postoperative when the wounds were evaluated and occipitofrontal circumference measured. Further follow-ups were at 4 weeks and at three months. Collaborating staff of the Comprehensive Community Based Rehabilitation in Tanzania (CCBRT) thereafter regularly followed up the children at home.

Results: The male to female ratio was 1.8 to 1. Forty-seven of the children (72%) were less than 12 months old but no patient was under 1 month of age at operation. The mean occipitofrontal circumference was 50.7cm. Shunt blockage was the commonest complication (32.3%) followed by infection (24.6%). The combined complication rate of shunt infection and wound infection was 46.1%. Shunt-related mortality was 13 (20.0%). There was no statistically significant correlation between the occipitofrontal circumference and type of complication or mortality. The mean age among the patients showing disconnection was 21.3 months compared to a mean age of 8.1 months for those not having this complication (P-value=0.04)

Conclusion: The complication rates were higher than those in Western series but compared well with findings from sub Saharan Africa other studies.

Introduction

The procedure of shunting CSF into the peritoneal compartment to cure symptoms of hydrocephalus in childhood is well established and has altered the outlook of this disease[1]. However, complications related to ventriculoperitoneal shunts (VPS) have continued to cause concern in the care of hydrocephalic children[2,3,4,5]. Review of literature from sub- Saharan Africa revealed only scanty information on the outcome of shunt surgery for hydrocephalus. From the few reports available, shunt surgery in this region is associated with significant complications[6,7,8,9]. Furthermore the difficulties encountered in the follow-up of operated patients have made it difficult to study the true outcome of VPS surgery in such series[10].

In many areas of Africa appropriate shunts cannot be obtained because of their high cost prompting improvisation of simple monoshunt systems employing silastic tubing without valves[7,10]. Ventriculoperitoneal shunt surgery has been performed in this country for many years. However, no prospective study has been done to evaluate the outcome of such surgery. It was for that reason that the authors found it necessary to undertake a study aimed at establishing the pattern, causes and frequency of complications of VPS in their practice in order to find ways of improving the outcome of management of hydrocephalus in the region. The findings of complications of VPS performed in Dar es Salaam, Tanzania on 65 children with hydrocephalus during the period from January 1996 to January 1999 are presented and discussed.

Patients and Methods

A total of 102 consecutive patients with hydrocephalus were operated upon using the

Chhabra univalve ventriculoperitoneal shunt system. The patients were referred to the Neurosurgical Unit from the paediatric surgical wards of Muhimbili National Hospital or from the neonatologist. Operations were performed by two of the authors (ADAK and JFK) who were both practicing neurosurgeons. The decision to operate was based on the head circumference, which was larger than expected for age or rapidly increasing when correlated with standard head circumference charts.

Many children also had clinical manifestations of raised intracranial pressure. All symptomatic children irrespective of head size had surgery. All patients were admitted at least a day before surgery and were examined to exclude pre-operative conditions such as chest infection anaemia or skin infection. A pre-anaesthetic visit further confirmed the children's suitability for general anaesthesia and surgery. Intravenous ampiclox was given to all the children at the time of shaving the scalp and for a further 3 days. Intubation anaesthesia was used in all cases.

The right occipital access to the lateral ventricle was used for the ventricular catheter and the peritoneal catheter was passed subcutaneously in the usual way. CSF was collected for bacteriological studies. In the cases where CSF was obviously turbid or haemorrhagic the procedure was abandoned and external drainage done for a few days while antibiotics were continued in the case of infected CSF. Operation was rescheduled when CSF was clear. The patients were discharged to the wards after fully recovering from the anaesthetic and were allowed to breast-feed. Patients were usually discharged home on the 5^{th} to 7th postoperative day.

The first follow-up was at 2 weeks postoperative when the wounds were evaluated and occipitofrontal circumference measured. Further follow-ups were at 4 weeks and at three months. Collaborating staff of the Comprehensive Community Based Rehabilitation in Tanzania (CCBRT) thereafter regularly followed up the children at home. At this follow-up the head circumference of the children was measured and any suspected deterioration reported to the us. In this way the children had been followed up for various periods of time ranging from 1 to 5 years.

The CCBRT staff also reported any deaths. Deaths not directly related to the hydrocephalus or shunt implant were recorded as such. At the authors' clinics shunt function was reviewed, the occipitofrontal circumference measured and the neurological status documented. Demographic and clinical data was recorded on a standard questionnaire. The data was analyzed using Stata Statistical Software Version 4.0, Stata Corporation, Texas, USA.

Results

The total number of children operated upon was 102 of whom 65 had complete follow-up information. Table 1 shows the age and sex distribution of the 65 children. There were 42 (64.6%) males and 23 (35.4%) females. Forty-seven of the children (72%) were less than 12 months old but no patient was under 1 month of age at operation. The mean occipitofrontal circumference was 50.7cm with the lowest measuring 36 cm and the highest 73 cm. Table 2 shows the type and frequency of shunt complication. The complications were: shunt blockage, shunt infection, wound infection, disconnection and extrusion. Shunt blockage was the commonest complication (32.3%) followed by infection (24.6%). The combined complication rate of shunt infection and wound infection was 46.1%. Shunt-related mortality was 13 (20.0%). There were 8 shunt extrusions; 6 through the gastrointestinal tract protruding through the anus and 2 through the skin of the abdominal wall.

Mortality was reported in 13 children (20%). There was no statistically significant correlation between the occipitofrontal circumference and type of complication or mortality (Table 3). When the age of the patients were correlated with the complications observed (Table 4) there was a statistically significant higher disconnection rate among the older children where the mean age among the patients showing disconnection was 21.3 months compared to a mean age of 8.1 months for those not having this complication (P-value=0.04). The other complications showed no correlation with age.

Table 1. Age and sex Distribution of the Children, n=65

Age Group (Months)	Male (%)	Female (%)	Total (%)
1-5	9 (75.0)	3 (25.0)	12 (18.4)
6-11	22 (62.9)	13 (37.1)	35 (53.8)
22-99	6 (66.7)	3 (33.3)	9 (13.8)
100+	5 (55.5)	4 (44.4)	9 (13.8)
Total	42 (64.6)	23 (35.4)	65 (100)

Table 2. Patients' mean occipitofrontal circumference by type of post-surgical complication, n=65

Complication	Mean Occipitofrontal Circumference		P-Value
	Complication present	No complication	
Shunt blockage	52.5	49.7	0.19
Shunt disconnection	52.3	50.6	0.57
Shunt infection	51.1	50.2	0.71
Wound infection	51.8	50.5	0.54
Shunt extrusion	52.37	50.4	0.29
Died	50.8	50.7	0.97

Table 3. Frequency of post-surgical complications

Complication	Number	%
Shunt blockage	21	32
Shunt disconnection	7	10.7
Shunt infection	16	24.6
Wound infection	14	21.5
Shunt extrusion	8	12.3
Died	13	20.0

Table 4. Patients' mean age (months) by type of complication

Complication	Mean Age of Patients in Months		P-Value
	Complication present	No complication	
Shunt blockage	12.1	8.2	0.38
Shunt disconnection*	21.3	8.1	0.04
Shunt infection	6.0	8.4	0.44
Wound infection	7.5	10.1	0.61
Shunt extrusion	5.7	10.0	0.50
Died	13	8.6	0.40

*Difference is statistically significant (P-value < 0.05)

Discussion

This study presents an audit of ventriculoperitoneal shunts (VPS) surgery in a cohort of 65 children who have been well followed-up. Only the major complications likely to influence shunt survival and patient morbidity and mortality have been presented. Shunt blockage was the leading complication (32%) followed by shunt infection (24.6%). Lee et al[12] found shunt blockage in 12.2% of their series of 246 shunt procedures in Seoul, Korea. Their infection rate was 4.1%. Shunt infection was found together with blockage in most

instances in our series indicating that shunt malfunction could have been caused by infection in these children. Vanaclocha et al[11] have 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. Peacock and Currer[9] found shunt blockage to be 20% in their series of 440 children.

Mild skin infection not involving the shunt implant and not requiring shunt removal was not considered as shunt infection in our study. However, when non-shunt infection was considered together with shunt infection, it was found that infective complications constituted the most frequent

complication overall of VP shunt surgery. Mwan'gombe and Omulo[6] have reported an infection rate of 24.6% among children operated for non-tumour hydrocephalus in Nairobi. Our high infection rates of about 1 in 4 compare poorly with North American figures of 8-10% and published infection rates of below 1%[13] **Error! Reference source not found.** We found no effect of age, or head circumference on the frequency of infection. There have been contradicting reports regarding the influence age has on infection. Some authors state that children below 6 months are more likely to be infected[18] while others have found no influence of age on the rate of infection[16,17].

The other shunt complication was disconnection. This complication occurred in 10.7% of operations. It is interesting but not clear why disconnection positively correlated with the mean age of the children, occurring more frequently in the older children ($p<0.05$). Aldrich and Harmann[14] found that disconnection accounted for 15% of their shunt malfunctions and that occipitally placed shunts had a higher tendency to dislocate than frontally placed shunts. However, in a report of a prospective randomized study Bierbauer et al[15] found no advantage of anteriorly placed shunts over posteriorly placed shunts in terms of shunt malfunction or infection. The exclusive use of the occipital placement of the shunt in this cohort cannot therefore explain the high disconnection rate. The mortality presumed to be shunt-related among our patients was 20%. The apparently high mortality needs further evaluation. In spite of the good follow-up in this series it was not in all instances possible to be sure about the causes of death. The mortality is therefore considered shunt-related as the worst scenario situation and it could well be that a few of the children died from other causes. It would appear difficult to be certain regarding the cause of death unless all children died in hospital. There is the understandable tendency for the mothers to ascribe whatever clinical deterioration of their children to the known illness for which surgery had been performed in the first place.

Conclusion

An account of complications of VP shunt surgery for childhood hydrocephalus in a well-followed up series have been presented. The complication rates were higher than those in Western series but compared well with findings from sub Saharan Africa other studies. There is a need for studies of specific complications to be carried out in order for evidence-based measures to be recommended in the attempt to reduce the unacceptable morbidity and mortality.

Over the past years there has been a rising interest in Endoscopic third ventriculostomy for the treatment of hydrocephalus. Warf[19], in his series in Uganda has found that ETV, previously thought unsuitable for post meningitic hydrocephalus, is eminently suitable in a significant proportion of children with this type of hydrocephalus. As the majority of hydrocephalus in our practice is post infective, ETV could provide an attractive alternative to shunting as it avoids the numerous shunt-related complications. The authors are currently studying the applicability of ETV in the children presenting with varying types of hydrocephalus.

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