Research Article

Shunt Revision Overview in Patients with Hydrocephalus

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Date Submitted:9.2.2014

Date Accepted:11.6.2014

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Abstract

Background: Hydrocephalus is a notorious neurosurgical disease that carries the adage "once a shunt always a shunt." Most patients with hydrocephalus are treated with ventriculo-peritoneal (VP) shunt placement; however, malfunction is common and is usually caused by mechanical failure.

Aim: To evaluate the patients who were in need for shunt revision, analyzing them according to their age, sex, and causes of their hydrocephalus, and investigating the etiological causes for their revisions.

Patients and Methods: In a retrospective study, the records of 90 patients who underwent their shunt revision in the Neurosurgical hospital and neurosurgical departments of AL-Kadhmia teaching hospital and the hospital of surgical specialties between January 2000 till June 2002 were analyzed peri-operatively

Results: It was revealed that most of the revised patients were children (their age≤10). The majority of them were shunted at first due to congenital hydrocephalus and acquired hydrocephalus respectively. Regarding the frequency of revision in these patients the majority were revised once and few of them were revised for more than one time. Peri-operatively clinical status of shunt function was determined which showed upper end block in 27.8%, post-operative meningitis in 13.3%. Yet, lower end block was found in 10% of the cases.

Conclusion: Shunt failure is still far too common especially in pediatric age groups. Upper end block together with surgical errors and suboptimal techniques plays a significant role in shunt revision.

Keywords: Hydrocephalus, shunt revision

INTRODUCTION

Hydrocephalus is a common pediatric disorder resulting from a mismatch in CSF production and absorption. It encompasses many pediatric diseases including congenital malformations, spinal dysraphism, hemorrhage, infections, and tumors[1] . Studies have shown that hydrocephalus disrupts the overall cytoarchitecture, and the cytology of cortical neurons is affected[2,3]. Treatment of hydrocephalus has undergone several revisions beginning with head wrapping, medication, and ultimately CSF shunting and endoscopy. These therapies are aimed at preventing or reversing the neurological damage caused by the distortion of the brain due to this condition [4]. At present, the most popular management of hydrocephalus is CSF diversion through shunts[1]. These devices have been shown to extend survival and lead to improved neurological outcome. Most patients with hydrocephalus are treated with ventriculo-peritoneal (VP) shunt placement; however, malfunction is common and is mostly caused by mechanical failure or obstruction that requires shunt revision [5,6,7]. Most cases of shunt malfunction are due to occlusion of the proximal

ventricular catheter [8]. While in majority of the cases infection is the cause of shunt malfunction when a distal malfunction is suspected [9]. The incidence of VP shunt malfunction requiring revision is up to 70% [10]. In most centers, the ratio of shunt revision to initial shunt surgery is 2:1[11]. The presentation of shunt block may undoubtedly be with what might be termed 'classical' symptoms, namely headache vomiting and drowsiness and sleepiness [12]. The present study was conducted to evaluate the patients who were in need for shunt revision, and were analysed according to their age, sex, and causes of their hydrocephalus and the etiology for their revisions.

PATIENTS AND METHODS

We conducted a retrospective review of 90 ventriculo-peritoneal shunts that were placed and/or revised between January 2000 till June 2002 for patients who were admitted to the Neurosurgical hospital and neurosurgical departments of AL-Kadhmia teaching hospital and the hospital of specialities in Baghdad and who were in need for shunt revision. For each patient, age at initial and all subsequent shunt revisions, type of valve, cause of shunt malfunction, and etiology of hydrocephalus were recorded. History was taken from them or their families regarding chief compliant, history of present illness, past medical and surgical history, family history, perinatal history, occupational history and systems review. Also, examination of those patients was done including general examination and neurological examination including head circumference and fundoscope examination and these were recorded pre-and post-operatively for follow up. Furthermore, investigations which were performed for each patient preoperatively which included complete blood picture, blood group, blood biochemistry, ECG to older patients, chest X-ray, brain ultrasound for infants and C-T scan for all the older patients. Special investigations were achieved when infection was suspected including C.S.F analysis sent for biochemistry study and culture and sensitivity to reach the causative microorganism, swab from the infected wounds, blood culture and urin exam and culture. The revision types were all V.P to V.P . Cases were analysed according to the etiological causes of shunt failure. Regarding the use of prophylactic- antibiotics all the patients received antibiotics during the induction of the anaesthesia. The post-operative follow up was done by general examination and by brain C-T-scan in some cases to watch the result of the operation.

RESULTS

The sex distribution with regard to the revision operations as given in table (1) showed that males (65.6%) were more common than females (34.4%) in the current study . The age groups of the patients are given in Table(2), in which the majority of the revised patients were children (their age≤10). The pathological causes of hydrocephalus were the bases for table (3), which shows that the majority of the patients were shunted at first due to congenital hydrocephalus and acquired hydrocephalus respectively. Regarding the frequency of revision in these patients the majority were revised once and few of them were revised for more than one time as shown in table (4). Per-operatively clinical status of shunt function was determined which showed upper end block in 25 (27.8%), post operative meningitis in 12 (13.3%). Yet, lower end block was found in 9 (10%)as seen in Table (5).

Table 1. Sex distribution of revised patients.

Sex	No. of Patients	Percent %
Male	59	65.6
Female	31	34.4
Total	90	100%

Table 2. Age distribution of revised patients.

Age	No. of patients	Percent %
< 1 Year	18	20 %
1-10 Years	45	50 %
11-20 Years	13	14.4%
> 20 Years	14	15.6 %
Total	90	100%

Table 3. Causes of hydrocephalus that have been shunted according to their pathology

Causes of hydrocephalus	No. of patients	Percent %
Congenital	40	44.4 %
Posterior fossa tumor	19	21.1 %
Post - meningitic	13	14.4 %
Post - meningocele repair	9	10 %
Colloid cyst	3	3.3 %
Others	6	6.7 %
Total	90	100%

Frequency of revision	No. of patients	Percent %	No. of operations
One revision	73	81.1	73
Two revisions	12	13.3	24
Three revisions	2	2.2	6
Four revisions	2	2.2	8
Five revisions	1	1.1	5
Total	90	100%	116

Table 4. Frequency of revision, their percentages, and the number of Operations done.

Table 5. Causes of revision in the revised 90 patients

Causes of revision	No. of patients	Percent %
Upper end obstruction by choroid plexus adhesions or debries	25	27.8
Post operative meningitis	12	13.3
Lower end obstruction	9	10
Infected abdominal wound	6	6.7
C.S.F collection under the skin in the abdominal incision because of improper rectus sheath suturing	6	6.7
Infected cephalic wound	5	5.6
Upper end disconnection	5	5.6
Long upper end catheter	5	5.6
Short upper end catheter	3	3.3
Device displacement	2	2.2
Epidural haematoma	2	2.2
Lower end disconnection	2	2.2
Intraventricular haematoma	2	2.2
Exposed lower end catheter (Intradermal tunneling)	2	2.2
Calcification of pericranium around the device	2	2.2
Lower end catheter introduced extra-peritonialy by using trocher	2	2.2
Total	90	100 %

DISCUSSION

hydrocephalus in children is a condition of endemic proportions. over 15,000 new cases of hydrocephalus are diagnosed each year[14]. the current study also found that congenital hydrocephalus comprises the majority of shunted patients and this could explain the highest percentage of the shunt revision in children . Besides, it could be related to the high percentage of posterior fossa tumor in this age group which was the second most common cause for hydrocephalus in this study. With advances in technologies, CSF diversion involving a 1-way valve system, Shunting was developed in the 1950s [15] ,and since that time, many more developments have been made in the era of modern shunt treatment . Yet, these devices are prone to malfunction(some of it due to surgical technique errors) with up to 70% requiring revision. shunt obstruction and infection comprise the majority of malfunctions and usually present dramatically [16,7,17], this is in agreement with our findings in which most of the revised cases were due to upper end obstruction by ingrowth of the choroid plexus due to flow of CSF drawing the plexus in and by glial tissue from astrocyte proliferation, or could be blocked by debries such as connective tissue, lymphocytes, multinucleated giant cells, neutrophils, foreign material around the catheter tip. Valve obstructions can also be the cause of shunt obstruction and is seen in patients with venticulitis, meningitis and intraventricular hemorrhage (IVH), because the CSF of these patients contains high proportion of proteins and debris. Valve obstruction is usually indistinguishable from distal obstruction clinically. In the present study meningitis was the second commonest cause for shunt revision and it goes in concordance with study held by Singh and Rohilla et al.[18]. In the current study most of the patients were in need for one time revision, however few patients were in need for more than one time revision and this could be explained by the technical errors and surgical complications such as suboptimal length of upper end catheter, C.S.F collection under the skin in the abdominal incision because of improper rectus sheath suturing, lower end catheter introduced extra-peritonialy by using trocher, infected abdominal wounds or cephalic wounds due to suboptimal aseptic measures, disconnected upper or lower end , epidural hematomas, exposed lower end catheter (Intradermal tunneling).

In conclusion, pediatric hydrocephalus is a prevalent condition with multiple causes. Shunt failure is still far too common despite technological advances in the treatment of hydrocephalus. Although upper end block due to Choroid plexus invagination into the ventricular catheter seems to be the commonest cause for shunt malfunction and revision, yet surgical errors and suboptimal techniques

plays a significant role in shunt revision. This last issue, in fact, imposes us to recommend that shunt surgeries to be done by or under close supervision from the expert specialist surgeons who are more familiar with those sort of surgeries to decrease the rate of failure that may arise from technical errors

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