



Original Article

Comparative study of ventriculoperitoneal shunting in paediatric patients with hydrocephalus using a novel technique- A step towards reducing morbidity

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ABSTRACT: The incidence of hydrocephalus throughout the globe is very high and ventriculoperitoneal shunting has been the procedure of choice in managing it. Though it is one of the first procedures which a neurosurgical resident/trainee assists and performs, no modification has been done or proposed in performing this procedure keeping in mind the position of chamber of the Chhabra shunt system. We did a prospective randomized pilot study of 68 consecutive paediatric patients (Age <18 years) of hydrocephalus to find if there was any difference in results after performing ventriculo-peritoneal shunting using traditional technique (TT) and modified technique (MT) in terms of ease and duration of surgery as well as failure and complication rate. All patients were managed with ventriculo-peritoneal shunting using TT and MT alternatively. The study consisted of 1 year of assessment followed by 1 year of follow-up. Results are considered significant at p value <0.05 and highly significant at p value <0.01. Procedure related variations were seen in each group, however in patients operated by MT, there was reduction in total duration of surgery with no kinking of chamber. Majority of patients showed immediate improvement in either procedure, however, continued improvement till final follow-up as well as complications like infection, peri-catheter swelling and incidence of shunt migration was seen in more patients operated using TT which was statistically significant. We propose a novel method of utilizing modified tunneler with a distal "Capsule" which provides just enough space both, at the appropriate distance and for adequate length,

for a proper and adequate alignment of the chamber to fit snugly and thus avoids procedure related risks and complications as well as reduces total duration of surgery thereby aids in decreasing chances of infection. The current study was carried out with the aim of simplifying the procedure and to minimize other shunt related risks and complications

KEYWORDS: Traditional technique (TT); Modified technique (MT); Paediatric hydrocephalus

I. INTRODUCTION

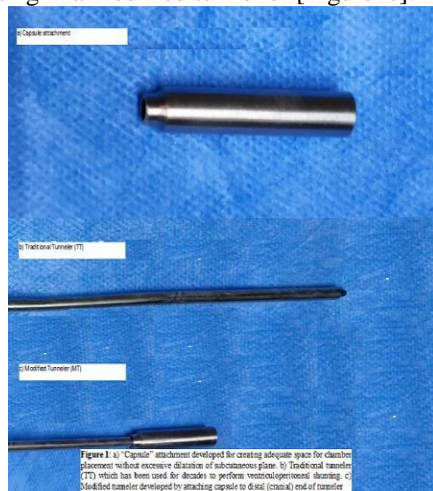
The incidence of hydrocephalus throughout the globe is very high, particularly in low- and middle-income countries, which incur the greatest burden of disease [1]. The ICBDSR-based incidence of hydrocephalus diagnosed at birth is 81/100,000. A significantly lower incidence was identified in high-income countries [2]. Obstruction to the flow of cerebrospinal fluid anywhere along the length of a ventriculo-peritoneal shunt results in failure and correspondingly the paediatric patient shows features of this shunt mainly as difficulty feeding, nausea/vomiting, and irritability. Examination may reveal bulging fontanelle and dilated scalp veins. Older children may present with headache, nausea/vomiting, and even drowsiness. CSF shunt infection is one of the most distressing neurosurgical complication [3]. Case incidence of shunt infection ranges from 8-40% and the operative incidence has ranges from 2.8-14% [4]. The failure rates up to 50% have been reported in paediatric patients at 2 years [5,6]. Though this procedure is being done for decades, however, no modification has been done or



proposed in performing this procedure keeping in mind the position of chamber of the shunt tubing [7,8]. Since the surgery involves passing the tunneler subcutaneously from the level of umbilicus to scalp incision, there is a risk of injury to various vital organs and nerves [9,10,11,12,13]. The current study was carried out with the aim of simplifying the procedure and to minimize other shunt related risks and other complications.

II. METHODOLOGY

This was a prospective randomized pilot study of 68 consecutive paediatric patients (Age <18 years) of hydrocephalus conducted, after clearance from institutional ethics committee, in the Department of Neurosurgery at Govind Ballabh Pant Institute of Post Graduate Medical Education and Research and associated Maulana Azad Medical College, New Delhi, to evaluate the efficacy and advantages of MT. The MT has been developed for placement of ventriculoperitoneal shunt after evaluating the inherent difficulties encountered with the TT. It is basically a capsule like attachment [Figure 1a] which connects at the distal end of the traditional tunneler [Figure1b], resulting in a modified tunneller [Figure1c].



The MT is started similar to TT with openings made at cranial and abdominal ends, however, once the distal end of tunneler (cranial end) is out of the subcutaneous plane, a capsule shaped attachment is attached to it [Figure 2].



It fits into the tunneller like cap of a pen. Once attached, the tunneler is partially withdrawn from the abdominal end gradually [Figure 3] for 8 centimeters beyond the cranial opening of subcutaneous plane (10 centimeters in neonates where length of peritoneal end is shortened to provide additional widened space for connector). Once the capsule has reached destined site, the tunneler is pushed out again, the attachment removed and catheter is passed as in TT. The MT is extremely simple and basic, but its benefits are considerable. The space so created ensures the chamber fits snugly and perfectly, thereby eliminating any dead space which is usual and common in cases where dilatation is done using instruments like artery forceps or Penfield dissector. The space for proper placement of chamber is made at exact place so that no need for manipulation while placing the catheter and any kinking is avoided. It further eliminates the need to re-position the chamber as well as avoids contact of blood with opening in the chamber, thus minimizing risk of blockage and infection. Patients of 18 years and below having hydrocephalus, irrespective of etiology, were included. Patients with other intracranial and intraspinal pathologies and associated renal and cardiac co-morbidities were excluded.



Figure 3: Intra-operative image showing the tunnel being pulled down so as to dilate subcutaneous plane upto level of mastoid which is final position of chamber of catheter

after performing ventriculo-peritoneal shunting using 2 techniques in terms of surgical placement of catheter; duration of surgery; need for repeat surgery and complications.

Sample size: The calculated sample size was 126 but as it was a pilot study, a convenient sample of 68 patients was taken. All analyses were performed using SPSS Software version 22. The results of the study were analyzed using appropriate statistical tests (Pearson's Chi Square Tests). Results are considered significant at p value <0.05 and highly significant at p value <0.01.

III. RESULTS

Out of the total of 68 patients (100%), 34 (50%) patients underwent ventriculo-peritoneal shunting by TT and MT randomly and consecutively. 20 (58.82%) and 17 (50%) diagnosed patients of congenital hydrocephalus underwent TT and MT respectively. Procedure related variations were seen in each group, however in patients operated by MT, there was reduction in total duration of surgery and blood loss with no need to reposition the chamber. There was also no kinking of chamber or contact of chamber opening with blood in MT group [Table 1].

Objective of study: The aim of this study was to find if there was any difference in results

Parameter	Traditional Technique	Modified Technique	Statistical Significance
68(100%)	34 (50%)	34 (50%)	
Diagnosis: Congenital Others	20 (58.82%) 14 (41.18%)	17 (50%) 17 (50%)	
Average total duration	35 min	28 min	
Tunneling to shunt fixation	10 min	8 min	
Blood loss during dilatation	3 ml	2 ml	
Kinking of chamber	10 (29.41%)	NIL	p <0.001
Contact with blood	19 (55.88%)	4 (11.76%)	p <0.05
Need to reposition chamber	6 (17.65%)	NIL	

Table 1: Clinical and technical parameters associated with TT and MT and their statistical significance



Majority of patients showing immediate improvement in either procedure, being 32 (94.12%) in TT and 31 (91.18%) in MT. However, only 17 patients (50%) showed continued improvement till final follow-up in TT in contrast to 28 patients (82.35%) in MT which was statistically significant. A small number of patients required shunt revision and endoscopic third

ventriculostomy from each group. Mild complications were seen in 16 (47.06%) and 7 (20.59%) patients in TT and MT respectively, which was significant. Severe complications were seen in 9 (26.47%) and 2 (5.88%) patients in TT and MT respectively which was again statistically significant. 3 patients (8.82%) in TT and 2 patients (5.88%) in MT deteriorated [Table 2].

Results	Traditional Technique	Modified Technique	Statistical Significance
(68100%)	34 (50%)	34 (50%)	
Immediate Improvement	32 (94.12)	31 (91.18%)	
Continued Improvement at 1 year	17 (50%)	28 (82.35%)	p <0.05
Shunt revision	5 (14.71%)	3 (8.82%)	
Severe Complications	9(26.47%)	2 (5.88%)	p <0.05
Mild complications	16 (47.06%)	7 (20.59%)	p<0.001
Deteriorated	3 (8.82%)	2 (5.88%)	
Conversion to ETV	2 (5.88%)	1 (2.94%)	

Table 2: Clinical outcome and complications seen in patients operated using TT and MT

Complications observed in both the groups [Table 3], however peri-catheter swelling and incidence of shunt migration was seen in more

patients operated using TT and was statistically significant. Other complications observed included redness of tract, shunt extrusion and infection.

Complication	Traditional Technique	Modified Technique	Statistical Significance
Redness of tract	9 (26.47%)	7 (20.59%)	
Peri-catheter swelling	7 (20.59%)	NIL	p <0.001
Revision	5 (14.71%)	3 (8.82%)	
Shunt extrusion	4 (11.77%)	2 (5.88%)	
Shunt Migration	3 (8.82%)	NIL	p< 0.05
Infection (including meningitis)	2 (5.88%)	NIL	

Table 3: Major complications seen with TT and MT



IV. DISCUSSION

Ventriculo-peritoneal shunting is one of the most common neurosurgical procedure performed. However not much attention has been given to the technique involved in the procedure. It tends to play a crucial role for ensuring proper placement of the tubing in the subcutaneous plane free of any kinking. Several techniques and modifications have been suggested have been suggested [7,8,14,15,16] but no modification has been done or proposed in performing this procedure keeping in mind the position of chamber of the shunt tubing. There are several studies on management of shunt failure due to migration and infection [17,18]. Skin of paediatric patients, especially post tubercular, is very fragile, hence transient redness of skin is seen in any many cases suggesting need of careful and gentle tunneling. The space created by various instruments like artery forceps results in a lot of dead space where CSF gets collected and is prone to infection. There is adequate evidence that duration of surgery, minimizing contact of shunt tubing with gloves and decreased need of manipulation of tubing are associated with less risk of infection and shunt failure [19,20,21,22]. Duration of surgery has a direct impact on outcome and complications. Revisions are associated with increased morbidity. Our Modified technique (MT) showed reduced duration of surgery by an average of 7 minutes when compared with traditional technique (TT). Further, it showed no kinking in the tubing and absence of blood contact with opening of chamber. Rates of both mild and severe complications were found reduced in MT which was statistically significant. There was no need to revise position of chamber with reduced need for shunt revision and overall better outcome was seen with our technique.

V. CONCLUSION

The study was highly suggestive of superiority of this new technique. It was found to reduce operative time, blood loss during surgery, reduced contact of catheter with skin and other tissue thereby associated with reduced infection and complication rate. It was found to give continued improved results at the end of follow-up period of 1 year. The current study was carried out with the aim of simplifying the procedure and to minimize other shunt related risks and complications. However, a larger dedicated study incorporating role of etiology and associated factors on outcome is needed for effective analysis.

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