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Endoscopic Third Ventriculostomy Success Score In Predicting Short-Term Outcome In Children With Hydro-Cephalus

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ABSTRACT

Background: Endoscopic third ventriculostomy (ETV) has been a shared treating option in cautiously selected hydro-cephalus-cases. The success or potential outcomes of its utilization in hydro-cephalus treatment may be expected using a pre-operative scoring tool. An instance of such a tool is the ETV-success scoring (ETVSS).
Aim of the work: to assess ETVSS as a pre-operative prognostic device in hydro-cephalus-kids who met the criteria of inclusion for ETV operation.
Patients and Methods: Study conducted a prospective hospital-based research on 68-children of ages <2-yrs that visited at the Hospital out of 161 hydro-cephalus -children. The expected ETVSS was estimated via the adding of cases' ages, assumed etiology and previous shunting. These kids were allocated into 3 groups regarding the ETVSS as high score expects better ETV consequence and contrariwise. They have been followed-up for 6-mths to find out the ETV rate of success.
Result: the mean predicted ETVSS from this study was 49.2 ± 18.6 with a mean SS of 53%.
Conclusion: The estimate of ETV success and nonsuccess is probable nowadays for immediate success and with further involvement may be utilized as a long-term outcomes gauge.

Keywords: *Hydro-cephalus; Endoscopy; Third ventriculostomy; Pediatric neurosurgery.*

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INTRODUCTION

The growing fame of ETV in treating hydro-cephalus over the last 10-yrs has enhanced the treatments outcomes, with the relevant enquiry currently concentrated on the criteria of selection that expect good outcomes. [1] Hydro-cephalus is a disturbing operative disorder that when left without treatment leads to reduced psychosocial and mental developments and cosmetical dis-figuring craniofacial dis-proportion and can finally cause mortality. Early suitable treating is accompanying with a significant decrease in morbidities and death in addition to development in the hydro-cephalus-children's life quality. [2]

The hydro-cephalus has grown with time. Shunting was the conventional treatment method of cases with the associated complications like shunt infections and malfunctions. In the last 20-yrs, there is an increase in the ETV usage in hydro-cephalus treating in particular cases with a decrease of complications that conventionally associated with shunt. [3] The ETVSS was confirmed to be an advantageous pre-operative device that expects the ETV outcomes. [1] In spite of the main benefit of being free of shunt, ETV is accompanying with variable rates of success ranged between 50 and 90% and can cause development of hydro-cephalus that could require additional cerebrospinal fluids (CSF) alteration. It is consequently suitable to invent clear-cut criteria of selection between hydro-cephalus cases so as to gain best advantage from the operation in opinion of the modest rate of nonsuccess of the operation. [4]

The progress of ETVSS is a try to precisely expect the ETV outcomes and calculate the mutual predictive parameters like age of case, hydro-cephalus etiologies and preceding shunt history. The scoring system aids to recognize nondependent factors that expect better consequence. This work was exactly aim to evaluate the ETVSS role as a pre-operative factor in hydro-cephalus children. [5]

We aim to assess ETVSS as a pre-operative prognostic device in hydro-cephalus-kids who met the criteria of inclusion for ETV operation.

PATIENTS AND METHODS

The current work prospective hospital-based research done at AL Hussein and Sayed Galal hospitals involved 68-cases of suitable kids who satisfy the criteria of inclusion and experienced ETV out of 161-

cases who existing with hydro-cephalus throughout an 18-mths of investigation interval thereafter attaining ethical authorization from the human and research ethics committee. The criteria of inclusion include kids <2-yrs who existing with clinical characteristics and brain CT-scan results of hydro-cephalus and fit for an ETV operation by the criteria of exclusions.

The criteria of exclusion were hydro-cephalus-cases >2-yrs with and un-conscious, comatose and brain-dead cases. Cases who have hydro-cephalus treatment with methods other than ETV and cases with no brain CTS were as well omitted. Cases that had choroid plexus cauterization (CPC) besides ETV were omitted. [6]

A knowledgeable agreement has been attained from the involved children's parents and guardians. Gestation age at delivery, supposed hydro-cephalus etiologies, preceding shunt history and ages at operation were documented. The supposed hydro-cephalus etiologies were settled by brain-CTS as a step of pre-operative assessment. Occipitofrontal circumferences (OFC) was determined at presentations via the glabella and occiput as reference point. Developing indicators (neck control, social smile, sitting with and with no supporting, standing, crawling, walking and talking) were assessed and recorded. [7]

Endoscope set-up was prepared. The right-side ventricle has been cannulized, CSF flowing was approved and an elastic endo-scope was presented into the forward horn of the right-side ventricle via Kocher's point which gives a straight path via the foramen of Monro to the flooring of the 3rd ventricle.

The flooring of the 3rd ventricle has been recognized by identified land-marks with basilary artery complex located at the back edge of the 3rd ventricular flooring at the mammillary bodies' levels. The 3rd ventricular flooring was fenestrated bluntly via electro-cautery, and at the ventriculostomy aperture, CSF flowing was realized.

The ETVSS was estimated by adding of scores for ages, supposed etiologies (from brain-CTS) and existence or nonattendance of preceding shunting insertions, and the estimated ETVSS was recorded for every case.

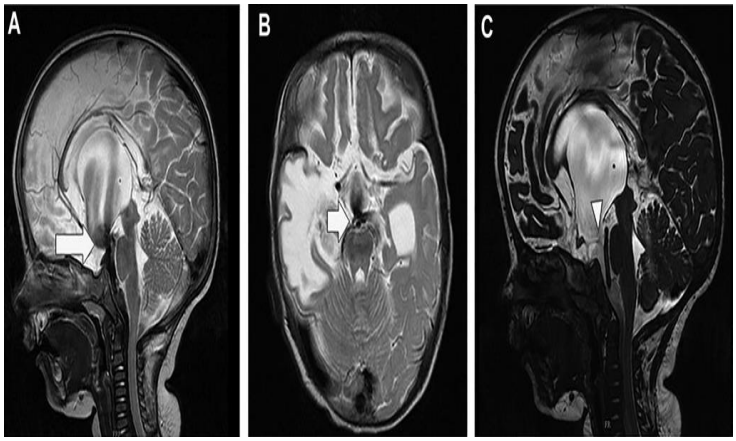

Fig. 1: An infant who experienced ETV for axial scans (A and B) and Sag CISS (C), the arrow head displays the defects disruptive hydro-cephalus, with post-operative MRI of the flooring with a subtle flowing void. Sag CISS, sagittal CISS scanning display concentrated flowing void (arrows in A and B) in the sagittal

RESULT

Collected data involve history of delivery, supposed hydro-cephalus etiologies, attendance or nonattendance of preceding shunt, complications at presenting, developing indicators, brain-CTS results, treating and outcomes. Case's privacy was assured via using assigned serial number for every case. The gathered data statistical analysis has been done via IBM-SPSS-22 (Illinois, USA). Association was performed to approve correlations among ETVSS and ETV outcomes via Pearson's association ranking order, whereas the variance analyzing (ANOVA) and Kaplan-Meier statistical tool have been utilized for comparison between means, and $p<0.05$ was judged as significant. ROC curve was utilized to find out the prognostic strength of the variable. Following-up was for a retro of 6-mths which was performed via routine clinical visits and telephone, and OFC and developing landmark evaluated.

	n=68
Age (months)	6.12 ± 4.82
<6-mths	40(58.8%)
6-12-mths	16(23.5%)
>12-mths	12(17.7%)
Gender	
Male	46(67.6%)
Female	22(32.4%)
male to female ratio	2.1:1
Previous shunting	
No	53(77.9%)
Yes	15(22.1%)

Table 1: Baseline characteristic of patients (n=68).

In table (1), 68-cases with full info have been investigated. The ages ranging between 0 & 24-mths with a mean of 6.12 ± 4.82-mths. 59% cases were <6-mths ages while 23.5% were from 6 to 12-mths. 46 (67.6%) cases were males, whereas 22 (32.4%) were female with a male to female ratio of 2.1:1. 53 (77.9%) of the 68-cases had no

preceding shunt previous to the ETV operation, whereas 15 (22.1%) had ventriculoperitoneal shunt previous to ETV.

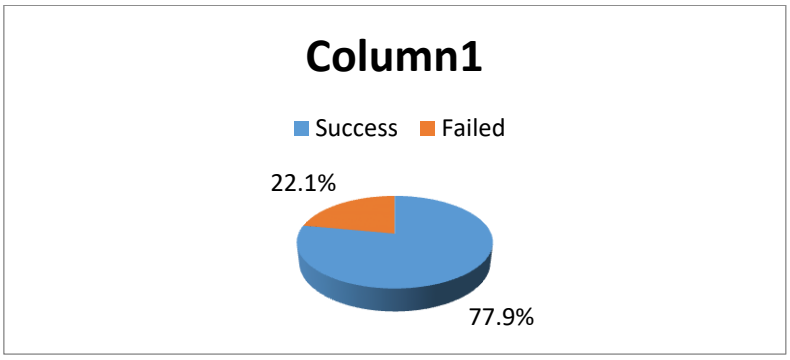

Fig. 2: Rate of success versus failure rate among patients.

Figure 1 showed that 22.1% of cases had unsuccessful ETV which was the main complication, but other inferior complications have been found in 3 cases with SSI that was everyday managed with wound cares and anti-biotics.

Age groups	Failed ETV (%)	Successful ETV (%)
<6-mths	12(30%)	28(70%)
6-12-mths	0(0%)	16(100%)
>12-mths	3(25%)	9(75%)

Table 2: Comparing of ages at operation with outcomes of ETV (n=68).

In table 2, at 6-mths following-up, the ETV was effective in kids ageing from 6 to < 12-mths (100%, p = 0.001), then those aging from 12 to 24-mths (80%, pvalue = 0.05) and 1 to < 6-mths (70%), while ETV unsuccessful in 75% of cases aging <1-mth.

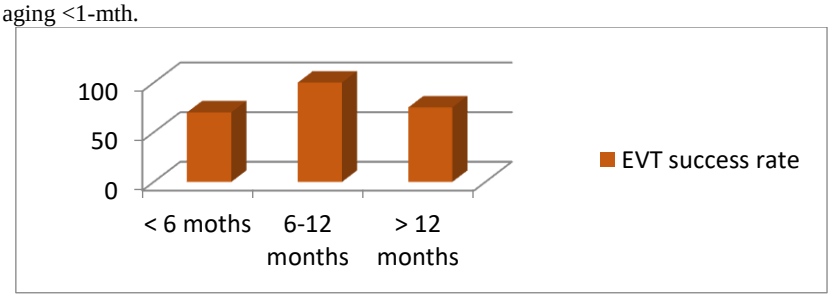

Fig. 3: ETV success rate in age groups.

Predicted ETVSS	Number of patients	Mean ETVSS score	Successful ETV	Failed ETV
10–40	24	28.4 ± 9.7	10	14
50–70	38	57.8 ± 8.7	37	1
≥ 80	6	80.0 ± 0.0	6	0(0%)
Total	68	49.2 ±18.6	53	15

Table 3: The association among estimated ETVSS and ETV outcome.

In this table, the mean estimated ETVSS from this work was 49.2 ± 18.6 with a mean SS of 53%.

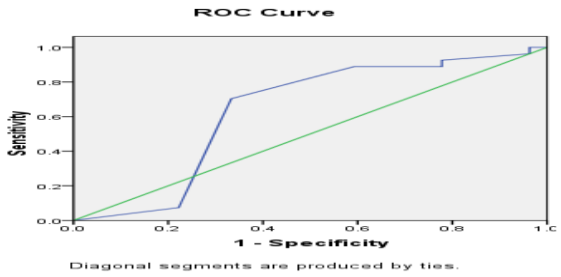

Fig. 4: ROC curve of mean predicted ETVSS.

This figure showed that the AUC was 0.802 with a sensitivity of 83% and specificity of 87% of mean predicted ETVSS.

DISCUSSION

Hydro-cephalus is a range of disorders where there is an incongruity of CSF productions and absorptions, with subsequent enlargement of ventricles. There is several suggested sorting for hydro-cephalus. Most frequently in usage is the noncommunicating and communicating types. In the obstructive diversity, the block is proximal to the arachnoid granulation tissue and can be more sorted into intra- or extra-ventricular. The communicating kind advances owing to faulty absorptions at the arachnoid granulations. Other sorting includes etiological sorting viz. tumor connected, posthemorrhagic, postinfectious, and posttraumatic, exvacuo and ordinary pressure hydro-cephalus. [8]

The choice to manage a case operatively may be tasking in opinion of the choices accessible for hydro-cephalus treating. The choice is built on obtainable treating methods, effectiveness of this methods, obtainable knowledge, apparatus and treatment selection by the case's parents. ETV is a treating method that appears to have few complications in comparison to more conventional technique of shunt. [9] But, the usage of a well-tailored criteria of choice as the ETVSS performed pre-operatively is vital to find out who will expect advantage from ETV and aid to decrease the necessity for repeating the operations after failure. [10]

ETV accomplishment is definite as liberty from the following operative procedures for the aim of CSF diversions. An unsuccessful ETV is described as having happened in patients that will need following operative interventions by CSF diversions thereafter primary management with ETV or mortality within 6-mths afterword 1st ETV. [11]

Complications comprise blood loss from the barriers of the 3rd ventricle. This is frequently temporal and ends with irrigations and occasionally balloon tamponage. Greater vessel blood loss like perforator or basilar artery branches may cause substantial morbidities. Basilar artery aneurysms/pseudo-aneurysms can consequence from this loss. Hypo-thalamic injuries can consequence from eccentric holes. This another time has extremely high morbidities. Hole of the flooring in ETV may be theoretically influence the hypothalamus-pituitary axis causing hormone disturbance. Fritsch et al. inspected 20-cases but concluded no clinical significance. More researches are wanted to determine the endocrine outcomes post-ETV1. [4]

So, in this work, we aim to assess ETVSS as a pre-operative prognostic device in hydro-cephalus-kids who met the criteria of inclusion for ETV operation.

The current work is a prospective hospital-built research of 68 suitable kids who satisfy the experienced ETV out of a number of 161-cases existing with hydro-cephalus throughout an 18-mths.

Assessment of the studied cases as regard sociodemogrphic data revealed that the ages of the 68-cases ranging between 0 & 24-mths with a mean of 6.12 ± 4.82-mths. 59% of cases were <6-mths old while 23.5% were gred from 6 to 12-mths old. 46 (67.6%) cases were males, whereas 22 (32.4%) were females with a ratio 2.1:1.

In accordance with our findings, the report of Morgan et al. [1] revealed that the ages of the 68 cases ranging between 0 & 24-mths with a mean of 5.45 ± 5.41-mths, 57% of cases <6-mths ages while 20% were from 6 to 12-mths old. 47 (69.1%) cases were males, while 21-cases (30.9%) were females with a ratio of 2.2:1.

In another study of Durnford et al. [(12)] reported that the ages median was 39-mths (ranging from 1 to 6889-days). The percentage of effective ETVs at 6-mths was 72.9% (121-ETVs), that was analogous to the model cohort value of 66.3% (410-ETVs), (alteration 6.5%, 95% CI 1.2%–14.3%, p value= 0.49). The 36-mths rate of success was 64.5% (107-ETVs). There were more cases in younger aged groups; 49-cases (29.5%) were <6-mths of ages in our group in comparison to 129 (20.9%) in the model data set (alteration 8.6%, 95% CI 1.0%–16.3%, pvalue = 0.07).

Fani et al. [13] involved 59-cases <2 years of ages revealed results analogous to this work regarding ages and gender distributions. Males were 62.7% of their cases, and 55.95% of all cases were <6-mths in comparison to 64.48% in the current work who were <6-mths ages.

Then as regard previous shunting in our study; 53 (77.9%) of the 68 cases had no preceding shunting previous to the ETV operation, whereas 15 (22.1%) had ventriculoperitoneal previous to ETV.

This comes in accordance with the study of Durnford et al., 2011[12] which reported that 41-cases in their group had a preceding shunt implanted (24.7%) in comparison to 25.2% in the model data set (change 0.5%, 95% CI -7.9% to 6.9%, p = 0.91).

ETV accomplishment is described as liberty from the subsequent operative process for the aim of CSF diversions. An unsuccessful ETV is described as having happened in patients that will need following operative interventions by CSF diversions thereafter primary treatments with ETV or mortality within 6-mths afterward 1st ETV. [14]

In the present work, 50 (22.1%) 0ut of the 68 cases had unsuccessful ETV which was the main complication, but other inferior complications have been found in 3-cases with SSIs and managed with every day wound care and anti-biotics.

Similar to our findings, Morgan et al. [1] reported that 18 (26.5%) of the 68 cases had unsuccessful ETV which was the Amin complication, but other inferior complications were revealed in 3-cases with SSIs.

In our study, at 6-mths following-up, the ETV was effective in cases aging between 6 and 12-mths (100%, p-value = 0.001), then by those aging between 12 & 24-mths (80%, p -value= 0.05) and 1

to 6-mths (70%), while ETV unsuccessful in 75% of cases aging <1-mth.

In the study of Baldauf et al. [15] the rate of ETV success in 21 cases<2-yrs ages was investigated. It was revealed in this work that the rate of ETV success in cases<2-yrs ages suffered from obstructive hydro-cephalus be contingent on ages and etiologies with a total rate of success 43%. In babies, ETV was effective in 37.5% of patients. On a study conducted on 41 cases<2-yrs ages, Sufianov et al. [16] revealed that ETV was effective in 71.4% of kids amid 1 to 2-yrs and in 75.0% of kids <1-yr. They settled that ETV success in this group (<2-yrs) be contingent on the width of the flooring of 3rd ventricle and the ages at which hydro-cephalus.

He et al. [17] have concluded 16 effective ETV operations out of 17 tried patients of childhood hydro-cephalus of diverse etiologies.

A retrospective study by Jernigan et al. [18] of 5,416-cases who experienced CSF diversions either in the procedure of shunting or ETV observed a rate of 64% nonsuccess afterward ETV, >40% failures rate realized post shunting. This rate was even more noticeable if ETV was performed in 3-mths of delivery.

Ogiwara et al. [19] retrospectively studied 23-cases <6-mths of ages who were managed with ETV. They were of the view that ETV may be counted as the primary for hydro-cephalus treating in kids >3-mths of ages.

In the present study, the association among estimated ETVSS and outcomes of ETV was assessed; the mean estimated ETVSS from this work was 49.2 ± 18.6 with a mean SS of 53%, the AUC was 0.802 with a sensitivity of 83% and specificity of 87% of mean estimated ETVSS.

Several researches have authenticated this system for scoring to expect procedure success rate. Durnford et al. [12] outwardly confirmed the ETVSS by retrospective matching real successes at 6 as well as 36-mths in 166-cases of ages mean of 39-mths. They revealed that the ETVSS nearly estimated the total long-term rate of success in elevated, moderate and low risky cohorts; the mainstream of cases has elevated scores of successes. The mean estimated ETV success probability at 6-mths was non-significantly high in the 121-successful patients than in the 45 unsuccessful (mean 66 ± 18.762 versus 62 ± 19.2, pvalue= 0.24). The 6-mths ETV rate of success was greater than the mean estimated success chance for moderate as well as low success strata, but somewhat low for the elevated success probability stratums. Treating success at 36-mths was 0.42 for low (ETVSS ≤ 40), 0.66 for moderate (ETVSS 50–70) and 0.78 for elevated chance of success strata (ETVSS ≥ 80). The mean estimated success chance was of high significance for the 99-patients in which ETV persisted successful at long-term following-up than for the 67 in which it had unsuccessful (mean 69% ± 16.8% versus 59%, ± 20.6, pvalue = 0.001).

Breimer et al. [9] investigated 104 cases <18-yrs of ages and revealed the ETVSS to be a more consistent gauge of short- instead of long-term successes.

Foley et al. [20] considered the ETVSS to be a suitable device for specific valuation of cases and for charting their prospective courses regarding ETV responding.
A multi-center research including over 1000-cases studied by Kulkarni et al. [10] with more details while inventing the ETVSS.
In the recent systematic review of Limbrick et al. [21] citing more than 100 researches, evidences proposes that shunt as well as ETV deliver a comparable results in the majority of cases.

Furthermore, Morgan et al. [1] reported that the mean estimated ETVSS (48.82±19.20%) and actual ETVSS (56.20±15.10%) via the ANOVA was associated significantly (pvalue< 0.05).

CONCLUSION

The ETVSS more nearly expected the 36-mths rates of success for elevated, reasonable, and low success chances groups, and consequently perhaps long-term outcomes, than the 6-mths outcomes it was intended for. Our work proposes that the ETVSS may be beneficial in clinical decisions taking in estimating long-term ETV outcomes but more modifications of the model, validations and comparisons with shunt treatments is needed.

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