

Endoscopic third ventriculostomy and choroid plexus cauterization versus Endoscopic third ventriculostomy alone in treatment of hydrocephalus in infants

A Systematic Review

*A Dissertation submitted in partial fulfillment of the conditions for the
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Contents

List of Figures	VI
List of tables	VIII
List of Abbreviations	IX
Introduction	1
Rationale and justification of the study:	1
Aim of the Study	2
Objectives	2
Review of Literature.....	3
A historical Back ground about CSF discovery	3
Neuroanatomy of the Ventricular System	6
The Lateral Ventricles.....	6
Foramen of Monro:	9
The Third Ventricle	11
Choroidal Fissure and Choroid Plexus	18
Brain Cisterns	21
Endoscope related anatomy of the third ventricle	24
The Septum Pellucidum.....	30
The Liliequist membrane.....	32
Physiological Background.....	35
Biological Function of CSF	37
CSF Circulation and Absorption.....	38
Cerebrospinal fluid pressure	40
CSF Dynamics after Endoscopic third ventriculostomy.....	41
Hydrocephalus	43

Etiology of Hydrocephalus.....	44
The Pathogenesis of Hydrocephalus	47
Secondary effects of hydrocephalus	49
Signs and symptoms of Hydrocephalus.....	49
Treatment Modalities to Hydrocephalus	54
CSF Shunts	55
Endoscopic third Ventriculostomy	57
Choroid Plexus Cauterization	61
Methodology.....	62
Search Strategy	63
Data collection, Analysis and Appraisal	66
Data Analysis	66
Results.....	67
Study Characters	67
Etiology of Hydrocephalus in infants and difference in Age groups	73
Preoperative symptoms, signs and investigations:.....	77
Operative details as reported by different authors	78
Primary Outcomes	81
Complications as secondry outcomes:.....	88
Discussion and Data Analysis	90
Conclusion.....	105
References	106
English Summary.....	122
Arabic Summary	124

List of Figures

Figure 1: Bottom of the second column of the Edwin Smith Papyrus.....	4
Figure 2: Self-explaining text from page 172 in Breasted’s translation of the Edwin Smith Papyrus	5
Figure 3: Lateral view of a glass cast of the ventricular system	6
Figure 4: Neural relationships of the lateral ventricles	7
Figure 5: Relations to the Foramen of Monro, Superior view	10
Figure 6: Relations to the Foramen of Monro , Enlarged view	10
Figure 7: Structures seen in the floor and lateral walls of the posterior segment of 3rd ventricle when viewed from the front	13
Figure 8: Enlarged view of the anterior wall of the third ventricle.....	13
Figure 9: Midsagittal section of the third ventricle	15
Figure 10: Midsagittal views of the third ventricle	15
Figure 11: Anterior view of the floor and lower part of the third ventricle showing relations of the aqueduct of sylvias	17
Figure 12: The relationship between the lateral and third ventricle and the choroid plexus.	20
Figure 13: Lateral view of a midsagittal section of the brain showing the supratentorial cisterns	22
Figure 14: Inferior view of the basal cisterns.....	23
Figure 15: Examining the floor of the third ventricle in cadaveric specimens	24
Figure 16: Schematic drawing of the related nuclei of the third ventricle and the site of ventricular puncture for ETV.....	26
Figure 17: The endoscopic implications of a diminished prepontine cistern	27
Figure 18: Schematic showing sagittal views of the third ventricle.....	29
Figure 19: A schematic representation of the anterior, middle and posterior regions of the septum pellucidum in a sagittal view	31
Figure 20: A schematic representation of the components of the Liliequist membrane (LM) in sagittal view	33
Figure 21: Three-dimensional illustration of Liliequist’s membrane	34
Figure 22: Subfrontal endoscopic view of ventriculocisternostomy in the third ventricular floor	34

Figure 23: The central nervous system CSF compartments	35
Figure 24: Distribution of CSF in the central nervous system.....	36
Figure 25: CSF spaces and site of CSF production, circulation and elimination	38
Figure 26: MRI imaging illustrating CSF spaces selection and volume rendering before and after endoscopic third ventriculostomy.....	42
Figure 27: Head circumferences charts	51
Figure 28: Schematic indicating method of making various linear ventricular measurements	53
Figure 29: Illustration for Scarff technique for open ventriculostomy	54
Figure 30: Artist's illustrations demonstrating ETV	57
Figure 31: Calculation of the ETVSS	60
Figure 32: Performing choroid plexus cauterization.....	61
Figure 33: Illustration demonstrating the typical maximal extent of CPC obtained with a rigid neuroendoscope	62
Figure 34: A schematic showing the article selection process from Medline database search and manual review of bibliographies	68
Figure 35: Chart illustrating etiology of hydrocephalus in both procedure ETV CPC and ETV alone	76
Figure 36: Chart illustrating total patients with different etiologies of hydrocephalus, treated with either ETV CPC or ETV alone	91
Figure 37: Chart illustrating comparison of outcome between ETV CPC vs ETV alone in Post inf HCP.....	92
Figure 38: Chart illustrating comparison of outcome between ETV CPC vs ETV alone in HCP due to idiopathic AS	93
Figure 39 :Chart illustrating comparison of outcome between ETV CPC vs ETV alone in HCP associated with MMC.....	95
Figure 40: Chart illustrating comparison of outcome between ETV CPC vs ETV alone in comm HCP	97
Figure 41: Chart illustrating comparison between % of successful outcomes by both ETV CPC and ETV alone with different etiologies	99
Figure 42: Chart illustrating comparison between % of successful outcomes by both ETV CPC and ETV alone with different etiologies below age of 6 months	99
Figure 43: Chart illustrating comparison between complication due to ETV CPC and ETV alone	103

List of tables

Table 1: Etiological mechanisms of pediatric hydrocephalus	45
Table 2: Genetic abnormalities associated with pediatric hydrocephalus	46
Table 3: Characteristics of studies reporting ETV CPC	69
Table 4: Characteristics of studies reporting ETV alone	70
Table 5: Characters of patients involved in the studies	71
Table 6: Etiology of HCP in patients who underwent ETV CPC	74
Table 7: Etiology of HCP in patients who underwent ETV alone	75
Table 8: Pre op radiology according to authors	77
Table 9: Operative details in patients underwent ETV CPC	78
Table 10: Operative details in patients underwent ETV alone	80
Table 11: Outcomes of patients with AS that underwent ETV CPC	81
Table 12: Outcomes of patients with AS that underwent ETV alone	82
Table 13: Outcomes of patients with Post inf HCP that underwent ETV CPC	83
Table 14: Outcomes of patients with Post inf HCP that underwent ETV alone	83
Table 15: Outcomes of patients with MMC that underwent ETV CPC	84
Table 16: Outcomes of patients with MMC that underwent ETV alone	84
Table 17: Outcomes of patients with Comm HCP that underwent ETV CPC	85
Table 18: Outcomes of patients with MMC that underwent ETV alone	85
Table 19: Outcome of second ETV after failure	86
Table 20: Timing of failure post intervention	87
Table 21: Complications of surgery in patients that underwent ETV CPC	88
Table 22: Complications of surgery in patients that underwent ETV alone	88

List of Abbreviations

AS	Idiopathic aqueductal stenosis
CA	Cerebral aqueductoplasty
Comm	Communicating
CNS	Central nervous system
CP	Choroid Plexus
CPC	Choroid Plexus Cauterization
CSF	Cerebro spinal fluid
CT	Computed tomography
DW	Dandy Walker
ETV	Endoscopic third ventriculostomy
ETV CPC	Endoscopic third ventriculostomy with choroid plexus cauterization
ETVSS	ETV success score
FM	Foramen of Monro
FOHR	Frontal occipital horn ratio
FT	Floor of third ventricle
HCP	Hydrocephalus
ICP	Intra cranial pressure
Inf	Inflammatory
Lt	Left
MMC	Myelomeningocele
MR	Magnetic resonance
Non comm	Non Communicating
NR	Not reported
OFC	Occipito frontal circumference
RCT	Randomized control trial
Rt	Right
TCUS	Trans cranial ultra sound
T2WI	T2 weighted image of MRI
VPS	Ventriculoperitoneal shunt

Introduction

Rationale and justification of the study:

Infantile hydrocephalus is one of the variables and complex diseases in neurological surgery; hydrocephalus defined as an active distension of the ventricular system resulting from inadequate passage of cerebrospinal fluid from its point of production within the cerebral ventricles to its point of absorption into the systemic circulation.(1;2)

Hydrocephalus in infants which either can be congenital without obvious extrinsic cause or secondary to hemorrhage, infection or neoplasm(3) needs intervention and treatment by one way or another.

Endoscopic third ventriculostomy (ETV) is a procedure in which a CSF diversion is created through a ventriculocisternostomy directly into the subarachnoid space, besides the widely spread belief that it reduces the transmantle pulsatile stress by increasing compliance of the ventricular wall(4), this procedure has been debatable in infants due to high discrepancy in failure rates among different studies.

The first neurosurgeon to use the ventriculoscope in visualizing through the lateral ventricles was Dandy in 1922.(5) A year later came William Mixter, who became the first neurosurgeon to perforate successfully the floor of the third ventricle using an endoscope.(6) The combined efforts of both Dandy and Mixter kept unrevealed until recent decades when the ETV procedure began to gain widespread acceptance again, after the eyes were stolen by the discovery of the shunts, in part due to the achievements in fibro optical and mechanical instrumentation together with stereotactic/ultrasound guided techniques.(7;8)

Meanwhile Dandy in 1918 was the first to introduce the coagulation and removal of the choroid plexus in the lateral ventricle as a treatment for hydrocephalus, however, this procedure has diminished due to the low success rate and high rates of complications.(9)

Recently, the combination of ETV with Choroid plexus cauterization (CPC) in infants has been gained increasing popularity by virtue of a myriad of reports with promising and favorable results.(10) With the rationale being that an imbalance in CSF absorption capacity may be one of the reasons behind ETV failure. Cauterization of the choroid plexus would, in theory, decrease CSF production, compensating for the presumably hindered absorption capacity of CSF in infants and upon other mechanisms.(11-14)

Aim of the Study

To review and summarize available knowledge on the role of adding choroid plexus cauterization to the standard procedure of endoscopic third ventriculostomy in the management of hydrocephalus in infants.

Objectives

Primarily, to review, revise and calculate the success of endoscopic third ventriculostomy with choroid plexus cauterization (ETV CPC) in comparison to endoscopic third ventriculostomy (ETV) alone in treatment of hydrocephalus in full term infants with different etiologies, and infants with no prior interventions.

Secondary, evaluating the added benefits and risks from the inclusion of CPC to the ETV procedure. In addition to evaluating the success of the ETV procedure for the second time.

Review of Literature

A historical Back ground about CSF discovery

The history of cerebrospinal fluid (CSF) was studied in context with the history of neuro anatomy, neurophysiology and neuropathology not as a separate entity. It was not till the sixteenth century since the CSF when as such was discovered, a long earlier in history as early as 2500 BC a fluid within the skull and vertebral column has been described by ancient Egyptians.

In 1862 an antique dealer named Edwin Smith bought a papyrus scroll from a local dealer in Luxor, Egypt. This scroll is almost 5 meters long and was found to contain as highly fascinating medical texts from ancient Egypt. It is the oldest known manuscript on traumatic injuries, mostly in the field of neuro trauma. It only contains scientific approaches without involvement of magic or spells, making it one of a kind compared to other documents back at this age. Dated back to 1500 BC, the time of dynasties 16–17 in ancient Egypt, believed to be a copy of a text written during the period of the old kingdom between 3000 and 2500 BC. Some authors speculates that Imhotep was the author of the original manuscript.(15)

The Edwin Smith Papyrus consists of 48 case reports describing various neuro trauma cases starting with the head proceeded by the spinal cord and lastly peripheral nerve injuries. Furthermore each case is structured into examination, diagnosis, prognosis and treatment, followed by summary, which has been added as an original text illustration using unfamiliar terms at time when the Smith Papyrus was written. The document is now displayed at the New York Academy of Medicine.(Fig1)

In case number six was the first known mentioning of CSF. The patient had “a gaping wound in the head with compound comminuted fracture of the skull and rupture of the meningeal membrane”.(15) The meninges were described for first time in history, moreover, the word brain (marrow of the

Review of Literature

skull) appeared for the first time in any kind of literature. Aside from the anatomical details, the fluid surrounding the brain, by which the author most likely referred to the cerebrospinal fluid was described as well in this case of brain injury. Most authors therefore refer to the Smith Papyrus as the first appearance CSF in the medical literature.(Fig 2) (16;17)



Figure 1: Bottom of the second column of the Edwin Smith Papyrus. The hieroglyphs in blue circles refer to watery fluid in context with the surface of the brain (Courtesy of The New York Academy of Medicine Library)

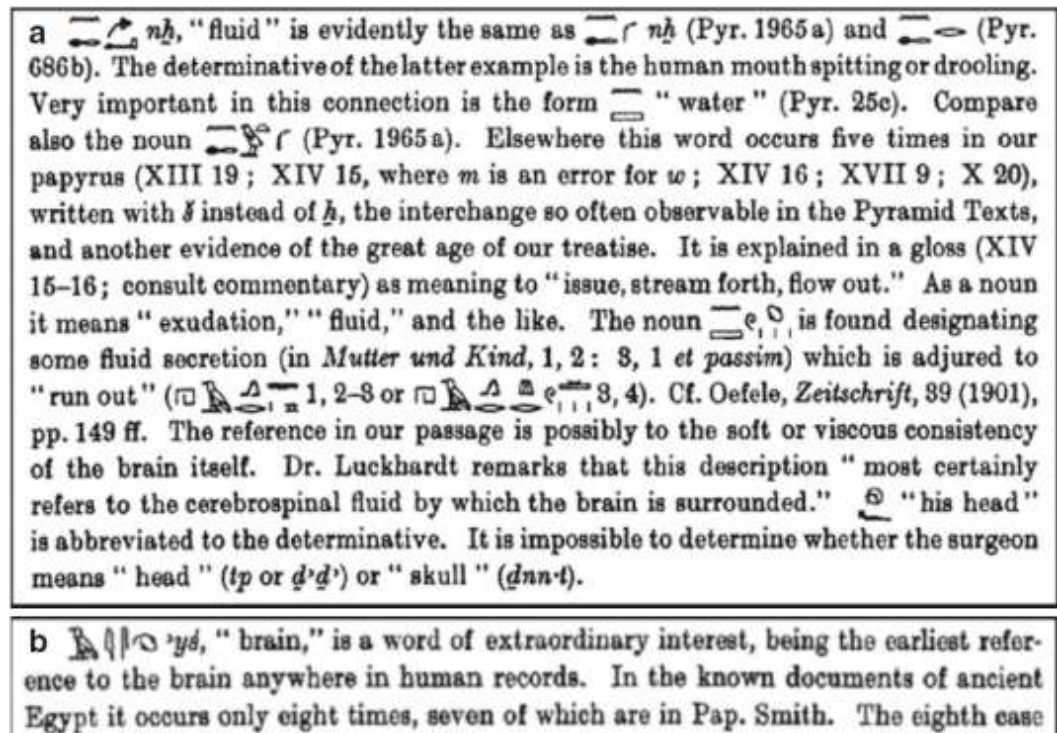


Figure 2: (a) Self-explaining text from page 172 in Breasted's translation of the Edwin Smith Papyrus (b) Text from page 166 in Breasted's translation of the Edwin Smith Papyrus (case six), mentioning the word brain for the first time in medical literature(15)

Further discoveries were made but it was not till later in time in mid-19th century when the final breakthrough came with Francois Magendie a French experimental physiologist who eventually established the place of CSF in neuroanatomy and physiology. He also stated that the CSF is a normal rather than a pathological constituent of the human body, and most importantly he gave the name "liquide cerebrospinal"(18) which has been used since then.

Neuroanatomy of the Ventricular System

The ventricular system of the brain is composed of four freely communicating cerebrospinal fluid (CSF) filled cavities: the two lateral ventricles, the third ventricle, and the fourth ventricle. The lateral ventricles are C-shaped cavities that lie deep in each cerebral hemisphere.(19) (Fig 3)



Figure 3: Lateral view of a glass cast of the ventricular system.(20)

The Lateral Ventricles

Each lateral ventricle is divided into:

- Body.
- Atrium.
- Anterior (frontal)horn.
- Posterior (occipital) horn.
- inferior (temporal) horn.

Each of these parts has medial and lateral walls, a roof, a floor, and an anterior wall.(21)

The body occupies the parietal lobe and extends from the posterior edge of the foramen of Monro to the point where the septum pellucidum disappears and the corpus callosum and fornix meet.

The lateral wall is composed of the caudate nucleus superiorly and the thalamus inferiorly, separated by the striothalamic sulcus, the groove in which the stria terminalis, and the thalamostriate vein course.

The medial wall is composed of the septum pellucidum superiorly and the body of the fornix inferiorly.