# 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 award of a Master Degree In Neurosurgery*

By


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*Antony Kaldas*

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# 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 | Myelomeningeocele |
| MR | Magnetic resonance |
| Non comm | Non Communicating |
| NR | Not reported |
| OFC | Occipito frontal circumfrance |
| 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 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)

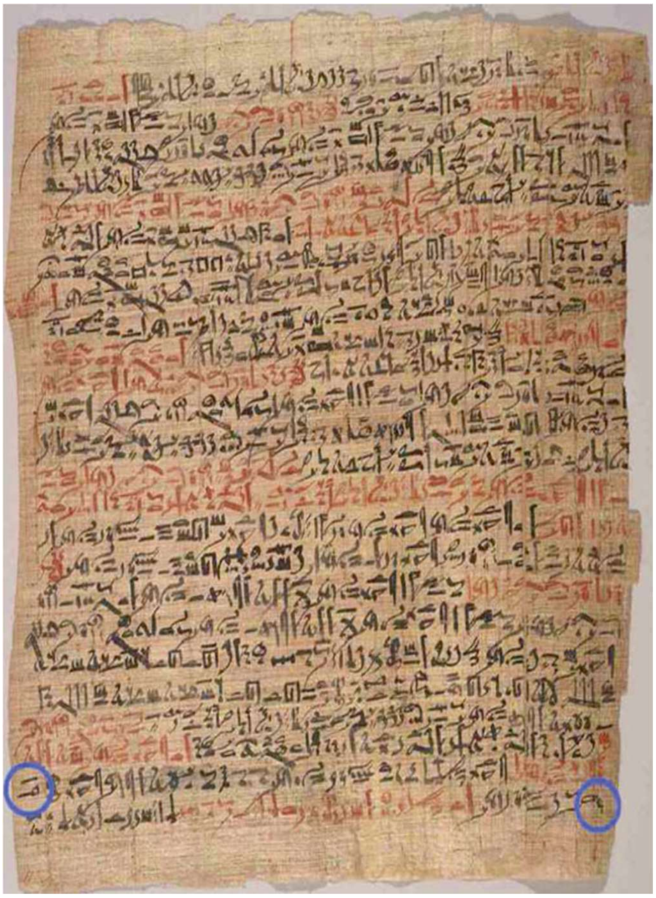
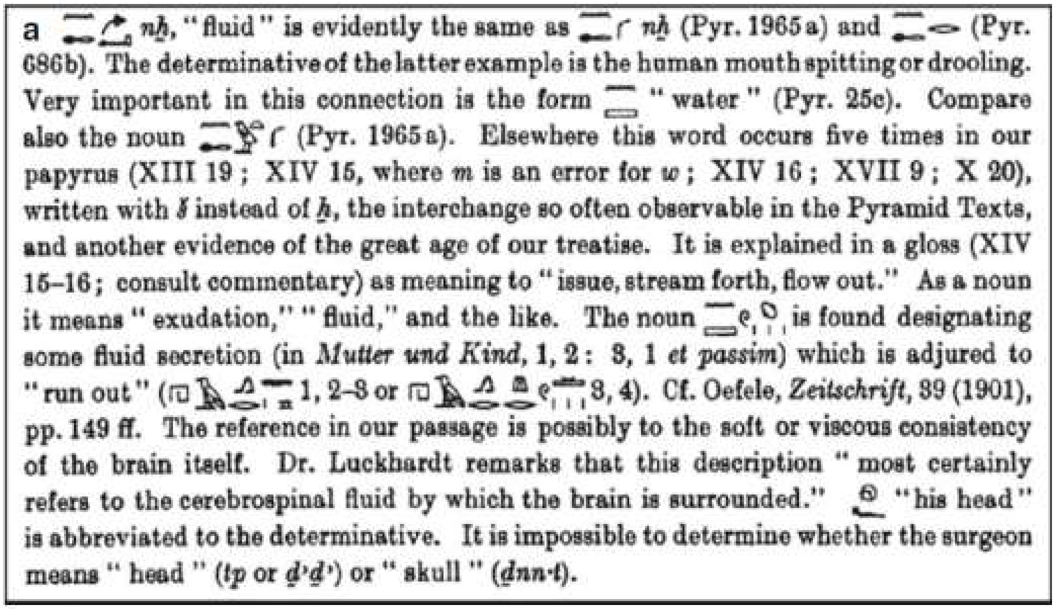
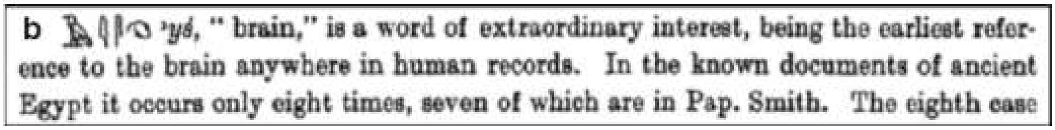


Figure 1: Bottom of the second column of the Edwin Smith Papyrus. The hieroglyphs in blue circles refer to watery fluid in context with the surface of the brain (Courtesy of The New York Academy of Medicine Library)



a nḫ, "fluid" is evidently the same as nḫ (Pyr. 1965 a) and (Pyr. 686b). The determinative of the latter example is the human mouth spitting or drooling. Very important in this connection is the form "water" (Pyr. 25c). Compare also the noun (Pyr. 1965 a). Elsewhere this word occurs five times in our papyrus (XIII 19; XIV 15, where *m* is an error for *w*; XIV 16; XVII 9; X 20), written with *š* instead of *ḫ*, the interchange so often observable in the Pyramid Texts, and another evidence of the great age of our treatise. It is explained in a gloss (XIV 15–16; consult commentary) as meaning to "issue, stream forth, flow out." As a noun it means "exudation," "fluid," and the like. The noun is found designating some fluid secretion (in *Mutter und Kind*, 1, 2: 3, 1 *et passim*) which is adjured to "run out" ( 1, 2–3 or 3, 4). Cf. Oefele, *Zeitschrift*, 39 (1901), pp. 149 ff. The reference in our passage is possibly to the soft or viscous consistency of the brain itself. Dr. Luckhardt remarks that this description "most certainly refers to the cerebrospinal fluid by which the brain is surrounded." "his head" is abbreviated to the determinative. It is impossible to determine whether the surgeon means "head" (*tp* or *ḏʾḏʾ*) or "skull" (*ḏnn·t*).



b *ʾyś*, "brain," is a word of extraordinary interest, being the earliest reference to the brain anywhere in human records. In the known documents of ancient Egypt it occurs only eight times, seven of which are in Pap. Smith. The eighth case

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 where 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)

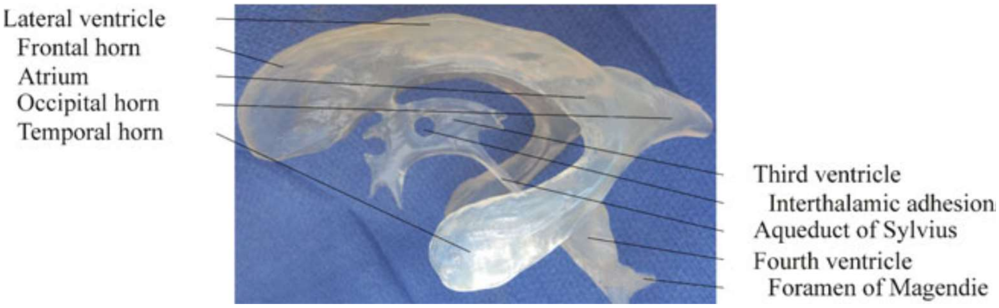



Figure 3: Lateral view of a glass cast of the ventricular system.(20)

## 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.