CHANGES IN BLOOD CONSTITUENTS FOLLOWING SHUNT PROCEDURES IN TREATMENT OF HYDROCEPHALUS

THESIS

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By

Osama Mohamed Ali Sayed Al Ghannam

M. B. B. Ch., D. S. & D. P. M. & N.

Ain Shams University

Faculty of Medicine

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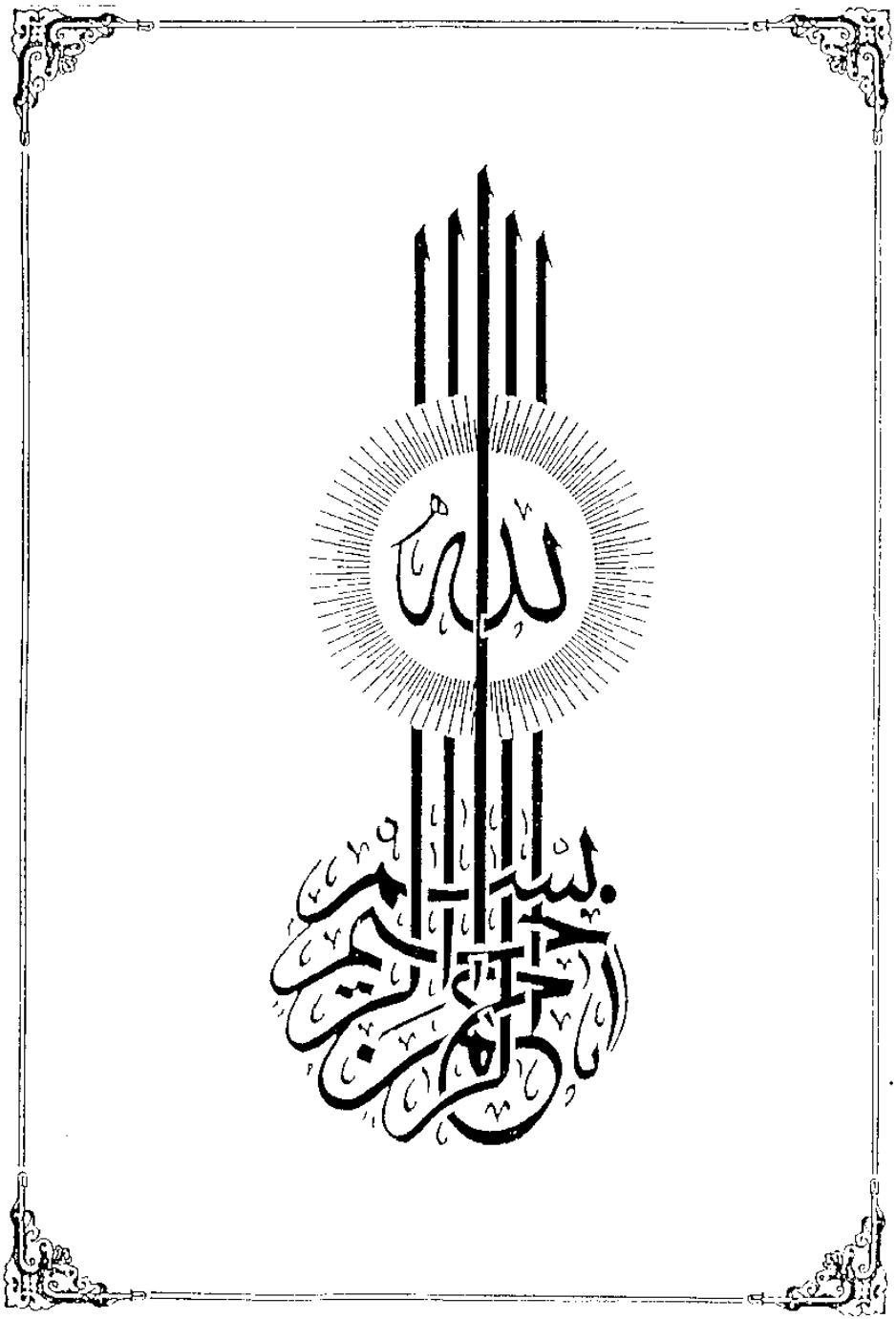

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The ventriculovenous shunts, which is a prevalent one today actually drains the C.S.F. from one of the lateral ventricles into the systemic circulation through one of the neck veins. This drainage may be harmful or harmless.

The aim of this work is to study the possible changes in the blood constituents of the hydrocephalic infants as a result of diversion of C.S.F. pathway directly into the blood stream via ventriculovenous shunts.

INTRODUCTION

I N T R O D U C T I O N

Hydrocephalus is a pathological condition and not a disease, with many variations but it is always characterised by an increase in the amount of C.S.F. which is, or has been under increased pressure. There are two types of hydrocephalus; communicating and obstructive hydrocephalus. In the communicating type there is a free communication between the ventricles and the spinal subarachnoid space. In obstructive hydrocephalus there is obstruction to the circulation of C.S.F.

Hydrocephalus should be differentiated carefully from hereditary macrocrania and megalocephaly due to metabolic disorder, in both of which conditions the ventricular system is of normal size. Hydrocephalus must be distinguished from chronic subdural hematoma in infancy, where increase in head size is due to excessive fluid in the subdural spaces. Also it should be distinguished from abnormal collections of fluid which are not under pressure such as porencephalic cysts of the brain or enlarged C.S.F. pathways that occupy the space remaining because of cerebral agenesis or loss of cerebral substance incident to post-natal disease or trauma or due cerebral atrophy which is due to diffuse cerebral sclerosis, general paralysis of the insane, presenile and senile dementia and some epileptics. Hydrocephalus in infancy and

ildhood may be due to a number of different causes; Congetal, neoplastic, infectous, traumatic and operative ..... c.

There is a special entity which is called external hydcephalus in which the C.S.F. is accumulated over the cerebral mispheres. In such cases the brain is pushed towards the se of the skull and the ventricular system is reduced to minimum and eventually the brain occupies only a small fracon of the great cranial cavity which is filled with C.S.F. ternal hydrocephalus may be due to operation in III ventricle a hydrocephalic infant and after foetal irradiation (J. nyszn, 1969).

The treatment of hydrocephalus is widely variable; remol of the cause of obstruction if removable in case of obstrtive types. There were many old methods of treatment like ght bandaging of the head, repeated ventricular or lumbar ucture, and induced dehydration. Also choroid plexus cision was used (Scraff 1952). The recent procedures are the nt operations like ventriculo-venous, ventriculopleural, triculo-peritoneal and thecoureteral, and thecoperitoneal nts, but the most commonly and widely used types of these cedures are the ventriculovenous and ventriculo-peritoneal nts.

The aim of this work is to study in the ventriculo-venous shunt, which is the one widely used, the possible changes in the blood constituents following diversion of C.S.F. directly into the blood stream.

NORMAL CIRCULATION OF C.S.F.

The C.S.F. circulates in a special system which is just as definite as are the systems for the blood, lymph, ... etc. and this is called the third circulation (Cushing, 1926). The C.S.F. is constantly circulating i.e. is being constantly formed and just as constantly absorbed; is shown by the fact that dyes injected into C.S.F. are excreted by the kidnies and when a curve of the excretion is plotted. The rate of absorption is found to be fairly constant. The total amount of fluid contained in C.S.F. spaces is renewed every 6 - 8 hours, owing to the continous formation and absorption.

The circulatory system for C.S.F. :

It is divided into :

- The ventricular system,
- Subarachnoid spaces.

From certain very precise experiments (Dandy from 1913 to 1923) and Berg 1902) it will be seen that C.S.F., formed

mainly in the ventricular system, that the fluid,is absorbed mainly in the subarachnoid space, So this results in the unidirectional flow of C.S.F. (Woollam , 1958).

All of the ventricular system and the subarachnoid space are normally in free comunication with each other through well defined openings. Each lateral ventricle communicates with the medially placed III ventricle by a single opening, the interventricular forman (foramen of Monro), This foramen which located at the junction of the anterior horn with the body of the lateral ventricle. This foramen is the only means of exit for the entire lateral ventricle. The III ventricle has two inlets, the two interventricular foramina and only exit which is the aqueduct of sylvius. The aqueduct passes through the mid-brain to enter the posterior part of the IV ventricle. It is the sole channel for the III ventricle and both lateral ventricles for C.S.F.

It is the weakest link in the whole circulatory system for C.S.F. The IV ventricle is situated completely in the posterior cornail fossa. It has 3 openings connect the IV ventricle with the subarachnoid space. A median foramen of Magendi opens into the cysterna magna and two (paired)

lateral formina of Luschka open in the cysterna lateralis. Milhorat (1975), found that the C.S.F. flows from sites of origin to sites of absorption. He deduced many fractors which propell the C.S.F. in its circulatory route, these are:

1. The continuous out-pouring of newly formed C.S.F.
2. The ciliary action of the ventricular ependyma.
3. The ventricular pulsation, respiratory variations and pulsation of the chorid plexuses and cerebral arteries.
4. Pressure gradient across arachnoid villi which is an important factor (Shulman, 1964).
5. The "sump pump" action of the dural sinuses (Bradley 1970).

Formation of Cerebro-Spinal fluid:

Formation of C.S.F. is known from animal experiments of Dandy and Blackfan (1913, 1914). When an obstruction is placed in the aqueduct of Sylvius of a dog this leads to progressive dilatation of the III and both lateral ventricles. When the foramen of Monro is occluded the lateral ventricle, of that side will continue to dilate but the remainder of the ventricular system will be unaffected. Also Dandy in 1919, 1929 extripated in his expirements, the chorcid plexus of the lateral ventricle

Milhorat (1971, 1972, 1973 & 1974) deduced that 0 % of the C.S.F. is formed extrachoroidally mainly from the cerebral parenchyma. Also he and Cserr (1974) found that this part of C.S.F., is not a pathological exudate but actually a drainage of the brain extracellular fluid.

The use of ^{24}Na by Milhorat in his experiments proved that the cerebral parenchyma involved in formation of C.S.F. was that which surrounds the ventricles and that which surrounds the subarachnoid space. Many investigators (Sweet 1951, Bowsher 1960, Sato 1967, 1971 & 1972 & Levin 1974) concluded that a minor fraction of C.S.F. is formed extraventricularly by the leptomeninges.

The old investigators (Mestrezat, 1912 , Foley 1923 & Fremmont - Smith 192) reported that C.S.F. is formed by simple filtration, but this soon criticized by Flexener (1938) data which depends on the difference of C.S.F. composition and that of the plasma filtrate. Recently Davson (1967) concluded that C.S.F. is definitly an active secretion where its formation depends upon expenditure of energy and active transport.

bsorption of C.S.F. :

Many investigators (Sweet 1950, 1951 & Retzuis 1952 nd Wolsten-holme 1958) agreed that the C.S.F. is retur- ed to the blood across the arachnoid villi. In addit- on there are subsidiary sites of absorption probably clude the ventricular ependyma, leptomeninges, and e lymphatics of the spinal and cranial nerves (Bowcher 960 and Milhorat 1971). Also the choroid plexus was und to take negligable part in absorption of C.S.F. oollam 1958 & Wright 1972). There are 2 factors (Weed 35) enhance absorption of C.S.F. :

The higher hydrostatic pressure of C.S.F. as compared to the dural sinus pressure.

The difference in colloid osmotic pressure between the protein-poor C.S.F. and the plasma.

chanism of C.S.F. Absorption :

The actual mechanisms of absorption of C.S.F through e arachnoid villi was studied by many investigators ke Sprong (1934) till segal (1970). They reached the nclusion that some channels or other open communica- on exist between the C.S.F. and the venous blood. On other hand Shabo (1971) & Aleksne (1972) found

ectron microscopic study that the arachnoid villi are vered by a non-fenestrated, tightly junctioned layer epithelial cells. Davson (1973) used radioactive bstances in his experiments and examined serial secons of arachnoid villi cells in the electron microope. He concluded that the cells covering, the aracoid villi passed through a cycle of vacculation arting on the C.S.F. side of the cells and grew until reached the venous sinus side of the cell leading to rmation of discrete channels passing right through the ll and large enough to allow the passage of proteins, rticulate material and C.S.F. These channels, allow nporary flow of fluid under the higher pressure, i.e. S. into the venous sinuses.