EFFECTS OF ANAESTHETIC AGENTS ON INTRACRANIAL HAEMODYNAMICS

Essay

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Presented By

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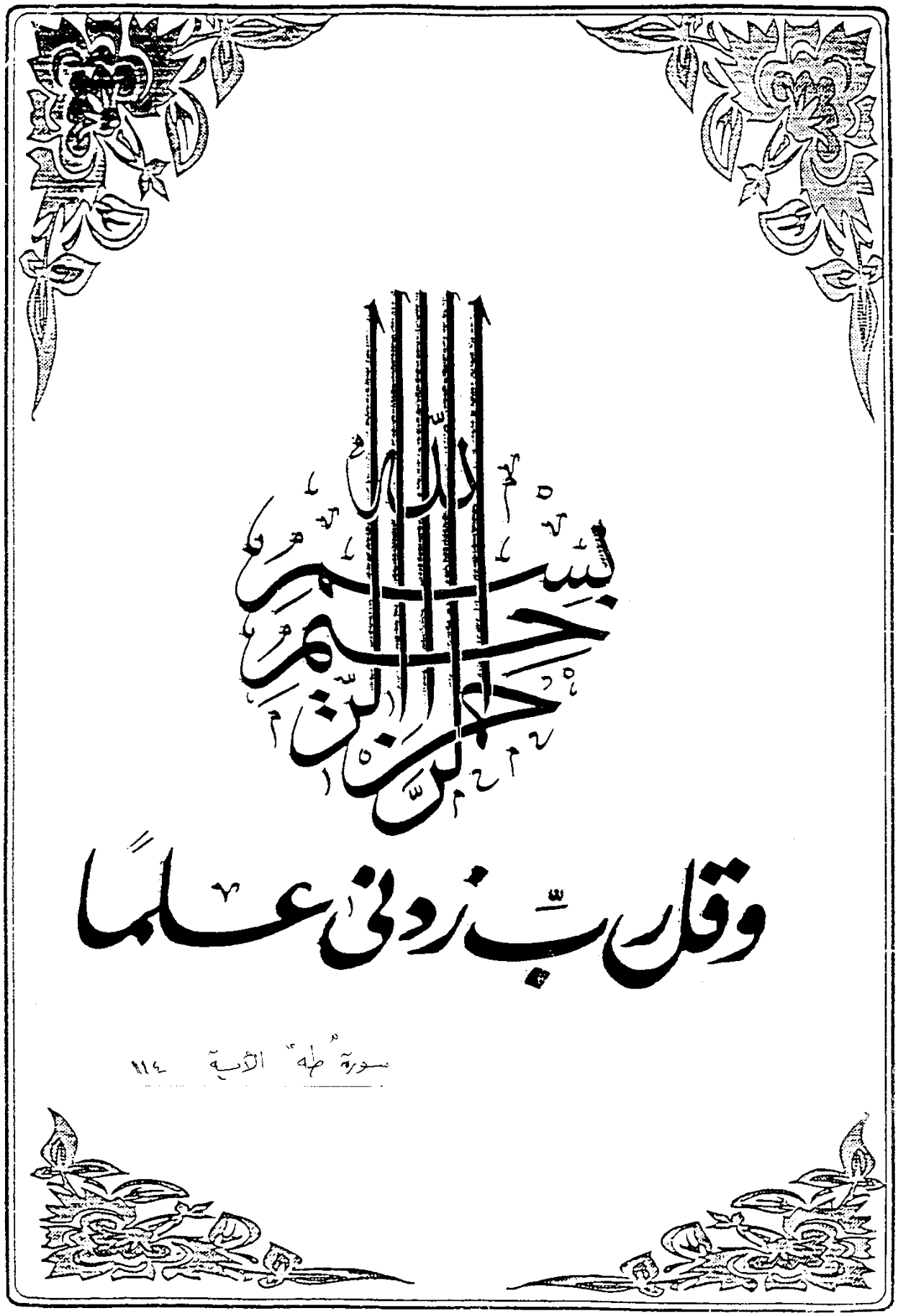

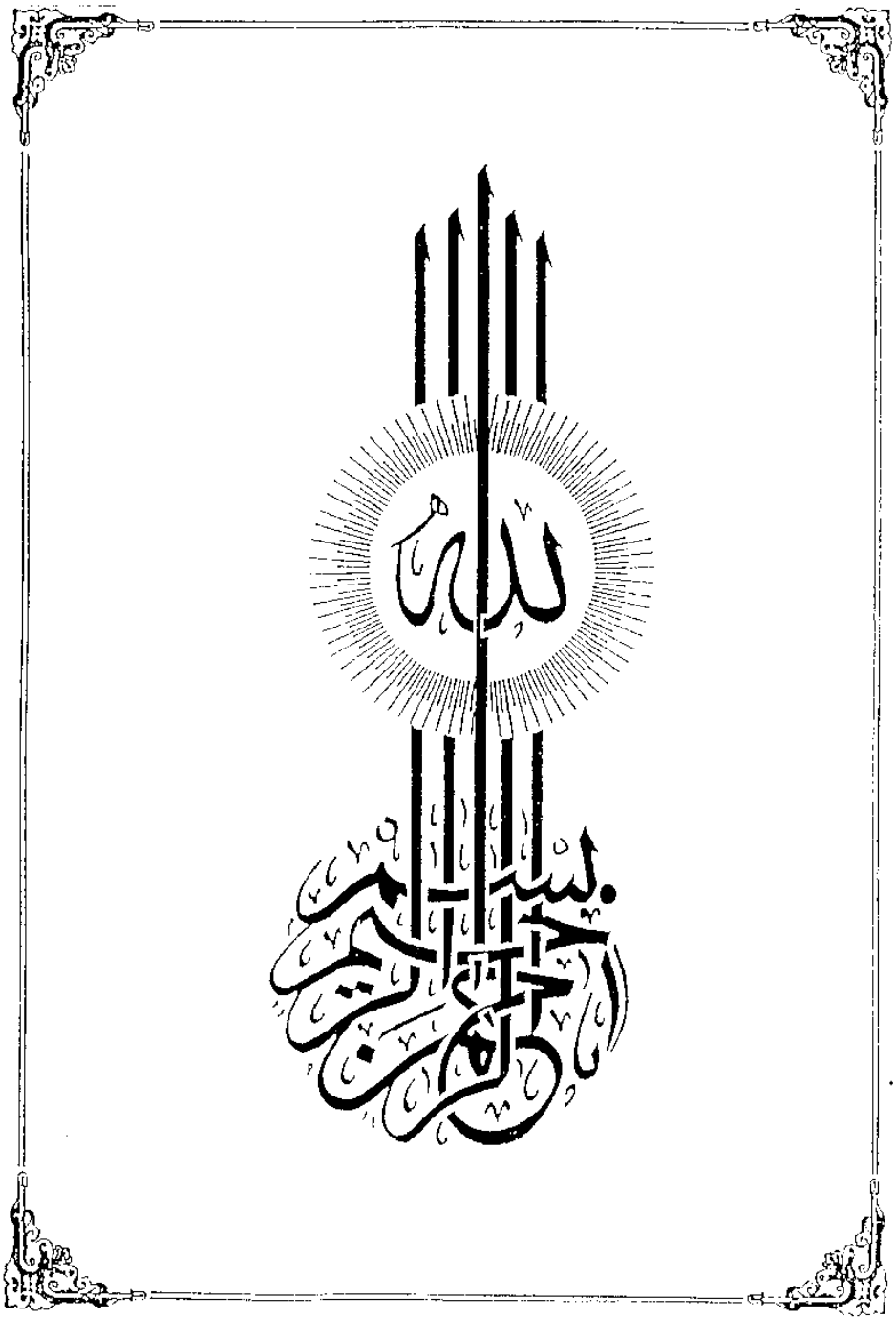

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Ahmed Metwally Khattab

* To My Family *

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Introduction

The intracranial space may be regarded as a rigid container of almost a constant volume consisting of 3 compartments, namely:

- the brain tissue with its intracellular water (85%),
- the cerebral blood volume (5%)

and - the cerebro-spinal fluid (10%).

(*Craen and Gelb, 1992*)

"Intracranial dynamics" deal with the pattern of change and the variations in the intracranial forces and mechanics. These dynamics are determined by the former 3 compartments.

A volume change in any of these compartments requires a reciprocal change to occur in one or both of the other compartments to maintain the intracranial pressure (ICP) constant (*Bode, 1990*).

Increased ICP is a common finding in patients with a wide variety of neoplastic, congenital, vascular, infectious and traumatic lesions of the central nervous system.

* The clinical importances of raised ICP, particularly during neurosurgical anaesthesia, are:

1) The cerebral perfusion pressure (which is the difference between the mean arterial pressure and the intracranial

pressure) decreases progressively until a critical point is reached at which ischaemia is produced.

2) With further elevation of ICP, conization of the medullary centers may occur with the resulting arrest of the vital functions.
3) The brain tissue may herniate through the craniotomy wound making the surgical procedures more difficult and traumatizing.

An inapropriate anaesthetic management can increase brain damage and make neurological surgery more difficult.

So, the aim of this work is to discuss the determinats of cerebral blood flow, cerebrospinal fluid dynamics, cerebral metabolic rate and consequantly the intracranial pressure. Then to evaluate the effects of various anaesthetic agents on them.

In the following chapters we are going to discuss the following items:

1) Anatomical considerations of the brain, its blood supply and C.S.F. forming structures.
2) Physiology of cerebral blood flow, including the cerebral autoregulation, and the cerebral metabolism.
3) Cerebrospinal fluid dynamics and the intracranial pressure control; along with measurements and monitoring of the intracranial dynamics.

4) Effects of various anaesthetic agents and other drugs commonly used to supplement anaesthesia, particularly in neurosurgical anaesthesia, on the cerebral blood flow, cerebral metabolism and the intracranial pressure.

5) Putting a suggested plan to induce and maintain anaesthesia in the neurosurgical patient undergoing craniotomy, without subjecting him to the hazards of further increase in the intracranial pressure with a subsequent neurological damage and loss of blood from the craniotomy wound intraoperatively.

CHAPTER 2

ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS

Anatomical and Physiological Considerations

I- Brain Anatomy.
II- Cerebral Circulation.
III- Cerebral Metabolism.
IV- C.S.F. Dynamics.
V- I.C.P. Dynamics.
VI- Measurements and Monitoring of Cerebral Haemodynamics.

I- Brain Anatomy

The brain is the greatly modified and enlarged anterior portion of the CNS. It is surrounded by 3 protective membranes (meninges); which are from inside to outside the pia mater, the arachnoid, and the dura mater, and are enclosed within the cranial cavity of the skull *(Chusid, 1983)*.

It is formed of different parts in the form of: 1) 2 cerebral hemispheres, 2) a brain stem and 3) a cerebellum:

1) The 2 Cerebral Hemispheres: which make up the largest portion of the brain, are separated by the deep "longitudeinal cerebral fissure". Each cerebral hemisphere consists of a cerebral cortex, white mater, basal ganalia (deeply placed nuclei) and lateral ventricle.

2) The Brain Stem: is formed of the diencephalon (the part enclosing the 3rd ventricle and including the thalamus, geniculate bodies and the hypothalamus), midbrain, pons, and medulla oblongata.

3) The Cerebellum: is located in the posterior fossa of the skull behind the pons and medulla. It consists of central part called the "vermis" and 2 cerebellar hemispheres.

Brain Ventricles:

Within the brain substance is a communicating system of 4 cavities filled with cerebrospinal fluid (CSF). These 4 ventricles are designated as the 2 lateral ventricles, the third ventricle, and the fourth ventricle.

The 2 lateral ventricles are the largest of the ventricles. They are actually the cavity between the cerebral hemispheres. Each lateral ventricle has a body, an anterior, a posterior, and an inferior horn. The anterior horn lies in the forntal lobe, the posterior horn in the occipital lobe, and the inferior horn in the temporal lobe.

The third ventricle is the cavity of the diencephalon. Each lateral ventricle is connected with the third ventricle by an interventricular foramen (Foramen of Monro).