Endoscopic Management of Third Ventricular Tumours

An Essay Submitted for fulfillment of
Master Degree in Neurosurgery

by:
Ahmed Mahmoud AbdelKawy Zahran
M.B.B.Ch.
Faculty of Medicine, Ain Shams University

Under Supervision of:

Dr. Salah AbdelKhalek Ibrahim Hemida
Professor of Neurosurgery
Faculty of Medicine, Ain Shams University

Dr. Amr Mohamed Nageeb El-Shehaby
Assistant Professor of Neurosurgery
Faculty of Medicine, Ain Shams University

Dr. Zeiad Youssry Ibrahim Fayed
Lecturer of Neurosurgery
Faculty of Medicine, Ain Shams University

Faculty of Medicine
Ain Shams University
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TABLE OF CONTENTS

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INTRODUCTION

The third ventricle is located in the center of the head, below the corpus callosum and the body of the lateral ventricle, above the sella turcica, pituitary gland, and midbrain, and between the cerebral hemispheres, the two halves of the thalamus, and the two halves of the hypothalamus. It is intimately related to the circle of Willis and its branches and the great vein of Galen and its tributaries. Accordingly, tumors in the region of the third ventricle are among the most difficult to expose and remove (Rhoton 2004).

Tumours of the third ventricle could be classified into anterior and posterior third ventricular tumours: Anterior tumours e.g. colloid cyst, astrocytomas, craniopharyngeoma, meningiomas, metastatic, ependymomas and choroid plexus papilloma. While Posterior third ventricular tumours comprise mainly pineal tumours and germinomas. (Fonseca RB *et al,* 2012).

There are basic approaches to the third ventricle: transcortical, and transcallosal, which are facilitated by endoscopy. Less used, would be the sub-frontal via lamina terminalis access and stereotactic techniques.

The endoscopic technique is improving its results and establishing itself as a reliable method of choice for many

neurosurgeons, to access the pathologies of the third ventricle with the least complications. (Wolfgang Seeger, 2006).

Primary endoscopic approach for solid tumors has got some limitations, thus it should be considered as a treatment option in highly selected patients with strict criteria and disciplined surgical technique to minimize risk and maximize potential for definitive treatment. As for cystic tumors (primarily colloid cysts), although endoscopic resection has become the established current standard, yet some procedure related complications do exist and need further evaluation to improve outcome. (Patra *et al 2005).*

Aim of the work:

Discussing third ventricular brain tumours and their neurosurgical management.

Introduction of neuroendoscopy as a tool that could be an alternative to conventional surgical intervention will be the core of my work depending on literature review.

Advantages of endoscopic management as well as its complications in comparison with conventional surgery will be mentioned in details.

I. ANATOMY OF THE THIRD VENTRICLE

The third ventricle is a narrow, funnel-shaped, unilocular, cavity. It is located in the center of the head, below the corpus callosum and the body of the lateral ventricle, above the sella turcica, pituitary gland, and midbrain, and between the cerebral hemispheres, the two halves of the thalamus, and the two halves of the hypothalamus. It is intimately related to the circle of Willis and its branches and the great vein of Galen and its tributaries. (Figures 1.1. & 1.2.)

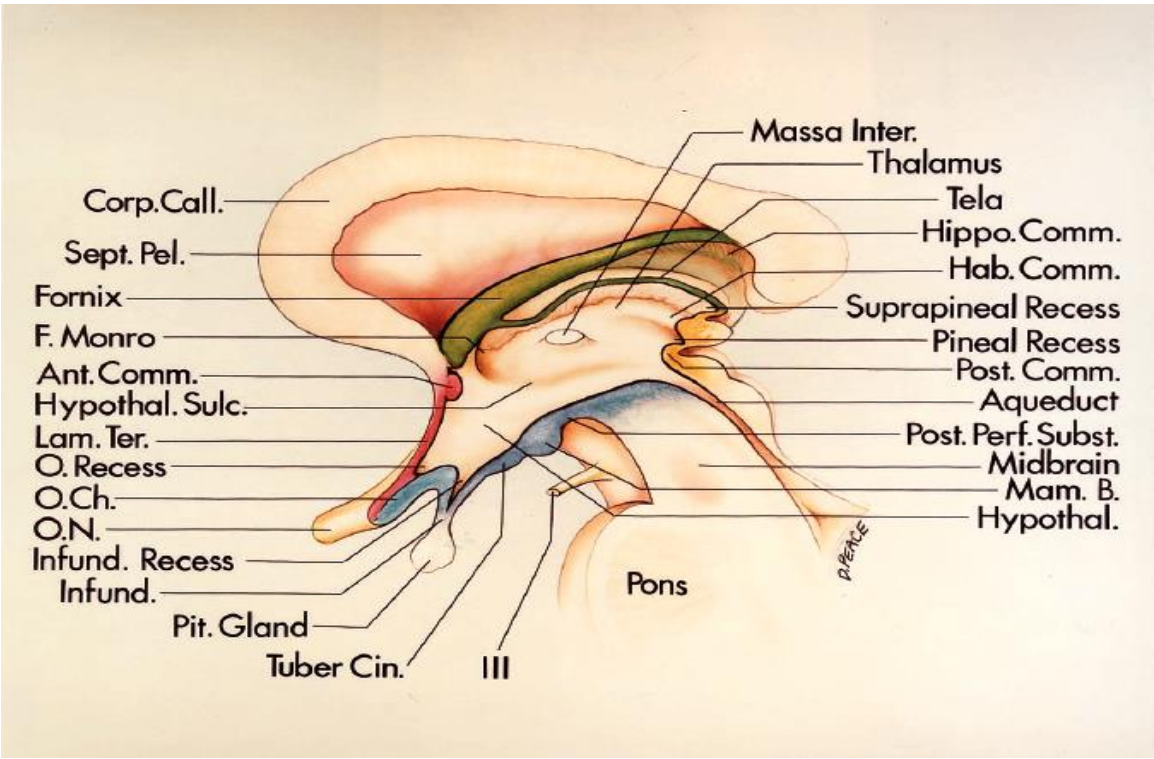

Fig 1.1: Mid-sagital section of the third ventricle (Rhoton 2002)

It communicates at its anterosuperior margin with each lateral ventricle through the foramen of Monro and posteriorly with the fourth ventricle through the aqueduct of Sylvius. It has a roof, a floor, and an anterior, posterior, and two lateral walls. (Rhoton 2002)

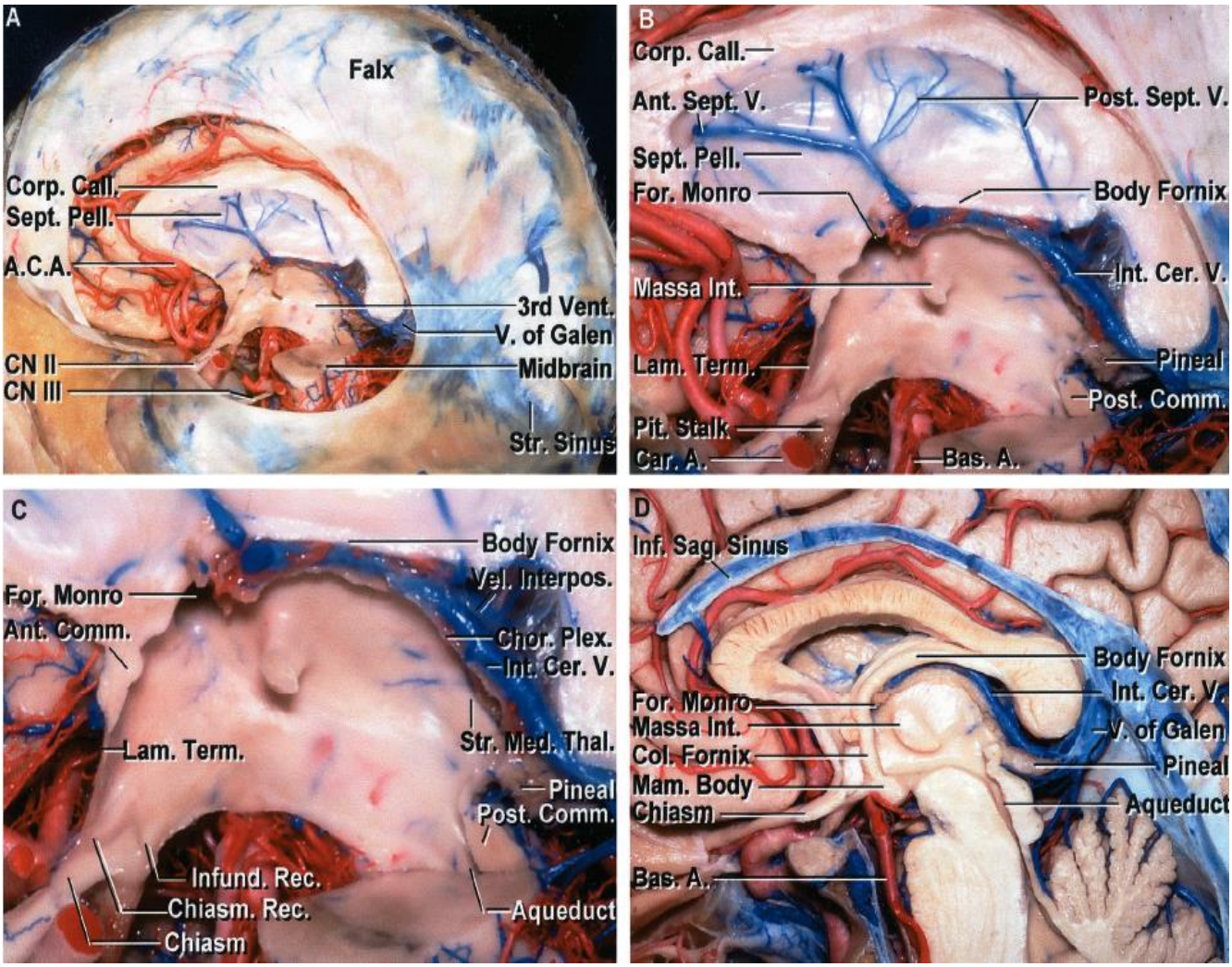

Fig. 1.2: Mid-sagital views of the third ventricle: A. The location of the 3rd ventricle in the center of the brain with its surrounding structures, B. Magnified view of A, C. Close up view of the midline 3rd ventricle & D. Sagital section in the 3rd ventricle just to the left of the midline (Rhoton 2002)

Roof

The roof of the third ventricle (Figure 1.3) forms a gentle upward arch, extending from the foramen of Monro anteriorly to the suprapineal recess posteriorly. The roof has four layers: one neural layer formed by the fornix, two thin membranous layers of tela choroidea, and a layer of blood vessels between the sheets of tela choroidea. The choroidal fissure is located in the lateral margin of the roof. The upper layer of the anterior part of the roof of the third ventricle is formed by the body of the fornix, and the posterior part of the roof is formed by the crura and the hippocampal commissure. The septum pellucidum is attached to the upper surface of the body of the fornix.

The tela choroidea forms two of the three layers in the roof below the layer formed by the fornix. The tela choroidea consists of two thin, semiopaque membranes derived from the pia mater, which are interconnected by loosely organized trabeculae. The final layer in the roof is a vascular layer located between the two layers of tela choroidea. The vascular layer consists of the *medial posterior choroidal arteries* and their branches and the *internal cerebral veins* and their tributaries. Parallel strands of choroid plexus project downward on each side of the midline from the inferior layer of tela choroidea into the superior part of the third ventricle. The velum interpositum is the space between the two layers of tela choroidea in the roof of the third ventricle. It is located on the medial side of the body portion of the choroidal fissure in the roof of the third ventricle

below the body of the fornix and between the superomedial surfaces of the thalami. The upper layer of the tela choroidea is attached to the lower surface of the fornix and the hippocampal commissure. The lower wall has an anterior part that is attached to the small ridges on the free edge of the fiber tracts, called the striae medullaris thalami, that extend along the superomedial border of the thalamus from the foramen of Monro to the habenular commissure. The posterior part of the lower wall is attached to the superior surface of the pineal body. The suprapineal recess of the third ventricle is located between the lower layer of tela choroidea and the upper surface of the pineal body. The paired parallel strands of choroid plexus in the roof of the third ventricle are attached to the lower layer of tela choroidea. Many of the veins draining the frontal horn and body converge on the velum interpositum to form the internal cerebral veins. The internal cerebral veins arise in the anterior part of the velum interpositum, just behind the foramen of Monro, and they exit the velum interpositum above the pineal body to enter the quadrigeminal cistern and join the great vein. The velum interpositum is usually a closed space that tapers to a narrow apex just behind the foramen of Monro, but it may infrequently have an opening situated between the splenium and pineal body that communicates with the quadrigeminal cistern to form the cisterna velum interpositum. There also may be a space above the velum interpositum between the hippocampal commissure and splenium called the cavum vergae. (Rhoton 2002)

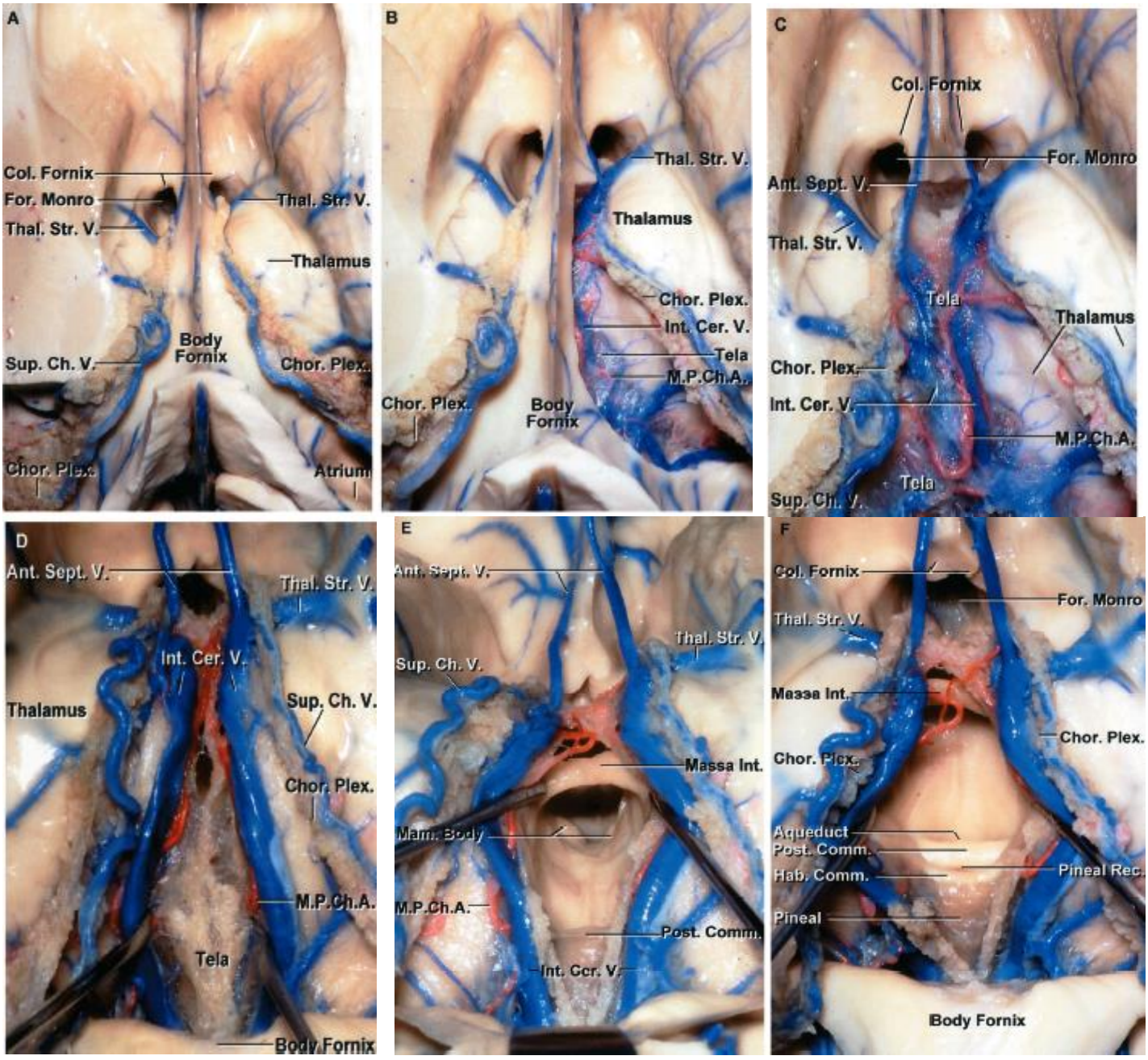

Fig. 1.3: Roof of 3rd ventricle. A. Roof is seen in the floor of lateral ventricle after removing upper part of a hemisphere, B. Magnified view of A with removal of the right lateral edge of the fornix to expose the tela choroidae, C. Body of fornix folded backwards with full exposure of the tela choroidae, D. Upper layer of the tela removed, E.&F. 3rd ventricle invaded after opening the tela choroidae (Rhoton 2002)

Floor

The floor of the third ventricle (Fig. 1.4) extends from the optic chiasm anteriorly to the orifice of the aqueduct of sylvius posteriorly. The anterior half of the floor is formed by diencephalic structures, and the posterior half is formed by mesencephalic structures. When viewed from inferiorly, the structures forming the floor include, from anterior to posterior, the optic chiasm, the infundibulum of the hypothalamus, the tuber cinereum, the mammillary bodies, the posterior perforated substance, and (most posteriorly) the part of the tegmentum of the midbrain located above the medial aspect of the cerebral peduncles. The optic chiasm is located at the junction of the floor and the anterior wall of the third ventricle. The chiasm slopes posteriorly and superiorly from its junction with the optic nerves. The inferior surface of the chiasm forms the anterior part of the floor, and the superior surface forms the lower part of the anterior wall. The optic tracts arise from the posterolateral margin of the chiasm and course obliquely away from the floor toward the lateral margin of the midbrain. The infundibulum, tuber cinereum, mammillary bodies, and posterior perforated substance are located in the space limited anteriorly and laterally by the optic chiasm and tracts and posteriorly by the cerebral peduncles. The infundibulum of the hypothalamus is a hollow, funnel-shaped structure located between the optic chiasm and the tuber cinereum. The pituitary gland (hypophysis) is attached to the infundibulum, and the axons in the infundibulum extend to the posterior lobe of the

hypophysis. The tuber cinereum is a prominent mass of hypothalamic gray matter located anterior to the mamillary bodies. The tuber cinereum merges anteriorly into the infundibulum. The tuber cinereum around the base of the infundibulum is raised to form a prominence called the median eminence. The mamillary bodies form paired, round prominences posterior to the tuber cinereum. The posterior perforated substance is a depressed, punctuated area of gray matter located in the interval between the mamillary bodies anteriorly and the medial surface of the cerebral peduncles posteriorly. The posterior part of the floor extends posterior and superior to the medial part of the cerebral peduncles and superior to the tegmentum of the midbrain.

When viewed from above and inside the third ventricle, the optic chiasm forms a prominence at the anterior margin of the floor. The infundibular recess extends into the infundibulum behind the optic chiasm. The mamillary bodies form paired prominences on the inner surface of the floor posterior to the infundibular recess. The part of the floor between the mammillary bodies and the aqueduct of sylvius has a smooth surface that is concave from side to side. This smooth surface lies above the posterior perforated substance anteriorly and the medial part of the cerebral peduncles and the tegmentum of the midbrain posteriorly. (Rhoton 2002)

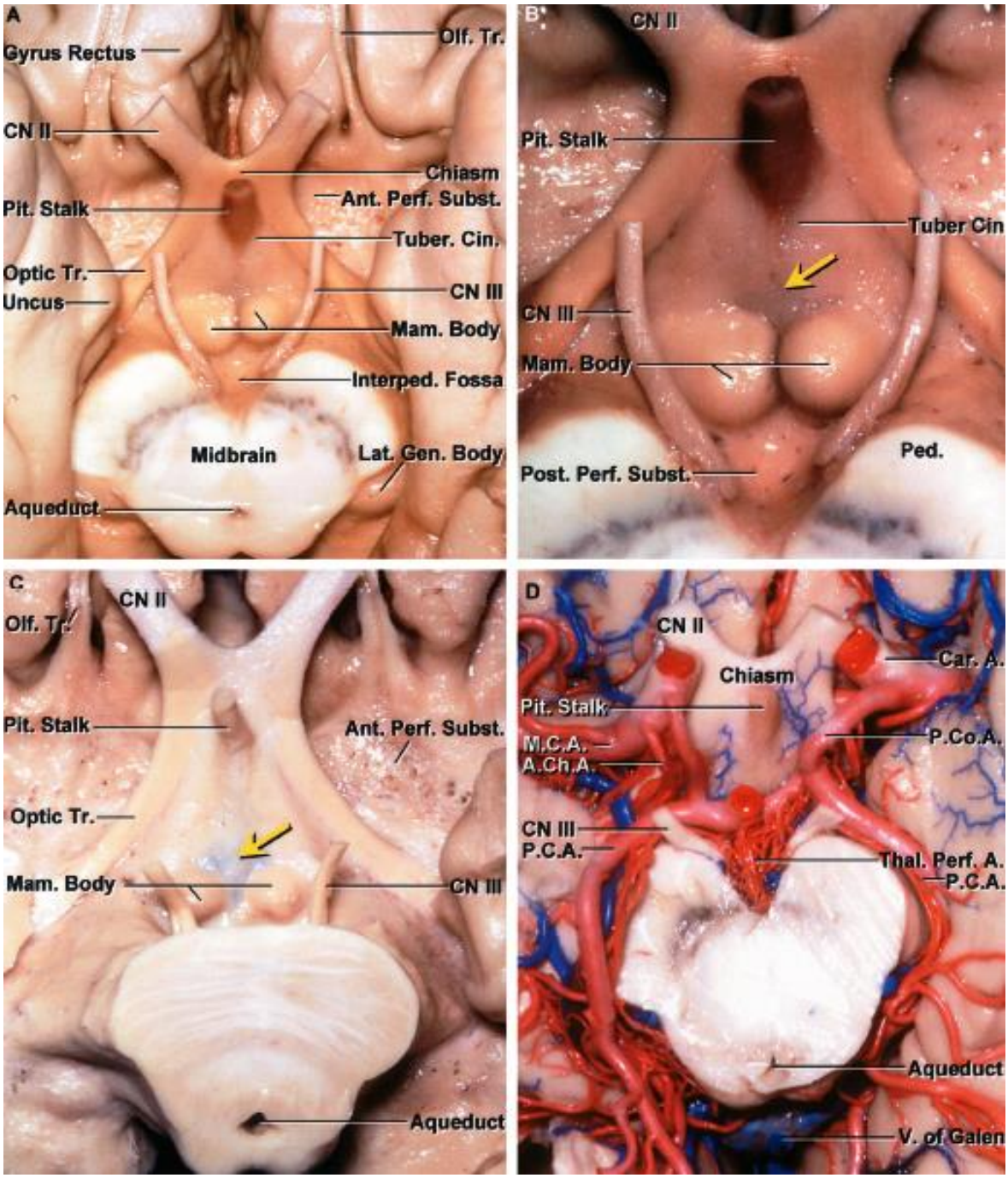

Fig. 1.4: A. Floor of the 3rd ventricle, B. Magnification of A, C. Floor of 3rd ventricle in another specimen and D. Floor of the 3rd ventricle with preserved vasculature (Rhoton 2002)

Anterior Wall

The anterior margin of the third ventricle (Fig. 1.5 A&B) extends from the foramina of Monro above to the optic chiasm below. Only the lower two-thirds of the anterior surface is seen on the external surface of the brain; the upper third is hidden posterior to the rostrum of the corpus callosum. The part of the anterior wall visible on the surface is formed by the optic chiasm and the lamina terminalis. The lamina terminalis is a thin sheet of gray matter and pia mater that attaches to the upper surface of the chiasm and stretches upwards to fill the interval between the optic chiasm and the rostrum of the corpus callosum. When viewed from within, the boundaries of the anterior wall are formed, from superior to inferior, by the columns of the fornix, foramina of Monro, anterior commissure, lamina terminalis, optic recess, and optic chiasm.

The foramen of Monro on each side is located at the junction of the roof and the anterior wall. The foramen is a duct-like canal that opens between the fornix and the thalamus into the lateral ventricle and extends inferiorly below the fornix into the third ventricle as a single channel. The foramen of Monro is bounded anteriorly by the junction of the body and the columns of the fornix and posteriorly by the anterior pole of the thalamus. The size and shape of the foramina of Monro depend on the size of the ventricles: if the ventricles are small, each foramen is a crescent-shaped opening bounded anteriorly by the concave curve of the fornix and posteriorly by the convex

anterior tubercle of the thalamus. As the ventricles enlarge, the foramen on each side becomes rounder.

The structures that pass through the foramen are: the choroid plexus, the distal branches of the medial posterior choroidal arteries, and the thalamostriate, superior choroidal, and septal veins. The anterior commissure is a compact bundle of fibers that crosses the midline in front of the columns of the fornix. The anterior-posterior diameter of the anterior commissure varies from 1.5 to 6.0 mm. The distance from the posterior end of the anterior commissure to the anterior border of the foramen of Monro ranged from 1.0 to 3.5 mm (average, 2.2 mm), and the distance from the upper edge of the optic chiasm to the anterior border of the anterior commissure ranged from 8 to 12 mm (average, 10 mm). The lamina terminalis fills the interval between the anterior commissure and the optic chiasm. The lamina attaches to the midportion of the superior surface of the chiasm, leaving a small cleft between the upper half of the chiasm and the lamina, called the optic recess. (Rhoton 2002)