25 - ORIGINAL ARTICLE
NEW METHODOLOGY

Transseptumpellucidumrostrostomy. Anatomical considerations and neuroendoscopic approach[1]

Transseptopelucidorostrostomia. Considerações anatômicas e abordagem neuroendoscópica

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ABSTRACT
PURPOSE: Verify the presence of the rostral lamina of the corpus callosum, and set parameters for neuroendoscopy.
METHODS: Relationship of the floor of the frontal horn of lateral ventricle and the hypothalamic-septal region were studied after sagittal and axial sections of the brains. Measurements were compared using F and Student t tests. The correlations between anterior-posterior diameter of the interventricular foramen / anterior-posterior diameter of the fornix column, and between anterior-posterior diameter of the interventricular foramen / length of the rostral lamina were performed by Pearson index test.
RESULTS: There was no statistically significant difference in measurements performed in both hemispheres ($p<0.05$). Positive correlations were observed between the anterior-posterior diameter of the interventricular foramen / anterior-posterior diameter of the fornix column ($R = 0.35$), and between the anterior-posterior diameter of the interventricular foramen / length of the rostral lamina ($R = 0.23$).
CONCLUSION: Rostral lamina was observed in all brains. It was possible to perform an endoscopic fenestration in the rostral lamina, communicating safely the lateral ventricle with a polygonal subcallosal cistern.
Key words: Hydrocephalus. Neuroendoscopy. Septum Pellucidum. Anatomy.

RESUMO
OBJETIVO: Verificar a presença da lâmina rostral do corpo caloso e padronizar parâmetros para a realização de neuroendoscopia.
MÉTODOS: A relação do assoalho do corno frontal do ventrículo lateral e a região hipotálamo-septal lateral foi estudada através de secções sagitais e axiais dos cérebros. As medidas foram comparadas utilizando os testes F e t-Student. As correlações entre diâmetro ântero-posterior do forame interventricular / diâmetro ântero-posterior da coluna do fornix, e entre o diâmetro ântero-posterior do forame interventricular / comprimento da lâmina rostral foram estudadas pelo teste de Pearson.
RESULTADOS: Não houve diferença estatisticamente significante nas medidas realizadas em ambos hemisférios ($p <0.05$). Correlações positivas foram observadas entre diâmetros ântero-posteriores do forame interventricular / coluna do fornix ($R = 0.35$), os diâmetros ântero-posteriores do forame interventricular / comprimento da lâmina rostral ($R = 0.23$).
CONCLUSÃO: A lâmina rostral foi observada em todos espécimes. Foi possível realizar uma fenestração endoscópica na lâmina rostral, comunicando com segurança o ventrículo lateral a uma cisterna poligonal subcalosa.
Descritores: Hidrocefalia. Neuroendoscopia. Septo Pelúcido. Anatomia.

Introduction

Surgical techniques for treating obstructive hydrocephalus have been described even before the identification of communication between the CSF and other compartments of the brain. Dandy, in 1922, for the first time opened the lamina terminalis through a craniotomy, communicating the third ventricle with the basal cysterns[1]. Mixter, in 1923, performed the first endoscopic third ventriculostomy toward interpeduncular cistern[1]. Contemporary authors have observed reduction in the incidence of hydrocephalus in subarachnoid hemorrhage, opening the lamina terminalis during surgical clipping of cerebral aneurysms[1,2,3]. Nakao and Itakura described the opening of the lamina terminalis with flexible endoscope to treat hydrocephalus secondary to tuberculous meningitis[1] and since then the procedure became routine to treat obstructive hydrocephalus. Another brain internal shunt described, performed with endoscope, is the communication of the third ventricle with the quadrigeminal cistern, through the suprapineal recess[4].

In some situations, third ventriculostomy may became technically difficult, mainly when there is thickening of the floor of the third ventricle (for instance due to inflammatory reaction), hindering the identification of anatomical parameters, or when the interpeduncular cistern is reduced by an ecstatic basilar artery. In these situations, the knowledge of internal ventricular system alternative shunts may have its value. Remarks of functioning catheters from ventricular shunts placed accidentally in the longitudinal fissure of the brain are evidence that this place can act as an alternative shunt pathway.

The objective of this paper was to study the feasibility to perform anatomical communication between the ventricular system and the longitudinal fissure of the brain through a fenestration of the rostral lamina of the corpus callosum and establish the anatomical parameters for its completion as a neuroendoscopic procedure.

Methods

Identification and measurement of anatomical references to the floor of the frontal horn of lateral ventricle and cerebral longitudinal fissure

Sixteen 10% formalin fixed brains provided by Department of Pathology, Faculty of Medicine – Alfenas University (UNIFENAS), obtained from autopsies, which showed normal appearance in the initial macroscopic inspection, were used. Nine were female and seven males, aged ranged from 13-69 years (43.5 ± 13.14) and weights varied from 940-1533 grams (1162.7 ± 148.75). After a midline sagittal cut, the following anatomical structures were identified in each hemisphere: the corpus callosum and its divisions, the interventricular foramen, the fornix column, the lamina terminalis, the supra-optic recess, the mammillary bodies, the tuber cinereum, the paraterminal gyrus and anterior cerebral artery (Figure 1).

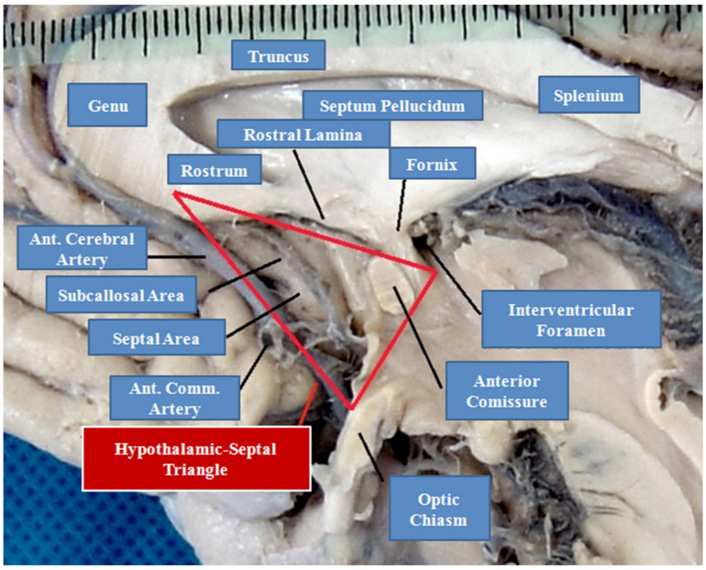

FIGURE 1 - Midline sagittal section of the brain showing the rostral lamina, hypothalamic-septal triangle, and neighbor structures.

The central sulcus, the pre-central gyrus and pre-central sulcus were identified in the hemispheres surfaces and a point, 4 cm anterior to pre-central sulcus and 3 cm from the midline (Kocher point) was marked, and used as an entry point to the ventricle (Figure 2).

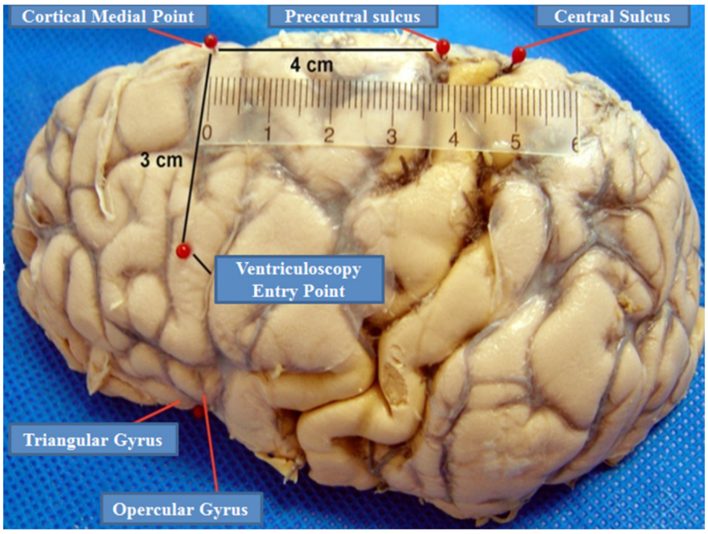

FIGURE 2 - Superior view of a left brain hemisphere. Identification of the central sulcus, precentral sulcus, cortical medial point, corticotomy's entry point to ventriculoscopy, triangular gyrus and opercular gyrus.

Needles were placed in the rostrum, genu, body and splenium of the corpus callosum, the supra-optic recess and the tuber cinereum/mammillary bodies, located anterior to the floor of the third ventricle to measure distances among these structures. The portion of the rostrum of the corpus callosum which appeared thinner, laminar, adjacent to the bottom of the septum pellucidum was identified as the rostral lamina[5], which is limited posteriorly by the fornix column. The diameter of the interventricular foramen was measured from posterior portion of fornix column to the posterior wall of the foramen. Two reference points were marked in the anterior cerebral artery: one at the origin of the anterior communicating artery, and another in its first flexure of portion A2, at the point of change in the upward path, below the rostrum of the corpus callosum.

Following, each brain hemisphere was axially sectioned at the junction of the septum pellucidum with the corpus callosum. This cut allowed an overview of the floor of the lateral ventricle, maintaining the medial wall of ventricle formed by each leaflet of the septum pellucidum. Needles were inserted in the beginning of rostral lamina, the boundary between rostral lamina and fornix column and posterior limit between fornix column and interventricular foramen (Figure 3).

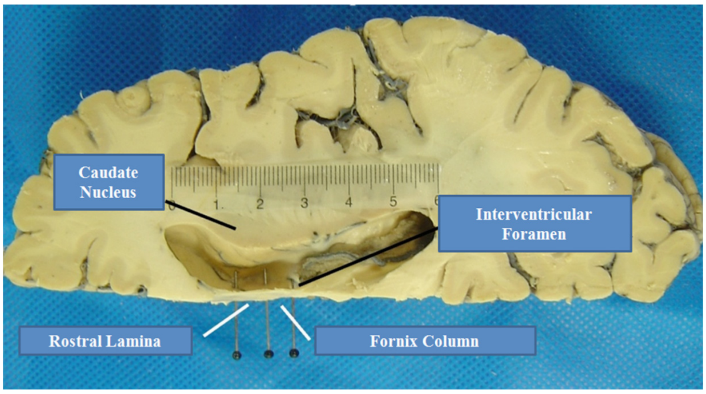

FIGURE 3 - Superior view of an axial section through the lateral ventricle with needles marking the anterior border of the interventricular foramen / fornix column and the fornix column / rostral lamina border.

Based on the pre-established anatomical landmarks points marked, the following measures were performed (Figure 4): length of the rostral lamina; anterior-posterior diameter of the interventricular foramen; anterior-posterior diameter of the column of fornix; thickness of rostrum of the corpus callosum; distance from the interventricular foramen to the tuber cinereum; distance from the rostral lamina to supra-optic recess; distance from the rostral lamina to anterior communicating artery; and distance from the rostral lamina to anterior cerebral artery.

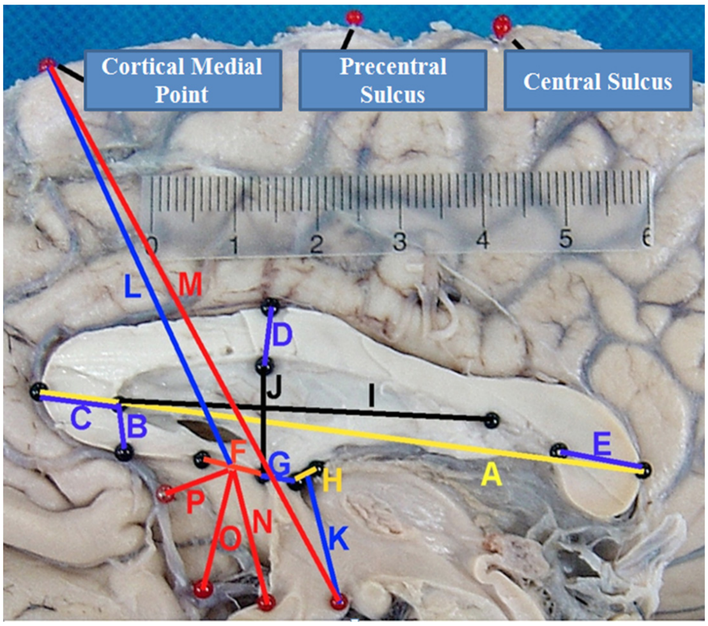

FIGURE 4 - Midline sagittal section of the brain showing the measured lines. A) Rostrum / splenium line; B) Rostrum thickness; F) Rostral lamina length; G) Fornix column thickness; H) Interventricular foramen diameter; J) Septum pellucidum height; K) Interventricular foramen to tuber cinereum distance; M) Cortex to tuber cinereum distance; N) Rostral lamina / supra-optic recess distance; O) Rostral lamina / anterior communicating artery distance; P) Rostral lamina / anterior cerebral artery distance.

Endoscopic fenestration communicating the lateral ventricles and cerebral longitudinal fissure

Two brains that had slightly dilated ventricles were carefully reconstructed using methylmetacrylate adhesive, to reconstruct the septum pellucidum, the rostrum of corpus callosum, the third ventricle and the original positions of the anterior cerebral arteries and anterior communicating artery. Prior to reconstitution, in each hemisphere, a tunnel corticectomia was performed centered in the Kocher point, and moving toward the interventricular foramen to allow ventriculoscopy and ostomy in the septum pellucidum and rostral lamina, based on parameters. The endoscopic procedure was performed with rigid endoscope with a diameter of 2.7 mm (Minop ®) with 4 work channels (Minop ®), 6 mm trocar with a 0 degree lens, and gripping forceps and dissection of 2 mm (Minop ®), coupled to a video system (Endoview®) for registration. After the procedure, the brains were sectioned in the sagittal and axial, for study by direct visualization of the ostomy.

Statistical analysis

Variances and means of measurement, obtained from both hemispheres were compared using F test and the means using Student t test for paired observations, accepting as significant P values <0.05. Correlation tests of Pearson were performed between the anterior-posterior diameter of interventricular foramen / anterior-posterior diameter of the fornix column, and between the anterior-posterior diameter of the interventricular foramen / length of the rostral lamina. Statistical tests were performed using Microsoft Office Excel 2003.

Results

Measures of anatomical references of the floor of the frontal horn of lateral ventricle / cerebral longitudinal fissure

Measurements of the distances between anatomical landmarks located on the floor of the frontal horn of the lateral ventricle and septal triangle are presented in Table 1. There was no significant difference between the measurements obtained from both hemispheres (p <0.05, F test for variance and Student t test for paired observations between means). Positive correlations were observed between the anterior-posterior diameter of interventricular foramen / anterior-posterior diameter of the fornix column (Pearson correlation coefficient – R = 0.35), and between the anterior-posterior diameter of the interventricular foramen / length of the rostral lamina (Pearson correlation coefficient – R=0.23). The averages anterior-posterior diameter of the interventricular foramen (4.93 ± 0.60 mm), anterior-posterior diameter of the fornix column (5.78 ± 0.93) and length of rostral lamina (7.09 ± 1.02 mm) were calculated using the values from both hemispheres. Based on these parameters, an anatomical point for performing a transseptumpellucidumrostrostomy was defined: anteriorly to limit between interventricular foramen with the fornix column, at a distance proportional to twice the anterior-posterior diameter of the interventricular foramen, at the intersection between lower portion of the septum pellucidum and the floor of the frontal horn of the lateral ventricle.

TABLE 1 - Rates and standard deviations of measures performed between anatomical points close to hypothalamic-septal triangle.

	Hemispheres	
	Right	**Left**
Rostral lamina length	7,07±1,22mm	7,12±0,82mm
Interventricular foramen diameter	4,84±0,66mm	5,03±0,55mm
Fornix column diameter	5,74±0,92mm	5,82±0,98mm
Corpus callosum rostrum thickness	6,89±1,47mm	6,7±0,9mm
Interventricular foramen / tuber cinereum distance	18,14±2,86mm	17,76±2,9mm
Rostral lamina / supra-optic recess distance	16,65±2,55mm	16,08±2,84mm
Rostral lamina / anterior communicating artery distance	15,33±2,6mm	15,95±2,73mm
Rostral lamina / anterior cerebral artery distance	8,62±2,0mm	8,76±1,72mm

Endoscopic fenestration communicating the lateral ventricles and cerebral longitudinal fissure

The following steps were used to accomplish the transseptumpellucidumrostrostomy technique:

1. Identification of the right interventricular foramen, the fornix column, the septum pellucidum, the septal vein and the right frontal horn.
2. Location of the previously set point to perform the ostomy;
3. Perforation of the septum pellucidum and the floor of the frontal horn with a 2.0 mm tip forceps;
4. Expansion of the ostomy with a 3F Fogarty catheter;
5. Inspection of the ostomy and identification of left subcallosal area, subcallosal artery and left anterior cerebral artery;
6. Endoscopic inspection of the ostomy through the left ventricle for viewing the right subcallosal area and the left anterior cerebral artery;
7. Endoscopic inspection of the ostomy through the right ventricle, moving the entire set with optics allowing visualization of the anterior cerebral arteries and the optic chiasm;
8. Final inspection of the transseptumpellucidumrostrostomy through the left and right ventricles.

Upon completion of the transseptumpellucidumrostrostomy, examination of the ostomy showed the following characteristics: initially there was little advancement of the dissection 2-3 mm beyond the rostral lamina reaching a small portion of the rostrum of the corpus callosum (Figure 5), and later the limit of the ostomy was approximately 5 mm in front of the fornix (Figure 5). Ostomy had a sideways look tilted and lateral (Figures 6 and 7), due to the septum pellucidum presenting at the lower floor with an inclination of the frontal horn, following the shape of the base floor and its relationship with the head of the caudate nucleus (Figure 7). Medially ostomy communicates with the left ventricle through the perforation of the septum pellucidum. The transseptumpellucidumrostrostomy presented approximately 6 mm in diameter, roughly corresponding to the endoscope trocar's diameter.

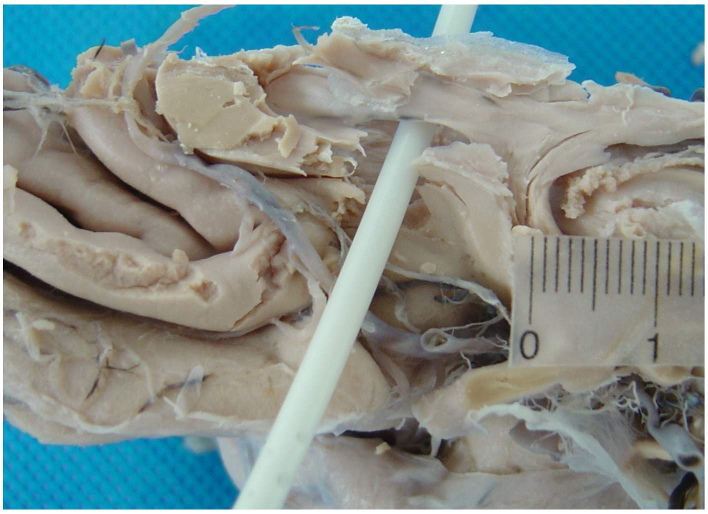

FIGURE 5 - Sagittal section of brain after transseptumpellucidumrostrostomy with a catheter through the ostomy.

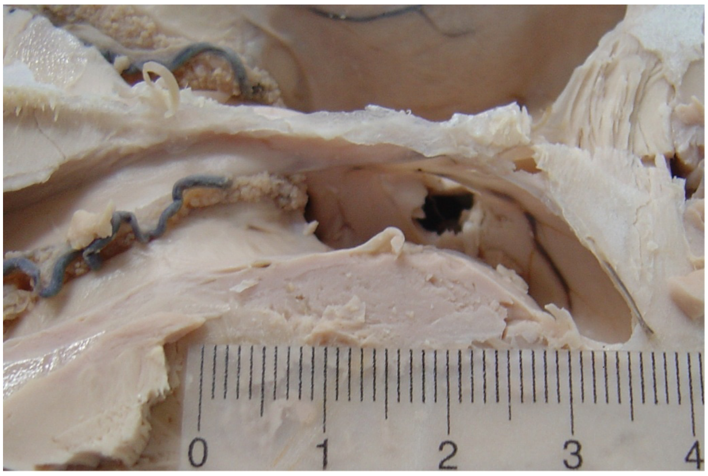

FIGURE 6 - Superior view of an axial section of the brain at the level of the lateral ventricles showing the hole of the transseptumpellucidumrostrostomy.

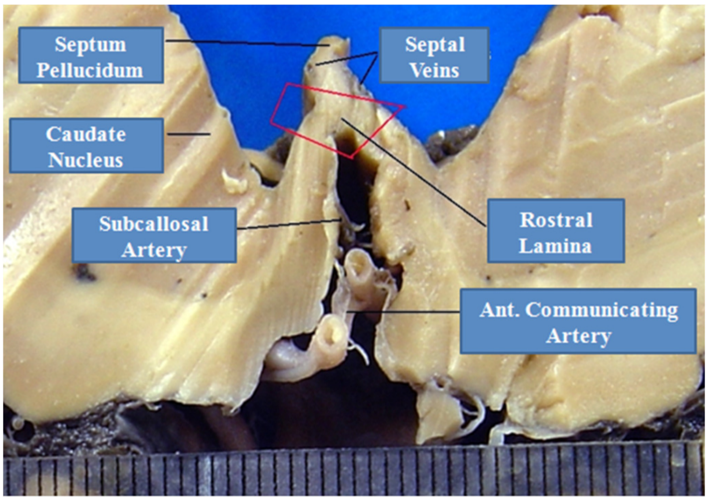

FIGURE 7 - Coronal section of the brain at the ostomy point, showing the anatomical relationship of the rostral lamina (lâmina rostral) with the septum pellucidum (septo pelúcido) and its inclined plane with the caudate nucleus on the frontal horn floor. The polygonal area in red is the site of the transseptumpellucidumrostrostomy.

Discussion

Contemporary surgical treatment of hydrocephalus is based in CSF shunts for extracranial spaces, especially ventricle-peritoneal shunts, or for intracranial spaces through holes communicating the cerebral ventricles to the cisterns of the subarachnoid space. Although used since long time ago, intracranial shunts remained in obscurity until the development of new endoscopy equipment[1,2,3,4]. The neuroendoscopic third ventriculostomy, a fenestration of the floor of the third ventricle, communicating with the interpeduncular cistern, has been used with great frequency for treating obstructive hydrocephalus.

Nevertheless, in some situations it is not feasible due to technical difficulties, and the knowledge of alternatives internal derivations can be important. The search for an alternative route to third ventriculostomy motivated this study.

Considerations on anatomical structures related to the frontal horn and hypothalamic-septal triangle

The rostrum of the corpus callosum in the sagittal view tapering gradually to become a thin layer, called the rostral lamina, which follows toward the column of the fornix, anterior commissure and the upper end of the lamina terminalis[6] (Figure 1). The superior rostral lamina is continuous with the leaflets of the septum pellucidum, and is located at the apex of the angle formed by the intersection of the planes of the septum pellucidum and the floor of the frontal horn. Direct view of the rostral lamina above the floor of the frontal horn with a ventricular endoscope is not possible because it is covered by the septum pellucidum (Figure 2). Below the rostral lamina is the hypothalamic-septal triangle[1] limited by a line joining the anterior surface of the optic chiasm to the posterior portion of the anterior commissure, a line connecting the posterior commissure to the knee joint of the rostrum of the corpus callosum (callosus-comissure line), and, closing the triangle, a line joining the junction of the rostrum with the knee of the corpus callosum to the optic chiasm (Figure 1). In this triangle and in its boundaries are located the optic chiasm, the lateral and medial septal nuclei, the interstitial nucleus of the stria terminalis, the diagonal stripe of the basilar part of the telencephalon (diagonal band of Broca), the accumbens nucleus, the anterior nuclei of hypothalamus, the fibers of the anterior comissure, the fornix columns, portions of the cingulum, the stria terminalis, the stria medullaris of the thalamus, the medial fasciculus of the telencephalon, fibers associated with the medial olfactory stria[6], and the distal part of the A1 segments of the cerebral arteries, and anterior communicating artery and its branches (hypothalamic arteries and subcallosal median artery).

The rostral lamina was identified in the sagittal sections of all the anatomical specimens. However, it was not visible in the axial sections because it is hidden by the insertion of the septum pellucidum and its lower portion terminates in an oblique way, bilaterally, in a small ramp toward the head of the caudate nucleus, forming an angle with this nucleus. Based on the mean proportion and on the positive correlation among the interventricular foramen, fornix column and rostral lamina, a point placed anteriorly to the anterior border of the interventricular foramen, at a distance of approximately twice the diameter of this foramen, was determined, where it was possible to achieve the longitudinal fissure of the brain, through a ostomy (transseptumpellucidumrostrostomy). The initial fenestration was performed with a 2 mm tip forceps, at the base of the septum pellucidum, and it could be reached with an endoscope introduced in the cortex through the Kocher point, the same used in procedures such as third ventriculostomy.

The septal nuclei are located adjacent to the septum pellucidum. In animals, the septal nuclei have medial and lateral components. In humans the lateral septal nucleus may correspond to neurons located near the ventricular surface, while the medial septal nucleus corresponds to those near the septum pellucidum[7]. In addition, these cells are continuous with the medial gray matter on the medial surface of the cerebral hemispheres, the rostral portion of the lamina terminalis**.** It's reported difficulty in identifying the septal nuclei in man, and it's described that the upper part of the septal region from the thin septum pellucidum is devoid of nerve cells and that the bottom of the septum (precommissural septal nucleus) is subdivided into medial and lateral[8]. The medial wall (septum pellucidum), anterior (genu of corpus callosum) and floor (the rostrum of the corpus callosum) of the frontal horn of the lateral ventricle are drained by tributaries of the deep white matter near the frontal pole that will form the septal veins. These veins course along the medial wall and floor of the lateral ventricle to reach the anterior septum pellucidum, in the direction of the interventricular foramen, pass around the fornix, enters the choroidal region and end in the internal cerebral vein[3].

In the anatomic specimens, under direct vision, the lateral limit of the ostomy was at a little distance from the midline due to the slope of the floor of the lateral ventricle at the base of insertion of the septum pellucidum. The anterior limit of the ostomy extended beyond the rostral lamina till the rostrum of the corpus callosum, breaking some of its fibers and its posterior limit was the head of the fornix column. The medial portion of the ostomy performed through the right ventricle reached the left ventricle, passing below the septum pellucidum and it was identified by visualization from the left lateral ventricle. The ostomy was located below the septal vein, anterior to the junction of their tributaries. Through the right ventricle, the subcallosal artery could be identified below, in the foreground and directing the endoscope anterior and inferior, the A2 segments of the anterior left and right cerebral arteries and the left cortical subcallosal area, could be seen. Following with the endoscope inferior and posterior, it was possible to visualize the optic chiasm, but this maneuver required to push the endoscope against the brain parenchyma at the posterior edge of the ostomy. On inspection through the left ventricle, the left anterior cerebral artery and the right subcallosal area were seen. The distances between the rostral lamina and the anterior cerebral arteries, the anterior communicating artery and the supra-optic recess showed the presence of a small polygonal region where it is possible to go forward and work with the endoscope (Figure 8).

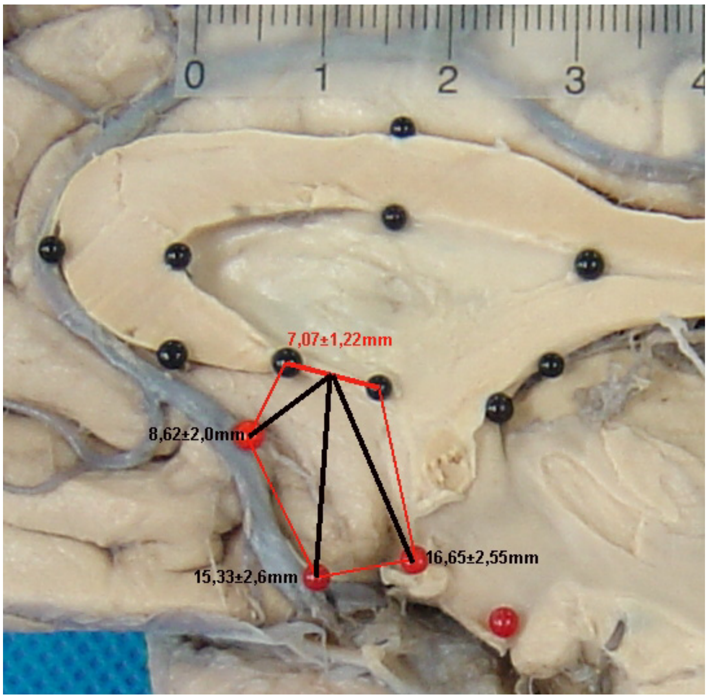

FIGURE 8 - Subcallosal polygonal region (red lines) for access to subcallosal structures: anterior cerebral artery, anterior communicating artery and optical chiasm, with its distances from rostral lamina (black lines).

Functional considerations of the septal region

Experiments in rats showed that these animals prefer to receive electrical stimulation in the septal nuclei than to receive food and water. Because of this, this area was judged to be the "pleasure area" which would also have an important role in the sexual and feeding behaviors. Destruction of septal nuclei in these animals causes the septal syndrome, described as an exacerbation of behavioral responses of most environmental stimuli that occur in the sexual sphere, feeding, and reactions of aggression[3]. Little is known about the function of the septal nuclei in humans. Nevertheless, it has been observed that surgical section of the rostral lamina during surgeries to treat subcallosal aneurysms and ablative surgery to epilepsy (callosotomy or hemispherectomy) or accidental perforation (ventricular catheters) is not associated with clinical signs attributable to specific lesions of this area.

Technical feasibility and functionality of internal derivation

In this study we demonstrate that the communication with the ventricular longitudinal fissure of the brain through transeptumpellucidumrostrostomy is anatomically possible, but some questions need to be answered. Is it effective in the treatment of hydrocephalus? The CSF flow into the longitudinal fissure of the brain would be sufficient to drain a blocked ventricle? The CSF will reach the arachnoid villi in the cranial convexity allowing its absorption?

Review two aspects of the physiology of CSF, where its absorption occurs and how it flows, could help to clarify these issues. Cushing in 1902, noted that there was a communication from the subarachnoid space and the sagittal sinus and that probably there would be a filter or a valve mechanism from the subarachnoid space and venous sinuses[1,9,10]. There is wide acceptance that this passage is performed through the arachnoid villi, but the exact nature of these channels and the mechanism of drainage of CSF into the superior sagittal sinus are not fully clarified[5,6,8,9,11].

More recently, other authors demonstrated that the lymphatic system can play a considerable role in the process of absorption of CSF, perhaps more important than the arachnoid villi[10,12,13,14]. The action of the arachnoidal granulations as the main route for absorption of CSF is strongly questioned by Greitz[13] as well as the classic model of flow of CSF down to the posterior spinal cord and ascending to the anterior region was thus questioned because it not explain the rapid distribution of the radionuclide injected in the subarachnoid space and its large accumulation in the lumbar region. A model for pulsatile flow of CSF would better explain these facts and the accumulation of radionuclides in the convexity, as well as its bleaching in the region in the basal cisterns and the cerebral parenchyma[13]. Criticisms of arachnoid granulations of absorptive functions are: the development of granulation does not occur until the closing of the fontanel in children, no valve mechanism was demonstrated in the granules; labeled albumin is presented in venous blood after its injection in the lumbar CSF, before being detected in the convexity, and the presence of radioisotope late in the convexity and in the lumbar region, indicating areas with limited exchange of CSF[13]. Greitz said that the CSF is absorbed by the brain capillaries and it is transported through the subarachnoid space by vascular pulsation[13].

Based on the fact that the CSF production occurs throughout the nervous system, mainly by the choroid plexus, and its absorption occurs through the brain capillaries, Greitz proposed a hydrodynamic theory for the transport and absorption of CSF and its participation in the formation of hydrocephalus: the arterial pulsations have significant involvement in the flow of CSF, which occurs in a pulsatile manner and not in the flowing stream, right from the time that the CSF exits the ventricular system and travels through the subarachnoid space where it is absorbed by capillaries in the brain[13]. The role of arterial pulse in the flow of CSF is related to the compliance of the CSF compartment and the determination of intracranial pressure. This model is based on three assumptions: 1) under physiological conditions the arterial pulse is converted to non-pulsatile venous flow per share of arterial compliance, 2) the dynamic movement of CSF through the foramen magnum is the primary facilitator of the occurrence of intracranial arterial expansion and, 3) the hydrostatic pressure depends on the tissue hydrostatic pressure and capillary pressure gradient oncotic / osmotic created by the blood-brain barrier[15]. Under physiological conditions, based on the doctrine of Monro-Kelly, the expansion systolic blood expelled by the foramen magnum CSF and venous blood to the venous sinuses, compressing the veins producing bridges and venous flow. The compression increases venous pressure and retrograde venous dilates the capillaries during the cardiac cycle. At the same time, the arterial pulse wave dilates the arterial side of capillaries by the effect "Windkessel" (ability to release, in the diastolic phase, the elastic expansion absorbed by the artery in the systolic phase), and transforms the pulsating blood flow in capillary flow continuously. The expansion pressure is essential for "Windkessel" and depends on the intracranial compliance, which is directly related to compliance of the dural and veins grafts[13]. The decreased compliance increases CSF pressure, but not enough to increase the pressure gradient for blood, necessary for the absorption of CSF. The pressure difference associated with decreased cerebral flow and increased capillary vascular resistance are the responsible factors for poor absorption of CSF[13].

The improvement in treatments such as third ventriculostomy or insertion of a ventriculoperitoneal shunt for hydrocephalus in situations with restricted intracranial compliance occurs not only by increased absorption of CSF, but also by increase of the intracranial compliance. This dilates the compressed vessels and increases the intracranial compliance and dilated capillaries, facilitating increased of blood flow and absorption of CSF. Similarly, the shunt restores venous compliance because the diversion of CSF causes a forced dilation of blood vessels enabling tablets[13]. Thus a communication with the interhemispheric fissure by transseptumpellucidumrostrostomy would also increase intracranial compliance in a manner similar to third ventriculostomy, allowing the output of the CSF of the lateral ventricle, by compression resulting from the expansion of the brain parenchyma and goes through the subarachnoid space due to pulsatile flow followed by subsequent absorption through the capillaries of the brain. Theoretically, this communication can work well, however, its practical feasibility should be tested in patients.

Conclusions

The rostral lamina is a constant structure in human brains and can be used as a site for an ostomy to communicate the lateral ventricle with longitudinal fissure of the brain. Using an endoscope, it can be located anterior to the fornix column using as a reference a point placed anteriorly to the limit of the interventricular foramen and the fornix column, at a distance equal to twice the anterior-posterior diameter of the interventricular foramen, at the intersection of the lower portion of the septum pellucidum and the floor of the frontal horn. The study of the major anatomical landmarks related to the longitudinal fissure of the brain and the rostral lamina showed that perforation of the rostral lamina in this location is safe, because there is a cistern in the subcallosal region of the longitudinal fissure of the brain, practically devoid of anatomical structures.

References

1. Li KW, Nelson C, Suk I, Jallo GI. Neuroendoscopy: past, present and future. Neurosurg Focus. 2005;19:E1.
2. Andaluz N, Zucarello M. Fenestration of the lamina terminalis as a valuable adjunt in aneurysms surgery. Neurosurg. 2004;55:1050-9.
3. Sindou M. Favorable influence of opening the lamina terminalis and lilliequist's membrane on the outcome of ruptured intracranial aneurysms: a study of 197 consecutive cases**.** Acta Neurochir. 1994;127:15-6.
4. Daniel RT, Lee GYF, Reilley PL. Suprapineal recess: an alternative site for third ventriculostomy? J Neurosurg. 2004;101:518-20.
5. Go GK, houthoff H, Hartsuiker J, Blaauw EH, Havinga P. Fluid secretion in arachnoid cysts as a clue to cerebrospinal fluid absorption at arachnoid granulation. J Neurosurg. 1986;65:642-8.
6. Fox RJ, Walji AH, Mielke B, Petruk KC, Aronyk KE. Anatomic details of intradural channels in the parasagittal dura: a possible pathway for flow of cerebrospinal fluid. Neurosurgery. 1996;39:84-91.
7. Walter BA, Valera VA, Takahashi S, Ushiki T. The olfactory route for cerebrospinal fluid drainage into the peripheral lymphatic system. Neuropathol Appl Neurobiol. 2006;32:388-96.
8. Conegero CI, Chopard RP. Tridimensional architecture of the collagen element in the arachnoid granulations in humans. Arq Neuropsiquiatr. 2003;61:561-5.
9. Davson H, Domer FR, Hollingsworth JR. The mechanism of drainage of cerebrospinal fluid. Brain. 1973;96:329-36.
10. Johnston M, Zakharov A, Koh L, Armstrong D. Subarachnoid injection of Microfil reveals connections between cerebrospinal fluid and nasal lymphatics in the non-human primate. Neuropathol Apple Neurobiol. 2005;31:632.
11. Bergsneider M, Egnor MR, Johnston M, Kranz D, Madsen JR, Mcallister II JP, Stewart C, Walker ML, Williams MA. What we don't (but should) know about hydrocephalus. J Neurosurg. 2006;104:157-9.
12. Boulton M, Armstrong D, Flessner M, Hay J, Szalai JP, Johnston M. Raised intracranial pressure increases CSF drainage through arachnoid villi and extracranial lymphatics. Am J Physiol Regul Integr Comp Physiol. 1998;275:889-96.
13. Greitz D. Radiological assessment of hydrocephalus: new theories and implications for therapy. Neurosurg Rev. 2004;27:145-65.
14. Mollanji R, Bozanovic-Sosic R, Zakharov A, Makarian L, Johnston MG. Blocking cerebrospinal fluid absorption through the cribriform plate increases resting intracranial pressure. Am J Physiol Regul Integr Comp Physiol. 2002;282:1593-9.
15. Bergsneider M, Alwan AA, Falkson L, Rubinstein EH. The relationship of pulsatile cerebrospinal fluid flow to cerebral flow and intracranial pressure: a new theoretical model. Acta Neurochir Suppl. 1998;71:266-8.

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