Original article

Neuroanatomical correlation between choroid plexus mass in the choroidal fissure and the interventricular foramen area

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Abstract

Introduction: Our aim was to evaluate the correlation between choroid plexus mass (g) in the choroidal fissure and the ipsilateral interventricular foramen area, bilaterally. Material and methods: We analyzed seven cadaveric specimens with exposed brain, reaching the transcallosum access in all specimens, dissecting the corpus callosum to reach the left and right choroidal fissure. After identifying the thalamostriate and septal veins, we localized the interventricular foramen scrapping all the choroid plexus in that region as well as its posterior extension allowing us to completely visualize the III ventricle. The area of the interventricular foramen was calculated with a pachimeter using the formula πR^2. The choroid plexus mass was measured with an appropriate scale. The choroid plexus mass and ipsilateral interventricular foramen correlation was evaluated by the Pearson correlation. Results and conclusion: Neither difference between right and left choroid plexus mass was observed (Student *t* test – $p = 0.374$) nor with interventricular foramen area ($p = 0.345$) and we decided to evaluate the 14 results together. There was correlation between choroid plexus mass and its respective IF ($r = 0.6863$; $p < 0.01$). A better knowledge of the choroidal fissure is very important to a more precise approach to the pathologic processes that affect the III ventricle. Different from the transforaminal, interforniceal, subchoroidal, and subforniceal, the choroidal fissure access is a natural approach. We speculate that undetermined etiology hydrocephaly may have its origins in a deficit of ventricular drainage or in the choroid plexus excess.

Keywords: neuroanatomy, choroidal fissure, lateral ventricles, III ventricle, neurosurgery.

1 Introduction

The choroidal fissure (CF) is a natural fissure that links the fornix taenia to the choroid taenia, in this way putting together the thalamus and the fornix. The CF is easily identified if we look at the pathway of the choroid plexus (stuck to the thalamus and to the fornix through the ependima) from the temporal horn of the lateral ventricle to the interventricular foramen (WEN, RHOTON Jr, and DE OLIVEIRA, 1998; MARINKOVIC, GIBO, MILISAVLJEVIC et al., 2005). The CF is divided in body, atrium, and temporal portion and there is no extension of the CF, even that of the choroid plexus, to the frontal horn of the lateral ventricle (WEN, RHOTON Jr and DE OLIVEIRA, 1998; REKATE, SPETZLER, ROSENFELD et al., 2005; ROWE, 2005). The atrial portion of the CF is located in the atrium of the lateral ventricle (body), between the crus of the fornix and the pulvinar of the thalamus. On the other hand, the temporal portion of the CF is located between the fornix fimbria and the inferolateral portion of the thalamus (WEN, RHOTON Jr and DE OLIVEIRA, 1998; RHOTON Jr, 2002a, b; ONO, ONO and RHOTON Jr, 1984; WEN, RHOTON Jr, DE OLIVEIRA et al., 1999). In the body of the lateral ventricle, the choroid plexus (CP) is located medially, stuck to the floor of the ventricle. The CP in the body of the lateral ventricle is medially fixed to the fornix and, laterally, to the thalamus. (WEN, RHOTON Jr and DE OLIVEIRA, 1998; MARINKOVIC, GIBO, MILISAVLJEVIC et al., 2005; IKEDA, SHOIN, MOHRI et al., 2002; RHOTON Jr, 2002a, b). The CP is the structure responsible for the liquor production (CSF). Histologically, the CP is a villous structure with stroma (leptomeningeal cells, conjunctive tissue, and blood vessels) covered by ependima-originated epithelium. (WEN, RHOTON Jr and DE OLIVEIRA, 1998; RHOTON Jr, YAMAMOTO and PEACE, 1981; NAGATA, RHOTON Jr and BARRY, 1988). All the four brain ventricles have CP responsible for the production of CSF. The lateral ventricle has a C-shaped CP (Figure 1), covering the CF, as well as the trigone and part of the temporal horn of the lateral ventricle. (MARINKOVIC, GIBO, MILISAVLJEVIC et al., 2005; RHOTON Jr, YAMAMOTO and PEACE, 1981; NAGATA, RHOTON Jr and BARRY, 1988). The thalamostriate vein goes, anteriorly, on the thalamostriatum sulcus, between the body of the caudate nucleus and the thalamus, in a subependimal location; behind the interventricular foramen, this thalamostriate vein goes into the choroid fissure, under the choroid taenia. The anterior septal vein, medially to the interventricular foramen (IF) goes at a very close distance to the septum pellucidum. (MARINKOVIC, GIBO and MILISAVLJEVIC et al., 2005; RHOTON Jr, 2002a, b; ONO, ONO and RHOTON Jr, 1984; IKEDA, SHOIN, MOHRI et al., 2002).

The CSF production is continuous and there is a total renovation of all CSF every 8 hours (MARINKOVIC, GIBO, MILISAVLJEVIC et al., 2005; IKEDA, SHOIN, MOHRI et al., 2002; RHOTON Jr, 2002a, b). The drainage of the CSF through the lateral ventricle occurs through the interventricular foramen (Monro`s foramen), reaching the III ventricle and going to the midbrain´s aqueduct to the IV ventricle, in front of the cerebellum. (WEN, RHOTON Jr and DE OLIVEIRA, 1998). Once in the IV ventricle, the CSF is drained by the lateral (Luchka) and medial (Magendie) foramens to the subdural space. In this space, a good amount of the CSF reaches the upper sagital sinus through the arachnoid granulations (Pachioni), made up of arachnoid tufts. (WEN, RHOTON and DE OLIVEIRA, 1998; REKATE, SPETZLER, ROSENFELD et al., 2005; RHOTON Jr, 2002a, b). Our aim was to check whether there is a correlation between the CP mass (g) in the choroidal fissure and the ipsilateral area of the IF, bilaterally.

2 Material and methods

We studied seven cadaveric specimens, with the brain exposed, avoiding the procedure of craniotomy. We took the transcallosum route (Figure 2a), excising the leptomeninge (Figure 2b) still present in all the specimens, dissecting the upper-lateral portion of the corpus callosum to get access to the right and left CF (Figures 3a, b).

After the identification of the thalamostriate and septal veins, we localized the IF starting the scrapping of all CP in that region, as well as its extension in the posterior way

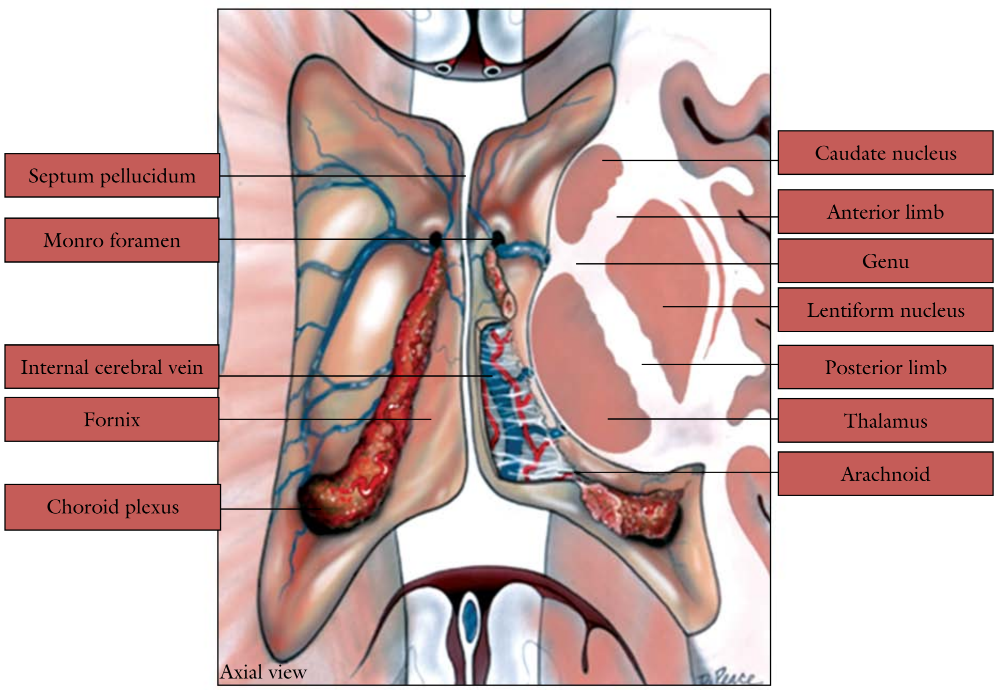

Figure 1. Scheme showing the region of the choroidal fissure. Modified from Rhoton Jr (2002a).

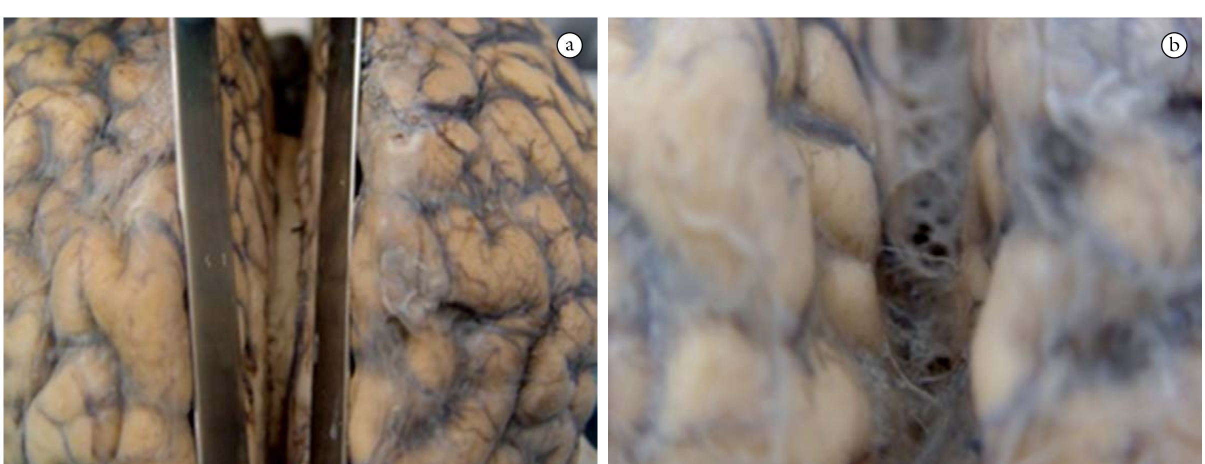

Figure 2. a) Transcallosum access to choroidal fissure. b) Presence of leptomeninge in the way to the CF.

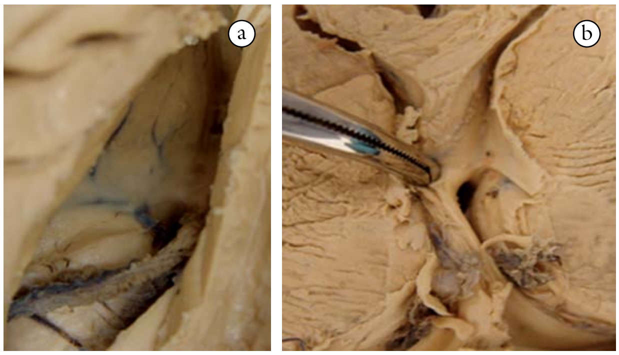

Figure 3. a) Transcallosum access to the choroidal fissure. We can see the interventricular foramen and the choroid plexus of the choroidal fissure. b) In axial section, we can see the frontal horns of the lateral ventricles and the exposition of the right interventricular foramen (the tweezer is traccioning the fornix).

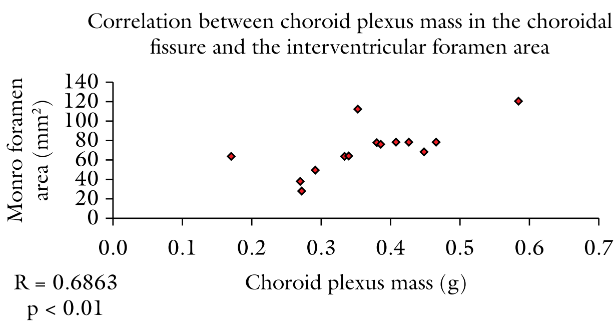

Figure 4. Neuroanatomical relationship between the area of the IF and the mass (g) of the choroid plexus. We show a positive and significant relation with $r = 0.6863$, $p < 0.01$.

(covering all the CF) up to the complete visualization of the III ventricle (Figure 3). With a pachimeter, we calculated the area of the IF, obtaining the diameter of the foramen, aplying the formula πR^2. Using an appropriate scale, we weighted all the scrapped CP, in all its extension, from the CF to the temporal horn of the lateral ventricle. We verified that there exist a statistical correlation (Pearson Correlation) between the weight of the scrapped CP with the area of the ipsilateral IF.

3 Results

There was no difference between the weight of the right and the left CP (Student *t* test, $p = 0.345$) neither with the area of the IF (Student *t* test, $p = 0.345$). So, we decided to analyze the 14 results in only one group. There was a statistically significant correlation between the weight of the CP and its respective IF (Pearson correlation, $r = 0.6863$, $p < 0.01$) (Figure 4).

4 Conclusion

The adequate knowledge of the CF is fundamentally important for a more precise approach of the pathological processes that occur in the III ventricle. Differently of the transforaminal, interforniceal, subchoroidal, and subforniceal approaches, the CF access is a natural way of reaching this region. (WEN, RHOTON Jr, DE OLIVEIRA et al., 1999; REKATE, SPETZLER, ROSENFELD et al., 2005; ROWE, 2005; RHOTON Jr, 2002a, b; NAGATA, RHOTON Jr and BARRY, 1988). The importance of the correlation between the mass of the choroid plexus and the area of the interventricular foramen shows that the CSF drainage can be deficient in those cases of undetermined etiology hydrocephaly. On the other hand, hyperproduction of CSF may occur in these cases. Either due to the excessive CSF production or to defective drainage, an increased intracranial pressure may take place (RAMMLING, MADAN, PAUL et al., 2008; CHENG, JACOBSON and BILSTON, 2007; SCHUHMANN, SOOD, MCALLISTER et al., 2008).

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