

Endoscopic anatomy of the velum interpositum: A sequential descriptive anatomical study

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ABSTRACT

Background: The velum interpositum and structures lying within and over it undergo morbid anatomical changes with hydrocephalus that have not been mentioned in the literature.

Objectives: The aim of this article is to describe the diverse endoscopic anatomical findings for this surgically important region.

Materials and Methods: One thousand five hundred and twenty cranial endoscopic procedures performed from September 1993 till March 2011 have been retrospectively reviewed. Anatomical changes in the velum interpositum and covering layers have been reported in 40 cases.

Results: The changes of the velum interpositum have four patterns. These are 1-Distracted mounting to disruption of layers, 2-Reverse in the normal curvature, 3-Reverse of the triangular shape with change in size, and 4-Cystic dilatation causing hydrocephalus.

Conclusion: The velum interpositum and roof of the third ventricle are sites of changes associated with hydrocephalus that show specific patterns described in a sequential anatomical study.

Key words: Endoscopic, interpositum, velum

Introduction

The velum interpositum is a triangular space between the two layers of the tela choroidea in the roof of the third ventricle. The upper layer of the tela choroidea is attached to the lower surface of the fornix and hippocampal commissure. The lower layer is attached anteriorly to stria medullaris thalami and posteriorly to the superior surface of the pineal body.^[1]

The velum interpositum is usually a closed space that tapers to a narrow apex just behind the foramen of Monro. It may have opening that communicates with the quadrigeminal cistern to form the velum interpositum cistern. There may

also be a space above the velum interpositum between the hippocampal commissure and splenium called the cavum vergae. The internal cerebral veins and their tributaries and medial posterior choroidal arteries are found within the velum interpositum.^[1]

Surgery in the third/lateral ventricle essentially requires good anatomical background for the velum interpositum and related structures. Lesions reported to arise within the velum interpositum which includes: Arachnoid cyst, pilocytic astrocytoma, meningioma, atypical teratoid tumors, epidermoid cyst, colloid cyst, and arteriovenous malformations.^[2-8]

Moreover, the velum interpositum and structures lying within and over it undergo morbid anatomical changes with hydrocephalus that have not been mentioned in the literature. The aim of this article is to describe the diverse endoscopic anatomical findings for this surgically important region.

Materials and Methods

One thousand five hundred and twenty cranial endoscopic procedures performed from September 1993 till March 2010 have been retrospectively reviewed. Anatomical

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changes in the velum interpositum and covering layers have been reported in 40 cases. We classified these changes of the velum interpositum into four categories as follows; 1-Distracted mounting to disruption of layers, 2-Reverse in the normal curvature, 3-Reverse of the triangular shape with change in size, and 4-Cystic dilatation causing hydrocephalus.

Results

The changes of the velum interpositum have four patterns (Figures 1-4): These are 1-Distracted mounting to disruption of layers, 2-Reverse in the normal curvature, 3-Reverse of the triangular shape with change in size, and 4-Cystic dilatation causing hydrocephalus

Discussion

Despite many years of anatomical research, there are still some structures which remain incompletely or inadequately described. One such structure is the velum interpositum.^[9]

The velum interpositum is the space between the two layers of tela choroidea in the roof of the third ventricle. This roof has four layers: One neural layer formed by the fornix, two thin membranous layers formed by tela choroidea, and a layer of blood vessels between the sheets of the tela choroidea.

Despite the advances in neuroendoscopy in the past decades, little information about the description of the velum interpositum is available, mostly related to velum interpositum cysts.^[10,11]

The velum interpositum is a site for anatomical changes in hydrocephalus. Distension and dilatation of the third/lateral ventricle would affect the layers in the roof of the third ventricle including the velum interpositum. We found that these changes have specific descriptive patterns.

Distension of the lateral and third ventricle in hydrocephalus causes disruption of the layers in the roof of the third

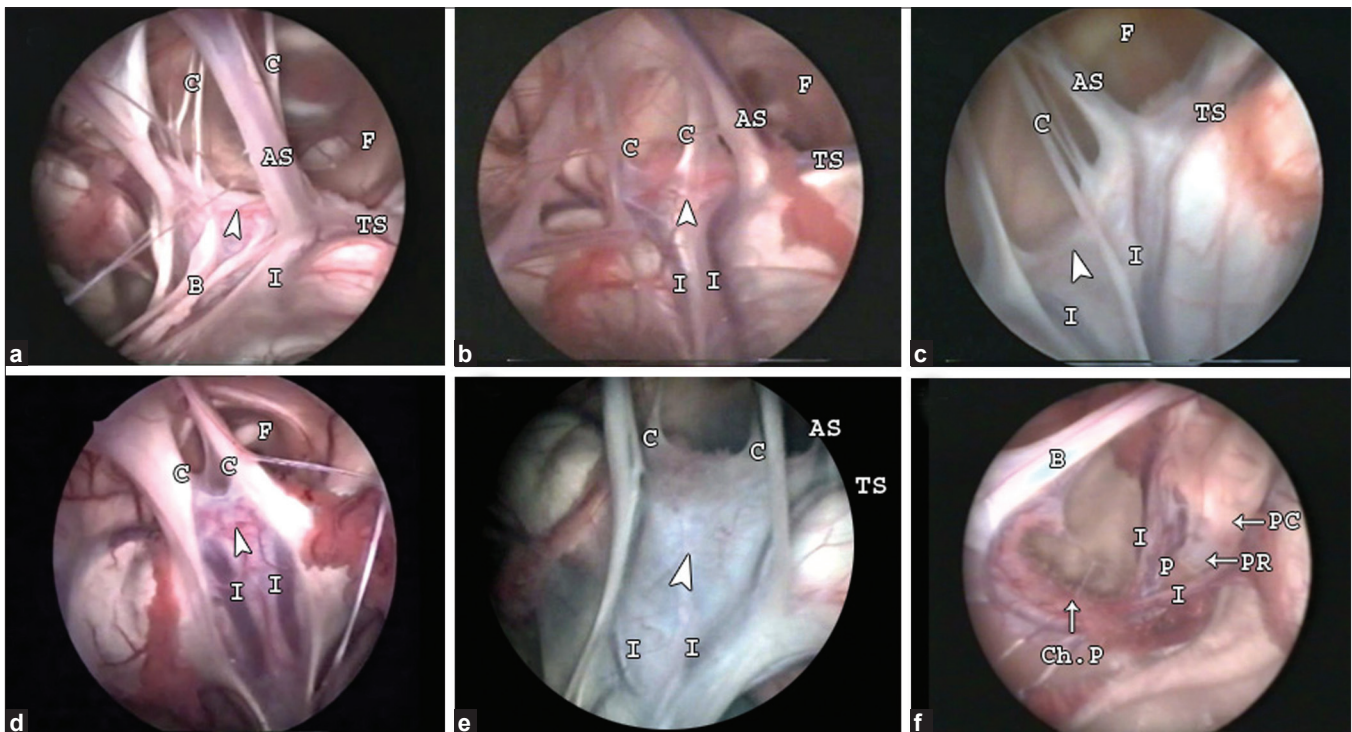


Figure 1: Shows variable degrees of distraction mounting to disruption of the layers forming the roof of the third ventricle. **(a)** Widely disrupted septum pellucidum. The anterior septal vein (AS) is running on a remaining small sheet of the septum pellucidum. The body of the fornix is seen in between the remaining lower leaflets of the septum pellucidum covering the right internal cerebral vein (I). The stretched columns of the fornices (C) form the boundaries of both Monro's Foramina (F). The tela choroidea of the third ventricle is seen at the junction between the columns and the body of the fornix (arrow head). **(b)** With more distraction and disruption both internal cerebral veins (I) can be seen within the tela choroidea (arrow head). **(c)** There is display of the columns (C) extending posteriorly to separate the body of the fornix. **(d)** The columns of fornix (C) extend posterior as widely separated body(ies) instead of fusing in midline into one single body. Both internal cerebral veins (I) are well seen within the tela choroidea (arrow head). The latter's uppermost part shows the choroid plexus of the third ventricle continuous with that of the lateral ventricle. **(e)** The tela choroidea of the third ventricle is seen as wide sheet containing both internal cerebral veins (I). Its most anterior part shows the choroids plexus of the third ventricle. **(f)** Complete disruption of the roof of the third ventricle has occurred. The structures within the posterior third ventricle are revealed. It is only the body of the fornix that forms the upper limit. Both internal cerebral veins are freely hanging down within the cavity of the third ventricle forming a postero-inferior curve veiled by the remaining choroids plexus (Ch.P). The posterior commissure (PC), pineal recess (PR) and pineal gland (P) are clearly seen

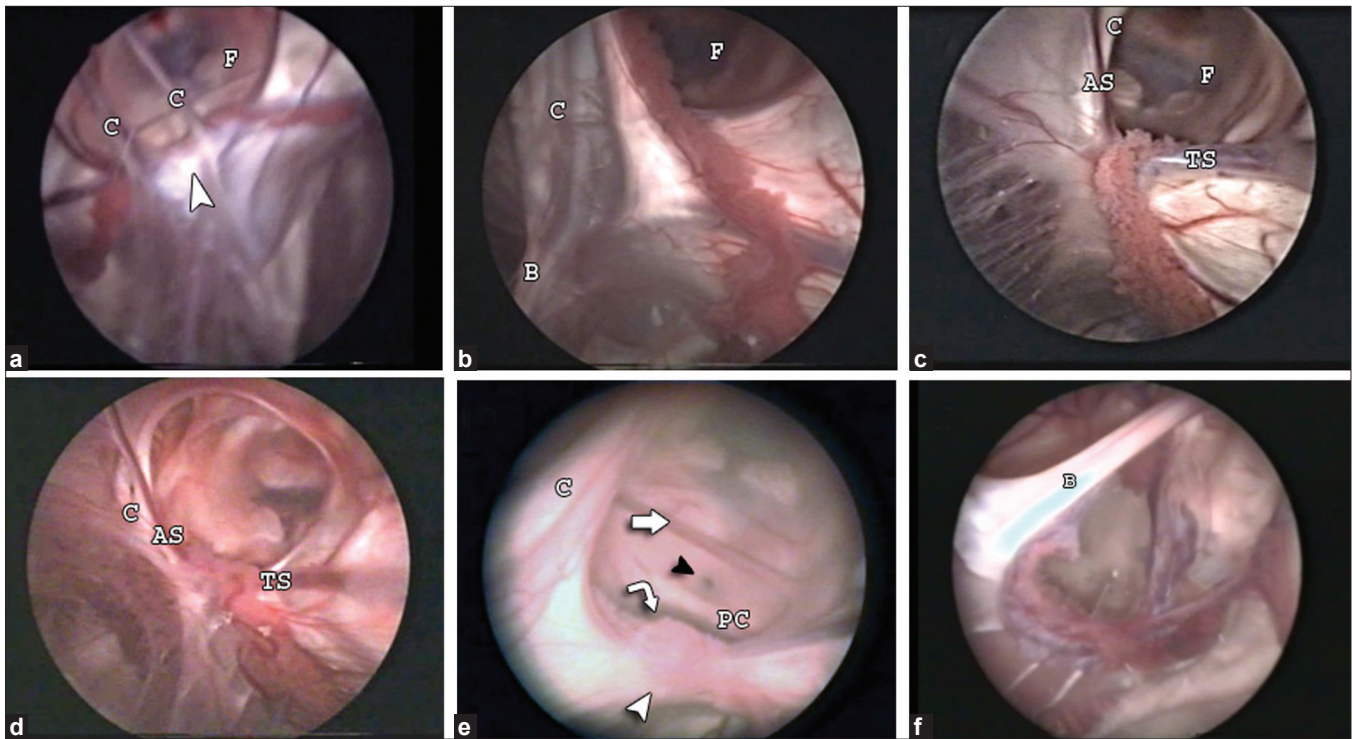


Figure 2: Shows the variant degrees of reversal of the gentle up/forward curve of the velum interpositum. (a) There is more upward bulging of the velum interpositum (b) Up/backward bulging and angulation occurs. (c) With further distension of the foramen and ballooning of the third ventricle more backward bowing is noted. (d) The roof of the third ventricle is almost vertically oriented. (e) Marked stretch of the foramina and third ventricle, resulted in reversal of the curve backwards (white arrow head). This revealed the structures of the posterior third ventricle like the cerebral aqueduct (black arrow head) and the stretched thinned out massa intermedia (straight white arrow). The posterior commissure (PC) is stretched and well demarcated by an anterior slope made by the aqueduct and a posterior slope made by the pineal recess (curved white arrow). (f) A complete reverse of the curvature with associated disruption of the layers of the third ventricle roof as described before in Figure 1f

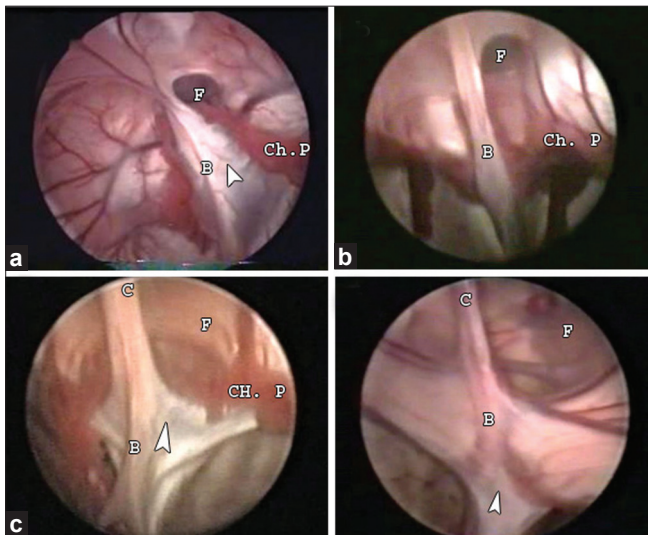


Figure 3: Shows reversal of the triangular shape of the velum interpositum. (a) Absent posterior septum pellucidum revealing normal triangular shape of the velum interpositum with the apex at the foramen of Monro and wide base posteriorly. (b) Reversal of the normal triangle with wide base at Monro's foramina and narrow posterior apex. (c) Marked dilatation of the foramen of Monro with a wide base anteriorly that tapers to a narrow posterior apex. (d) Even further dilatation of the foramen of Monro with a narrow posterior apex of the velum interpositum and an additional reduction of its size

ventricle from above downward ending in velum interpositum disruption. This pattern of changes is described in [Figure 1a]. The disruption of the septum pellucidum leaflets reveals the structures underneath. The display of the columns and the separation of the fused bodies of the fornix are also a result of distractive force. In [Figure 1b-d], the tela choroidea and internal cerebral veins can be well seen. More distraction may widen the tela choroidea sheets [Figure 1e] which we consider a step that precedes tela choroidea disruption. In one patient with marked triventricular hydrocephalus, we found a complete disruption of the third ventricular roof including the velum interpositum [Figure 1f]. A freely viewable all third ventricle structures from anterior to posterior can then be seen clearly.

The roof of the third ventricle extends from the foramen of Monro anteriorly to the suprapineal recess posteriorly forming gentle upward arch.^[1] Another change pattern found in this study is the reversal of the gentle up/forward curve of the velum interpositum. Distension of the lateral and third ventricle causes more upward bulging of the velum interpositum. With marked ballooning of the third ventricle and widening of the foramina of Monro, more backward bulging occurs that further progresses to complete reversal of the curve to become up/backward [Figure 2a-f].

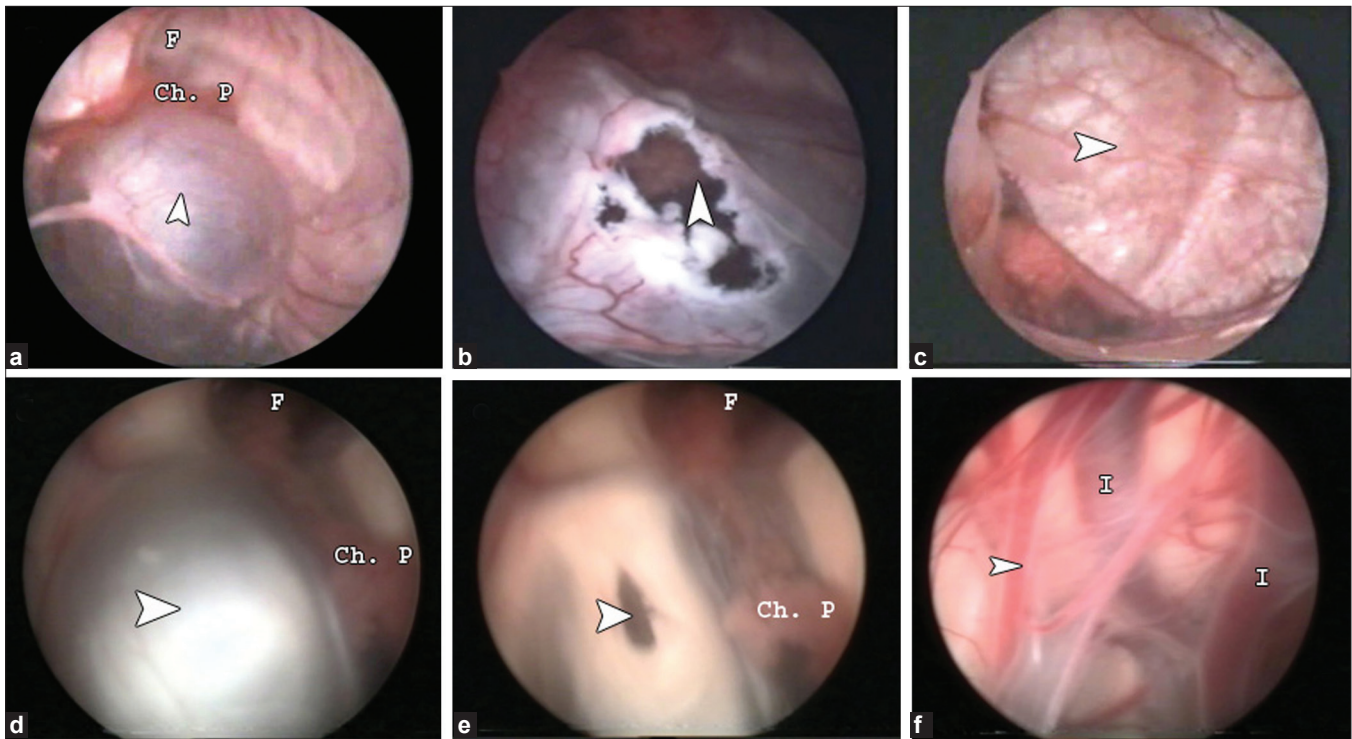


Figure 4: Shows velum interpositum cysts. **(a)** View through the right lateral ventricle showing velum interpositum cyst (arrow head) pushing up the choroid plexus. **(b)** The same lesion after wide fenestration (arrow head). **(c)** A view of the previous lesion - from interior - showing thick arachnoid cyst membrane (arrow head). **(d)** View through the right lateral ventricle showing velum interpositum cyst (arrow head) pushing the choroid plexus laterally. **(e)** Collapse of the previously shown lesion after fenestration. **(f)** Endoscopic view of the previous lesion - from interior - showing both right and left internal cerebral veins (I) and branches of the medial posterior choroidal artery (arrow head) covered by thin layer of arachnoid

In review of our cases, we couldn't find a marked symmetrical stretch of the third ventricular roof. Instead, the roof either undergoes disruption as described before or gets smaller in size with reversal of its triangular shape. Normally the velum interpositum tapers to a narrow apex just behind the foramen of Monro.^[1] This is shown in [Figure 3a]. Dilatation of the third ventricle and widening of the foramina of Monro change this apex. The triangular shape is reversed to wide base at the foramen of Monro tapering to narrow posterior apex. This is frequently associated with reduction of the velum interpositum size [Figure 3b-d].

The velum interpositum is usually a closed space, but it may have an opening situated between the splenium and pineal body that communicates with the quadrigeminal cistern to form the velum interpositum cistern.^[1]

Endoscopic fenestration of symptomatic velum interpositum cysts has been scantily described in the literature.^[10,11] We report five cases of cystic dilatation of the velum interpositum, all obstructing the posterior third ventricle, causing hydrocephalus. One case had arachnoid cyst, the other four cases had cystic cavum velum interpositum, all treated by endoscopic fenestration into the lateral ventricle (ventriculocystostomy), and one with additional cisternostomy into the quadrigeminal cistern. A property of

the cystic dilatation of the cavum velum interpositum is the identification of the vascular structures (internal cerebral veins and medial posterior choroidal arteries) which are seen uncovered by any of the tela choroidea layers. In this case, these vascular structures are only covered by faint arachnoid trabeculae [Figure 4f]. Endoscopic fenestration into nearby lateral ventricle successfully controlled both the cyst and associated hydrocephalus.

Conclusion

The velum interpositum is a site for anatomical changes associated with hydrocephalus. These changes have specific patterns proven in this sequential descriptive anatomical study. They were classified into four categories as follows; 1-Distracted mounting to disruption of layers, 2-Reverse in the normal curvature, 3-Reverse of the triangular shape with change in size, and 4-Cystic dilatation by itself causing hydrocephalus.

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