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ORIGINAL PAPER

Cavum velum interpositum, cavum septum pellucidum, and cavum vergae: a review

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Abstract
Introduction Anterior midline intracranial cysts may be found most often in three forms: cavum septum pellucidum, cavum vergae, and cavum velum interpositum. A single offering that reviews these entities is difficult to find in the extant literature. Therefore, the present review was performed.
Materials and methods Various search engines and germane texts were reviewed for the terms cavum septum pellucidum, cavum vergae, and cavum velum interpositum.
Results We report the findings of our search of the literature regarding these midline cystic structures.
Conclusions A better understanding of the associated anatomy, embryology, and pathology of these cysts will assist the clinician who treats such patients.

Keywords Cysts · Congenital · Midline · Septum pellucidum

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Introduction

For the past century, there have been many descriptions, categorizations, and definitions of cystic midline brain malformations. After magnetic resonance imaging (MRI) was introduced, the diagnosis of these midline cysts increased. Even though this technology has made diagnosing these midline cysts easier, there is still much confusion as to their terminology, classification, and spectrum of expression. To better understand these structures, this paper will provide an explanation and description of the various occurrences of congenital midline cysts.

Neurological cysts can be classified as follows: benign neoplastic such as dermoid and epidermoid cysts, colloid cysts, and craniopharyngiomas. Malignant neoplastic cysts are cystic tumors of glial origin including different grades of astrocytoma including glioblastomas, as well as oligodendrogliomas. Non-neoplastic cysts include arachnoid cysts, Rathke's cleft cyst, posterior fossa cysts, including Dandy Walker and cisterna magna, and congenital intra-axial midline cysts.

Midline cysts occur in the interhemispheric region of the brain and have a circular or elliptical shape. Anterior midline intracranial cysts may be found most often in three forms: cavum septum pellicidum, cavum vergae, and cavum velum interpositum. Even though most of these fluid collections are benign, there can be pathologic effects in some patients depending on the size of the cavities [11, 26, 28]. This paper will focus on the radiology, embryology, anatomy, pathology, and treatment of these three conditions.

Cavum velum interpositum

The velum interpositum space is the subarachnoid space between the connected fornix and its respective choroid plexus, and the choroid forming the roof of the third

Fig. 1 Axial MRI noting a cavum velum interpositum

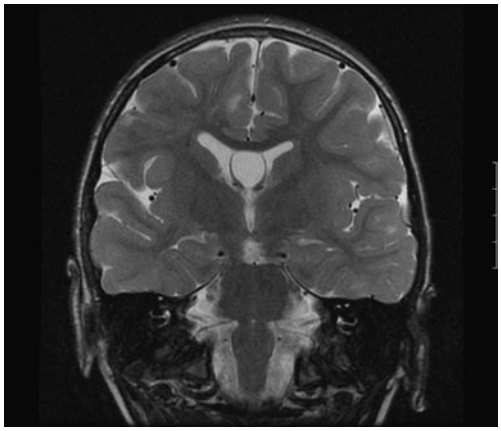

Fig. 3 Axial MRI noting a cavum septum pellucidum

ventricle inferiorly. It is an anterior extension of the quadrigeminal plate cistern located superior to the pineal gland. If this potential space is dilated, then it is known as the cavum velum interpositum (Fig. 1). The differential diagnosis of these midline cystic brain lesions includes an enlarged third ventricle, a vein of Galen aneurysm, an interhemispheric cyst in relation to the agenesis of the corpus callosum, and a suprasellar arachnoid cyst [5, 27].

Most cases of cavum velum interpositum occur in newborns [5]. A typical axial MRI or CT scan will display a triangular-shaped CSF space between the lateral ventricles. On sagittal images, a cavum velum interpositum appears like a slit with collections of CSF behind the foramen of Monro, below the fornices, and above the tela choroidea of the third ventricle. Some MRI images show that the subarachnoid spaces of the whole brain are not dilated [15].

During the early fetal stages, a continuous layer of pia mater encloses the prosencephalon and diencephalon. As the brain slowly develops, the growing and covered cerebral vesicles of the forebrain overlap the pia mater of the third ventricle. This causes double layering of the tela choroidea or velum interpositum, of the roof of the third ventricle. The anterior aspect of the tela choroidea is closed and is at the foramen of Monro where the pia mater folds on itself. When the posterior end remains open, the formation of the cavum velum interpositum occurs. The potential space between the double layers of the tela choroidea creates the cavum velum interpositum that interacts with the quadrigeminal cistern. The internal cerebral veins are situated between the two layers of the cavum velum interpositum as is the posterior medial choroidal artery [10]. On axial imaging, the cavum velum interpositum has a distinct triangular appearance with an apex directed anteriorly toward the forniceal columns (Fig. 1). An enlarged cavum velum interpositum displaces the internal cerebral veins inferiorly and laterally.

Although many approaches to treatment have been used for certain midline cysts, many case reports have used a

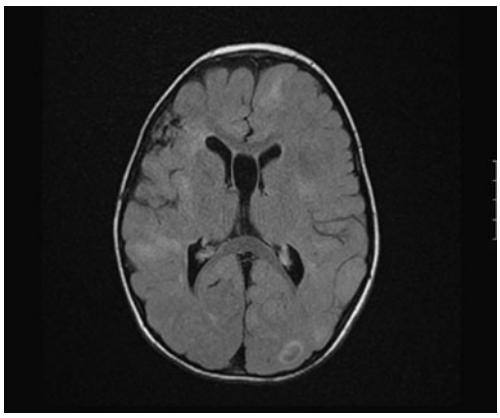

Fig. 2 Coronal MRI demonstrating a cavum septum pellucidum

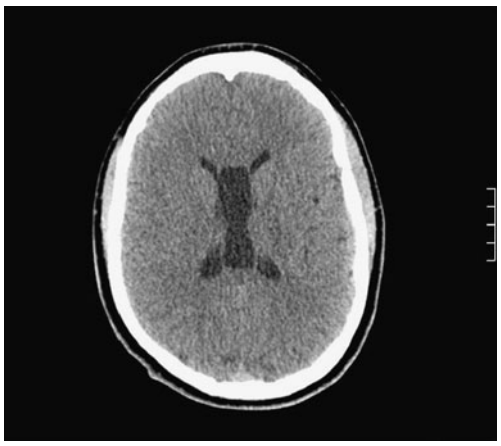

Fig. 4 Axial MRI noting a cavum septum pellucidum and cavum vergae

minimally invasive endoscopic fenestration technique for treating specifically cavum velum interpositum cysts [3, 8, 9]. Surgical fenestration is the preferred treatment of these cysts [8].

Cavum septum pellucidum

When a septum pellucidum has a separation between its two leaflets this is termed a cavum septum pellucidum (Figs. 2 and 3). This cavity is sagittally oriented and has a concentration of CSF that filters from the ventricles through the septal laminae [18]. Cavum septum pellucidum is bounded on all sides: anteriorly by the genu of the corpus callosum, superiorly by the body of the corpus callosum, posteriorly by the anterior limb and pillars of the fornix, inferiorly by the anterior commissure and the rostrum of the corpus callosum, and laterally by the leaflets of the septum pellucidum [2]. Since it is an enclosed space, it is not a part of the ventricular system and does not communicate with the subarachnoid space [16, 17]. The cavum septum pellucidum is lined with glial, neuronal and ependymal cells.

There are many variants of cavum septum pellucidum, but the most common type is non-communicating. Cavum septum pellucidum is present in all fetuses, but over 85% of them fuse around 3–6 months after birth [6]. This structure may persist in up to 20% of adults. Its prolonged presence in the brain has been associated with many conditions such as schizophrenia, post-traumatic stress disorder, and chronic brain trauma [7, 14, 29]. Physical forces may increase the incidence of cavum septum pellucidum in boxers [23]. Corsellis et al. [4] found it in 12 out of 13 brains in professional boxers. The boxer's cavum displayed a characteristic fenestration with detachment of the fornix from the undersurface of the corpus callosum, with the two flattened forniceal bodies splaying out horizontally [12, 19].

The cavum septum pellucidum's embryological development explains why it is so pervasive in infants. The cavum septum pellucidum is found in the caudal portion of the interhemispheric fissure. During the fifth month of the embryonic period, the corpus callosum closes superiorly and the forceps minor enlarges to the frontal lobes while the fornix stays in its initial position [21]. The corpus callosum forms from anterior to posterior, except the rostrum, which connects the genu and the lamina terminalis. Because of this, the leaflets of the septum pellucidum are pulled towards the lamina terminalis, sealing the cavum from the posterior fornix to the rostrum of the corpus callosum, due to the frontalization of fibers in the genu portion by the seventh month [13]. When the gap is not closed, then the condition remains. This can cause the symptoms mentioned above and potentially hydrocephalus.

Cavum vergae

The third related intracranial midline cyst is a cavum vergae first described by Verga and sometimes referred to as Verga's ventricle (Figs. 4 and 5). Cavum vergae is an extension of a cavum septum pellucidum posteriorly past the columns of the fornix and foramina of Monro. This structure is present in up to 30% of newborns but persists into adulthood in less than 1% of individuals. The posterior floor of a cavum vergae is, therefore, the commissure of the fornix. This condition takes place when there is a separation of the leaflets of the septum pellucidum with posterior extension to the splenium of the corpus callosum. The anterior columns of the fornix separate the anterior cavum septum pellucidum and the posterior cavum vergae. Historically, these cavities, cavum septum pellucidum and cavum vergae were considered fifth and sixth ventricles, respectively [1, 2]. This argument was refuted since they do not contain choroid plexus. The cavum vergae is bordered anteriorly by the posterior border of the cavum septi pellucidum, inferiorly by the body of the fornix, and superiorly and posteriorly by the corpus callosum. Anatomically speaking, these two cavities are not separated [1, 2]; however, a cavum septum pellucidum may exist without a cavum vergae. Some have described the passage between these two cavities as Verga's aqueduct.

During development, these spaces obliterate anteroposteriorly: the cavum vergae followed by the cavum septum pellucidum. Some researchers believe that the development of cavum septum pellucidum and the development of cavum vergae are linked, but this is still debatable [2, 20].

If the cavum septum pellucidum and cavum vergae are present, an endoscopic transforaminal approach into the third ventricle may lead to complications. Instead, a transcavum interforniceal path for endoscopic surgery in the third ventricle may be safer [22, 24, 25].

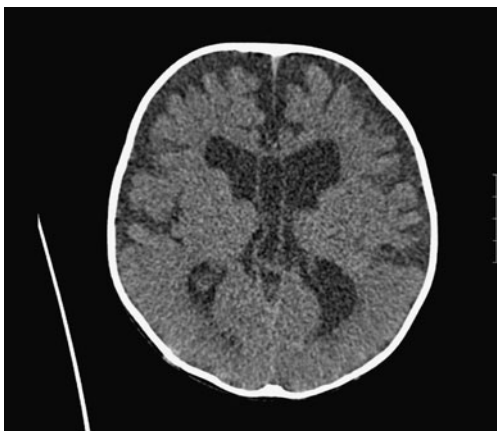

Fig. 5 Axial MRI noting a cavum septum pellucidum and cavum vergae

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