

A case of septum pellucidum subependymoma with a subtle imaging appearance simulating a cavum septum pellucidum

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ABSTRACT

Subependymoma is a rare benign slowly growing tumor which usually appears as a well-defined lobulated entirely intraventricular mass, in the fourth or lateral ventricles. We report a case of subependymoma involving the septum pellucidum in a 28 year old female demonstrating a subtle and unusual radiological appearance. It showed very low attenuation on computed tomography, with very high signal on T2- and low signal on T1 weighted magnetic resonance images, merging with the ventricular wall, without definite focal mass. This appearance made the tumor difficult to differentiate from the cerebrospinal fluid and simulating a cavum septum pellucidum. The patient was treated by craniotomy and gross total resection of the mass.

CASE REPORT

CASE REPORT

A 28 years old female was referred to undergo computed tomography (CT) in our institution for papilledema. She was complaining of reduced vision, associated with intermittent headache and vomiting for the last one year. The non-contrast brain CT showed mild dilatation of the lateral ventricles with no definite focal mass, but a vague abnormality noted in the third ventricle, obscuring the septum pellucidum (Fig 1). From this appearance, a mass lesion was suspected and magnetic resonance imaging (MRI) was advised for further evaluation. The CT did not show any evidence of calcification or hemorrhage in the suspicious region.

Subsequent MRI again showed subtle changes. The T1 and T2 weighted images were unremarkable apart from non-visualization of the septum pellucidum giving an appearance similar to a cavum septum pellucidum (Fig 2 a and 3), but careful evaluation of the fluid attenuation inversion recovery (FLAIR) images revealed a septum pellucidum mass having a minimal signal change from the cerebrospinal fluid (CSF) (Fig

4). It showed a very high signal on T2 and very low signal on T1 weighted images making it difficult to appreciate on these sequences. This mass was diffusely involving the septum pellucidum, and extending to merge with the medial wall and the roof of the left lateral ventricle. Some irregularity was noted in the uppermost ventricular sections at the sites of tumor involvement (Fig 5). The mass was measuring 3x2.5x1.5 cm size in the region of the septum pellucidum, and ranging from 0.8-1.2 cm thickness in the lateral ventricular wall. No significant enhancement was seen in the postcontrast images (Fig 2) and no restriction in the diffusion was detected (Fig 6).

Taken these findings, in a 28 years old patient, the diagnosis of a non-enhancing intraventricular neoplasm involving the septum pellucidum was made; with the differential diagnosis included ependymoma, subependymoma, low grade glioma and central neurocytoma.

The patient underwent right frontal craniotomy and gross total resection of the mass, with third ventriculostomy.

The histopathological examination demonstrated characteristic features of subependymoma including monomorphic cells with pseudorosettes formation around the blood vessels in a background of marked edema and hemorrhage. There was no evidence of necrosis or pleomorphism (fig 7 and 8). The tumor cells also showed positivity for glial fibrillary acidic protein (GFAP) and MIB-1 proliferation index was lower than 1%.

The patient tolerated the surgery well without significant postoperative complications. She was followed up by neurosurgery service for the last one and a half year and she is doing well with no evidence of recurrence in the follow up CT and MRI studies (Fig 9 and 10).

DISCUSSION

Subependymoma is a rare, benign, slowly growing tumor with non-invasive characteristics, it accounts for less than 1% of all intracranial neoplasms [1, 2]. It was first described by Scheinker in 1945 which was followed by slightly more than hundred case reports and few studies that evaluated the imaging features and the treatment options [3]. These potentially curable tumors arise from the walls of the lateral or fourth ventricles, so the differentiation from other intraventricular tumors especially ependymomas has a therapeutic importance. However, due to its rarity and variable imaging characteristics, reliable pre-operative diagnosis remains challenging.

Most of these tumors are asymptomatic, but when symptomatic, subependymomas often present with symptoms related to CSF obstruction and hydrocephalus [1, 4]. The commonest locations are the fourth and lateral ventricles, but have also been reported in the third ventricle, septum pellucidum, and the spinal canal [2-6].

The world health organization (WHO) classifies subependymoma as a grade 1 neoplasm [2], yet the histological origin has remained controversial. In the 1970s, electron microscopy of subependymoma demonstrated a mixed population of ependymal cells, astrocytes, and intermediate morphology bi-potential cells with the capability of differentiating into ependymal cells or astrocytes [1,7, 8]. Subependymomas are characterized by an extremely low mean MIB-1 labeling index, an important and well-recognized marker of cell proliferation, which raise the possibility that this lesion more likely be a hamartoma rather than a neoplasm [7, 9, 10].

Histopathologically, subependymomas show low cellularity; and characterized by clusters of isomorphic tumor cell nuclei embedded in a dense fibrillary matrix of glial cell processes with frequent microcysts and absent mitoses. The cells are frequently showing rosette appearance around the blood vessels. These neoplasms are strongly immunoreactive for GFAP [1, 6, 10].

Clinical presentation:

Most of these tumors are asymptomatic and detected incidentally at autopsy. Subependymomas sometimes obstruct critical portions of the CSF pathway, causing hydrocephalus. The most common symptoms include headache, gait ataxia, vertigo or dizziness, nausea and vomiting [1, 5].

Most of subependymomas are smaller than 2 cm in size, however; symptomatic tumors are usually larger. The presence of symptoms was found by some authors to be related to the tumor size, with the majority of symptomatic subependymomas measuring greater than 3-5 cm [1, 4, 5]. Maiuri concluded that most important factor related to the presenting symptom is the tumor location; with tumors originating in the region of foramen of monro and third ventricle appear smaller in size at presentation than those not interfering with the CSF flow like in the trigone of the ventricle [4, 9]. In our case, the patient presented with headache and vomiting which are frequent presenting symptoms, in addition to reduced vision. Ophthalmological examination revealed papilledema likely related to the increased CSF pressure caused by tumor obstructing its pathway that explained the patient symptoms.

These neoplasms may become symptomatic at any age and develop in both sexes, but exhibit a peak incidence in middle-aged and elderly male patients [6, 10].

Imaging:

Unlike the current case, most of the literature described well-defined, lobulated subependymomas which are easily detected by CT and MR imaging. Authors also reported non-specific and variable imaging characteristics of these neoplasms with the imaging features found to be related to the anatomical location.

Common features of subependymoma include a lobulated, well-defined intraventricular mass with no paraventricular extension and no peritumoral edema. The majority are solid or solid with areas of cystic degeneration [1, 11-13].

On CT, the majority of subependymomas appear as intraventricular masses that are hypodense or isodense. On MRI, these tumors are usually well-defined solid with a hypo to isointense signal on T1 weighted images and a hyperintense signal on T2 weighted images.

Here, we described a case of subependymoma which demonstrated very subtle and unusual imaging appearance. Unlike others, the current case showed no well-defined lobulated intraventricular mass, but a rather diffuse infiltration of the septum pellucidum and the ventricular wall. The mass had a very low attenuation on CT, and a homogenous very high signal on T2 and low signal on T1 weighted MRI, which rendered that lesion inseparable from the surrounding CSF. No evidence of hemorrhage, cyst or contrast enhancement was noted in the current case.

Studies showed variable CT and MRI enhancement characteristics of these tumors, ranging from absent to intense

enhancement. Heterogeneous contrast enhancement and calcification are recognized features of the fourth ventricular subependymomas, while lateral ventricular subependymomas usually lack calcification and show minimal or no contrast enhancement [1, 11, 12, 14].

Differential diagnosis:

As these tumors are rare with non-specific imaging characteristics, the differentiation from other intraventricular lesions can be very difficult. The differential diagnosis includes ependymoma, central neurocytoma, subependymal giant cell astrocytoma, choroid plexus papilloma, meningioma, glioma and metastasis. The age, location and the imaging features help in narrowing the differential diagnosis [12].

The lateral ventricular subependymoma is more easily differentiated from other intraventricular tumors comparing to the fourth ventricular subependymoma. Jelinek concluded that the lateral ventricular tumors are always enhancing and the only non-enhancing tumor is subependymoma [4, 13].

According to Hoeffel, even though there is no specific sign of subependymoma, it should be considered if we are encountering a complete intraventricular mass causing little or no edema, which is non-enhancing or minimally enhancing [12]. Furthermore; the slow progression of these tumors helps in the differentiation from other more common tumors of the ventricles.

Supratentorial ependymomas are often paraventricular while subependymomas are entirely intraventricular. Ependymomas are more likely to show calcification, cyst formation and contrast enhancement than supratentorial subependymoma [1, 12, 14].

Unlike subependymoma, the choroid plexus papilloma occurs in young children in the region of the choroid plexus and it intensely enhances. The subependymal giant cell astrocytomas are always located near the foramen of monro and intensely enhance. They are associated with ventricular wall calcifications as part of the stigmata of tuberous sclerosis which help in their differentiation.

Central neurocytoma is a tumor which is related to the septum pellucidum. Both subependymoma and central neurocytoma tend to occur in the anterior portions of the lateral ventricles, but central neurocytoma is usually seen in a younger age group and shows a more heterogeneous isointense signal on T1, T2 MRI. Cysts, calcification and contrast enhancement are common features of central neurocytoma but they are rare in subependymoma. Furthermore; subependymomas almost always appear hyperintense on T2 images.

Meningiomas are usually seen in middle age patients especially females, they are frequently calcified and intensely enhance, with iso- or hyperdense attenuation on CT in contrast to subependymomas which appear iso or hypodense. On MRI, meningiomas demonstrate iso to hyperintense signal on T2 and iso to hypo intense signal on T1 weighted images unlike

subependymomas which appear hyperintense on T2. Meningioma resembles subependymoma in being homogenous on both CT and MRI.

Gliomas are differentiated by their fast growth as well as the heterogeneous appearance and involvement of the corpus callosum [1, 4, 12].

In the 4th ventricle the differentiation between subependymomas and other intraventricular tumors especially ependymomas is more difficult because the 4th ventricular subependymomas can show calcification and heterogeneous enhancement. Unlike subependymomas, ependymomas may infiltrate into the adjacent paraventricular parenchyma, an important finding to differentiate these two tumors [4].

Treatment and prognosis:

The optimal therapy for symptomatic subependymomas is complete surgical excision which was found to be curative. The preoperative diagnosis is helpful as these lesions are benign slowly growing and has better prognosis than other common intraventricular tumors, which help in the preoperative planning. Lateral ventricular subependymomas often can be completely resected, while the 4th ventricular tumors are frequently arising from the floor of the ventricle adjacent to the brainstem and the cranial nerves rendering complete resection difficult.

In cases in which surgery is risky, in certain tumor locations, the decision may be to follow up these tumors. If the patient is symptomatic, subtotal resection and debulking may be performed to improve the CSF pathway, as the outcome is favorable even if removal is subtotal. Follow up MRI is advised after partial resection [1, 13, 15].

The current surgical approach of these tumors like other intraventricular tumors depends on the exact location of the lesion, the amount of hydrocephalus and the experience of the surgeon. Interhemispheric transcalsal approach is preferred over transcortical approach to reduce damage of the neural tissues [7, 16]. In our patient, this was not possible due to prominent vascularity in the interhemispheric area, so transcortical approach was decided to remove this septum pellucidum tumor. In spite of tumor extension to the left ventricular wall, right frontal craniotomy was performed in order to avoid the dominant hemisphere particularly the speech area.

If we are dealing with a small tumor, neuronavigation and the use of microneurosurgical techniques can be useful to guide the surgeon and minimize neural damage.

Prognosis of the resected tumors is generally excellent. Few studies reported a worse prognosis in the older age group, most likely related to the higher incidence of age-related surgical complications. Recurrence is very rare after complete tumor resection.

The role of radiotherapy in the treatment of these lesions is still controversial due to the limited number of studies; it is

not generally recommended if the resection is complete, but can be considered after subtotal resection or recurrent tumors [11, 16].

TEACHING POINT

Subependymoma is a rare low grade curable tumor. While the appearance is nonspecific, this neoplasm should be considered in the differential diagnosis of a non-enhancing entirely intraventricular lesion, which is showing no edema, especially if this lesion appears homogenous. We present a case of this rare tumor with unusually subtle imaging appearance simulating a cavum septum pellucidum, to draw attention to the difficulty in appreciating some intracranial tumors and the importance of systematically approaching the different regions in the brain, especially the ventricles.

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FIGURES



Figure 1 (left): 28 year old female with septum pellucidum subependymoma. Plain CT Axial showing subtle abnormality in the region of the septum pellucidum which is not normally visualized (arrows), with mild bilateral lateral ventricular hydrocephalus. The neoplasm has a homogenously low attenuation on CT approaching that of CSF giving such appearance. No evidence of calcifications was noted. Spiral CT scan, axial, 5 mm slice, KVP 1.4, exposure 300.

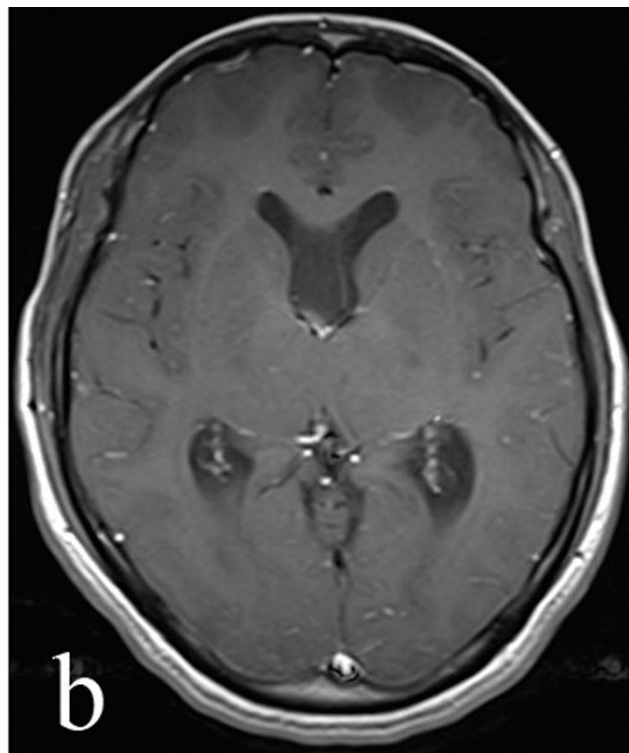
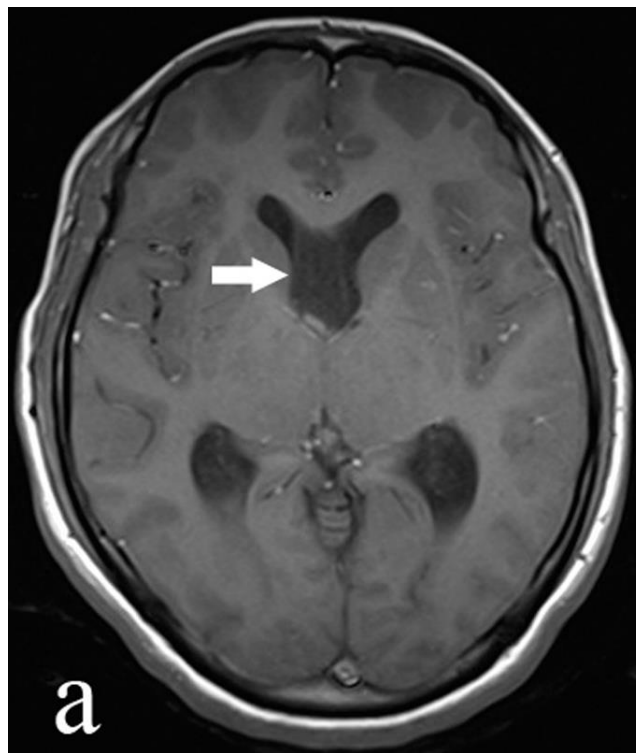


Figure 2: 28 year old female with septum pellucidum subependymoma. MRI Axial T1 images are showing a subtle homogeneously hypointense lesion in the region of the septum pellucidum (arrow), measuring 3x2.5x1.5 cm in size, with mild bilateral lateral ventricular hydrocephalus. (a) Precontrast. (b) Postcontrast study which demonstrates no significant enhancement. MRI: 3 Tesla magnet, T1 weighted image (TE = 8.4, TR = 400), axial, 5 mm slice. The postcontrast study used Gadolinium (Dotarem), 10 ml.

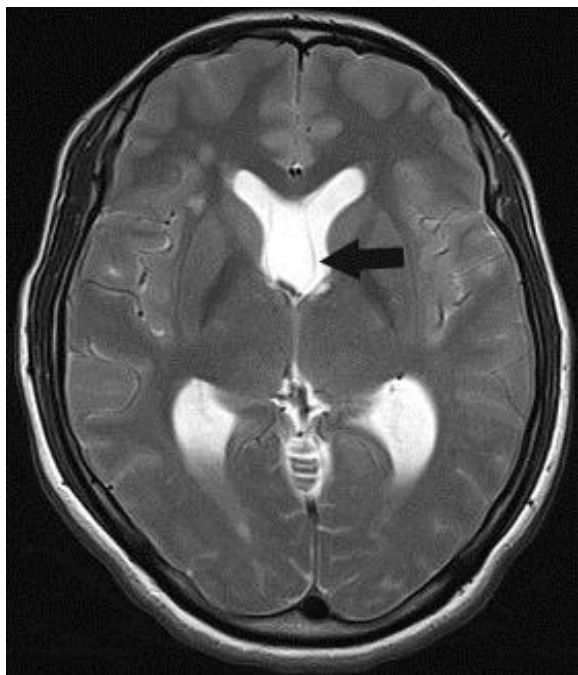


Figure 3 (left): 28 year old female with septum pellucidum subependymoma. MRI Axial T2-weighted image appears unremarkable. A subtle hyperintense lesion is seen (arrow), which may be confused with a cavum septum pellucidum, with mild bilateral lateral ventricular hydrocephalus. MRI: 3 Tesla magnet, T2 weighted image (TE = 99, TR = 3000), axial, 5 mm slice.

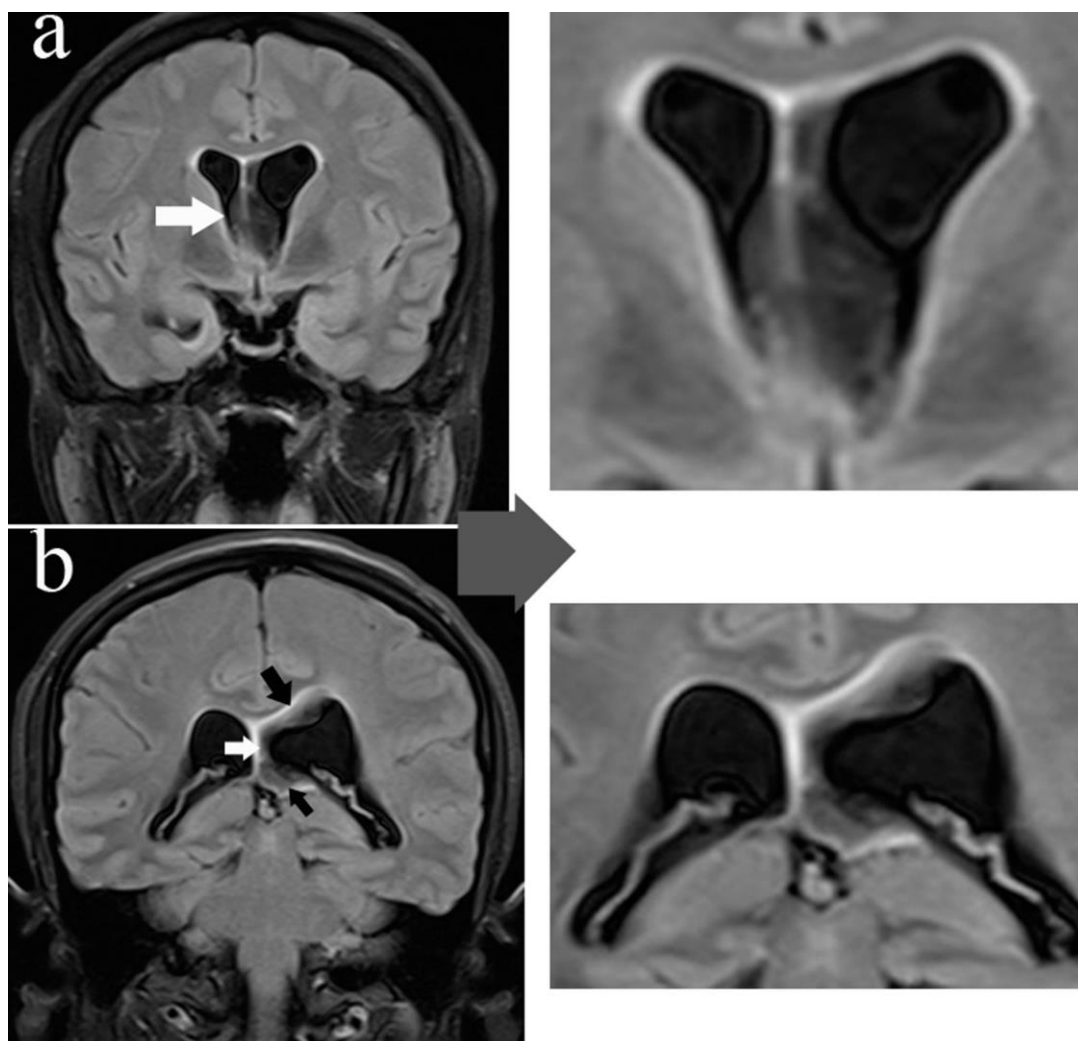


Figure 4: 28 year old female with septum pellucidum subependymoma. MRI coronal FLAIR images, with magnified views, (a) at the level of the frontal horns showing subtle mass involving the septum pellucidum (large white arrow) which shows slightly different signal intensity from that of the CSF. It is measuring 3x2.5x1.5 cm in size. (b) at the level of the trigone, showing linear extension of the mass along the medial left ventricular wall and roof (small arrows) with about 0.8-1.2 cm thickness. MRI: 3 Tesla magnet, T2 coronal FLAIR image (TE = 94, TR = 9000), coronal, 5 mm slice.

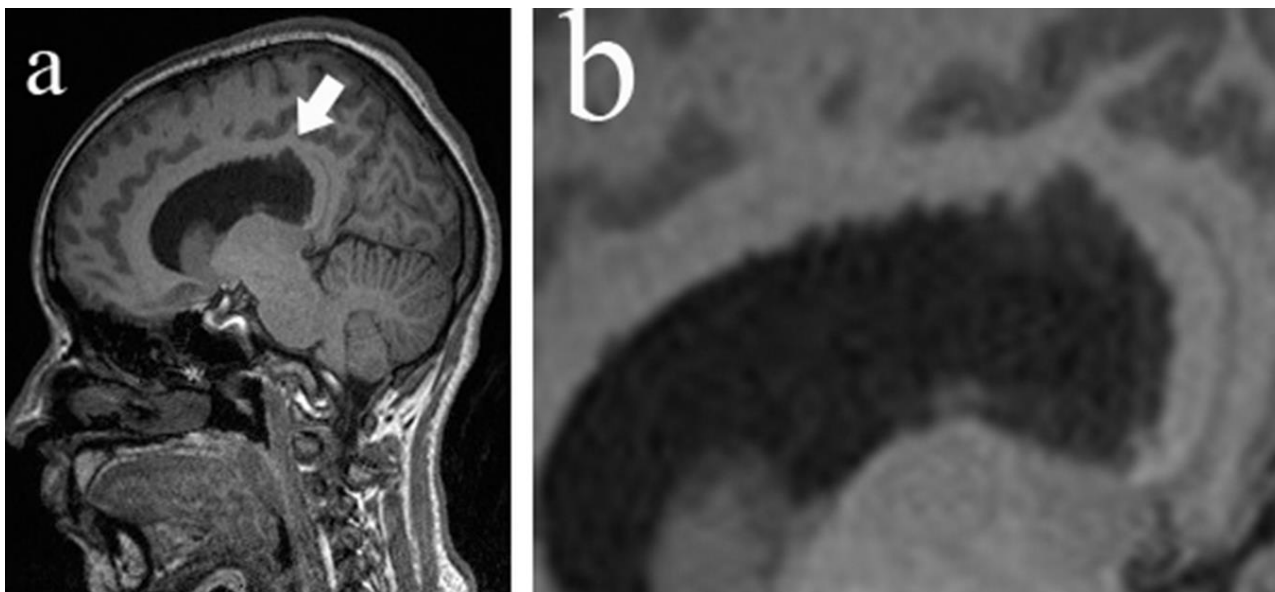


Figure 5: 28 year old female with septum pellucidum subependymoma. (a) Plain MRI sagittal T1 image showing irregularity in the roof of the left lateral ventricle (arrow). (b) A magnified view. MRI 3 Tesla magnet, T1 weighted image (TE = 2.5, TR = 1900), sagittal, 1 mm slice.

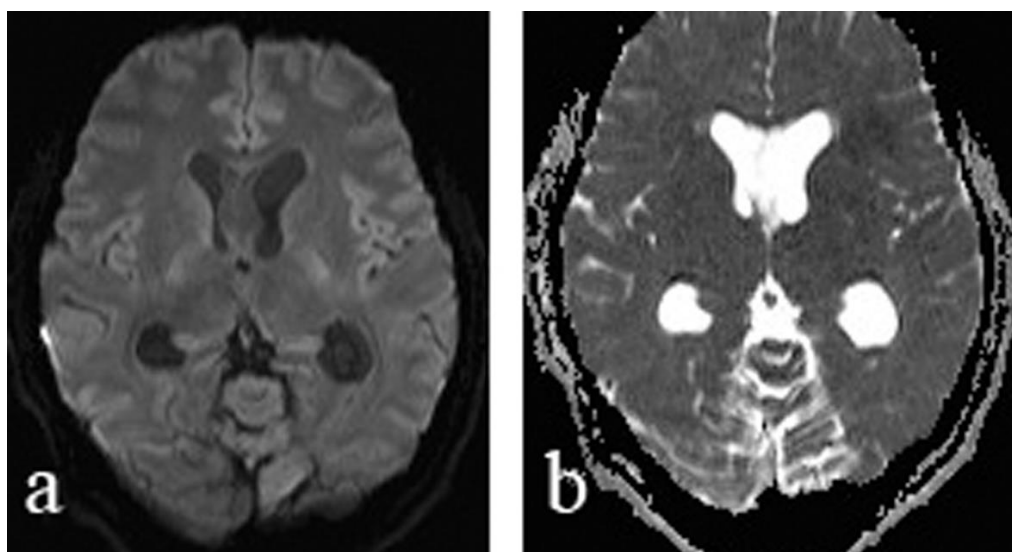


Figure 6: 28 year old female with septum pellucidum subependymoma. MRI diffusion weighted sequence. (a) DWI image (b) ADC map. No abnormal signal is seen to suggest a diffusion restriction in the septum pellucidum mass. MRI: 3 Tesla magnet, DWI (TE = 110, TR = 12000, b=1000), ADC map, axial, 5mm slice.

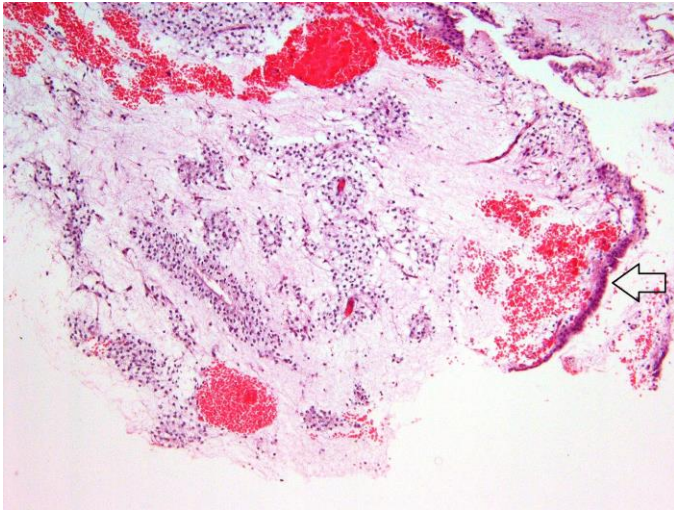


Figure 7 (left): Histopathological examination of the mass in low power microscope showing characteristic clusters of monomorphic cells in a dense fibrillary background suggestive of subependymoma. The arrow indicates the ventricular ependymal surface.

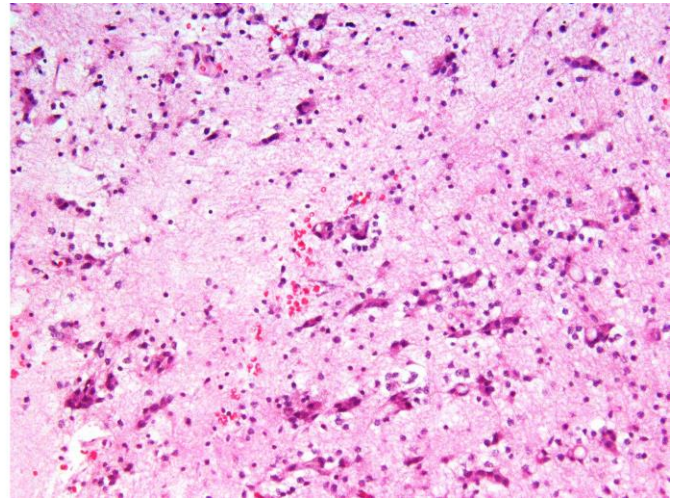
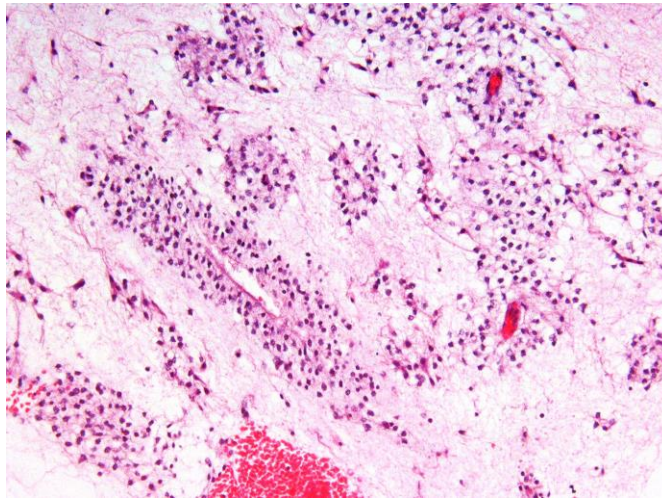
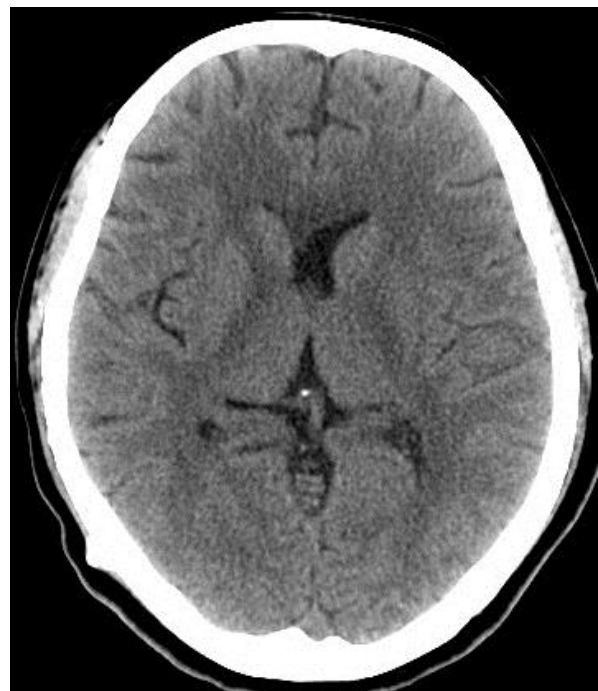


Figure 8: The postoperative histopathology of the mass showing the characteristic rosette appearance of the monomorphic cells in a dense fibrillary background in keeping with subependymoma.

Figure 9 (right): 28 year old female with septum pellucidum subependymoma. Follow up plain CT scan one and a half year postoperatively, shows no evidence of recurrence. Multislice 64 CT scanner, with 2.5 mm reconstruction axial section. Kvp 120, exposure 63.



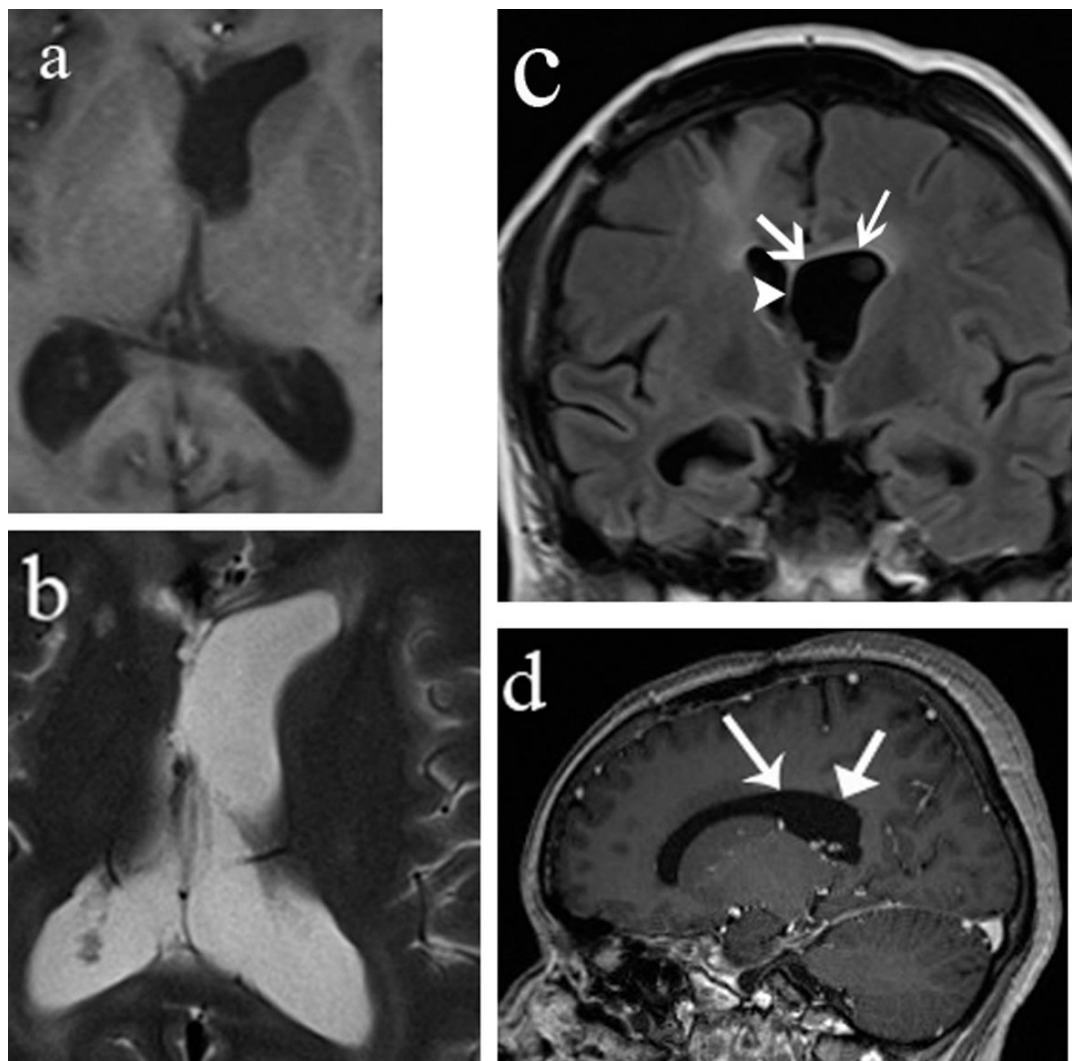


Figure 10: 28 year old female with septum pellucidum subependymoma. Follow up MRI one and a half year postoperatively (a) Magnified view of the axial precontrast T1 image (b) Magnified view of the axial T2. (c) Coronal FLAIR in the region of foramen monro. (d) Contrast enhanced T1 sagittal section, showing the left lateral ventricle. Images demonstrate no recurrence of the removed intraventricular mass (the arrows indicate its site). 3Tesla MR, T1 weighted image (TE = 8.4, TR = 500), T2 W (TE=99,TR=3000). Coronal FLAIR (TE=94,TR=7000), 5mm slice. The postcontrast study used Gadolinium (Dotarem),10 ml.

Incidence	Less than 1% of the intracranial neoplasms
Age	Most common in middle age, but can occur at any age, most are asymptomatic and discovered at autopsy
Gender	Male to female ratio is about 3:1
Etiology	Mixed ependymal and glial cells origin
Risk factors	No known risk factors
Imaging appearance	Completely intraventricular mass, usually homogeneously hypo to isodense on CT, hypointense on T1 and hyperintense on T2 MRI, usually showing minimal or no enhancement.
Treatment	Optimal therapy is complete surgical resection, if not possible, debulking or partial resection
Prognosis	Generally favorable, complete resection is curable

Table 1: Summary table of subependymoma

Intraventricular neoplasms	Site	Epidemiology	CT	MRI	Contrast enhancement
Subependymoma	<ul style="list-style-type: none"> Entirely intraventricular mass Commonest site is the 4th and the lateral ventricles 	<ul style="list-style-type: none"> Occur at any age and in both sexes, but most commonly seen in middle age male 	<ul style="list-style-type: none"> Isodense or hypodense Calcification is rare 	<ul style="list-style-type: none"> Homogenous T2:hyperintense T1:hypo to isointense 	<ul style="list-style-type: none"> Lateral ventricular lesions show no or minimal enhancement, while the 4th ventricular lesions can enhance
Central neurocytoma	<ul style="list-style-type: none"> Septum pellucidum 	<ul style="list-style-type: none"> Young adults 	<ul style="list-style-type: none"> Calcification is very common 	<ul style="list-style-type: none"> Heterogeneous with cysts and calcification T2:Isointense T1:Isointense 	<ul style="list-style-type: none"> The solid components show enhancement
Subependymal giant cell astrocytoma	<ul style="list-style-type: none"> Foramen of Monro 	<ul style="list-style-type: none"> Usually in young patients with tuberous sclerosis 	<ul style="list-style-type: none"> Subependymal calcifications as part of tuberous sclerosis 	<ul style="list-style-type: none"> T2:Hyperintense T1:Hypointense 	<ul style="list-style-type: none"> Intense enhancement
Ependymoma	<ul style="list-style-type: none"> Posterior fossa: intraventricular. Supratentorial ependymoma is commonly paraventricular 	<ul style="list-style-type: none"> Children and young adults 	<ul style="list-style-type: none"> Isodense heterogeneous calcifications and cysts are common 	<ul style="list-style-type: none"> Heterogeneous and lobulated with cysts T2:hyperintense T1:isointense 	<ul style="list-style-type: none"> Solid components show enhancement
Choroid plexus papilloma	<ul style="list-style-type: none"> Commonest site is the region of choroid plexus in the lateral ventricle 	<ul style="list-style-type: none"> Children younger than 4 years 	<ul style="list-style-type: none"> Isodense or hyperdense commonly calcify 	<ul style="list-style-type: none"> T2:Hyperintense, T1:Isointense to hypointense 	<ul style="list-style-type: none"> Intense enhancement
Intraventricular meningioma	<ul style="list-style-type: none"> Commonest site is the trigone 	<ul style="list-style-type: none"> Middle age, more in female 	<ul style="list-style-type: none"> Homogenous isodense, or hyperdense calcification is frequent 	<ul style="list-style-type: none"> Homogenous T2:Iso or hyperintense T1:Hypo to isointense 	<ul style="list-style-type: none"> Intense homogenous enhancement
Glioma	<ul style="list-style-type: none"> Usually involves the corpus callosum 	<ul style="list-style-type: none"> Middle age, and elderly more in male 	<ul style="list-style-type: none"> Heterogeneous sometimes with hemorrhage 	<ul style="list-style-type: none"> Heterogeneous T2:Hyperintense T1:Hypointense 	<ul style="list-style-type: none"> High grade tumors are enhancing.

Table 2: Differential diagnosis table of subependymoma from intraventricular neoplasms

ABBREVIATIONS

- ADC: Apparent diffusion coefficient
- CT: computed tomography.
- FLAIR: fluid attenuated inversion recovery.
- GFAP: glial fibrillary acidic protein.
- MRI: Magnetic resonance imaging.
- TE: echo time.
- TR: repetition time.
- WHO: world health organization

KEYWORDS

subependymoma; septum pellucidum; tumor; MRI

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