Subarachnoid cisterns - What the radiologist needs to know.

Poster No.: C-0264
Congress: ECR 2016
Type: Educational Exhibit
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Keywords: Anatomy, CNS, CT, MR, eLearning, Normal variants, Cerebrospinal fluid
DOI: 10.1594/ecr2016/C-0264

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Learning objectives

To show radiology residents the basic anatomy and the imaging features of the subarachnoid space, with special emphasis on the subarachnoid cisterns, and also to serve as a review for more experienced radiologists.

Background

The meninges are the membranes that cover the brain and spinal cord and consist of three layers: the dura mater, the arachnoid mater and the pia mater. The subarachnoid space is the anatomic space between the arachnoid mater and the pia mater. It is narrow due to the close adherence between those two layers. It contains cerebrospinal fluid as well as vascular and nervous elements. The subarachnoid cisterns are cerebrospinal fluid-filled regions of the subarachnoid space created by the separation of the aforementioned layers.

Images for this section:

![Diagram showing a detail of a coronal section of the top of the skull, showing the membranes of the brain and the subarachnoid spaces.](image)

**Fig. 1:** Diagram showing a detail of a coronal section of the top of the skull, showing the membranes of the brain and the subarachnoid spaces.
Findings and procedure details

There are a few proposed classification systems for the subarachnoid cisterns. One of the most used is the Liliequist classification of CSF cisterns, that separates them in ventral, dorsal and communicating cisterns. A description of the classification is provided in Table 1 on page 5.

Below, the reader can find a detailed description of each of the cisterns referred in Table 1 on page 5:

VENTRAL CISTERNs

- **Chiasmatic or supra-sellar cistern:** this cistern lies superiorly to the sellar diaphragm (part of the subarachnoid space goes through the infundibular orifice and forms a small cavity above the pituitary gland), and close to the optic nerves, chiasma and tracts as well as the Willis circle and the hypothalamus. (Fig. 2 on page 6 and Fig. 4 on page 8). The parasellar cisterns constitute the lateral continuations of the suprasellar cistern and contain a segment of the oculomotor nerve as well as the posterior communicating and anterior choroidal arteries and the basal vein.
- **Sylvian or lateral cisterns:** they communicate medially with the supra and para-sellar cisterns and laterally with the subarachnoid space of the lateral (Sylvian) fissure. It contains the M1 segment of the middle cerebral artery, the origin of the lenticulostriate branches and the first portion of the basal vein. (Fig. 5 on page 9)
- **Medullary cistern:** the subarachnoid space surrounding the medulla oblongata. It has a posterior communication with the cisterna magna. (Fig. 2 on page 6)
- **Pontine cistern:** It encases the pons and shows a central portion and two lateral recesses located between the pons and the cerebellum. This cistern is limited superiorly by the cerebellar tentorium. Its content comprise, in a descending fashion: the 5^{th} cranial nerve, the superior cerebellar artery, the 4^{th} 8^{th} and 7^{th} cranial nerves, the loop of the anterior-inferior cerebellar artery, the 9^{th}, 10^{th} and 11^{th} cranial nerves in close relationship with the posterior-inferior cerebellar artery, the 12^{th} cranial nerve and the basilar artery. (Fig. 2 on page 6)
- **Crural cisterns:** are the spaces located between the cerebral peduncles (medially) and the uncus (laterally). (Fig. 4 on page 8)
- **Inter-peduncular cistern:** limited anteriorly by the sella turcica, the pituitary stalk and the optic chiasma. The membrane of Liliequist incompletely separates it of the chiasmatic cistern. It contains the bifurcation of the basilar artery and the apparent origin of the 3^{rd} cranial nerve. (Fig. 4 on page 8)
DORSAL CISTERNS

- **Ambient and quadrigeminal cisterns or cistern of the great cerebral vein**: it is located between the splenium of the *corpus callosum* and the cerebellum and contains the great cerebral vein, thus the name, the apparent origin of the 4th cranial nerve, and the pineal gland. (Fig. 4 on page 8 and Fig. 7 on page 11)
- **Peri-callosal cistern**: It is a narrow space right above the *corpus callosum* which encases the pericallosal artery. (Fig. 2 on page 6)
- **Retro-thalamic cistern**: also considered the "wings" of the ambient cistern, are the lateral extensions of the ambient cisterns located posterior to the pulvinar nuclei. (Fig. 6 on page 10)
- **Supra-cerebellar cistern**: It is the subarachnoid space between the tentorium of the cerebellum and the superior aspect of the cerebellar vermis and encloses the superior cerebellar artery and superior vermian veins. (Fig. 2 on page 6 and Fig. 6 on page 10)

COMMUNICATING CISTERNS

- **Cistern of the lamina terminalis**: it extends above the anterior aspect of the third ventricle. It contains the first segment of the anterior cerebral arteries and its branches. This cistern acts as a communication among the peri-callosal, and inter-peduncular cisterns. (Fig. 2 on page 6 and Fig. 3 on page 7)
- **Cisterna Magna or cerebello-medullary cistern**: It is the biggest of the subarachnoid cysterns. Located under the cerebellum and behind the medulla oblongata. It communicates with the fourth ventricle (via the median aperture or foramen of Magendie), the medullary subarachnoid space, and the peri-cerebellar subarachnoid space. (Fig. 2 on page 6 and Fig. 8 on page 12)

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**Table 1:** Liliequist classification of the subarachnoid cisterns.

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**Fig. 3:** Gadolinium-enhanced T1 weighted axial image showing the cistern of the lamina terminalis in a translucent dark blue overlay. Notice the A1 segment of the left anterior cerebral artery inside the cistern.

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**Fig. 4:** T1 weighted axial MR image of the perimesencephalic cisterns in color overlay. Green: chiasmatic cistern. Orange: inter-peduncular cistern. Light blue (bilateral): crural cistern. Purple: Ambient cistern.

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**Fig. 5:** Detail of an axial gadolinium-enhanced T1-weighted image showing part of both sylvian cisterns with a green overlay.

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Fig. 6: Axial non-enhanced CT image showing the supra-cerebellar (green overlay) and retothalamic (purple overlay) cisterns.

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Fig. 7: Gadolinium-enhanced T1-weighted axial image showing in detail the quadrigeminal cistern (light green overlay).

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Fig. 8: Axial FLAIR image of the posterior fossa showing the cisterna magna.

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Conclusion

The understanding of the radiologic anatomy of the subarachnoid cisterns is important not only as a basic anatomy knowledge but also for radiologists to be able to correctly interpret pathological findings.

Personal information

References

