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Cavum veli interpositi. Roentgen Anatomy — Pathology and Physiology

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Summary. 158 pneumoencephalographies of infants less than 2 years old were examined and 53 of them had a large cavum veli interpositi. A neuroradiological description of this cistern is given and a comparison made with injected anatomical specimens. A statistical comparison with 105 pneumoencephalographies without a cavum veli interpositi does not show any correlation between the presence of this cistern and pathological conditions. This investigation indicates that a large cavum veli interpositi in the newborn has no relation to hydrocephalus or cerebral atrophy. The younger the child, the more frequent is the presence of this cistern, especially under eight months of age.

La citerne sous — trigonale. Aspects radio-anatomiques. Signification physiopathologique

Résumé. Ce travail porte sur l'étude de 158 encéphalographies gazeuses fractionnées de nourrissons de moins de deux ans, dont 53 montrent la présence d'une volumineuse citerne sous trigonale. Une description neuro-radiologique précise de la citerne sous trigonale est effectuée par comparaison à l'injection de pièces anatomiques. Une étude statistique comparative à un groupe témoin comportant 105 encéphalographies gazeuses fractionnées de nourrissons, sans opacification de la citerne sous trigonale, permet de prouver qu'il n'y a aucune corrélation entre l'opacification de cette citerne sous trigonale et l'existence d'un processus pathologique quelconque. Cette étude démontre que la dilatation de la citerne sous trigonale chez le nouveau-né n'est liée, ni à l'hydrocéphalie, ni à l'atrophie cérébrale; il ne s'agit pas d'une malformation. Elle se retrouve d'autant plus fréquemment que l'enfant est plus jeune et, en particulier, en dessous de huit mois.

Cavum veli interpositi. Röntgen-Anatomie, -Pathologie und -Physiologie

Zusammenfassung. Bei 158 Pneumoencephalographien an Kindern unter 2 Jahren fand sich in 53 Fällen ein großes Cavum veli interpositi. Ausführliche neuroradiologische Beschreibung dieser Cisterne mit Vergleich zu anatomischen Untersuchungen. Eine Korrelation zwischen dem Nachweis dieser Cisterne und pathologischen Befunden ergab sich nicht. Die Untersuchungen zeigen, daß der Nachweis eines Cavum veli interpositi keine Beziehungen zum Hydrocephalus oder zu einer Hirnatrophie hat. Besonders bei Kindern unter 8 Monaten ist diese Cisterne sehr häufig nachzuweisen.

Characteristics of the cisternal spaces in the newborn partially reflect cerebral development. These cisternal spaces have been especially studied since the pneumoencephalographic investigation of young children has increased. Taveras and Wood [6] indicate that the cisternal spaces are proportionally larger in children than in adults. Carlson and Lodin [1] show that the volume of the suprasellar cisterns is related to progressive groth of the cerebral hemispheres. Eisenman, Rosen and O'Loughlin [3] ascertain that after three years of age the volume of the interpeduncular cistern begins to decrease in size, while the ambient cistern and the prepontine cistern remain almost the same size.

It is a well known fact that the cisterna magna may have different sizes even in the adult. In 1973, Dobbing and Sands [2] showed that maximal growth of the brain (weight and cellular density) increases up to one year of age and then decreases up to four years of age.

This investigation shows the development of the cavum veli interpositi to be related to the development of the ventriculo-cisternal system in children and tries to establish its pathological and physiological meaning. This problem was discussed in 1969 by Vrousos [7] in her thesis.

Roentgen Anatomy

The cavum veli interpositi, or interventricular cistern, extends from the cistern of Galen anteriorly enclosing (Fig. 1) the internal cerebral veins and the vein of Galen. The cavum veli interpositi is situated over the roof of the 3rd ventricle and under the fornix. It extends forward to the foramen of Monro. Laterally, it is bounded by the columns of the fornix above and the thalamus below. The pneumoencephalographic aspect should not be mistaken for a cavum Vergae, if frontal and sagittal tomograms are performed (Figs. 2 and 3).

The pneumographic descriptions of Ruggiero [5] and Liliequist [4] are well known:

A) — *In the AP Projection* (Fig. 2)

The cistern is triangular, or more often trapezoidal, with its base inferiorly and more or less rounded at

Fig. 1. Injection of anatomic material. a) Brain of a term still-born infant. The contrast medium (in white) outlines a large cistern of Galen (CG) which extends anteriorly by a very large cavum veli interpositi (CVI) above the third ventricle (V 3) up to the foramen of Monro. No fibrous tract is present at the level of the cavum veli interpositi (CVI). b) Adult anatomical material. The contrast medium outlines the cistern of Galen (CG) and partially the cavum veli interpositi (CVI) where many fibrous tracts are seen; this explains the absence of dilatation of the cavum

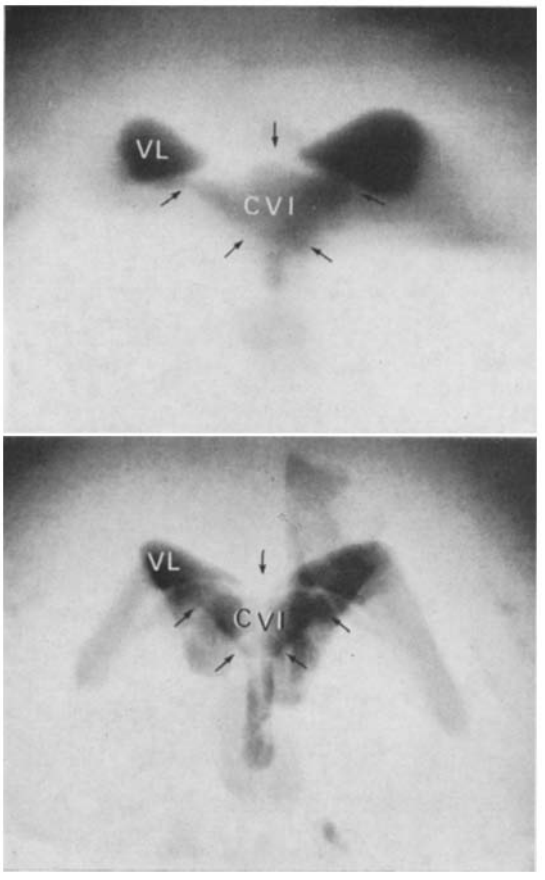

Fig. 2. Pneumoencephalographic aspect of the cavum veli interpositi in the AP projection. a) In frontal tomography. The cavum veli interpositi (CVI) (arrows) is triangular in shape with the apex inferiorly. Its location is between the two lateral ventricles (LV). b) In the standard AP projection. The cavum veli interpositi is trapezoidal (CVI) with its small base inferiorly and its superior angles rounded

the angles. The importance of frontal tomograms must be emphasized because they allow differentiation from superimposed frontal horns, ventricular atrium and roof of 3rd ventricle.

B) — *In the Lateral Projection* (Fig. 3)

In 75% of the cases, the cavum veli interpositi is a comma-shaped shadow which is wider posteriorly similar to a "falx" or "Toucan's peck" (Fig. 3).

In 20% of the cases, it is oval in shape.

In 5% of the cases it still has a comma shape but with the wider end anteriorly. The level of its roof with regard to the lateral ventricles allows differentiation from a cavum Vergae.

As a matter of fact, visualization of this cistern sets the problem of its pathological and physiological meaning: the size is frequently large in the pneumo-

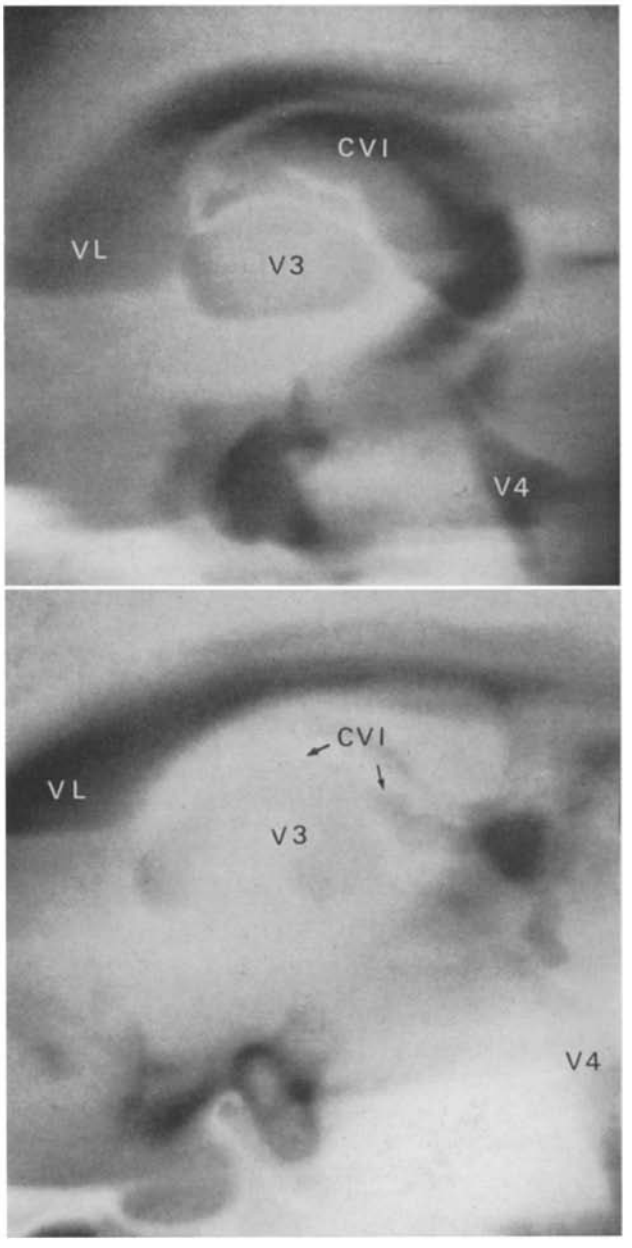

Fig. 3. Pneumoencephalographic aspect of the cavum veli interpositi in midline sagittal tomography. a) This shows the comma shape, with the larger end postériorly. This is the most frequent aspect of the cavum veli interpositi (CVI) during infancy. b) This shows the aspect of the cavum veli interpositi (CVI) slightly visualized in an adult patient; its location is in between the third ventricle (V 3) and the posterior part of the corpus callosum

encephalography of infancy. In adults and children older than two years, the cistern is often not visualized (0.3%) and is much smaller in size.

Is the cavum veli interpositi a normal anatomical variant or a pathological condition related to cerebral atrophy, hydrocephalus or central nervous system ab-

normalilties? It appears in this investigation that the cavum is a normal developmental phase of the infant's brain.

Material and Methods

This statistical investigation concerns infants of less than 24 months, admitted to the Pediatric Department, to the Neurosurgery Department and to the Pediatric Intensive Care Unit.

53 pneumoencephalographies with a large cavum veli interpositi were compared to 105 pneumoencephalographies of infants without a cavum. Case selection of both groups is identical.

The statistical correlation between both groups is checked by the "Chi square" test. Parameters are sex, age, clinical indications of pneumoencephalography, previous clinical history, associated pathological conditions, neuroradiological diagnosis and technical conditions of the procedure.

Results

Frequency

30% of the pneumoencephalographies studied had a large cavum veli interpositi. The frequency varies according to age as is shown in Table 1. The frequency is high in the newborn, decreases subsequently and disappears at 17 months of age.

Table 1. *The frequency of the cavum veli interpositi (CVI) according to age*

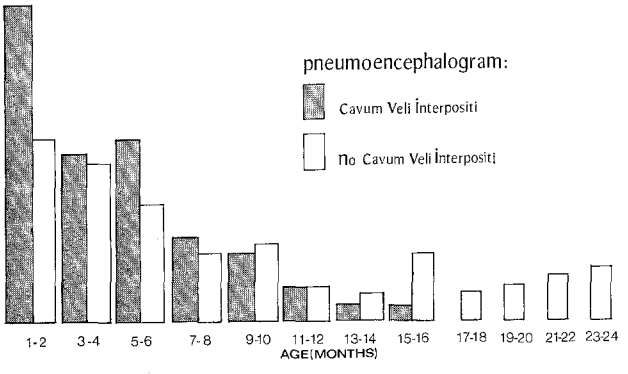

Table 2. *Frequency of cavum veli interpositi*

Age distribution	Cavum veli interpositi	
	Presence (%)	Absence (%)
Under 3 months	43	26
3 to 6 months	28	20
6 to 12 months	22	24
12 to 24 months	5	34

"Chi square" = 13.52 for 6 degrees of variation. There is less than a 5% chance that the difference between both groups is due to chance. The difference is considered significant.

It is shown that the frequency decreases with age. Several infants had at least two pneumoencephalograms; the cavum veli interpositi was only shown during the first weeks of life and not during a subsequent air study.

A personal review of 400 pneumoencephalograms of adults and children older than 2 years reveals only 11 instances of cavum veli interpositi. In all these cases, the cistern was smaller and there was no correlation with any pathological condition. Our impression therefore is that a cavum veli interpositi is related to brain development and disappears with brain maturity.

Sex

Sex incidence is identical for males and females.

Clinical Indication for Pneumoencephalography

Table 3 shows the presence of a cavum veli interpositi according to the clinical indication for pneumoencephalography.

Table 3

Clinical condition	Cavum veli interpositi	
	Presence (%)	Absence (%)
Increase of cranial diameter	35	44
Subdural hematoma	11	11
Cerebral abnormality	15	8
Psychomotor retardation	15	20
Seizures	5	12
West's syndrome	11	2
Other neurological conditions	5	3

"Chi square" = 10.82 for 6 degrees of variation. The two groups are identical for the parameter studied. There is no correlation between clinical signs and the presence of a cavum veli interpositi.

Associated Pathological Conditions

Table 4 shows the presence of a cavum veli interpositi according to associated pathological conditions.

"Chi square" = 11.98 for 7 degrees of variation. There is no correlation between the partmeters.

Infectious Diseases

A past infectious disease existed in only 15% of infants with a cavum veli interpositi. The infection is either acquired (meningitis) or congenital (rubella or toxoplasmosis). There is no significant difference between the two groups.

Table 4

Pathological conditions	Cavum veli interpositi	
	Presence (%)	Absence (%)
Trisomy	0	2
Spina bifida	2	1
Meningocele	0	2
Apert's syndrome	4	0
Other craniofacial dysmorphisms	11	14
Other vertebral abnormalities	2	0
No abnormality	77	81

Table 5

	Cavum veli interpositi	
	Presence (%)	Absence (%)
Prematurity	13	6
No prematurity	87	94

Table 6

		Cavum veli interpositi	
		Presence (%)	Absence (%)
No Block		70	63
BLOCK	Opto chiasmatic arachnoiditis	24	24
	Stenosis of aqueduct of sylvius	4	7
	Imperforation of foramen of magendie	2	4

Prematurity

Relation between prematurity and the presence of a cavum veli interpositi.

"Chi square" = 1.9 for 1 degree of variation. No significant difference between the two groups.

Block of CSF Circulation

Relation between a block and the presence of a cavum veli interpositi:

There is no significant difference between the two groups.

The absence of air circulation at the level of the optochiasmatic cistern may give rise to a differential diagnosis in the infant. Indeed are we dealing with optochiasmatic arachnoiditis or with a technical artefact? The personal experience of the authors is that this represents a normal aspect in the newborn. In fact a subsequent pneumoencephalogram fairly often shows normal air circulation. Besides, such aspects of optochiasmatic block are seen frequently and independently of any clinical symptoms particularly ophtalmological.

The absence of any correlation between a block of the CSF circulation and the presence of a cavum veli interpositi may be surprising since dilatation of this cistern has often been imputed to hemodynamic troubles.

Cerebral Atrophy

Relation between cerebral atrophy and the presence of a cavum veli interpositi:

Table 7

	Cavum veli interpositi	
	Presence (%)	Absence (%)
Diffuse cerebral atrophy	9	23
Diffuse cisternal dilatation	7	0

"Chi square" = 11.93 for 2 degrees of variation. There is less than a one percent chance for this difference to be due to chance. The difference between the two groups is significant enough to rule out that the presence of a cavum veli interpositi may be related to cerebral atrophy. On the other hand, there is a correlation between the presence of a cavum veli interpositi and a diffuse dilatation of the cisternal system. But the meaning of this diffuse cisternal dilatation is sometimes questionable.

Hydrocephalus

Relation between the presence of a cavum veli interpositi and hydrocephalus:

Table 8

	Cavum veli interpositi	
	Presence (%)	Absence (%)
Hydrocephalus	13	34
Absence of hydrocephalus	87	66

"Chi square" = 7.58 for 1 degree of variation. The difference is highly significant; therefore there is no correlation between the presence of a cavum veli interpositi and hydrocephalus.

Diagnostic Factors

Relation between the presence of a cavum veli interpositi and the final neuroradiological diagnosis (Table 9). This table sums up some of the previous data.

"Chi square" = 28 for 6 degrees of variation. There is about a one per 1000 chance that the difference is due to a hazard. Paradoxically pneumoencephalography is more often normal in newborn infants with than in newborn infants without a cavum veli interpositi. This proves that the cavum veli interpositi has no pathological meaning.

Table 9

Neuroradiological diagnosis	Cavum veli interpositi	
	Presence (%)	Absence (%)
Communicating hydrocephalus	7	26
Non communicating hydrocephalus	6	7
Cerebral atrophy	7	22
Isolated ventricular dilatation of undertermined etiology	4	4
Cerebral mass lesion	11	8
Nervous system abnormality	5	11
Normal	58	20

Technical Factors

There is no correlation between the presence of a cavum veli interpositi and technical factors during pneumoencephalography, in particular the injection site (lumbar or suboccipital). There is no correlation either with a partial subdural injection.

Impression

1. The presence of a large cavum veli interpositi is a normal variant in premature and newborn infants as well as in infants less than eight months of age.
2. There is no statistical correlation between the presence of a cavum veli interpositi and an acquired or congenital pathological condition.
3. The cavum veli interpositi is related to brain development; it disappears with brain maturity.

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