SUMMARY AND CONCLUSIONS

Cerebrospinal fluid is an ultrafiltrate of plasma which circulates in the subarachnoid space, located between the pia and arachnoid membranes. It is largely produced by the choroid plexuses, while lesser amounts are produced by the ependymal cells lining the ventricles. The choroid plexus epithelium and associated capillary endothelium make up the blood-brain barrier and regulate the passage of substances into the CSF from blood. The arachnoid villi reabsorb the fluid.

The function of the CSF includes cushioning and lubrication of the central nervous system, circulation of nutrients, and waste collection. Total CSF volume is 90-150 mL in adults and 10-60 ml in neonates. There is a constant turnover of about 14% of the volume per hour. About 300-500 mL of CSF are formed per 24 hours (0.35 mL per minute). CSF is obtained by lumbar puncture, with removal of fluid from the lumbar sac, located at the L3-4 or L4-5 interspace. At this level, the needle cannot injure the spinal cord, which in adults ends at L1.

Noncommunicating hydrocephalus in adults remains a difficult diagnosis because of heterogeneous features. Aqueductal stenosis (AS) includes a large variety of etiologies: posthemorrhagic or postmeningitic obstruction, compression of the aqueduct, or presence of a third ventricle mass. Patients with late-onset AS present with various clinical and radiologic features. New theories have emerged about the pathogenesis of AS in adults, and venous hypertension has been suggested as the primary phenomenon responsible for ventricle dilataion and aqueductal obstruction.4 As a consequence, the determination of the underlying mechanism in hydrocephalus is relevant due to surgical implications because endoscopic third ventriculostomy (ETV) is mainly successful in obstructive hydrocephalus.
Aqueductal stenosis can result from a small lesion / neoplasm in the midbrain, debris or adhesions from hemorrhage or inflammatory diseases. MRI can exclude other lesions causing obstruction of the CSF flow through the aqueduct; such as lesions in the posterior third ventricle or posterior cranial fossa.

Cine MRI is now useful for the evaluation of CSF dynamic compromise especially in partial obstructive and communicating hydrocephalus. The typical features of related anatomy are shown on conventional MRI. Aqueductal stenosis (AS) is the most common form of non-communicating hydrocephalus in adults. Primary AS is an isolated stenosis of the aqueduct and secondary AS is caused by compression of the aqueduct by space-occupying intracranial lesions. Primary AS has been classified in four histological types: atresia, forking, septum and gliosis. Traumatic head injuries have been claimed to cause AS in a few cases, but the causal relationship is unclear. Headache is a frequent symptom in AS. In younger AS patients, other symptoms and signs of raised intracranial pressure are frequently found, such as obscurations, occulomotor disturbances, diplopia, papillary edema, nausea and tinnitus.

Phase-contrast MR imaging (PC-MR imaging) is a rapid, simple, and noninvasive technique, which is sensitive to CSF flows. In the past decade, the use of this technique has increased in the evaluation of cranial and spinal CSF flows, with considerable support in understanding the mechanical coupling between the cerebral blood and the CSF flows throughout the cardiac cycle (CC) and the temporal coordinated succession of these flows in healthy young subjects.

Further studies, by using PC-MR imaging, proposed a dynamic model for mechanical coupling between blood and CSF intracranial flows. The systolic arterial fill flow peak in the carotid arteries results in an instantaneous increase
of the intracranial pressure. The first and faster way to decrease intracranial pressure is a large CSF venting in the subarachnoid spaces, which drops the cerebral subarachnoid space pressure. Then flush flows occur in the cerebral venous and aqueductal CSF compartments.

An imbalance in this mechanical coupling is presumed to be responsible for pathologic cerebral states, such as normal pressure hydrocephalus (NPH) or Alzheimer disease. Despite technical controversies, CSF flow measurements at the aqueductal level have yielded considerable support for diagnosis and therapeutic decisions in communicating hydrocephalus. Nevertheless, to our knowledge, this technique has never been evaluated in AS.

Chiari malformations (CM) constitute an interesting clinical entity, where the embryological background still requires further studies. Recent imaging studies have increased the diagnostic ability of these anomalies enabling clinicians to adapt a conservative approach both in surgical and nonsurgical methods of management. The spectrum of clinical presentation in children differs significantly from that of adults or adolescents. While early surgical correction is recommended for symptomatic cases, incidental and asymptomatic malformations are best treated by watchful expectancy. In the majority of instances, improvement ensues in the symptoms, while minor disability in the form of neck pain and headache persists in a small group of patients. Often, this occurs with the group that has a normal volume of posterior fossa while those with small PCF volumes show remarkable improvement. More than 85% are relieved of their head and neck pain. With the fluidity of the definition of the adult Chiari malformation, as well as the increasing number of asymptomatic patients with significant radiological tonsillar herniation, it is the clinical judgment of the physicians evaluating this disorder that is of the utmost importance to avoid the therapeutic extremes of pursuing unnecessary surgery or with-holding necessary treatment from patients.