Pituitary Gland/ Suprasellar Region/ Pineal Region
Pituitary macroadenomas are the most common suprasellar mass in adults. Defined as pituitary adenomas greater than 10 mm in size. Patients typically present with symptoms of local mass effect on adjacent structures (especially optic chiasm). Some may present with hormonal imbalance, with symptoms of hypopituitarism (from compression) or secretion.
Craniopharyngioma

- Derived from pituitary gland embryonic tissue.
- Occur most commonly in children but also in men and women in their 50s and 60s.
- Most frequently arise in the pituitary stalk and project into the hypothalamus.
- Usually present as a single large cyst or multiple cysts.
Metastatic Disease

Small cell lung cancer metastatic to the hypothalamus/pituitary infundibulum.
Pituitary Apoplexy

- **Pituitary apoplexy** is an acute clinical syndrome caused by either hemorrhagic or non-hemorrhagic necrosis of the pituitary gland.
- Although variable, it typically comprises of headache, visual deficits, ophthalmoplegia, and altered mental status.
- An existing macroadenoma is usually present (60-90%) but it can occur with healthy glands in few isolated cases.
Pineal germinomas are the most common tumor of the pineal region accounting for ~50% of all tumors. There is a marked male predominance with a M:F of ~13:1. Most patients are 20 years or younger at the time of diagnosis. They can result in mass effect and compression of the tectal plate leading to obstructive hydrocephalus and Parinaud syndrome (upward gaze palsy).
Extra-axial Tumors (mass effect)
Vestibular Schwannoma

- **Vestibular schwannomas** are benign tumors that arise from the vestibulocochlear nerve (CN VIII).

- They classically present on imaging as a solid nodular mass with an intracanalicular component that often results in widening of the porus acusticus. They usually show intense contrast enhancement and, when larger, cystic degeneration can be present.

- The typical presentation is with adult-onset sensorineural hearing loss or tinnitus. In some patients, this goes unnoticed, and presentation is delayed until the lesion is much larger and presents with symptoms related to mass effect on the brainstem or cerebellum.
Metastatic Disease to the Temporal Region- Extra-axial
Cerebellopontine Angle Meningioma
Epidermoid cysts are benign congenital lesions of ectodermal origin. They account for approximately 1% of all intracranial tumors. Although these lesions are congenital, patients are usually not symptomatic until adulthood.
Glomus jugulare tumors are rare, slow-growing, hypervascular tumors that arise within the jugular foramen of the temporal bone and frequently involve the lower cranial nerves. They are included in a group of tumors referred to as paragangliomas.
Aneurysm
Inflammation/ Demyelinating/ Autoimmune Disease
Demyelinating lesions can be supratentorial or infratentorial. Usually bright on FLAIR and/or T2. Classic Dawson’s fingers on sagittal view.
Active Demyelination

Active demyelinating lesions show enhancement.
Osmotic Demyelination

• Concentrated, frequently symmetric, noninflammatory demyelination within the central basis pontis.
• Conditions predisposing patients to central pontine myelinolysis include alcoholism, liver disease, malnutrition, and hyponatremia. Risk factors for central pontine myelinolysis in the hyponatremic patient include the following:
  • Serum sodium of less than 120 mEq/L for more than 48 hours
  • Aggressive IV fluid therapy with hypertonic saline solutions
  • Development of hypernatremia during treatment.
Osmotic Demyelination in the Acute Phase
Limbic Encephalitis

Tumors which can result in limbic encephalitis:
- Small cell lung cancer (classic)
- Testicular germ cell tumor
- Thymic tumors
- Breast cancer
- Ovarian cancer
- Hematologic malignancies
- Gastrointestinal malignancies

- Bilateral mesial temporal lobe involvement is most common (60%).
Trauma
Hippocampal Sclerosis

- Hippocampal sclerosis (AKA mesial temporal sclerosis) is the most common pathologic substrate for temporal lobe epilepsy.
- MTLE with HS is often associated with a precipitating injury such as complex febrile seizures, birth trauma, meningitis, or head injury that happens in early life.
- A latent period of several years may precede dysexecutive seizures (previously known as complex partial seizures).
- The hippocampal MRI abnormalities in MTLE HS can be bilaterally symmetric, but more often are unilateral or clearly asymmetric.
- Brain MRI also frequently shows abnormalities of volume (atrophy) and signal (T2 increase or T1 decrease) in structures outside of the hippocampus, usually ipsilateral to the sclerotic hippocampus.
Another Case of MTS
Acute Traumatic Hemorrhage/Contusion
Post-traumatic Encephalomalacia
Hemorrhagic Diffuse Axonal Injury

GRE
Herpes Encephalitis

- Childhood and adult herpes encephalitis is usually due to HSV-1 (90%).
- Hyperintense medial temporal, inferior frontal cortex.
- Involvement of cingulate and contralateral temporal lobe very suggestive.
- Can hemorrhage.
Prion Disease

- Creutzfeldt-Jacob and variant CJD
- On T2WI and FLAIR the changes in the cortex can be difficult to detect. Diffusion weighted imaging can see them better.
- The pulvinar signal abnormality is in variant CJD.
- Hockey stick sign-restricted diffusion involving pulvinar and dorsomedial thalami.
Parasitic Infections

Toxoplasmosis

Neurocysticercosis

<table>
<thead>
<tr>
<th>First stage</th>
<th>Vesicular</th>
<th>Cyst + Scolex Non enhancement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second stage</td>
<td>Coloidal</td>
<td>Ring enhancement Edema</td>
</tr>
<tr>
<td>Third stage</td>
<td>Granular nodular degeneration</td>
<td>Decreased enhancement and edema Begins calcification</td>
</tr>
<tr>
<td>Fourth stage</td>
<td>Involution</td>
<td>Obvious calcification on CT and MRI (T2*WI)</td>
</tr>
</tbody>
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Table 1. Stages of cysticerci on MRI.
Congenital Anomalies
Heterotopias

- Normal neurons located in abnormal locations, anywhere from the subependymal region to the cerebral cortex.
- Result from the arrest of neuroblast migration.
- Patients commonly present with epilepsy
- Associated with pachygyria, agenesis of the corpus callosum, Chiari II malformation, arachnoid cyst, schizencephaly, and cephalocele
- Three types- subependymal, subcortical and band
Sulcation Anomalies

Lissencephaly—lack of development of sulci and gyri

Polymicrogyria—numerous small gyri. Predilection for the perisylvian region which is involved in 80% of patients and commonly bilateral involvement. Lines schizencephalic cleft.

Stenogyria—packing of small gyri with shallow sulci and preservation of the general sulcal pattern. Most common cortical malformation described in Chiari II and is seen predominantly in the posterior and medial portion of the hemispheres.

Open and closed lip schizencephaly—characterized by a CSF–filled cleft, which is lined by gray matter. The cleft extends across the entire cerebral hemisphere, from the ventricular surface to the periphery of the brain.
Asymptomatic Schizencephaly in an Adult
Tuberous Sclerosis

- Infantile spasms or myoclonic seizure most common presenting symptom
- Imaging – common findings
  - Subependymal Hamartomas
  - Subcortical “Tubers”
  - T2 hyperintensity along Radial-glial lines
Sturge-Weber

- Angiomatosis involving face, choroid of the eye and leptomeninges
- Important to delineate extent of leptomeningeal angioma if resection is planned
  - Post contrast images best for showing angioma
  - “Burned out” calcified lesion may not have enhancement
Resting State Functional MRI- The State of the Art in Functional Sleep Imaging

Our brain is a network. It consists of spatially distributed, but functionally linked regions that continuously share information with each other. Functional connectivity is defined as the temporal dependency of neuroimaging activation patterns of anatomically separated brain regions and in the past years an increasing body of neuroimaging studies has started to explore functional connectivity by measuring the level of co-activation of resting-state fMRI time-series between brain regions. These studies have revealed interesting new findings about the functional connections of specific brain regions and local networks, as well as important new insights in the overall organization of functional communication in the brain network.

This resting brain activity is observed through changes in blood flow in the brain which creates what is referred to as a blood-oxygen-level dependent (BOLD) signal.


Increased interhemispheric resting-state functional connectivity after sleep deprivation: a resting-state fMRI study.

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Abstract

Several functional imaging studies have investigated the regional effects of sleep deprivation (SD) on impaired brain function; however, potential changes in the functional interactions between the cerebral hemispheres after SD are not well understood. In this study, we used a recently validated approach, voxel-mirrored homotopic connectivity (VMHC), to directly examine the changes in interhemispheric homotopic resting-state functional connectivity (RSFC) after SD. Resting-state functional MRI (fMRI) was performed in 28 participants both after rest wakefulness (RW) and a total night of SD. An interhemispheric RSFC map was obtained by calculating the Pearson correlation (Fisher Z transformed), between each pair of homotopic voxel time series for each subject in each condition. The between-condition differences in interhemispheric RSFC were then examined at global and voxelwise levels separately. Significantly increased global VMHC was found after sleep deprivation; specifically, a significant increase in VMHC was found in specific brain regions, including the thalamus, paracentral lobule, supplementary motor area, postcentral gyrus and lingual gyrus. No regions showed significantly reduced VMHC after sleep deprivation. Further analysis indicates that these findings did not depend on the various sizes of smoothing kernels that were adopted in the preprocessing steps and that the differences in these regions were still significant with or without global signal regression. Our data suggest that the increased VMHC might reflect the compensatory involvement of bilateral brain areas, especially the bilateral thalamus, to prevent cognitive performance deterioration when sleep pressure is elevated after sleep deprivation. Our findings provide preliminary evidence of interhemispheric correlation changes after SD and contribute to a better understanding of the neural mechanisms of SD.


Abstract

Resting-state functional magnetic resonance imaging (rs-fMRI) is widely used to investigate the functional architecture of the healthy human brain and how it is affected by learning, lifelong development, brain disorders or pharmacological intervention. Non-sensory experiences are prevalent during rest and must arise from ongoing brain activity, yet little is known about this relationship. Here, we used two runs of rs-fMRI both immediately followed by the Amsterdam Resting-State Questionnaire (ARSQ) to investigate the relationship between functional connectivity within ten large-scale functional brain networks and ten dimensions of thoughts and feelings experienced during the scan in 106 healthy participants. We identified 11 positive associations between brain-network functional connectivity and ARSQ dimensions. ‘Sleepiness’ exhibited significant associations with functional connectivity within Visual, Sensorimotor and Default Mode networks. Similar associations were observed for ‘Visual Thought’ and ‘Discontinuity of Mind’, which may relate to variation in imagery and thought control mediated by arousal fluctuations. Our findings show that self-reports of thoughts and feelings experienced during a rs-fMRI scan help understand the functional significance of variations in functional connectivity, which should be of special relevance to clinical studies.
Fig 3: BrainMap components are well matched to ICA components. Ten ICNs from the analysis of the 29,671-subject BrainMap activation database (Right column of each pair: [37]) paired to 10 ICNs that were selected out of 20 components from the ICA analysis of the current rs-fMRI dataset (right column). The networks were paired using spatial cross-correlation with mean $r = .46$ (range = .25–.71); the weakest of these correlations thus has a significance of $P = 10^{-5}$ (corrected). All ICA spatial maps were converted to $Z$ statistic images via a normalized mixture-model fit and then thresholded at $Z = 3$. The figure shows the 3 most informative orthogonal slices for each pair. ICNs are displayed in a gradient from red to yellow ($3 < Z < 5$), superimposed on the MNI152 standard space template image, in radiological convention (left = right). The $r$ statistic is displayed at the top of each panel.
Magnetoencephalography (MEG) is the measurement of the magnetic field generated by the electrical activity of neurons.

It is usually combined with a magnetic resonance imaging to get what is called magnetic source imaging.

The technology that has helped record these minute magnetic fields is super-conducting quantum interference detector which is like a highly sensitive magnetic field meter.

The actual sensors recording magnetic fields are magnetometers and/or gradiometers.

MEG fields pass through the head without any distortion. This is a significant advantage of MEG over electroencephalography.

MEG provides a high spatial and temporal resolution.

MEG currently has two approved indications in the United States, one is for pre-operative brain mapping and the other is for use in epilepsy surgery.

MEG studies have shown functional brain tissue inside brain tumors.

Thank you for your attention and enjoy your holiday weekend!

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