Metastatic Brain Tumor

Patient's profile

ผู้ป่วยชายไทย อายุ 45 ปี ถนัดซ้าย ปฏิเสธประวัติโรคประจำตัว ภูมิลำเนา จังหวัดพระนครศรีอยุธยา สิทธิ ประกันสุขภาพถ้วนหน้า

Chief complaint

แขนซ้ายอ่อนแรง 1 เดือนก่อนมาโรงพยาบาล

Present illness

1 month PTA อ่อนแรงแขนซ้าย เขียนหนังสือไม่ได้ ค่อยๆเป็นมากขึ้นขาซ้ายอ่อนแรงเล็กน้อยรักษาที่ รพ แถวบ้าน ได้รับการรักษาแบบโรคสมองขาดเลือด ได้รับยา ASA แต่อาการไม่ดีขึ้น จึงหยุดยาเอง, ไม่มีเบื่ออาหาร น้ำหนักลด จาก 76 เป็น 74 กิโลกรัม ใน 1 เดือน ไม่ได้ตั้งใจลดน้ำหนัก ไม่มีอาการชัก ไม่มีไข้ มีอาการสับสนซ้ายขวา มีอาการชา ปากเบี้ยวข้างซ้าย พูดไม่ชัด เดินได้แต่เซ ต้องมีคนพยุง มีอาการปวดหัวเล็กน้อย 2-3 ครั้ง

Past history

ปฏิเสธประวัติโรคประจำตัว และยาที่ใช้เป็นประจำ

ปฏิเสธประวัติแพ้ยาแพ้อาหาร

ปฏิเสธประวัติอุบัติเหตุ

Social history

สูบบุหรี่ ตอนอายุ 25 ปี สูบได้ 1 ปีแล้วเลิก

ดื่มสุราเพื่อสังสรรค์

ปฏิเสธประวัติการใช้ยาต้ม ยาหม้อ ยาลูกกลอน สมุนไพร หรืออาหารเสริมอื่นๆ

Family history

ในครอบครัวมีสมาชิก 5 คน ได้แก่ ผู้ป่วย ภรรยา ลูกชาย แม่ และย่าของตัวผู้ป่วย

ให้ประวัติ ยายเป็นมะเร็งเต้านม

Physical Examination

V/S: BT 37 C, BP 125/93 mmHg, HR100 bpm, RR 20/min, SpO2 95%

General appearance : A Thai middle age male looks confused, good cooperative, oriented to time,place,and person

HEENT: no pale conjunctiva, anicteric sclera, cervical lymph nodes and thyroid gland cannot be palpated

CVS: regular pulse, normal S1, S2 , no murmur, capillary refill<2 seconds

RS: clear and equal breath sound both lungs, no adventitious sound

Abdomen: not seen surgical scar, normoactive bowel sound, soft, no tenderness, no guarding

Extremities: no pitting edema

Skin: warm and moist skin, no rash

Neurological Exam

Mental status

- Level of consciousness: E4V5M6, confused
- Content of consciousness:
  - Oriented to time, place and person
  - Impaired registration and attention
  - Impaired calculation
  - Agraphia

- Cranial nerves
  - CN I: normal both sides

- CN II, III: pupils 3mm RTLBE, RAPD negative.
- CN III, IV, VI: full EOM, no nystagmus
- CN V: corneal reflex positive, normal sensation on V1-V3, normal facial sensation, no masseter and temporalis muscle atrophy
- CN VII: Left facial palsy UMN, no dysarthria
- CN VIII: normal hearing both ears by screening test.
- CN IX: uvula no deviate
- CN X: normal gag reflex
- CN XI: no weakness of trapezius and sternocleidomastoid muscle
- CN XII: no tongue deviation

- Motor
  - No muscle atrophy
  - Normal muscle tone
  - Motor power

	Rt.	Lt.
upper	V	III
lower	V	IV

- Sensory
  - Normal pain, temperature and touch sensation
  - Normal proprioception and vibration
  - Finger agnosia
  - Left and right disorientation

- Reflex Rt. Lt.

Biceps	2+	2+
Triceps	2+	2+
Brachioradialis	2+	2+
Patellar	3 +	2+
Achilles reflex	2+	2+

Babinski's sign - negative

- Cerebellar sign
  - finger to nose test: cannot evaluate on the left due to weakness, Rt side - intact
  - Dysdiadochokinesia : normal
  - Heel to shin can not evaluate due to confusion
  - truncal ataxia cannot evaluate due to confusion
  - Romberg sign can not evaluate due to confusion

- Stiffness of neck: Kernig's sign negative, Brudzinski's sign negative

Pertinent findings

- Left arm and leg weakness for 1 month
- Dysarthria
- Acalculia
- Agraphia
- Left and Right disoriented

Problem List

1. Left Hemiplegia for 1 month
2. Gerstmann syndrome

Differential Diagnosis

เนื่องจากผู้ป่วยมีประวัติ Focal neurological deficits ได้แก่ Contralateral Hemiparesis และ Contralateral facial palsy โดยลักษณะการอ่อนแรงจะเป็นบริเวณแขนมากกว่าขา อีกทั้งยังมี Gerstman syndrome ได้แก่ Acalculia, Agraphia, Left and right disorientation จึงสามารถบอกได้ว่าตำแหน่ง lesion อยู่บริเวณ cerebral hemisphere ในหลายส่วน ได้แก่ frontal lobe, Parietal lobe ฝั่ง dominant โดยการดำเนินโรคที่เกิดขึ้นค่อนข้างเร็วเป็นแบบ acute onset จึงสามารถจำแนกสาเหตุการเกิดของอาการได้ดังต่อไปนี้

1. Tumor

เนื่องจากผู้ป่วยมาด้วยอาการProgressive focal neurological deficit และมีprogressionของอาการค่อนข้างเร็วจึงนึกถึงmalignancyมากกว่าbenign Malignancyที่นึกถึงกลุ่มเนื้องอกสมองที่นึกถึงคือ

- Primary brain tumor
    - กลุ่ม Malignant gliomas ประกอบด้วย
        i. Anaplastic astrocytomy(WHO grade III)

        เนื่องจากเป็นเนื้องอกในสมองที่พบในผู้ชายมากกว่าผู้หญิง อายุของผู้ป่วยอยู่ในช่วงอายุ 40-50ปี มักมาด้วยอาการ focal neurological deficit ซึ่งเข้าได้กับผู้ป่วยรายนี้ ส่วนอาการอื่นๆที่สามารถพบได้เช่น อาการของIncrease intracranial pressure เช่น ปวดศีรษะตอนเช้าหลังตื่นนอน ไอ จาม เบ่งแล้วปวดมากขึ้น อาเจียนแล้วปวดน้อยลง projectile vomiting เห็นภาพซ้อน ตาพร่ามัว ซึมลง หมดสติ, seizures ซึ่งในผู้ป่วยรายนี้ไม่พบ Common

siteของเนื้องอกชนิดนี้อยู่ที่frontal lobe
ซึ่งสามารถอธิบายเรื่องอาการอ่อนแรงของผู้ป่วยรายนี้ได้

ii. Glioblastoma multiforme(WHO grade IV)
เนื่องจากเป็นเนื้องอกในสมองชนิด primary brain tumor ที่พบมากที่สุด
พบในผู้ชายมากกว่าผู้หญิง มักมาด้วยอาการ focal neurological deficit
ซึ่งเข้าได้กับผู้ป่วยรายนี้ ส่วนอาการอื่นๆที่สามารถพบได้เช่น
อาการของIncrease intracranial pressure, seizures
ซึ่งในผู้ป่วยรายนี้ไม่พบ Common site ของเนื้องอกชนิดนี้อยู่ที่
supratentorial ซึ่งสามารถนึกถึงได้ในรายนี้
ข้อคัดค้านคืออายุผู้ป่วยไม่ได้อยู่ในช่วงอายุ 55-60 ปี
แต่ก็ยังสามารถนึกถึงได้

- Meningioma เนื่องจากมีอาการปวดศีรษะ มี focal neurological deficit
พบมากในช่วงอายุ 40-50ปีข้อคัดค้านคือไม่มีrisk factor เช่น ได้รับสารกัมมันตรังสี,
มีประวัติติดเชื้อ Inoue-Melnick virus(IMV), หรือประวัติมี BRCA gene, estrogen
receptor, Dopamine D1 receptor และพบในผู้หญิงมากกว่าผู้ชายสัดส่วน 2:1

- Metastasis เนื่องจากพบอาการอ่อนแรงและมีอาการแบบacute ส่วนอาการอื่นๆที่พบได้ เช่น
ปวดศีรษะ ชักได้แต่ในผู้ป่วยรายนี้ไม่พบอาการเหล่านี้ ไม่มีประวัติเบื่ออาหารน้ำหนักลด
และหากตรวจร่างกายอาจพบ papilledema แต่ในผู้ป่วยรายนี้ไม่ได้ตรวจ ophthalmoscope

2. Infection โดยโรคที่นึกถึงคือ Brain abscess เนื่องจากมีประวัติปวดศีรษะร่วมด้วย ตรวจร่างกายมี
focal neurological deficit อาการมาแบบ acute onset และไม่จำเป็นต้องมีไข้
แต่เนื่องจากผู้ป่วยไม่มีประวัติการติดเชื้ออื่นๆ เช่น TB, Bacterial infection หรือ Fungal infection
ไม่มีประวัติการใช้สมุนไพร ยาต้ม ยาหม้อ ยาลูกกลอน หรือ ประวัติการใช้ steriod ไม่ได้จัดเป็นกลุ่ม
immunocompromise host จึงทำให้นึกถึงสาเหตุนี้ลดลง

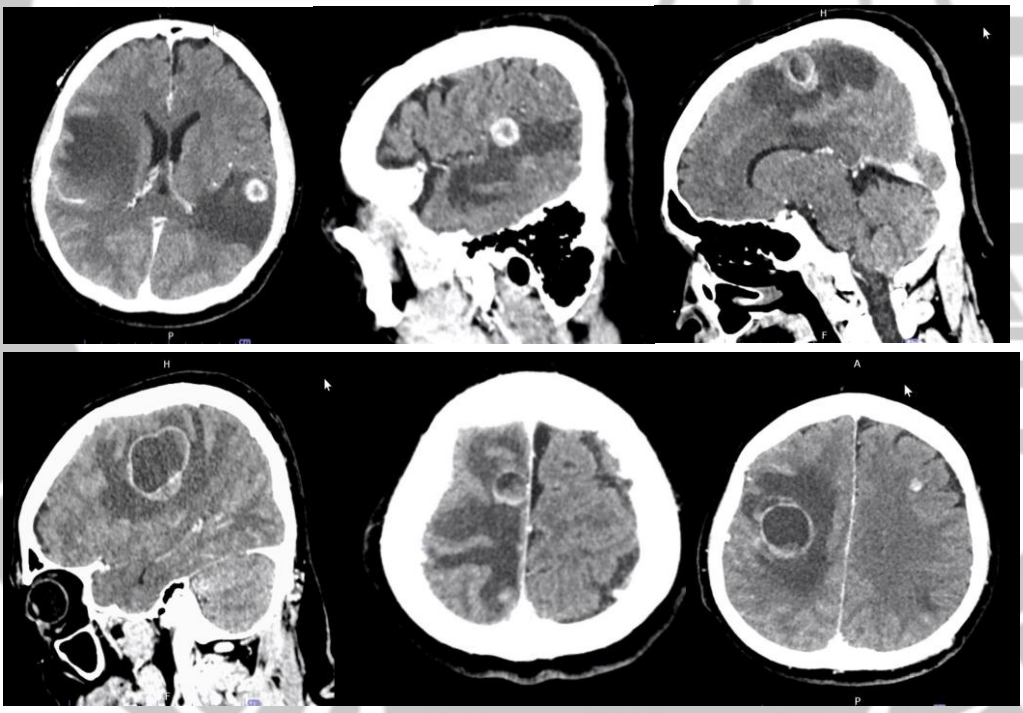
3. Vascular สำหรับโรคที่นึกถึงได้ คือ Arteriovenous malformation
เนื่องจากมาด้วยอาการอ่อนแรงซีกซ้ายเป็น focal neurological deficit มีอาการของ dysarthria

ซึ่งอาจเกิดจากภาวะ “steal phenomenon” ได้แต่มีข้อค้านคือ อายุผู้ป่วย
เนื่องจากภาวะนี้มักพบในคนอายุน้อยกว่า 35 ปี ส่วนสาเหตุอื่นของvascular เช่น ischemia และ hemorrhage นึกถึงได้น้อยเนื่องจากอาการไม่ได้ sudden onset

Investigation

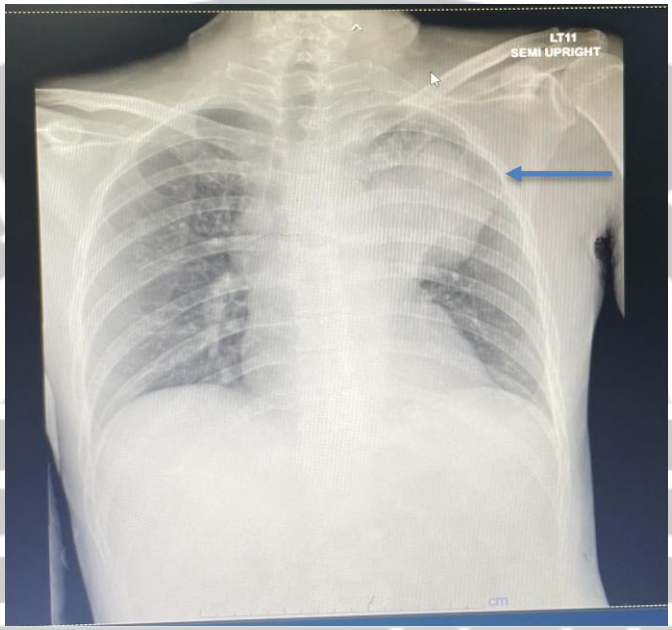
CT brain with contrast

- Multiple brain metastasis, at least 4 lesions, largest at right parietal lobe rounded, well circumscribed hypodense lesion with enhancing rim size about 3*3*4 cm with vasogenic edema



Chest X ray

- Left upper lung mass (Arrow)



Management

- Set OR for Left craniotomy with tumor removal under navigator
- Levetiracetam 500 mg 1tab po before OR
- Mannitol (20 mg) 500 ml IV before OR

Discussion

Metastatic Brain Tumors

General information

Tumors that spread to the brain from a primary neoplasm located in other organs of the body are referred to as metastatic brain tumors. Brain metastases are a common complication of cancer and the most common type of brain tumor. Anywhere from 10% to 26% of patients who die from their cancer will develop brain metastases. While few cancers that metastasize to the brain

can be cured using conventional therapies, long-term survival and palliation are possible with minimal adverse effects to patients. Increasingly, neuro-cognition and quality of life are being recognized as important endpoints for patients as survival continues to increase.

Epidemiology

Brain metastases are the most common type of intracranial tumor. In the United States, an estimated 98,000 to 170,000 cases occur each year. The incidence of brain metastases is increasingly likely because of several factors. Patients with a systemic metastatic disease have a longer survival with new systemic therapies (including immunotherapy) that have recently seen more widespread use. Furthermore, the growing use of sensitive magnetic resonance imaging (MRI) techniques has contributed to the better detection of small asymptomatic brain metastases.

Etiology

Virtually any systemic malignancy can metastasize to the brain, but there are some that have a greater proclivity to do so. Melanoma tends to metastasize to the brain. Other malignancies such as lung, breast, renal and colon cancers are also frequently encountered. Metastatic brain tumors tend to be more common in adults than in children and occur in men and women with equal frequency.

Sources of cerebral metastases in adults	
Primary tumor	%
Lung CA	44
Breast	10
Kidney (Renal cell))	7
GI	6
Melanoma	3
Undetermined	10

Reference: Handbook of Neurosurgery 9th edition

Pathophysiology

Metastatic cancer passes through the bloodstream and enters the central nervous system through a breakdown of the blood-brain barrier. Clonal cells then proliferate, causing local invasion, displacement, inflammation, and edema. Distribution throughout the central nervous system is more common in areas of high blood flow; however, different histological subtypes tend to have different distributions of location within the brain.

Clinical presentation

Besides the following symptoms, many patients may experience additional complications caused by the original tumor and its related manifestations.

- Increased Intracranial Pressure (ICP): In most patients, symptoms of brain metastases are caused by the expansion of lesions and increased ICP. The most common symptoms of increased ICP are headache, vomiting and disturbance of consciousness.
- Headache: Headache is the initial symptom in about half of brain tumor patients and is eventually experienced by the majority, at some point.
- Vomiting: Vomiting is an occasional accompaniment to the headache. It is far more common in children than in adults. In children, vomiting may be especially dramatic or forceful, so much so that it may be labeled as “projectile” in nature.
- Alteration in Consciousness: Patients at some point commonly experience alterations in consciousness, including both the level of consciousness and/or its quality. A brain tumor can induce a wide spectrum of changes in mental status, ranging from subtle alterations in personality to states of profound and irretrievable coma.

- Seizures (Epileptic Seizures/Fits): Seizures are associated with brain tumors in almost 35 percent of patients. Age increases the risk of epilepsy caused by a tumor especially in individuals beyond 45 years of age.
- Focal (Specific) Neurological Symptoms: Whereas headaches, altered mental status and seizures may be seen with tumors that occur in many parts of the brain, some symptoms are associated with tumors that occur in specific locations. These focal neurological symptoms affect the side of the body opposite from the side where the tumor resides and may include different modalities of sensation such as tingling and motor changes (hemiparesis).

Investigations

A head computed tomogram (CT) allows for a quick examination, although fine-slice MR of the brain with contrast is the gold standard for neuroimaging in cases of suspected brain metastases. MR allows for a determination of the number and anatomical location of tumors and the degree of associated edema. Basic laboratory assessment including complete blood count, metabolic panel, and liver function test should be performed.

Treatment

Initial Treatment

1.Anticonvulsant : e.g. Keppra (levetiracetam) start with 500 mg PO or IV q 12 hr. Generally not needed for posterior fossa lesions

2.Corticosteroids: Many symptoms are due to peritumoral edema (which is primary vasogenic), and respond to steroids within 24-48 hrs. This improvement is not permanent, and prolonged steroid administration may produce side effects. Typical dose for a patient with significant symptoms who is not already on steroids: Dexamethasone 10-20 mg IV, followed by 6 hrs for 2-3 days, after which it is converted to 4 mg PO QID. Once symptoms are controlled, this is tapered to 2-4 mg PO TID as long as symptoms do not worsen.

3.H2 antagonist (e.g. Ranitidine 150 mg PO q 12 hrs) or Proton pump inhibitor(Omeprazole)

Definite Treatment

1. Surgical resection (for limited brain metastases in patients with good performance status and surgically accessible lesions). The historical standard in patients with good performance status has been surgical resection. Local recurrence following surgical resection remains high, with one trial recently reporting 12-month freedom from local recurrence of 43% following surgical resection and observation. Local control can be improved with post-operative radiosurgery or whole-brain radiotherapy. Postoperative therapy should remain an individualized treatment recommendation, considering the number of non-resected metastases, tumor histology, follow-up, and patient preference. Whole-brain radiotherapy following surgical resection of brain metastases can increase intracranial control compared to postoperative stereotactic radiosurgery but results in poorer neuro-cognitive outcomes.
2. Whole-brain radiotherapy is given by daily radiotherapy treatments (usual 10 to 15) targeting the whole brain. For patients with poor performance status or many brain metastases, the standard of care is whole-brain radiotherapy. Whole-brain radiotherapy provides control of individual brain metastases as well as reduces the risk of failure in the

brain at a new site. These benefits must be weighed against its potential neurocognitive side effects which occur for many patients to a varying degree. Emerging data suggest that for patients with extremely poor performance status, whole-brain radiotherapy may have a minimal benefit over steroids alone. Therefore, in the management of brain metastases, treatment decisions will need to be made on an individual patient level, taking into account the goals of treatment in a particular situation as well as the acceptable side effect profile.

3. Stereotactic Radiosurgery is a more precise form of radiotherapy which delivers a large dose only to the area of the brain metastasis, usually in a single fraction. For patients either not eligible for surgical resection of brain metastases or who elect for non-surgical therapy, stereotactic radiosurgery offers an excellent option for controlling a limited number of intracranial metastases. Although first used in combination with whole-brain radiotherapy to intensify local treatment, stereotactic radiosurgery is now commonly used as a stand-alone therapy. While ultimate control of brain metastases varies with dose and lesion size, lesions less than one centimeter has high local control with single-fraction radiosurgery. For larger lesions, multi-fraction treatments are sometimes employed. Stereotactic radiosurgery is considered standard for patients with one to four brain metastases, but emerging data indicate it may be an acceptable treatment for patients with up to ten brain metastases.

Each of these treatments has distinct advantages as well as a unique side effect profile. A multidisciplinary treatment team of a neurosurgeon, radiation oncologist, and neuro-oncologist should participate in the formulation of the treatment plan together with the patient.

Prognosis

Many people with metastatic brain tumors have widespread tumor metastasis. The effectiveness of treatment of brain metastases is almost always determined by how well the primary cancer is controlled. In the absence of control of the primary cancer, treatment of metastatic brain

tumors would be a futile endeavor. The prognostic factors are complex and largely depend upon the status of systemic disease, extent of neurological deficit, length of time between first diagnosis of cancer and the diagnosis of brain metastasis, the type of primary tumor and the nature, size and invasiveness of the metastatic lesion, among other things. Hence, careful coordination and communication between the neurosurgeon, radiation oncologist and primary oncologist is essential. Relapse of disease either in the brain or the body is common and hence, frequent, and consistent follow-up with imaging studies is also essential.

Median survival of patients with brain metastasis

Type of cancer(s)	Median survival (months)	Median survival by GPA (months)
Overall	7-12	
Lung adenocarcinoma (NCLC)	15	7-46
Breast cancer	14-16	3-36
Melanoma	7-10	5-34
GI cancer (Gastric, Colon, Pancreas)	5-8	3-17
Renal cell carcinoma	10-12	4-35

Graded Prognostic Assessment (GPA): 4 prognostic factors; Age, Karnofsky performance status (KPS), extra-cranial metastes, and number of brain metastases.Brainmetgpa.com was used to calculate the GPA for an individual patient.

Gerstmann's syndrome

In 1924 the Austrian neuroscientist Josef Gerstmann described a rare neurological disorder which was observed by him in a few patients consisting of tetrad of symptoms

1. Acalculia: an impairment in performing calculations
2. Finger agnosia: discriminating their own fingers
3. Agraphia: can not writing by hand
4. Left-right disorientation: distinguishing left and right

This syndrome is also described in normal apparently but brain-damaged children, who present with learning disability, where it's called developmental Gerstmann's syndrome.

Etiology

Gerstmann's syndrome is caused by specific brain lesions which affect the posterior lobule of the parietal lobe in the dominant hemisphere, which is usually in the left hemisphere but in some patients it could be the right, especially the angular gyrus and adjacent structures (at the confluence of parietal, temporal and occipital lobes), some studies showed that it's caused not only by lesion in the mentioned area but also in the left middle frontal lobe of the dominant hemisphere. The cause of this syndrome may be from

- Ischemic stroke, Tumors.
- Carotid artery dissecting aneurysm or stenosis.
- Middle cerebral artery aneurysm.
- Progressive multifocal leukoencephalopathy.
- Chronic subdural hematoma.
- Multiple sclerosis.
- Cortical atrophy.

Other diffuse etiologies are:

- Alcoholism.
- Carbon monoxide poisoning.
- Lead intoxication.
- Anaphylactic shock.
- Systemic lupus erythematosus.

Other reported cases presented with Gerstmann's syndrome, like cystic lesions with dilated perivascular spaces, as a complication of cerebral angiography, as a complication of the contrast which is used in angiography, as a complication of endovascular treatment of dural arteriovenous malformation,
posterior leukoencephalopathy syndrome,necrotizing granulomatous inflammation
of small-medium sized subarachnoid vessels,adverse drug reaction of Acetazolamide and embolism from left atrial myxoma. Transient symptoms of this syndrome may occur as a result of parietal lobe epilepsy.

Epidemiology

Because of the variation of the causes, this syndrome can occur in children, young and elderly patients, where it has been called "developmental Gerstmann's syndrome" in children.Finding a patient with two to three symptoms of this syndrome is not rare but finding a patient with the full syndrome is rare.

- symptoms of this syndrome may be complete or partial and may be attributed to other cerebral symptoms and can occur in elderly and children.

- This syndrome may be transient and caused as an ictal symptom in partial epilepsy, but it may occur as 3 symptoms out of 4.
- The symptoms and signs of this disease in children may appear late in the years after perinatal asphyxia and may only suffer from other symptoms in the neonatal period; seizures.
- Other symptoms and signs which may accompany this syndrome differ according to the cause of this syndrome such as; apraxia, optic ataxia,cognitive decline, numbness or weakness.Gesture imitation defects and toe agnosia may be seen as an association with finger agnosia so it may be named as digit agnosia.
- Developmental Gerstmann's syndrome occurs in children with the tetrad of the mentioned symptoms, with or without dyspraxia as a fifth symptom
- As the number of Gerstmann's syndrome component increased the responsible brain lesion tend to be larger

Some special neurological examination should be done to diagnose the 4 components of Gerstmann's syndrome;

Finger Agnosia: The examiner should cover the patient eyes and ask him to stretch his fingers, then the examiner should touch the patient fingers lightly and the patient should respond by identifying the finger as soon as it was touched, this examination should be done firstly with opened eyes to eliminate the misunderstanding or lack of alertness, this test may be affected if the patient has tactile insensitivity, a minimum 20% false recognition by the patient is needed to diagnose the patient with finger agnosia.

Right-left disorientation: physician should give the patient a card with written instruction such as " place left hand to right ear" and the patient should be asked to read it loudly, if the patient read it incorrectly, the physician should contact with the patient verbally, then the patient should be asked to do similar instruction.

Dysgraphia: physician should show a clock to the patient, and the patient should write the name of it without saying it firstly, then physician should show the word "SEVEN" to the patient, and after having read it, and presenting it orally, patient should be asked to write it, then the patient should repeat the sentence " He shouted the warning" and should explain it and write it.

Dyscalculia: a patient should be given a card which has this simple equation written on it "85-27" and he should be asked to write it and calculate it, then the patient should be asked to do a multiplying equation in his head without writing it or seeing it.

Any patient with the symptoms and signs of Gerstmann's syndrome should be evaluated by neuroimaging MRI/CT scan, abnormalities should be seen in the dominant angular gyrus with or without the involvement of the surrounding areas, abnormalities that should be seen in the imaging differs according to the cause of the syndrome.

Treatment / Management

Some causes of Gerstmann's syndrome may be reversible and can be treated such as, removing the tumor, the hemorrhage or epilepsy focus lesion or treating the diffuse etiology such as carbon monoxide poisoning

Differential Diagnosis

- Posterior cortical atrophy which shares the symptom of agraphia with Gerstmann's syndrome, other symptoms includes; hemineglect, optic ataxia, and verbal alexia.
- Some occipital lobe lesions which include agraphia with Alexia.
- Alzheimer disease, which causes degeneration of the networks in the brain, and may have an association with gerstmann syndrome, also the Syndrome of progressive posterior cortical dysfunction may cause similar symptoms, and sometimes causing the syndrome itself

Prognosis

Presence of Gerstmann's syndrome with other disorder can make the normal life impossible, mainly due to the severe light-left disorientation. patient with Gerstmann's syndrome may show an excellent recovery after intensive rehabilitation and treatment, but acalculia may have a delay in the recovery. Also, children with developmental Gerstmann's syndrome may exhibit improvement in the syndrome, but this may require early recognition and diagnosis of the syndrome.

Care Coordination

For patients with Gerstmann's syndrome coordination between neurologist, psychiatrist, physiotherapist, occupational therapist, home health nurses, and neurosurgeon should be applied to get a better outcome.

Dominant Hemisphere

As mentioned above, the dominant hemisphere was usually the left hemisphere. The left hemisphere almost exclusively handles language and speech, the right handles emotion and image

processing but only about 20 percent of left-handed patients have brains that divide up these duties so rigidly. There are 20 percent of left-handed patient to have right dominant hemisphere.

When a person experiences a stroke, brain tumor, or injury that affects the dominant side of the brain, the ability to use language is disrupted.

The language areas of the brain include several structures that are in the frontal, temporal, and parietal lobes. A stroke or another injury to any of these specialized language regions, which include Broca's area, Wernicke's area, and the arcuate fasciculus, can cause specific types of aphasia that correspond to the specific language region of the brain affected by the stroke or brain injury.

Some of the most common types of aphasia include:

- Expressive aphasia, also known as Broca's aphasia: The inability to speak in a fluent and clear way.
- Receptive aphasia, also known as Wernicke's aphasia: The inability to understand the meaning of spoken or written language. Often, people who have Wernicke's aphasia can speak fluently but speak with words and phrases that do not make sense.
- Anomic or amnesia aphasia: The inability to find the correct name for objects, people, or places.
- Global aphasia: The inability to speak or understand speech, read, or write

References

American Association of Neurological Surgeons. Metastatic Brain Tumors. Neurosurgical Conditions and Treatments [Internet]. 2022 [cited 2022 Sep 11]. Available from: https://www.aans.org/en/Patients/Neurosurgical-Conditions-and-Treatments/Metastatic-Brain-Tumors

Amsbaugh MJ, Kim CS. Brain Metastasis. [Updated 2022 Apr 9]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan [cited 2022 Sep 11]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470246/

Keith J. Stelzer. Survival in Patients With Brain Metastases: Summary Report on the Updated Diagnosis-Specific Graded Prognostic Assessment and Definition of the Eligibility Quotient. [Updated 2020 Sep 15]. [cited 2022 Sep 11]. Available from: https://ascopubs.org/doi/10.1200/JCO.20.01255

GERSTMANN JS.Syndrome of finger agnosia, disorientation for right and left agraphia and acalculia local diagnostic value. Arch NeurPsych. 1940;44(2):398-408. Available from: https://jamanetwork.com/journals/archneurpsyc/article-abstract/648570

Roux FE, Boetto S, Sacko O, Chollet F, Trémoulet M.Writing, calculating, and finger recognition in the region of the angular gyrus: a cortical stimulation study of Gerstmann syndrome.J Neurosurg. 2003 Oct;99(4):716-27. Available from: https://pubmed.ncbi.nlm.nih.gov/14567608/

Altabakhi IW, Liang JW. Gerstmann Syndrome. Treasure Island (FL): StatPearls Publishing; 2022 Jan Available from:https://www.ncbi.nlm.nih.gov/books/NBK519528/

Jang A, Smith TA, Trainor S, Caldwell PC.Manifestation of metastatic lung adenocarcinoma as Gerstmann syndrome.[Internet] Available from: http://dx.doi.org/10.1136/bcr-2020-238098

Mark S. Greenberg. Handbook of Neurosurgery 9th ed. New york: Thieme Medical Publishers,Inc.; 2020

บุญเลิศ มิตรเมือง. Textbook neurosurgery สำหรับนักศึกษาแพทย์และแพทย์เพิ่มพูนทักษะ. พิมพ์ครั้งที่1. ชุมพร: ศูนย์แพทยศาสตรศึกษาชั้นคลินิก โรงพยาบาลชุมพรเขตรอุดมศักดิ์; 2562

The Dominant Brain Hemisphere Controls Language [Internet]. Verywell Health. 2022 [cited 15 September 2022]. Available from: https://www.verywellhealth.com/what-is-the-dominant-language-hemisphere-3146147#:~:text=The%20dominant%20hemisphere%20of%20the%20brain%20is%20usually,dominant%20hemisphere%20may%20be%20on%20the%20right%20side.

จัดทำโดย

1. นายษมาวีร์ จิระบรรจง 6011670285

2. นางสาวรสิตา ณ ระนอง 6011670590

3. นางสาวลลิต ภาวิลาส 6011670251

4. นางสาวป่านตะวัน สมภาร แพทย์ฝึกหัด