

Hemianopsia

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ABSTRACT

Hemianopsia is a visual field defect characterized by the loss of vision in one half of the visual field. It is caused by damage to the optic nerve, optic tract or the visual cortex in the brain.

Common causes of hemianopsia are stroke, brain tumors, multiple sclerosis, migraine. Hemianopsia is Heteronymous and Homonymous. Heteronymous Hemianopsia is Bitemporal and Binasal. Bitemporal Hemianopsia is the pathognomonic for chiasmal lesions in pituitary adenomas (bitemporal hemianopsia and for colors green, red), craniopharyngiomas (asymmetric bitemporal hemianopsia). Binasal heteronymous hemianopsia is rare. Homonymous hemianopsia (with reduced acuity visual) is present in retrochiasmatic lesions: optic chiasmatic gliomas, arachnoiditis opto-chiasmatic, carotid aneurysms, trauma.

Homonymous hemianopsia is right or left. Cause of homonymous hemianopsia is injury located at the occipital lobe 45%, to the optic radiation 12%, optic tract 10%, lateral geniculate nucleus 1,3%.

Homonymous hemianopsia are field defects congruent, or incongruent. Temporal lobe lesions produce superior homonymous hemianopsia "pie in the sky" hemianopsia, frequently incongruent. Parietal lobe lesions produce homonymous hemianopsia inferior "pie on the floor". Homonymous hemianopsia macular sparing, homonymous scotomas is present in occipital lobe lesions without other neurological deficits symptoms.

Keywords

Heteronymous, Hemianopsia, Bitemporal hemianopsia, Binasal hemianopsia, Homonymous hemianopsia, Quadrantanopsia, Congruent, Incongruent visual field.

HEMIANOPSIA

Hemianopsia is a visual field (VF) defect characterized by the loss of vision in one half of the visual field. It is caused by damage in the optic nerve, optic chiasma, optics radiations and the visual cortex in the brain in occipital lobe [1]:

- Fibres from nasal half of the retina, optic nerve corresponding to the field temporal after decussation in chiasma.

Common causes of hemianopsia are: stroke, brain tumors, head injuries, multiple sclerosis, aneurysm, migraine.

In relation to the location of the lesion, hemianopsia deficits

present different aspects that have a very important neuro-ophthalmological diagnostic significance.

HETERONYMOUS HEMIANOPSIA

- when the vision loss is localized in the symmetrical halves of the VF
- affects two opposite halves of the VF
 - **Bitemporal hemianopsia** – pathognomonic sign for chiasmal lesions
 - It is rare, the deficit is frequently incongruent
 - **Binasal hemianopsia** – extremely rare and of obscure pathogenesis

BITEMPORAL HETERONYMOUS HEMIANOPSIA is the loss of both temporal hemifields corresponding to damage to the fibers of both nasal hemiretinas [2-4].

- The lesion affects the median sector of the chiasm, the point where both nasal bundles cross.
- Bitemporal hemianopia is not initially noticed by the patient, the peripheral isopters being normal.
- **Typical bitemporal hemianopia is not frequent.**
- In compressions of the lower face of the chiasm, the deficit is initially installed in the supero-external quadrants and later, it extends to the infero-external ones.
- Often, the deficit is unequal in the two eyes: hemianopia in one eye, quadrantanopsia in the other or blindness in one eye and hemianopia in the other. Sometimes the deficit is limited to the presence of bilateral central hemianopsia scotomas.
- It should be noted that there is **no parallelism between the perimetric defects of both eyes.**
- Bitemporal hemianopia is found in sagittal chiasmatic lesions, pituitary adenomas, craniopharyngiomas, optic chiasmatic gliomas, opto-chiasmatic arachnoiditis, tuberculum sellae meningiomas, obstructive hydrocephalus with chiasmatic compression by the floor of the third ventricle, arachnoiditis, carotid aneurysms located in the saddle, anterior cerebral aneurysms, craniocerebral trauma involving the chiasm.

BINASAL HETERONYMOUS HEMIANOPSIA is the loss of both nasal hemifields, corresponding to damage to the fibers of the temporal hemiretinas [5].

- The lesion affects the direct uncrossed temporal fasciculus at the level of the chiasm (in lateral lesions of the chiasm).
- Binasal hemianopsia is a rare symptom that occurs in bilateral lesions affecting the external extremities of the chiasm: aneurysm or sclerosis of the two internal carotid arteries, syphilitic meningitis, opto-chiasmatic arachnoiditis, subtentorial tumors, which sometimes cause hydrocephalus in such a way that the third ventricle compresses the lateral parts of the chiasm, some tumors of the third ventricle or of the hypothalamus, which press directly on the chiasm in the lateral parts, some tumors of the chiasm.

HOMONYMOUS HEMIANOPSIA

- **HOMONYMOUS HEMIANOPSIA** when the vision loss affects the lateral halves of the same side of the VF and expresses conditions located beyond the optic chiasm
 - Hemianopsia is limited by the vertical diameter with VF loss on both sides [5,6]
 - Homonymous hemianopsia is present in retrochiasmatic lesions (bands, optic radiation in vascular processes, tumors), with VF loss on the same side in the right and left eye
 - Homonymous hemianopsia is:
 - **Right homonymous** – when the temporal half of the right VF and the nasal half of the left VF are lost
 - **Left homonymous** – the halves of the VF on the left side are lost with clear boundaries
- Homonymous hemianopsia occurs because at the optic chiasm, the nasal fibers from the retinas of both eyes cross in the midline to pass into the optic bands on the opposite side, along with uncrossed direct fibers from the temporal halves of

the retina [7,8]

- The left band thus corresponds to the left halves of the two retinas and the right band of the right halves
- In the external geniculate bodies, the fibers of the band articulate with the optic radiations that carry visual impressions to the cortex, **so homonymous hemianopia can be caused by lesions of the retrochiasmatic optic pathways or of the cortical center of vision. If the lesion is located on the right, the hemianopia is in the left lateral field and vice versa [9].**
- Often cause of HH is located at the occipital lobe 45% followed by an injury to the optic radiation 32%, or optic tract 10%, lateral geniculate nucleus 1,3%.
- Cause of homonymous hemianopsia: stroke, brain infections and inflammations (encephalite, neurosyphilis), brain lesions, brain tumors, traumatic brain injury, degenerative brain disease like Alzheimer disease, multiple sclerosis, neuromyelitis optica, migraines (aura), epilepsy, metabolic disease [10,11]
- Negative symptoms loss or decrease in ability vision.
- Positive symptom – new or additional effect bright forg or haze, distortion or flashes in the part of vision.
- **Homonymous hemianopsia can be:**
 - **Congruent**
 - when the deficient areas of the two eyes in the 2 fields are superposable, identical
 - present in posterior lesions of the optic bands, lesions of the lateral geniculate body and optic radiations
 - **Incongruent**
 - there is a difference between nasal VF and temporal VF
 - present in anterior optic disc lesions and temporal tumors [3,6]
- **Quadrantanopsia,**
 - is the visual deficit in the quadrant with loss of vision in the homonymous superior and inferior quadrants, with irregular vertical border, clear horizontal border and preservation of the fixation point
 - corresponds to lesions of the optic radiations or a lip of the calcarine fissure secondary to a tumor or vascular lesion
- **Crescent hemianopsia** is present in lesions of the internal and anterior optic radiations (temporal crescent fasciculus)
- **Homonymous hemianopsias without involvement of the macula** are present in lesions of the optic radiations at the level of the calcarine fissure, or more anteriorly
- **Double homonymous hemianopsia with macular preservation** – a VF reduced to 5 degrees around the macula persists, as well tubular vision in occipital tumors
- **Relative hemianopsia** – unilateral visual inattention or visual extinction, present in occipital or occipitoparietal lesions

VF Defects at the Level of the Optic Chiasm

- **Lesions affecting the optic chiasm body**
- Lesions affecting the optic chiasm body **produce a bitemporal defect** that can be quadrantic or peripheral, central, or both, with or without “macular sparing” [2,9].
- In most cases, visual acuity is normal, rarely diminished

- When the lesion compresses the chiasm below (pituitary adenoma), field defects are typical.
 - When peripheral fibers are affected, field defects usually begin in the supero-outer quadrant of both eyes.
 - In the field of the right eye, the defect progresses clockwise.
 - Field defects are unequal in the two eyes; thus, one eye may become nearly or completely blind, while the defect in the field of the other eye is minimal
- Pituitary adenoma, tuberculum sella and meningioma, craniopharyngioma and aneurysms can produce bitemporal field defects.
- Alternatively, suprachiasmatic, suprasellar compressive lesions such as tuberculum sella meningioma, craniopharyngioma, aneurysms, and dolichoectatic anterior cerebral arteries may affect the superior fibers of the optic chiasm, with infiltrative lesions similar to malignant and benign glioma and cavernous angioma, but the visual field defects in such cases are bitemporal but located inferiorly.
- Infiltrative tumors: glioma and germinoma, demyelinating and inflammatory lesions affecting the optic chiasm, can produce typical bitemporal field defects - arcuate defects and nonspecific reduction in sensitivity, not correlated with the location, size or extent of the lesion. Successful decompression of the chiasm in such cases results in improvement of the visual field [12,13].
- When trauma affects the optic chiasm, the most common field defect is complete bitemporal hemianopia.
- Inflammatory or infiltrative compressive lesions, affecting the body of the optic chiasm, produce defects that are incomplete and usually have a relative component.

Lesions Affecting the Posterior Angle of the Optic Chiasm

- Lesions affecting the posterior part of the optic chiasm produce:
 - bitemporal hemianopic scotomas
 - cecocentral scotomas due to metabolic, toxic, or even hereditary processes, rarely tumoral.
- True bitemporal hemianopic scotomas are almost always associated with normal visual acuity and color perception, whereas cecocentral scotomas are invariably associated with reduced visual acuity and dyschromatopsia.

Junctional Scotoma

- It translates a lesion located in the internal, anterior angle of the chiasm.
- It is found especially in tumors of the anterior angle of the chiasm at the junction between the optic nerve and the chiasm.
- **Pituitary tumors initially produce deficits in the superior temporal quadrant, and craniopharyngiomas initially produce deficits in the inferior temporal field.**

VF Defects in Craniopharyngioma

- Visual field defects in craniopharyngioma are frequently **asymmetric bitemporal hemianopsias or a homonymous type with reduced acuity [13,15].**

- The craniopharyngioma typically compresses the optic chiasm superiorly and posteriorly, first interfering with the superior nasal retinal nerve fibers that cross the optic chiasm upward and posteriorly, producing a defect in the inferotemporal quadrant.
- Visual field defects are frequently detected with optic nerve lesions but may occur with optic chiasm compression.
- Macular nerve fibers decussate through the posterior and superior optic chiasm.
- Craniopharyngioma will produce not only **inferotemporal field defects but also bitemporal hemianopic scotomas [9,14].**
- With further extension, **the visual defect progresses clockwise in the left eye and counterclockwise in the right eye to involve the superior visual field.**
- Cases starting with homonymous central hemianopsia scotomas and paradoxical cases of homonymous hemianopsia with sparing of macular vision are cited.

VF Defect in Glioma and Meningioma

- Visual defects due to meningioma and glioma take the form of a slowly **progressive loss of monocular vision.**
- When both fields are involved there is a tendency towards marked asymmetry.
- Visual field loss typically includes a defect in the temporal visual field, **but may also involve the nasal visual field [10,15].**
- The optic chiasm is located in the anteroinferior region of the third ventricle. An enlarged third ventricle due to increased intracranial pressure can press on the superior part of the chiasm, resulting in **visual deficits in the initial lower quadrants.**
- Visual field loss can be much more severe, particularly if there is papilledema of the optic disc, thus giving rise to visual field defects in this part of the optic nerve.

VF Defects in Pituitary Adenoma

- Bitemporal visual field defects are classically associated with compression of the optic chiasm.
- Optic chiasm compression may be asymmetric, with an asymmetric visual field defect, so that temporal visual field loss is present in one eye and, the other eye may have very little involvement.
- With extensive optic chiasm compression there may be substantial visual field loss.
- A paracentral scotoma in the superior temporal quadrant may represent very early involvement of the nasal retinal fibers by a tumor that has already extended to the optic chiasm.
- Junctional scotomas are a rarely documented visual field defects and are described as an early feature of chiasmatic compression.
- Early decrease in central visual acuity and the presence of a unilateral central scotoma indicate a poor visual prognosis because the visual disturbances are irreversible and the macular bundle is affected.
- Hemianopic scotomas and chiasmatic syndrome indicate a

favorable visual prognosis.

- Asymmetric chiasmatic syndrome, homonymous hemianopsia worsens the visual prognosis (posterior evolution) [10].
- Concentric narrowing of the field, accompanied by late-onset hemianopsia, indicates changes in the optic nerve, independent of compression and worsens the visual prognosis. This is more favorable in rapid evolutions, because the atrophy of the optic fibers did not have time to set in.

VF Defects in Vascular Abnormalities

- Visual field defects may be caused by arterial aneurysms.
- The internal carotid arteries are closely related to the optic nerves and optic chiasm, as is the precommunicating portion of the anterior cerebral artery.
- An aneurysm involving both arteries may compress both the optic nerve and the optic chiasm.
- Dilation of the internal carotid aneurysm may produce lateral compression of the optic chiasm; the field defect is usually unilateral, but may be bilateral with large aneurysms or bilateral carotid aneurysms.
- Binasal field loss is most often due to pressure affecting the lateral aspect of the optic nerves, rarely the lateral aspect of the optic chiasm.

VF Defects in Retrochiasmatic Lesions

- Unilateral lesions of the visual sensory pathway beyond the optic chiasm the optic tract, lateral geniculate body, optic radiation, or striate cortex **produce homonymous visual field defects without loss of visual acuity** [3].
- Homonymous visual field defects develop slowly when they are caused by compression and rapidly when they are caused by hemorrhage, ischemia, or inflammation.
- Compressive lesions generally produce progressive loss of visual field from the periphery of the field to the center.

VF Defects in Optic Tract Lesions

- Although lesions affecting the optic tract are uncommon, they are of great importance because they are located in the first region beyond the optic chiasm where the lesions produce homonymous visual field defects.
- Optic tract lesions account for approximately 3% to 11% of cases of homonymous hemianopsia
- **Lateral homonymous hemianopsia** involves the temporal field in one eye and the nasal field in the other eye. It can be right or left, as is the location of the lesion that affects the direct and crossed bundles in one hemisphere (from the origin of the optic tract to the tip of the occipital lobe).
- From an etiological point of view, lateral homonymous hemianopsias are found in vascular cerebral lesions. The anterior choroidal artery irrigates the optic tract.
- Central hemianopsia scotomas can be homonymous through a mild lesion of the optic tract.
- Bilateral scotomas with hemianopsia disposition express a visual pathway disorder in the retrochiasmatic segment.
- Visual field irregularities are found in partial lesions of the optic tract, resulting in peripheral scotomas that vary from eye

to eye. They are found in inflammatory and vascular lesions of the optic tract from the retina to the cerebral cortex [10,12].

- Causes are varied and include tumors, vascular processes, demyelinating diseases, and trauma.
- Visual field defects in optic tract diseases are characterized by a marked incongruity of the field defect in association with an afferent pupillary defect on the same side with hemianopsia and optic disc pallor.

Congruent Visual Field Loss

- Homonymous hemianopia field defects are considered congruent when the defect is not complete (i.e., does not occupy the entire half of the field) and the defect extends to the same meridian angle in both eyes [8,13].
- Complete homonymous hemianopia cannot be categorized as “congruent” because it is complete.
- Optic tract lesions tend to produce marked incongruent field defects.
- **The more congruent the homonymous hemianopia, the closer the lesion will be to the occipital cortex (further posterior in the visual pathways).**
- Congruity is due to the fact that a lesion affects nerve fibers from the corresponding retinal points that lie adjacent to each other.
 - Hemianopsia is congruent when the deficit of the two fields corresponds exactly.
 - **It is found in posterior lesions of the bands, external geniculate bodies and optic radiations (especially in vascular lesions of these territories).**

Incongruent Visual Field Loss

- Hemianopsia is incongruent when the deficits in the two fields do not correspond exactly. It occurs in extensive lesions of the temporal lobes or in anterior lesions of the optic chiasm.
- Partial lesions of the optic tract will produce contralateral homonymous visual field defects.
- Incomplete pairing of the retinal nerve fibers of the two eyes results in incongruity.
- **Marked incongruity indicates an optic tract lesion, whereas lesions of the optic radiations tend to produce only mild incongruity; lesions of the visual cortex are highly congruent.**

VF Defects in Lateral Geniculate Body Lesions

- Lesions affecting the lateral geniculate body are usually less commonly diagnosed than those of the optic tract but can be caused by vascular disease, neoplasm, inflammation, demyelination, and trauma.
- **Lesions of the lateral geniculate body can result in congruent or incongruent homonymous field defects [15].**
- Defects of the lateral geniculate nucleus:
 - **All retrochiasmatic lesions give contralateral homonymous hemianopia.**
 - **Congruity describes incomplete homonymous hemianopia defects that are identical** in all attributes: location, shape, size, depth, slope of the edges.

- **The more posterior the lesion is (towards the occipital cortex), the more likely the defects will be congruent [11,16].**
- Optic tract syndrome presents with:
 - incongruent homonymous hemianopsia
 - bilateral retinal nerve fiber layer atrophy or optic atrophy
 - pupillary abnormalities:
 - relative afferent pupillary defect: on the side opposite the lesion (the eye with temporal field loss)
 - Wernicke’s pupil: light stimulation of the “blind” retina does not produce pupillary reactions, while light projected onto an “intact” retina produces normal pupillary constriction.
 - Behr’s pupil: anisocoria with a wide pupil on the side of the hemianopsia.
 - Types of defects:
 - incongruent homonymous hemianopia
 - single sector and sector-sparing defects, due to dual blood supply to the lateral geniculate nucleus from the posterior and anterior choroidal arteries.
 - A number of different types of visual field defects can occur from lesions of the lateral geniculate body, depending on the extent and nature of the lesion and the area of the lateral geniculate body involved.

VF Defects in Optic Radiation Injuries

- Optic radiations extend from the lateral geniculate body to the striate cortex
- Alterations in the lateral geniculate body produce “wedge”, “spear”-shaped incongruent defects
- Alterations in the temporal radiations produce [10,13]:
 - VF alterations – contralateral homonymous superior quadrantanopsia
 - paroxysmal olfactory and gustatory hallucinations
 - visual hallucinations
 - epilepsy
 - receptive dysphasia by touching the dominant hemisphere
- Alterations of the anterior parietal radiations
 - VF alterations with contralateral homonymous inferior quadrantanopsia
 - agnosia
 - visual perception difficulties
 - right/left confusion
 - acalculia
- Main radiations
 - complete homonymous hemianopsia
 - vascular lesions in the posterior cerebral artery territory
 - produces in 90% of cases isolated homonymous hemianopsia without neurological deficit
 - other causes: migraine, trauma, tumors
 - VF alterations
 - posterior cerebral artery occlusion causes congruent homonymous hemianopsia with macular preservation
 - lesion in the occipital cortex can cause congruent homonymous macular deficit
 - visual hallucinations – Anton syndrome

- Riddoch phenomena – perceiving visual target not static

Internal Capsule Injury

- The internal capsule is composed of all fibers, afferent and efferent that go to or come from central cortex. The most posterior component of the internal capsule is the optic radiation.
- Interruption of the optic radiation is characterized by a contralateral homonymous hemianopsia usually complete, associated with contralateral hemianesthesia from damage to adjacent thalamocortical fibers in the posterior limb of the internal capsule [14].
- Other ocular signs in internal capsule lesions include transient deviation of the eyes toward site of the lesion and weakness of the frontalis and orbicularis on the contralateral hemiplegic site (rarely) vascular cause predominant.
- Visual field defects are dependent on the area involved and the extent of optic radiation inclusion within the lesion.
- Defects VF can be hemianopsia or quadrantanopsia. Lesions of the internal capsule affect the optic radiation while they are still a compact bundle, causing hemianopsia with variable extension the horizontal meridian with impairment of central vision.

VF Defects in Temporal Lobe Lesions

- Temporal lobe lesions can affect the optic radiations giving homonymous visual field defects in tumors and abscesses.
- Temporal lobe surgery for epilepsy can generate such defects, which are often asymptomatic.
- Most cases are accompanied by macula sparing in patients with partial or complete quadrant defects from temporal lobe damage, but in the peripapillary field, monocular crescent may be present.
- Temporal lobe lesions produce superior homonymous hemianopsia (Meyer loop)
- “pie in the sky” hemianopsia, frequently incongruent [3,10]
- **Most visual field defects in temporal lobe lesions are incongruent**, but the incongruity is not as severe as that in the case of optic tract and as that due to lesions of the lateral geniculate bodies [12].
- Patients with temporal lobe lesions with homonymous visual field defects may experience visual hallucinations.
- **The more posteriorly the lesion is located in the temporal lobe, the more frequent total congruent hemianopia with or without macular sparing.**

VF Defect in Parietal Lobe Lesions

- Parietal lobe lesions can produce ocular symptoms that are important in clinical diagnosis.
- Homonymous hemianopia affecting mainly the lower fields is due to damage to the optic radiation in the superior parietal lobe and is more congruent than in temporal lobe lesions.
- Because the entire optic radiation passes through the parietal lobe, large lesions can produce complete homonymous hemianopia with macular fissure.
- **Parietal lobe lesions produce a relatively congruent and**

incomplete homonymous hemianopia (or moderate incongruence) that is denser below than above, conjugate eye movements on the side opposite the lesion (Cogan's sign), and an abnormal optokinetic response.

- disturbance of the fixation reflex regarding the reading ability may develop before the appearance of other symptoms. (It is sometimes manifested during the visual field test, when the patient cannot maintain central fixation despite repeated instructions).
- visual agnosia
- difficulties with word recognition.

VF Defects in Occipital Lobe produce isolated Homonymous Hemianopsia without other Neurological Deficits [17]

- Homonymous hemianopsia deficits is presents in occipital lobe lesions without other neurologic symptoms. These lesions include macular sparing due the dual blood supply, homonymous scotomas. If the lesions extends anteriorly may present alexia without agraphia. Bilateral occipital lobe lesions produce bilateral HH of various types (cortical blindness) anosognosia.
- homonymous defects can be congruent; paracentral or peripheral; complete or incomplete, and can be with macular protection at 5° centrally
- homonymous hemianopsia can be caused by ischemic, neoplastic, vascular, demyelinating, traumatic lesions

Conclusion

Hemianopsia is a bilateral visual field defect, meaning an alteration of the pathways from the optic chiasma to the occipital cortex. Hemianopsia is typically caused by damage to the optic nerve, optic tract or the visual cortex in the brain. Bitemporal heteronymous hemianopsia is pathognomonic sign for chiasma lesions (rare) with deficit frequently incongruent Binasal hemianopsia is extremely rare and of obscure pathogenesis (internal carotid alterum). Bitemporal hemianopsia is found in sagittal chiasmatic lesions, pituitary adenomas, craniopharyngiomas, optic chiasmatic gliomas tuberculum sellae meningiomas, obstructive hydrocephalus with chiasmatic compression by the floor of the third ventricle, trauma homonymous hemianopsia in retrochiasmatic lesions-bands, optic radiation in vascular process, tumors), with VF loss on the same side in the right and left eye – Right and left homonymous hemianopsia. HH can be congruent or incongruent. Visual field defects in retrochiasmatic lesions are HH with develop slowly by compression and rapidly by hemorrhage ischemia or inflammation. Compressive lesions generally produce progressive loss of visual field from the periphery of the field to the center. VF defects in optic tract lesions are homonymous hemianopsia involve the temporal field in one eye, and the nasal field in the other eye. VF defects in

lateral geniculate body lesions are HH congruent or incongruent. All retrochiasmatic lesions give contralateral homonymous hemianopsia. Temporal lobe lesions produce superior HH “pie in the sky”. Parietal lobe lesions produce HH inferior “pie on the flour”. Occipital lobe lesions produce insolated HH without neurological deficits lesions affecting the calcarine sulcus of the occipital lobe tend to cause HH with sparing of the macula.

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