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Homonymous hemianopsia

Niedowidzenie połowicze jednoimienne

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Streszczenie: Niedowidzenie połowicze jednoimienne (HH) to defekt pola widzenia charakteryzujący się zajęciem dwóch prawych lub lewych połówek pola widzenia obojga oczu. Jest on spowodowany uszkodzeniem drogi wzrokowej na odcinku za skrzyżowaniem nerwów wzrokowych. Najczęstszymi przyczynami HH są: udar mózgu, guzy mózgu, urazy głowy, zabiegi neurochirurgiczne, stwardnienie rozsiane oraz inne rzadziej występujące stany kliniczne. Niedowidzenie połowicze prowadzi do ciężkiego upośledzenia widzenia i wpływa na inne wzrokowe funkcje poznawcze. Pacjenci z tym defektem skarżą się na trudności z czytaniem i oceną otoczenia w wystarczająco szybki sposób, aby zrozumieć sens oglądanych przedmiotów. Pacjent z HH często się potyka, upada i potrąca przedmioty w swym otoczeniu, gdyż zwykle ich nie zauważa i nie ma świadomości, że istnieją. Bywa zdziwiony, że w jego polu widzenia nagle pojawił się człowiek lub inny obiekt. Prognozy odnośnie cofnięcia się ubytków w polu widzenia są bardzo różne i zależą od przyczyny oraz stopnia ciężkości uszkodzenia mózgu i drogi wzrokowej. Podstawową metodą w leczeniu pacjentów z niedowidzeniem połowiczym jest rehabilitacja wzrokowa. W przypadku pacjentów z HH stosowane są trzy rodzaje metod rehabilitacyjnych: terapie optyczne, terapie związane z ruchami oka oraz techniki poprawiające zakres pola widzenia.

Słowa kluczowe: jednoimienny połowiczy defekt pola widzenia, rehabilitacja wzrokowa.

Summary: Homonymous hemianopia (HH) is a visual field defect involving either two right or the two left halves of the visual field of both eye. It results from the damage of the visual pathway in its suprachiasmatic part. The causes of HH include stroke, brain tumors, head injuries, neurosurgical procedures, multiple sclerosis and miscellaneous conditions. HH result in a severe visual impairment and affect a variety of cognitive visual functions. Patients with HH frequently have difficulties with reading and scanning scenes in sufficiently rapid fashion to make sense of things as a whole. They stumble, fall or knock objects in their surroundings, since they cannot see them and they are frequent surprised that somebody or something suddenly appeared in their visual field. The prognosis of visual field deficit recovery is highly variable and depends on the cause and severity of brain and optic pathway injury. The fundamental method in the management of HH patients is rehabilitation. Rehabilitation techniques used in HH include three groups of methods: optical therapies, eye movement-based therapies, and visual field restitution therapies.

Key words: homonymous visual field defects, eye rehabilitation.

Homonymous hemianopia (HH) is a visual field defect characterized by the involvement of two right or left halves of the visual field in both eyes. It results from the damage of the visual pathway in its suprachiasmatic part, specifically an injury of the optic tract, lateral geniculate nucleus, optic radiation or visual cortex. This deficit, once found, has no location value, i.e. based on the perimetry result itself one cannot indicate the damaged level of the visual pathway.

Usually homonymous deficits are not complete and involve less than half of the visual field. These are the so-called "partial homonymous deficits". Due to the irregular course of the nerve fibers in the optic tracts and optic radiation on both sides of the visual pathway, partial homonymous visual field defects of the right and left eye can differ in shape, size and location. This bilateral similarity or its lack is referred to as congruence or incongruence, respectively. Lesions located in the anterior part of the optic tracts cause the most incongruent deficits. The more posteriorly the lesion is located, the higher the congruence is observed. The most congruent are deficits resulting from the injuries in the posterior part of the optic radiation.

In summary, the complete unilateral damage of the visual pathway above the optic chiasm is reflected in contralateral homonymous hemianopia. In contrast, an incomplete injury of these structures causes more or less congruent homonymous defects, involving less than one half of the visual field. In the case of the temporal lobe injuries, the defects are located mostly in the upper visual field quadrants of both eyes, while the damage of the parietal lobes is reflected by the defects in the lower quadrants. Impairment of the anterior part of visual cortex is reflected by homonymous hemianopia with macular sparing. However, typical homonymous hemianopia will develop in cases where pathological lesions involve the posterior part of visual cortex with high macular representation.

The results of epidemiologic studies confirm that homonymous visual field defects are partial (62%) rather than complete (38%). Deficits of one quadrant (47%) predominated amongst partial homonymous deficits, followed by homonymous scotoma involving an area smaller (21%) or larger (20%) than one quadrant. Homonymous hemianopia with macular sparing is the least frequent finding (12%) (1).

ISSN 0023-2157 Index 362646

Figure 1 presents the types of the most frequent homonymous deficits.

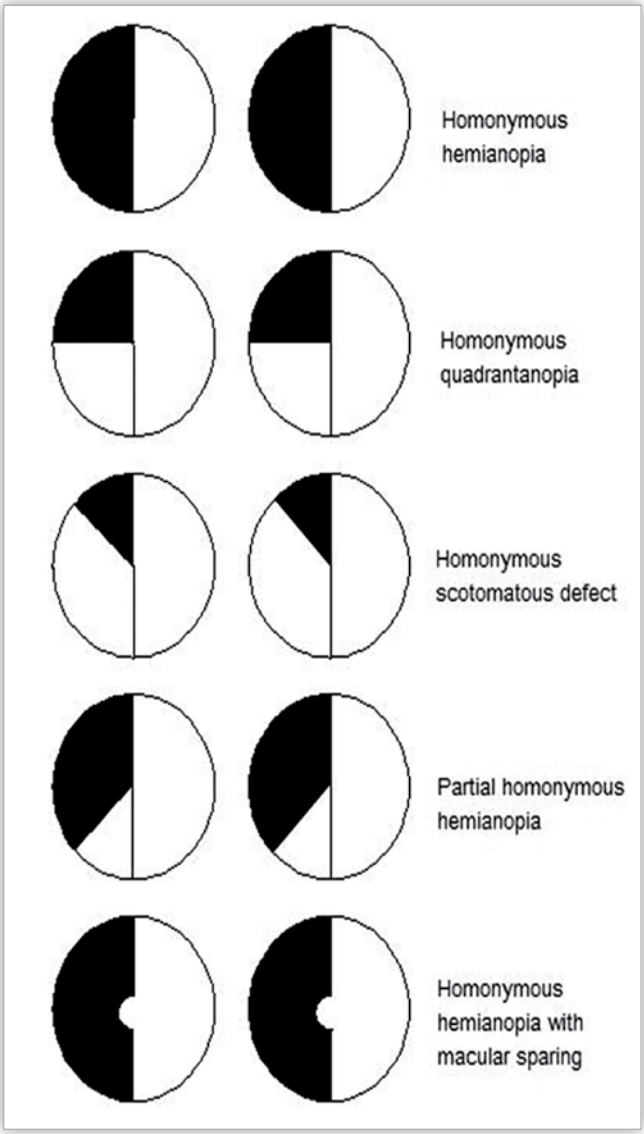

Fig. 6. Homonymous defects of the visual field.
Ryc. 6. Połowicze jednoimienne ubytki w polu widzenia.

Causes

In adults, vascular disorders (ischemic stroke, intracerebral hemorrhage) constitute the most frequent reasons for the HH-associated optic tract damage and are responsible for 42–89% of cases where homonymous visual field deficits are present. The other causes include head injuries (12–15%), brain tumors (12%), neurosurgical procedures (2–3%), multiple sclerosis (0.5–3.5%), and miscellaneous conditions (0.5–1.5%) (1-5). In extremely rare cases, HH can develop as a transient symptom of migraine or hyperglycemia (6). In contrast, neoplastic process is the leading cause of HH in children (39%), followed by cardiovascular disorders (25%), and head injuries (19%).

Among patients with stroke-related HH predominate older adults (average of 58 years of age), while non-stroke HH predominates among younger individuals (average of 36 years of age) (5). Gender does not play an important role in the etiology of stroke-related HH. In contrast, young males constitute a majority of patients with post-traumatic HH as a result of higher prevalence of head injuries in this group. The development of post-traumatic HH is usually associated with numerous additional neurological deficits; only 20% of patients with post-traumatic HH do not show other focal symptoms. In most cases, HH develops in patients with severe and numerous foci of brain damage (4). In the case of stroke-associated HH, visual field deficits more frequently have "isolated" character, and nearly half of the patients do not show other additional neurologic symptoms (5).

Topography of the visual pathway injuries observed in patients with homonymous visual field defects suggests that a clear correlation between the cause and location of these defects is specific solely for patients with ischemic stroke. In 54% of post-stroke cases, the lesions locate in the visual cortex, followed by the optic radiation (33%); lateral geniculate nucleus and optic tract are the least frequently affected. In patients with brain tumors or head injuries, most of the damages locate within the optic radiation (23–31%), followed by visual cortex (12–24%), and optic tract (10–19%). Nearly 25–50% of non-stroke HH is associated with multifocal lesions of various parts of the optic tract (4,5,7). Brain tumors are responsible for about two-thirds of temporal lesions and about one-half to one-third of the parietal and occipital lesions (8).

Symptoms

Some patients with partial homonymous hemianopia, and less frequently also those with complete HH, are not aware of their visual deficits. Patients with HH frequently stumble, fall or knock objects in their surroundings, since they cannot see them and therefore are oblivious to their existence. They are frequently surprised that somebody or something suddenly appeared in their visual field. Additionally, they experience reading difficulties, losing some words or their parts. Since reading is done from the left to the right side, patients with right-sided hemianopia lose the endings of long words or lines, while left-sided HH is associated with the inability to see the beginnings of a text.

Usually, HH patients have normal visual acuity. However, sometimes they may experience an impression of losing vision in one eye. The so-called visual neglect is a symptom frequently associated with HH; for example males experiencing this symptom shave only one half of their face, neglecting the other side and leaving it unshaved.

Hemianopia can be associated with various focal symptoms depending on whether the left or the right cerebral side is injured. Right-sided injury may be associated with the inability to see objects, along with sensory problems and left-sided hemiparesis. In contrast, the left-sided brain injury can cause difficulties in reading and speaking along with right-sided hemiparesis.

Besides typical focal symptoms, whose character depends in the site of central nervous system injury, disorders associated with the so-called mass effect can be observed in HH patients. These symptoms are particularly specific for brain tumors and post-traumatic hematomas, and both are associated with increased intracranial pressure and resulting optic disk swelling.

The diagnosis of homonymous hemianopia is made based on visual field testing. Perimetry testing results are specific for

the type of injury, but based on this examination one cannot distinguish the topography of visual pathway injury and/or its cause. Usually, computed tomography and magnetic resonance imaging of the head are required to delineate the visual pathway damage.

Prognosis

The prognosis of visual field deficit recovery is highly variable and depends on the cause and severity of brain and optic tract injury. The prognosis is usually unfavorable in patients with ischemic stroke. The improvement, if noted, usually is observed during initial months after the incident underlying HH. Within the first month post-ictus, the spontaneous improvement is observed in at least 50% of patients, and further chances of recovery decrease linearly. Spontaneous recovery of visual field defects is still possible three to six months post-ictus, but such outcome is relatively rare. Further chances of improvement and the resumption of visual function fall dramatically; visual field deficits of various severity persist in most patients (9,10).

Rehabilitation and therapy

Finding HH's cause and its elimination, whenever possible, are vital and principal elements in managing this condition. Brain tumor constitutes a classic example of such an attitude; its early detection and removal are associated with rapid remission of abnormalities seen on perimetry. The prognosis is worse in cases where homonymous hemianopia results from the stroke or massive head injury. Persistent visual field deficits frequently develop in such patients, with resulting abovementioned perceptive deficits. Coping with homonymous hemianopia is not simple; even normal everyday activities, such as walking or reading, become problematic.

In such cases, rehabilitation is fundamental in the management of HH patients; it is intended to teach the individual various methods of dealing with the existing perception deficits. Rehabilitation techniques used in hemianopia include three main groups of methods: optical therapies, eye movement-based therapies, and visual field restitution therapies (11-13).

Optical therapy

The aim of this method is to improve visual perception by distorting and replacing part of the intact visual field with part of the damaged field. Most frequently this method uses prisms that transfer the image towards the optical axis. Depending on the needs, prismatic glass can extend over the entire spectacle lens or cover only the area corresponding to visual field deficit (half of the lens) (14). In the case of the left-sided hemianopia, the prism is located in the temporal part of the left spectacle lens, with its base directed left. This results in the transfer of the image to the nasal "seeing" part of the visual field. Usually, the prisms are used only in one eye, since they reduce visual acuity. Poor visual acuity in both eyes can be more challenging than visual deficits themselves. Using the 40-dioptre prisms can result in extending visual field even up to 20°. However, usually the 15- to 30-dioptre prisms are used, increasing effective visual field up to a maximum of 15° (13).

Other examples of optical support for HH patients include the so-called hemianoptic spectacles. These spectacles incorporate small mirrors into the structure of eyeglasses; due to their inclination patient can see the reflections of objects located in the hemianopic part of the visual field.

Eye movement therapy

The objective of this type of visual rehabilitation is to improve perception, utilizing compensative and adaptive eye movements. These strategies enhance the patients` ability to explore their blind hemifield. One strategy involves waiting for the target with the eyes in mid-position and making repeated search movements towards the blind side. In another approach, the eyes are directed towards the blind side and wait for the target where it is expected to appear. Sometimes, the patients try to "catch" the target with a large saccade which overshoots the target and "brings" it into the seeing hemifield.

Analysis of the eye fixations of patients looking at a simple pattern indicate that whereas normal persons from control group look mainly at the center, the hemianopic patients paradoxically concentrate on the blind side. Essentially, this is a compensatory reaction, because deviation of the fixation point towards the hemianopic side brings the whole pattern into the seeing hemifield (13).

Performing "large" eye movements towards the anoptic part (right or left) of the visual field is recommended during walking or other activities. In particular, the person accompanying the patient during walking should stay on the "anoptic" side and hold on to his/her arm. Also, when in theater or cinema, the patients should not sit in the front of the stage but rather laterally, and as far as possible towards the direction of the visual field deficit (e.g. individuals with right-sided visual field defects should sit in the most right-sided part of the stage). In such a location, they will be able to see all the events with the "healthy part" of their visual field.

Visual field restitution therapy

This strategy is designed to restore function within the damaged visual field. Patients practice detecting simple stimuli presented to the damaged visual field. The sensitivity in the blind spot of the visual field increases after such repeated stimulation (15). Visual field restitution focuses on retraining the vision at the border of the field defect or improving the vision deep into the blindfield by making use of nonstriate visual pathways. Increasing neuronal activity in areas of the striate cortex surrounding the damages area was postulated as a mechanism of vision improvement.

In conclusion, visual rehabilitation can be very successful in many cases and improves the patients` quality of life. However, high amounts of effort and self-discipline are required from the patient to achieve this goal (often more than 100 hours of therapy is needed). One should expect the demand for neuroophthalmological rehabilitation to increase as the survival rates of severe cerebral lesions are rising.

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ISSN 0023-2157 Index 362646

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The study was originally received 14.03.2012 (1358)/
Praca wpłynęła do Redakcji 14.03.2012 r. (1358)
Accepted for publication 30.06.2012/
Zakwalifikowano do druku 30.06.2012 r.

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