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Visual symptoms in migraine

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ABSTRACT

Migraine is a condition characterized by recurrent headache. Visual aura (VA) is the most common migraine aura. VA symptoms divide into two groups: positive and negative. Patients often report various visual phenomena, which can be challenging to describe. Because visual aura may mimic other conditions that also cause visual symptoms, it can disguise those issues. An interdisciplinary approach and a careful differential diagnosis are necessary.

Keywords: migraine, migraine aura, vision aura, retinal migraine

1. INTRODUCTION

Migraine is a disease characterized by recurrent headaches. Although it seems common and harmless, it ranked third among worldwide causes of disability-adjusted life years in the Global Burden of Disease Study 2021 (GBD 2021 Nervous System Disorders Collaborators, 2024). This health problem affects one in ten people worldwide (Woldeamanuel and Cowan, 2017).

Migraines may occur with or without aura. Features of typical migraine pain are: moderate or severe intensity, unilateral localization, pulsating character, worsening during physical activity, and additional symptoms like photophobia, phonophobia, or nausea/vomiting. Patients can be diagnosed with migraine without aura if they have experienced at least five attacks fulfilling the mentioned criteria, and there is no better explanation in the International Classification of Headache Disorders, 3rd edition (ICHD-3). In contrast, migraine with aura is associated with the same group of symptoms but is preceded by an aura. There are different types of migraine with aura:

- Migraine with typical aura - an aura is an entirely reversible phenomenon that may consist of visual, sensory, speech, or language disturbances, but no motor, brainstem, or retinal symptoms. Symptoms of an aura develop gradually. The duration of each symptom is no longer than one hour. A typical aura precedes a headache or exists without one.
- Migraine with brainstem aura - aura symptoms clearly originating from the brainstem. At least two of the following symptoms are required: dysarthria, vertigo, tinnitus, hypacusis, diplopia, ataxia, or decreased level of consciousness (GCS ≤13). Symptoms have to be reversible. Motor or retinal symptoms are absent.

- Hemiplegic migraine - migraine with aura, including typical aura symptoms and reversible motor weakness. Motor symptoms typically last less than 72 hours, but in some cases, they may persist for weeks.
- Retinal migraine - attacks of monocular visual disturbance, including scintillations, scotomata, or blindness, associated with migraine headache.

Migraine is chronic when headache recurs for more than 3 months and occurs on at least 15 days per month. Additionally, at least 8 days per month, attacks have the features of migraine headache (Headache Classification Committee of the International Headache Society, 2018). 20-60% of migraine patients experience a prodromal phase, with symptoms like mood swings, distraction, lack of appetite, sleep disturbances, excessive yawning, osmophobia, and poliuria. In some patients, migraine also appears with a postdromal phase—fatigue, drowsiness, nausea, restlessness, phonophobia, and photophobia can last even for a few days (Stępień, 2022).

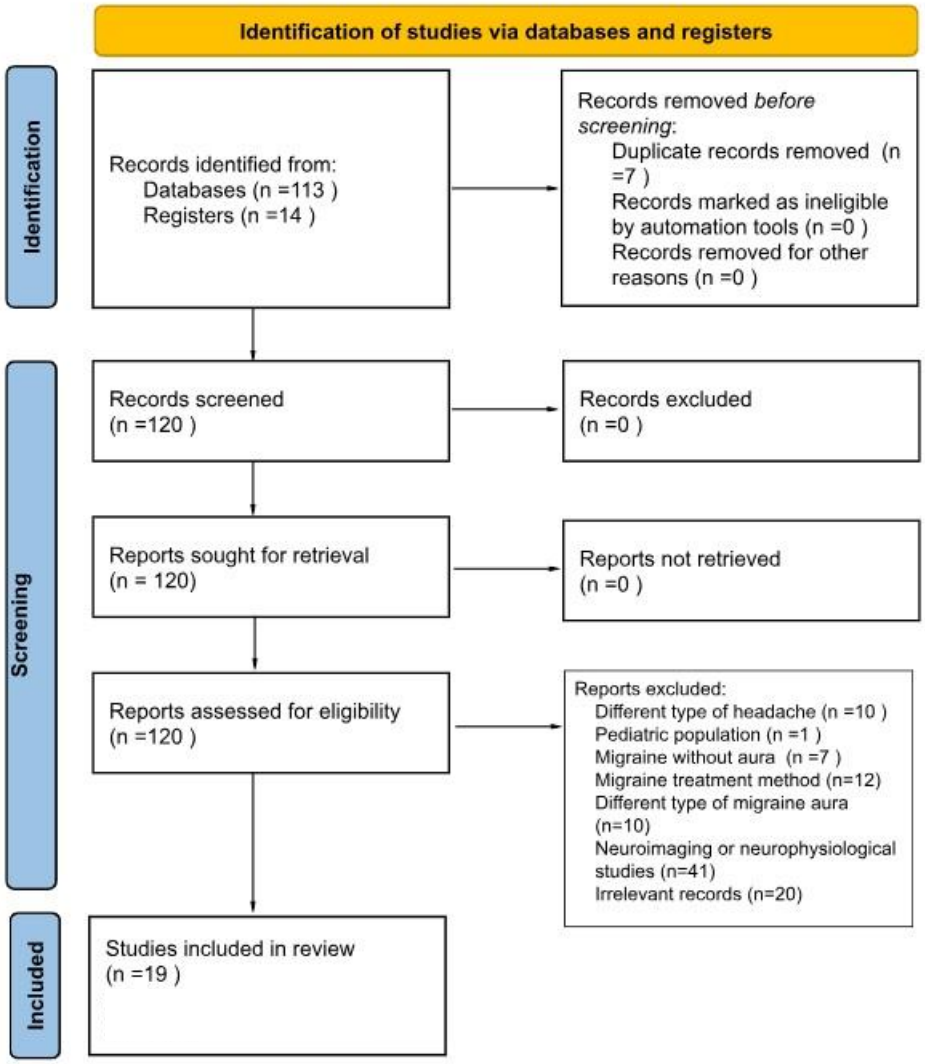

Figure 1. PRISMA chart.

2. REVIEW METHODS

Our review focuses on visual disturbances in migraine aura. We have chosen suitable articles using the PubMed Advanced Search Builder. We have used combinations of the following keywords for searching: “visual aura” and "migraine". The following filters were applied: 10 years, Free full text, Full text, English, and adult (19+ years). We indentified 113 articles through datbase searching. Additionally, we have identified 14 records by reviewing the reference lists of key papers and by consulting current guidelines.

Records were screened by titles and abstracts. After all, 19 records were incuded in our review. PRISMA chart showing the article selection process is available below (Figure 1). We used records from last 10 years and a few older, if we considered them important for review.

3. RESULTS & DISCUSSION

Visual aura (VA) is the most common of all types. Out of 216 auras in 72 patients evaluated by Viana et al. in a prospective diary-aided study (2017), visual symptoms occurred in 212 (98%), sensory symptoms in 77 (36%), and dysphasic symptoms in 22 (10%) (Viana et al., 2017). There are two groups of VA symptoms: positive (such as bright lights and zigzag lines) and negative (like scotoma) (Domitrz, 2018).

Description of visual aura - diagnostic difficulties

Patients with VA report a variety of visual phenomena, which can be challenging to describe. Viana et al., (2019), identified 14 studies describing visual aura disturbances in a population. The total number of visual symptoms (elementary visual symptoms, EVSs) described in all those papers was 30. Some of them were reported in only one article, while others (flickering lights, bright lights, zigzag lines, scotoma/hemianopsia) were reported in the majority of studies. The authors proposed definitions of 25 EVSs that may be helpful in medical interviews with patients. They named phenomena like: bright light, foggy/blurred vision, zigzag lines, scotoma, scotomata, small bright dots, white dots/round forms, colored dots/round forms, lines (colored lines), geometrical shapes, 'like looking through heat waves, water or oil', visual snow, bean-like forms, hemianopsia, deformed images, tunnel vision, oscillopsia, mosaic vision, fractured objects, corona effect, anopia, micropsia, macropsia, 'like negative film and complex hallucinations.

According to researchers, for some EVSs, when reported, patients should be asked about additional features, such as colour or pattern. Patients should be asked to describe them in their own words, eventually with suggestions about similarities to familiar objects, such as stars, sparkles, or the movements of a butterfly (Viana et al., 2019). Due to difficulties in verbally describing EVSs, some clinical tools may be useful. In 2024, the authors created a collection of images illustrating previously reported elementary visual symptoms. The authors aimed to develop a standardized migraine aura iconography (Standardized MA Iconography 1.0 – SMAI 1.0). 98.1% of participants considered at least one image from the SMAI 1.0, representing a visual disturbance they had experienced during their MA. Only 0.3% of patients did not recognise any SMAI 1.0 images as part of their aura. SMAI 1.0 helped to identify nearly 80% of the EVSs reported by the participants (Viana et al., 2024). The study revealed that iconography is a promising tool in recognising VA in patients. Modern technology, such as virtual reality or the creation of images with artificial intelligence, may help develop such diagnostic methods.

Retinal migraine

This condition is sometimes described as "ocular migraine" and "ophthalmic migraine". ICHD defined it as 'migraine headache associated with repeated attacks of fully reversible monocular visual disturbance (like scintillation, scotoma or blindness). Aetiology is unclear. Several studies have suggested retinal vasospasm as a potential cause of retinal migraine. Another theory is cortical spreading depression (CSD). CSD is one of the possible biological mechanisms of the visual symptoms of migraine aura, although this has not been proved in humans. Symptoms in retinal migraine differ from those of visual migraine aura. In VA, visual disturbances often present as complex patterns of positive and negative symptoms. Most retinal migraine cases appear with negative symptoms and a strict monocular presentation. Retinal migraine should be considered a diagnosis of exclusion. It is important to exclude other causes of transient monocular visual loss (Chong et al., 2021).

Patients with visual phenomena - differential diagnosis

Diagnosis of visual disturbances requires an interdisciplinary approach. Symptoms might be associated with health problems like neurological or ophthalmological issues, psychiatric disorders, systemic disease, injury, or drug intake. We are presenting some possible cases that require differentiation from migraine aura.

Occipital epilepsy

The most frequent visual disturbances in migraine aura can be the first and, at times, the only symptoms of occipital epilepsy. Differential diagnosis is complicated because postictal headaches may closely resemble migraine headaches. The duration of symptoms

can be helpful in distinguishing between the two: epileptic seizures generally develop quickly and resolve more rapidly. Additionally, some findings suggest that visual phenomena in epilepsy appear colorful and round-shaped, whereas EVSs in migraine aura are usually black-and-white and linear (Kacprzak and Domitz, 2019).

Ischemic incidents

Migraine can be a 'stroke mimic' with a clinical presentation similar to ischemic stroke, leading to overdiagnosis. Sometimes cerebral ischemia is falsely diagnosed as migraine, so migraine is also a 'stroke chameleon'. Migraine aura can occur with many neurological impairments, such as speech and vision disturbances, vertigo, and even recurrent motor weakness. Moreover, a headache does not necessarily follow those focal symptoms. Even if a headache appears, it is not specific and may also be a symptom of a stroke (Borończyk et al., 2025). Visual symptoms of migraine aura typically spread across a field of vision and gradually resolve in the primarily affected localizations. This way of development, or a two-phase course of symptoms, suggests migraine aura. In ischemic incidents, scotoma is relatively rapid, with localisation depending on the occluded vessel (Kacprzak and Domitz, 2019). The medical history of migraine is also important. It is worth noting that migraine itself (especially with aura) is a risk factor of ischemic stroke, transient ischemic attack, and retinal vascular occlusion as well (Borończyk et al., 2025; Lusk et al., 2024; Ho et al., 2024).

Cerebral lesions

Visual symptoms and headache may be signs of cerebral lesions. Shams et al. presented nine new and thirty-one already published cases of patients who fulfilled diagnostic criteria for migraine visual aura, but their symptoms were caused by focal occipital pathology. Authors claimed that neither previous history of migraine (with or without aura) nor visual aura characteristics (presence of scintillating scotoma, duration, localisation) are always helpful in differential diagnosis. Features like absence of headache, especially in patients younger than 50 years old, visual aura lasting seconds or less than 5 minutes, age above 40 years old, and no history of migraine, should raise doubts about a diagnosis of idiopathic migraine. Moreover, researchers identified specific symptoms in migraine aura that require neuroimaging, including: stereotypical visual aura, an increase in the frequency of visual aura, a change in the pattern or characteristics of usual visual aura, any unexplained visual field defect, and negative visual phenomena/subjective persistence of a scotoma following a typical visual aura (Shams and Plant, 2011). Evcili et al., (2018) presented three more cases of migraine-like visual aura in patients with cerebral lesions. All three patients, aged 23-33, were diagnosed with an astrocytoma. In all cases, visual symptoms were associated with headache, and headache fulfilled migraine diagnostic criteria.

Acute angle closure attack

Sometimes, patients with aura and migraine are misdiagnosed with an acute angle closure attack. Both include symptoms such as visual disturbances and unilateral headache. But the visual disturbances manifest differently. In the migraine with aura, brilliant and moving scotomas precede localized scotomas. Binocular scintillations that expand gradually, scotomas in the form of" scintillating scotoma" or" fortification scotoma" that usually last 5 to 60 minutes, are specific for a migrainous visual aura, especially if a headache precedes the aura. The characteristic visual aura appears in a hemifield rather than the whole field of a single eye. Retinal migraine is a monocular attack of visual impairment that is fully reversible, combined with migraine headaches. Adverse monocular visual events with a duration of a maximum of 1 hour and migraine headaches on the same side as the visual loss are characteristic, but it is necessary to exclude ophthalmological issues. In acute angle-closure attacks, vision is completely blurred, accompanied by rainbow phenomena. Gonioscopy is an essential ophthalmologic exam. If the anterior chamber angle is wide open, the diagnosis of angle closure attack is excluded. However, migraine and acute glaucoma sometimes occur at the same time (Stan et al., 2020).

Alice in Wonderland Syndrome (AIWS)

AIWS is a disorder characterized by a change in visual and somatosensory perception. A patient with AIWS may perceive objects or body parts as altered in various ways (metamorphopsia). Micropsia (reduction) and macropsia (enlargement) are disorders of perceived size. Tellopsia is the overestimation of distance. In pelopsia, objects appear closer than they really are. Patient may also experience profound alterations in the perception of space and time (Kacprzak and Domitz, 2019; Ilik and Ilik, 2014).

In a prospective cross-sectional cohort study conducted by Fitzek et al., (2024) 133 of 808 migraine patients reported AIWS symptoms throughout their lives. Micropsia and/or telopsia were most frequent (72.9%). Macropsia or pelopsia were less common (38.3%). 65.1% of participants had both AIWS symptoms and headache. Patients suffering from migraines with aura were more likely

to report AIWS symptoms than those without aura. AIWS may also occur in mononucleosis, complex partial epilepsy, nonspecific hyperpyrexia, intoxication with drugs like topiramate, psychotic disorders, and brain tumors (Kacprzak and Domitz, 2019; Ilik and Ilik, 2014).

Visual snow syndrome (VSS)

VSS is a persistent disturbance in the entire visual field resembling the 'static' or 'snow' of a badly-tuned analogue television. The symptoms can persist for years. Many patients experience additional visual and non-visual issues, including palinopsia, photophobia, the blue-field entoptic phenomenon, nyctalopia, tinnitus, irritability, lethargy, and concentration problems. Despite the high prevalence of migraine in patients with VSS in comparison with the general population, symptoms of VSS are not consistent with the typical migraine visual aura. This feature is one of the diagnostic criteria of VSS. Moreover, symptoms cannot be better explained by another disorder (Schankin et al., 2014). The study summary is presented in Table 1.

Table 1. Study summary

Features of typical migraine pain	• moderate or severe intensity, • unilateral localization, • pulsating character, • worsening during physical activity, • additional symptoms like photophobia, phonophobia, or nausea/vomiting.
Definition of typical migraine aura	• entirely reversible, • visual, sensory, speech, or language disturbances, but no motor, brainstem, or retinal symptoms, • duration of each symptom is no longer than one hour, • precedes a headache or exists without one.
Diagnostic criteria of migraine with aura	• at least five attacks fulfilling the mentioned criteria • no better explanation in the ICHD-3, • preceded by an aura.
Types of migraine with aura	• migraine with typical aura • migraine with brainstem aura • hemiplegic migraine • retinal migraine.
Symptoms of migraine visual aura	• bright light, • foggy/blurred vision, • scotoma, scotomata, • small bright dots, white dots/round forms, colored dots/round forms, lines (colored lines), bean-like forms, zigzag lines, • 'like looking through heat waves, water or oil', 'like negative film' • visual snow, • hemianopsia, tunnel vision, anopia • deformed images, micropsia, macropsia, oscillopsia, • mosaic vision, fractured objects, corona effect, • complex hallucinations.

Differential diagnosis of migraine with visual aura	• retinal migraine, • occipital epilepsy, • ischemic incidents, • cerebral lesions, • acute angle closure attack, • Alice in Wonderland Syndrome, • visual snow syndrome.

4. CONCLUSION

Vision disturbances are a common phenomenon associated with migraine aura. There are various types of vision symptoms in VA. One individual can experience a complex pattern of positive and negative symptoms. Patients may struggle to describe their symptoms verbally. Therefore, a thorough medical interview is essential. Vision aura can resemble other medical conditions that cause visual symptoms and mask them. This kind of disorder requires an interdisciplinary approach and careful differential diagnosis.

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Author's contribution

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All authors have read and agreed with the published version of the manuscript.

Informed consent

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Ethical approval

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Conflict of interest

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Data and materials availability

All data associated with this study will be available based on reasonable request to the Corresponding Author.

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