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REVIEW ARTICLE

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Computer vision syndrome—A common cause of unexplained visual symptoms in the modern era

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Summary

Objectives: The aim of this study was to assess the evidence and available literature on the clinical, pathogenetic, prognostic and therapeutic aspects of Computer vision syndrome.

Methods: Information was collected from Medline, Embase & National Library of Medicine over the last 30 years up to March 2016. The bibliographies of relevant articles were searched for additional references.

Findings: Patients with Computer vision syndrome present to a variety of different specialists, including General Practitioners, Neurologists, Stroke physicians and Ophthalmologists. While the condition is common, there is a poor awareness in the public and among health professionals.

Interpretations and Implications: Recognising this condition in the clinic or in emergency situations like the TIA clinic is crucial. The implications are potentially huge in view of the extensive and widespread use of computers and visual display units. Greater public awareness of Computer vision syndrome and education of health professionals is vital. Preventive strategies should form part of work place ergonomics routinely. Prompt and correct recognition is important to allow management and avoid unnecessary treatments.

1 | INTRODUCTION

Computer Vision Syndrome, also referred to as "Digital Eye Strain", is defined by the American Optometric Association (AOA) as a group of eye and vision-related problems resulting from prolonged use of computers, tablets, e-readers and cell phones. Computers have made life easier in terms of unlimited access to information, improved work efficiency and ease of communication that could not have been imagined about a few decades ago. Despite the improvement in the quality of life, more and more people have become susceptible to the ill effects of working at a computer terminal for long hours. Very often, these symptoms resemble a TIA as evidenced by the number of patients turning up at the TIA clinic with quite a similar spectrum of eye symptoms. It is important that the cause of the symptoms is identified, not only to aid in the appropriate management but also to avoid unnecessary treatment.

Case vignette: *A 39-year old lady complained of recurrent blurring and transient loss of vision on several occasions in the preceding twelve weeks. The visual loss lasted for less than 15 seconds and was painless. Her eyes had also been feeling gritty lately. She was fidgety and restless. Her husband had recommended a visit to the optician as she was often straining with her eyes. She was irritable and frequently complained of pain in her lower neck. She had been seen by her General Practitioner and prescribed Aspirin on a daily basis initially along with Atorvastatin 40 mg daily; After 2 weeks Aspirin was changed to Clopidogrel. She was then referred to the TIA clinic as her symptoms were ongoing. Even during her consultations she was noted to be constantly on her smartphone sending and receiving messages with amazing speed. This suggested prolonged and well practiced use of her phone, suggesting prolonged use. All routine blood tests, including thyroid function,*

ESR and a carotid ultrasound scan were normal. She was seen by a stroke specialist (SM) and a diagnosis of computer vision syndrome (CVS) was given; it was noted that she spent long hours on her smart-phone not only during the day but at night as well. A visit to the ophthalmologist (SDM) subsequently revealed dry eyes as well. She and her family were educated and counselled about CVS and given advice about screen filters, posture, a need for frequent rest-periods and artificial tears. Clopidogrel and Atorvastatin were discontinued.

Review criteria

- Non-systematic review of manuscripts discussing 'Computer vision syndrome'.

Message for the clinic

- With the widespread use of computers and visual display units, more and more people are getting susceptible to ill effects of computers.
- Symptoms may be ocular or extra-ocular.
- Presentation to the General Practitioner, Neurologists for headache or referral to TIA or Stroke clinics or to the Opticians / Ophthalmologists with visual symptoms is not unusual.
- Correct diagnosis and management is essential to treat the individuals and avoid unnecessary treatments.
- Attention should be paid to work related ergonomics often involving simple measures.
- The public health implications of this condition are profound and should be taken seriously by individuals, employers and Health authorities.

2 | SYMPTOMS AND PATHOPHYSIOLOGY

Computer vision syndrome(CVS) is a form of repetitive strain disorder that has been on the rise among people who use visual display units (VDU) such as computers, tablets, cell phones etc for more than 3 hours a day at a distance less than 20 feet.[1] The level of discomfort has been seen to be proportional to the amount of computer use.[2,3] But recent studies have shown that it is unlikely that the use of computers can cause permanent damage to the visual system.[4-7] Our eyes perceive images on a VDU and printed paper differently. Images on a VDU are in fact blurred and lack sharp edges unlike printed paper. But it is not seen blurred because of the rate at which it is refreshed or rewritten on the screen by the beam of signals.[8]

Computers, like most other electrical devices, emit ionising and non-ionising radiations. The amount of radiation, however, is significantly below the recommended safety levels. Previous small studies have failed to clearly establish any link between computer use and health of computer users, both ocular and general.[9-12]

The major complaints experienced by VDT users comprise eye strain, headache, blurred vision, transient blindness and neck/shoulder pain.[13] Blehm and colleagues, classified the symptoms of CVS into four types: visual, ocular surface-related, asthenopic and extra-ocular, as depicted in Table 1.[1] The extent to which a person may experience these symptoms is largely dependent on his/her visual ability in relation to the visual demands of the task being performed. The transient blindness is thought to be due to bleaching of the photo-pigment in the retina and rapid shifts from light adaptation to dark adaptation and vice versa. Uncorrected vision, poor computer design and workplace ergonomics and a highly demanding visual task can all contribute to the development of visual symptoms and complaints.

2.1 | Is it "a repetitive strain disorder"?

Working at a computer requires the eyes to continuously move back and forth so that they can focus and align with what you see. The six extra-ocular muscles in each eye accommodate to changing images on the screen to create a clear image for the brain to interpret.[14] The posture while working at a computer terminal for long hours is an important factor that contributes to muscular and ocular problems. Computer vision syndrome can be considered as a repetitive stress injury for the following reasons:

- Repeated eye movements—Working at a computer requires the user to continuously shift his/her eyes from the screen to the keyboard, or from the screen to work documents and back again. As the object being viewed keeps changing frequently, the eyes will need to keep changing focus to maintain a clear image. It is known to us that the flexibility of the lens gradually decreases with age leading to a condition known as presbyopia, most common after about the age of 40. Hence, individuals are unable to effectively

TABLE 1 Major categories of symptoms in computer vision syndrome (Blehm et al., 2005)

Symptom category	Symptoms	Possible causes
Asthenopic	Eye strain, Tired eyes, Sore eyes	Binocular vision Accomodation
Ocular surface-related	Dry eyes Watery eyes Irritated eyes Contact lens problems	
Visual	Blurred vision Slowness of focus change Double vision Presbyopia	Refractive error Accomodation Binocular vision Presbyopic correction
Extra - ocular	Neck pain Back pain Shoulder pain	Computer screen location
Transient blindness	Loss of vision	Bleaching of photopigment, with the viewing eye becoming light-adapted

focus on computer screens and close work without adequate spectacle lens correction.[15]

- Symptoms are work related—The different aspects of a computer screen like screen resolution, contrast, image refresh rates, screen glare etc may play a huge role in the development of eye symptoms in CVS. The working distance as well as the angle between our eyes and the screen is considered to be equally important factors.[16,17]
- Long time frame required for occurrence of symptoms & recovery—though the visual symptoms and asthenopia occur as localised fatigue and disappear with the discontinuance of work, they often return when the work is resumed. The eyes are not able to adapt to repeated stress that causes fatigue so that they no longer happen with further exposure.[18]
- On exposure to light the photo-pigment becomes bleached, requiring time to regenerate.

2.2 | Ocular challenges in CVS

The use of computers has been associated with a minor but temporary myopic shift of refraction as compared with typists who showed no change in refraction in a cross sectional study done by Saito et al.[19] All subjects who developed a myopic change also complained of asthenopia. Standing up, moving away, and looking away from the computer can help reduce ocular symptoms as well as neck, back and shoulder pain. Although an episode of TIA is not precipitated by computer use and so the symptoms would not be relieved by taking frequent breaks from computer work. This will require a thorough clinical examination to rule out the possibility of a TIA so as to reduce any chances of developing disability. Levy et al. proposed that it is ideal to take an hourly break during computer use while others suggested frequent short breaks split thrice over an hour, ie, every 20 minutes. This was mainly in view of avoiding repetitive stress disorder.[20]

However, those subjects who suffer from under-corrected errors of refraction like myopia, astigmatism, presbyopia and so on are already prone to the development of computer-related eye stress.[21–24] Maintaining the same posture for a long period of time can contribute significantly to muscular problems like neck, back and shoulder pain. A simple way to overcome these would be to keep varying the posture while seated at a computer terminal. Frequent breaks in between computer use have been beneficial in improving comfort and relaxing the accommodative system.[25] A small break from computer use for 5-10 minutes more frequently is better than taking a long break every 2-3 hours.[26] Again, in a clinical scenario of stroke/TIA, any non-visual complaints would be mostly in terms of weakness or numbness of the limbs on either side of the body, speech impairment, neglect etc which are not precipitated by computer work or relieved by the intervals from work. A clinical assessment would be essential here to prevent the progression of symptoms which may result in loss of productivity.

Dry eyes are a common problem with frequent use of computers. This can be attributed to the blink rate which has been noted to be considerably reduced during VDT usage which in turn leads to poor tear film quality.[27] Decreased blinking and evaporation during computer use causes ocular surface changes and can result in tired eyes. Application of elasto-viscous drops has not been found to be effective on counteracting the issue of dry eyes.[27,28] We need to bear in mind that dry eyes can also be a manifestation of certain systemic diseases like Sjogren's syndrome, rheumatoid arthritis, collagen vascular diseases, thyroid diseases etc. Some classes of drugs like diuretics, antihistamines, antipsychotics, antidepressants, oral steroids etc can also produce similar symptoms.

2.3 | Workplace illumination

One of the most significant environmental factors that can affect vision in computer use is lighting. Bright illumination in the peripheral visual field may cause glare and discomfort to the eyes. This problem can be overcome by proper workstation design and arrangement. The amount of light needed for computer work and that for other office tasks like reading, writing etc is different. Workers over 50 years of age require twice the levels of light of young adults for comfortable computer work.[29]

Light reflected from computer screens is equally important as the peripheral lighting. The brightness of the screen and that of the work room should be balanced. Filters can be placed in front of the screens to cut down on the glare and reflection. But then this should only be a supplement and not a replacement solution as filters by themselves do not reduce the occurrence of asthenopia.[30] The colour of computer characters may also play a role in affecting vision. Black characters on a white background or vice versa have been observed to be easier on the eyes than looking at coloured characters.[31]

2.4 | Importance of gaze angle

Improper viewing distances and angles can give rise to the need for unhealthy postures during work at VDTs.The direction of gaze can affect focusing of the eyes and accommodation. Higher gaze angles at computer terminals reduce the amplitude of accommodation thus placing more strain on the focusing mechanism of the eyes.[32] As the direction of gaze moves down, the eye muscles tend to be less strained. Thus it would be ideal to maintain a downward gaze of about 15 degrees

TABLE 2 Remedial measures for computer vision syndrome

1. Specially designed ocular examination for computer users & appropriate counselling about good practices, prior to prolonged use.
2. 1,2,10 (One to Ten) rule: Mobile phones at 1 foot (30 cm); Desktop devices and laptops at 2 to 2.5 feet;10 feet for TV screens
3. Rest breaks: 20/20/20 rule—after every 20 minutes of computer viewing, look into the distance 20 feet away for 20 seconds to allow the eyes to refocus.
   The American Optometric Association suggests a break of 15 minutes after 2 hours of continuous computer use.
4. Using computer monitors in 'ergonomic' position—(40 in and 14 degree down gaze) and appropriate seating
5. Use of computer glasses or screen filters
6. Limiting computer and screen time with frequent rest periods
7. Appropriate lighting (20-70 foot candles)
8. Education of children and young people
9. Treatment of dry eye, refractive errors, including astigmatism & presbyopia

when looking at a computer screen.[33] The top of the screen should essentially be below the horizontal eye level and tilted back 10-20 degrees away from the worker. Older workers may find it more difficult to adjust to these work requirements as compared with the younger lot. Specific occupational lenses with special designs, powers or lens tints may be useful to maximise visual abilities and comfort.[34]

2.5 | Other useful measures

Table 2 summarises some important 'remedial measures' to reduce the symptoms of CVS. Adequate breaks from computer work and limiting the screen time is believed to have dramatic effect in controlling the symptoms of CVS. It has been postulated that after working at a VDT for 20 minutes, the VDT user should look at a distance of more than 20 feet for at least 20 seconds (20/20/20 rule). This has shown to improve the work efficiency as well as address the issue of eye- strain.[35,36]

As mentioned earlier, workplace ergonomics play a part in CVS. Hence, a couple of simple suggestions regarding the positioning of the computer and its chair would be worth taking into consideration.[37-39] Placing the computer screen at one arm distance or 40 inches away with a downward gaze of at least 14 degrees can go a long way in relieving symptoms.[37] A chair that provides good support to the back, legs, buttocks and arms would be a good idea to control the musculoskeletal issues that arise in CVS. It will help avoid awkward postures, contact stress and forceful exertions. Using the keyboard in such a position that the arms and wrists are in neutral position may help avoid contact stress.

The lighting specifications at the workplace need to be looked into to avoid glare and reflections that can lead to eye strain. The lighting intensity should only be half the normal needed when computers are being used. Excessive glare from the screens can be controlled through the use of antiglare filters and flat computer screens.[40]

Single vision lenses with focal length adjusted for computer use is preferred over bifocal lenses in symptomatic workers. This is because in presbyopes the glasses are designed in such a manner that the part for near vision is placed in the lower segment of the lens. Thus they will be forced to tilt their head backwards to view the screen through the lower segment of the glasses which is likely to give rise to undue strain on the neck muscles.

Therefore, improved quality of illumination, screen ergonomics, appropriate keyboard and mouse designs, alternative input methods like touch, stylus etc may be crucial yet extremely simple methods to prevent the symptoms related to CVS.[41-43]

Recently, colleagues described 'transient blindness due to smartphones'.[44] In our own practice, we have been encountering this phenomenon in a number of patients presenting to the TIA clinic with visual symptoms. This is something all physicians need to keep in mind in their day to day practice.

3 | SUMMARY

Computer Vision Syndrome is a repetitive strain disorder characterised by symptoms like transient loss of vision, blurred vision, dry eyes, headache, eye fatigue, neck pain and so on. It results from prolonged use of VDTs over an extended period of time but studies have shown that the effects are not always lasting. The condition is commonly encountered in Neurology and Stroke/TIA clinics. The symptoms are relieved when computer work is stopped most of the times. Other points to keep in mind regarding the management of this condition would be workplace ergonomics and the visual ability of the user. A number of treatment modalities have been discussed in literature. But we still have a long way to go to understand this syndrome better and come up with newer and effective approaches of management. It would be ideal to educate children and instill in them the right practices of using computers. It is vital to correctly distinguish CVS from 'transient ischaemic attacks and amaurosis fugax, so that either condition is managed appropriately and unnecessary treatments and lifelong antithrombotic therapy avoided.

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