Eye problems in Radiologists

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Learning objectives

To review eye problems and radiation-induced eye injury in radiologists. To describe the prevalence of and factors contributing to eye problems among radiologists.

Background

In recent years, technologic advances (including the introduction of MDCT) coupled with an increasing number of unfilled radiology positions have led to an increasing workload for radiologists. In fact radiologists working under a heavy workload potentially face a range of health issues, including musculoskeletal injuries, eye strain and etc. Eye strain is a well-recognized consequence of computer over-use, and can be a particular issue for radiologists. Posterior subcapsular cataract (PSC) is common among interventional radiologists. Visual acuity is easily measured and corrected, but very little has been written regarding its importance to practicing radiologists. We review the eye problems in radiologists and the proper prevention of them in this article.

Imaging findings OR Procedure details

Introduction

In recent years, technologic advances (including the introduction of MDCT) coupled with an increasing number of unfilled radiology positions have led to an increasing workload for radiologists. In fact, according to the US Occupational Health and Safety Administration, radiologists working under a heavy workload (as most do) potentially face a range of health issues, including musculoskeletal and repetitive strain injuries, eye strain, lumbar disc problems and even carpal tunnel syndrome. Eye strain is a well-recognized consequence of computer over-use, and can be a particular issue for radiologists. Posterior subcapsular cataract (PSC) is common among interventional radiologists. Visual acuity is easily measured and corrected, but very little has been written regarding its importance to practicing radiologists. We review the eye problems in radiologists and the proper prevention of them in this article.

Eye Strain

Computer technology, which has transformed the workplace, has also introduced an array of related health complaints, most of which involve the visual and musculoskeletal systems. Symptoms of eye strain are the most commonly reported complaints among computer users [1, 2]. Because eye strain has mainly been investigated and described

in computer workers, it has also been termed "computer vision syndrome" [1]. Eye strain (asthenopia) is a symptom complex that involves sensations of irritation to the eye itself, changes in vision (such as blurred or double vision), and associated symptoms such as headache [2, 3]. The main cause of eye strain is thought to be fatigue of the ciliary and extraocular muscles due to the prolonged accommodation and vergence required by near-vision work [1-4]. Another causative factor that has been implicated in eye strain is dryness of the eyes resulting from an increased exposed surface area of the cornea when focusing straight ahead (rather than down at written text) and a decreased blink rate due to mental concentration [2]. Computer video-tape display factors and workstation design, including screen resolution and contrast, image refresh rates, screen flicker and glare, and working distances and angles are thought to contribute to symptoms [1-3]. Psychologic factors also play a role in determining the degree to which symptoms are experienced and expressed [2, 3]. No permanent damage to the visual system occurs, although work performance can be temporarily compromised [3]. Many studies have been performed to assess eye strain in office workers using computers with current estimates of prevalence of approximately 40% [2]. Improving the ergonomic design of workstations and modifying the work habits of computer users (with supplementary breaks) have been shown to have positive effects on eye strain in these workers [2, 5-7].

With the introduction of PACS and extensive use of computers for administrative tasks [8], radiologists are likely to be susceptible to such computer-related symptoms. Although the type of lighting and the variety of tasks performed in the office workplace differ considerably from those in the environment in radiology interpreting rooms, eye strain is likely to occur by similar mechanisms.

Eye strain can hinder productivity and diagnostic interpretation by causing "perceptual errors, performance errors, decrease in reaction time, fatigue, and even burn out..." [11]. These symptoms are therefore highly relevant to the radiologist in today's work environment.

Those with small refractive errors and oculomotor problems may only become symptomatic during the demanding conditions of sustained work on VDTs. Formal eye assessment and use of appropriate corrections may therefore be beneficial for radiologists [2, 4, 13, 14].

The influence of workstation design on eye strain is of great interest because workstations are highly modifiable especially at the stage of initial PACS implementation. Noticeable screen flicker is a factor correlates strongly with eye strain. Apparent or noticeable flicker may be avoided by optimizing the refresh rate for CRT monitors and pixel response time for LCD monitors [16-18]. Appropriate and timely computer screen maintenance is also likely to be helpful.

Lighting in the viewing environment is a key factor in workstation design that is often not adequately addressed in PACS implementation [19]. Although we inquired whether the lighting of the viewing environment was adjustable, we did not ask more detailed

questions about ambient lighting. For example, factors such as the type of lighting (overhead vs indirect), the presence of windows or view boxes, and the number and position of monitors in the image interpreting room are likely to be important, as indicated by Siegel et al. in a survey of radiologists using PACS [20].

Many radiologists may not be aware of other simple strategies to reduce eye strain that have been described in the computer literature. For example, one recommendation is **the 20-20-20 rule**: focus 20 ft (6.1 m) away from the monitor for 20 sec every 20 min. This allows users to change their posture and temporarily rest the muscles of accommodation. The ideal position for viewing a monitor is **25 inches (60 cm)** away, with the gaze directed slightly below the horizontal plane [21]. Monitors placed on top of a PC housing on a conventional table (height, 28 inches or 72 cm) are likely to be at eye level for the average viewer and therefore too high [22]. White coats should be removed when working at a computer to avoid the reflection of light or glare onto the monitor. Monitor brightness should be matched to that of the viewing environment [21]. Artificial tears and increased blinking may help; the eyes frequently become dry from a reduced rate of blinking while one is using computers [3, 23].

In conclusion, eye strain are common in radiologists and do not vary significantly between those using PACS and film. Given ongoing technologic advances, the rate-limiting factor to productivity will be radiologist fatigue, including eye strain. Taking breaks of any length at least every hour, limiting work day length, eliminating computer screen flicker, and adopting other simple strategies discussed previously may improve symptoms. Increased high image volume studies (e.g., screening CT) in radiology practices may increase symptom prevalence, and time spent reviewing such studies should be limited. According to existing literature studying computer users, improving the ergonomic design of workstations is likely to help symptoms, but education of radiologists on proper viewing habits is equally important.[28]

"Radiologists tend to use computers in a different way to everyone else in the world.[29]

"If the monitor is placed too high, for example if you are using more than one monitor and if it is placed in a portrait rather than landscape display, and if you are having to tilt up from the horizontal routinely, then that is going to cause strain. You do not want the person to be too low and you do not want the table too high.[29]

"But you should not be reading in a room that is too dark or too bright. You need, ideally, adjustable light, so that the amount of light bouncing off the walls should be the same amount of light coming off the computer screen. That prevents your iris from having to open and close all the time as you move your eye around.[29]

Radiology reading is not like normal word processing; most of the stuff you need to be looking at will be in the middle of the screen. But you do have to plan for the desk to be a bit lower and make sure the chair can be raised.[29]

Or it can simply be that the physical environment - the lighting particularly - is simply not right. "Most radiologists work in the dark; not because they want to, but because the lights are so wrong they end up just turning them off,".[29]

Interventional Radiology Carries Occupational Risk for Cataracts

Interventional Radiologists are at high risk of radiation-induced eye injury and should consider eye protection to avoid posterior subcapsular (PSC) cataract formation. The researchers found that the frequency and severity of PSC cataracts increased with age and years in practice. It is urging interventional radiologists to more seriously consider wearing high-quality radiation eye protection. It must also be warning them against being too cavalier about radiation risk because of the long latency between initial exposure and findings.[30]

"There are alternatives to protective lead glasses that will block radiation and reduce the dose to the eye."The glasses will not make it zero, but it will substantially reduce the dose to the eye. Advances in the technology with procedural modifications to minimize exposure time are also reasonable approaches." [30]

"Currently, radiologists are told they have no risk of cataracts if they stay under **2,000 milligray** but the feeling that we are protected if we do not exceed that level is incorrect." [30]

The eye lens, along with bone marrow, is highly sensitive to radiation. Because PSC cataracts form in the back of the lens, they decrease contrast sensitivity before they affect visual acuity. This differs from most forms of age related cataracts, which interfere with visual acuity first. [30]

"One of the most important findings was that the changes observed were found in interventional radiologists in their mid-40s. **"Even though these small opacities will not yet interfere with the ability to work, they have to be taken seriously because they reflect radiation exposures dating back 10 or more years."** [30]

"It is to be expected that more recent exposure will lead to cataract progression and possibly disabling consequences even if work habits are changed immediately," **"Interventional radiologists need 20/20 vision in both eyes to have excellent stereopsis and to perform the delicate procedures demanded in their occupation.** The treatment, cataract extraction, is a frequent and very successful surgery, but is still associated with risks that can negatively affect outcome and visual rehabilitation. For interventional radiologists even successful cataract surgery could result in less than optimum outcomes and define the end of their career." [30]

Radiologists and visual acuity

The relevance of visual acuity (VA) to practising radiologists is not a subject which has been investigated or discussed extensively.

Radiological interpretation and diagnosis depends on a number of factors. One of these may be **the radiologists' innate visual acuity**. Several studies have shown that this may be of relevance in the detection of lesions [31, 32,3 4], although other factors such as training, knowledge, viewing distance and image quality have generally been regarded as more important. However, in all these studies it is commented that the subjects tested all had near normal VAs, and that a stronger relationship between VA and lesion/nodule detection would become evident as the VA worsened [32]. Visual acuity is easily measured and corrected, but very little has been written regarding and corrected, but very little has been written regarding its importance to practising radiologists. There is a progressive normal deterioration in VA with age which will affect all radiologists, and in addition, there may be **an increased effect from the non-stochastic effect of ionising radiation on the lens**. **The lens** is amongst **the most radio-sensitive tissues in the body**, and opacities can develop which may lead to visual impairment. The pathogenesis involves damage to dividing cells in the anterior epithelium which then migrate posteriorly to accumulate beneath the capsule of the posterior pole of the lens. This accumulation of damaged cells and breakdown products causes posterior displacement of the lens bow and leads to a small central posterior subcapsular opacity. If this lesion progresses it can extend to involve the anterior cortex and nucleus of the lens eventually leading to the development of cataracts. Review of records from previous radiation workers and follow-up of radiotherapy patients suggests that a dose of more than 8 Gy of low-LET radiation would be needed to result in cataract development under the protracted radiation exposure to which radiologists are subject [35]. It is doubtful that most radiologists are at any increased risk of cataractogenesis, but those involved in interventional procedures or excessive screening may be. There may be a place for monitoring these individuals on a more regular basis to try and avoid any potential radiation damage to the lens. Although most of the radiologists are aware of and respect the potential risk, few actually use protective measures such as lead glasses or screens. This may be related partly to poor design of these aids in which case consultation and discussion with their manufacturers may be of value.

It has been shown that decreased VA increases the threshold contrast required to detect and identify high-frequency information [36]. A direct relationship has been shown between resolution and the contrast required for detection of high-frequency information (> 2-line pairs/mm), on images viewed at distances of 30 cm or more. High-frequency information may not be important in all aspects of radiology, such as nuclear medicine, but in a number of other tasks it may be vital as in the detection of mammographic microcalcifications. There is increasing recognition that contrast sensitivity or grey-scale discrimination tests should be included in visual assessment [33, 36,37,3 8]. Contrast sensitivity decreases with age, but the effect of this on visual function is not yet fully established [8]. In the case of cataracts, deterioration initially affects mainly high spatial frequencies, but posterior subcapsular cataracts may cause contrast sensitivity loss earlier at low spatial frequencies [37]. There is an increasing emphasis on quality

assurance and unfortunately an increase in litigation after missed lesions, at least in the United States [33]. This may increase with a growing number of radiology screening programmes being implemented. As a consequence, the observer may be assessed as well as the images he or she interprets. Requirements exist in certain non-medical professions where vision is considered important, for periodic VA and contrast sensitivity tastings.

This would suggest that attitudes among radiologists would not necessarily be a barrier to the implementation of mandatory VA and contrast sensitivity testing at the onset of and periodically during their careers. The main concerns raised related to the actual testing process and the experience of the occupational health department to provide this.[39]

It may be that individual radiologists should organize their own tests with an optometrist of their choice, and let their employers bear the cost.[39]

Much effort is expended into improving image quality and resolution, training and interpretation skills, and there is sufficient evidence available to show a link between VA and detection of lesions to make this exercise worthwhile. It will become more relevant with increasing litigation, and any move to regular testing, if deemed necessary, would be better instigated by the profession itself. Employers should bear the cost of this exercise, and there may then also be a possibility of obtaining medical insurance to cover a radiologist against potential loss of career or earnings as a result of loss of vision or accelerated deterioration of VA.[39]

Conclusion

According to abundance of eye problems related to over-use of computers in radiologists recognition and proper prevention of them is necessary for radiologists.

Personal Information

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