REVIEWS

Improving outcome in stroke patients with visual problems

SALLY A. JONES, ROGER A. SHINTON

Department of Elderly Medicine, Birmingham Heartlands Hospital, Birmingham, UK

Address correspondence to: S. A Jones, Department of Elderly Medicine, Birmingham Heartlands Hospital, Birmingham B9 5SS, UK. Tel: (+44) 7855 765811. Fax: (+44) 121 7530653. Email: prideofouralley@yahoo.com

Abstract

Background: stroke is a common condition, frequently with significant effects on a patient's ability to live an active and independent life. Anything that may potentially have a beneficial effect on the rehabilitation of such patients should therefore be explored, and as ocular and visual problems are common in patients with stroke, it is important that their implications are understood.

Objective: this article aims at providing a broad overview of the literature relating to visual problems in stroke patients, looking particularly at the impact on, and the potential for, recovery and rehabilitation.

Methods: the online database PubMed was searched for literature relating to visual and ocular problems in stroke. The resulting abstracts and articles were then reviewed to extract clinically relevant information. Findings are summarised and discussed.

Conclusions: visual problems in stroke are associated with problems with activities of daily living (ADL), falls and rehabilitation. Because many visual problems are easily corrected or improve with intervention, there may be a role for formal screening for visual problems in stroke patients in a rehabilitation setting. The orthoptist has an important role to play in stroke rehabilitation, and links between the stroke and orthoptic departments should be established in all units.

Keywords: vision disorders, stroke, cerebrovascular disorders/complications, elderly

Introduction

Stroke is a common condition, frequently with significant effects on a patient's ability to live an active and independent life. It is therefore important that anything that may potentially have a beneficial effect on the rehabilitation of such patients is explored.

Ocular and visual problems are an important issue in just about every facet of stroke medicine. Stroke itself can present with various visual problems including gaze palsies, visual field defects, diplopia, reduced vision, ptosis, pupillary and eye movement disorders and cortical blindness. In addition, other conditions directly related to stroke and the risk thereof are also manifested in the eye—for example, diabetic and hypertensive retinopathies, hypercholesterolaemia associated with arcus, xanthelasma and retinal changes and age-related eye conditions such as macular degeneration, cataract and refractive errors.

This article aims at providing a broad overview of the literature relating to visual problems in stroke patients, looking particularly at the impact on, and the potential for, recovery and rehabilitation.

Search methods

A literature search was performed using the online database PubMed to identify articles containing combinations of the search terms stroke, vision, rehabilitation, eye movements, visual field defects, retinopathy and ophthalmoplegia. Limits were set to articles in English, to all adults, to human subjects and to those items with abstracts. Initially, only core clinical journals were searched, but this was subsequently widened to all Medline articles from 1951 onwards. This gave a total of 1,068 articles of which, following review of all abstracts, 63 were felt to be directly related to the subject of this article. All these articles were then read in full, and those relevant to this article are cited or discussed. Single case reports were excluded. Additional references were retrieved from bibliographies of some of the articles obtained. A similar search was also performed
The eye and stroke

Decreased visual acuity

Poor visual acuity is a risk factor for falls and a common impediment to rehabilitation [1], and after stroke, visual impairment may exacerbate the impact of other impairments on overall disability [2]. Postural stability has been shown to be related to visual conditions [3], and visual ability has been shown to contribute to both the level of care needed and the patient's level of satisfaction with life following stroke [4]. A study of 103 cognitively intact nursing home residents showed a strong link between low vision and activities of daily living (ADL) performance [5].

There are clearly many causes of decreased visual acuity in both stroke patients and the general population, including refractive error, glaucoma, cataract, macular disorders, retinal detachments and central retinal vessel occlusions. Some causes are more readily treatable than others, but if poor visual acuity is not even highlighted in a patient, then easily correctable causes may go untreated and the rehabilitation and subsequent quality of life may be adversely affected. A prospective study in Belfast of 77 consecutive stroke patients admitted for rehabilitation following acute stroke showed 14% of their patients to have a visual impairment that benefited from refractive correction. In addition to this, 19 of their 77 patients did not have their glasses in hospital with them [2]. This study, therefore, highlights not only the common finding of easily correctable refractive error in stroke patients but also the need for physicians and nursing staff to enquire about glasses in the first instance—a very simple and cost-effective way of improving visual acuity! Many cases and causes of decreased visual acuity are more difficult to resolve or may not be amenable to treatment at all, but recognition of the problem is clearly an important first step.

Disorders of eye movements

Conjugate eye deviation towards the affected hemisphere is a well-recognised finding in acute stroke [6]. In addition to this, eye movement disorders due to involvement of the third, fourth and sixth cranial nerves are also common, leading to a manifest squint with blurring of vision and/or diplopia, although not all patients are symptomatic. Brain stem stroke can lead to a variety of ocular motility disorders including infranuclear cranial nerve palsies, supranuclear gaze disorders, internuclear ophthalmoplegia, nystagmus and ocular dysmetria [7].

The reported incidence of squint in the literature varies from 28% in patients with cortical stroke [8] to 52% [9]. The natural history of such problems varies. Up to 36% of patients with squint are asymptomatic [8], and others find that their symptoms and impairments improve over time with little or no intervention. However, others suffer ongoing distressing symptoms with subsequent rehabilitation problems and may benefit from intervention of some kind. Several interventions have been shown to be beneficial, including the use of temporary prisms, covering an eye [9] or teaching compensatory head postures [7, 10].

In addition to diplopia, patients may also experience problems with saccades and smooth pursuit as well as reduced binocular convergence and reduced stereopsis, leading to problems with depth perception, hand–eye coordination and difficulty reading. In many cases, these problems improve over time with no specific intervention [9, 10], although a very small case series published last year was able to show positive effects of oculomotor rehabilitation on saccades, fixation, pursuit and reading ability [11]. Orthoptist involvement in the 'stroke team' is of great importance; because not only are many of these terms and problems poorly understood by many physicians, but it is the orthoptist who is able to advise on and help with diplopia, gaze problems and nystagmus [7] (Table 1).

Visual field defects

Visual field loss has many causes but is a well-recognised complication of stroke, with an incidence in acute stroke patients reported as 20% [12]. A large study of people in the community showed homonymous visual field defects in 8.3% of post-stroke patients [13]. A smaller study showed asymptomatic visual field loss in 29% of transient ischaemic attack (TIA) patients and 57% of minor stroke patients [14], which, though asymptomatic, may carry implications for tasks such as driving.

Visual field loss is associated with impairment in daily functioning and a higher risk of incident falling [15], which obviously has implications for rehabilitation. It is also an important predictor of functional status on discharge from stroke rehabilitation units [16], with the same article concluding that visual field defects should be given as much attention as hemiparesis during rehabilitation for patients with right hemisphere stroke.

Visual field defects often improve with time, and a study of acute stroke patients observed that, along with visual neglect, this recovery is maximal during the first month [17]. Patients with persistent visual field defects should be

Table 1. Some terms explained

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saccades</td>
<td>Very small fast conjugate changes in fixation, e.g. in reading</td>
</tr>
<tr>
<td>Stereopsis</td>
<td>Depth perception</td>
</tr>
<tr>
<td>Smooth pursuit</td>
<td>Ocular tracking of a moving object</td>
</tr>
<tr>
<td>Binocular convergence</td>
<td>Distance perception, from the brain's ability to use the angle created by each eye converging on an image</td>
</tr>
<tr>
<td>Visual neglect</td>
<td>Reduced response to visual stimuli from the side contralateral to the cerebral lesion when visual fields are intact</td>
</tr>
</tbody>
</table>
offered specific retraining strategies as recommended in the National Clinical Guidelines for Stroke published by the Royal College of Physicians [18]. Several types of retraining have been described, with techniques tending to be based on teaching compensatory eye movements to compensate for the defect. A German study of 21 hemianopic patients and 23 controls showed that 4 weeks of compensatory visual field training led to a marked improvement in detection and reaction time of visual stimuli in all their subjects with hemianopia and that this improvement was still maintained at 8 months [19]. The same study showed that ADL skills also improved in all their patients. There have been several other studies looking at the effects of eye movement training in patients with visual field defects [20, 21] with improvement in ADL or function as well as studies showing an additional benefit of additional audio or attentional stimulation [22, 23]. In addition to learning strategies to compensate for a visual field defect, there is also some evidence, albeit in small studies, to suggest that the visual field defects may also be partially reversible even in the chronic phase [24]. By repetitive stimulation of the area involved, it is possible to enlarge the visual field with average enlargements of the field of vision of 5 degrees (range 0–20) [25]. However, another study showed no improvement of the actual defect border in their patients following training [26] (Table 2).

**Visual neglect**

Visual neglect is common in patients following stroke, and differentiation from visual field defects is not always easy, particularly as the two conditions may co-exist. Star cancellation and similar tests, although time consuming, can aid diagnosis.

Prevalence figures vary from article to article. The incidence of visual neglect in a London study of 171 patients with acute hemispheric stroke was found to be 82% in assessable right hemisphere patients and 65% in left hemisphere patients [27]. Another study detected visual perception disorders in 25 of 46 patients with hemiplegia [28]. A third study detected visual neglect in 8–11% of patients at 3 weeks after stroke [29]. Visual neglect may adversely affect functional recovery [30] and exerts a slowing influence on rehabilitation [29]. It is therefore important that clinicians are aware of different methods of management.

The natural history of visual neglect varies and, in many cases, improves spontaneously. One study showed recovery to be most rapid over the first 10 days and to reach a plateau at 3 months [31], with another study stating that significant neglect was rarely observed by 6 months [29]. There is some evidence to suggest that the severity of visual neglect at 3 and 6 months can be predicted by its severity at 2–3 days [31], which may help identify those patients likely to benefit from the treatment. For those patients in whom visual neglect is a persisting problem, possible management strategies include teaching the patient to be aware of the problem and modifying behaviour and the environment. The occupational therapist can be particularly helpful here. Other strategies described include scanning strategies, monocular patching, visual stimulation and the use of prisms. Scanning strategies have been shown to be beneficial in reducing unilateral visual neglect in small studies [30], and there is also some evidence regarding the benefit of eye patching together with lateralised visual stimulation in reducing neglect in daily activities [32]. A pilot study looking at treating neglect using feedback of eye movements did not show any significant improvement in neglect [33]. Fresnel prisms have also been shown to improve visual perception in stroke patients with homonymous hemianopia or unilateral neglect [34] improving oculomotor bias and neglect dyslexia [35], although evidence is lacking as to whether or not this leads to a significant improvement in ADL (Table 3).

**Retinal abnormalities**

As with decreased visual acuity, retinal abnormalities in stroke patients are usually coincidental findings or manifestations of co-morbid conditions rather than a manifestation of the stroke itself. Nonetheless, retinal problems such as hypertensive and diabetic retinopathies, anterior ischaemic optic neuropathy, age-related macular degeneration and central and branch retinal vessel occlusions remain an important issue in stroke patients, not least as treatment of the underlying cause can help limit sight loss and also help protect future vision for the other eye. Even after controlling for systemic risk factors, retinopathy severity and visual impairment have been found to be related to all-cause and stroke mortality [36], and a large Australian study showed retinopathy to predict stroke independent of traditional risk factors [37]. The Atherosclerosis Risk in Communities Study, using a cohort of 10,358 subjects, showed retinal microvascular abnormalities to be predictive of incident stroke [38–40]. Similarly, another large population-based study found that persons with retinal emboli are at an increased risk of stroke-related death [41]. Hypertensive retinopathy changes have also been shown to be related to an increased risk of stroke, as have retinal changes in normotensive individuals [42]. Patients with retinopathy should therefore have all risk factors for cerebrovascular disease aggressively addressed. Smoking cessation should also be addressed. Not only has a meta-analysis of 32 studies provided strong evidence of smoking being a risk factor for stroke itself [43], but it is also strongly associated with

---

**Table 2. What does an orthoptist do?**

- One of the allied health professions
- 3-year course leading to Honours degree
- Specially trained in the diagnosis and management of problems related to:
  - Childhood visual screening and paediatric contact lenses
  - Strabismus
  - Perimetry (visual fields)
  - Tonometry (ocular pressures)
  - Intra-ocular lens implant assessment
  - Visual electrical potentials
  - Low vision aids
  - Abnormal eye movements and co-ordination
  - Disorders of binocular vision

Information from British Orthoptic Society Web site (http://www.britishorthopticsociety.co.uk).
Visual problems in stroke patients

Table 3. What are Fresnel prisms and how can they help?

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Thin transparent acrylic sheets that can adhere to a patient’s glasses</td>
</tr>
<tr>
<td>• Available in a series of moulded facets to replace traditional heavy wedge shape of a prism</td>
</tr>
<tr>
<td>• Can shift an image from the ‘blind area’ into the residual visual field where the image can then be seen</td>
</tr>
<tr>
<td>• Can also shift images in patients with diplopia, so that the two images are joined</td>
</tr>
<tr>
<td>• Patients have to be taught to adapt to life with their prisms due to the apparent shift in space of what they see</td>
</tr>
</tbody>
</table>

Fresnel himself was a French physicist (1788–1827) who worked with polarised light and whose lens/prism was originally used in lighthouses.

age-related macular degeneration, a risk that is reversed on giving up smoking with important implications for protecting sight in the other eye [44]. There is also data suggesting a possible association between retinal vein occlusion and stroke [45].

Discussion

It is evident from clinical practice and the literature that visual disorders are prevalent in stroke medicine and are involved in all stages. In primary prevention, ocular pathology can help identify those at risk of stroke. In acute stroke, visual disorders may form all or part of the initial presentation, and subsequently, visual problems may be a rehabilitation issue or affect the quality of life and ADL after stroke [4, 5]. There is evidence that both stroke and visual impairment are associated with depression in the elderly [46] and that visual loss is associated with a significantly poorer quality of life directly comparable with that caused by systemic medical conditions [47, 48]. Dependence on others for performing ADL has been shown to be significantly related to the presence of eye disorders [5], and vision functions other than visual acuity have been shown to affect day-to-day functioning of older adults [49] which is clearly important in stroke patients who may have a variety of visual problems. It is also clear that many patients can benefit from intervention, although many of the studies regarding treatment are small, highlighting a need for further work in this area. There may, therefore, be a role for the screening of stroke patients for visual problems in order that their rehabilitation potential is optimised. Retinal screening has already been piloted in patients attending a fast-track TIA clinic and found to be useful [50]. Perhaps patients in a stroke rehabilitation setting would also benefit from routine screening for visual disorders. Formal screening may identify patients who may have significant visual problems but which are not perhaps immediately obvious particularly in patients with cognitive impairment or dysphasia that may not be able to easily communicate such difficulties. The Cardiff Acuity Test has been shown to have statistically significant correlation to standard Snellen acuity tests and requires no speech or understanding on the part of the subject [1]. This method of assessing visual acuity involves assessing patients eye movements to indicate whether or not they have seen increasingly faint targets presented on cards.

The role of the physician, occupational therapist, speech therapist and physiotherapist in the management of stroke patients is well recognised. Common sense tells us that the role of the orthoptist in such patients is also important. Not only can the orthoptist assist in the management of clinically obvious visual pathology, but they are also well trained in more detailed assessment and management and in picking up more subtle problems such as in saccades and stereopsis which are often poorly understood by physicians. In addition to this, they can play a role in teaching carers and family of the effects of visual problems and the ways in which the patients environment may be adapted to help [51]. Unfortunately, despite being an important part of the multidisciplinary team, the role of the orthoptist is often neglected, an issue which probably needs to be addressed in many units.

Key points

• Visual problems are common in stroke and are associated with problems with ADL, falls and rehabilitation.
• Many visual problems are easily corrected or improve with intervention.
• There may be a role for formal screening for visual problems in stroke patients in a rehabilitation setting.
• The orthoptist has an important role to play in stroke rehabilitation, and links between the stroke and orthoptic departments should be established in all units.

Acknowledgements

We thank Anne Southgate, Orthoptist at Birmingham Heartlands Hospital, for providing orthoptic advice and literature.

Conflicts of interest

None known.

References

5. Marx MS, Werner P, Cohen-Mansfield J, Feldman R. The relationship between low vision and performances of activities of


47. Brown MM, Brown GC, Sharma S, Busbee B. Quality of life associated with visual loss: a time tradeoff utility analysis
Sporadic cerebral amyloid angiopathy—an important cause of cerebral haemorrhage in older people

BHOMRAJ THANVI, TOM ROBINSON

Leicester General Hospital, Medicine for the Care of Older People, Leicester, UK

Address correspondence to: B. Thanvi. Email: bthanvi@hotmail.com

Abstract

Cerebral amyloid angiopathy (CAA) is an important cause of primary intracerebral haemorrhage (PICH) in older people, accounting for ~10% of all types of PICH. The amount of amyloid deposition in the vessels and vasculopathic changes determine the propensity to PICH. The risk factors of CAA include advanced age and the presence of certain alleles of apolipoprotein E. There are no specific clinical features of CAA-related PICH, although lobar, recurrent or multiple simultaneous haemorrhages in older patients should raise suspicion of its diagnosis. A definitive diagnosis of CAA requires pathological examination of the affected tissue. However, with modern imaging techniques, it is possible to make a diagnosis of ‘probable CAA’ in patients presenting with PICH. Gradient-echo magnetic resonance imaging is a sensitive, non-invasive technique for identifying small haemorrhages in life. Currently, there is no specific treatment available for CAA. Recent advances in the immunopathology and pathogenesis of CAA are expected to help in developing specific anti-amyloid therapy.

Keywords: cerebral amyloid angiopathy, primary intracerebral haemorrhage, older people, elderly

Introduction

Cerebral amyloid angiopathy (CAA) is a clinicopathological condition resulting from the extracellular deposition of an amorphous eosinophilic substance (a fibrillar protein, amyloid) in the walls of small- and medium-sized arteries. When stained with Congo red and viewed under polarising microscope, this substance gives a yellow–green birefringence, and therefore, this entity is also known as congophilic angiopathy. The earlier reports emphasised the association of cerebral amyloid with Alzheimer’s disease. It is now clear that CAA may occur in the absence of clinical and/or pathological evidence (e.g. amyloid plaques) of dementia. Although CAA can manifest in several ways, the most serious manifestation of CAA in older people is the rupture of cerebral vessels, leading to primary intracerebral haemorrhage (PICH). PICH account for ~10% of all strokes in the United Kingdom [1], but there are racial and geographical variations across the globe as it is more common in some parts of Asia, e.g. Japan [2], and in blacks [3]. The incidence of PICH increases with age [3].

CAA mostly occurs in the sporadic form. Rare familial forms occur in younger age and include hereditary cerebral haemorrhage with amyloid—Icelandic, Dutch and Finnish