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Original Paper

Diagnosis and Rehabilitation of Visual Field Defects in Stroke Patients: A Retrospective Audit

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Key Words
Brain injury · Disability · Visual field defect · Visual rehabilitation

Abstract
Objective: Visual field defects (VFD) after stroke can cause significant disability and reduction in quality of life. Adequate diagnosis of VFD and referral to visual rehabilitation are important to improve outcome. Our aim was to conduct a retrospective clinical audit to investigate how neurologists detect and follow up VFD in stroke patients in a university hospital in Norway. ***Methods:*** All patients registered in the Bergen NORSTROKE Registry from February 2006 to May 2009 with (1) occipital lobe infarctions and (2) non-occipital infarction and clinically detected VFD were included in the study. Their medical records were reviewed for referral to perimetry for examination of VFD and for referral to a visual rehabilitation program within the first year after brain injury. ***Results:*** Of 353 patients, 34 (9.6%) were referred to perimetry and 8 (2.3%) to visual rehabilitation. Patients referred to perimetry were younger (65.1 vs. 74.7 years, $p < 0.001$), had lower modified Rankin Scale scores (2.53 vs. 3.47, $p = 0.003$), and scored lower on the National Institutes of Health Stroke Scale upon admission (6.68 vs. 13.90, $p < 0.001$). Men were more often referred to perimetry than women (73.5 vs. 26.5%, $p < 0.001$), and those referred were younger (61.2 vs. 75.8 years, $p = 0.03$). ***Conclusions:*** Only few patients were referred to perimetry, and even fewer were offered visual rehabilitation. Age and gender were negative predictors for referral. Neurologists' awareness of the significant disability related to VFD must be increased. Focused diagnostics on visual impairment and early referral to a visual rehabilitation program should be mandatory in stroke unit services.

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Introduction

In Norway, about 15,000–16,000 patients suffer from stroke every year [1]. Among these, 8–26% experience visual field defects (VFD) [2, 3], but prevalence rates as high as 57% have also been reported [4–6]. Spontaneous recovery can occur in as many as 40% of patients and is usually seen in the very first weeks and up to 6 months after injury [6]. However, many patients will have persistent VFD and thus experience difficulty with activities of daily living (ADL), such as personal hygiene, grooming, feeding, driving, reading, shopping and financial management [7]. VFDs have also been positively correlated with falling and with general dependence in patients' daily lives [6–8].

The aim of visual rehabilitation is to improve awareness of visual field loss and to employ strategies to promote the patient's ability to scan in the area of the defect [9]. Both compensatory and restitution therapies have been shown to improve visual function in patients with VFD [10–13]. Guidelines for the management of acute stroke provided by the American Heart Association (AHA) and the European Stroke Organisation (ESO) underline the importance of physiotherapy, occupational therapy, language training and cognitive assessment, but do not mention the need for perimetry to assess VDF as well as the need of visual rehabilitation [14, 15]. Norwegian guidelines recommend that stroke patients with VFD should be examined by perimetry and referred to visual rehabilitation [16]. However, visual rehabilitation remains scarce in Norway [17, 18]. International consensus on the importance of visual rehabilitation is lacking, and uncertainty still prevails as to the true restorative potential in visual rehabilitation [19]. Yet, there is no evidence to suggest that the regions of the brain involved in eye sight are less plastic than areas involved in motor function. An important part of visual rehabilitation is to teach patients coping strategies, such as restoring reading ability and improving orientation. Thus, suitable rehabilitative measures for a visual impairment, chosen after thorough diagnostic evaluation, enhance the patient's independence and quality of life [19]. Norwegian neurologists are actively involved in the acute care of stroke patients. It is therefore necessary that neurologists are trained to detect the occurrence of VFD in patients with brain injury and help them to be included in a visual rehabilitation program.

The aim of this study was to conduct a clinical audit of how neurologists at the Department of Neurology, Haukeland University Hospital, Bergen, Norway, detect and follow up VFD among their stroke patients, by mapping retrospectively (1) the rate of referral to the Department of Ophthalmology, Haukeland University Hospital, for perimetry, and (2) the rate of referral to visual rehabilitation.

Methods

Two groups of patients with either occipital infarction or non-occipital infarction and a clinically detected VFD within the time period from February 2006 to May 2009 were identified through a search of the Bergen NORSTROKE Registry. The search was conducted using STATA 11® [20]. The Bergen NORSTROKE Registry is an extensive, community-based database of all stroke patients admitted to the Department of Neurology. All patients with stroke in the population area of this university hospital are admitted to the Department of Neurology. This department has a highly specialized stroke unit with access to all diagnostic and treatment modalities and is involved in extensive research activity. All patients included in the Bergen NORSTROKE Registry are recorded by experienced doctors as having suffered a stroke based on a thorough history, clinical examination and CT and/or MRI scans of the brain.

All patients with stroke admitted to the Department of Neurology underwent a clinical assessment of their visual fields with confrontational visual field examination (Donders con-

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frontation test as part of the National Institutes of Health Stroke Scale (NIHSS)) at the bedside by certified neurologists and stroke nurses (www.ninds.nih.gov, last accessed August 29, 2011). When a VFD was found, it was classified as either complete or incomplete. Complete defects were sharply delineated at the vertical midline and detected in both the upper and the lower quadrant of the visual field. Patients with VFD due to trauma, tumors or ocular conditions as well as patients with VFD admitted directly from the Department of Ophthalmology were excluded. Neglect as an additional diagnosis was not an exclusion criteria. The patients' electronic medical records were reviewed by one investigator (K.M.S.) for referral to perimetry and/or referral to visual rehabilitation. The investigator was a neutral reviewer and had no prior clinical affiliation to the Neurological ward at the Haukeland University Hospital. Informed consent was obtained on admission from all patients or by a proxy. The study was approved by the Western Regional Ethics Committee.

Results are presented as means, ratios and percentages. Parametric statistical tests were used. p values were computed using a 95% confidence interval (CI). Where multiple regression analysis is used, results are presented as odds ratios (OR) with CI and p values. STATA 11 was used for all statistical analysis.

Results

Of 1,420 patients registered in the Bergen NORSTROKE Registry, we identified 353 patients with either occipital infarction or non-occipital infarction with VFD. Among these, 194 (55.0%) were male, and the mean age was 69.9 years. Occipital infarction was found in 102 (28.9%) patients, and non-occipital infarction and clinically detected VFD was found in 251 (71.1%) patients. On admission, incomplete hemianopia was found in 143 out of 349 (41.0%) patients, complete hemianopia in 132 out of 349 (37.8%), and amaurosis in 21 out of 349 (6.1%). Among patients with occipital infarction, normal visual field was registered in 53 out of 349 (15.2%), while in 4 patients the result of the visual field examination was missing.

The overall referral rate to perimetry was 34 out of 353 (9.6%) patients, for those with occipital infarction 19 out of 102 (18.6%), and for patients with non-occipital infarction it was 15 out of 251 (6.0%). Patients referred to perimetry were younger (65.1 vs. 74.7 years, $p < 0.001$), more often employed prior to stroke (47.1 vs. 16.8%, $p < 0.001$), had a lower modified Rankin Scale (mRS) score (2.53 vs. 3.47, $p = 0.003$), and their admission NIHSS scores were lower (6.68 vs. 13.90, $p < 0.001$) (table 1). The history of previous illness prior to infarction did not differ among referred and non-referred patients. Men were more often referred to perimetry than women (73.5 vs. 26.5%, $p < 0.001$). When adjusting for age, NIHSS score on admission and gender, patients referred to perimetry had a statistically significant lower age (OR 0.96, 95% CI 0.94–0.99, $p = 0.005$) and a lower NIHSS score upon admission (OR 0.92, 95% CI 0.87–0.97, $p = 0.001$). Among patients with a mRS of <3, the referral rate to perimetry was 21 out of 126 (16.7%).

From only 24 out of the 34 (70.6%) patients referred to perimetry, results could be retrieved. Of these patients, 10 (41.7%) had either complete or incomplete hemianopia, 4 (16.7%) quadrantanopia, 4 (16.7%) normal visual field and 6 (25.0%) some other VFD. Of the 10 patients with hemianopia confirmed by perimetry, the clinical assessment upon admission showed that 9 patients were scored as complete or incomplete hemianopia and 1 as having a normal visual field. Of the 4 patients with quadrantanopia confirmed by perimetry, 1 was initially scored as having normal visual field and 3 as having incomplete hemianopia. Of the patients with normal visual field confirmed by perimetry, 3 were scored as having a normal visual field and 1 was scored as having complete hemianopia at admission ($p = 0.03$).

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Table 1. Characteristics of stroke patients referred to perimetry (n = 353)

Feature	Referred (n = 34)	Not referred (n = 319)	p value
Age	65.1 ± 3.0	74.7 ± 0.7	<0.001
Female	9/34 (26.5%)	150/319 (47.0%)	<0.001
Male	25/34 (73.5%)	169/319 (53.0%)	<0.001
Employed prior to stroke	16/34 (47.1%)	51/303 (16.8%)	<0.001
Married or living with partner	17/33 (51.5%)	174/309 (56.3%)	0.6
NIHSS, admission	6.7 ± 1.3	13.9 ± 0.6	<0.001
NIHSS, day 7	5.4 ± 1.4 (14)	10.7 ± 0.9 (91)	0.04
mRS, day 7	2.5 ± 0.2	3.5 ± 0.1	0.003
Thrombolysis	4/34 (11.8%)	66/317 (20.8%)	0.2
Previous illnesses			
Previous cerebral infarction	7/34 (20.6%)	62/316 (19.6%)	0.9
Myocardial infarction	4/34 (11.8%)	59/317 (18.6%)	0.3
Hypertension	9/34 (26.5%)	165/315 (52.4%)	0.004
Chronic atrial fibrillation	2/34 (5.9%)	45/314 (14.3%)	0.2
Depression	6/23 (26.1%)	52/158 (32.9%)	0.5
Diabetes	3/34 (8.8%)	46/308 (14.9%)	0.3

Table 2. Stroke patients referred to perimetry (n = 34) and localization of infarction

Feature	Occipital (n = 19)	Non-occipital (n = 15)	p value
Age	66.3 ± 4.1	63.4 ± 4.6	0.6
Female	6/19 (31.6%)	3/15 (20.0%)	0.5
Male	13/19 (68.4%)	12/15 (80.0%)	0.5
mRS, day 7	2.0 ± 0.2	3.3 ± 0.3	<0.001
NIHSS, admission	2.3 ± 0.4	12.2 ± 2.1	<0.001
NIHSS, day 7	1.5 ± 0.5 (6)	8.4 ± 2.8 (8)	0.06
Acute thrombolysis	1/19 (5.3%)	3/15 (20.0%)	0.2

Patients referred to perimetry with occipital infarction had significantly lower mRS (1.95 vs. 3.27, $p < 0.001$) and NIHSS scores (2.32 vs. 12.20, $p < 0.001$) (table 2).

More male than female patients were referred to perimetry, and they were also younger (61.2 vs. 75.8 years, p = 0.03) (table 3). Among all patients of the Bergen NORSTROKE Registry, 823 out of 1,420 (58.0%) were male and 597 out of 1,420 (42.0%) were female. The mean age for men was 68.0 ± 0.49 years versus 75.4 ± 0.51 years for women. When correcting for age and NIHSS score on admission using multiple regression analysis, the correlation between sex and referral to perimetry was no longer statistically significant (p = 0.2).

The overall referral rate to visual rehabilitation was 8 out of 353 (2.3%), for the occipital infarctions 3 out of 102 (2.9%) and for the non-occipital infarctions 5 out of 251 (2.0%). The visual rehabilitation program was provided by trained visual therapists and focused on visual orientation, coping and reading strategies.

Discussion

Among 353 patients with either occipital infarction or non-occipital infarction with a clinically detected VFD, only 1 out of 10 was referred to perimetry to verify the clinical findings. Only 1 out of 50 patients was further referred to visual rehabilitation. Although perim-

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Table 3. Gender differences among stroke patients referred to perimetry (n = 34)

Feature	Women (n = 9)	Men (n = 25)	p value
Age	75.8 ± 5.0	61.2 ± 3.4	0.03
mRS, day 7	2.9 ± 0.3	2.4 ± 0.3	0.3
NIHSS, admission	4.4 ± 1.6	7.5 ± 1.6	0.3
NIHSS, day 7	3.5 ± 1.3 (4)	6.2 ± 2.5 (10)	0.5
Thrombolysis	0	4/25 (16.0%)	0.2

etry results were traceable for only a small group of patients referred to perimetry, the tendency was that the findings at perimetry match the prior clinical assessment.

Although there are variations between different countries in how stroke units are organised, neurologists play an essential role in diagnosis and treatment in many of them [13]. Previous studies have shown that stroke patients cared for by neurologists are more likely to be referred to diagnostic procedures and rehabilitation facilities [21] involving both physiotherapy and occupational therapy as integrated parts of a stroke unit. However, our study may indicate that the focus in daily neurological clinical practice is mainly on motor symptoms, and that symptoms such as visual impairment receive less attention. It may also reflect an inadequate awareness of the need for accurate diagnostics of poststroke visual disturbances and the existence of focused visual rehabilitation.

The patients who were referred to perimetry were significantly younger, more likely to be employed prior to infarction, had significantly milder strokes on admission, and significantly better ADL function after 1 week than those not referred. The neurologist's selection for referral could thus be influenced by the severity of the stroke, indicating a concern that these patients would not be able to cooperate on visual field testing by perimetry. However, even mildly impaired patients with low mRS scores (mRS <3) were still only referred to perimetry in 1 out of 5 cases. This could imply that even if stroke severity, age and occupational status are important factors, the main factor for referral to perimetry is the clinical practice of the individual doctor.

Patients with occipital infarction were more often referred to perimetry than patients with non-occipital infarction. A reason for this may be that patients with occipital infarction are more likely to have a VFD as their only disability, whereas patients with non-occipital infarction and VFD often have additional impairments that complicate diagnostics and rehabilitation. Neurologists may have excluded perimetry as an option in patients with non-occipital infarctions, considering them to be too severely affected to cooperate.

Men were more often referred to perimetry than women. One explanation for this may be that the average age of referred men was lower than that of women. The younger the patient, the more likely he/she is to still be driving [22], and vision assessment is crucial in determining ability to drive. This is unfortunate as age is often used as a poor surrogate marker for pre-morbid function and – maybe more importantly – since diagnosing visual field impairments in an elderly population could prevent falling and further injury [9].

A strength of this study is that the Bergen NORSTROKE Registry is a community-based registry. Our findings are representative for the whole Bergen county, and can probably be generalized for the Norwegian population. Another strength is that all patients with occipital infarction were included, even those who did not have a clinically acknowledged VFD (52%). Having an occipital infarction entails a high risk of acquiring a VFD. Although confrontational testing ad modum Donders is a useful assessment tool in an acute setting, it may underestimate the degree of VFD and many patients may go undiagnosed [2, 23]. Occipital infarction as such should therefore be an indication for referral to perimetry, regardless of clinical findings. This indication is strengthened when considering the extent to which pa-

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tients with VFD continue to drive [2, 5]. A selection bias may be that only patients with the largest VFD are detected by confrontational testing. If this is the case, one could expect the real referral rates among our patients with non-occipital infarction and VFD to be even lower.

Our findings indicate that the management of VFD in stroke patients should be improved. Having a VFD is disabling and a negative predictor for post-stroke mobility [24], therefore, the diagnosis of visual impairment should be made as early as possible. Although confrontational testing has its clear limits, it is far better than no assessment at all, when done correctly. If visual symptoms are detected or suspected, patients should be referred to formal visual assessment, including perimetry, as soon as they are capable and regardless of age and perceived ability. One should also consider extending the stroke team to include eye services, so that patients unable to visit an eye department could be seen in the stroke unit by an ophthalmologist.

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Disclosure Statement

The authors have no conflicts of interest to disclose.

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