Original article

The indications for and the diagnostic yield of imaging in neuro-ophthalmic and orbital disorders

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Abstract

Introduction: Neuro-imaging is an important method for investigation in neuro-ophthalmic and orbital conditions. These investigations are expensive and time consuming. This study describes the diagnostic yield of neuroimaging in patients referred from neuro-ophthalmic services. **Objective:** To evaluate the diagnostic yield of neuroimaging in patients with neuro-ophthalmic and orbital disorders. **Materials and methods:** Retrospective review of records of 188 patients referred to radiology department for imaging by the neuro-ophthalmic services at University Hospital Coventry. **Main outcome measures:** Imaging findings were defined to be significant, if it led to changes in patient management, and as relevant, if the abnormal imaging finding related to the patient's neuro-ophthalmic complaint, examination finding or condition. The imaging findings were categorized into five groups based on significance and relevance as (a) significant and relevant, (b) significant and not relevant, (c) relevant and not significant, (d) not significant and not relevant, or (e) normal. The percentage of tests with a significant and relevant finding was defined as the diagnostic yield. The yield of the imaging test ordered was also analyzed based on neuro-ophthalmic examination findings and indication for imaging. **Results:** One hundred and eighty eight neuro-imaging studies were analyzed. The majority of this referral was made for evaluation of the orbit (30%) and the anterior visual pathway (22%), followed by motility disorder (16%) and cerebro-vascular accidents (11%). Hemifacial spasm, nystagmus and headache were less common indications for imaging referral. Sixty-one (32.4%) had significant and relevant findings to the patient's neuro-ophthalmic condition. In the majority (33/61, 54%), imaging was done to evaluate the orbit. **Conclusion:** Among the imaging referral from neuro-ophthalmic practice, request for evaluation of the orbit provided a higher diagnostic yield.

Keywords: Diagnostic yield, Neuro-ophthalmology, Neuro-imaging

Introduction

Diagnostic radio-imaging has been evolving considerably over the last several decades enabling clinicians to diagnose and treat diseases. Specifically, computed tomography (CT) scans and magnetic resonance imaging (MRI) scans are used widely to evaluate patients with neuro-ophthalmic symptoms. Although neuroimaging provides invaluable information about various pathologies of the head and neck, it is done at considerable expenses. In today's era of increasing health care costs to the patients and threat of malpractice claims

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to the clinicians, there has been increasing concern about overuse or underuse of imaging (Lee et al, 2009). With the advancement of medical technology in the setting of limited resources, clinicians face dilemma of choosing an appropriate diagnostic test which could give high yield and be cost effective. The objective of this study was to evaluate the diagnostic yield of neuroimaging in patients seen in the ophthalmology service.

Materials and methods

This retrospective review included data of the patients referred by the ophthalmology department for radio-imaging at University Hospital Coventry, UK, from October 2006 to March 2007. Data collection included demography, indications for imaging referral, imaging modality and findings. A detailed clinical history was obtained, including principal symptoms, examination results, diagnosis and management. Imaging findings were categorized based on significance and relevance. Imaging findings were defined to be significant if it led to changes in patient management. Relevance was defined as an abnormal imaging finding that related to the patient's neuro-ophthalmic complaint, examination finding, or condition. The results were then classified into 5 groups: (a) significant and relevant, (b) significant and not relevant, (c) relevant and not significant, (d) not significant and not relevant, or (e) normal. The percentage of tests with a significant and relevant finding was defined as the diagnostic yield (Mehta et al, 2012).

Subgroup analysis was then performed based on indication for neuro-imaging referral for which patients were classified into the following categories: (a) disc pallor, (b) disc oedema, (c) motility defect, (d) visual field defect, (e) extraocular orbit, (f) anisocoria, (g) unexplained decreased visual acuity, or (h) other. Patients with multiple examination findings, such as visual field defect, disc pallor, decreased visual acuity, were placed in one category with the most significant finding based on the following hierarchy from the greatest to the least significance: disc abnormalities, visual field defect and decreased visual acuity. Patients were placed under unexplained decreased visual acuity if corrected acuity was worse than 6/6 and no other examination findings were present. Neuro-imaging referrals not fitting elsewhere were included in "other" category, for example, headache with nystagmus.

The overall yield rate and yield rates by indications for neuro-imaging were calculated. P values were determined using chi square test.

Results

One hundred and eighty eight patients were referred by the ophthalmology department for radio-imaging. Mean age of the cohort was 51.98 years (standard deviation 24.45 years; range being 11 months – 93 years). There were 88 male (46.8 %) and 100 female (53.2%) patients. The indications requested for imaging were diverse (figure 1).

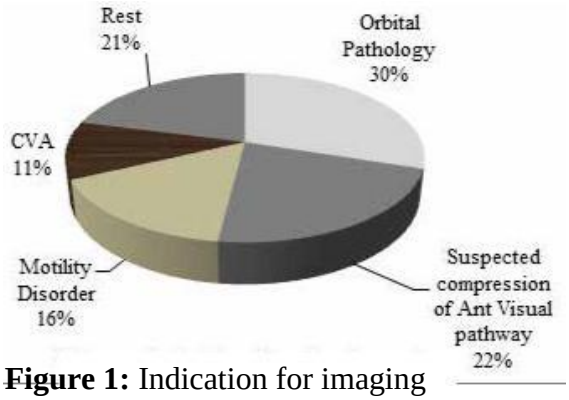

Figure 1: Indication for imaging

In the majority of the cases, 126 (67%), a CT scan was requested while MRI was requested in 62 (33%).

Out of the 188 imaging studies analyzed, 61 (32.4%), had significant and relevant findings to the patient's neuro-ophthalmic condition (table 1). In the majority of these (33/61, 54%) imaging was done to evaluate the orbit. Seven among the 188 imaging studies (3.7%) had significant finding unrelated to the neuro-ophthalmic indication. They included, two

patients with motility defect, one had single carotid in right side and with long standing occlusion in left side while in the other patient, a small focal infarction at anterior limb end of left internal capsule was detected; two had optic disc pallor without compression of the visual pathways; one patient investigated for constricted visual field defect showed diffuse muscle thickening; one patient with history of both eye orbital decompression with persistent proptosis on left eye and in one a blow out fracture was detected while investigating for an unrelated visual phenomenon. In five (2.7%) patients, investigation revealed a finding that was relevant to the diagnosis but did not change the management. These included two patients with motility defect – one had retinoblastoma in the past, investigation revealed deranged muscle anatomy, the other had right fourth cranial nerve palsy with a history of carcinoma of bowel while the investigation showed no cranial or orbital abnormality except a subtle cavernous sinus lesion; one patient with disc oedema had dilated optic nerve sheath; one with hemifacial spasm had cerebro-vascular ectasia and tortuosity in posterior fossa and; one with enucleation during childhood investigated for infection had implant anteriorly with intact posterior extraocular muscles. In 14 (7.4%), imaging studies were not significant and not relevant. These cases mostly included small infarcts and atrophic changes of the brain.

Out of the 188 imaging studies analyzed, 101 (53.8%) were reported to be normal.

Table 1: Proportion of significant and relevant imaging findings

	No. of imaging studies (%)
Significant* and relevant[!]	61 (32.4)
Significant and not relevant	7 (3.7)
Not significant and relevant	5 (2.7)
Not significant and not relevant	14 (7.4)
Normal	101 (53.8)

* Refers to abnormal imaging finding that resulted changes in management.

[!] Refers to abnormal imaging finding related to patient's neu-ro-ophthalmic complaint, examination finding or condition

For subgroup analysis performed based on indications for neuro-imaging referral, the diagnostic yield for individual indication is represented in table 2. Patients with orbital causes had a diagnostic yield of 68.7%; those with disc oedema had a yield of 29.4% while in patients with unexplained decreased visual acuity, the yield was 27.3%. In referrals made for visual field defect and for motility defect, the diagnostic yield was 25% and 11.1% respectively.

Table 2: Proportion of significant and relevant findings, by indication for neuro-imaging

	Imaging findings				
Indication (N)	**Significant and Relevant, n (%)**	**Significant and Not Relevant, n (%)**	**Not Significant and Relevant, n (%)**	**Not Significant and Not Relevant, n (%)**	**Normal, n (%)**
Disc Pallor (19)	3 (15.8)	2 (10.5)	0 (0.0)	3 (15.8)	11 (57.9)
Disc Oedema (17)	5 (29.4)	0 (0.0)	1 (5.9)	2 (11.8)	9 (52.9)
Motility Defect (36)	4 (11.1)	2 (5.6)	2 (5.6)	3 (8.3)	25 (69.4)
Visual field defect (28)	7 (25)	1 (3.6)	0 (0.0)	3 (10.7)	17 (60.7)
Extra-ocular Orbit (48)	33 (68.7)	1 (2.1)	1 (2.1)	0 (0.0)	13 (27.1)
Anisocoria (2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (50.0)	1 (50.0)
Unexplained decreased visual acuity (22)	6 (27.3)	0 (0.0)	0 (0.0)	1 (4.5)	15 (68.2)
Other[¥] (16)	3 (18.6)	1 (6.3)	1 (6.3)	1 (6.3)	10 (62.5)

[¥] Indications in this category included nystagmus, hemifacial spasm, blepharospasm, headache, tremor, loss of consciousness.

Discussion

Often ophthalmologists are the first clinicians to evaluate patients with orbital or intracranial structural lesions. In such cases, radio-imaging of the visual pathways and orbit becomes crucial for the diagnosis and management of these conditions. Though it seems intuitive that the imaging study needs to match the clinical findings, this does not always occur. As seen in this study, out of the 188 radio-imaging, 32.4% of the tests yielded an abnormality that was clinically significant for the management of this condition. This finding was consistent with studies, which had also evaluated the diagnostic yield (Mehta S et al, 2012 & McClelland C et al, 2012).

When analysis was made based on indication for imaging, orbital causes were seen to have a higher diagnostic yield of 68.7%, as in the observation noticed by Mehta et al (Mehta S et al, 2012). We noticed a lower diagnostic yield for disc pathologies, 15.8% and 29.4% for disc pallor and disc oedema, respectively. In a study, to report the diagnostic yield of the evaluation for the unexplained optic atrophy, Lee et al had observed the yield of 20% (Lee AG et al, 2005). Studies for evaluating yield for motility defect have been conflicting. The yield for motility defect in our series was 11.1%. Chou et al had identified etiology by neuroimaging in 13.6% (Chou KL et al, 2004). In one study, Murchison et al found a diagnostic yield of 4.3% (Murchison AP et al, 2011). Tamhankar et al observed a yield of 16.5% (Tamhankar et al, 2013). This variation could be because of the differences in the patient population. Some cohorts had higher proportion of patients with vasculopathic etiology (Murchison et al), while some had larger proportion of patients with tumor and/or tumor like condition, inflammatory lesion and pituitary apoplexy (Tamhankar et al). Imaging done for visual field defect, the diagnostic yield in this study was 25%, consistent with 28.2% in the study of Mehta at al (Mehta et al, 2012). In cases of unexplained decreased visual acuity, 68.2% had a normal finding, comparable to 66.7% in the study of Mehta et al (Mehta et al, 2012).

There are few limitations of this study. First of all, the problems inherent with a retrospective study must be acknowledged. Secondly, there is an issue with sample size as well. Despite these limitations, this study has incorporated possible situations an ophthalmologist may experience in day to day clinical care. A prospective study with adequate sample size in a multi-centric setting would overcome the shortcomings of this study.

Conclusion

Neuroimaging studies are frequently ordered to investigate neuro-ophthalmic and orbital conditions. This retrospective review was done to study the indications and the diagnostic yield of imaging in neuro-ophthalmic and orbital disorders. The majority of the imaging referral was made for evaluation of the orbit and the anterior visual pathway. The imaging studies for orbital pathology had a higher diagnostic yield. This study has limitation of its retrospective nature and of sample size. It is recommended that a prospective study in a multi-centric set up in near future would overcome the limitation inherent in this study.

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Acknowledgments

We thank Dr OludolapoAdesanya, MBBS, PG Dip (Nucl Med), MRCP, FRCR, Consultant Radiologist, University Hospital Coventry, United Kingdom and Mr. Harpreet S Ahluwalia, MBBS, MD,MRCOphthal, FRCS, FRCOphthal, Consultant Ophthalmologist, University Hospital Coventry, United Kingdom for their support during this study.

Source of support: nil. Conflict of interest: none