SCIENTIFIC REPORT

Outcomes of referrals by community optometrists to a hospital glaucoma service

B Bowling, S D M Chen, J F Salmon

Br J Ophthalmol 2005;89:1102–1104. doi: 10.1136/bjo.2004.064378

Aim: To determine the outcomes resulting from optometric referrals to a specialist glaucoma screening clinic over a 10 year period.

Methods: Details of the initial clinical assessment of all new patients referred to the adult glaucoma screening clinic at Oxford Eye Hospital were collected prospectively from July 1994 to June 2004.

Results: Optometrists working in community practice initiated 2505 referrals. Of these, glaucoma was confirmed in 510 patients (20.4%), including 160 with normal intraocular pressure (IOP). A diagnosis of ocular hypertension was made in 747 patients (29.8% of referrals) and 125 (5.0%) were categorised as glaucoma suspects. There was no evidence of a diagnostic trend over the period of data collection. Treatment to lower IOP was commenced in 458 patients (18.3%). Nearly half of those referred, 1148 (45.8%), were discharged from ophthalmological review at the first visit.

Conclusion: In this survey, the largest of its nature, only one in five subjects had glaucoma and nearly half were discharged from hospital ophthalmological review. The findings provide a baseline against which the effectiveness of any future system of glaucoma detection in the United Kingdom can be compared.

Partly in response to the increasing burden on the hospital eye service resulting from demographic changes, major modifications to the way glaucoma detection and care are carried out in the United Kingdom are likely in the near future. Government plans envisage a significant proportion of clinical glaucoma management being transferred from hospital to primary care.¹ Central to the new system will be the development of a cadre of specialist optometrists, who, it is proposed, will assume much of the work of screening and initial management of referrals for suspected glaucoma currently carried out by ophthalmologists.

In light of these impending developments in service provision, we examined the outcomes of glaucoma referrals to our unit under the current system. Our principal aim was the provision of feedback to local referral sources, comparing our own data with previously published results. Given the large number of referrals surveyed, the information furnished should also be of interest to a geographically and professionally wider audience, aiding planning and resource allocation and providing a baseline against which the effectiveness of any novel system can be compared.

METHODS

During the 10 year period from July 1994 to June 2004, a standardised proforma was used to collect data relating to the first assessment of every new referral for suspected glaucoma to the adult glaucoma screening clinic at the Oxford Eye

Hospital, Oxford, United Kingdom. Although details of the examining ophthalmologist in each case were not collected, most of the patients were seen by the same glaucoma specialist (JFS), with a small proportion assessed by a glaucoma fellow. The data do not include referrals to other consultants at the same hospital during this period.

Information recorded on the proforma included source of referral, patient age, Afro-Caribbean ethnicity, and intra-ocular pressure (IOP) at the first hospital assessment; a subjective assessment of whether the optic disc appearances were distinctly glaucomatous (unequivocal focal, or concentric neuroretinal rim loss and/or greater than 0.2 difference in cup:disc ratio between two eyes with symmetrical disc diameters), distinctly non-glaucomatous (including characteristic of other pathology) or of uncertain status; a subjective assessment of the visual fields as characteristically glaucomatous (deep paracentral, arcuate, ring, nasal step, or end stage defect) non-glaucomatous (including characteristic of other pathology, particularly central neurological disease) or uncertain; and the presence on examination of other ocular pathology. A provisional diagnosis was determined based only on information available at the initial assessment:

- (1) glaucoma: IOP >21 mm Hg with characteristic optic disc and/or visual field changes
- (2) normal tension glaucoma (NTG): as glaucoma but IOP ≤21 mm Hg at the initial hospital visit
- (3) glaucoma suspect: irrespective of IOP, not possible with reasonable certainty to categorise the appearance of the optic discs and visual fields of either eye as clearly glaucomatous, but unable to classify those of both eyes as clearly non-glaucomatous
- (4) ocular hypertension (OHT): defined as IOP >21 mm Hg without glaucomatous optic disc or visual field changes
- (5) no glaucoma or OHT.

A diagnosis of other visual pathway pathology was recorded in addition to (1)–(5) as appropriate.

A record was made of whether the patient was discharged from ophthalmological review and whether IOP lowering treatment was instituted.

RESULTS

A total of 2620 new referrals were received from community primary care sources, of which 2505 were initiated by optometric practices. Referrals initiated by a general practitioner without optometric input were excluded from the analysis. The average age of the patients was 63 years (SD 13.2, range 19–94). Only 26 patients (1.0%) were of Afro-Caribbean ethnic background.

Abbreviations: IOP, intraocular pressure; NTG, normal tension glaucoma; OHT, ocular hypertension

Table 1 Diagnostic outcomes divided by year

Year	No of referrals	Glaucoma including NTG (%)	Glaucoma suspect (%)	OHT (%)
1994	133	27 (20)	11 (8)	26 (20)
1995	244	39 (16)	19 (8)	70 (29)
1996	210	52 (25)	17 (8)	71 (34)
1997	194	48 (25)	8 (4)	66 (34)
1998	252	58 (23)	12 (5)	70 (28)
1999	229	46 (20)	5 (2)	110 (48)
2000	256	55 (21)	11 (4)	91 (36)
2001	235	50 (21)	6 (3)	69 (29)
2002	274	53 (19)	11 (4)	65 (24)
2003	278	46 (17)	12 (4)	63 (23)
2004	200	36 (18)	13 (7)	46 (23)

Diagnostic outcomes

In all, 510 patients (20.4%, 99% confidence interval (CI) 18.3% to 22.5%) had chronic glaucoma, and of these 160 (31.4% of glaucomas; 6.4% of referrals, 99% CI 5.1% to 7.7%) fell within the NTG diagnostic category as defined above. Significant additional visual pathway pathology was present in nine (1.8%) of the patients with glaucoma. OHT was found in 747 patients (29.8%, 99% CI 27.4% to 32.2%), of whom 27 (3.6% of patients with OHT, 1.1% of referrals) had significant additional pathology; 125 of the referred patients (5.0%, 99% CI 3.9% to 6.1%) were classified as "glaucoma suspects." Seven (5.6%) of the glaucoma suspects had additional ocular or other visual pathway pathology; 1123 (44.8%, 99% CI 42.2% to 47.4%) of referrals were judged to have no evidence of glaucoma or OHT. Of this group, 149 (13.3%, equating to 5.9% of referrals) had other pathology. The results, divided on a yearly basis over 10 years, are summarised in table 1.

Management outcomes

A total of 1148 patients (45.8% of optometrist initiated referrals, 99% CI 43.2% to 48.4%) were discharged from ophthalmological review; 942 (82.1% of discharged patients) had no evidence of glaucoma or OHT, though 78 of these (6.8% of discharges) had other significant ocular or other visual pathway pathology. Two hundred and one discharged patients (17.5%) had OHT, the majority of whom had a

highest IOP of 22 mm Hg or 23 mm Hg. Four patients with glaucoma (0.3% of discharged patients, 0.8% of those with confirmed glaucoma), including three with NTG, were discharged, as was one glaucoma suspect. IOP lowering treatment (including laser and surgery) was instituted for 458 patients in total (18.3% of referrals, 99% CI 16.3% to 20.3%). Of these, 363 (79.3%) had glaucoma (including 87 patients with NTG, 19.0% of those treated), 75 (16.4% of those treated) had OHT, and 20 (4.4%) were glaucoma suspects.

DISCUSSION

The outcomes of patients referred to an ophthalmologist for suspected glaucoma have been examined in previous studies.²⁻¹³ The results of these are set out in table 2.

Differences between surveys are evident across a range of parameters including diagnostic definitions and classification systems, methods of data collection, referral sources and population demographics. Some studies included only a small number of patients, and have been criticised for the resultant limited statistical legitimacy.¹⁴ It is important to emphasise in this context that our own reported diagnostic outcomes are based exclusively on the information available at the initial consultation. This should also be borne in mind when considering our figures for the initiation of treatment.

Table 2 Previous studies of the outcome of optometric referrals for suspected glaucoma

Authors	Year of publication	Sample size	Confirmed glaucoma (%)	Glaucoma suspect (%)	OHT (%)	No glaucoma, no OHT (%)
Clarkin and Harcourt	1983	34	11 (32)	2 (6)	2 (6)	19 (56)
Harrison <i>et al</i>	1988	147*	33 (22)	73 (50)†		41 (28)
Brittain <i>et al</i>	1988	93	41 (44)	20 (22)	NA	32 (34)
Tuck and Crick	1991	704	283 (40)	222 (32)†		199 (28)
Sheldrick <i>et al</i>	1994	213	68 (32)	NA	48 (23)	97 (46)
Bell and O'Brien	1997	271‡	46 (17)	13 (5)	113 (42)	112 (41)
Vernon (1988 group)	1998	75	36 (48)	9 (12)	27 (36)	3 (4)
Vernon (1993 group)	1998	71	24 (34)	11 (15)	16 (23)	20 (28)
Newman <i>et al</i>	1998	82	35 (43)	1 (1)	16 (20)	30 (37)
Theodossiadis and Murdoch	1999	87	19 (22)	18 (21)	12 (14)	38 (44)
Pooley and Frost	1999	19	5 (26)	NA	NA	NA
Vernon and Ghosh (control group)	2001	105	39 (37)	9 (9)	17 (16)	40 (38)
Vernon and Ghosh (intervention group)	2001	102	32 (31)	7 (7)	19 (19)	44 (43)
Theodossiadis <i>et al</i> (control group)	2004	119	55 (46)†		NA	NA
Theodossiadis <i>et al</i> (intervention group)	2004	210	102 (49)†		NA	NA
Bowling <i>et al</i>	2005	2506	511 (20)	125 (5)	747 (30)	1123 (45)

*Includes 27 direct GP referrals.

†Figures published in combined diagnostic categories.

‡Includes 11 direct GP referrals.

NA, not available.

Our confirmed glaucoma rate of just over 20% is similar to the 17% rate found in the Edinburgh study of 271 patients seen over 6 months from 1993 to 1994⁷ and the 22% found by Harrison *et al*³ and Theodossiades and Murdoch.¹⁰ The diagnosis of NTG is complicated by considerations such as diurnal IOP variation.¹⁵ Theodossiades and colleagues¹⁰ specifically excluded NTG as a category distinct from open angle glaucoma in their study of referrals as it was thought that the diagnosis could not be made authoritatively following a single clinic appointment. Based on the IOP at the initial hospital examination, approximately one third (31%) of our confirmed glaucomas fell within the NTG group, a similar rate to the 33% reported by the Edinburgh study.⁷

Our OHT rate was just under 30%. There has been substantial variation in reported rates, which in recent studies range from 14% to 42%.⁷⁻¹⁰ Not all published studies have included OHT as a distinct diagnostic category, including the largest before our own,⁵ which grouped patients with OHT and glaucoma suspects together in the category "uncertain, follow up required." We found a glaucoma suspect rate of 5.0%. Half of the studies reviewed did not have an explicit "glaucoma suspect" grouping, and valid comparison with other published data is particularly difficult with respect to this category, which, almost by definition, may be prone to a higher degree of subjectivity.

Treatment to reduce IOP was instituted for 458 patients (18.3% of referrals), mainly for glaucoma. A minority of those treated had OHT or were glaucoma suspects. While some previous surveys detail the proportion of patients with OHT commenced on treatment, none has reported the number of treated confirmed glaucoma patients. Some of our patients are likely to have been treated subsequent to the first consultation upon which the presented findings are based. This may apply particularly to patients with NTG, for whom treatment is often withheld pending evidence of progression; in our survey, 79% (276/350) of those with glaucoma featuring elevated IOP were treated at the first visit, but only 54% (87/160) of those with NTG.

A total of 1148 (45.8%) patients were discharged from ophthalmological review, the majority of whom had no evidence of glaucoma; some had OHT but were considered to be at extremely low risk of developing glaucoma, and others had pathology which did not require further ophthalmological intervention at the time of assessment. Four patients with glaucoma (including three with NTG) and one glaucoma suspect were discharged, as their life expectancy was considered low in comparison with the risk of visually significant glaucomatous progression. In the only other study reporting a specific figure for patients who were discharged, 30% required no follow up.⁷ By no means will every referral have been made in the belief that the patient definitely had glaucoma. This has been studied by Tuck,¹⁶ who found that 74% of the patients referred by an optometrist with "almost definite" glaucoma were confirmed as having the condition, compared with only 21% of "possible" glaucomas. Community optometrists are under considerable pressure to detect every case of sight threatening disease,¹⁷ with a missed diagnosis having potentially serious ramifications for the responsible practitioner. In contrast, little disadvantage results from a false positive referral. Many patients will have been referred in the belief that they had OHT rather than glaucoma and that only monitoring was required. Under the present system there may be no alternative in these circumstances to a request for appraisal by the hospital eye

service, but these patients may in the future be managed in the community by a specialist optometrist. Henson *et al* have reported a cost effective 40% reduction in new glaucoma referrals to Manchester Royal Eye Hospital from a scheme involving initial assessment by specially trained community optometrists,¹⁸ although figures for diagnostic accuracy have not yet been published.

In conclusion, this study is the largest survey to determine the outcomes resulting from optometric referrals for suspected glaucoma to a specialist hospital eye clinic. It is hoped that planned changes to the system of referral for suspected glaucoma in the United Kingdom will lead to a substantial decrease in the number of false positives reaching the hospital eye service, without a commensurate increase in false negatives.¹

ACKNOWLEDGEMENTS

The authors are grateful to Peter McKenzie for help with the collation of the data, and to Nicola Alder for statistical advice.

Authors' affiliations

B Bowling, S D M Chen, J F Salmon, Oxford Eye Hospital, Radcliffe Infirmary, Woodstock Road, Oxford, OX2 6HE, UK

Competing interests: none declared

Correspondence to: J F Salmon, MD, FRCOphth, Oxford Eye Hospital, Radcliffe Infirmary, Woodstock Road, Oxford, OX2 6HE, UK; john.salmon@orh.nhs.uk

Accepted for publication 17 March 2005

REFERENCES

- 1 **Glaucoma Subgroup Report**. In: *First report of the National Eye Care Services Steering Group*, National Eye Care Steering Group. London: Department of Health, 2004:1-13.
- 2 **Clearkin L**, Harcourt B. Referral pattern of true and suspected glaucoma to an adult ophthalmic clinic. *Trans Ophthalmol Soc UK* 1983;**103**:284-7.
- 3 **Harrison RJ**, Wild JM, Hobley AJ. Referral patterns to an ophthalmic outpatient clinic by general practitioners and ophthalmic opticians and the role of these professionals in screening for ocular disease. *BMJ* 1988;**297**:1162-7.
- 4 **Brittain GPH**, Austin DJ, Kelly SP. A prospective study to determine sources and diagnostic accuracy of glaucoma referrals. *Health Trends* 1988;**20**:43-4.
- 5 **Tuck MW**, Crick RP. Efficiency of referral for suspected glaucoma. *BMJ* 1991;**302**:998-1000.
- 6 **Sheldrick JH**, Ng C, Austin DJ, *et al*. An analysis of referral routes and diagnostic accuracy in cases of suspected glaucoma. *Ophthalmic Epidemiol* 1994;**1**:31-9.
- 7 **Bell RWD**, O'Brien C. The diagnostic outcome of new glaucoma referrals. *Ophthalmic Physiol Opt* 1997;**17**:3-6.
- 8 **Vernon SA**. The changing pattern of glaucoma referrals by optometrists. *Eye* 1998;**12**:854-7.
- 9 **Newman DK**, Anwar S, Jordan K. Glaucoma screening by optometrists: positive predictive value of visual field testing. *Eye* 1998;**12**:921-4.
- 10 **Theodossiades J**, Murdoch I. Positive predictive value of optometrist-initiated referrals for glaucoma. *Ophthalmic Physiol Opt* 1999;**19**:62-7.
- 11 **Pooley JE**, Frost EC. Optometrists' referrals to the hospital eye service. *Ophthalmic Physiol Opt* 1999;**19**:16-24.
- 12 **Vernon SA**, Ghosh G. Do locally agreed guidelines for optometrists concerning the referral of glaucoma suspects influence referral practice? *Eye* 2001;**15**:458-63.
- 13 **Theodossiades J**, Murdoch I, Cousens S. Glaucoma case finding: a cluster-randomised intervention trial. *Eye* 2004;**18**:483-90.
- 14 **Gilchrist J**. Accuracy of glaucoma referrals: need to report precision of estimates. *Br J Ophthalmol* 2000;**84**:124.
- 15 **Ido T**, Tomita G, Kitazawa Y. Diurnal variation of intraocular pressure of normal-tension glaucoma. *Ophthalmology* 1991;**98**:296-300.
- 16 **Tuck MW**. Referrals for suspected glaucoma: an International Glaucoma Association survey. *Ophthalmic Physiol Opt* 1991;**11**:22-6.
- 17 **Stevenson R**. Automated perimetry by optometrists in patients at low risk of glaucoma [comment]. *Br J Ophthalmol* 1999;**83**:759-60.
- 18 **Henson DB**, Spencer AF, Harper R, *et al*. Community refinement of glaucoma referrals. *Eye* 2003;**17**:21-6.