Doctors and the assessment of clinical photographs — does colour blindness matter?

JOHN L CAMPBELL

ANTHONY J SPALDING

FRAZ A MIR

JENNIFER BIRCH

SUMMARY

Colour vision deficiency (CVD) is a common anomaly, especially in the male population. A group of doctors with CVD was compared with a control group. Doctors with CVD differed from controls in respect of their ability to detect, and in their confidence in the assessment of, abnormalities presented in clinical photographs. These findings suggest that doctors with CVD should take special care to ensure safe clinical practice.

Keywords: colour vision deficiency; clinical photographs; general pracitioners.

Introduction

ALTHOUGH colour vision deficiency (CVD) affects 8% of the male population, few studies have considered the effect of the presence of CVD on the clinical decision-making process. Doctors with CVD have, however, reported a wide range of difficulties encountered in clinical practice.[1-3] This study aims to provide evidence of the effect of the presence of CVD on the assessment of clinical photographs by general practitioners (GPs).

Method

Twenty-three male GPs of less than 60 years of age with a known CVD and who had contributed to a previous study[1] were invited to take part in a further investigation. All except one were male and members of the Royal College of General Practitioners (RCGP). A control group was formed from 28 male doctors (all members of the RCGP) whose names were obtained from health authority lists.

Subjects completed a questionnaire based on their interpretation of 38 photographs representing common clinical presentations encountered in primary medical care and some less common conditions where colour was considered to be an aid to diagnosis (Box 1). We explained to subjects that this study was not a test of clinical knowledge of diagnostic ability, but of the assessment of normal and abnormal features in clinical photographs.

For each photograph, subjects were invited to comment on whether the material was within normal limits (yes, no, don't know), to describe any abnormal clinical signs using free text, to identify and outline areas of abnormality on a transparent overlay, and to record the degree of confidence regarding their assessment of abnormalities using a four-point scale (very confident to very low confidence). Results presented here relate to the identification of abnormality in the photographs and to the degree of confidence expressed by the subjects regarding their interpretation of the material. The presence of CVD was confirmed or excluded using a variety of tests including the Ishihara plates administered under standardized conditions.

Analysis

Case and control groups were compared in respect of age using the student's *t*-test, for the distribution of responses regarding reported normality of photographic material using the chi-squared test, and for the degree of confidence expressed by subjects using the Mann–Whitney U-test. In the presentation (although, not in the analysis) of confidence data, responses were dichotomized to 'confident' or 'unsure' from the four-point scale data collected.

Results

Cases were similar to controls in respect of their age (44.1±7.1 versus 41.8±6.3 years; $t = 1.19$; $P = 0.240$). The groups were significantly different, however, in respect of the assessment of normality in six out of 38 (16%) photographs examined, and in respect of the confidence of their interpretation in 25 out of 38 (66%) photographs (Table 1). A particularly striking example was that of a rubella rash (Item 22) where only 4% of controls reported the photograph as 'normal' compared with 40% of cases. The opposite effect was seen in the photograph of a stool specimen from a patient receiving iron therapy (Item 3): 93% of controls but only 52% of cases reported the picture as normal. The reduction in confidence among doctors with CVD was reported for photographs from across the whole range of clinical features presented. Where differences in confidence existed between the two groups, doctors with CVD were less confident than controls.

Photographs were selected on their likelihood of being associated with colour confusion in congenital red-green colour deficiency. Material included photographs of specimens of:

- urine (4 photographs),
- vomit (5 photographs),
- stool (4 photographs),
- optic fundi (4 photographs),
- otoscopic examination (4 photographs),
- pharynx (1 photographs),
- skin rashes (3 photographs),
- discoloration of body surfaces (jaundice, 5 photographs; pallor, 4 photographs; cyanosis 2 photographs), and
- picture of pathology slide of tubercle bacilli (´ 100 magnification) stained by the Ziel–Neelsen method (1 photograph), and
- a face of a woman with no pathology.

Among this material were included a total of seven non-pathological specimens.

Box 1. Clinical photographs used in study.

J L Campbell, MD, MRCGP, senior lecturer; J A Spalding, MRCGP research associate; and F A Mir, BSc (Hons), medical student, Department of General Practice, King's College, 5 Lambeth Walk, London. J Birch, MPhil, FBCO, senior lecturer, Department of Optometry and Visual Science, City University, London.

Submitted: 27 July 1998; final acceptance: 28 January 1999.

Table 1. Number (%) of responders reporting photograph as 'normal' and number (%) reporting confident assessment. Comparison of groups after exclusion of 'don't know' and missing responses. Table ordered by control group response regarding normality.

Item	Photograph	Notes	Number (%) of subjects reporting photograph as normal			Number (%) of subjects reporting confidence in assessment of photographs		
			Cases	Controls	P-value[a]	Cases	Controls	P-value[b]
1	Face of woman	Normal	21/23 (91)	27/28 (96)	0.583	13/15 (87)	19/20 (95)	0.274
2	Urine	Normal	20/20 (100)	25/27 (93)	0.500	14/17 (82)	20/22 (91)	0.020
3	Stool	Iron therapy; no fresh blood present	11/21 (52)	25/27 (93)	0.001	7/14 (50)	18/22 (82)	0.010
4	Vomit	From postmortem sample; no blood	15/19 (79)	23/25 (92)	0.378	11/17 (65)	17/23 (74)	0.146
5	Tympanic membrane	Normal	6/21 (29)	18/27 (67)	0.009	14/19 (74)	16/21 (76)	0.843
6	Face of woman	Pallor	12/22 (55)	16/26 (62)	0.624	11/17 (65)	11/22 (50)	0.659
7	Mucous membrane of cheek	Pallor	16/20 (80)	14/26 (54)	0.065	7/15 (47)	9/22 (41)	0.812
8	Lower face of man	Jaundice	13/20 (65)	13/24 (54)	0.467	5/16 (31)	13/20 (65)	0.053
9	Head and upper trunk of baby	Mild cyanosis	17/21 (81)	10/26 (39)	0.003	8/16 (50)	13/27 (48)	0.543
10	Pharynx	Normal	3/17 (18)	10/26 (39)	0.146	15/19 (79)	17/26 (65)	0.631
11	Urine	Bile present	6/21 (29)	9/28 (32)	0.788	10/19 (53)	22/26 (85)	0.003
12	Fingernails	Upper - normal; lower - pallor	7/18 (39)	7/26 (27)	0.402	6/21 (29)	12/25 (48)	0.267
13	Upper face of baby	Jaundice in right eye	7/19 (37)	6/22 (27)	0.511	13/20 (65)	12/26 (46)	0.253
14	Tympanic membrane	Normal	5/23 (22)	7/28 (25)	0.785	13/19 (68)	23/28 (82)	0.226
15	Urine	Small amount of blood content	2/19 (11)	7/28 (25)	0.278	15/22 (68)	24/28 (86)	0.035
16	Right eye	Jaundice of sclera	8/21 (38)	6/25 (24)	0.301	6/20 (30)	16/25 (64)	0.026
17	Left eye (everted palpebra)	Pallor of lower conjunctiva	6/19 (32)	6/26 (23)	0.524	9/19 (47)	16/24 (67)	0.048
18	Vomit	Altered blood present with spinach	3/20 (15)	6/28 (21)	0.716	11/19 (58)	23/27 (85)	0.003
19	Trunk and limbs of baby	Cyanosis of the extremities	4/22 (18)	4/25 (16)	0.834	16/22 (73)	20/26 (77)	0.729
20	Vomit	Fresh blood present	2/22 (9)	2/28 (7)	0.801	18/23 (78)	28/28 (100)	0.002
21	Optic fundus	Black or dark brown; retinitis pigmentosa	0/22 (0)	2/28 (7)	0.497	17/22 (77)	23/26 (89)	0.007
22	Skin of back	Rubella rash	8/19 (42)	1/28 (4)	0.002	9/19 (47)	16/18 (89)	0.001
23	Stool	Blood present	6/21 (29)	1/28 (4)	0.033	13/20 (65)	28/28 (100)	0.001
24	Tympanic membrane	Flamingo pink (Schwartz sign)	4/19 (21)	1/27 (4)	0.144	9/20 (45)	24/27 (89)	0.002
25	Stool	Iron therapy; no fresh blood present	0/21 (0)	0/27 (0)	–	10/19 (53)	23/28 (82)	0.004
26	Upper face of man	Jaundice	6/20 (30)	0/28 (0)	0.003	9/16 (56)	20/24 (83)	0.033
27	Lower leg	Early erythema nodosum	3/21 (14)	0/28 (0)	0.072	10/22 (46)	28/28 (100)	0.001
28	Vomit	Fresh blood present	2/21 (10)	0/28 (0)	0.179	15/23 (65)	28/28 (100)	0.001
29	Urine	Moderate blood content	2/23 (9)	0/28 (0)	0.198	22/23 (95)	28/28 (100)	0.019
30	Tissue stained by Ziel–Neelsen	Tubercle bacilli	1/20 (5)	0/25 (0)	0.444	6/18 (33)	16/27 (59)	0.142
31	Neck, chest, and abdomen	Cholinergic urticaria	1/23 (4)	0/28 (0)	0.451	22/23 (96)	18/18 (100)	0.048
32	Chest and lower face of man	Jaundice	1/19 (4)	0/26 90)	0.422	20/21 (95)	28/28 (100)	0.004
33	Optic fundus	Detached retina with old haemorrhages and other pathology	0/23 (0)	0/28 (0)	–	15/23 (65)	27/28 (96)	0.003
34	Optic fundus	Haemorrhages with diabetic retinopathy (spot and dot)	0/23 (0)	0/28 (0)	–	19/23 (83)	28/28 (100)	0.001
35	Optic fundus	Melanoma	0/22 (0)	0/26 (0)	–	13/23 (57)	26/28 (93)	0.001
36	Vomit	Fresh blood absent	0/18 (0)	0/28 (0)	–	12/22 (55)	22/26 (85)	0.003
37	Stool	Fresh blood present	0/23 (0)	0/27 (0)	–	21/23 (91)	28/28 (100)	0.001
38	Tympanic membrane	Acute otitis media	0/22 (0)	0/28 (0)	–	21/23 (91)	26/26 (100)	0.027

[a]Pearson chi-square with Fisher's exact test correction as appropriate; [b]Mann–Whitney U-test.

Discussion

This study has examined the effect of the presence of red-green colour deficiency on the assessment of clinical photographic material by clinicians. Two important findings result from this study. The first relates to difficulties encountered by doctors with CVD in the recognition of normality. It appears that at least some doctors with CVD may have a problem in this regard. The second finding of importance relates to the confidence of subjects in assessing the photographic material. Cases differed from controls in their confidence of interpretation of 25 out of 38 photographs covering the spectrum of clinical material presented. Although cases were self-selected and may have unduly lacked confidence, this is a striking difference with potentially significant implications for medical practice.

We conclude that real differences existed between doctors with CVD and controls in respect of their ability to detect, and in their confidence in the assessment of, abnormalities presented in clinical photographs. This work has been conducted using photographs in the absence of case histories, and care should be taken before projecting the results to other clinical situations. No evidence presently exists of an association between CVD and the outcome of case management. However, in considering the results presented here with those from other studies,[4,5] we support the suggestion by Poole *et al*[6] that doctors with CVD should adopt safe working practices in relation to their management of patients, and should consider paying special attention to history taking, and should (where appropriate) use supportive technology or third-party advice to support their clinical care.

References

1. Spalding JA. Doctors with inherited colour deficiency: their difficulties in clinical work. In: Cavonius CR (ed.). *Colour Vision Deficiency XII 1995*. London: Kluwer Academic Publishers, 1997.
2. Currier RD. A two and a half coloured rainbow. *Arch Neurol* 1994; **51:** 1090-1092.
3. Logan JS. The disability in so-called red-green blindness. An account based on many years of self-observation. *Ulster Med J* 1977; **46:** 41-45.
4. Koningsberger JC, van Norren D, van Niel JC, Dekker W. Does color vision deficiency in the endoscopist influence the accuracy of endoscopic diagnosis? An anonymous study with Dutch gastrointestinal endoscopists. *Endoscopy* 1994; **26:** 549-553.
5. Davison SP, Myslinski NR. Shade selection by colour vision defective dental personnel. *J Prosthetic Dentistr* 1990; **63:** 97-101.
6. Poole CJM, Hill DJ, Christie JL, Birch J. Deficient colour vision and interpretation of histopathology slides: a cross sectional study. *BMJ* 1997; **315:** 1279-1281.

Acknowledgements

We acknowledge to cooperation of the clinicians who participated in this study. Thanks are also due to the Wellcome Trust Photographic Library; Professor S Lucas, the Photographic Library; Dr D Ezra, T Stannard, and A Dyer, Department of Medical Photography of Guy's and St Thomas's NHS Trust; St John's Institute of Dermatology Photographic Library; Moorfields Hospital Photographic Library. This study was supported by a grant from the Scientific Foundation Board of the United Kingdom Royal College of General Practitioners.

Address for correspondence

Dr J L Campbell, Guy's, King's and St Thomas's School of Medicine, Department of General Practice, King's College, 5 Lambeth Walk, London SE11 6SP.