Serial fluorescein photography in acute retrobulbar neuritis

EMANUEL S. ROSEN AND BRYAN ASHWORTH

From the Departments of Ophthalmology and Neurology of the University of Manchester and United Manchester Hospitals

Fluorescein fundus photography is of value in the detection of early papilloedema (David, Heyman, and Hart, 1963; Miller, Saunders, and Fytyche, 1965). We have applied this technique to the serial study of patients with acute retrobulbar neuritis. This disorder is usually unilateral and the unaffected eye could be used as a control. Also, since papilloedema is not present at the onset of symptoms and the condition is self-limiting, it has been possible to follow in serial studies the evolution and resolution of the disc oedema.

Clinical papilloedema is detected in about half the patients with acute retrobulbar neuritis. Fluorescein photography might be expected to reveal abnormalities when there is no visible ophthalmoscopic change and this has also been investigated.

MATERIAL

Ten patients were studied. They were unselected apart from having attended the hospital. They presented the characteristic clinical features of acute retrobulbar neuritis with pain, impaired visual acuity, and central scotoma. One patient developed a similar disturbance in the other eye while under observation.

The age range was 20 to 47 years, with a mean of 29 years. There were seven females and three males. Three patients had clear evidence of associated disease of the nervous system indicating multiple sclerosis, and three others gave a history of neurological disturbance suggestive of demyelinating disease. The remaining four patients had no evidence of associated disease.

METHOD

Each patient was investigated after dilatation of the pupils with 5% homatropine and 2% cocaine. A Zeiss fundus camera with Zeiss-Siemens flash generator was used. Colour photographs of both discs were taken on Kodachrome II film at × 5 magnification. Stereoscopic photographs of the discs were taken by means of the ‘successive exposure camera shift method’.

The patient was given a single injection of 3 ml. 25% solution of sodium fluorescein into an antecubital vein.

The camera was modified for fluorescein photography by the insertion of a fluorescence exciting filter, Ilford Bright Spectrum Blue 622, and a barrier filter, Kodak Wratten 15. Fine grain monochrome Ilford FP3 film was used (Rosen, 1967). The retina of the affected eye was viewed through the camera while the fluorescein injection was given and the first exposure was made as soon as the dye reached the retina. Photographs were then taken in rapid sequence for 15 seconds. At one minute the affected disc was again photographed and immediately afterwards the other disc. This required movement of the camera but the interval between photographs was of the order of 10 seconds. This was repeated at two, five, 10, 15, and 30 minutes.

The FP3 film was rapidly processed in Phentrace and Hypam (Ilford) and then printed on Ilfoprint R4-1K by the ‘activation stabilization technique’ in an Ilfoprinter 951. All optic discs were printed at × 12 magnification.

The prints were mounted on a large board in sequence so that each horizontal row comprised one series. Later series were mounted in a similar way with corresponding prints in a vertical line (Fig. 1). In this way a composite record of the appearance of the disc of one patient could be built up and the natural history of the disorder appreciated.

The colour, stereoscopic, and fluorescein photographs for each patient were reviewed together and compared. The stereoscopic photographs were of special value.

DENSITOMETRY Emitted fluorescence is recorded on photographic negatives as an area of increased density. This was measured by projecting the negative in an enlarger and using a Melico photographic enlarging densitometer. It was confirmed by means of a density step wedge that the densitometer scale was linear. Densitometry readings were taken from the nasal and temporal side of each disc (avoiding the disc edge or any crescent) and from three points in the retina one disc diameter from the edge of the disc at 4, 8, and 12 o'clock respectively. Care was taken to avoid major vessels in the retina. The three retinal readings were averaged and a ratio of disc density/mean retinal density was calculated. In this way allowance was made for variation in background illumination and other technical factors. In each instance separate ratios were calculated for the nasal and temporal sides of the disc.

RESULTS

Twenty-nine sequences of film from 10 patients...
FIG. 1a. Fluorescein photographs of Case 2. Seven series each comprising the left disc seen at 15 sec, 100 sec, and five, 15, and 30 min with right disc for comparison at five, 15, and 30 min.
FIG. 1b. Fluorescein photographs of Case 2. Seven series each comprising the left disc seen at 15 sec, 100 sec, and five, 15, and 30 min with right disc for comparison at five, 15, and 30 min.
were available for study. The clinical and photog-

Table 1.

ographic findings are set out in the Table. Oedema

**TABLE**

of the disc was visible on ophthalmoscopy or colour

of 10 Patients with Acute Retrolubular Neuritis

film in three cases.

**CLINICAL AND PHOTOGRAPHIC FINDINGS IN**

In the normal eye fluorescence is seen in the

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Side</th>
<th>Time from onset (days)</th>
<th>Colour film of disc</th>
<th>Fluorescein Dens. at 15 min (nasal disc)</th>
<th>Associated disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>JA</td>
<td>47</td>
<td>M</td>
<td>R</td>
<td>6</td>
<td>Normal</td>
<td>1:33 1:21</td>
<td>Myelopathy</td>
</tr>
<tr>
<td>RL</td>
<td>22</td>
<td>F</td>
<td>L</td>
<td>4</td>
<td>Normal</td>
<td>1:09 1:10</td>
<td>Paraesthesiae</td>
</tr>
<tr>
<td>SP</td>
<td>22</td>
<td>F</td>
<td>R</td>
<td>18</td>
<td>Normal</td>
<td>0:98 1:22</td>
<td>Myelopathy</td>
</tr>
<tr>
<td>WS</td>
<td>25</td>
<td>M</td>
<td>L</td>
<td>42</td>
<td>Oedema</td>
<td>1:45 1:24</td>
<td>Paraesthesiae</td>
</tr>
<tr>
<td>M</td>
<td>39</td>
<td>F</td>
<td>R</td>
<td>28</td>
<td>Normal</td>
<td>1:33 1:21</td>
<td>Myelopathy</td>
</tr>
<tr>
<td>PS</td>
<td>34</td>
<td>F</td>
<td>R</td>
<td>7</td>
<td>Normal</td>
<td>1:37 1:25</td>
<td>Paraesthesiae</td>
</tr>
<tr>
<td>DD</td>
<td>33</td>
<td>M</td>
<td>L</td>
<td>14</td>
<td>Oedema</td>
<td>1:67 1:03</td>
<td>Paraesthesiae</td>
</tr>
<tr>
<td>SG</td>
<td>20</td>
<td>F</td>
<td>L</td>
<td>35</td>
<td>Normal</td>
<td>1:45 1:00</td>
<td>Myelopathy</td>
</tr>
<tr>
<td>PH</td>
<td>24</td>
<td>F</td>
<td>L</td>
<td>8</td>
<td>Normal</td>
<td>1:47 1:40</td>
<td>Paraesthesiae</td>
</tr>
<tr>
<td>JH</td>
<td>23</td>
<td>F</td>
<td>R</td>
<td>7</td>
<td>Normal</td>
<td>1:42 1:32</td>
<td>Myelopathy</td>
</tr>
</tbody>
</table>

In the affected eye fluorescence of the disc is

usually marked at two minutes. In patients with

clinical papilloedema fluorescence is particularly

striking. The ophthalmoscopic changes were most

marked in Case 7 and a description of the fundus

of this patient based on stereocolour photographs

at ×15 magnification (Fig. 3) will provide a back-

ground for discussion. The patient was seen 14 days

after the onset of symptoms, when the visual acuity

on the left side was reduced to perception of hand

movement. The retinal arteries and veins appeared

normal and measurements of the diameter of these

vessels on serial films showed no significant varia-

tion. The peripapillary capillary network was

visible, indicating capillary dilatation. The small

vessels on the disc appeared normal but linear

haemorrhages were present and extended outwards

in a radial pattern. The groups of nerve fibres were

more clearly demarcated than usual. The physio-

logical cup was particularly well seen on stereoscopic

photographs. The disc edge was swollen between

4 o'clock and 1 o'clock but there was striking

absence of swelling at 3 o'clock (temporal edge).

No exudate was visible in the retina. The fluorescein

photographs confirm these findings and show

marked fluorescence of the swollen edge of the disc

followed by diffusion of the dye.

Localized oedema of a small segment of the disc

was well demonstrated in fluorescein photographs.

These changes at a sub-ophtalmoscopic level are

seen in Figure 1. In this patient the visual acuity on

the affected side was reduced to 6/60 on the fourth
day. Fluorescence was much more marked a week later. By the 45th day the acuity was 6/6 but fluorescence was still marked. The serial densitometry readings for this patient are shown in Figure 2. Without fluorescence studies it is doubtful whether any change in the optic disc could have been detected. In acute retrobulbar neuritis leakage is first seen at the nasal edge of the disc and may remain confined to a small segment.

In the affected eye the increase in fluorescence with time is greater than in the normal and more marked on the nasal side of the disc. This is shown in Fig. 4 in which the difference in density ratio for the affected and control eye is shown for the 10 patients at five, 10, 15, and 30 minutes after injection. The increase between 15 and 30 minutes is very slight. The Student t test applied to the figures at 15 minutes (see Table) gives a difference between affected and control eyes \( P < 0.01 \). It is likely that the fluorescein densitometry is abnormal for the affected eye in nine of the 10 cases.

Several other observations were made. Filling in of the physiological cup was not seen in any affected disc even when papilloedema was present. Stereoscopic photographs were of special value in this assessment.

Measurement of artery and vein diameter was done in those cases when serial films were available. No significant changes were found. However, there are several difficulties in making such measurements. It is often hard to define the vessel limits even with serial films of the same fundus, also there is unavoidable photographic variation due to light reflection and the retinal camera has a very short depth of focus.

Haemorrhage was seen only in Case 7 and was not a marked feature. It seems doubtful whether haemorrhage ever occurs in this condition in the absence of marked oedema of the disc. Exudates in the fundus were not observed in any of these patients, although the fluorescein technique might be expected to reveal soft exudate (Hodge and Dollery, 1964).

**DISCUSSION**

Magnified colour stereoscopic photographs of the disc gave excellent definition and enabled us to obtain the maximum amount of anatomical detail before applying the fluorescein technique.

In this study a single large dose of fluorescein in concentrated solution was injected as rapidly as possible into an antecubital vein. The dose used was larger and more concentrated than that used by most previous workers (Dollery, Mailer, and Hodge 1965; Miller et al., 1965). The advantages of this were ease of administration (an intravenous catheter was not
used), a high initial retinal intravascular concentration of dye which improves angiogram contrast, and more sensitive detection of leakage of dye from the vessels. Normal retinal vessels are not permeable to fluorescein in the concentration used and differ in this respect from choroidal vessels and most other blood vessels (Dollery, 1967).

The blood supply to the optic nerve is complex. The nerve head is supplied by a rich anastomosis of vessels derived from the ciliary and retinal circulations. There is evidence from fluorescein studies of the normal disc that two fluorescent components are present: one in surface vessels and one in a deeper vascular bed (Hill, 1966). It has been found that the superficial vessels fill with the retinal vessels and the deep plexus is in phase with the choroidal circulation (O'Day, Crock, and Galbraith, 1967). These vessels cease to fluoresce as dye passes to the veins. Persistence of fluorescence of the disc suggests that dye leaks from the vessels, possibly from the choroidal vessels, and this would also explain the increase in fluorescence up to 30 minutes. In acute retrobulbar neuritis the leakage of fluorescein is more marked. This may be apparent after two minutes but is much more marked after 15 minutes.

The fluorescein technique is clearly of value in detecting segmental oedema and sub-opthalmoscopic oedema, which cannot be recognized in the living subject in any other way. Leakage of dye presumably indicates increased capillary permeability and it is only when this leakage is considerable that oedema can be recognized with the ophthalmoscope.

The diagnosis of acute retrobulbar neuritis is essentially clinical. Difficulties arise in some cases because of the brief duration of the visual symptoms. In clinical situations of this type fluorescein photography may be of value in confirming the organic nature of the process.

Fluorescence was studied by means of photographs taken at intervals up to 30 minutes from the time of injection. This differs from previous work, which has been mainly directed to recording events in the arterial phase and first few minutes following injection. It was also possible to compare the photographs of the affected eye with the control eye but this is scarcely practicable during the arterial phase when exposures in rapid sequence are necessary. It was shown that in the group of control eyes mean disc fluorescence as measured by densitometry increased slightly during the 30 minutes following injection, but the increase at 15 minutes was significantly greater in the affected eyes. The leakage effect is more marked on the nasal side of the disc.

In reviewing the fluorescein photographs it is not always easy to appreciate their significance in isolation. A review of sets of film taken serially reveals a graduation of change (Fig. 1). In this patient (Case 2) when series six photographs were examined, it was thought that they were probably within normal limits. However, after the seventh series became available it was revealed that minor abnormalities were present in series six. Densitometry measurements increased the accuracy of assessment particularly in an individual case where several film series could be compared (Fig. 2). Rigid standardization of photographic technique is essential if densitometry is used.

**SUMMARY**

Ten cases of unilateral acute retrobulbar neuritis have been studied clinically and photographically using stereoscopic, colour, and fluorescein photographs. In three patients oedema of the disc could be seen by direct ophthalmoscopy. Serial studies were made and the findings related to the clinical state. Fluorescein photographs may demonstrate oedema of the disc which is sometimes localized to a small segment and detected only by ophthalmoscopy in the more severe cases. The affected eye was compared with the unaffected eye of the same patient and the degree of fluorescence was measured with a densitometer. In nine patients the findings on fluorescein photography were probably abnormal.

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