Thus only 10 patients had a true inaccurate computed tomographic assessment. In six of these 10 patients the computed tomographic report suggested more advanced disease than was found at operation (a 3.2% rate of false positives). Ideally, the number of false positives should be reduced to zero; five of the six false positive cases occurred early in our series, and only one false positive occurred in the last 100 patients analysed. The number of false negatives (35 patients, 19%) was much higher, as expected, as we had aimed at underestimating disease that was present so that no patient was denied thoracotomy for a resectable tumour.

The disease in 113 patients was considered to be inoperable on computed tomography. Mediastinoscopy was performed in nine patients, and all had evidence of mediastinal spread as predicted by computed tomographic findings. In 47 patients disease was assessed as inoperable on computed tomography of the thorax alone, and this was accepted by the thoracic surgeons after careful and full discussion. Thirty two other patients whose disease was assessed as inoperable on computed tomography also had evidence of metastatic spread. The remaining group of 30 patients did not have an operation, although their disease was assessed as operable on computed tomography.

Computed tomography of the thorax is now performed early, before any other investigation for secondary spread, and is used routinely to help to assess suitability for thoracotomy. We recommend that a report of inoperability based on computed tomographic

findings is reliable and accurate but accept that metastatic spread to nodes may be impossible to visualise and computed tomography may underestimate the extent of the disease present.

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(Accepted 13 November 1985)

Retinal changes in malignant hypertension

ELLON MCGREGOR, CHRISTOPHER G ISLES, J L JAY, A F LEVER, G D MURRAY

Abstract

To assess the diagnostic and prognostic importance of papilloedema in malignant hypertension a two part study was undertaken. Four observers reviewed 56 photographs of fundi from patients with grade 3 or 4 hypertensive retinopathy. Complete agreement on the presence or absence of haemorrhages was recorded in 52 cases and on exudates in 53 cases. Opinion on papilloedema, however, was divided, all four observers agreeing in only 34 cases. In the second part of the study survival in 139 consecutive hypertensive patients with bilateral retinal haemorrhages and exudates was examined by life tables. Ten year survival was 46% in patients with bilateral haemorrhages and exudates alone (n=43) and 48% when papilloedema was also present (n=96). Multivariate analysis confirmed that papilloedema was not related to survival.

These results suggest that papilloedema is an unreliable

physical sign and does not adversely influence prognosis in hypertensive patients who already have bilateral retinal haemorrhages and exudates when effective treatment is available. Papilloedema should no longer be regarded as a necessary feature of malignant hypertension.

Introduction

Despite recommendations by the World Health Organisation that the criteria for malignant hypertension should include hypertensive patients with bilateral retinal haemorrhages and exudates alone¹ some clinicians insist that papilloedema should also be present.² To try to resolve this issue we assessed the importance of papilloedema in severe hypertension in a two part study.

Patients and methods

In the first part of the study four observers (a senior physician, two junior physicians and a senior ophthalmologist) assessed 56 transparencies of fundi (28 pairs) showing grade 3 or 4 hypertensive retinopathy. The slides were selected from files of the Medical Research Council unit provided that a minimum of one haemorrhage or one exudate was present in at least one of the pair of fundi and each could be sharply focused. Thirty six slides were from patients described in the second part of the study. Photographs of normal fundi were not included as our test was of the extent that clinicians agreed on the presence of retinal changes when the diagnosis of malignant hypertension was suspected. The transparencies were projected singly, and each observer was asked to record whether haemorrhages, exudates, and papilloedema were present or absent. The degree of consensus among observers was then determined.

Medical Research Council Blood Pressure Unit and Tennent Institute of Ophthalmology, Western Infirmary, Glasgow G11 6NT

ELLON MCGREGOR, MB, CHB, senior house officer
CHRISTOPHER G ISLES, BSC, MRCP, senior registrar
J L JAY, BSC, FRCS, consultant, Tennent Institute of Ophthalmology
A F LEVER, FRCP, consultant

Department of Statistics, University of Glasgow, Glasgow G12
G D MURRAY, PHD, lecturer

Correspondence and requests for reprints to: Dr Ellon McGregor, Medical Research Council Blood Pressure Unit.

In the second part of the study all case records ($n=193$) of patients with hypertension and grade 3 or 4 retinopathy admitted to the blood pressure unit of the Western Infirmary, Glasgow, from 1968 to 1983 and to the renal unit at Glasgow Royal Infirmary from 1979 to 1983 were reviewed by one of us (AFL) who was unaware of each patient's outcome. The diagnosis of malignant hypertension was accepted if the attending physician had recorded the presence of haemorrhages and exudates in both fundi. If this information had not been given but bilateral haemorrhages and exudates were present in fundal photographs, which accompanied the case sheets in 156 of 193 cases, the patient was also included in the study. The presence or absence of papilloedema was judged similarly. By these criteria 139 consecutive patients were identified: 43 with haemorrhages and exudates alone and 96 with haemorrhages, exudates, and papilloedema. The relation between presence of papilloedema and survival was then determined: firstly, by life table analysis and, secondly, by Cox's proportional hazards model³ to control for the possible influence of age, sex, smoking habit, underlying diagnosis, initial serum creatinine concentration, and initial and achieved blood pressures. We assessed the proportional hazards model graphically by stratifying separately for each covariate and examining plots of the log minus log survival function.

Results

The four observers agreed that haemorrhages were present or absent in 52 of 56 slides and disagreed in four cases. A similar consensus was obtained for exudates, with disagreement in three cases. Opinion on papilloedema, however, was divided, the observers agreeing in only 34 of the 56 cases.

The possibility that florid papilloedema was recognised correctly but mild papilloedema was not was also examined. Among 21 slides considered originally to show florid papilloedema there was complete agreement in 18 cases. Observers were less likely to agree when papilloedema was either mild or absent (16 of 35 cases). No single observer was responsible for this difference of opinion.

In the second part of the study as there were no significant differences in the survival of men and women ($\chi^2=0.01$, 1 df, $p=0.97$) life tables for both sexes were combined. Ten year survival was 46% in patients with bilateral haemorrhages and exudates alone and 48% when papilloedema was also present. The lack of association between papilloedema and length of survival was confirmed using the proportional hazards model, which showed associations between survival and age ($p=0.06$), smoking habit ($p=0.03$), underlying diagnosis ($p=0.01$), initial serum creatinine concentration ($p=0.01$), and achieved blood pressure ($p<0.01$) but not papilloedema ($p=0.48$). Controlling simultaneously for the other covariates, we found no evidence of an association between papilloedema and survival ($\chi^2=0.89$, 1 df, $p=0.34$), as shown in the figure which gives an estimate of survival with and without papilloedema for a subject whose covariates correspond to the mean of the combined groups.⁴

Discussion

In 1939 Keith *et al* published life tables showing survival in untreated hypertensive patients based on retinal features at presentation.⁵ The prognosis for papilloedema (grade 4 retinopathy) and haemorrhages and exudates (grade 3) was worse than for arteriovenous nicking (grade 2) and arteriolar narrowing (grade 1). The presence of papilloedema was associated with the worst prognosis of all and became synonymous with the term "malignant" hypertension. Subsequently, some authors have favoured "accelerated" hypertension to describe patients with grade 3 retinopathy.² With the advent of effective antihypertensive drugs survival of patients with grade 3 and grade 4 retinopathy has improved considerably.⁶⁻⁷

The World Health Organisation has recently recommended a new definition of malignant hypertension that includes patients with bilateral retinal haemorrhages and exudates alone.¹ The detection of fibrinoid arteriolar necrosis in eight of 19 patients who had retinal haemorrhages and exudates but not papilloedema⁸ was cited as evidence supporting this new definition. As important, we believe, is the observation that soft exudates and papilloedema share a similar pathogenesis.⁹

In this study we present two additional reasons for adopting the World Health Organisation's criteria. Firstly, different observers are more likely to agree that a patient has haemorrhages and exudates than they are about papilloedema. As expected, florid

Relation between papilloedema and survival in 139 hypertensive patients with bilateral retinal haemorrhages and exudates after controlling for age, sex, smoking habit, underlying diagnosis, initial serum creatinine concentration, and initial and achieved blood pressures by multivariate analysis. Numbers of patients observed at beginning of each time interval are given. After eight years there were no deaths among six remaining patients without papilloedema. Failure of papilloedema to influence prognosis was confirmed by likelihood ratio test ($\chi^2=0.89$, 1 df, $p=0.34$).

papilloedema was recognised in most cases, but papilloedema when less severe led to considerable disagreement. This suggests therefore that mild papilloedema is a highly subjective physical sign. Secondly, survival in our patients with bilateral retinal haemorrhages and exudates alone was similar to survival in those who also had papilloedema. The failure of papilloedema to affect prognosis adversely was confirmed by multivariate analysis, conflicting with previous data.⁵⁻⁶ Two explanations may account for these differences. One is that papilloedema may be associated with a poorer prognosis when hypertension is untreated or treatment is fairly ineffective and that better control of blood pressure has equalised the outcome. The other is that in the earlier analyses hypertensive patients with only one haemorrhage or exudate in only one eye were classified as having grade 3 retinopathy; many of these patients may have had retinal vascular occlusions and hence a better prognosis.¹⁰

In summary, our study suggests that papilloedema, unless florid, is an unreliable physical sign and is of no additional prognostic importance in patients treated for hypertension who already have bilateral haemorrhages and exudates. We therefore propose that the World Health Organisation's definition of malignant hypertension is more widely adopted.

We thank Drs A E Blewett and R Davidson for taking part in the assessment of fundus slides.

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(Accepted 6 November 1985)