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Pseudotumor cerebri

Longitudinal study using contrast sensitivity and automated static perimetry

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ABSTRACT. The visual function of 13 patients with pseudotumor cerebri (P.C.) was investigated with a test battery including color vision, V.E.P.s, contrast sensitivity (C.S.) and automated static perimetry (A.S.P.).

C.S. and A.S.P. were both undertaken on a Vision R Monitor System. Ten patients were evaluated since the beginning of the papilledema (group I), three after resolution of papilledema (group II). The color vision test was of poor sensitivity. V.E.P.s were normal. In the acute phase, C.S. was altered in 70% of cases. The enlargement of the blind spot was constant and a visual field defect was found in 60% of cases. The changes of the fundus, C.S. and A.S.P. followed the development of papilledema and improved with it. After resolution of papilledema persistent alterations of fundus and A.S.P. were often associated.

C.S. seems to be a more independent parameter, which normalizes most easily but which has not a predictive value for the final visual outcome. For the diagnosis and the pathogenic study, the fundus examination and A.S.P. are the most useful parameters. C.S. may be used as index of surveillance but further studies are necessary.

Key words: pseudotumor cerebri; idiopathic intracranial hypertension; papilledema; visual function study; contrast sensitivity function; automated static perimetry; color vision test; fluorescein angiography.

INTRODUCTION

An ophthalmic survey of patients suffering from pseudotumor cerebri (P.C.), also known as idiopathic intracranial hypertension, remains an important area of investigation. The study of the development of visual field defects and visual loss in P.C. is well known[1-6]; one in three patients had a visual field defect and one in five had a visual acuity deficit. Only recently have automated static perimetry (A.S.P.)[7, 8] and contrast sensitivity (C.S.) function[9-12] been used in an attempt to provide new clues in the study of visual dysfunction.

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MATERIALS AND METHODS

From April 1987 through May 1988, thirteen P.C. patients were evaluated in our Neuro-Ophthalmology Clinic using the same test battery including C.S. and A.S.P.; ten cases were examined since the beginning of the papilledema

(group I), three cases were tested respectively six months, 15 months and seven years after resolution of papilledema (group II).

These patients fit the criteria for the diagnosis of P.C.[13]; signs and symptoms of increased intracranial pressure without focal neurological signs except for oculomotor palsies, a normal cerebrospinal fluid composition with an elevated opening pressure and absence of neuroradiological abnormalities.

Ophthalmic examination included best corrected visual acuity (V.A.), intraocular pressure, pupillary reactions and ocular motility study. Fundus photographs and fluorescein angiography were realized in all cases and in six cases a photographic study of the peripapillary nerve fiber layer as well. Papilledema was classified as 'mild', 'moderate', 'severe', as proposed by Smith and Baker[7]. Gliotic changes of the optic disc were noted. Color vision was evaluated with: Ishihara plates[14], Panel D[15], and Lanthony Desaturated Panel D15[16]. A score was established with the last test[17]. V.E.P.s with pattern inversion technique were realized in nine cases[18].

Contrast sensitivity function and computerized perimetry were both performed on a Vision Monitor R System*. The cathode ray tube has been described elsewhere[19].

C.S. was investigated using stationary vertical sinusoidal gratings, presented on a television screen. Six spatial frequencies, between 0.8 and 26 cycles per degree, were presented, with a mean luminance of 100 cd/m^2. The display subtended 2.2×1.6 degrees of visual angle when viewed at a distance of 3.50 m. The distance was kept constant throughout the session. The test was realized monocularly each eye wearing its best optic visual correction. The luminance contrast threshold level was determined for each spatial frequency, by increasing contrast by 1 dB step, from the subliminal level until the patient could see the pattern. For each spatial frequency a mean of three measures was realized. Contrast sensitivity was defined as the reciprocal of contrast threshold. The results were compared with those of control subjects matched for age (18 control subjects of less than 40 years, 12 of more than 40 years). For the first five spatial frequencies (0.8 to 13 c/d) every value less than 2.5 standard deviations (SD) compared with the control population was considered as pathological ($p<0.01$). An isolated lowering of the last value (26 c/d) was not considered pathological, because of equipment limitations (the range of contrast variation of the equipment is limited in the highest spatial frequencies to 8 dB). Abnormal results were categorized by the spatial frequency attenuation range as 'low' for 0.8 and 1.6; 'mid' for 3.2 and 6.5; 'high' for 13 and 26 and 'full' for 0.8 to 26 c/d.

For the automated static perimetry study a program of 95 points scattered in the central 30° was used. The program combined a threshold strategy for the determination of the foveolar point sensitivity and a suprathreshold strategy for the others. A constant control of fixation and attention was provided. The results were compared with a reference map established with young normal control subjects (between 20 and 30 years) and adjusted according to age. Based on our experience, a loss of sensitivity of at least 10 dB for one point, 6 dB for two adjacent points and 4 dB for three adjacent points, was considered pathological.

When possible, a Goldmann kinetic perimetry was realized using a minimum of two isopters, one peripheral (V4) and one central (II2). The physiological blind spot was mapped with the central target.

* Commercially available in France from Luer (Paris) and in Europe from Metrovision (Villeneuve d'Ascq, France).

TABLE 1. Continued

Visual field findings other than blind spot enlargement, A.S.P. and Goldmann perimetry	*Length of follow-up*	
	*	**
isopters constriction, scotoma, 'H.L.H.'	9 mo	15 mo
isopters constriction, scotoma, 'H.L.H.'		
isopters constriction, scotoma	4 mo	14 mo
isopters constriction, inferonasal defect		
	3 mo	6 mo
isopters constriction	4 mo	7 mo
isopters constriction		
	2 mo	3 mo
isopters constriction, scotoma	2 mo	6 mo
isopters constriction, inferonasal defect, scotoma		
	10 mo	18 mo
	3 mo	5 mo
inferonasal defect, scotoma	3 mo	7 mo
scotoma		
scotoma	3 mo	4 mo
scotoma		
	3 mo	6 mo
	2 mo	15 mo
	7 mo	7 years

*length of papilledema; **length of survey.

dertaken in all cases and the opening pressure was constantly higher than 200 mm H_2O. A cerebral angiography performed in 12 cases was normal in ten cases. In two cases (Nos. 7 and 11), a thrombosis of the superior longitudinal sinus was detected. In case No. 6 a cerebral angiography was not performed because of the patient's young age (14 years). In this case, in spite of the normality of the M.R.I., a transverse sinus thrombosis could not be excluded.

All patients were observed from the onset of the disease and regularly controlled, ten of them with A.S.P. and C.S. in addition to the classic ophthalmic observation. Patients were seen about every month, more frequently in the very acute phase. The minimum follow-up was three

months, the maximum 26 months. Each patient had an average of four controls (between two and 11).

RESULTS

Visual condition in the acute phase of papilledema (Table 1).

Ophthalmic findings. Six patients complained of transient visual blurring. One patient first experienced visual blurring after competing in a biathlon (No. 7). Six complained of diplopia (unilateral sixth nerve palsy: four cases; bilateral sixth nerve palsy: one case; unilateral sixth and fourth nerve palsy: one case). Four patients had diminished visual acuity (Nos. 1, 2, 9, 12), ranging from 20/50 to 20/30; only two cases (Nos. 1 and 2) were bilaterally affected. The visual acuity was normal in nine cases. All of the patients had a bilateral papilledema. The fundus examination showed a grade HI papilledema in eight cases, grade II in one, grade I in four. Choroidal folds were found in three cases, retinal folds in one. Color vision tests were realized in eight cases. Even with a major papilledema, only three eyes obtained an abnormal score using the Lanthony method[17]. V.E.P.s realized in nine cases were normal.

Contrast sensitivity function was tested in ten patients in the initial stage (group I). In three cases C.S. was normal (Nos. 5, 7, 8); in seven cases abnormalities were detected, two in one eye (Nos. 6 and 9) and five in both eyes (Nos. 1, 2, 3, 4, 10). A high frequency attenuation was noted in seven eyes (associated with a normal V.A. in five eyes and an abnormal V.A. in two eyes), a 'full' frequency attenuation or the association of 'high' and 'mid' or 'mid' and 'low' frequency attenuation was observed in five eyes (with normal V.A.: two eyes; abnormal V.A.: three eyes).

Visual field. Results were divided into isolated blind spot enlargement and visual field defects. An automated static perimetry exploration was undertaken in ten patients (group I). All patients had a blind spot enlargement and six of them had visual field defects. The latter included an isopter constriction in four cases (Nos. 1, 2, 4, 6), central and paracentral scotomas in five cases (Nos. 1, 2, 6, 9, 10), inferonasal defects in three cases (Nos. 2, 6, 9) (Fig. 1). In case No. 1 the perimetric deficit simulated an homonymous lateral hemianopsia.

A Goldmann kinetic perimetry was undertaken in seven cases (Nos. 1, 2, 3, 5, 6, 7, 10). A comparison between automated static perimetry and Goldmann kinetic perimetry is given in Table 2. The three patients of the second group had only a Goldmann perimetry, which showed an isolated enlargement of the blind spot.

TABLE 2. Comparison of automated static perimetry (A.S.P.) and Goldmann kinetic perimetry (G.K.P.): seven cases (group I)

	A.S.P.	*G.K.P.*
big blind spot	14 eyes	14 eyes
cent. paracent. scotomas	6 eyes	2 eyes
constriction isopters	4 eyes	4 eyes
inferonasal cent. defect	2 eyes	0
others, pseudo HLH	2 eyes	2 eyes

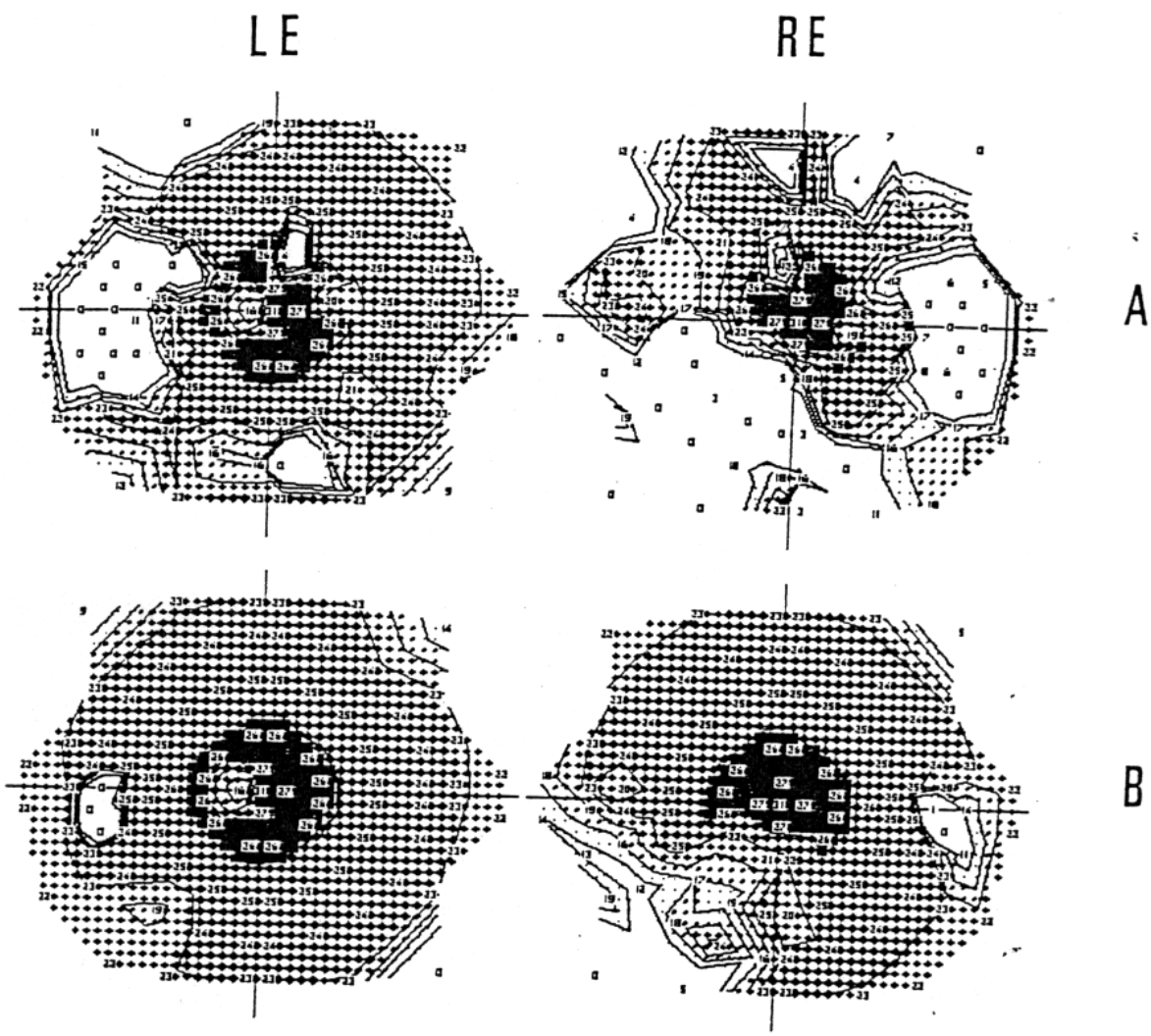


Fig. 1. Observation No. 6. A.S.P.: A - in the acute phase of papilledema, B - four months after resolution of papilledema.

Correlations between V.A., C.S. and A.S.P.: (group I). When V.A. was lowered (Nos. 1, 2, 9) the visual parameters such as C.S. and A.S.P. were also pathological. When V.A. was normal, visual parameters varied. Three patients with normal C.S. (Nos. 5, 7, 8) were younger (average age 22) and had only a blind spot enlargement on their central visual field. Four patients with abnormal C.S. (Nos. 3, 4, 6, 10) were older (average age 28) and had associated abnormalities of their visual field in three cases.

Final visual outcome after resolution of papilledema

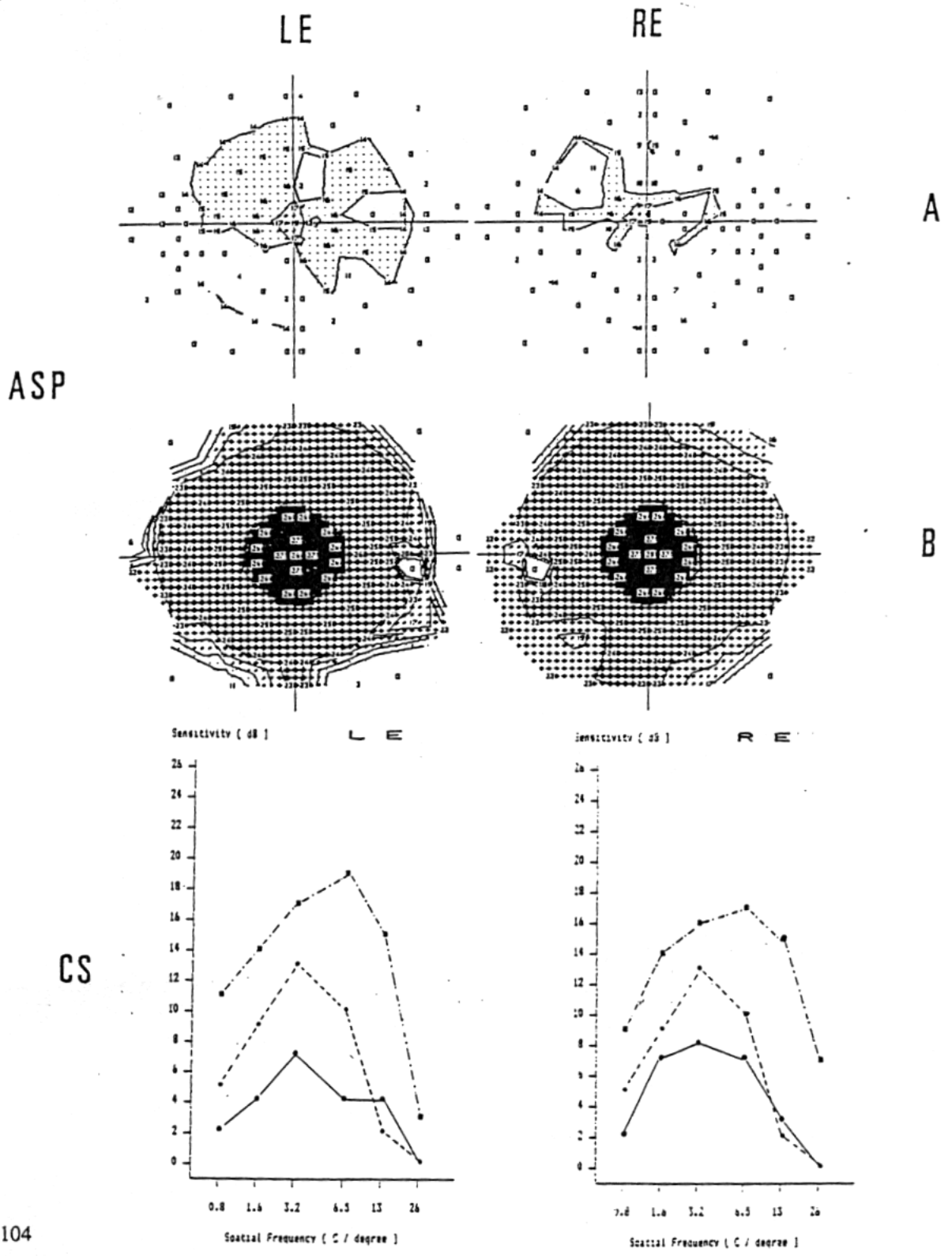
Evolution and treatment. All 13 patients were first treated medically with diuretics, acetazolamide, osmotic agents and sometimes corticoids.

With medical treatment alone nine cases improved in two to four months and in one additional case in ten months (No. 7). An anticoagulation therapy was added in cases Nos. 7 and 11 (superior longitudinal sinus thrombosis). In three cases (Nos. 1, 2, 9) visual acuity and all the different visual parameters (C.S., A.S.P.) deteriorated in spite of the medical treatment and a surgical lum-

TABLE 3. Visual parameters after resolution of papilledema

n	*Grade*	*Final V.A.*	*Fundus*	*A.S.P.*	*C.S.*
Group I					
1	2	RE 20/20	N	N	N
	2	LE 20/20	choroidal folds	N	N
2	3	RE 20/30	N	N	high frequency attenuation
	3	LE 20/20	choroidal folds	inferonasal defect	N
3	3	RE 20/20	N	N	N
	3	LE 20/20	N	N	N
4	1	RE 20/20	choroidal folds	N	N
	1	LE 20/20	N	N	N
5	1	RE 20/20	N	N	N
	1	LE 20/20	N	N	N
6	3	RE 20/20	retinal folds	inferonasal defect	N
	3	LE 20/20	N	scotoma	N
7	3	RE 20/20	gliosis optic disc	N	N
	3	LE 20/20	N	N	N
8	1	RE 20/20	N	N	N
	1	LE 20/20	gliosis optic disc	big blind spot	N
9	3	RE 20/25	N	big blind spot + inferonasal defect	high frequency attenuation
	3	LE 20/20	N	big blind spot	N
10	3	RE 20/20	N	N	N
	3	LE 20/20	N	big blind spot + scotoma	N
Group II					
11	3	RE 20/20	N	N	N
	3	LE 20/20	N	N	N
12	1	RE 20/20	N	N	N
	1	LE 20/20	gliosis optic disc	big blind spot	N
13	3	RE 20/20	N	N	N
	3	LE 20/20	N	N	N

n: number of observations; grade: grade of papilledema; V.A.: visual acuity; RE: right eye; LE: left eye; A.S.P.: automated static perimetry; C.S.: contrast sensitivity function.


LE
RE
A
ASP
B
Sensitivity (dB)
L E
Sensitivity (dB)
R E
CS
0.8 1.6 3.2 6.5 13 26
Spatial Frequency (C / degree)
Spatial Frequency (C / degree)

boperitoneal shunt was decided upon. The condition of these patients improved rapidly during the first month after surgery in spite of surgical problems. In case No. 1 the bypass was changed because of peritoneal adherences. One year later the condition of the patient is good and needs no further treatment, as shown in Fig. 2. In case No. 2 the surgical material was removed because of a suppuration. No relapse was observed during the following nine months.

Visual parameters. The conditions of different visual parameters after resolution of papilledema are summarized in Table 3. Twenty-four eyes kept or recovered a normal V.A. associated with a normal C.S. The reduction of visual acuity observed in two eyes (Nos. 2, 9) was moderate, 20/30 and 20/25 respectively and was associated with a persistent attenuation of the high frequency on the C.S. In these two eyes, the A.S.P. was normal in one (No. 2) and in the other (No. 9) an inferonasal defect and 'a big blind spot' persisted. Fundus modification and visual field abnormalities were most frequently found as sequelae rather than reduced V.A. The different fundus abnormalities observed consisted of choroidal folds, gliotic modification of the optic disc and retinal folds. Persistent visual field abnormalities were noted in eight eyes: big blind spot (four eyes), inferonasal defects (four eyes), scotoma (two eyes). The inferonasal defect of the central visual field was often associated with abnormalities of the fundus (choroidal or retinal folds). The isolated big blind spot could persist a very long time (15 months in case No. 12) associated or not with gliotic modification of the optic disc.

Correlations between V.A., fundus, A.S.P. and C.S. after resolution of papilledema.

In all cases there was a correlation between the resorption of the papilledema and the improvement of the C.S. and A.S.P.

None of the five cases with initially a grade I or II papilledema kept a visual field defect. Three of them had a normal A.S.P. and C.S.; two had a persistent 'big blind spot'.

After resolution of grade III papilledema, half of the cases had normal A.S.P. and C.S.; half of the cases kept visual field changes with scotoma or inferonasal defects.

The two cases of persistent attenuation of C.S. (Nos. 2, 9) initially had a grade III papilledema.

DISCUSSION

Our patients show the characteristic features of P.C. as described in the literature[1-5] with a peak incidence in the third decade, a high incidence of obesity (seven cases) and a female predominance (seven females, three males). Associated conditions have also been described[20]: impairment of intracranial venous drainage, a high frequency of endocrine and metabolic dysfunction including menstrual disorders and pregnancy. One of our cases (No. 12) had an 'empty sella', an etiologic factor well known as well[21]. Transient visual blurring and diplopia due to uni- or bilateral sixth nerve palsy are well documented in P.C.[1-5]. A fourth nerve palsy (No. 11) is less frequently

Fig. 2. Observation No. 1, *A.S.P.: A - alteration of visual field in spite of medical treatment, B - after surgical lumboperitoneal shunt.
*C.S.: ● ——— ● before surgical treatment, ■ —·—·— ■ after surgical treatment, —— inferior limit (< 2.5 D.S.) of the normal population.

described[7, 22, 23]. None of the signs remained after disappearance of papilledema.

There are some difficulties in the comparison of different visual parameters. The results are often contradictory and impossible to categorize accurately. Vision color tests appear to be poorly sensitive. V.E.P.s are always normal. However, our study is not longitudinal and we cannot argue about the results found by Sorensen[22] who described V.E.P. modifications during the evolution of P.C. V.E.P. does not seem very effective in detecting visual loss in P.C.[12].

We will essentially discuss the results of fundus, A.S.P. and C.S. and we will try to establish correlations between these parameters. In all our cases, papilledema was constant, bilateral and most often fully developed. The degree of papilledema and the age of the patients influenced neither the length of evolution nor the visual prognosis. But with an initial grade I or II papilledema, no persistent visual field defect or persistent C.S. attenuation were observed. All the patients who retained sequelae of C.S. or A.S.P. had initially a grade III papilledema and the V.A. in two eyes was only moderately altered. The persistent modifications of the visual field in the 'severe' papilledema are probably associated with an ischemic phenomenon of the optic disc during the acute phase of the disease[25].

In recent studies using automated static perimetry[7, 8] as well as in previous ones using kinetic perimetry, the enlargement of the blind spot is usually separated from visual field defects. With kinetic Goldmann perimetry[1-5] or a tangent screen[5], one in three patients suffering from P.C. had a visual field defect. Automatic static perimetry improved the detection level of abnormalities. In our study, the blind spot is constantly enlarged in the acute phase of papilledema and a visual field defect found in 60% of the cases. Scotomas are more easily detected with A.S.P. However, there are some difficulties in establishing criteria for the definition of scotoma[7, 8]. Theoretically, with our suprathreshold strategy, all defects are pathological. Our clinical experience had led us to dismiss 'shallow scotoma'. We have adopted criteria which are intermediate between those of two previous studies[7, 8], undertaken with automated static perimetry. Smith and Baker[7] and Wall[8] found respectively 77.5% and 75% of visual field defects using program 32 of Octopus[7, 8] and a full field program of Digilab[7]. The difference between their results and ours derives probably from their threshold strategy, which is more precise but time consuming[8]. The importance of the strategy used is illustrated by Wall and George[8] who found 75% abnormalities on a Goldmann perimeter using an Armaly strategy. The suprathreshold strategy used in the present study appears a good compromise regarding its sensitivity for the detection of visual field defects and its clinical acceptability in patients suffering from headaches. In the different studies[1, 3-8], whatever the technique used, the most frequent visual defects found in P.C. are isopter constrictions and inferonasal defects. Alterations of the fundus and A.S.P. are often associated. In our observations (Nos. 2, 6, 9), the inferonasal defect is not only a generalized depression on the nasal side of the visual field, as expressed by Wall and George[8]. It was a real loss which persisted three months after resolution of papilledema and in two cases (Nos. 2 and 6) in association with persistent choroidal or retinal folds. No precise pathogenic explanation can be provided, but visual field defects of nerve fiber bundle type found in P.C. are very similar to those described in glaucoma[26].

We found perturbations of the C.S. in 70% of our cases and in 60% of the eyes (12/20). To our knowledge, four recent studies have evaluated, with C.S., patients suffering from P.C. Wall[9]

found an altered C.S. in 75% of his patients (54% of the eyes). He tested 12 patients, nine in the active phase of the disease and three after resolution of papilledema; 20% of these patients had a visual acuity less than 20/20. However, using Arden gratings, he could not explore high frequencies above 6.4 cycles per degree. Lorance *et al.*[10] explored only three patients suffering from P.C. All their patients had abnormal C.S. (high and full frequency attenuation) with a visual acuity of 20/25. In this last study, the authors performed C.S. using a television-generated stimulus and tested ten spatial frequencies (from 0.5 to 22.8 cycles per degree). In two recent studies[11, 12], testing respectively 20 and 15 patients, the authors found C.S. loss in 43% and 60% of the eyes. Both used a TV monitor, but their technical conditions are different from ours and no precise comparison is available.

C.S. is a parameter easily altered in P.C. in the acute phase of the disease even with a normal Snellen acuity. It does not seem to have a predictive value for the final visual outcome. However, there is a parallelism between the resorption of papilledema and the improvement of C.S. The C.S. is the parameter which normalizes most easily.

The modifications of the fundus, the A.S.P. and the C.S. follow the evolution of papilledema and improve with it. Alterations of the fundus and A.S.P. are often associated. The C.S. seems to be a more independent parameter. The differing results lead us to use several visual parameters in parallel for the follow-up of the visual condition in P.C. In spite of the good visual prognosis in this study, the risk of visual loss can never be excluded[5]. The study of the optic disc and of the visual field is essential and the most useful in the diagnosis and in the pathogenic study; C.S. is a parameter without specificity, which is often altered and which normalizes rapidly. Maybe it will become a useful index of surveillance but further studies with a longer evolution are necessary.

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