Factors affecting visual loss and visual recovery in patients with pseudotumor cerebri syndrome

Fatores que influenciam na perda e na recuperação visual de pacientes com a síndrome do pseudotumor cerebral

Clara L. Afonso[1], Aley Talans[1], Mário Luiz Ribeiro Monteiro[1]

ABSTRACT

Purpose: To investigate the frequency of visual loss (VL), possible predictive factors of VL, and improvement in patients with pseudotumor cerebri (PTC) syndrome.

Methods: We reviewed 50 PTC patients (43 females, seven males) who underwent neuro-ophthalmic examination at the time of diagnosis and after treatment. Demographic data, body mass index (BMI), time from symptom onset to diagnosis (TD), maximum intracranial pressure (MIP), occurrence of cerebral venous thrombosis (CVT), and treatment modalities were reviewed. VL was graded as mild, moderate, or severe on the basis of visual acuity and fields. Predictive factors for VL and improvement were assessed by regression analysis.

Results: The mean ± SD age, BMI, and MIP were 35.2 ± 12.7 years, 32.0 ± 7.5 kg/cm^2, and 41.9 ± 14.5 cmH_2O, respectively. Visual symptoms and CVT were present in 46 and eight patients, respectively. TD (in months) was <1 in 21, 1-6 in 15, and >6 in 14 patients. Patients received medical treatment with (n=20) or without (n=30) surgery. At presentation, VL was mild in 16, moderate in 12, and severe in 22 patients. Twenty-eight patients improved and five worsened. MIP, TD, and hypertension showed a significant correlation with severe VL. The best predictive factor for severe VL was TD >6 months (p=0.04; odds ratio, 5.18). TD between 1 and 6 months was the only factor significantly associated with visual improvement (p=0.042).

Conclusions: VL is common in PTC, and when severe, it is associated with a delay in diagnosis. It is frequently permanent; however, improvement may occur, particularly when diagnosed within 6 months of symptom onset.

Keywords: Pseudotumor cerebri; Visual loss; Intracranial hypertension; Papilledema

RESUMO

Objetivo: *Investigar a frequência de perda visual (PV) e os possíveis fatores preditivos para perda e para melhora visual em pacientes com a síndrome do pseudotumor cerebral (SPC).*

Métodos: *Foram revisados 50 pacientes com SPC submetidos a exame neuroftalmológico no momento do diagnóstico e após o tratamento. Dados demográficos, índice de massa corpórea (IMC), tempo decorrido entre o início dos sintomas e o diagnóstico (TD), pressão intracraniana máxima (PIM), ocorrência de trombose venosa cerebral (TVC), e as modalidades de tratamento foram revisadas. PV foi graduada em discreta, moderada e grave, baseada na acuidade e no campo visual. Fatores preditivos para perda e melhora visual foram avaliados por análise de regressão linear.*

Resultados: *Quarenta e três pacientes eram do sexo feminino. A média de idade, o IMC e a PIM (± desvio padrão) foram: 35,2 ± 12,7 anos, 32,0 ± 7,5 kg/cm^2 e 41,9 ± 14,5 cmH_2O, respectivamente. Sintomas visuais estavam presentes em 46 e TVC em 8 pacientes. TD (em meses) foi <1 em 21, 1-6 em 15 e >6 em 14 pacientes. Pacientes receberam tratamento clinico apenas (n=30) ou associado a tratamento cirúrgico (n=20). Na apresentação a PV era discreta em 16, moderada em 12 e grave em 22 pacientes. Vinte e oito pacientes melhoraram e 5 pioraram. PIM, TD e hipertensão arterial correlacionaram significativamente com PV grave. O melhor fator preditivo para PV grave foi o TD>6 meses (p=0,04; razão de chances 5,18). TD entre 1 e 6 meses foi o único fator significativamente associado com melhora visual após tratamento (p=0,042).*

Conclusões: *Perda visual é comum na SPC e quando grave se mostra relacionado a atraso no diagnóstico. É usualmente permanente mas pode haver melhora visual especialmente quando a doença é diagnosticada nos primeiros 6 após o início dos sintomas.*

Descritores: *Pseudotumor cerebral; Perda visual; Hipertensão intracraniana; Papiledema*

INTRODUCTION

Pseudotumor cerebri (PTC) syndrome is a term used to describe patients with raised intracranial pressure (ICP) without localizing neurological findings, ventriculomegaly, or evidence of intracranial tumor. The diagnosis is currently applied to patients with either (1) idiopathic intracranial hypertension in the absence of an identifiable cause of intracranial hypertension or (2) cerebral venous outflow system obstruction or impairment[1-3]. Idiopathic intracranial hypertension (IIH) is diagnosed on the basis of criteria originally described by Dandy[4], with modifications proposed by Friedman and Jacobson[5], including the following: 1) symptoms and signs attributable to increased ICP or papilledema; 2) elevated ICP recorded during lumbar puncture in the lateral decubitus position; 3) normal cerebrospinal fluid (CSF) composition; 4) no imaging evidence of ventriculomegaly or a structural cause for increased ICP, such as a brain parenchymal, ventricular, meningeal, or venous sinus abnormality; and 5) no other cause of intracranial hypertension identified, such as the use of certain medications. Increased ICP without brain tumor or ventriculomegaly and attributable to cerebral venous sinus thrombosis (CVT), sinus stenosis, or venous hypertension from other causes is referred to as secondary PTC[6,7].

Submitted for publication: November 14, 2014
Accepted for publication: March 17, 2015

[1] Department of Ophthalmology, Faculdade de Medicina, Universidade de São Paulo (USP), São Paulo, SP, Brazil.

Funding: This study was supported by grants from: Fundação de Amparo a Pesquisa do Estado de São Paulo, FAPESP (2009/18527-0), São Paulo, Brazil; Coordenação de Aperfeiçoamento do Pessoal de Nível Superior, CAPES, Brasilia, Brazil; and Conselho Nacional de Desenvolvimento Científico e Tecnológico, CNPq (306487/2011-0 and 307393/2014-3), Brasília, Brazil. The funding organizations had no role in the design or conduct of this research.

Disclosure of potential conflicts of interest: None of the authors have any potential conflict of interest to disclose.

Corresponding author: Mário L. R. Monteiro. Av. Angélica, 1.757 - Conj. 61 - São Paulo - SP - 01227-200 - Brazil - E-mail: mlrmonteiro@ terra.com.br

The main morbidity of PTC, visual loss (VL) from acute or chronic papilledema, has been described and studied in detail by several authors[8-11]. The incidence of visual impairment varies across studies; however, the VL field may occur in up to 92% of eyes of patients with PTC.[11] Although VL may initially be reversible, it tends to be permanent once retinal nerve fiber layer (RNFL) loss and retinal ganglion cell (RGC) atrophy develop[8-10,12]. VL may also be caused by retinal complications such as retinal hemorrhage, choroidal folds, or the development of a peripapillary neovascular membrane[13-15].

The occurrence and severity of PTC-related VL are quite variable and very often do not correlate well with other findings of the disease. Few studies have evaluated predictive factors for the occurrence and severity of VL in PTC[8,9,16,17], making early diagnosis and timely treatment difficult, despite the importance of minimizing permanent disability. Although VL is frequently permanent in advanced cases of PTC, visual improvement may occur in the early stages, although at an incidence that is not well defined in the literature at present. Therefore, this study aimed to determine the incidence of VL and visual improvement and investigate possible predictive factors associated with its occurrence in a series of patients with PTC who underwent detailed clinical and neuro-ophthalmic evaluation at the time of diagnosis and after treatment.

METHODS

This study included data from 50 patients (43 females, seven males) diagnosed with and treated for PTC, with papilledema that resolved at least 6 months prior to the final evaluation. This included patients with IIH and intracranial hypertension secondary to elevated intracranial venous pressure[2]. IIH was defined on the basis of previously published criteria, with high CSF opening pressure (ICP >25 cmH_2O) measured by lumbar puncture at the time of diagnosis; normal magnetic resonance imaging (MRI) and magnetic resonance venography (MRV); normal CSF composition; and normal neurological examination, except for papilledema and possible sixth cranial nerve palsy[3,5]. In patients with cranial sinus thrombosis, the diagnosis was based on neuroimaging studies, including MRV and/or cerebral angiography.

Inclusion criteria for this study consisted of a complete ophthalmological examination, including VF testing using standard automated perimetry (SAP) with the 24-2 SITA-Standard strategy (Humphrey Field Analyzer, Carl-Zeiss Meditec, Dublin, CA) or Goldman perimetry at the time of diagnosis. Patients were also required to have undergone a complete neurological examination, spinal tap with manometry, and CSF analysis as well as normal MRI and/or computed tomography (CT) scan study at the time of diagnosis in addition to evaluation by MRV and/or arteriography to confirm or rule out the presence of CVT. In addition, all the study subjects were older than 15 years, had no ocular abnormalities other than acute or chronic papiledema, and had ametropia of less than 5 spherical diopters and 3 cylindrical diopters. Patients were also required to have a post-treatment ophthalmic examination, including VF assessment, after the treatment for PTC and at least 6 months after the resolution of papilledema. After treatment, patients were required to have clinically resolved papilledema (grade 0 according to the Frisen Scale[18]). The study was approved by the Institutional Ethics Committee.

The study parameters included age, sex, weight, body mass index (BMI), history of systemic hypertension, presenting symptoms, presence of visual complaints such as blurred vision and transient visual obscurations (TVO), time from symptom onset to diagnosis of PTC (TD), best-corrected visual acuity (VA) using a Snellen chart, presence and severity of papilledema or optic atrophy, and types of treatment. The maximum intracranial pressure (MIP), defined as the highest measurement of ICP on a lumbar puncture obtained at the time of diagnosis or during follow-up, was recorded.

In total, 100 eyes were evaluated and submitted to VA and VF analysis. The VA decimal measurements were categorized in three groups: A: worse than 0.1, B: between 0.1 and 0.9, and C: 1.0 (normal acuity). Visual field was measured with either manual or standard automated perimetry (SAP). Manual perimetry was performed using Goldmann equipment (Haag-Streit AG, Bern, Switzerland) with the use of the V/4e, I/4e, I/3e, and I/2e targets. SAP was performed with Humphrey Field Analyzer (Carl-Zeiss Meditec, Dublin, CA) using the Swedish Interactive Threshold Algorithm (SITA-standard 24-2 program) and a Goldmann size III stimulus on a 31.5-apostilb background. A grading system was used to classify VF defects documented with Humphrey or Goldmann perimetry and was slightly modified from a previously published article (11); the classification was either normal (grade 0) or graded from 1 to 4 in terms of VL severity. VF abnormalities on manual perimetry were either normal (grade 0) or classified into four grades as follows: grade 1: nerve fiber layer-type defect encompassing the blind spot and the central VF with normal I/2e isopter; grade 2: VF defect including abnormality in the I/2e isopter, with a VF defect greater than 20°; grade 3: absence of isopter I/2e in the central area, with a total field greater than 20°; and grade 4: VF of <20°. When using SAP, VF defects were classified as follows: grade 0: normal field; grade 1: mean deviation worse than -4.0 decibels (dB) with a nerve fiber layer VF defect; grade 2: mean deviation between -4.0 and -12.0 dB; grade 3: mean deviation between -12.0 and -20.0 dB; and grade 4: mean deviation worse than -20.0 dB. When both types of VF defects were present, the classification was based on SAP.

Patients were also classified taking into consideration the visual function of both eyes, with a bilateral visual score as follows: *Mild VL:* normal VA, VF better than grade 3 in each eye, and sum of scores ≤3; *Moderate VL*: VA better than 0.1 in each eye, VF defect better than grade 4 in each eye, and sum of scores of both eyes ≤4; and *Severe VL:* VA <0.1 in at least one eye, VF grade 4 in at least one eye or sum of scores ≤5.

At the final post-treatment examination, improvement in visual function was defined as a ≥0.1 decimal increase in VA or any downgrade on the bilateral VL scale (e.g., from moderate to mild VL). Worsening of visual function was defined as a ≥0.1 decimal decrease in VA or any upgrade on the bilateral VL scale. Visual function was considered unchanged when the VA and visual score remained the same.

Findings were expressed as mean and standard deviation (SD) for continuous variables and as proportions for categorical variables. To identify possible predictive factors for VL, categorical variables were analyzed using the chi-square test, whereas continuous variables were evaluated using Student's *t* test. McNemar's test was used to compare the percentage of eyes with VA reduction and the score of VF loss before and after treatment. Using the variables with $p<0.10$ in the univariate model, a multivariate stepwise logistic regression model was adjusted for investigating factors associated with VL. The level of statistical significance was set at 5% ($p=0.05$).

RESULTS

Table 1 shows the clinical data of all patients. The mean ± SD age, BMI, and MIP were 35.2 ± 12.7 years, 32.0 ± 7.5 kg/cm^2, and 41.9 ± 14.5 cmH_2O, respectively. Headache was present in 80% of patients and visual symptoms in 92%, including TVO, diplopia, and blurred vision. Time from symptom onset to diagnosis of PTC (TD) was <1 month in 21, 1-6 months in 14, and >6 months in 14 patients. Seven and nine patients had a history of oral contraceptive use and hypertension, respectively. CVT was present in eight patients (16%).

On the initial examination, VA was normal in 18 patients, 0.1-0.9 in at least one eye in 20 patients, and worse than 0.1 in at least one eye in 12 patients. Diplopia from sixth nerve paresis was present in 12 patients. The grading of VF loss for each of the 100 eyes in the sample is shown in table 1. Combining VA and VF data, VL was considered mild in 16, moderate in 12, and severe in 22 patients. Most patients (68%) had moderate or severe VL at presentation. Visual function improved in 28 patients, worsened in five, and remained unchanged in 17.

After treatment, VL was classified as mild in 24, moderate in 10, and severe in 16 patients (Table 1). The mean follow-up time was 4 years (1345 days). Forty-four patients received treatment with carbon anhydrase inhibitors, eight received anticoagulant treatment, six underwent shunting procedures, and 14 received optic nerve sheath fenestration.

The ability of each parameter to predict severe VL was statistically evaluated. In table 2, patients with severe VL are compared with patients with mild or moderate VL. Using the severity of VL as a dependent variable, univariate regression analysis was performed investigating possible predictive factors. An association (p<0.1) was found for maximum ICP, TD >6 months, and high blood pressure. As shown by our multivariate logistic regression analysis, the most important predictive factor for severe VL was TD >6 months [p=0.04; odds ratio (OR)=5.18]. We also tested for possible associations between each parameter and visual improvement after treatment. According to univariate logistic regression, the only predictive factor for visual improvement was TD 1-6 months (p=0.042).

Table 1. Demographic data and clinical findings of 50 patients (100 eyes) with pseudotumor cerebri syndrome

Characteristic	Number (%) or mean ± SD
Sex	
Male	7 (14%)
Female	43 (86%)
Age at first diagnosis mean ± SD, years	35.2 ± 12.7
Body mass index mean ± SD, kg/m^2	32.0 ± 7.5
Maximum intracranial pressure mean ± SD, cmH_2O	41.9 ± 14.5
Main clinical manifestation at onset	
Headache	40 (80%)
Transient visual obscurations	24 (48%)
Time from first symptom and diagnosis, months	
<1	21 (42%)
1-6	15 (30%)
>6	14 (28%)
Medical history	
Use of birth control pills	7 (80%)
Hypertension	9 (48%)
Visual acuity at time of diagnosis	
Worse than 0.1 in at least one eye	12 (24%)
Between 0.1 and 0.9 in at least one eye	20 (40%)
Normal in both eyes (1.0)	18 (36%)
Visual field at presentation (100 eyes)	
Grade 0	12 (12%)
Grade 1	31 (31%)
Grade 2	20 (20%)
Grade 3	15 (15%)
Grade 4	22 (22%)
Classification of visual loss at presentation (patients)	
Mild	16 (32%)
Moderate	12 (24%)
Severe	22 (44%)
Classification of visual loss after treatment (patients)	
Mild	24 (48%)
Moderate	10 (20%)
Severe	16 (32%)
Outcome of visual function after treatment	
Improvement	28 (56%)
Stable	17 (34%)
Worsening	5 (10%)

*= see methods for grading of visual function loss; SD= standard deviation.

DISCUSSION

The epidemiologic findings of our study confirm that PTC is a disorder with a distinct preponderance in women, with approximately 6 women for every man afflicted. Patients were predominantly overweight women (average BMI of 32 kg/cm^2, Class I obesity) of childbearing age (average, 35 years). This profile has been extensively described in the literature, particularly for patients with IIH[9,11,16,19]. Headache, present in 80% of our patients, was the most prevalent symptom, matching figures reported in other studies (72%-94%)[8,9,11,20,21]. The incidence of TVO in our series (48%) was within the range provided in the literature (44-72%)[8,9,11,20-22]. Most of our patients (58%) had symptoms for >1 month before the diagnosis was established. In 28%, symptoms were present for >6 months. The fact that PTC is often diagnosed late may explain why only 36% of our patients had normal VA in both eyes at presentation; 88% of the eyes in the sample had VF defects and 68% of these presented with moderate or severe VL. Our finding of VL in 88% of the eyes on the initial examination is comparable with the indices reported by Wall and George (91% of patients; 87% of eyes) in a prospective study of 50 patients[11] and slightly higher than the indices (49-72%) reported in several other studies employing appropriate perimetry techniques[8,9,12,20-23].

In addition to analyzing the distribution of symptoms and signs and the occurrence of VF in a series of PTC patients, we evaluated risk factors possibly associated with VL. Because blindness is the most significant complication of PTC, despite great variations in incidence and severity, it is very important to identify factors that directly influence disease outcome. Nevertheless, few authors have attempted such factor identification[8,9,11,16].

In our study, as shown by univarate analysis, TD >6 months, MIP, and hypertension were significantly associated with severe VL. Despite the low prevalence of hypertension in our study (18%), this condition proved to be a statistically significant predictor for VL severity (p=0.014). Similarly, in a study by Corbett et al.[24], hypertension was the only statistically significant risk factor for VL; in their series, the prevalence of hypertension was 22%, and 61% of hypertensive patients had severe unilateral or bilateral VL. Therefore, our findings are in agreement with those of Corbett et al.[24], who consider hypertension to be the single most important risk factor for VL in a patient with PTC. We agree with their suggestion that hypertensive vascular narrowing compounds the mechanical and vascular compromise that occurs at the optic disc in eyes with papilledema[24]. We also found a positive correlation between MIP and VL. It is important to consider that because ICP widely varies in PTC patients, it is impossible to accurately define MIP in a study such as ours. However, by defining MIP, we at least had an estimate of ICP grade elevation in our patients. Although no other study has specifically addressed this issue, Corbett et al.[9] suggested that the absolute magnitude and constancy of CSF pressure elevation may play a mechanical role in VL.

The time from symptom onset to PTC diagnosis was <1 month in 42%, 1-6 months in 28%, and >6 months in 28% of our patients. Using multivariate logistic regression, the most important factor for the occurrence of severe VL in our study was TD >6 months, with a p value of 0.04 and OR of 5.18. Although no previous study has specifically correlated TD with VL, the association was expected and draws attention to the importance of an early diagnosis to reduce the incidence of severe VL. In our study, when univariate analysis was used to verify other possible risk factors for VL, neither headache nor TVO or BMI was associated with severe VL. Although headache was present in 80% of cases in our study, it was not found to be a predic-

Table 2. Severe versus mild/moderate visual loss after treatment in 50 patients with pseudotumor cerebri syndrome

Clinical data	Severe visual loss, *n*=16	Mild or moderate visual loss, *n*=34	*p* value
Female sex (*n*=43)	14	29	0.834*
Age (mean ± SD)	39.4 ± 15.8	33.3 ± 10.7	0.176†
Body mass index (mean ± SD)	32.9 ± 7.3	30.1 ± 7.6	0.231†
Headache (*n*=40)	12	28	0.544*
Visual symptoms (*n*=46)	16	30	0.153*
TVO (*n*=29)	7	22	0.161*
Symptoms for 6 months or more (*n*=14)	8	6	0.021*
Cerebral venous thrombosis (*n*=8)	2	6	0.676*
Hypertension (*n*=9)	6	3	0.014*
Maximum intracranial pressure (mean ± SD)	47.9 ± 16.6	39.1 ± 12.7	0.048†

*= Chi-square test; †= Student's *t* test; Significant values are in italic; TVO= transient visual obscuration.

tive factor for severe VL (*p*=0.544), a finding supported by previous studies[8,9]. This is possibly because patients with headache are likely to be diagnosed earlier, before severe VL is established. Our findings for TVO were also in agreement with the literature: despite elevated frequency (48%), no significant association between TVO and severe VL was observed[8,9].

Other risk factors for VL have been proposed. Wall and George identified two factors significantly correlated with deterioration: small optic cup size and weight gain over the year preceding diagnosis. Most patients had high-grade papilledema, and the authors considered the possibility that a crowded disc with small scleral canals increases the vulnerability of the axons. Szewka et al.[16] found a trend toward more severe VL in one or both eyes at last follow-up among patients with BMI > 40. Logistic regression modeling revealed that 10-unit (kg/m^2) increases in BMI increased the odds of severe VL by 1.4 times (*p*=0.03) after controlling for sex, race, diagnosed hypertension, and diagnosed sleep apnea.

Permanent VF in PTC patients has been extensively discussed in the literature; however, the possibility of visual improvement has not received the same attention. Corbertt et al. found that 58% eyes of 57 patients had permanent VA or VF loss at follow-up; however, they did not specify how many eyes had improved with treatment. Orcutt et al.[8] found that throughout their study, 49% of eyes of 68 patients had VL, including 18% that did not deteriorate and 31% that worsened during follow-up. According to the authors, 51% had normal acuity and VF throughout the study; however, the question of improvement was not addressed. Wall and George[11] followed 50 patients with IIH prospectively and found that VF loss was initially present in 87% of eyes but only in 51% at the final visit. Visual improvement occurred in 60% of patients, while 10% worsened. Visual improvement occurred in 60% of patients, whereas 10% worsened. Craig et al.[21] observed improvement of VF in 39% of 42 patients in a retrospective study. Yri et al.[20] prospectively evaluated 20 patients with IIH followed for a mean period of 21 months. In total, 50% of the eyes with accurate VF findings had some degree of VL at presentation; however, only 21.2% did not have normal VF after treatment. Hung et al.[25] followed 10 patients with IIH and found visual function improvement in all but two eyes during follow-up. At the last visit, 40% of eyes had normal VF; however, it was mild or minimal in 40% and severe in two patients[25].

In the present study, visual improvement occurred in 56% of 50 patients with PTC, 34% remained unchanged, and 10% worsened. Our findings match the figures published by Wall and George[11] for a cohort of 50 patients. We also tested whether any study parameters were associated with visual improvement after treatment. Logistic regression revealed that the only factor associated with visual improvement was time from symptom onset to diagnosis between 1 and 6 months (*p*=0.042). However, it is important to consider that although visual improvement occurred in more than half of our patients, VL was still moderate or severe in 52% on the final examination. The fact that visual improvement is more likely to occur when diagnosis is made within 6 months of symptom onset and the high number of patients with significant VL despite adequate treatment emphasize the importance of early diagnosis and appropriate treatment of this condition.

In conclusion, our study confirms that VL is a frequent and potentially serious complication of PTC. Although hypertension and MIP have been shown to be significantly associated with VL severity, the most important predictive factor was the time from symptom onset to diagnosis. Thus, efforts should be made to diagnose patients with PTC early to prevent permanent VL.

REFERENCES

1. Binder DK, Horton JC, Lawton MT, McDermott MW. Idiopathic intracranial hypertension. Neurosurgery. 2004;54(3):538-51; discussion 51-2.
2. Fraser C, Plant GT. The syndrome of pseudotumour cerebri and idiopathic intracranial hypertension. Curr Opin Neurol. 2011;24(1):12-7.
3. Friedman DI, Liu GT, Digre KB. Revised diagnostic criteria for the pseudotumor cerebri syndrome in adults and children. Neurology. 2013;81(13):1159-65.
4. Dandy WE. Intracranial pressure without brain tumor: diagnosis and treatment. Ann Surg. 1937;106(4):492-513.
5. Friedman DI, Jacobson DM. Diagnostic criteria for idiopathic intracranial hypertension. Neurology. 2002;59(10):1492-5.
6. Johnston I, Hawke S, Halmagyi M, Teo C. The pseudotumor syndrome. Disorders of cerebrospinal fluid circulation causing intracranial hypertension without ventriculomegaly. Arch Neurol. 1991;48(7):740-7.
7. Johnston I, Kollar C, Dunkley S, Assaad N, Parker G. Cranial venous outflow obstruction in the pseudotumour syndrome: incidence, nature and relevance. J Clin Neurosci. 2002; 9(3):273-8.
8. Orcutt JC, Page NG, Sanders MD. Factors affecting visual loss in benign intracranial hypertension. Ophthalmology. 1984;91(11):1303-12.
9. Corbett JJ, Savino PJ, Thompson HS, Kansu T, Schatz NJ, Orr LS, et al. Visual loss in pseudotumor cerebri. Follow-up of 57 patients from five to 41 years and a profile of 14 patients with permanent severe visual loss. Arch Neurol. 1982;39(8):461-74.
10. Wall M, George D. Visual loss in pseudotumor cerebri. Incidence and defects related to visual field strategy. Arch Neurol. 1987;44(2):170-5.
11. Wall M, George D. Idiopathic intracranial hypertension. A prospective study of 50 patients. Brain. 1991;114(Pt 1A):155-80.
12. Monteiro ML. Visual loss in pseudotumor cerebri. Arq Bras Oftalmol. 1994;57:122-5.
13. Coppeto JR, Monteiro ML. Juxtapapillary subretinal hemorrhages in pseudotumor cerebri. J Clin Neuroophthalmol. 1985;5(1):45-53.
14. Griebel SR, Kosmorsky GS. Choroidal folds associated with increased intracranial pressure. Am J Ophthalmol. 2000;129(4):513-6.
15. Monteiro ML, Jales MD, Pimentel SL. Juxtapapillary subretinal neovascular membrane in a patient with papilledema and idiopathic intracranial hyperthension. Rev Bras Oftalmol. 2009;68(1):42-7.
16. Szewka AJ, Bruce BB, Newman NJ, Biousse V. Idiopathic intracranial hypertension: relation between obesity and visual outcomes. J Neuroophthalmol. 2013;33(1):4-8.
17. Sureda-Ramis B, Alberca-Serrano R. [Prognostic factors in benign intracranial hypertension]. Arch Neurobiol (Madr). 1990;53(4):151-6.

18. Frisen L. Swelling of the optic nerve head: a staging scheme. J Neurol Neurosurg Psychiatry. 1982;45(1):13-8.
19. Daniels AB, Liu GT, Volpe NJ, Galetta SL, Moster ML, Newman NJ, et al. Profiles of obesity, weight gain, and quality of life in idiopathic intracranial hypertension (pseudotumor cerebri). Am J Ophthalmol. 2007;143(4):635-41.
20. Yri HM, Wegener M, Sander B, Jensen R. Idiopathic intracranial hypertension is not benign: a long-term outcome study. J Neurol. 2012;259(5):886-94.
21. Craig JJ, Mulholland DA, Gibson JM. Idiopathic intracranial hypertension; incidence, presenting features and outcome in Northern Ireland (1991-1995). Ulster Med J. 2001; 70(1):31-5.
22. Celebisoy N, Secil Y, Akyurekli O. Pseudotumor cerebri: etiological factors, presenting features and prognosis in the western part of Turkey. Acta Neurol Scand. 2002; 106(6):367-70.
23. Smith TJ, Baker RS. Perimetric findings in pseudotumor cerebri using automated techniques. Ophthalmology. 1986;93(7):887-94.
24. Corbett JJ, Savino PJ, Thompson HS, Kansu T, Schatz NJ, Orr LS, et al. Visual loss in pseudotumor cerebri. Follow-up of 57 patients from five to 41 years and a profile of 14 patients with permanent severe visual loss. Arch Neurol. 1982;39(8):461-74.
25. Hung HL, Kao LY, Huang CC. Ophthalmic features of idiopathic intracranial hypertension. Eye (Lond). 2003;17(6):793-5.