

COMPUTED TOMOGRAPHY SCAN OF THE HEAD IN PATIENTS WITH MIGRAINE OR TENSION-TYPE HEADACHE

Marcelo Moraes Valença¹, Luciana Patrícia A. Andrade Valença², Terce Liana Menezes³

ABSTRACT - A retrospective study was performed in order to evaluate the frequency of abnormalities found by computed tomography (CT) scan of the head in 78 patients with migraine or tension-type headache. In the present study CT scan was normal in 61.5% of the patients with migraine or tension-type headache. A number of abnormalities were encountered in more than one third of the patients studied, including inflammatory sinus disease (19.2%), cysticercosis (3.9%), unruptured cerebral aneurysm (2.6%), basilar impression (2.6%), intracranial lipoma (2.6%), arachnoid cyst (2.6%), empty sella (2.6%), intracranial neoplasm (2.6%), and others (2.6%). None of these lesions were symptomatic or responsible by the headache picture, therefore, considered incidental findings. In conclusion, the fortuitous encounter of some abnormalities on CT scan of the head is often higher than what we could predict in patients suffering migraine or tension-type headache. We briefly discuss clinical, epidemiologic, and practical management of some of the abnormalities detected by CT scan as well as the indication to request a neuroimaging investigation.

KEY WORDS: headache, migraine, tension-type, CT scan, basilar impression, cysticercosis.

Tomografia computadorizada do crânio em pacientes com migrânea ou cefaléia tensional

RESUMO - Um estudo retrospectivo foi realizado visando avaliar a frequência de anormalidades encontradas durante a realização de estudo por tomografia computadorizada (TC) em 78 pacientes com migrânea ou cefaléia do tipo tensional. A TC foi normal em 61,5% dos pacientes examinados. Em um terço dos pacientes estudados foram detectadas anormalidades, como doença inflamatória dos seios paranasais (19,2%), cisticercose (3,9%), aneurisma cerebral não-roto (2,6%), impressão basilar (2,6%), lipoma intracraniano (2,6%), cisto aracnoideo (2,6%), sela vazia (2,6%), neoplasia intracraniana (2,6%) e outras afecções (2,6%). Nenhuma destas lesões era sintomática (achado incidental). Concluindo, o encontro fortuito de algumas anormalidades na TC é frequentemente mais elevado do que se prediz em pacientes com cefaléia primária. Nós discutimos brevemente alguns aspectos clínicos, epidemiológicos e da conduta terapêutica-cirúrgica sobre algumas das anomalias diagnosticadas pela TC. Também levantamos, ou questionamos, aspectos éticos que determinam o limite entre o direito do paciente e o direito do médico em afirmar que um indivíduo com dor de cabeça não é portador de lesão intracraniana, baseado na história clínica e no exame físico do paciente.

PALAVRAS-CHAVE: cefaléia, migrânea, cefaléia tipo tensional, tomografia computadorizada, impressão basilar, cisticercose.

The unexpected or fortuitous encounter of some abnormalities on computed tomography (CT) scan or magnetic resonance imaging (MRI) of the head is often higher than what we could predict in patients suffering from migraine or tension-type headache. Fortunately, the majority of these lesions are benign anomalies. The incidence of such abnormalities de-

pends on the age, gender, and race of the patient as well as the environmental or geographic influences, which may predominate in a given population.

Since pain is a subjective complaint, the indications for neuroimaging examination for patients with headache are still disputed with. In 1982, the recommendations for CT scan, to investigate patients with

¹Professor Adjunto Doutor, Disciplina de Neurologia e Neurocirurgia, Departamento de Neuropsiquiatria, Centro de Ciências da Saúde (CCS), Universidade Federal de Pernambuco (UFPE), Recife PE, Brasil; atualmente Pesquisador Associado do Departamento de Neurologia, Psiquiatria e Psicologia Médica, Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto SP, Brasil (FMRP-USP) e Bolsista do CNPq (Pesquisador Visitante); ²Mestranda em Neurologia, FMRP-USP; ³Médica Neurologista, Hospital das Clínicas, UFPE e Doutoranda em Ciências Biológicas (Área Neurociências), UFPE.

Received 15 October 2001, received in final form 1 February 2002. Accepted 11 February 2002.

Dr. Marcelo M. Valença - Departamento de Neurologia, Psiquiatria e Psicologia Médica, FMRP-USP - 14049-900 Ribeirão Preto SP - Brasil.
E-mail: neuro@hotlink.com.br

headache, by the National Institutes of Health Consensus Conferences¹, were: 1) severe headache, 2) unusual headache, and 3) headache associated with abnormal neurological signs. In 1994, the Quality Standards Subcommittee of the American Academy of Neurology², by analyzing a total of 17 studies (class III; evidence provided by expert opinion, nonrandomized historical controls), recommended neuroimaging investigation (CT or MRI) "in patients with atypical headache patterns, a history of seizures, or focal neurologic signs or symptoms." There are at least two reasons that make the patient consult a physician for headache: a) because she or he is afraid of having an intracranial lesion such as brain tumor or aneurysm and b) because the pain is severe enough to negatively influence her or his quality of life. In this regard, at least two thirds of the patients, referred to a neurologist because of headache, are worried about the presence of brain tumor or other intracranial abnormalities³. The majority of these patients, if not all, wish from the physician the request of a CT or MRI of the head, mainly those in a private clinic. Obviously, based on the history and neurological examination, the physician should order a neuroimaging study when there is a suspicion of a symptomatic intracranial lesion. With the International Headache Society (IHS) classification and diagnostic criteria for headache disorders⁴, the separation of primary from symptomatic form of headaches became more precise, and the risk of misdiagnosing was reduced. Even so, without the help of neuroimaging we can never confirm that a patient presenting with migraine or tension-type headache does not have a serious intracranial space-occupying lesion. Nevertheless, it is not uncommon to find out patients with serious intracranial lesions, including tumor or ruptured aneurysm, that previous to the definitive diagnosis, had headache ignored by the fact of earlier existence of recurrent headaches. In view of that, 48% of brain tumor patients experience headaches that resemble either migraine and tension-type headache in 9% and 77% of cases, respectively, as described previously⁵.

This study was performed in order to analyze the frequency of CT abnormalities encountered in a population of 78 patients from the City of Recife, Northwest of Brazil, with clinical history of migraine, tension-like headache, or both.

METHOD

This is a retrospective study involving 78 patients who attended the private outpatient neurological clinic of the author MMV, from 1997 to 2000. The headache type was classified according to the IHS criteria⁴.

The patients were distributed in three subgroups: 34 patients with migraine, 35 patients with tension-type headache, and nine patients with the combination of both migraine and tension-type headache. Many of the patients already had a CT scan of the head at the moment of the first medical consultation. A CT scan was requested to patients with high anxiety regarding brain diseases, even after the explanation that the chance of disclosing a serious intracranial lesion by CT was statistically very small. In that case it was requested CT scan of the cranium without intravenous contrast infusion, because of the risk of allergic reactions. When necessary and in the case of the presence of abnormalities found in CT scan, other exams were requested (*i.e.*, MRI or cerebral angiography) in order to confirm the diagnosis.

Statistical analysis to compare the frequency of the intracranial lesions found by CT scan between all three described subgroups was performed by the chi-square test.

RESULTS

Table 1 illustrates the frequency of intracranial lesions encountered in the CT scan of the head in 78 patients with migraine, tension-type headache, or both. No statistical difference was present between headache subtypes, considering the frequency of the abnormalities found in the CT.

A 50-year-old woman with migraine had a CT scan demonstrating the presence of a right frontal meningioma (1.5 x 1.5 x 1.5 cm). A colloid cyst of the third ventricle, without hydrocephalus, was detected in a 37-year-old woman. Intracranial lipomas were present in two women, one at the level of the *crista galli* and the other at *corpus callosum*. In a 62-year-old woman, with tension-type headache, bilateral basal ganglia calcifications were present. Three patients were identified with parenchymal calcified lesions, characteristic findings of cysticercosis.

DISCUSSION

In the present study it is demonstrated that the CT scan of the head was normal in 61.5% of the patients with migraine or tension-type headache. A number of abnormalities were encountered in more than one third of the patients studied, including inflammatory sinus disease (19.2%), cysticercosis (3.9%), unruptured cerebral aneurysm (2.6%), basilar impression (2.6%), intracranial lipoma (2.6%), arachnoid cyst (2.6%), empty sella (2.6%), intracranial neoplasm (2.6%), and others (2.6%). None of these lesions were symptomatic or responsible by the headache picture: all were incidental findings.

In a literature review⁶ of 17 reported studies, including 1,825 subjects with headache that were investigated by either CT or MRI, potential surgical le-

Table 1. Frequency of intracranial lesions encountered in the CT scan of the head in 78 patients with migraine, tension-type headache, or both.

Abnormality	Headache subtype							
	Migraine		Tension-type		Both		All Group	
	N	%	N	%	N	%	N	%
Normal	22	64.7	20	57.1	6	66.7	48	61.5
Sinusitis	11	32.4	4	11.4	0	0.0	15	19.2
Cysticercosis	1	2.9	2	15.7	0	0.0	3	3.9
Aneurysm	1	2.9	1	2.9	0	0.0	2	2.6
Basilar impression	1	2.9	1	2.9	0	0.0	2	2.6
Lipoma	1	2.9	0	0.0	1	11.1	2	2.6
Arachnoid cyst	0	0.0	0	0.0	2	22.2	2	2.6
Empty sella	2	5.9	0	0.0	0	0.0	2	2.6
Concha bullosa	0	0.0	1	2.9	0	0.0	1	1.3
Meningioma	1	2.9	0	0.0	0	0.0	1	1.3
Colloid cyst (III ^o ventricle)	0	0.0	1	2.9	0	0.0	1	1.3
Basal ganglia calcification	0	0.0	1	2.9	0	0.0	1	1.3
Total	34	100	35	100	9	100	78	100

sions were found in 2.4% of the patients [21 tumors, 6 arteriovenous malformations (MAV), 3 aneurysms, 5 subdural hematomas, and 8 hydrocephalus]. Only 0.4% of a total of 897 migraineurs harbored an intracranial lesion disclosed by either CT or MRI (3 tumors and 1 MAV)⁶. As a result of such very low prevalence of serious intracranial lesions, the Quality Standards Subcommittee stated that "in adult patients with recurrent headaches that have been defined as migraine – including those with visual aura – with no recent change in pattern, no history of seizures, and no other focal neurologic signs or symptoms, the routine use of neuroimaging is not warranted."²

Two neurological entities are important to discuss in term of epidemiological value to the Northeast region of Brazil and, in particular, to the State of Pernambuco: neurocysticercosis and basilar impression. In spite of a small number of patients, this study may be the first one that demonstrates a frequency of 3.9% and 2.6%, respectively, for each one of these disorders in patients with headache, studied by CT scan, in Recife.

Cysticercosis - It was reported recently by Valença and Valença⁷ that ischemic cerebrovascular disease was the principal cause of epileptic seizures (17.3% of the patients) in Recife, and cysticercosis was the

second causal factor, identified in 8.8% of adult patients. However, this neuroparasitosis was the major etiologic cause of epileptic seizures in patients with less than 45 years of age. In the past cysticercosis was considered rare in Northeast of Brazil. Even though, in a period of five years (1990 – 1994) we identified 50 cases of neurocysticercosis in the Hospital das Clínicas, Universidade Federal de Pernambuco, including two necropsy cases with hydrocephalus and intraventricular cysts. Eighty-five percent of these patients complained of headache, following by seizure in 46%, and vomiting in 17%. We noticed the following epidemiological characteristic of our patient population: history of ingestion of undercooked swine meat in 89%, contact with swine in 57%, history of *Taenia* intestinal infection in 7%, and family history of *Taenia* or cysticercosis in 16% of the patients. A CT scan of the head revealed solitary lesion in 44%, multiple lesions in 38%, hydrocephalus in 8%, and in the remainder of the patients the neuroimaging was considered normal (unpublished results).

Cysticercosis is acquired by ingestion of *Taenia solium* eggs, often from fecally contaminated food or hands. Ingestion of infected pork causes adult tapeworm infection in the gastrointestinal tract. The intestinal *T. solium* infection is the major problem in terms of epidemiologic control of the disease. One

individual with this parasitosis may release 1-5 proglottids each day, each of which produces up to 50,000 eggs that, in turn, would survive for several months, in the environment. We should make all effort to identify individuals with the intestinal form of infection, with a particular interest to our patient, since up to 25% of the individuals with neurocysticercosis also have the intestinal form of the taeniasis solium (autoinfection). So, treatment and prevention of human intestinal infection are mandatory.

Furthermore, in another study⁸ completed in Recife, the study of 180 patients with Bell's palsy, two patients were found with previous history of cysticercosis, although CT scan, cerebrospinal fluid (CSF), or both were not requested usually in the evaluation of idiopathic peripheral facial palsy. In this study, probably the parasitosis was underestimated. Neurocysticercosis was also encountered in two patients of 85 young adults (15-45 years of age) with ischemic stroke in a population studied in Recife⁹. Among other risk factor for ischemic cerebrovascular disease^{10,11}, neurocysticercosis is also a cause of cerebral arteritis¹². So, in the State of Pernambuco the cysticercosis-taeniasis seems to be a question of public health worriment.

Basilar impression - As a general consensus it is believed that the incidence of basilar impression is particularly higher in the State of Pernambuco¹³⁻¹⁶, even though so far no epidemiological study was carried out to prove it. Professor Manoel Caetano de Barros (Universidade Federal de Pernambuco; personal communication) believes that it is the result of a genetic contribution following the Dutch invasion in the 17th century, for 34 years, of the Northeast of Brazil. Some of the patients studied by him were white subjects¹⁶.

On the other hand, recently it was discovered an ancient indigene cemetery in Furna do Estrago, City of Brejo da Madre de Deus, State of Pernambuco (219 km distant from Recife), with 83 skeletons of a prehistoric human group, called as the brachycephalics (*cabeças-chatas*), that lived in the region at about 2,000 years ago¹⁷⁻¹⁹. Since brachycephalus is often associated with basilar impression and platybasia (flat skull base), this archaeological encounter suggests a local genetic influence, in addition to a more recent introduction of an European gene. The stature of this prehistoric group was calculated to be 1.60 m in the male and 1.52 in the female¹⁹. In addition, supranumerary vertebra was identified in the lumbo-sacral region in some of the studied skeletons¹⁷.

Empty-sella syndrome - An empty sella turcica is usually an incidental finding, and is defined as the presence of any communicating extension of the subarachnoid space into the pituitary fossa, frequently as a result of incomplete anatomic formation of the diaphragma sellae. The entity can be classified as developmental (primary or idiopathic) and pathological (secondary)²⁰. The latter example as a consequence of secondary herniation of suprasellar arachnoid into the pituitary fossa, after a volume reduction of intrasellar contents due to operation, irradiation, infarction or necrosis. The clinical course in primary empty sella syndrome is often uneventful; consequently, no therapeutic intervention is required. Endocrine or visual field abnormalities may be associated sporadically with this anatomic variation²⁰. Several of the patients with this syndrome are middle-aged, obese, multiparous, and hypertensive women, in which the frequent complaint is headache²¹. The primary empty-sella syndrome may be encountered in association with pseudotumor cerebri, hypertension, congestive heart failure, and the hypoventilation-obesity, suggesting that changes in CSF pressures may play a role in its pathogenesis²⁰.

Unruptured intracranial aneurysm - The discover of an unruptured intracranial aneurysm can be: a) incidental, b) after rupture of another aneurysm, or c) when symptoms (*i.e.*, headache, cranial nerve palsy) are due to compression of neighboring structures²². It is known that 1-8 % of the population harbor a cerebral aneurysm and the annual incidence of ruptured aneurysm is 4-10 patients for each 100,000 individuals²³. In a recent study, Kojima et al.²⁴ reported a 7% (5.6% for men; 8.5% for women) prevalence of aneurysm among 8 680 participants undergoing MR angiography. The prevalence was different between groups of patients with (10.5%) or without (6.8%) family history of aneurysm, respectively. The prevalence was much higher (42.1%) in first- or second-degree relatives when there was familiar history of subarachnoid hemorrhage (SAH)²⁴.

The question is what to do when an incidental aneurysm is found during an investigation of a non-hemorrhagic neurological disease? The overall combined surgical morbidity and mortality rate of 15.8% give the impression to overcome the risk of rupture of 0.05% per year in an asymptomatic patient with aneurysm size smaller than 10 mm²⁵. On the contrary, in younger patients with aneurysm in which the angiographic dimension is >10 mm, the treatment is imperative. Whatever the dimension of an

incidental asymptomatic aneurysm, treatment should be avoided in older individuals, since the risk of surgery is higher than the natural history of the aneurysm²⁶. In this concern, Johnston et al.²² commented on that 40% of treated patients in the prospective cohort of ISUIA²⁵ had aneurysms <10 mm in diameter and no history of SAH. They concluded that "a large number of unruptured aneurysms are treated with high procedural risk and no overall benefit to the patient."

Although CT scan is not an adequate (low sensitivity) exam to detect unruptured cerebral aneurysm, eventually it is possible to identify on image suggesting the presence of an intracranial aneurysm. The ideal exam is still the intra-arterial digital subtraction angiography, in which the permanent neurological complications in subjects with suspected aneurysm is 0.07%²⁷. As a non-invasive imaging method, CT angiography has an overall accuracy of 98%, very similar to MR angiography. Another method for screening and detection of asymptomatic patients at risk of harboring a cerebral aneurysm is the transcranial Doppler ultrasound. Recent evidence indicated that there is no benefit in screening relatives of asymptomatic aneurysm patients without SAH²⁸.

Brain tumors - It is reported that patients with brain tumors "classically" present with headache, that is severe, worse in the morning, and is accompanied by nausea and/or vomiting. The above definition was found in only 17% of 111 patients harboring brain tumor, as described by Forsyth and Posner⁵. In two third of these patients with brain tumor, headache was frontal and bilateral, and in patients with unilateral headache (25%) the neoplasm was always located on the ipsilateral side⁵.

Colloid cyst is a rare cystic tumor (1 % of all intracranial tumors) filled with gelatinous viscous material present in the region of the foramen of Monro, that may be asymptomatic, and not infrequently found as incidental finding, such as was the case of Harvey Cushing autopsy²⁹.

The intracranial meningioma incidence increases with patient age, ranging from 0.3 per 100,000 in childhood to 8.4 per 100,000 in the elderly, accounting for near 30% of incidental tumors found at autopsy³⁰⁻³¹.

Inflammatory disease of the paranasal sinuses and "concha bullosa" - CT is the gold standard for exact delineation of inflammatory sinus disease³². It had

superseded the conventional standard radiography. Despite the fact that MRI plays a limited role in the evaluation of a non-complicated sinusitis, it has supplanted CT in the study of intracranial and orbital complications of sinusitis³³. In a previous study³⁴, 1,345 CTs of neurological and neurosurgical patients with no previous history of paranasal sinusitis were analyzed. In seventy-five of these patients, CT showed evidence of inflammatory changes, involving maxillary (57), ethmoid (46), sphenoid (24), and frontal (17) sinus.

Since unilateral opacification of paranasal sinuses in the CT or MRI may be the result of the presence of a neoplasm or mycotic sinusitis³⁵, mainly in the elderly, both the symptomatic and asymptomatic patients should be referred to a specialist.

"Concha bullosa" is the aeration of the middle turbinate. It is a frequent anatomical variant of intranasal anatomy that was present in 34%, on at least one side, of 320 patients evaluated by CT for sinus disease in a previous study³⁶. Recently, it was described a new type of headache associated with "concha bullosa"³⁷.

CONCLUSION

We would like to conclude this article with the following question: does the patient has the right to know by sure that he or she does not have a serious intracranial lesion, in the case of presenting "minor" or common neurological symptoms such as recurrent headaches? Indeed, some of the patients judge they have the right of having a CT or MRI to investigate the headache symptom, either because they want to pay the cost of the exam or because they are paying a health insurance plan.

Finally, we agree with Fabbrini et al.³⁸ that the general indications for CT or MRI in headache patients are still a matter of dispute. Neuroimaging should always be requested in the case of the presence of alarm signs (red flag signs): 1) abnormalities in neurological examination, 2) atypical headache not completely fulfilling IHS criteria, 3) changes in headache pattern, 4) lack of response to therapy, 5) presence of abnormalities in other investigations, such as EEG and skull x-ray, and 6) headache in patients with extracranial neoplasm.

REFERENCES

1. Consensus Conference. Computed tomographic scanning of the brain. JAMA 1982;247:1955-1958.
2. Quality Standards Subcommittee of the American Academy of Neurology. Practice parameter: report the utility of neuroimaging in the evaluation of headache in patients with normal neurologic examinations. Neurology 1994;44: 1353-1354.
3. Fitzpatrick R, Hopkins A. Referrals to neurologist for headaches not due to structural disease. J Neurol Neurosurg Psychiatry 1981;44:1061-1067.

4. Headache Classification Committee of the International Headache Society. Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. *Cephalalgia* 1988;8(Suppl 7):1-96.
5. Forsyth PA, Posner JB. Headaches in patients with brain tumors: a study of 111 patients. *Neurology* 1993;43:1678-1683.
6. Frishberg BM. The utility of neuroimaging in the evaluation of headache in patients with normal neurologic examinations. *Neurology* 1994;44:1191-1197.
7. Valença MM, Valença LPAA. Etiology of the epileptic seizures in Recife City, Brazil: study of 249 patients. *Arq Neuropsiquiatr* 2000;58:1964-1072.
8. Valença MM, Valença LPAA. Idiopathic facial paralysis (Bell's palsy): a study of 180 patients. *Arq Neuropsiquiatr* 2001;59:733-739.
9. Valença LPAA, Valença MM. Acidente vascular cerebral isquêmico em adultos jovens: experiência com 85 pacientes. *Anais do II Congresso Brasileiro de Doenças Cerebrovasculares*, 1999: 6.
10. Valença MM, Valença LPAA. Doença cerebrovascular isquêmica. In: Filgueira NA, Costa JJJr, Leitão CCS, Lucena VG, Melo HRL, Brito CAA (eds). *Conduitas em clínica médica*, 2. Ed, Rio de Janeiro: MEDSI, 2001:516-532.
11. Valença MM. Dislipidemia e outros fatores de risco no acidente vascular cerebral isquêmico. *An Fac Med Univ Fed Pernambuco* 1994;39:96-104.
12. Barinagarrementeria F, Cantú C. Frequency of cerebral arteritis in subarachnoid cysticercosis: an angiographic study. *Stroke* 1998;29:123-125.
13. Barros MC. Nossa experiência cirúrgica na malformação de Arnold-Chiari. *Neurobiologia (Recife)* 1957;20:183-187.
14. Barros MC. Contribuição ao estudo da impressão basilar associada a malformação de Arnold-Chiari. Tese. Recife, 1959.
15. Barros MC, Pernambuco J, Hazin M, Maia JA, Ataíde L. Observações sobre casos de platibasia e impressão basilar em brasileiros nordestinos. *Neurobiologia (Recife)* 1957;20:165-169.
16. Barros MC, Farias W, Ataíde L, Lins S. Basilar impression and Arnold-Chiari malformation. *J Neurol Neurosurg Psychiatry* 1968;31:596-605.
17. Múmias de dois mil anos foram achadas no agreste. *Jornal do Commercio*, 20 de junho de 1999.
18. Museu revela vida do homem pré-histórico. *Jornal do Commercio*, Recife, 14 de setembro de 2000.
19. Pires I. A dieta dos ancestrais nordestinos: cemitério indígena revela traços milenares da cultura alimentar do Nordeste. *Ciência Hoje*. 1996; 20:60-61 (Available from: URL: <http://www.agbcuritiba.hpg.com.br/textos/isabela.htm>)
20. Hodgson SF, Randall RV, Laws ER. Empty sella syndrome. In: Youmans JR (ed.), *Neurological surgery*, 4. Ed, Philadelphia Saunders 1996:3170-3178.
21. Neelon FA, Goree JA, Lebovitz HE. The primary empty sella: clinical and radiographic characteristics and endocrine function. *Medicine (Baltimore)* 1973;52:73-92.
22. Johnston SC, Gress DR, Kahn JG. Which unruptured cerebral aneurysms should be treated? A cost-utility analysis. *Neurology* 1999;52:1806-1815.
23. Valença MM, Valença LPAA. Hemorragia subaracnóidea: causas, manifestações clínicas e tratamento. *Neurobiologia (Recife)* 2000;63:97-104.
24. Kojima M, Nagasawa S, Lee Y-E, Takeichi Y, Tsuda E, Mabuchi N. Asymptomatic familial cerebral aneurysms. *Neurosurgery* 1998;43:776-781.
25. International Study of Unruptured Intracranial Aneurysms (ISUIA). Unruptured intracranial aneurysms-risk of rupture and risks of surgical intervention. *N Engl J Med* 1998;339:1725-1733.
26. White PM, Teadsale E, Wardlaw JM, Easton V. What is the most sensitive non-invasive imaging strategy for the diagnosis of intracranial aneurysms? *J Neurol Neurosurg Psychiatry* 2001;71:322-328.
27. Cloft HJ, Joseph GJ, Dion JE. Meta-analysis of risks of cerebral angiography in patients with subarachnoid hemorrhage, intracranial aneurysm and arteriovenous malformation. *Stroke* 1999;30:317-320.
28. Kirkpatrick PJ, McConnell RS. Screening for familial intracranial aneurysms. *BMJ* 1999;319:1512-1513.
29. Carmel PW. Brain tumors of disordered embryogenesis. In: Youmans JR, (ed.), *Neurological surgery*. 4. Ed. Philadelphia Saunders, 1996:2761-2781.
30. McDermott MW, Wolson CB. Meningiomas. In: Youmans JR (ed). *Neurological surgery*. 4. Ed. Philadelphia: Saunders, 1996:2782-2825.
31. Codd MB, Kurland LT, O'Fallon M, et al. Case-control study of neuroepithelial tumors in Rochester, Minnesota, 1950-1977. *Neuroepidemiology* 1990;9:17-26.
32. Duvoisin B, Landry M, Chapuis L, Kraysenbuhl M, Schnyder P. Low-dose CT and inflammatory disease of the paranasal sinuses. *Neuroradiology* 1991;33:403-406.
33. Ide C, Trigaux JP, Eloy P. Chronic sinusitis: the role of imaging. *Acta Otorhinolaryngol Belg* 1997;51:247-258.
34. Iemma M, Maurer J, Mann W. The incidence and location of inflammatory paranasal sinus lesions in CT. *Acta Otorhinolaryngol Ital* 1992;12:135-142.
35. Lehnerdt G, Weber J, Dost P. Unilateral opacification of the paranasal sinuses in CT or MRI: an indication of an uncommon histological finding. *Laryngorhinootologie* 2001;80:141-145.
36. Zinreich SJ, Mattox DE, Kennedy DW, Chisholm HL, Diffley DM, Rosenbaum AE. Concha bullosa: CT evaluation. *J Comput Assist Tomogr* 1988;12:778-784.
37. Anselmo-Lima WT, Oliveira JA, Speciali JG, et al. Middle turbinate headache syndrome. *Headache* 1997;37:102-106.
38. Fabbri G, Barbanti P, Pascali MP, Lenzi GL, Cerbo R. Impact of the International Headache Society Criteria on the use of neuroimaging for headache diagnosis in a headache clinic. *Headache* 1999;39:747-751.