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Intracranial tuberculomas: The Hofuf, Saudi Arabia experience

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Summary
Tuberculosis usually involves the brain through haematogenous spread. The mass lesion caused by tuberculosis in the brain is called tuberculoma, which is a conglomerate of tubercles. Tuberculomas may also be found in the spinal cord. Because of their slow growth they often become calcified. The study was conducted at the King Fahad Hospital, Hofuf, Al Hassia, Saudi Arabia between 1992 and 1998. It was a prospective study of all patients which had intracrainal mass lesions which showed typical ring-enhancement on brain CT scan with contrast. Twenty patients satisfied inclusion into the study. Of the 20 patients studied, 19 (95%) were males and 1 (5%) was a female. The ages ranged between 22 and 50 years. Eighteen (90%) of the patients were immigrant labourers from Asia and 2 (10%) were Saudi nationals, a male aged 50 years and a female aged 22 years. Fifteen (83.5%) were from India, 2 (11.1%) from Bangladesh, and 1 (5.6%) from Sri Lanka. The presenting feature in 60% of cases was focal seizure with secondary generalisation, 20% had primary generalized seizures, and 30% presented with headache, 25% with weakness of the limbs, 15% with fever and 10% each with vomitting and blurred vision, respectively. In 65% of cases, there was noneurological deficit but 35% had pyramidal weakness in the limbs. In 55% of cases the Tuberculomas were located in the left cerebral hemisphere, 30% in the right cerebral hemisphere and in 15%, the lesions were in both hemisphere. When a male Asian immigrant labourer aged between 20 and 40 years presents with seizures with or without headache, he should have a brain CT scan with contrast to exclude intracranial Tuberculoma. A short course of anti-tuberculous therapy may be tried where there is doubt, irrespective of normal erythrocyte sedimentation rate (ESR) We suggest that when the presenting symptom is primary generalized tonic clonic seizure, the intracranial Tuberculoma is located in the frontal lobe; a high erythrocyte sedimentation rate (ESR) may indicate multiple Tuberculomas.

Keywords: *Tubaculomas, generalized seizure, hemisphere, Saudi arabia*

Résumé
La tuberculose attaque la memoire par la distriubution de l'hématogéneuse. La lésion massive par la tuberculose dans le mémoire est appelé tuberculome qui est une conglomération des tubercules. Elle peut aussi être trouvée dans la moélle épiniére a cause de la croissance faible et souvent calcifiée. Cette étude était conduite a l'hopital King Fahad, Al Hassa, Arabie Saoudité entre 1992 et 1998.C'était une étude prospective sur les patients qui avaient des lésions massive intracraniére qui montraient des traces non-typique sur scanaire de la mémoire, vingt patients satisfisaient les critéres d'inclusion dans cette étude. 95(%(19) étaient des males et 5%(1) femele, d'age variant entre 22-50 ans. 90% des patients étaient de immigrants travailleurs d Asie et 10%(2) saoudiens.83.5% étaient des indiens, 11.1%(2) du Bangladesh et 5.6%(1) du Sri lanka. Les symptomes a la presentation chez 60% des cas étaient les crampes avec une generalisation secondaire, 20% avaient des crampes primaire generalisées, 30% avec les maux de tete, , 25%la fatigue des jambes, 15% ayant la fiévre et 10% faisant des vomissements et vision floue respectivement. Chez 65% des cas, il y avait pas de déficit neurologiques mais 35% avait une faiblesse pyramidale des jambes. Chez 55% des cas tuberculeux, étaient localisées dans les hémisphéres cérebralçs, 30% dans le cote droite et 15 des lésions dans les 2 hémisphéres. Lorsque l'immigrant asiatique employé agé entre 20-40 ans avait des crampes sans ou avec maux de tete. Il doit avoir un scanaire de la memoire pour exclure la tuberculome intracranial. Un courte durée de la thérapie anti-tuberculeux peut etre essayé ou il y a le doute, irrespective des taux de sédimentations de globules rouges. Nous avons suggéré que lorsque les symptomes tonique de crampes primaire generalisée sont présent, la tuberculome intracraniale est localisée dans le lobe frontal, un taux de sédimentation des erythrocytes peut indiquer de multiples tuberculomes.

Introduction

Tuberculosis is an ubiquitous infection and its manifestations are protean. The most common presentation is the involvement of the respiratory system but the Central Nervous System (CNS) is often affected through haematogenous spread as in Tuberculous Meningitis (TBM). It can also occur as a mass lesion anywhere in the body when it is described as a tuberculoma (TBL), which is defined as conglomerates of tubercles resulting from haematogenous spread of infection [1]. TBLs may be found in any part of the CNS and because of its slow growth it is often calcified. It is a common neurological disorder in many parts of the world.

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This paper describes our experience in the presentation, management and outcome of patients with intracranial tuberculomas (ICTBLs) admitted under our care at the King Fahad Hospital Hofuf, Saudi Arabia, from January 1992 to May 1998.

King Fahad Hospital Hofuf is a 620-bed government hospital which is the main referral hospital in the city. Hofuf and its environs have a large population of immigrants from the Asian and African countries. These Asians are mainly labourers and farm hands.

Patients and methods

The bio-data, clinical presentation and examination of all patients presenting with ICTBLs were documented on a designed protocol. To be included in the study the intracranial mass lesion must show a characteristic ring-enhancement on brain CT scan with contrast. Each patient had the following investigations done, namely: - complete blood count with erythrocyte sedimentation rate (ESR), full biochemistry profile, purified protein derivative (PPD}, chest x-ray, sputum examination, electrocardiograph, electroencephalograph and HIV screening.

Each patient received a quadruple antituberculous chemotherapy which included rifampicin, isoniazid, pyrazinamide and streptomycin in the usual adult recommended doses for periods ranging between 9 months to 12 months.

Brain CT Scan was repeated at 4 weeks, 8 weeks and 24 weeks after the commencement of treatment. Patients were followed-up until the clearance of the intracranial lesions or for as long as they were in the area. Antiepileptic drug, Phenytoin sodium or very occasionally carbamazepine was used to control seizures. Other presenting symptoms were treated accordingly.

Results

Twenty (20) patients satisfied the criterion for inclusion in the study. Of these, there were 19 (95%) males and 1 (5%) female. The age ranged between 22 and 50 years (Mean =31.75: SD=5.632). Eighteen (90%) of all the patients were immigrants from Asia, they were aged between 23 and 47 years (Mean =31.28: SD=5.594) and they were all labourers who had spent less than a year in the Kingdom before they developed symptoms that brought them to the hospital. The remaining 2 (10%) patients were Saudis – a male aged 50 years and a female aged 22 years. The immigrants hailed from India, 15 (83.3%): Bangladesh, 2 (11.1%) and Sri Lanka, 1 (5.6%).

The main presenting feature was focal seizure with secondary generalization in 60% of the cases, primarily generalized seizure in 20%; all epileptic seizures accounted for 80%. Thirty percent of the patients presented with headache, 25% with weakness of the limbs, 15% with fever and 10% each presented with vomiting and blurring of vision, respectively. One patient presented with features of tuberculous meningitis. In 60% of cases, there were no detectable neurological deficits. Twenty five percent of the patients had pyramidal weakness in the limbs. One patient had papilloedema and staphyloma.

Table 1 shows the presenting features in our 20 patients.

Table 1: Presenting Features of Intracranial Tuberculoma (N=20)

Symptoms	N	Signs	N
Focal seizures with secondary generalization	12	Hemiparesis	5
Generalized tonic-clonic seizures	4	Facioparesis (UMN)	2
Headache	6	Bilateral oculomotor palsy	1
Weakness of limbs	5	Papilloedema	1
Fever	3		
Vomiting	2	Retinitis	1
Blurring of vision	2	Staphyloma	1
		Meningeal irritation sign	1
		No neurological deficit	12

Table 2 shows the locations of the tuberculomas on CT scan.

Table 2: Locations of Tuberculomas in the Brain (N=20)
Solitary = 17

Site	Right	Left
Frontal Lobe	1	4
Parietal Lobe	2	3
Occipital Lobe	-	-
Fronto-Parietal Lobe	2	-
Parieto-Occipital	1	3
Temporo/ Parietal	-	1
Total	6	11

Multiple 3 both hemispheres and in all lobes and suprasellar.

In about 55% of cases, the ICTBLs were located in the left hemisphere, 30% in the right and in 15% the lesions were in both hemispheres. In 85% of patients, the ICTBLs were solitary. The "target sign" was demonstrated in one patient.

Table 3 summarizes the characteristics in the 20 patients.

Table 3: Summary of the Characteristics of 20 patients with ICTBLSs

No.	Age	Sex	Nationality	Presentation	Signs	CT Finding	ESR	PPD	CXR
1.	25	M	Indian	Focal Seizure/ Secondary Generalization	N	Left Frontal	6	0	N
2.	30	M	Indian	Generalized Seizure	N	Right Frontal	2	7	N
3.	26	M	Indian	Focal Seizure/ Secondary Generalization		Right Parietal	7	8	N
4.	27	M	Indian	Focal Seizure/ Secondary Generalization	N	Left Frontal	8	20	N
5.	25	M	Indian	Focal Seizure/ Secondary Generalization	N	Right Fronto-Parietal Hilar Nodes	2	0	Calcified
6.	26	M	Indian	Weak Lower Limbs	Left Hemiplegia	Right Fronto-Parietal	1	20	N
7.	47	M	Sri Lankan	Focal Seizure/ Secondary Generalization	N	Left Parieto-Occipital	10	0	N
8.	40	M	Bangladeshi	Generalized Seizure	N	Multiple Lesions in both hemispheres	90	0	Miliary shadowing
9.	23	M	Indian	Focal Seizure/ Secondary Generalization	N	Left Parieto-Occipital	18	0	N
10.	31	M	Indian	Headache, fever, weak limb	Right Hemiplegia	Left Parietal	6	16	N
11.	26	M	Indian	Headache, fever, TBM	N	Left Frontal	55	0	N
12.	35	M	Indian	Focal Seizure/ Secondary Generalization	N	Left Parietal	6	20	N
13.	30	M	Indian	Generalized Seizure	N	Left Frontal	13	0	N
14.	23	M	Bangladeshi	Focal Seizure/ Secondary Generalization/ Weakness of Limbs	Todd's Paralysis	Right Parietal	8	0	N
15.	45	M	Indian	Weakness of Limbs/ Headache	Left Hemiparesis	Right Parieto-Occipital	17	0	Calcified
16.	35	M	Indian	Headache, Blurred Vision Transient RUL weakness	N	Left Parieto-Occipital	14	6	N
17.	35	M	Indian	Focal Seizure/ Secondary Generalization/	Right Facio-Paresis (UMN)	Left Parietal	8	0	N
18.	50	M	Saudi	Chronic Headache, vomiting, Raised intracranial pressure	Papilloedema Staphyloma	Multiple large lesions in both hemispheres	90	7	N
19.	34	M	Indian	1st attack of Focal Seizure/Secondary Generalization	Right Facioparesis (UMN)	Left parieto-temporal	12	0	N
20.	22	F	Saudi	Not communicating, weak limb. Generalized Seizures, Poor vision, headache, fever	No motor deficit Left hemiplegia, Retinal degeneration	Supra sellar Basal Ganglia and parietal lobe (multiple lesions)	94	0	Tuber-culosis pneu-monic changes

The chest radiograph showed no evidence of tuberculous infection in 80% of cases. 10% showed calcified hilar adenopathy; 5% showed miliary shadowing and another 5% showed tuberculous pneumonia in the right lung. Fig. 1 shows the brain CT scan with contrast demonstrating multiple Tuberculomas with ring enhancement.

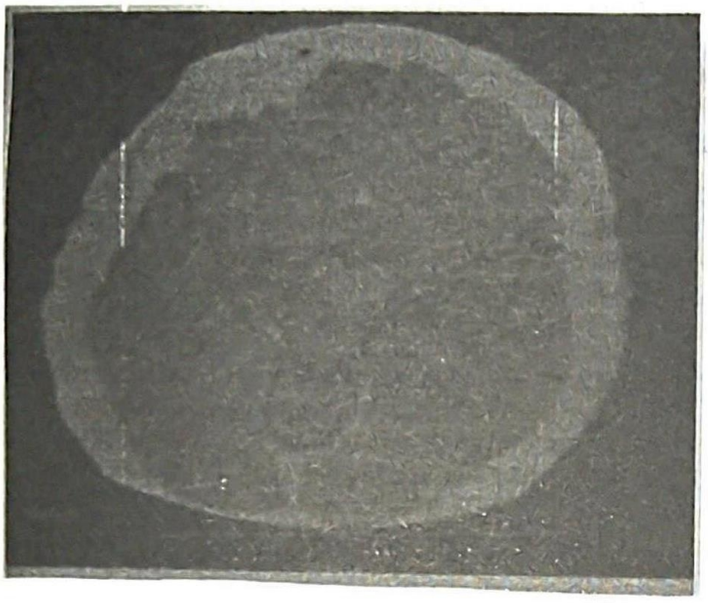

Fig. 1: *Brain CT scan with contrast showing ring enhancement of the multiple tuberculomas*

Fig. 2. CT scan of the same patient with enlargement of the lesion with surrounding oedema after treatment was commenced.

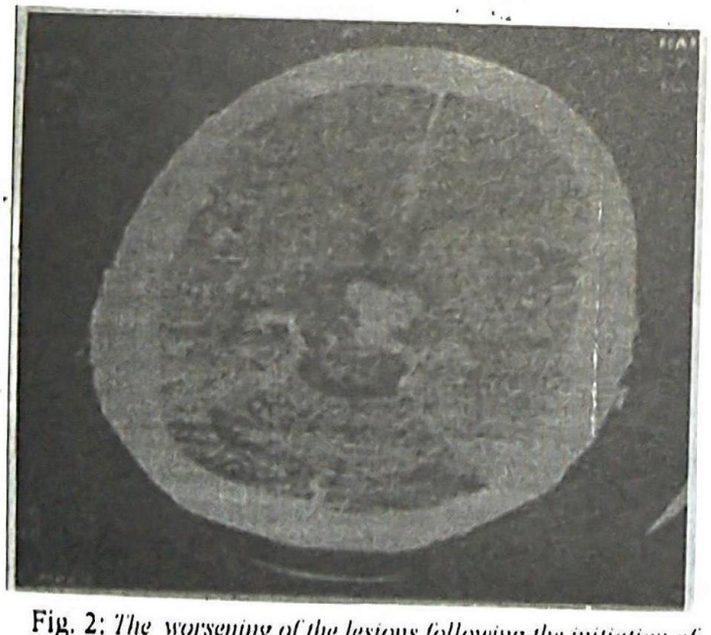

Fig. 2: *The worsening of the lesions following the initiation of treatment "the paradoxical phenomenon.*

The ESR was abnormal in 45% of cases. It was 90mmHr and above in the 3 patients with multiple ICTBLs. The purified protein derivative (PPD) was positive in 20%. The electroencephalogram (EEG) was abnormal in 60% of the patients.

One patient gave a history of old pulmonary tuberculosis and one was diabetic at the time of study. None of the patients tested positive to HIV screening.

Discussions

Intracranial Tuberculomas are usually a solitary, slow growing space occupying lesion (SOL) which presents with seizures, focal deficits and raised intracranial pressure [2]. In India and other Asian countries, especially among children, ICTBLs constitute 20 to 30% of intracranial SOL [3]. In the developing countries generally, tuberculomas constitute 5-8% of CNS – SOL and up to 30% of brain tumors [3,4]. In Kuwait, ICTBLs represented 1.4% of all cases of intracranial SOL [5].

In adults, the lesions tend to occur above the tentorium, as in all our patients and below the tentorium in children. They can be found anywhere intracranially, located in the brain parenchyma [2] and are usually solitary, although 15% to 34% are multiple [6].

From our data it would appear that tuberculomas have an affinity for the left hemisphere and in particular, the parietal lobe. Other sites of location that have been observed by other workers, include optochiasmic tuberculomas which may mimic optic nerve and chiasm tumors [7]. An exceptional location is the cavernous sinus where they may produce palsies of cranial nerves III and V with severe headache [8,9]. Although hypophyseal tuberculomas are exceptionally rare, cases have been reported in which sellar tuberculomas had been mistaken for adenoma [10] and it may imitate a craniopharyngioma if located in the suprasellar area [11] as we found in the only female in our series. Orbital tuberculomas may masquerade as orbital malignancy in areas where tuberculosis is non-endemic [12]. In the brainstem tuberculomas can present as isolated intrinsic masses [13]. If located in the dural space they may mimic meningioma-en-plaque [14,15,16]. Tuberculomas can mimic brain metastases [17]. In endemic regions, hypothalamic tuberculomas may present with features of hypopituitarism [18].

The CT scan has been shown to have a sensitivity of 100% and specificity of 85.7% in the diagnosis of ICTBLs, but the low positive predictive value of CT diagnosis indicates the need for histological confirmation [19]. Murayana *et al* [20] found that enhanced CT images correlated with histological studies and that 25% of their cases showed non-specific enhancement patterns. Vengsarkar *et al* [21] observed that CT has greatly influenced the diagnosis and management of ICTBLs.

The "target sign", defined as a central nidus of calcification or central enhancement surrounded by a ring enhancement, had been considered a pathognomonic finding in central nervous system tuberculomas. Bargallo *et al* [22] however, opined that it was a non-specific finding and might lead to erroneous diagnosis of CNS tuberculoma as it may be seen in primary brain lymphoma, toxoplasmosis and bacterial abscess.

Magnetic resonance imaging (MRI) has been found to be a useful tool in definitive diagnosis of ICTBL. Combination of the signal intensity patterns and conglomerate ring-like enhancing appearance of the lesions is characteristic of tuberculomas and may play an important role in differentiating ICTBL from other ring enhancing lesions [23,24]. Also; in vivo proton magnetic resonance spectroscopy (MRS) may be helpful in differentiating tuberculomas from other intracranial mass lesions which have diagnostic difficulties on MRI [25].

All the patients in our study were diagnosed by CT scan showing the characteristic ring-enhancement pattern before they were commenced on treatment. However, only the 2 Saudis with multiple ICTBLs needed open brain biopsy (OBB) and CT guided stereotactic brain biopsy (CT-SBB), respectively, for confirmation.

The main presenting features of ICTBLs are epileptic seizures [26,27,28]. In our series; we categorized the seizures according to the history, eye witness account and EEG abnormality seen in 60% of the patients. A large proportion of our patients had no neurological deficits. In Kuwait however, 69% of the patients presented with convulsions and focal neurological deficit was detected in 46% [5].

A distinct observation in this study is that 95% of our patients were males, aged below 50 years, except a Saudi male aged 50 years. The male preponderance observed by us accords with the findings of Abdul-Ghaffar *et al* [5] in which 77% were males. Whereas 90% of our patients were from the Asian countries, only 23% (3/13) were Asians in the Abdul-Ghaffar *et al* series.

It is also interesting that all our patients who presented with generalized seizures had ICTBLs in the frontal lobe. We therefore suggest that when the patient presents with generalized tonic-clonic seizures, the tuberculoma is likely to be in the frontal lobe. Elevated ESR may indicate multiple ICTBLs.

Ten percent (2/20) of our patients manifested paradoxical response to anti-tuberculous chemotherapy with increasing seizures within 2 and 4 weeks, respectively, of commencing treatment. Follow-up CT scan revealed increase in size of the lesions with some increase in the surrounding oedema. Treatment continued in spite of the reaction and within the subsequent couple of weeks the patients condition had improved and the size of the lesions and oedema on CT had regressed. One of the 2 patients required a short course of steroid at this stage. Although the use of steroids to suppress a paradoxical response is not proven [29]. Hejazi and Hassler [30] observed in their literature review that majority of patients had been treated with glucocorticoids (prednisone, prednisolone, hydrocortisone or dexamethasone) symptomatically if they showed perifocal oedema on CT or clinical worsening. Hence, they recommended systemic corticosteroids as adjuvant therapy for 4 to 8 weeks as worthwhile and effective.

Paradoxical response to antituberculous therapy has been reported by others [11, 29,30,31,32,33,34,35,36]. In nearly all the patients who demonstrated paradoxical response, the phenomenon occurred within weeks to months of commencement of therapy and there were initial symptoms of florid meningitis and most of them developed hydrocephalus [30]. Neither of our 2 patients who demonstrated paradoxical response, 2 and 4 weeks after the commencement of antituberculous chemotherapy, respectively, had florid meningitis or hydrocephalus.

Afghani and Lieberman [32] reported the case of a child whose ICTBL paradoxically enlarged while on treatment and on a further retrospective review of their other cases they found 23 cases in which tuberculomas increased in size or number and another 17 cases in which the lesions appeared during therapy. Evidence of new intracranial tuberculoma or the expansion of existing lesions, nevertheless, requires no change in the antituberculous regimen.

In our study, we did not have any in hospital mortality. The ICTBLs in our patients resolved with chemotherapy before the course was completed. All the patients were maintained on antiepileptic drugs.

Conclusion

We suggest that when an Asian immigrant especially male aged between 20 – 40 presents with seizures, with or without severe headache, he should have a brain CT scan with contrast to exclude the possibility of ICTBLs and where there is doubt, a short course of antituberculous therapy should be tried using the full recommended doses, irrespective of normal ESR, negative PPD and normal chest radiograph. We suggest that when the presenting symptom is generalized, tonic-clonic seizure, the ICTBL is likely to be in the frontal lobe and a high ESR may indicate multiple ICTBLs.

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References

1. Erdem G, Ceyhan M, Ecevit Z, Kenra G and Erkul E : Multiple Intracranial Tuberculomas in a Child : Turk J Pediatr 1996; 38 (1) : 95-99.
2. Bharucha NE and Raven RH. In Tropical Neurology (Ed) Shakir RA, Newman PK and Poser CM. WB Saunders Company Ltd. 1996; Chapter 9 pg 139.
3. Harder E, Al-Kawi MZ and Carney P: Intracranial Tuberculoma: Conservative Management. Am J Med 1983; 74:570-576.
4. Tandon PN and Pathak SN: Tuberculoma of the Central Nervous System. In Spillane JD (Ed). Tropi-

cal Neurology. London. Oxford University Press. 1973; 37-57.
5. Abdul-Ghaffar NU, El-Sonbaty MR and Rahman NA: Intracranial Tuberculoma in Kuwait Int J Tuberc Lung Dis 1998; 2(5): 413-418.
6. Dastur HM: Tuberculoma. In: Vinken PJ; Bryn GW (eds) Handbook of Clinical Neurology. New York. Elsevier, 1975; 18:413-426.
7. Kadioglu HH; Gundogdu C; Deniz O; Takci E and Tuzun IH : Optochismatic Tuberculoma – case report and review. Zentrabl Neurchir 1996; 57(1): 30-36
8. Grayeli AB; Redondo A; Salam J and Rey A: Tuberculoma of the Cavernous Sinus: case report. Neurosurgery (United States) 1998; 42(1): 179-181
9. Phookan G and Towns GM: Tuberculoma of the Cavernous Sinus – a case report. Br J Neurosurg 1995; 9: 205-207.
10. Ashkan K, Papadopoulos MC, Casey T, Thompson DN, Jarris S, Powell M, Thomas DG and Sellar Tuberculoma – report of two cases. Acta Neurochir (Wein) 1997; 139(6):523-525.
11. Altunbasak S, Baytok V, Alhan E, Yuksel B and Aksaray N: Suprasellar tuberculoma causing endocrinologic disorders and imitating craniophrayngioma. Pediatr Neurosurg (Switzerland) 1995; 28(6):328-331.
12. Chin PK, Jacobs MB and Hing SJ: Orbital tuberculoma masquerading as an orbital malignancy. Aust NZ J Ophthalmol (Australia) 1997; 25(1):67-69.
13. Rajshekhar V and Chandy MJ: Tuberculoma presenting as isolated intrinsic brain stem masses. Br J Neurosurg (England) 1997; 11(2): 127-133.
14. Lindner A, Schneider C, Hofmann E, Soerensen N and Toyka KV: Isolated meningeal tuberculoma mimicking meningioma: case report. Surg Neurol (United States) 1995; 43(1):81-84.
15. Ng SH, Tang LM, Lui TN, Ko SF, Wong HF, Wai YY and Wan YL. Tuberculoma en plaque: CT. Neuroradiology (Germany) 1996; 38(5): 453-455.
16. Bauer J, Johnson RF, Lery JM, Pojman DV and Ruge JR : Tuberculoma presenting as an en plaque meningioma – case report. J. Neurolsurg (United States) 1996; 85(4) 685-688.
17. El-sonbaty MR, Abdul-Ghaffar NU and Marafgy AA: Multiple intracranial tuberculoma mimicking brain metastases. Tuber lung Dis (Scotland) 1995; 76(3): 271-272.
18. Indira B; Panigrahi MK, Vajramani G, Shankar SK, Shantosh V and Das BS: Tuberculoma of the hypothalamic regions a rare case of hypopituitarism. Surg Neurol (United States) 1996; 45(4): 347-350.
19. Selvapandian S, Rajshekhar V, Chandy MJ and Idikula J: Predictive value of computed tomography-based diagnosis of intracranial tuberculomas. Neurosurgery (United States) 1994; 35(5): 845-850.
20. Murayama S, Murakami J, Hashimoto S, Torii Y and Masuda K: Non-calcified pulmonary tuberculoma: CT enhancement patterns with histological correlation. J Thorac Imaging (United States) 1995; 10 (2): 91-95.
21. Umesh S, Vengsarkar, Ramkrishna Prasad Pisipaty, Bharat Parekh, Venilal G. Panchal and Manohar N. shetty: Intracranial tuberculoma and the CT-Scan. J Neurosurg 1986; 64:568-574.
22. Bargallo , Berenguer J, Garcia-Barrionuevo J, Ubeda B; Bargallo N; Cardenal C and Mercader JM: The "target sign:" is it a specific sign of CNS Tuberculoma? Neuroradiology (Germany) 1996; 38(6): 547-550.
23. Tayfun C, Ucoz T, Tasar M, Atac K, Ogur, Osturk T and Yinanc MA: diagnostic value of MRI in tuberculous meningitis. Eur Radiol (Germany) 1996, 6(3):380-386.
24. Kim TK, Chang KH, Kim CJ, Goo JM, Kook MC and Han MH: Intracranial tuberculoma: comparison of MRI with pathologic findings. AJNR Am J Neuroradiol (United States) 1995; 16(9):1903-1908.
25. Gupta RK, Poptani H, Kohli A, Chhabra DK, Sharma B and Gujral RB: In vivo localised proton magnetic resonance spectroscopy of intracranial tuberculomas. Indian J Med Res (India) 1995; 101:19-24.
26. Martinez-Vasquez C, Bordon J, Rodriguez-Gonzales A, de la Fuente-Aguado J, Sopena B, Gallego-Rivera A and Martinez-Cueto P: Cerebral tuberculosa – a comparative study in patients with or without HIV infection. Infection (Germany) 1995; 23(3): 149-153
27. Isenmann S, Zimmermann DR, Wichmann W and Moll C: Mycobacterial DNA from formalin – fixed tissue. Clin Neuropatho (Germany) 1996; 15(3):155-158.
28. Patwari AK; Aneja S; Ravi RN; Singhal PK and Arora SK: Convulsions in tuberculous meningitis. J Trop Pediatr (England) 1996; 42(2):91-97.
29. Reiser M, Fatkenhener G and Diehl V: Paradoxical expansion of intracranial tuberculoma during chemotherapy. Review of the literature and own experience. Acta Neurochir (Wien) (Austria) 1997; 139(3): 194-202.
30. Hejazi N and Hassler W: Multiple intracranial tuberculomas with atypical response to tuberculostatic chemotherapy. Review of the literature and own experience. Acta Neurochir (Wien) (Austria) 1997; 139(3):194-202.
31. Abdul Jabbar M. Paradoxical response to chemotherapy for intracranial tuberculoma: two case reports from Saudi Arabia. J Trop Med Hyg 1991; 94:374-376.
32. Afgani B and Lieberman JM: Paradoxical enlargement or development of intracranial tuberculomas during therapy: case report and review. Clin Infect Dis (United States) 1994; 19(6): 1093-1099.

33. Rao GP, Nadh BR, Hamaratnan A, Srinivas TV and Reddy PK: Paradoxical progression of tuberculous lesions during chemotherapy of central nervous system tuberculosis. Report of four cases. J Neurosurg (United States) 1995; 83(2): 359-362.
34. Alame T, Keller K, Michel O, Sergysels R. Hyperthermia occurring with paradoxical development of cerebral tuberculomas. Respiration (Switzerland) 1996; 63(6):381-383.
35. Malik GM, Mubarik M, Basu JA, Kadla SA, Hussain T and Rashid S: Paradoxical expansion of cerebral tuberculomas during therapy for Pott's spine. J R Soc Med (England) 1996; 89(11):643-644.
36. Awada A; Daif AK; Pirani M; Khan MY; Memish Z and Al-Rajeh S: Evolution of brain tuberculomas under standard antituberculous treatment. J Neurol Sci (Netherland) 1998; 156(1):47-52.

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