INTRODUCTION

A spontaneously resolving (disappearing) single, small, enhancing computed tomographic (CT) lesions are the commonest imaging abnormality in Indian patients with new onset seizures (Fig. 1). Since the advent of computed tomography in India in late seventies, a large number of Indian patients of epilepsy have been noted to have single, small, enhancing CT lesions (SSECTL) with or without perifocal edema. Wadia et al, reported, at least 26% of Indian patient with

Abstract

Objective : To evaluate the effect of a short course of oral prednisolone on disappearance of lesion and seizure recurrence in newly diagnosed patients with single small enhancing CT lesion.

Methods : In this open-label, randomized, prospective follow-up study, 100 patients of new-onset seizures and a cysticercus granuloma presenting as single enhancing computed tomography detected lesion were randomly divided in two groups to receive either antiepileptic monotherapy (Group A) or antiepileptic drugs with oral prednisolone in a dose of 1 mg/kg body weight for 7 days and tapering off dose in next 3 days (Group B). Repeat CT scan was performed on 8th-12th week to know radiological state of lesion. The patients were followed up for 1 year for seizure recurrence.

Results : The majority of patients were in second decade. Male : female ratio 1.56:1. Mean number of seizure episodes was 4.33 ± 3.50 in group A and 4.23 ± 3.97 in group B. Partial seizure were the most common presentation (85%). 72% patients presented with single seizure or seizure in cluster. Solitary ring lesion was the commonest (69%) CT finding, most of them were located in parietal lobe (52%). Follow up CT scan showed complete resolution of lesion in 60.86% of total [group A (n=47), 32 patients, 68.08%; group B (n=45), 24 patients, 53.33%]. Significant difference in group A and B regarding lesion resolution was observed (χ²=5.926, d.f. = 1) p<0.05. Clinical follow up showed seizure recurrence in group A - 5 patients (10.63%), in group B - 12 patients (26.66%). Statistically significant higher number of seizure recurrences were noted in group B as compared to group A (χ²=3.95, d.f. = 1) p<0.05.

Conclusions : Short term oral prednisolone along with antiepileptic drugs helps in rapid resolution of single small enhancing lesions in patient with newly diagnosed seizure disorder with good clinical outcome. ©
focal epilepsy has SSECTL. The lesion could have either a ring or a disc-like enhancement and the size is less than 20 mm. The surrounding perifocal edema may be mild to moderate and there is usually no mass effect.

Sethi et al. in 1985, however reported the spontaneous resolution of these lesions and ever since their etiology has been the subject of debate and controversy.

Rajshekhar et al. have made an attempt to answer the controversy regarding the etiology of these lesions, by the help of stereotactic brain biopsy. After histopathological diagnosis he showed that, majority of these lesions are cysticercus granuloma and very few of them are tuberculoma, they proposed the radiological criteria of SSECTL to diagnose the lesion to be a solitary cysticercus granuloma and that these lesions itself or during natural course of disease acts as antigen, there is production of inflammatory cytokine (TNF, IL-1, MIP) causing cytotoxic as well vasogenic edema, which acts as epileptogenic foci in dying phase of cyst. The treatment protocol has also been a point of controversy. An excellent outcome in majority of the patients with an expectant conservative line of management only with antiepileptic drugs, has been suggested. To answer some of the controversial aspects especially related to the management of these patients we planned a study with following aims and objective: Firstly, to study the natural radiological course of the lesions, and to compare the effect of treatment regimens, (antiepileptic alone, antiepileptic + short course of oral steroid) on the resolution of these lesions on repeat CT scan after 8 to 12 week. Second, to prospectively study the clinical course of the seizures in these two group of patient.

**MATERIAL AND METHOD**

In this proposed study, newly diagnosed patients having neurocysticercosis with seizure disorder with ring/disc enhancing CT lesions were included. This study was carried out in the Department of Neurology, Institute of Medical Sciences, Banaras Hindu University. Each patient was subjected to neurological evaluation especially about the associated seizure disorder.

A fresh contrast enhanced cranial CT scan was obtained in each case in first week of seizure and after 8-12 weeks. The inclusion criteria (i) Clinical Criteria: Seizure (partial of generalized) should be the initial symptom, there should be no features of persistent raised intracranial pressure, there should be no history of progressive neurological deficit and there should be no evidence of an active systemic disease. (ii) The CT Criteria: CT scan should only show a solitary, contrast enhancing lesion, the lesion should measure less than 20 mm in maximal dimension and edema may or not be present, but is not severe enough to produce a shift of the midline structures as proposed by Rajshhekher et al in favor of solitary neurocysticercosis.

Each patient was subjected to a detailed neurological evaluation, with emphasis on the associated seizure disorder. An eyewitness account of the seizure by a relative or friend was obtained to know the details of the ictal event. The seizures were classified as per the International League Epilepsy (ILAE) classification. Diagnosis of raised intracranial pressure is made on the basic of presence of persistent headache, vomiting and papilloedem. Patients may have transient headache and vomiting just before or soon after seizures, but this is not taken as an indicator for raised intracranial pressure. All patient were subjected to general investigations included hemoglobin, total and differential leucocytes counts, ESR, Montoux text, X-ray chest. In addition to a contrast enhancing CT scan, each patient was also subjected to electroencephalography.

A contrast enhancing CT scan was done in patients presenting with new onset seizures within 7 days. Patients fulfilling the criteria already mentioned were included. The lesions were divided into 3 types : (i) Ring enhancing, (ii) Ring enhancing with an eccentric dot and (iii) Disc enhancing. Perifocal edema was classified as: Mild i.e. restricted to one lobe, Moderate i.e. spreading to the adjacent lobe and Severe i.e. causing a midline shift.

EEG was carried out on a 16 channel Grass Machine. Sleep deprivation, sedation, photic stimulation and a second record were also routinely obtained. EEG records were classified as normal, generalized abnormal and focally abnormal.

Patients were randomly divided into 2 groups on the basis of the treatment they received – Group A (Antiepileptics + Prednisolone 1 mg/kg/day for 10 days) and Group B (AED + Placebo). Antiepileptic treatment was started with Carbamazepine (10 mg/kg/day) in majority of the patients. Phenytoin (5-7 mg/kg/day) was also given in few. No other form of treatment was employed in these patients. Patients were followed up for at least one year for assessment of the clinical course.

Follow up CT scan was performed immediately after 8-10 weeks of the initial CT scan. Visual analysis was performed by an independent observer (radiologist, not familiar with the clinical course of the patient) the lesion was considered persisting if no change in the appearance of lesion was noted. The lesion was considered regressing, if on visual analysis the amount of edema had reduced or the size had diminished. The lesion was considered disappeared, when the follow-up CT scan was reported normal. Lesion if became hyperdense on plain CT scan, it was taken as calcified.

Statistical analysis was done for categorical values, the comparison of percentages was made using Chi-square analysis or fisher’s exact test if Chi-square was not available.

**RESULTS**
The present study deals with 100 patients presenting with new onset seizures and a CT scan showing a single, small, enhancing lesion. These patients have been selected as per the laid down criteria for SSECTL by Rajshekhar et al.\(^6\) Repeat CT scan was done in 92 patients to see the resolution of these lesions and patients were followed up for the seizure recurrence.

Majority of patients had partial seizures with secondary generalization as seen in 48\% patients while 28\% had only simple partial seizures (without generalization). Todd’s palsy was present in 11 patients. A large number of patients had postictal symptoms (34\%), mainly in form of headache, drowsiness and confusion. There was no statistical difference in the type of seizures in group A and group B were comparable. Average number of seizure in group A 4.33 ± 3.5 compared to 4.23 ± 3.97 in group B. Three patients presented with status epilepticus. Clinical pattern of seizure and electroencephalography findings are shown in Table 1. It was observed that most of the patients had seizures in clusters (group A 56\% and group B 68\%) followed by recurrent seizure (group A 28\% and group B 22\%).

Peripheral enhancement giving rise to ring like lesion was the commonest presentation (88\%). Majority of the patient had perifocal edema which was mainly mild (55\%). Eccentric dot was present in 19 patients. Most of the lesions (51\%) were situated in the parietal lobe (Table 2).

Image morphology on follow up CT scan after 8 to 12 week showed that majority of the lesions had disappeared i.e. resolved completely as witnessed in 60.86\% cases. Out of 56 cases showing complete resolution (Fig. 2), 32 (68.03\%) cases were those receiving antiepileptic drugs with corticosteroid compared to 24 (53.33\%) patients who received only antiepileptic drug with placebo. There was significant statistical difference in changes of follow-up CT scan of group A in comparison to group B on lesion resolution ($\chi^2=\ 5.926,\ df = 1,\ p<0.05$)(Table 3). Clinical follow up of

### Table 1: Clinical pattern of seizures

<table>
<thead>
<tr>
<th>Types of seizures</th>
<th>Total (n=100)</th>
<th>Group A (n=50)</th>
<th>Group B (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Simple partial</td>
<td>24</td>
<td>24.00</td>
<td>10</td>
</tr>
<tr>
<td>Partial with secondary generalization</td>
<td>48</td>
<td>48.00</td>
<td>25</td>
</tr>
<tr>
<td>Simple partial → CPS</td>
<td>4</td>
<td>4.00</td>
<td>3</td>
</tr>
<tr>
<td>Generalized Tonic-Clonic</td>
<td>15</td>
<td>15.00</td>
<td>8</td>
</tr>
<tr>
<td>Complex partial</td>
<td>4</td>
<td>4.00</td>
<td>2</td>
</tr>
<tr>
<td>CPS → Sec. generalization</td>
<td>5</td>
<td>5.00</td>
<td>2</td>
</tr>
<tr>
<td>Todd’s palsy</td>
<td>11</td>
<td>11.00</td>
<td>8</td>
</tr>
<tr>
<td>Postictal symptoms</td>
<td>34</td>
<td>34.00</td>
<td>16</td>
</tr>
<tr>
<td>Average no. of seizures before start of treatment (mean ± SD)</td>
<td>4.33±3.50</td>
<td>4.23±3.97</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Image morphology and location of CT lesions on 1st week of seizure

<table>
<thead>
<tr>
<th>Type of lesion</th>
<th>Total (n=100)</th>
<th>Group A (n=50)</th>
<th>Group B (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>I (ring enhancing lesion)</td>
<td>69</td>
<td>69.00</td>
<td>32</td>
</tr>
<tr>
<td>II (ring enhancing lesion with eccentric dot)</td>
<td>19</td>
<td>19.00</td>
<td>11</td>
</tr>
<tr>
<td>III (disc enhancing lesion)</td>
<td>12</td>
<td>12.00</td>
<td>7</td>
</tr>
<tr>
<td>Perifocal edema</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>20</td>
<td>20.00</td>
<td>12</td>
</tr>
<tr>
<td>Mild</td>
<td>55</td>
<td>55.00</td>
<td>23</td>
</tr>
<tr>
<td>Moderate</td>
<td>20</td>
<td>20.00</td>
<td>13</td>
</tr>
<tr>
<td>Severe</td>
<td>5</td>
<td>5.00</td>
<td>2</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parietal</td>
<td>52</td>
<td>52.00</td>
<td>29</td>
</tr>
<tr>
<td>Frontal</td>
<td>10</td>
<td>10.00</td>
<td>3</td>
</tr>
<tr>
<td>Parieto-occipital</td>
<td>8</td>
<td>8.00</td>
<td>4</td>
</tr>
<tr>
<td>Fronto-parietal</td>
<td>19</td>
<td>19.00</td>
<td>10</td>
</tr>
<tr>
<td>Occipital</td>
<td>4</td>
<td>4.00</td>
<td>1</td>
</tr>
<tr>
<td>Tamporo-parietal</td>
<td>7</td>
<td>7.00</td>
<td>1</td>
</tr>
</tbody>
</table>
seizure recurrences were infrequent as witnessed in only 17 patients. Most of these patients had recurrence numbering 1-3. In this are included 9 patients who had seizure recurrence while dose of antiepileptic drug was being build up. Statistically significant higher number of seizure recurrences were noted in Group B, as compared to group A ($\chi^2=3.93$, df = 1, p<0.05). Two patients in whom size of SSECTL increased on subsequent CT had recurrence of seizure were put on empirical ATT, follow up showed well control of seizure activity. One significant point noted that 6 of our patients who had 8-10 episode of seizure at initial presentation showed recurrence of seizure out of total 17 patients. Four out of total 6 patients who showed calcification on repeat CT scan had recurrence of seizure on follow up which was controlled by increasing the dose of AED (Table 4).

Recurrence of seizure was observed in patients where the lesion was persisting as well as where it had disappeared, however patients having abnormal CT on repeat CT scan had more recurrence.

**DISCUSSION**

Epilepsy is a common, treatable neurological disorders. The present, open label randomized prospective study includes 100 patients fulfilling both clinical and CT criteria, given by Rajshekhar et al.6,7 Garg and Nag8 observed a higher incidence among children and adolescents, as 72% of children had ring enhancing CT lesion. In our study, majority of patients were of younger age group; 80% of patients had first seizure episode either in the first or the second decade of life. The mean age of onset of seizures in years was $19.32 \pm 10.12$. Why these lesions are common in children is not clear. As these lesions most often have cysticercal etiology, possible poor hygienic conditions make children more susceptible. Regarding sex incidence male 64% out numbered females 36%. In patients having single, small, enhancing CT lesion, partial seizures were the commonest type (85%) of seizures, among the partial seizures, majority was of those having secondary generalization, which constituted 53% of total. Similar pattern was observed by Goulatia et al.9 who found partial, generalized and mixed seizures in 82%, 13% and 4.3% patients respectively. Todd’s palsy was seen in 11% of cases, an interesting observation was made in patients with parasagittal lesions, that they had transient contralateral hemiparesis. Majority of the lesions represent an acute inflammatory stage of neurocysticercosis, so seizures are usually of recent onset and tend to occur in clusters. The seizures are likely at the height of the inflammatory reaction around dying cysticerci, and with eventual resolution of this inflammatory phase, the risk of seizures progressively decreases. A large number of our patients had either a single episode or multiple seizures within 24 hours (in a cluster). Single seizure was observed in total of 10 patients 14% (group A) and 6% (group B). Seizures in cluster observed in 62 patients 56% and 68% respectively in group A and group B.

Majority of the cases had a ring like enhancement as seen in 88 out of 100 (88%) patients. Only 12% of the cases had disc-like enhancement. An eccentric dot inside the ring representing the cysticercus larva was seen in only 19 out of 88 (21.6%) patients Chopra et al11 observed this eccentric dot in 3 out of 122 patients, whereas Garg and Nag8 observed it in 43% of patients. Ring-like enhancement is seen in second (colloidal) and disc-like in third (granular-nodular) stages of cysticercus larva respectively.12 Rajshekhar et al9 has also noticed similar morphology in which most of the lesion had a ring-like enhancement with smooth outline and size less

<table>
<thead>
<tr>
<th>Group A (n=47)</th>
<th>Group B (n=45)</th>
<th>Total (n=92)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Lesion disappeared</td>
<td>32</td>
<td>68.08</td>
</tr>
<tr>
<td>Lesion calcified</td>
<td>24</td>
<td>53.33</td>
</tr>
<tr>
<td>Lesion regressed</td>
<td>19</td>
<td>20.65</td>
</tr>
<tr>
<td>Lesion same size</td>
<td>56</td>
<td>60.86</td>
</tr>
<tr>
<td>Lesion increased</td>
<td>5</td>
<td>10.63%</td>
</tr>
<tr>
<td>Total no. of patients with recurrence</td>
<td>5 (10.63%)</td>
<td>3</td>
</tr>
<tr>
<td>1-3 recurrences</td>
<td>8</td>
<td>26.66%</td>
</tr>
<tr>
<td>4-6 recurrences</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>&gt;6 recurrences</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. 2: Complete disappearance of SSECTL on 10th week of repeat CT scan.

Table 3: Follow up CT scan after 8-12 week of first seizure

Table 4: Clinical follow up for seizure recurrence
that 20 mm in maximal dimension. They had tried to
differentiate cysticercus granuloma from tuberculoma,
in which tuberculomas had size more than 20 mm in
diameter, perifocal edema was much more and the
outline irregular. Mass effect favoured tuberculoma.

SSECTL can be seen throughout the cerebral
hemispheres. Lesions are usually located superficially
in the gray matter or at the junction of gray and white
matter. Parietal lobes are the commonest location
for these lesions, followed by frontal and occipital
lobes. In our study also, the most favored site was the
parietal lobe (52%) followed by fronto-parietal (19%).
Considerable number of lesions were located either
at parieto-occipital region or temporo-parietal region.
These regions form the watershed areas of cerebral
circulation, and hematogenous spread of infective
agents are more likely to lodge in these regions, because
of the end arteries. Similar observations were made by
Goulatia et al and Sethi et al, where they found 82.6%
and 63.6% lesions respectively in the parietal lobe.

One of the most outstanding features of single small
CT lesions is their spontaneous resolution without any
etiological treatment was reported by Sethi et al and
Chopra et al reported complete spontaneous resolution
of SSECTL in 60.2% cases and reduction in size and
perifocal edema in 30.7% cases. In our study 68.86% of
the lesions disappeared in the patients who received
antiepileptics with oral prednisolone (group A) a total
of 32 patients out of 47 (68.08%) showed complete
disappearance. Eleven patients (23.4%) showed partial
resolution. Group B who received only antiepileptic
showed lesion disappearance in 24 out of 45 patients
(53.33%) and 8 patients (17.77%) had decrease in lesion
size. Overall lesion resolution in group A is 91.48%
compared to 71.11% in group B. Persistence of lesion or
calcification in group B (26.66%) out numbered in group
A (6.37%) and it is statistically significant ($\chi^2$ = 5.926, df = 1,
p < 0.05). A total of 19 out of 92 lesions regressed in size,
and 9 lesions showed no change with 2 lesion increasing
in size. In the 19 patients where lesions had regressed,
it ultimately disappeared in 4 patients on follow up
CT scan at 6 months. We may see disappearance in
other patients also on extended follow up. It is not
the difference in pathology or etiology that leads to
the persistence of a lesion but some other unknown
factor. It may be the variable natural history of solitary
cysticercus granuloma which results in “persistent”
lesions in some and “disappearing” lesion in others.\textsuperscript{7}
Even “persistent” lesions will ultimately resolve
without active intervention. However corticosteroid
helps in decreasing the edema and lesion resolution
this way it decreases the seizure recurrence Mall et al 13
also showed similar result in patients of SSECTL who
received prednisolone with antiepileptic.

Control of seizures is the most important aspect as far
as the patients are concerned. Chopra et al\textsuperscript{11} suggested
that, because single enhancing CT lesions are usually
benign in nature, such patients need only seizure
control, without giving much attention to the persistence
of the lesions. Potluri et al\textsuperscript{14} reported short course of
prednisolone improves the clinical status of patient
without much changes in radiological state. In our study,
recurrence was seen in a total of 17 out of 100 patients.
Out of 47 patients who received antiepileptic drugs with
oral prednisolone recurrence of seizure was observed in
only 5 patients (10.63%). In this are included 2 patients
where dose of antiepileptic drug was being build up.
Only 2 patients had more than 3 seizure recurrences.
In group B recurrence rate was 26.66%, 12 out of 45.
In this are included 7, were dose of antiepileptic was
being build up. The difference in two group in seizure
recurrence is significant ($\chi^2$ = 3.93, df = 1, p < 0.05). This
difference can be due to decrease in perifocal oedema
by corticosteroid. Most of patient had seizure in cluster,
Rajeshkar et al believed that these episodes are linked
to periodic excretion of cysticercus antigen as it is the
most common cause of SSECTL, which produces an
intense inflammatory activity around the dying lesion.
This inflammatory activity corresponds to an intense
enhancement of granuloma and increase in perifocal
oedema i.e. evident on CT scan. So the corticosteroid
inhibits the production of cytokine and check the focal
increase in blood brain barrier permeability, which
causes the flurry of seizure irrespective of etiology of
lesion.\textsuperscript{14} Garg et al\textsuperscript{15} noticed marked improvement in
postictal headache in patients of single enhancing lesion
with institution of short course of prednisolone, they
concluded the edema due to dying cyst is responsible
for headache and cluster of seizure, which decreases with
steroid.

Regarding use of albendazole in patients of
neurocysticercosis presenting as SSECTL Surekha et al,\textsuperscript{7} in their controlled study reported albendazole do not
change the prognosis of seizure outcome. Similar study
concluded by Singh et al,\textsuperscript{15} however regarding effect of
steroid on seizure recurrence in SSECTL Pautluri et also
showed better control of seizure in group where steroid
was used. Our study showed addition of short course of
oral prednisolone do help in control of seizure especially
during initial phase as well as lesion resolution on 8 to
12 weeks of repeat CT scan.

Hence emphasis should be placed on the management
of the associated seizure disorder, rather than the
CT lesion. Conventional antiepileptic monotherapy
is effective in majority of the patients. This has been
documented in our study, where 45 patients were
receiving only antiepileptic drugs and a recurrence
of seizure was seen in 12 patients. In these patients
where recurrence was observed, seizures were further
controlled with an increase in the dose of antiepileptic
drugs and 47 patients who received steroid in addition,
seizure recurrence observed only in 5 patients. So we
advocate that patients of solitary cysticercal granuloma with new onset seizures having a SSECTL in the cranial CT scan, should be put only on antiepileptic drug monotherapy along with short course of oral prednisolone and followed-up. ATT may be considered only if the lesion enlarges in size on the follow up CT scan. A short term antiepileptic therapy may be instituted in patients where the lesion has completely disappeared.

**CONCLUSION**

SSECTL is commonest finding of neurocysticercosis in newly diagnosed case of seizure disorder in young patients. Parietal lobe and watershed zone is commonest site of SSECTL. Most of these lesion disappear spontaneously irrespective of etiological diagnosis we recommend symptomatic treatment with appropriate antiepileptic agent with addition of short course of oral prednisolone to reduce the perifocal oedema and reduction in calcification of lesion which is main cause of epileptogenic foci. Further study may be looked for short course of antiepileptic therapy in patient who showed complete resolution of lesion.

**REFERENCES**

1. Wadia RS, Makhale CN, Kelkar AV, Grant KB. Focal epilepsy in India with special reference to lesions showing ring or disc like enhancement on contrast computed tomography. J Neurol Neurosurg Psychiatry 1987;50:1298-301.

**Announcement**

**APICON 2008 Kochi**

**Venue:** Le Meridien Hotel and International Convention Centre, Maradu, NH Bypass, Kochi.

**Dates:** 10th to 13th January 2008

For further details contact:- **Dr. NN Asokan**, Org. Secretary APICON 2008, Muvattupuzha Medical Centre M.C.Road, Muvattupuzha.

Phone: 0485-2812215(Hosp); 2835480/81/82(Res); Mob: 9847031241, 9895844000

Email: drnnasokan@hotmail.com

Website for APICON 2008 is www.apicon2008.org