

# ANALYSIS OF PARAHIPPOCAMPAL GYRUS IN 115 PATIENTS WITH HIPPOCAMPAL SCLEROSIS

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**ABSTRACT - Purpose:** Analysis of the parahippocampal gyrus (PHG) involvement in 115 patients with hippocampal sclerosis (HS) by MR imaging. The simultaneous occurrence of ipsilateral fornix (F) and mamillary body (MB) volume loss was checked also. These findings were correlated with the side of hippocampal involvement, the sex, patient's age, and the symptoms onset. **Method:** The MR images of 115 patients with HS were studied retrospectively. All the examinations were performed on 1.5 T units (SIGNA, GE, Milwaukee, WI) and included high resolution coronal T2-weighted images (3 mm thickness, 0.6 mm gap). **Results:** The patient's age ranged between 3.5 and 80 years (mean 34.1); 62 (53.9%) were female and 53 (46.1%) were male. There were HS on the left side in 53 (46.0%), on the right side in 51 (44.3%), and bilateral in 11 (9.7%). In 43 (37.3%) cases there were ipsilateral PHG volume loss and signal hyper intensity on T2-weighted imaging. In 29 (25.2%) cases there were ipsilateral fornix volume loss and in 10 (34.5%) of this there were also ipsilateral MB changes. In abnormal PHG, 23 (53.4%) were on the left side, 17 (39.5%) were on the right side, and 3 (7.1%) were bilateral. There were fornix changes in 15 (34.8%) cases and MB volume loss in 5 (11.6%) cases. Pertinent clinical data were obtained in only 18 (41.8%) of the PHG lesion cases and 11 (61.1%) of these patients had epileptic attacks for more than 20 years before the examination. **Conclusion:** PHG involvement must be investigated in patients with HS and we suggest that the term mesial temporal sclerosis should be used only if there are also changes at this anatomical site.

**KEY WORDS:** hippocampal sclerosis, epilepsy, MRI, parahippocampal gyrus.

## Análise do giro para-hipocampal em pacientes com esclerose hipocampal: estudo de 115 casos

**RESUMO - Objetivo:** Analisar o envolvimento do giro para-hipocampal (GPH) em 115 pacientes com esclerose hipocampal (EH) à RM. Estudou-se a porcentagem dos casos com redução volumétrica do fórnix (F) e corpo mamilar (CM) ipsilaterais, lado acometido, sexo, idade e tempo de convulsão. **Método:** Estudo retrospectivo de 115 casos retirados do nosso arquivo. Foram realizados cortes coronais STIR (3mm de espessura com 0,6mm de espaçamento) em aparelhos GE, Signa Horizon, LX e CVI, 1,5T. **Resultados:** Nos 115 casos estudados, a idade dos pacientes variava entre 3,5 e 80 anos (média 34,1 anos); 62(53,9%) eram mulheres e 53(46,1%) eram homens; 53(46,0%) à esquerda, 51(44,3%) à direita e 11(9,7%) bilaterais; 43(37,3%) apresentavam GPH com dimensões reduzidas e hipersinal ipsilateral, 29(25,2%) fornix reduzido ipsilateralmente e destes, 10(34,5%) tinham CM alterado ipsilateral. Dos GPH alterados, 23(53,4%) à esquerda e 3(7,1%) bilaterais; 15(34,8%) redução de volume CAF e 5(11,6%) no CM. Sabíamos o tempo de crises de 18(41,8%) pacientes com alteração do GPH e destes, 11(61,1%) apresentavam crises há mais de 20 anos. **Conclusão:** Concluímos que o radiologista deve estar ciente do envolvimento do GPH nos pacientes com esclerose do lobo temporal e sugerimos que o termo esclerose mesial temporal deva somente ser utilizado na presença de alterações do mesmo.

**PALAVRAS-CHAVE:** esclerose hipocampal, epilepsia, ressonância magnética, giro para-hipocampal.

Hippocampal sclerosis (HS) is the most common abnormality (50-70%) in association with temporal lobe epilepsy (TLE)<sup>1-4</sup>. It is characterized by neuronal loss and gliosis with atrophy and sclerosis. The temporal lobe epilepsy can be treated surgically in cases that are not controlled by drugs, because 70-90% of these patients become seizure free or have spo-

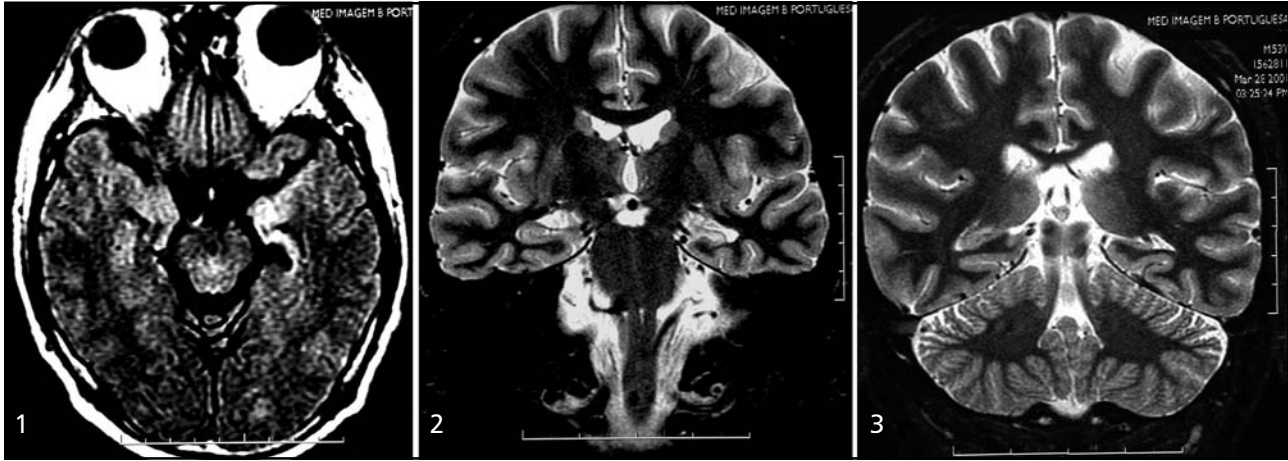
radic ones after surgery<sup>1,5</sup>. The presurgical diagnosis of HS is important for the surgical success<sup>5</sup> and is essential to determine the abnormal side<sup>4</sup>.

Magnetic resonance (MR) has become the most important imaging method to study patients with TLE, because morphological abnormalities and their extension can be easily identified<sup>6</sup> (Figs. 1-4,7,8 and 10).

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Figs 1, 2 and 3. Axial FLAIR and coronal STIR T2WI show hyper intensity in all left hippocampus and amygdala, with volumetric reduction of them.

The hippocampi, fornices and mammillary bodies are components of the limbic system. The hippocampi fibers project to the mammillary bodies through the fornices. It was previously suggested that if there is hippocampal neuronal damage, it will cause ipsilateral fornix and mammillary body atrophy as a result of transneuronal degeneration<sup>7</sup>. Adjacent parahippocampal gyrus white matter (PHGWM) reduction<sup>1,5,8,9</sup> can be another associated finding (Figs 6 and 10) and is thought to be the cause of recurrent seizures after the first surgery (10-20%)<sup>10</sup>, as reported in previous studies. These patients were submitted to a new surgical intervention for extension of mesial resected areas, with good results in most of the cases<sup>11,12</sup>.

This study proposal is to investigate the frequency of affection of PHGWM, fornix (Figs. 5A and 9A) and mammillary body (MB) (Fig. 5B) in HS patients, using MR images, trying to determine the importance of this finding in presurgical examination for TLE surgery.

## METHOD

We retrospectively studied the MRI examinations of 115 patients with HS and the following data were recorded: sex, age, time of epilepsy, affected hippocampus, fornix and MB side. There were 62 women (53.9%) and 53 men (46.1%) with ages ranging from 3,5 to 80 years (mean age 34.1y).

All images were obtained using a 1.5T GE, Signa (Horizon, CVI and LX) magnets with sequences coronal and sagittal STIR T2WI, axial and coronal FLAIR, axial FSE T2WI, axial Gradient-echo T2\*WI and coronal T1WI pre- and postcontrast (Gd-DTPA) sequences.

The used criteria to characterize the HS side were<sup>1</sup> visual evaluation of hippocampal volume<sup>5</sup>, hyper signal in T2WI and disorganization of hippocampal structures<sup>13</sup>, seen in at least two consecutive slices; the same criteria was used for PHGWM analysis. Fornix and MB were analyzed for asymmetry (atrophy).

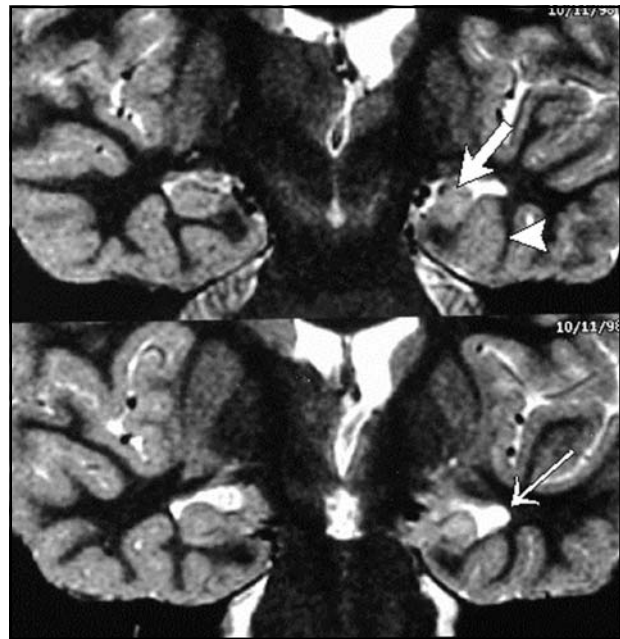


Fig 4. Coronal STIR T2WI - Hyper intensity and abnormal rotation of the left hippocampus (arrow), characterized by atypical aspect of the temporal horn of the left lateral ventricle (thin arrow) and by vertical adjacent collateral sulcus (arrowhead).

Although the quantitative volumetric analysis is more sensitive to detect subtle hippocampal atrophy, the qualitative (visual) analysis can be used in hippocampal assessment<sup>13</sup>.

There was no information in our files concerning clinical presentation that could be related with imaging aspects.

## RESULTS

It was found HS on the left side in 53 patients (46.0%), on the right side in 51 (44.3%) patients and bilateral in 11 patients (9.7%); 43 cases (37.3%) had ipsilateral PHGWM reduction and hypersignal on T2WI; we observed ipsilateral fornix reduction in 29

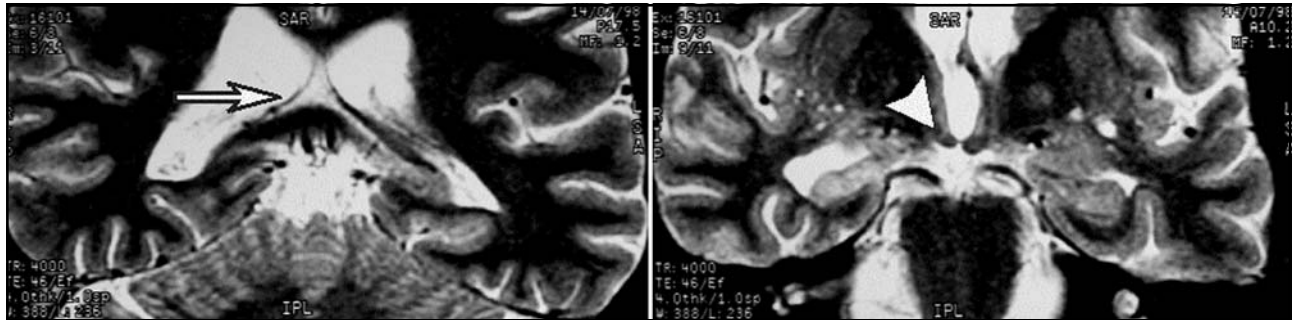


Fig 5 A and B. Atrophy of the right fornix (arrow) and ipsilateral mammillary body volumetric reduction.

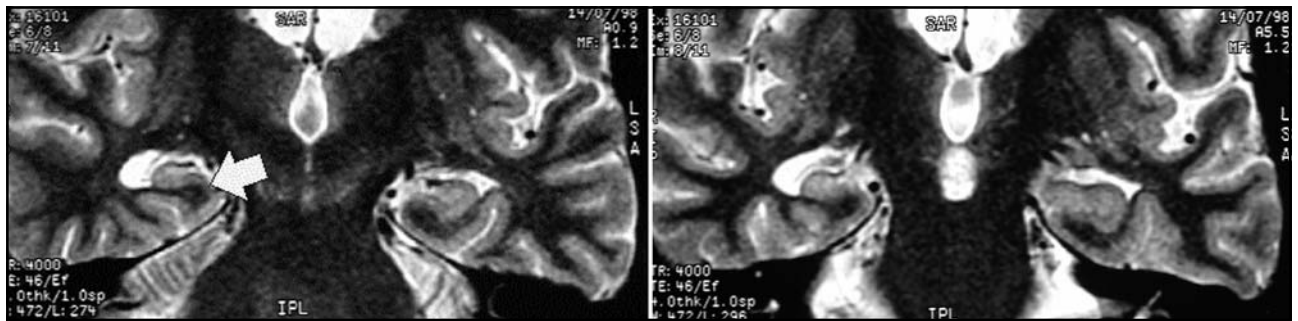


Fig 6 and 7. Right hippocampal sclerosis with mild PHGWM volumetric reduction (arrow).

patients (25.2%) and 10 (34.5%) of these had ipsilateral MB alteration. There were no cases of hippocampal damage with fornix or MB alteration on the normal side.

The duration of the epileptic symptoms were between 2 days and 44 years (mean age 19.7 years); One patient with MR performed 2 days after the first episode had fornix and MB alteration.

There were 23 (53.4%) epileptic patients with PHGWMA abnormalities at the left side, 17 (39.5%) at the right and 3 (7.1%) bilateral; 15 (34.8%) and 5 (11.6%) had fornix and MB reduction, respectively (table). There was no gender preference. The duration of the epileptic symptoms was known in 18 (41.8%) patients and 11 (61.1%) of them with seizures for more than 20 years.

PHGWMA, parahippocampal gyrus white matter abnormalities; ES, epilepsy symptoms; F, fornix; MB, mammillary body.

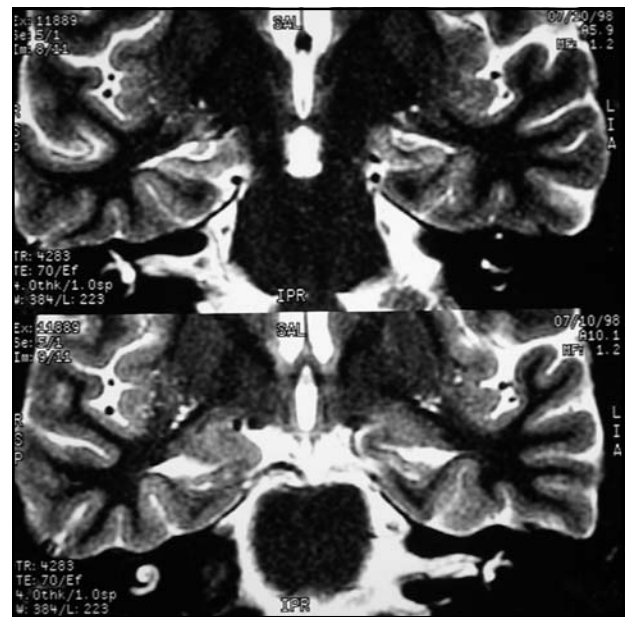


Fig 8. Coronal STIR T2WI - Bilateral hippocampal atrophy.

Table. Hippocampal sclerosis x PHGWMA

	N	Right	Left	Bilateral	ES	F	MB	♀	♂
HS	115	51 (44.3%)	53 (46.0%)	11(9.7%)	19.7 anos	29 (25.2%)	10 (34.5%)	53 (46.1%)	62 (53.9%)
PHGWMA	43 (37.3%)	17 (39.5%)	23 (53.4%)	3 (7.1%)	22.2 anos	15 (34.8%)	55 (11.6%)	22 (~50%)	21 (~50%)

PHGWMA, parahippocampal gyrus white matter abnormalities; ES, epilepsy symptoms; F, fornix; MB, mammillary body.

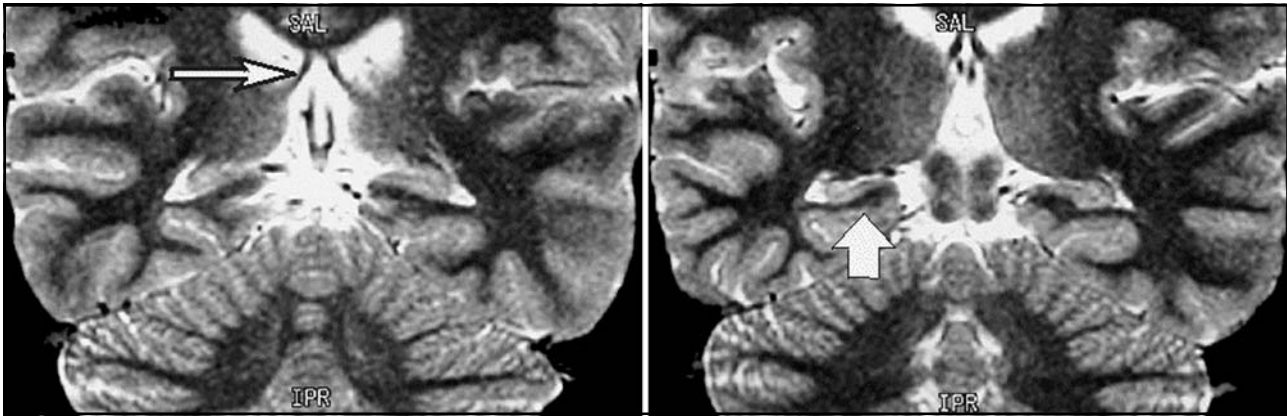


Fig 9 A and B. Right hippocampal sclerosis in association with mild parahippocampal gyrus hyper intensity on T2WI (short arrow) and ipsilateral fornix atrophy (thin arrow).

## DISCUSSION

The importance of a abnormal MR imaging in the diagnosis of HS is its higher rate of surgical cure in temporal lobe epilepsy (70-90%) in contraposition to the 50% in patients with normal MR imaging. The most important take home message to the radiologist is the use of the correct name of this entity, because HS is not mesial temporal sclerosis (MTS) synonymous. We also suggest that the term MTS should be used only in cases that present also PHGWM affection.

There were 43 (37.3%) patients with PHGWM abnormalities in this group of 115 cases. Another important fact was the correlation between parahippocampal gyrus findings and the duration of the epileptic syndrome that was more common in patients that had over 20 years of symptoms.

There was not significant difference in HS side (44.3% at right and 46% at left). PHGWM atrophy was slightly more common on the left side (53.4%). This does not necessarily indicate that side predisposition to PHGWM abnormalities exists. The average duration time of epilepsy in patients with abnormal PHGWM on the left side was longer (26 years) than on those with affection of the right side (16.7 years).

Bronen and col.<sup>5</sup> studied 9 patients and found 77% of PHGWM abnormalities, what is not in accordance with our findings (37.3%). It has to be considered the small size of their studied population (9 cases) and also the fact that the duration of symptoms is not specified in their paper. Meiners and col.<sup>9</sup> studied 80 patients with HS and found 68% of abnormal PHGWM. In their paper the duration of symptoms is not specified either. The percentages found by Oppenheim and col.<sup>8</sup> are in accordance with our own, despite the smaller number of cases (59)

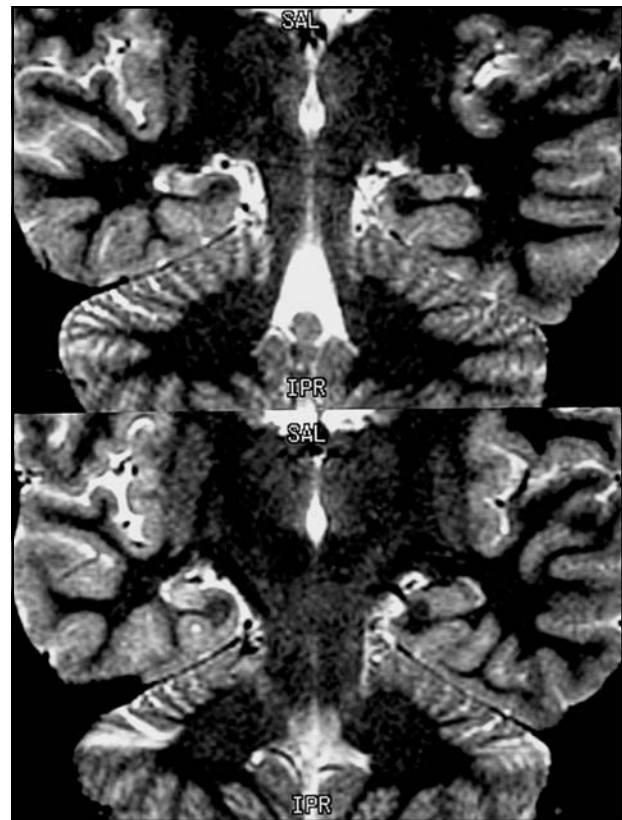


Fig 10. Right hippocampal sclerosis and parahippocampal gyrus hyper intensity in T2WI.

presented by them. Kim and col.<sup>7</sup> studied 33 patients with HS analyzing fornix and MB asymmetry and found 39% of abnormal fornices against 34.5% found in our series; but they had a small number of cases and didn't specify how long the symptoms last. It's important to mention that in their study, they found abnormal fornices in 6% of the cases in a control group, showing that asymmetry can exist in seizure free patient.

The limitations of the current paper were: 1- We did not have information concerning the duration of the symptoms in all of the patients (45 of 115 patients); 2- The MB analysis was impaired because of the retrospective nature of this study, where pre-existing films were reviewed and MB images were not always included. 3- A great number of cases were not pathologically proven. 4- The clinical presentation of the seizures was not always reported in the cases found in our radiological teaching files.

### CONCLUSION

It was shown that hippocampal sclerosis was more common in women and the parahippocampal gyrus white matter involvement occurred in 37.3% of the cases. The knowledge about parahippocampal gyrus white matter involvement in temporal lobe epilepsy cases is important and we suggest the use of the term mesial temporal sclerosis only in cases where this gyrus is involved.

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