

Hippocampal sclerosis in mesial temporal lobe epilepsy studies by MRI Texture analysis

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AIM OF THE WORK

- Mesial temporal refractory epilepsy is often associated to an ipsilateral hippocampus sclerosis
- From FALCONER surgery (1950), surgical therapy is able to stop the crisis.
- However a relapsing disease can be observed and would be depending of a **NACLH** in which:
- A middle sclerotic is difficult or impossible to identify on the basis :
- of a clinical and a qualitative MRI analysis.
- Is a **Texture Analysis** of a **NACLH** MRI able to characterise its structure as actually **normal or sclerotic** ?

Quantitative structural and biochemical NAWGM studies is a challenge for NMR in epilepsy, multiple sclerosis and other degeneratives diseases

- MRI : T1, T2, Pr.D. weighted images ,ROI Vol. for characterising : inflammatory processes: oedema, gliosis, atrophy.
- MRSI: NAA/Ch, NAA/ Cr, NAA/ Cr + Ch, Glx,...for characterising
- neural loss.
- DWI, Diff. Tenseur MRI / ADC, F.A. M.D., for characterising structural diffuse and localised changes (anisotropy)
- MTI : MTR for characterising biochemical and structural changes in the lesioned tissue as non active MT material : lipids, oedema,...
- In correlation with other conventional techniques:
- EEG, SEEG, MEG (synchronous electrical activities) SPECT (Ictal hyper perfusion) PET (interictal hypometabolic activities, receptors density)

Communications about NMR NAWGM in MS and
EPILEPSY at the 9th ISMRM and the 18th joint annual
meeting in Glasgow

	NACLH-NAWM studies	IPSIL.HIP.,MS Pl. studies	Texture Analysis
EPILEPSY	10	4	2
M.S.	26	8	4

Material and Methods

Patients

23 patients with clinical and EEG evidence of unilateral refractory mesial temporal epilepsy

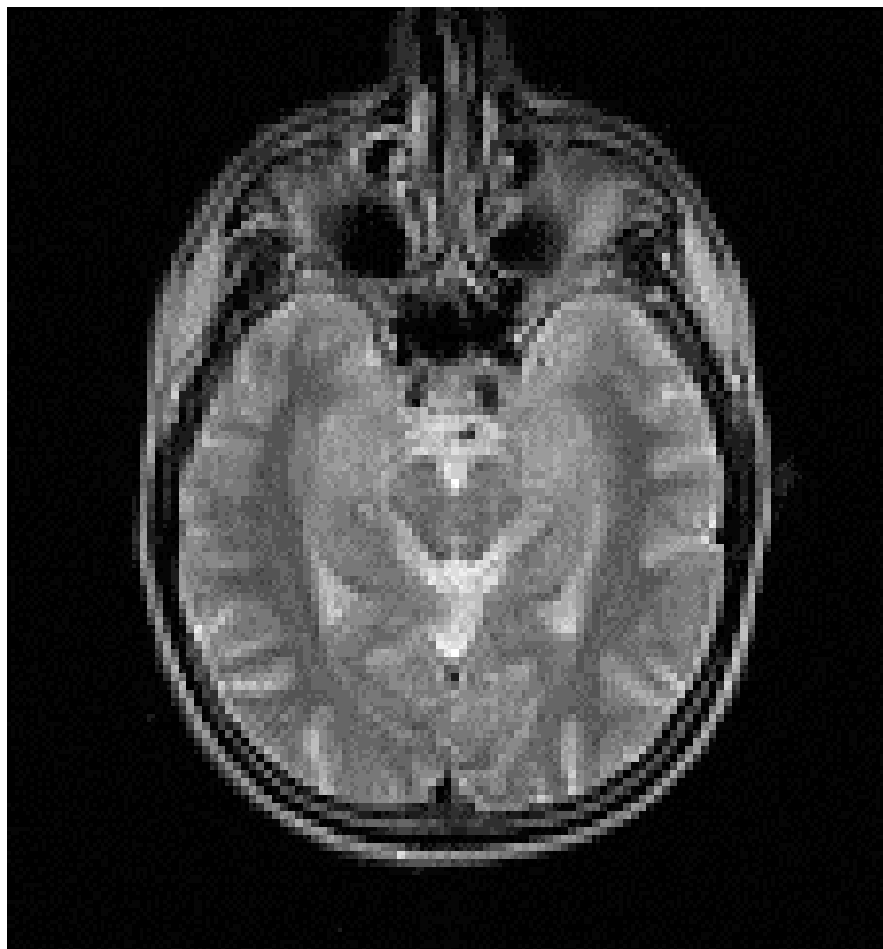
Ipsilateral signs of hippocampal sclerosis on MRI

Interictal hypovascularisation by SPECT

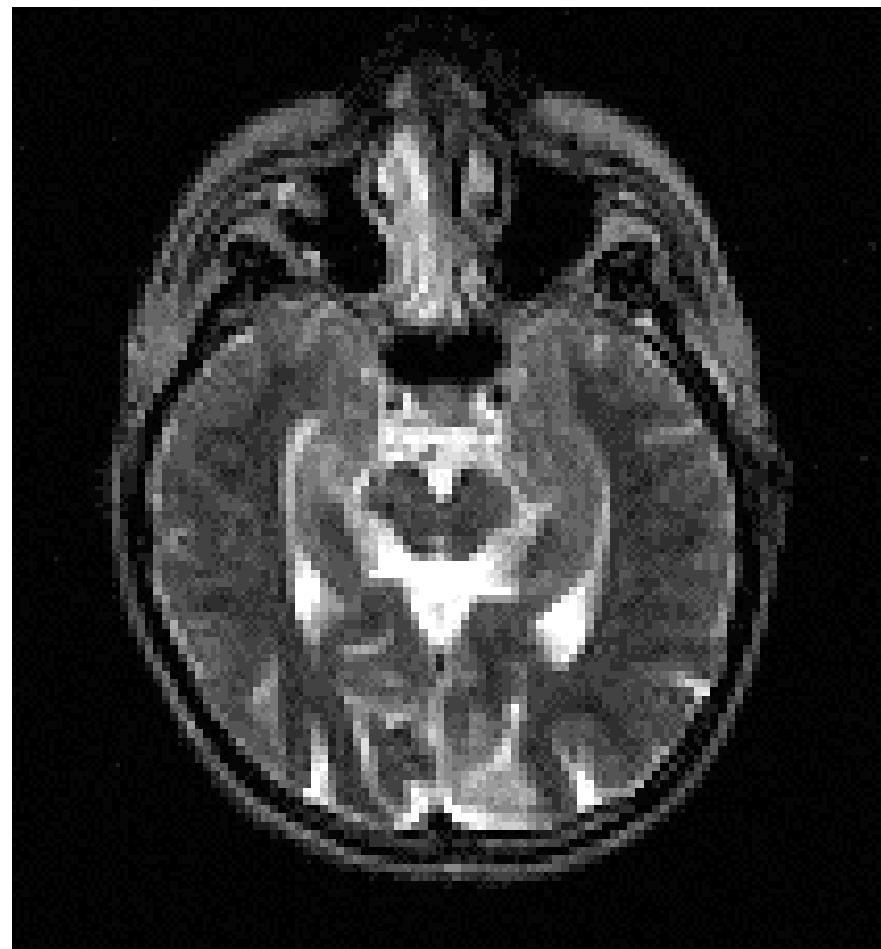
Absence of visual contralateral abnormalities on MRI

Control subjects

Control subjects without epilepsy in their medical history



CONTROL SUBJECT



RIGHT HIPPOCAMPAL
SCLEROSIS

Quantitative MRI and MRS studies in Temporal Lobe Epilepsy

- control subjects patients
- Ipsilateral controlateral
- Mean NAA/Cho+Cr : **0.66** **0.43** **0.56**
- ROI Vol.:3,4 ml
- 3 T. PRESS CHESS
- Normal range ratio : **0.55-0.88**
- T2 Mean (msec) : **118.5** **140.1** **123.6**
- T2 cut of > 1000 CSF suppress.
- T2 distrib.range: **113.9-122.1** **125.1-169.1** **116.1-146.6**
- 0.28 T. 6 mm slice ROI Vol.23mm3CPMG TR 2000ms TE 15 ms 48 echoes
- Normal T2 max.(W. Van Paesschen et al. Neurology 45 2233 1995 :116)
- I.J. Namer Epilepsia 40 1424-1432 1999

Method of classification

- Ipsilateral Hippocampi of the patients and hippocampi of the control subjects are classified into two groups:
 - Sclerosed Ipsilateral Hippocampi : **HS**
 - Normal Ipsilateral Hippocampi : **HC**
- Based on a incremental canonical discriminant fonction Analysis
 - Two fonctions of classification are determined :
- F (HC) and F (HS) for the 1st Echo Image and the 10th Echo Image
- the features which contributes least to the prediction group membership are eliminated

Classification fonctions

1st echo image

10 th echo image

b F(HC)

b F(HS)

b F(HC)

b F(HS)

78.1 **ENT04**
-10.2**COR33**
-29.6

100 **ENT04**
-7.3**COR33**
-46.6

494.5**COR01**
433.1**DENT04**
183.6**COR33**
88.9**DVAR40**
43.7**CON03**
21.4**SAV44**
-10.7**CON44**
-14.5**SAV22**
-67.8**DENT44**
-633.6

469.4 **COR01**
425.4 **DENT04**
168.7**COR33**
80.0**DVAR40**
42.3**CON03**
20.2**SAV44**
-10.0**CON44**
-13.4**SAV22**
-51.3**DENT44**
-578.2

Discriminant fonction
based on the first order
statistic features as variables
cannot be determined

Comparison of clinical classification and texture analysis classification of the epileptic patients and control subjects

Ipsilateral Hippocampi

both the left and right hippocampi of the 9 control subjects were taken in account in the discriminant procedure

1 st echo			
		clinical classification	
		sclerosis	normal
Texture Anal Classif	sclerosis	20	0
	normal	3	18*

Sensitivity $S = 20/23 = 86.9\%$

Specificity $F = 18/18 = 100\%$

Accuracy $A = 38/41 = 92.7\%$

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Ipsilateral Hippocampi

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10 th echo			
		clinical classification	
		sclerosis	normal
Texture Anal Classif	sclerosis	23	0
	normal	0	18*

Sensitivity $S = 23/23 = 100\%$

Specificity $F = 18/18 = 100\%$

Accuracy $A = 41/41 = 100\%$

Comparison of clinical classification and texture analysis classification of the epileptic patients and control subjects

Controlateral Hippocampi

both the left and right hippocampi of the 9 control subjects were taken in account
in the discriminant procedure

1 st echo		
		clinical classification
		normal
Texture Anal Classif	sclerosis	14
	normal	9

Comparison of clinical classification and texture analysis classification of the epileptic patients and control subjects

Controlateral Hippocampi

both the left and right hippocampi of the 9 control subjects were taken in account in the discriminant procedure

10 th echo		
		clinical classification
		normal
Texture Anal Classif	sclerosis	15
	normal	8

Classification of the epileptic patients in fonction of their controlateral hippocampus structure as determined by the texture analysis

Comparison with their T2 and MRS Data

3 classes	HS 1 st echo HS 10 th echo	HS 1 st HC 10 th HC 1 st HS 10 th	HC 1 st echo HC 10 th echo
T2 and NAA/Ch+Cr normal	4	3	2
T2 or NAA/Ch+Cr normal	2	4	2
T2 and NAA/Ch+C abnormal	2	4	0

**Comparison of the T₂ and the NAA/Ch+Cr ratio with
the contralateral hippocampus structure
as determined by texture analysis**

Naa/(cho+cr)	T ₂ (ms)	1 st Echo	10 th Echo
.47	<u>118</u>	C	C
.547	126	C	C
.47	<u>120</u>	C	C
<u>.55</u>	<u>118</u>	C	C
.498	<u>116</u>	C	S
<u>.573</u>	<u>117.9</u>	C	S
.43	146	C	S
.494	<u>122</u>	C	S
.51	<u>118</u>	C	S
<u>.73</u>	<u>120</u>	C	S
.388	138.8	S	C
<u>.650</u>	<u>120.5</u>	S	C
.536	126.7	S	C
.499	<u>121</u>	S	C
<u>.712</u>	<u>118</u>	S	C
.546	<u>122</u>	S	S
<u>.612</u>	<u>118</u>	S	S
.47	123	S	S
.534	<u>120.1</u>	S	S
.44	137	S	S
<u>.666</u>	<u>120</u>	S	S
<u>.661</u>	<u>118</u>	S	S
<u>.73</u>	<u>118</u>	S	S

Conclusion

Texture Analysis is a promising way to characterise
structural abnormalities
in the Normal Appearing Brain Tissue in epilepsy
, particularly useful
as a presurgical test in the drug resistant seizure

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.494	122	C	S
.51	118	C	S
.47	120	C	C
.499	121	S	C
.712	118	S	C
.546	122	S	S
.612	118	S	S
.47	123	S	S
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