中华医学会核医学分会
技术与继续教育学组

中华医学会核医学分会第十一届委员会
技术与继续教育学组
系列专家讲座

PET/MR在癫痫术前定位中的应用价值

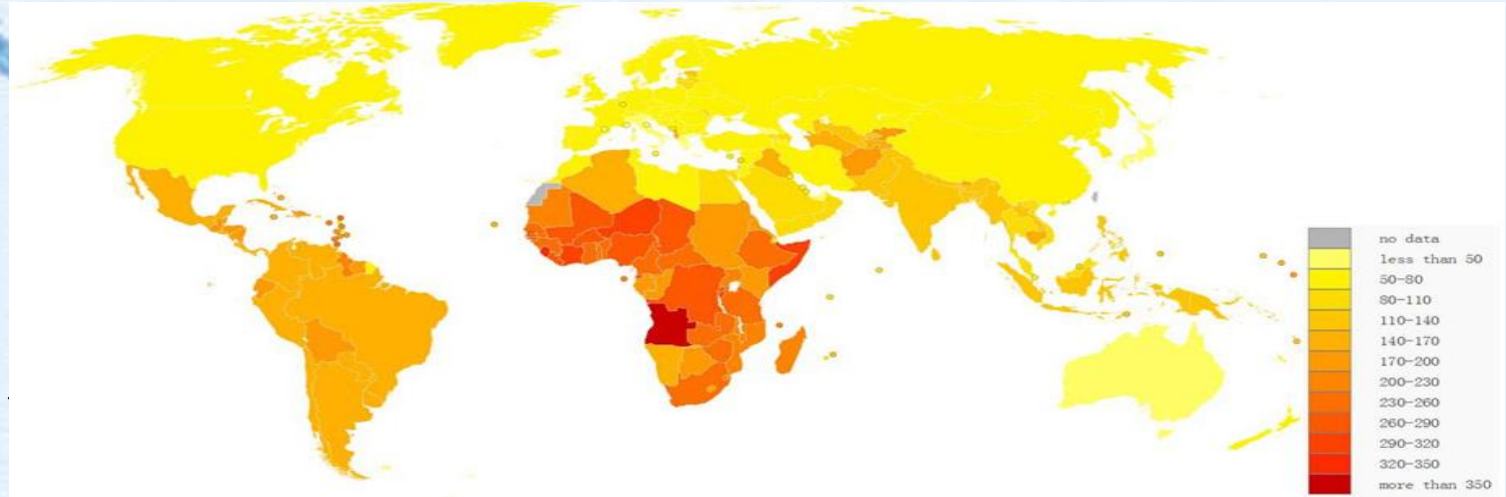
PET/MR and preoperative localization of seizure focus in refractory epilepsy patients

袁梦晖
空军军医大学第二附属医院核医学科
2019年

- 空军军医大学第二附属医院核医学科 副主任医师、副教授
- 科室副主任
- 中华医学会核医学分会技术与继续教育学组委员、陕西省核学会核医学分会副理事长、陕西省医师协会核医学分会常委

Epilespsy

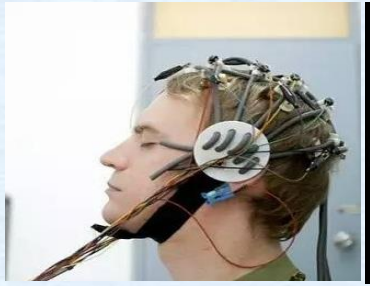
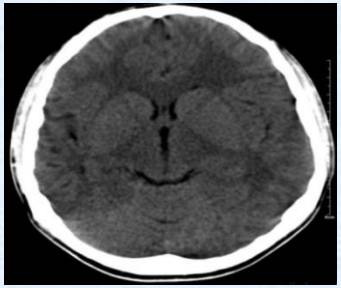
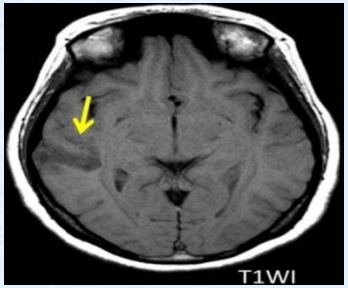
- Surgery is effective for patients with focal onset medically refractory epilepsy
- It requires definitive identification of the epileptogenic focus.
- And the localization of the epileptic focus with multimodal concordance is crucial for a good postoperative outcome.

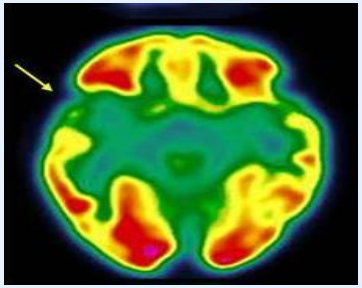


Oldan JD, et al. Seizure, 2018 Oct

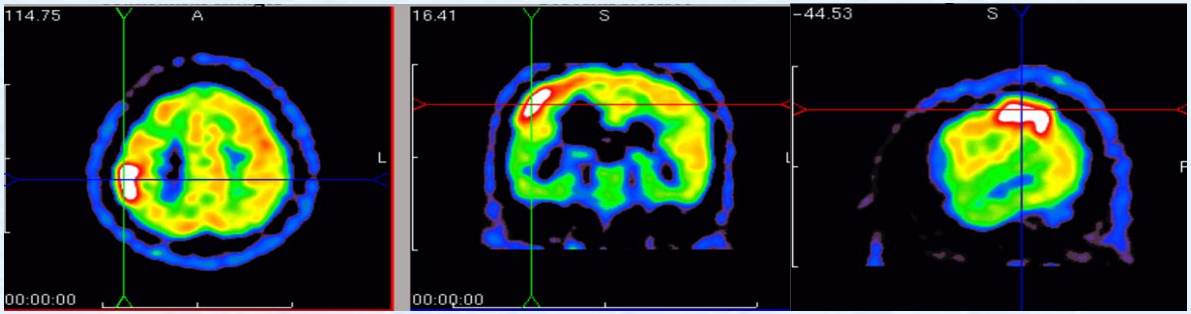
Identification of the epileptogenic focus

Loc electrode	VEEG	CT	MRI	Functional Imaging

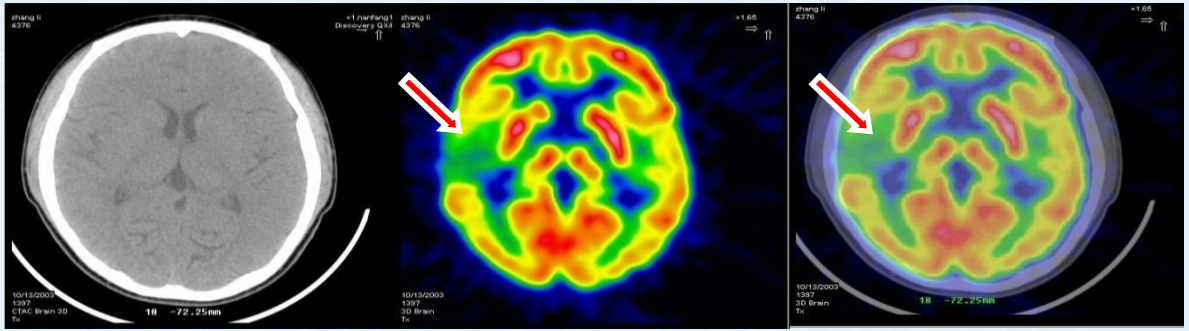







^{18}F-FDG PET and identification of the epileptogenic focus

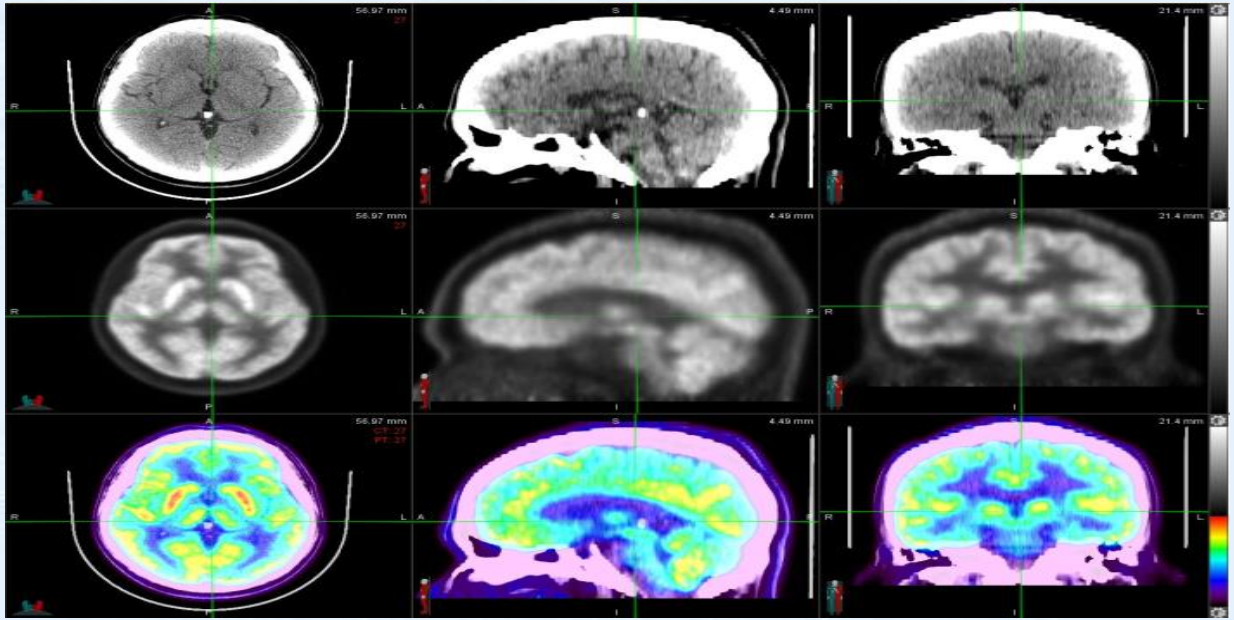


inphase ^{18}F-FDG PET imaging



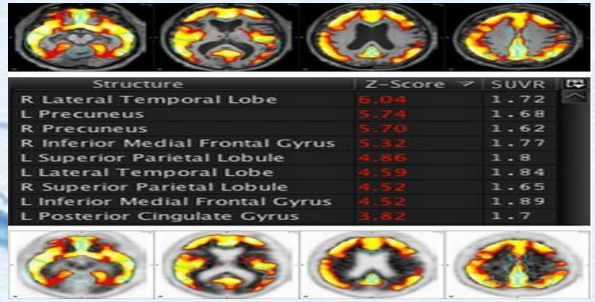
interphase ^{18}F-FDG PET imaging

Inadequate preoperative localization of ^{18}F-FDG PET

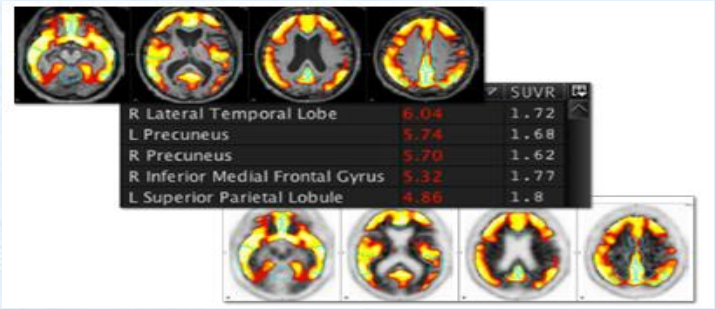


a. Visually apparent hemisphere asymmetry subjected to several sources of variablity, and therefore, relatively unreliable.
b. Subtle lesions are difficult to detect

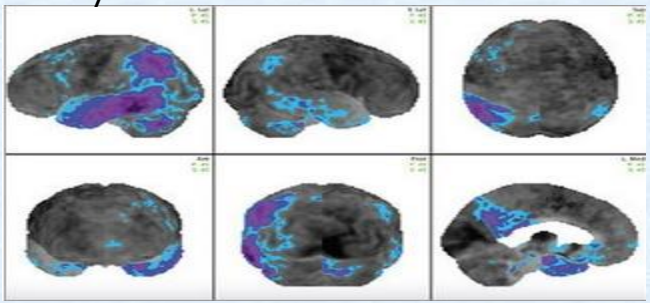
Construction of a novel Chinese normal brain database using ^{18}F-FDG PET images and MIM neuro software



Automated quantiative analysis



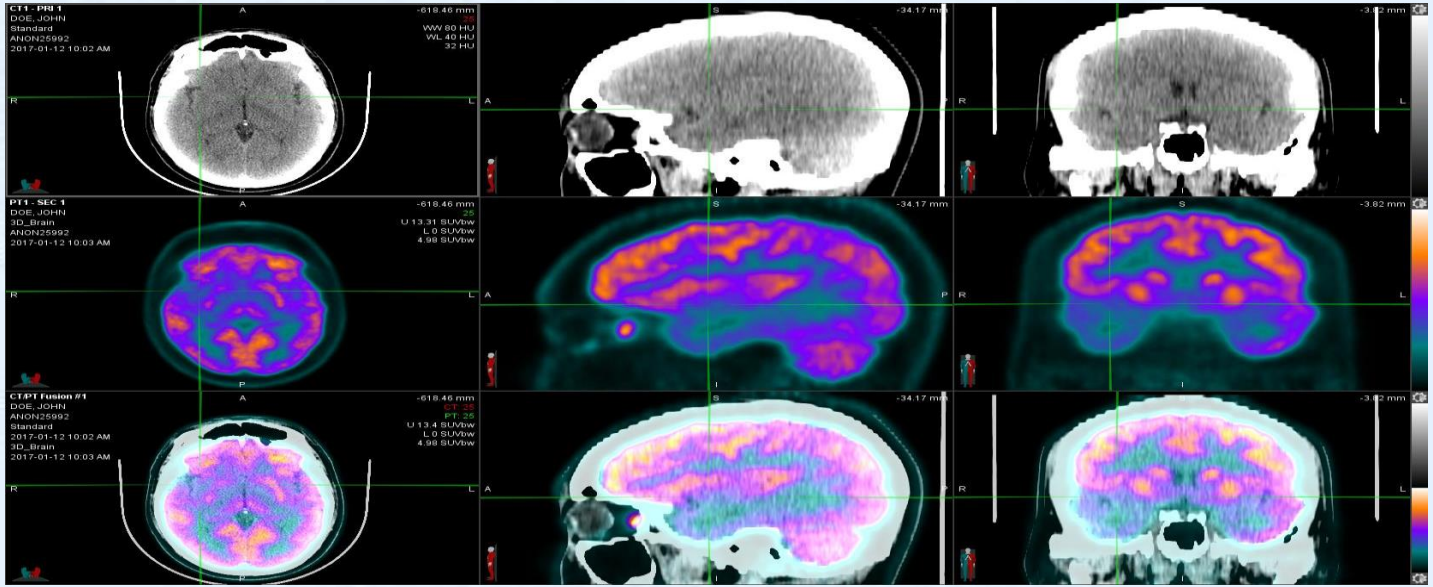
Accurate Registration technique



Easy visual analysis

Case 1

F, 23Y, Resistant to drug.



Visual analysis: Hypometabolism in right temporal lobe

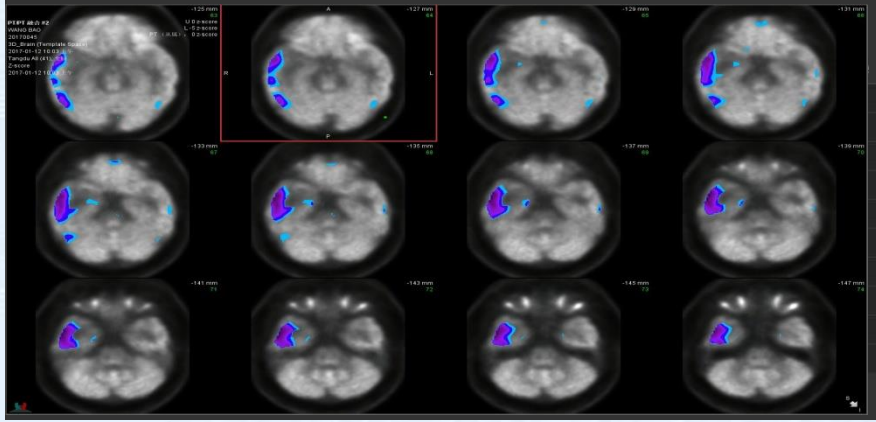
Z-Score List: Hypo

Patient Name: WANG BAO

Acq. Time: Jan 12, 2017 10:03:18 AM

Patient ID: 20170045

Comparison Sets: Tangdu All

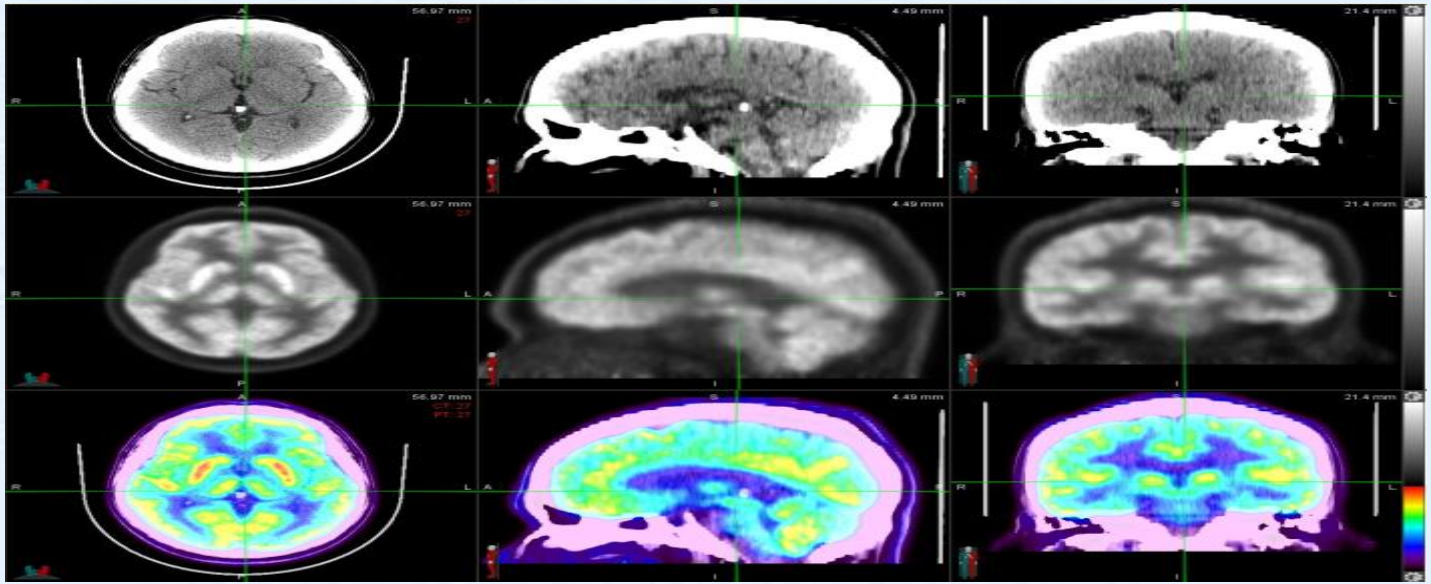


R Z-Score	L-R % Diff	L-R % Diff Z-Score
-4.09	19.47	4.65
-3.02	5.90	4.10
-1.92	2.17	0.79
-3.71	9.13	5.63
-3.25	7.84	4.59
-1.58	-0.24	0.18
-1.68	6.41	1.25
-2.06	6.50	2.33
-1.80	2.41	1.89
-1.79	30.33	5.44

QA：right temporal lobe *Z-Score*=-4.09，absolute value>1.96，
left temporal lobe *Z-Score*=-0.87

Case 2

M，27y，drug ineffective, surgical treatment was planned.



Visual analysis: Glucose metabolism of Cerebral cortex is normal.

Z分值列表： 偏低

病例姓名： ZHANG JIE

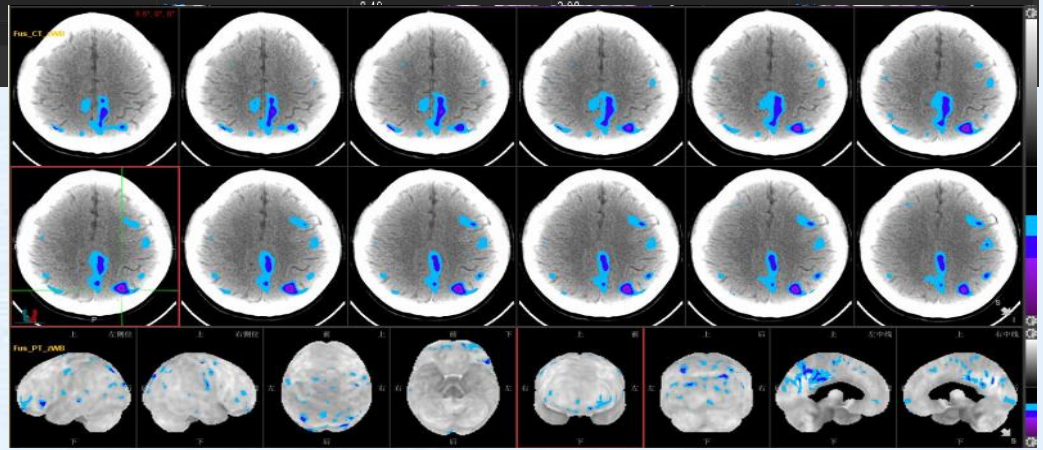
获取时间： 五月 3, 2017 10:19:38 上午

病例号： 20170589

对比集： Tangdu All

归一化结构： 全脑

Atlas	结构	Z分值 ▲	左Z分值	右Z分值	左右差别百分比	L-R % Z分值差异
MIM概率Atlas	Posterior Cingulate Gyrus 8/10	-2.25	-2.49	-1.45	-2.77	-1.45
单脑Atlas	Posterior Cingulate Gyrus	-2.19	-2.62	-1.62	-1.51	-1.73
单脑Atlas	Precuneus	-2.11	-1.81	-2.28	3.11	0.14
MIM概率Atlas	Precuneus 8/10	-2.10	-1.67	-2.23	2.98	0.39
单脑Atlas	Parietal Lobe	-1.74	-1.59	-1.57	-1.76	-0.49
单脑Atlas	Anterior Orbital Gyrus	-1.43				
单脑Atlas	Middle Orbital Gyrus	-1.43				



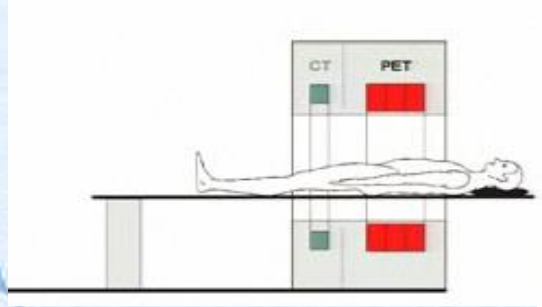
QA：

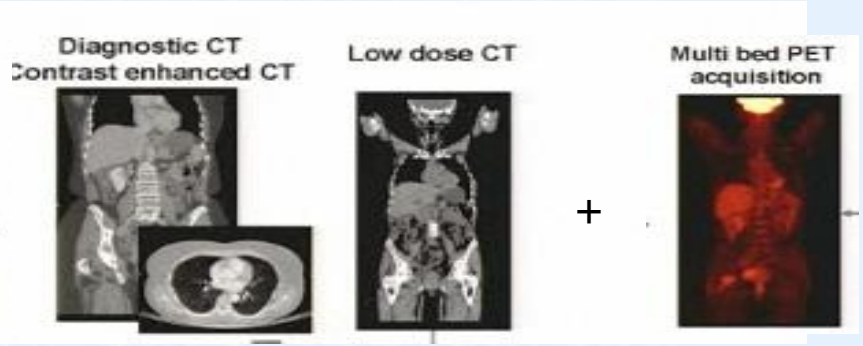
left parietal lobe *Z-Score*=-2.49，

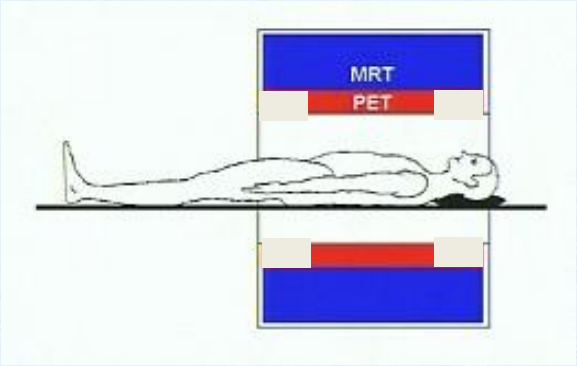
absolute value>1.96，

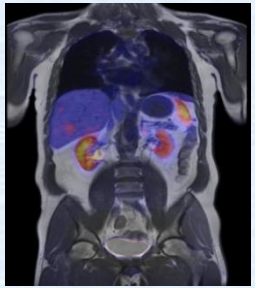
right parietal lobe *Z-Score*=-1.21

Advantage of PET/MR vs PET/CT



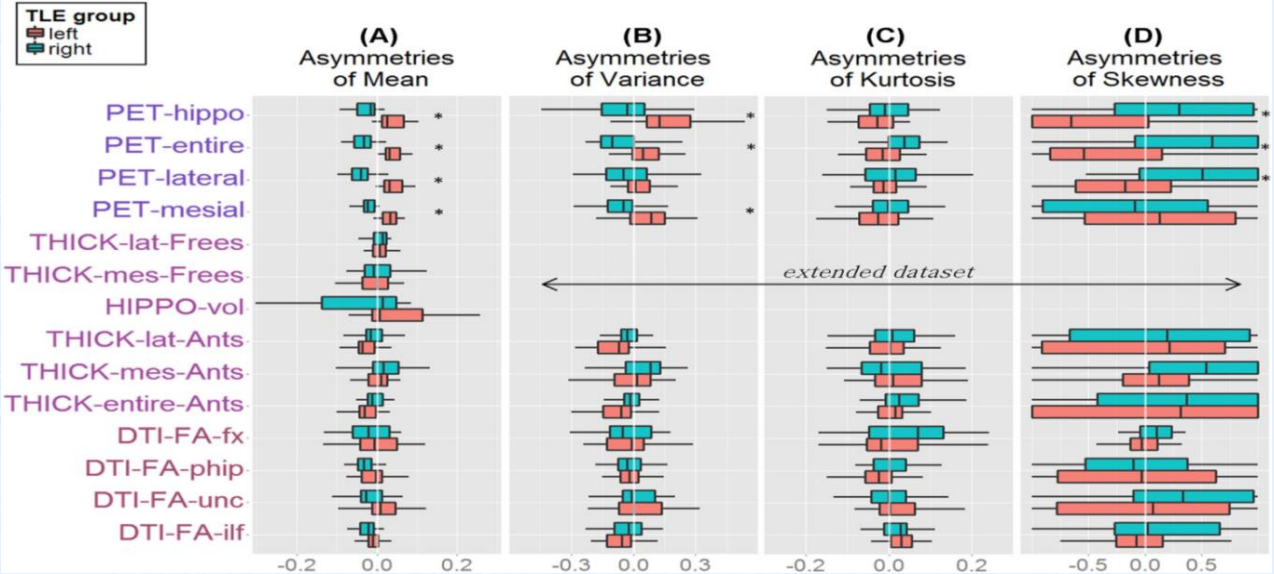






mMR

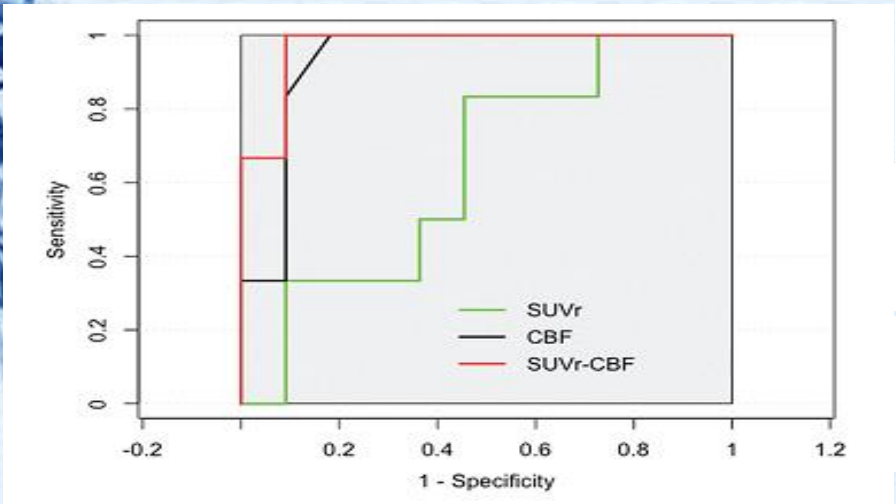
PET/MR based multiparametric imaging and Seizure focus localization

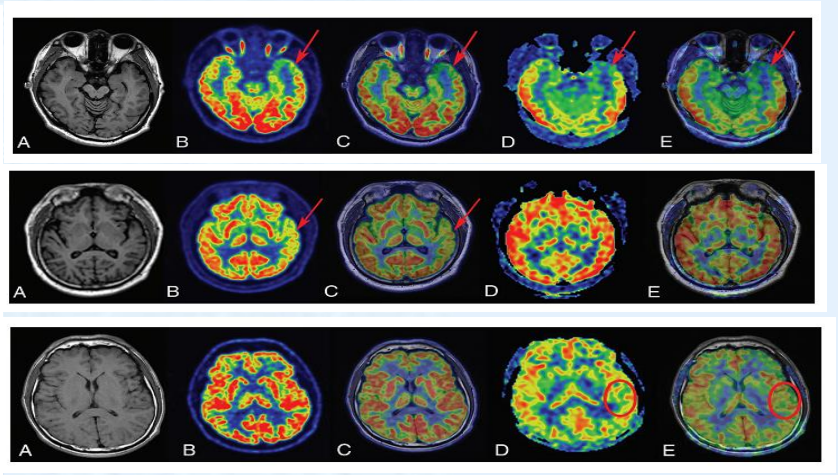


PET（Glucose metabolism）、MRI（cortex thickness）、DTI（FA）bilateral asymmetry was assessmented for preoperative localization，muitimodal localization is more effective than any single scan，PPR reached 100%.

D. Pustina et al. NeuroImage: Clinical. 2015, 20–31

PET/MR based multiparametric imaging and Seizure focus localization

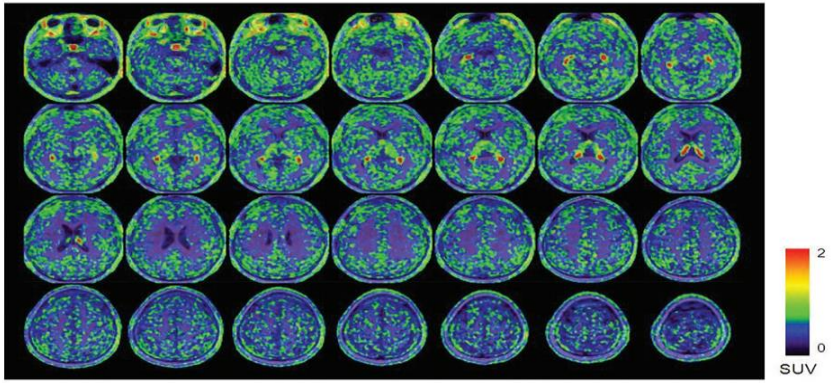




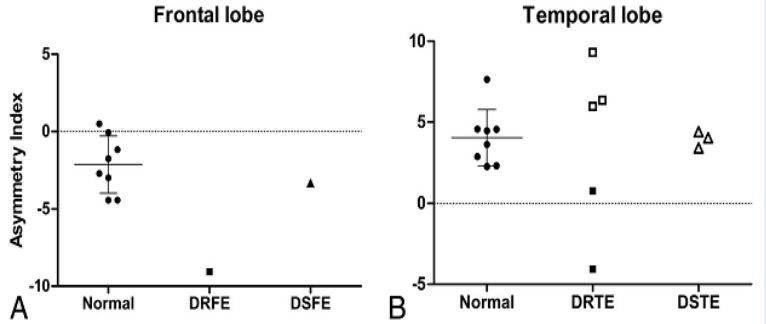
Receiver operating characteristic curves for SUVr, CBF, and combined SUVr and CBF to predict EZ, The combined PET and ASL obtained the highest area under the curve(0.97) with high sensitivity(100%) and specificity(90.9%), which showed the best performance in specificity for predicating EZ.

K. Shang et al. NAJNR Am J Neuroradiol 2018, 39:1791–98

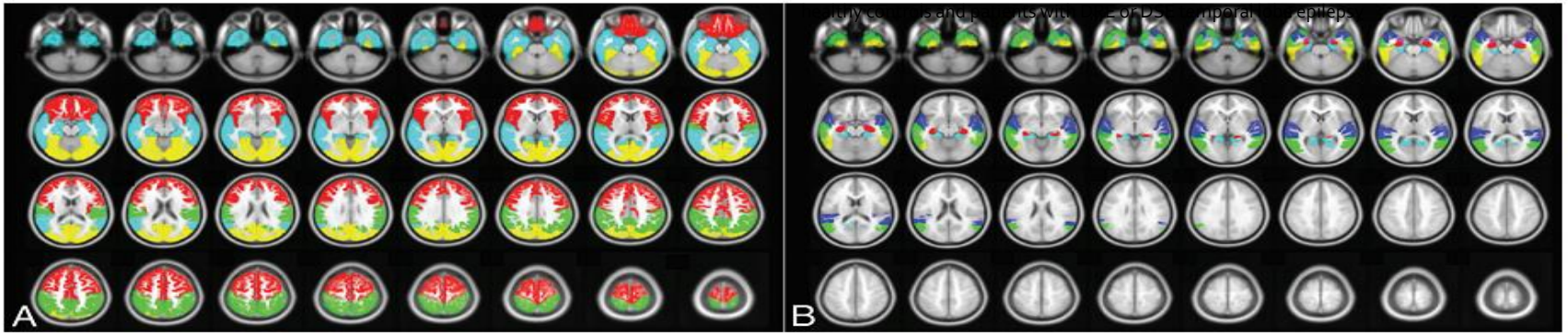
PET/MR based multi-tracer imaging and Seizure focus localization



(R)-[11C]-verapamil PET/MR uptake images in a patient who had drug-resistant left neocortical temporal lobe patients

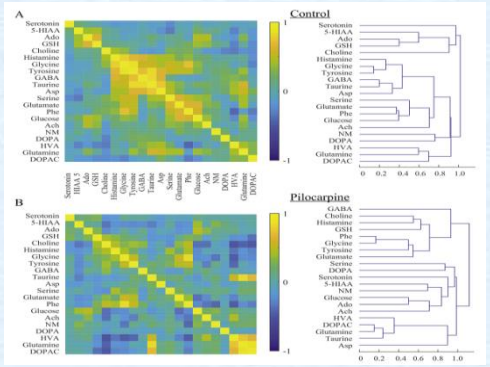


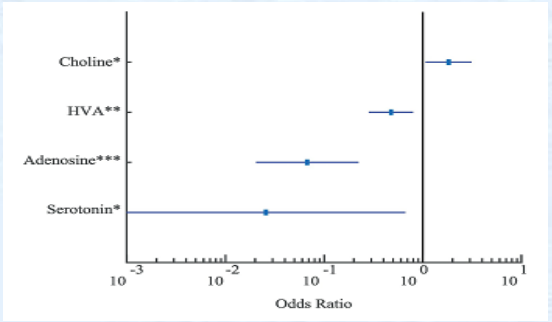
A, Asymmetry indices of the frontal lobes in healthy controls and in patients with drugresistant or drug-sensitive right frontal lobe epilepsy. B, AIs of temporal lobes in

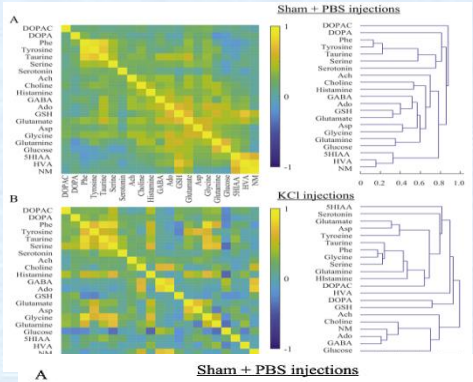


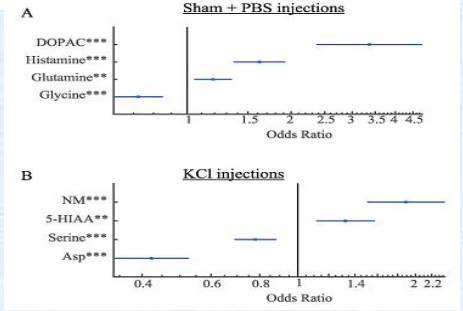
T1-weighted MR images (axial view, A) marking volumes of interest including the frontal, parietal, temporal, occipital cortices, and temporal ROI(B)

Processing new biomarkers of epileptogenesis









When increasing the hippocampus seizure risk, the concentrations of normetnephrine, serine, aspartate, and 5-hydroxyindoleacetic acid were the most prominent.

Luna-Munguia H, et al. Neurobiol Dis. 2018 Oct

PET/MR Scan in our unit

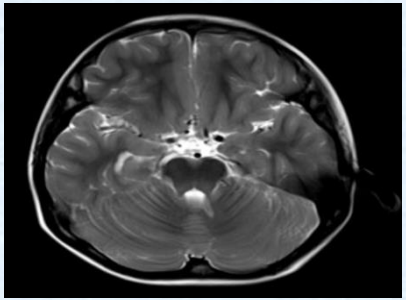
	Sequence
Loc	3-pl Loc PET Task
Attenuation correction	MARC
MRI routine sequence	Tra T2 TSE
	Tra T1 TSE
	Tra T2 FLAIR
	Tra DWI b
MRIspecial sequence	Sag T2 FLAIR Cor T2 FLAIR SPACE DIR Tra DTI MRS Tra Rest BOLD

Case 3

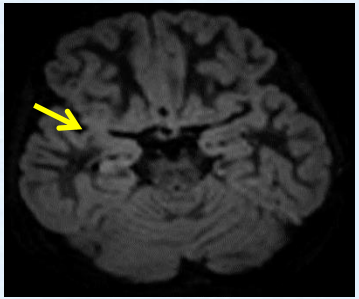
M, 9y,refractory epilepsy.

PET/MR showed hypometabolism in the right temporal lobe and hippocampus

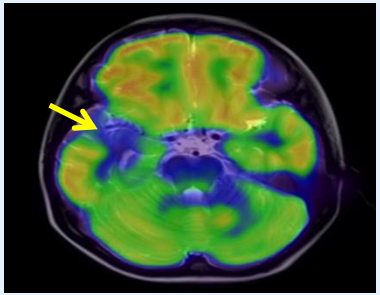
MR showed the gray matter in the right hippocampal area is not clearly demarcated, the cortex is relatively contralateral atrophy, and sclerosing nodules can be seen



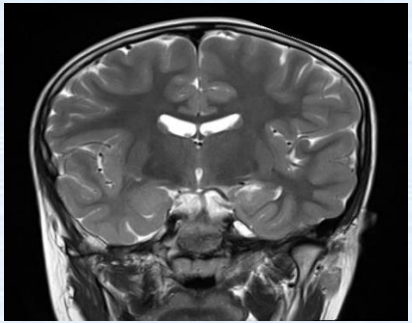
T2WI tra



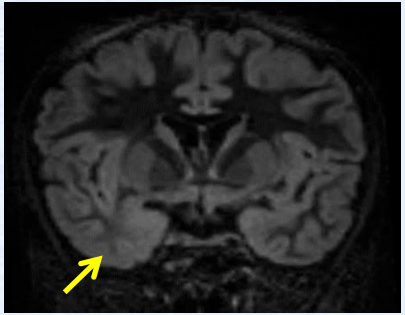
SPACE DIR tra



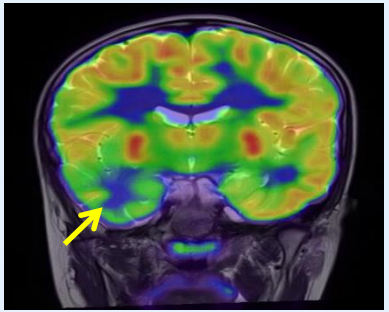
PET/MR fusion image tra



T2WI cor



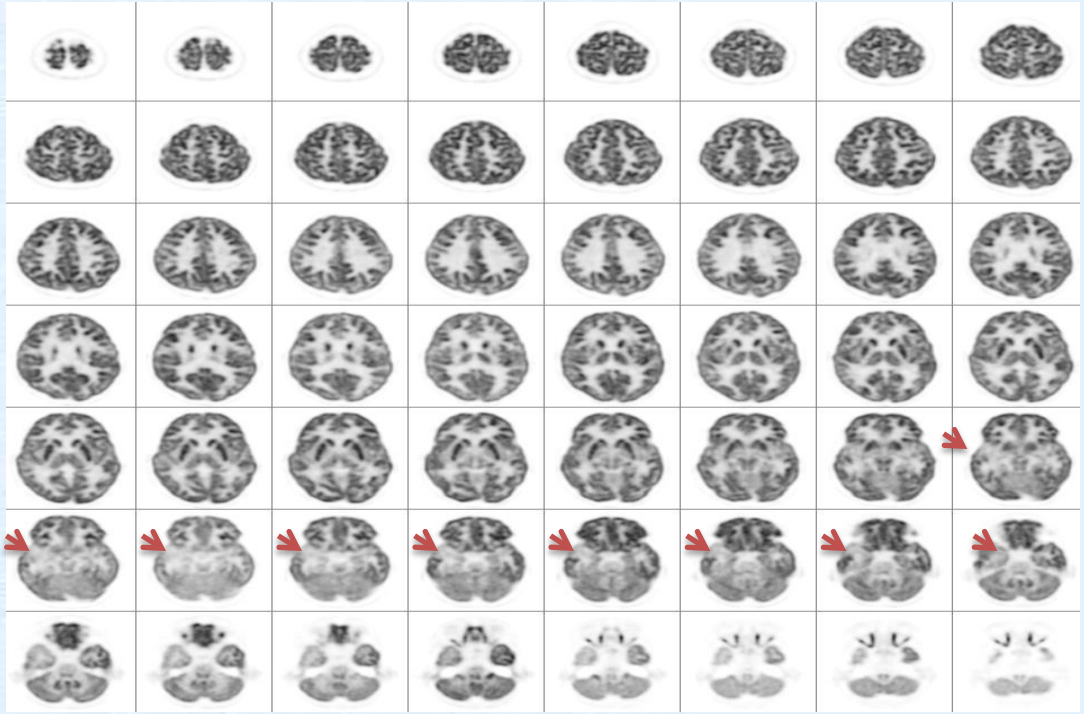
SPACE DIR cor



PET/MR fusion image cor

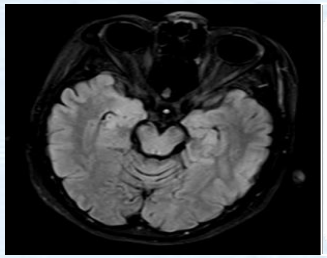
HD PET make the PET image clearer and the lesion edge sharper.

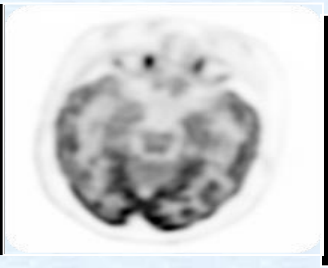
For epilepsy, HD PET is more conducive to the detection of epilepsy foci.

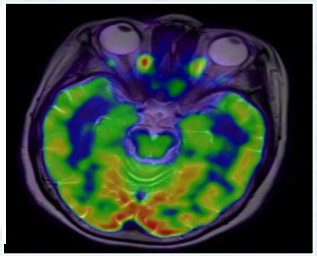


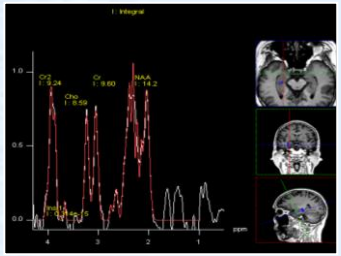
Case 4

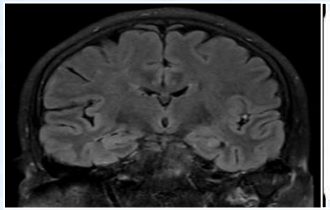
F, 60y, over 40 years of seizures.

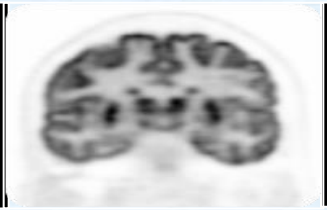

T2WI FLAIR tra

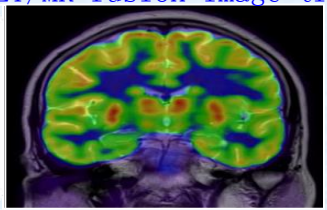

HD PET tra

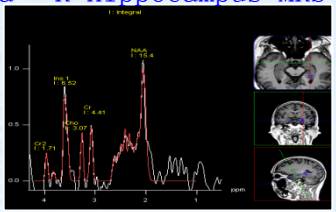

PET/MR fusion image tra


R hippocampus MRS


T2WI FLAIR cor


HD PET cor


PET/MR fusion image cor


L hippocampus MRS

Structual MRI showed the right hippocampus atrophied.

^{18}F-FDG PETshowed hypometabolism in right hippocampus.

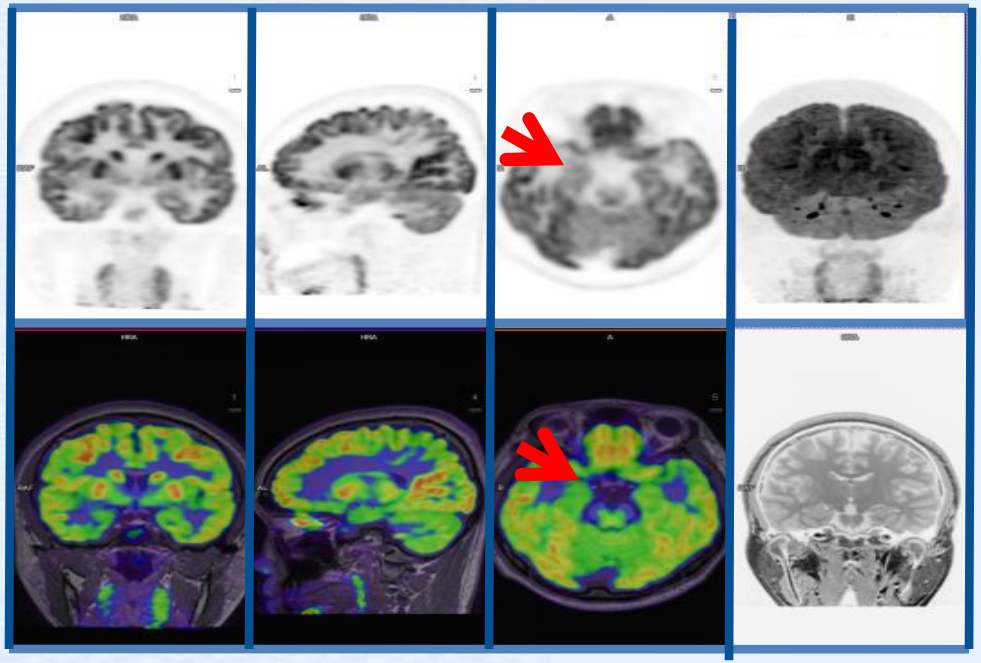
Bilateral hippocampus MRS showed normal NAA、glutamate in the left and decreased NAA，increased glutamate in the right side.

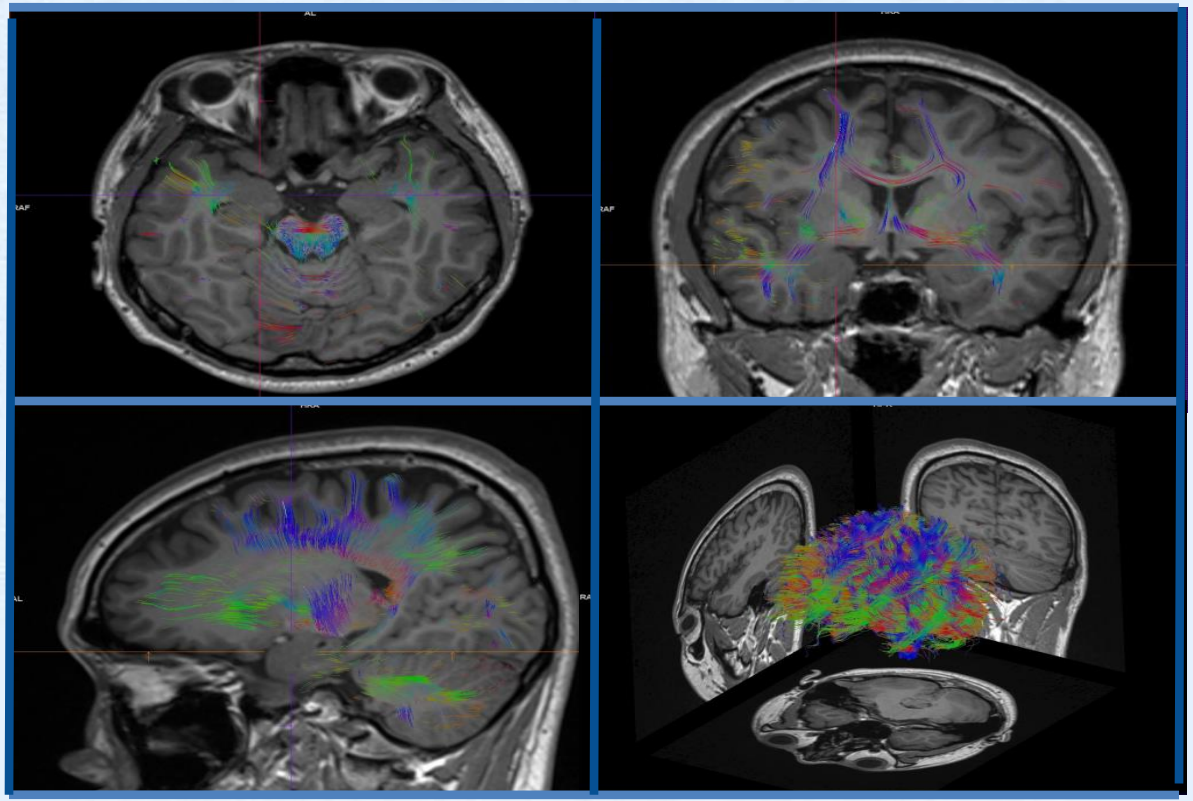
Case 5

M， 25y, The seizure lasted more than five years

Imaging：
118 MBq [^{18}F]FDG
55 min uptake

PET/MR fusion image showed the right hippocampal volume was increased and the signal was uniform.
The glucose metabolism was lower than the contralateral.

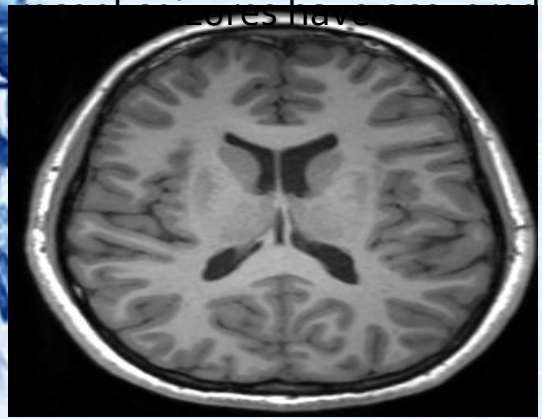




DTI images showed that the nerve fiber tracts in the right hippocampus were sparser than the contralateral ones

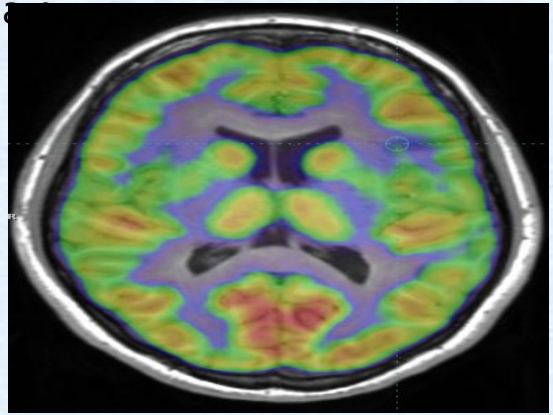
Case 6

F，16y，Left frontal epilepsy surgery later more than 2 years,



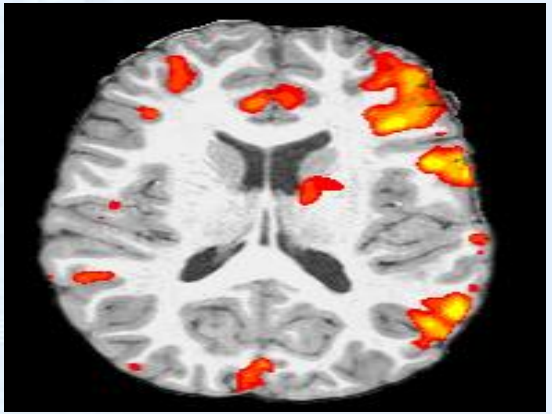
structural MRI scan

(normal ? occult dysplasia)



PET scan

(hypometabolic sulcus)



functional MRI scan

(surrounding language)

The Royal Children’s Hospital, Melbourne, Australia

MR scanning has not been established as safe for imaging fetuses and infants less than two years of age. The responsible physician must evaluate the benefits of the MR examination compared to those of other imaging procedures

PET/MR and localization the epileptogenic foci in our unit

- 19 patients with intractable epilepsy
- PET/MR showed 18 positive
- Solves the practical clinical problems

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