

Interictal and Ictal Patterns

Mohamad Z. Koubeissi, MD

Professor of Neurology Director, Epilepsy Center The George Washington University



DISCLOSURES

• Disclosure of Financial Relationships: None related to the current talk

Interictal Epileptiform Discharges

- Distinctive waveforms or complexes resembling those recorded in a proportion of human subjects suffering from epileptic disorders and in animals rendered epileptic experimentally".
 - The International Federation of Societies for Electroencephalography and Clinical Neurophysiology (1)
- EEG abnormalities associated with a predisposition (i.e. association is not absolute) to experiencing or developing epileptic seizures (2).
- Detection of epileptiform abnormalities increases the likelihood of an epileptic seizure disorder.
- Need to be taken together with the clinical history and other diagnostic test results

(1) (1974) A glossary of terms most commonly used by clinical electroencephalographers. Electroencephalogr Clin Neurophysiol 37:538-548. (2) Sam MC, So EL (2001). Epilepsia 42:1273-1278.





EEG of asymptomatic first-degree relatives of patients with JME, CAE, and rolandic epilepsy

- Possible genetic roles in all three syndromes, yet genes remain unknown
- Metanalysis: 15 studies, a total of 3,858 asymptomatic relatives.
- Prevalence of 'abnormal' EEG waves :
 - 42% for CAE
 - 33% for RE
 - 21% for JME
- Close to what would be expected based on Mendelian inheritance
- However, EEG signature traits were as low as 5%

Tashkandi et al. (2019) Epileptic Disord 21(1):30-41







Spikes/Sharp Waves

- Have pointed peaks when recorded at 30 mm per second.
 - Spike duration = 20 to 70 msec
 - Sharp wave duration = 70 to 200 msec
- Both types of waves often occur in the same clinical disorder or the same patient.
- Distinct from the background
- Disrupt the background
- Polyphasic
- Main component is surface negative
- Often followed by a slow wave with variable amplitude
- Have a field
- Asymmetrical slopes





month -FP1 ~ ~ - MmAAAMaaa F7 ~~ T5 - O1











P3-01 mm Marthan Marth Fp2-F4 when here the second se F4-C4 Werner Martin Mar C4-P4 Man Marken Can and Can a Fp1-F7 F7-T7 Mannan Mann Mannan Mannn T7-P7 man Mun for the formation of the second secon 1 sec Are and the second and the second and the second se T8-P8 man Martin Ma PB-02 month market and the second sec





Spike/Sharp Wave Locations

- Temporal > Frontal > Centrotemporal > Parietal > Occipital > Central /paracentral.
- Association with epilepsy is better for temporal than rolandic or occipital spikes (1)



(1) Fois A et al. (1988) Epilepsia 29:620-623



















Hyperventilation in a 63 year old woman

There is a spike hidden under this panel. Can you guess its location?













Spike/Sharp Wave Locations

- Occipital IED are encountered in migraine (1)
- About 60% of children with occipital spikes do not have epilepsy.
- Occipital "Needle spikes" are seen in the EEG of children with congenital blindness, but no seizures (2).

(1) Slatter KH (1968). Brain 91:85-98. (2) Kellaway P (1955) Electroencephalogr Clin Neurophysiol Suppl Suppl. 4:212-213.







Focal Spikes

- Scalp surface-positive IED can be seen
 - After brain surgery
 - In newborns with periventricular hemorrhage or leukomalacia
 - In young children with multifocal IED and global encephalopathy









*



Focal Spikes

- Spikes have typical features in
 - Benign Epilepsy with Centrotemporal Spikes
 - Negative over T and C
 - Positive end of the dipole over frontal regions
 - Benign Childhood Epilepsy with Occipital Paroxysms
 - Early-onset Childhood Seizures with Occipital Spikes (Panayiotopoulos syndrome) (1)

(1) Caraballo R et al (2000) Neurology 55:1096-1100.







BECTS







Temporal Intermittent Rhythmic Delta Activity (TIRDA)

- Intermittent sinusoidal trains of rhythmic 1 to 4 Hz waves at the temporal lobe, lasting for about 5 seconds
- Most commonly 2 to 3 Hz
- Appears either during wake or drowsiness and sleep.
- Highly correlated with temporal lobe seizures
- Temporal depth electrode recording during TIRDA showed active spiking activity in mesial temporal structures
- Two-thirds of the patients had a pathological lesion at the temporal lobe.





1 Fp1-F7		and a second and a second and a second	and the second sec	the second second second second		and the state of t	have been a second where the second
2 F7-T7	and and the second second	a management and a second	and the second second second	And many many many market		marked marked and the second	
3 T7-P7	warman warman war	- marine water and the second and th	and the constant of the second s	adama have been a sound	manun an	menon manager and a second	mound
4 P7-01	mon	momente	and and a second	mannews	monorman	mannon	mannena
5 Fp2-F8	mannen		many more and	man manual per	man man	a manual m	
6 F8-T8	nous and the second					and the second second	
7 18-P8	Mar shares have					m	here and the second
9 89-02				www.			
9 Ep1-E3							
11 C2 D2			and the second second				
10 00 01							
12 P3-01		for the second s	and and a second and a second and	for the second s	and the second second	and have been and the second	and the second of the
13 Fp2-F4	men man and mark	and a second and a s	and a second and a second and a second	and the second s	- Au	and the second sec	the second se
14 F4-C4	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				man and	······································	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
15 C4-P4			in the second se	man		hannen	hand when the second se
16 P4-02	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
17 Fz-Cz	m		m		······································	mm	man
18 Cz-Pz	mann	mann	moundance	mannen	hannen	mon	mound

GW SCHOOL OF MEDICINE

*



Secondary Bilateral Synchrony

- Focal or regional spikes leading directly to bisynchronous spikes and/or spike-waves.
- Focal interparoxysmal abnormality in same region.







Secondary bilateral synchrony. 33 years. Sequential 3 Hz theta with intermingled electropositive spikes at F8-T4 lead into irregular spike-wave discharges whose durations occasionally extend to 500 msec. These are followed by regional theta and right hemisphere-accentuated spikes. All of these features are characteristic of secondary bisynchrony and satisfy the definition of "a bilaterally synchronous discharge which can be shown to arise from a unilateral cortical focus. Calibration signal 1 sec, 70uV.





- <u>3-Hz spike-and-wave discharges</u>
- Bursts last 1-3 seconds, but can be longer
- Activated by hyperventilation or drowsiness
- Synchronous in timing and symmetric in amplitude
- Shifting asymmetries may be seen usually no more than 20 milliseconds difference
- Maximum over midline frontal region.
- EEG signature of absence epilepsy
- Can interfere with mental functions in a subtle manner



















FIGURE 7-8

EEG of a 43-year-old man with myoclonic seizures showing diffuse spike discharges. Diffuse spike-and-wave discharges were noted in EEG recordings.

Chen and Koubeissi. 2019. Continuum













- Generalized Atypical Spike-and-Slow-Waves
- Resemble 3 Hz spike-and-wave discharges, but have variable rates
- Complexes vary in amplitude and morphology
- Enhanced by drowsiness and non-REM sleep
- Correlate with primary generalized epilepsies
- In generalized epilepsies, focal spikes of low amplitude may appear during drowsiness





 $Fp2-F4 \cdots Fq-C4 \cdots Fq-$ FD1-FZ man White Marked T7-P7- man man half have been which have been and the second have been Fp2-F8 man F8-T8 man from the former for the former for the former former for the former former for the former former for the former former former for the former f T8-P8 man My May be Mark the M P8-02 Marine Marin Marine Mari





- <u>Slow Spike-and-Waves</u>
- Frequency is around 1.0 to 2.5 Hz
- Not as rhythmic in repetition
- Mostly sharp waves: wide duration and blunt peaks
- Fluctuating asymmetry of amplitude is common
- Drowsiness or Non-REM sleep may activate trains → ESES?
- May be enhanced by hyperventilation, but not photic stimulation
- Seen in Lennox-Gastaut syndrome





- Generalized Repetitive Fast Discharge (GRFD)
- Also known as paroxysmal fast rhythm, generalized paroxysmal fast activity, or "runs of rapid spikes"
- Alpha or beta frequency range
- Last typically less than 10 seconds
- Electrodecrement consists of very fast and very low amplitude activity
- GRFD may be preceded or followed by generalized slow spike-andwave discharge
- Often associated with Lennox-Gastaut syndrome
- Most GRFD occur during sleep
- May be an ictal rhythm could be accompanied by tonic seizures











- Photo-epileptiform discharges
- IEDs elicited by intermittent photic stimulation
- Can be self-limited or self-sustaining
- Four types
 - (1) generalized (most common)
 - (2) bilateral posterior dominant
 - (3) bilateral occipital
 - (4) focal unilateral discharge (least common)
- 70 to 77% of generalized photo-epileptiform discharges have seizure disorders, but bilateral occipital photoepileptiform discharges are less commonly associated with epilepsy.











Importance of Ictal Recordings

• Evaluation of paroxysmal episodes



- Characterizing and quantifying each seizure type
- Syndromic classification
- Indispensable for presurgical evaluation

(1) Koubeissi, M. and E. So (2013). Interictal and Ictal EEG. EEG in Clinical Practice. J. a. P. Ebersole, T.





Ictal Discharges – General Considerations

- Seizure patterns can be isomorphic or metamorphic
- An electrographic deviation from the baseline
 - Frequency Field
 - Morphology Amplitude
- The most recognizable EEG seizure pattern consists of rhythmic, organized discharge that may or may not have apiculate waveforms.

(1) Koubeissi, M. and E. So (2013). Interictal and Ictal EEG. EEG in Clinical Practice. J. a. P. Ebersole, T.





Focal Aware Seizures

- These can occur without a clear ictal correlate on the EEG
- 6 (or 10) cm² rule
- 21% of seizures are associated with EEG ictal discharge (1)
 - 33% with motor manifestations
 - 15% with no motor manifestations
- Seizures may be motor, sensory, autonomic, or psychic
- Semiology is an important indicator of the area of seizure onset
- When recorded, seizure discharges are not different from focal impaired awareness seizures
- May be focal fast frequency discharge, rhythmic slowing, or repetitive spike discharge. Irregular non-rhythmic delta or theta frequency discharge is less frequent.

(1) Devinsky, et al NEUROLOGY 1988;381347-1352





Focal Impaired Awareness Seizures

- EEG changes occur almost always Exceptions: some frontal or parietal lobe seizures
- Mesial temporal: Often theta-range temporal ictal discharge
- Classic Teaching:
 - Closer to ictal onset zone \rightarrow higher frequency
 - Deep or far generators \rightarrow slower frequency
- Common evolving discharge is that of rhythmic discharge, then developing into higher voltage and slower frequency discharge, then regular slow waves increasing in frequency





Temporal Lobe Seizures

- Most common focal epilepsy
- Originate from the hippocampus or other mesial temporal structures and propagate to involve the basal and lateral temporal lobe cortices, as well as frontal lobe regions.
- If limited to the hippocampus, non scalp discharge
- Workup of non-lesional cases
- Extratemporal may look temporal
- Temporal may look extratemporal









~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	mann	Marine and a service	and the second	for the second second	an and the second	adam adam a filing	new Managel Managel	wyww.	name and many
~~~~	Murra a					and a second	and water and a second se		
~				an warman and the	Yest-agenese Westerney and	www.www.www.		and the state of the second state	newselfedtment
~	**************************************							and the second	ann an









*

EEG in Extratemporal Epilepsy

- In general, ETLE is less commonly associated with ictal discharges
- A fast, beta-range ictal discharge may be more common
- FLE tend to have abrupt hypermotor activity and rapid propagation
- Only about half of FLE will have localizing EEG pattern
- In 25% of FLE, ictal beta discharge is present: 90% of the patients becoming seizure-free
- EEG of parietal lobe seizures often do not show localizing findings
- Occipital lobe seizures may propagate to ipsilateral or contralateral temporal lobe





	Fp1-F7 washing and the second
and the second se	F7-T7 warman warma
	17-P7
	P7-01
	Fp2-F8
	F8-T8
	TB-P8
	P8-02
	Fp1-F3
	F3-C3 where the second se
	C3-P3
a second to second	P3-01 parameter and a second an
	Fp2-F4
	F4C4 many from the second from the second for the s
	C4-P4 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
	P4-02
	FZ-GZ
2040s do a 2000	CZ-bs manufacture and a second as a
C	
C	
Fp1-F7 when have been seen the second	Fp1-F7 under many many many many many many many many
F7-T7	F7-T7 for the second se
T7-P7	T7-P7
P7-01	P7-01 parameter and a second s
Fp2-F8 man for the second for the se	FP2-F8 many man
F8-T8 who who who was a start who was a start of the star	F8-T8 wandergrand when and a man and a start and a sta
T8-P8 monounder and the second and t	T8-P8 and many half and a farmer and the second and
P8-02 mounter the second secon	P8-02 about my monorman many many and a share and a share a sh
Fp1-F3 water manufacture for the second seco	Fp1-F3 manuna m
F3-C3 was was a second and a second and a second	F3-C3 unine have been shown the second of th
C3-P3	C3-P3
P301 marshare and	P3-01 power manufacture and a second and a second and the second and the second s
Fp2-F4	FP2-F4 yummanananananananananananananananananana
F4-C4 Wanner Marken M	F4-C4 yunnummenter manuner manune
C4.P4 Monthe and a construction of the constru	C4-64 Malaumalarunanmarkalarunanmarkalarunan antari ana ana ana ana ana ana ana ana ana an
P4-02 Murrow Marine Market Marine Market Marine Market and Marine	P4-O2 Mix-wowledgeweenergewe
Fz-Cz www.harrow.h	FZ-CZ unanya manya many
CZ-PZ wanter and and and a second	Cz-Pz WWW.www.ind/ww
	E
Fp1-F7 Manuna Manun Manuna Manuna Manun	Fp1-F7 And Frank and
E2-12 approximately and a second seco	F7-T7
17-P7 manutation and a second and a	
P7-01 - upper Malan Malan Malan Markan Mar	
P2-18 mining and the second and the	Fp2-F8 where a shall a sha
F8-T8 JVANWYMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	FB-TB ~ Ale and an ale was a strain and a second and the second s
15-60 animan hard wat all and a share a	
18-02 Calleran alleran alleran and a share aller aller aller and a share aller a share and a share and a share a sh	P8-02
Lb1-L3 Angle and Marine Marine Marine and	Pp1-P3
F3-C3 - Water and Martin for the stand of th	F3-C3 Annahamment and
C3-P3 manufally minute Manufally and the standard and the standard and the standard standard standard standard	C3-P3 warman and the second se
warman warman and a second second and a second second and a second seco	10-5 marine marine and a second
+p2++4 mmmmunummmunummmunummmunummmunummmunummmunummmunummmunummmunummmunummmunummmunummmunummmunummmunummmunum	+p2+4 warman and a standard a standard a star and a star a war a Man and a star
ra-ca man any many many many many many many	14-04 Mart 1111 MAN June Mandra M March Maldra M Marth a Marth Marth Marth Marth Marth Marth Marth Marth
C4-D4 MM D-MAN MAN MAN MAN MAN MAN MAN MAN MAN MAN	C4-P4 MUNINIMUM MUNINIMUM MANAGEMENT C4-P4
P4-02 Jun www.www.www.www.www.www.www.www.www.ww	P4-02 May many many many many many many many ma
Fz-Cz WWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWW	FZ-CZ ~ france work from any how from the france of the fr
cz-pz mripwww.www.mww.www.www.www.www.www.www.www	CS-DZ Where and where we wanter and a second of the second

В

----------manna mon manner mann man man man man man - man man man mon man man man man m mumment was a second and a second and a second a mon man man man 50 µV 1 Sec. ······ ----and the second mound when a second and the second second mon man man man man ----Munanyammanyahananananananan in for a management of the second of the sec mourney and many way have more the -man when and a second mon man and a second and a seco mannennennennennen

I	-	-	•	
L		-	-	

А

P8-02	www.www.www.www.www.www.www.www.www.ww
Fp1-F3	Mandminimum and man and and and and and and and and and a
F3-C3	man
C3-P3	and my man when we have a second and a second and the second seco
P3-01	www. Mary mary mark and a second of the seco
Fp2-F4	meren manus man and man man and and and and and and and and and a
F4-C4	Wenger manufanter and the manufanter was well and the second and t
C4-P4	war Ma Mahan Maria Manu Manu Manu Manu Manu Manu Manu Mahan Mahan Mahan Mahan Manu Mahan Manu Mahan Manu Mahan Ma
P4-02	In work with a work with the work of the w
Fz-Cz	Manna and Manna and Manna and Manna Man
Cz-Pz	many way way way way way way way way way wa
	t half a statistic the structure for state

SCHOOL OF MEDICINE AND HEALTH SCIENCES

	and the second second	Marine a state	and an and and an	unter when the remained	Alatrians unreader	And and the production of the second	anahiki dhindunkunku hini	waisnes his advantural historia	annumenta i travazioni a esti	No. w. S. A. K. annihida i fatishi k	hi ka saharakan sala lakada sala h	anna and with a carbod	Albahaminta a jula ia	بأعداري الشابلية	بالمتألا لم
Fp1-F3		an a		an	and the second data	and a second state software	a, naanka naaraa haana misakka	and an a state of the state of	יז אל אשרי דיייר אישע אין אוער איין איין איין איי	l a service a defination define a service de la service	aaldaa fii fiifii fiisaddaa af af da	an haaraa ah dahaa ka na fiyaan ah haana ah dahaa ha na fiya	anadina dalar dalar dalar Anadina dalar	alla (Dalla an an Anna an Anna) Alla (Dalla an Anna an	. The second sec
F3-C3		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	and the second	non-en-reen-non-children	an a	sender and an and a second	~~denwardliketan%aak~aak~aa	Malike Manager Charles	ware-waren Waller waren ward	<u>በኢትዮጵያ የቀላላቸው</u> የቀሳ _ት አስትላቸው ለማ	unarishi ya manafani ya mani ya	daru alfelddorddad alfen	inhowsultures of the second states of the second st	WWW
C3-P3			~~~~~	~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~					~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~	~~~
P3-01				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	·····	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		m
Fp2-F4	man	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	manna	mmmmm	Marine Marine Marine Marine M	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	human	wwwww	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	man man	nor when the form	Mary
F4-C4	······	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	n	mm	a.m.			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	walkan that show have	munnundun	nt Naper
C4-P4		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	·····	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	mm	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			h	mmm	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~
P4-02	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	······	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	······	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	mm		www.	an man	m hours	w
Fn1_F7		mmmmm	www.www.	oline and the second states and the second	manna	Anier Harpinen Michael your Willing	water	wanner wanter water	Mannalla van marine	umunhahan M	whitelynamental	how when he was the	garyphyratellel yndrhydryddydd	and for when and and	MAN
F7-T7				and the second s	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	hanger a share manager		-	and a start and a start and a start a s	mytherenter	muumumuhudhud	manuna francisco	www.wallandurana	Mahmumana	mm
T7-P7	www.www.www.	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	and and the second s	m	hanne have been a start war	- Josephine - Jose		,	man	www.man	mon manufacture and the	hushingmajorain	-	-Myor
D7_∩1	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	and the contraction of the second	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~
	mmmmmm	mm mm	mmm	m.	hanno	nam	www.ww	- manna	anon Maria	L~m~~m~~	mmmmm	and man	mmm M	in nononin	ካሌሉ ስነ
		~~~~~~~~~~		n haven	mm. Makke	A AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	u see anna ar Maa	man and were	an and the area	A MAAM		A MARAA HA MARA	north m mad have		1. ¹⁴ .m
F8-18			· · · · · · · · ·						6. <u>6. 1. 146</u> 4.		. A A.K A.K	K. M. M. M. J.	unit to the other	. Arrole Aller	* v ·
T8-P8	~~	here and the second	and the second the second s	man	www.www.www.w	I san warden and a second	w www.www	A. Mandad and a	rmer ennovely vyrven	i na surana	הנהיו הייתן איי מיות עלמים	h dhur nur nursan ha	here have the second when a	מיירא איר איז	MANA
P8-02			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	,		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~	Server and the server of the server ser	- Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin Martin	m Maran and the second	man and a second and	M. Marchanter and a	www.www.www.	-port the counter water and the	man
Fz-Cz			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		······	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	······	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	· ····································	mmm		^
Cz-Pz			~~~~	~~~~~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	mm	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim$
EKG								<u> </u>					•		

Push button event in a 28 year old woman with episodes of confusion and "weird thoughts"







Same page with Sp2 included in montage







3 mo AAM with propionic acidemia, normal development, with 2 episodes of mouth twitching.





Fp1-T3 T3-01 Fp2-T4 T4-02 Fp1-C3 C3-O1 Fp2-C4 C4-O2 A1-T3 T3-C3 C3-Cz Cz-C4 C4-T4 T4-A2 EKG















20 MORE SECONDS LATER







#### 20 MORE SECONDS LATER





#### What's under the panel?

1 Fp1-F7	
2 F7-T7	When an
3 T7-P7	the second se
4 P7-01	
5 Fp2-F8	
6 F8-T8	
7 T8-P8	
8 P8-02	
9 Fp1-F3	
10 F3-C3	
11 C3-P3	
12 P3-01	
13 Fp2-F4	
14 F4-C4	
15 C4-P4	
16 P4-02	
17 Fz-Cz	
18 Cz-Pz	
19 Fp1-Pz	
20 F3-Pz	
23 C3-Pz	
25 F7-Pz	
26 T7-Pz	
27 P7-Pz	
28 P3-Pz	
29 U1-Pz	
30 FP2-P2	
35 F4-P2	
27 E0.P-	
38 P8-Pz	
39 T8-Pz	
41 P4-Pz	
42 02-Pz	
43 XI-Aar	
м	





#### **RH Seizure after Stroke**







## **Generalized Epilepsy**

#### • Absence epilepsy:

- Discharges that last longer than 3 seconds will often have clinical correlates
- Abrupt onset and offset, with no postictal slowing
- Average frequency of 3 Hz, starting at approximately 3.5
  Hz, and slowing down to 2.5 Hz
- Some ictal discharges may include polyspike components.
- Occasionally, the spikes may be more posteriorly prominent





## Generalized Epilepsy

- Juvenile myoclonic epilepsy (JME):
  - Bursts of bilateral frontal-maximum polyspike-and-slowwave discharge
  - Discharges may have irregular morphology and frequency
  - Shortly after arousal or during photic stimulation
  - One third of the patients will have a generalized photoepileptiform discharges
  - During myoclonic seizures, 10-16 Hz spike discharge
  - Some absence seizures seen in JME have an ictal 3-Hz discharge











#### Conclusions

- There is no evidence that the slower patterns result from propagation
- Several patterns were associated with each pathology
- All pathologies were associated with multiple SOPs
- Polyspikes followed by LVFA was found only with MCD, but in only 20% of MCD
- Impossible to assign a unique significance to any pattern



