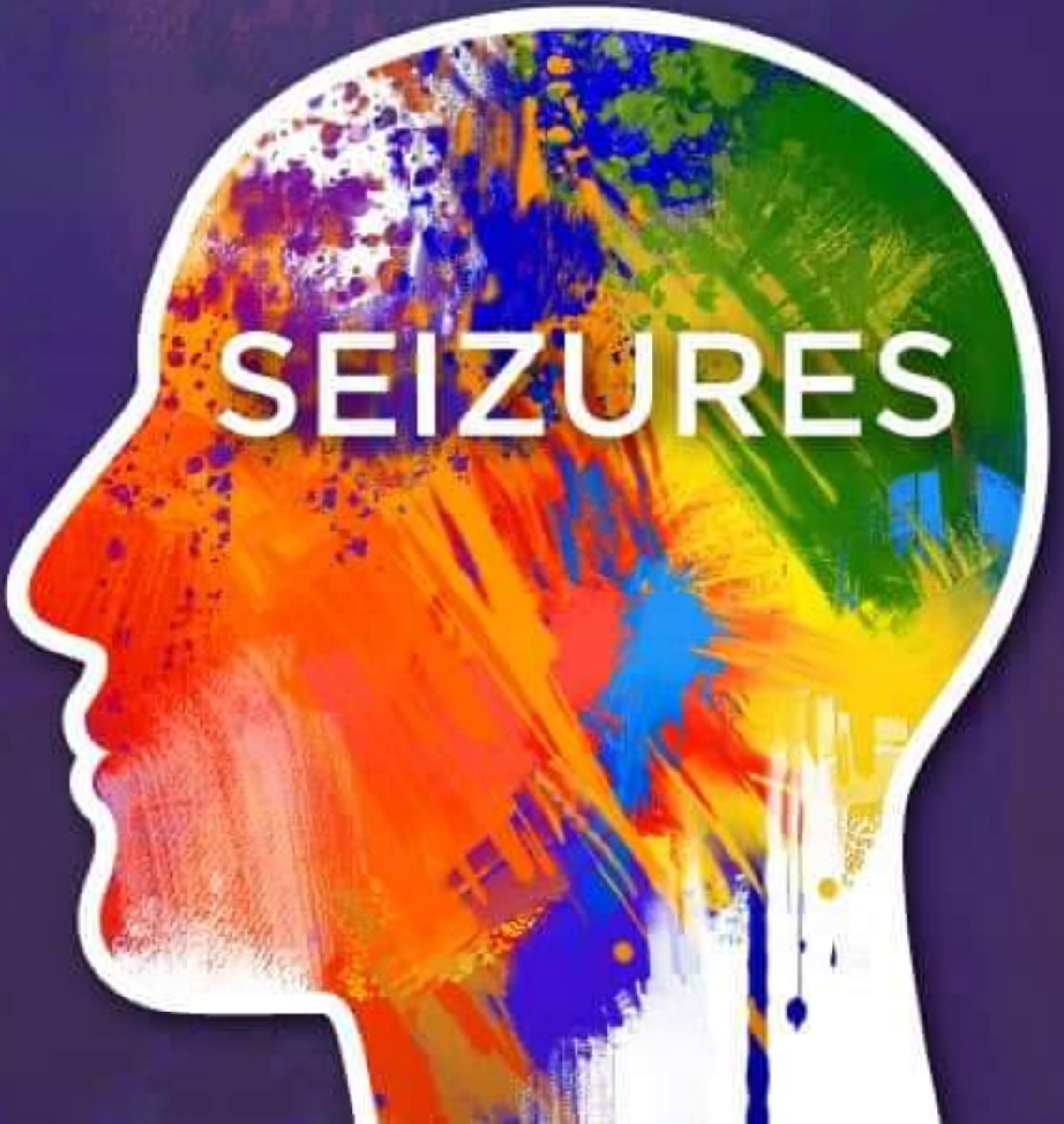
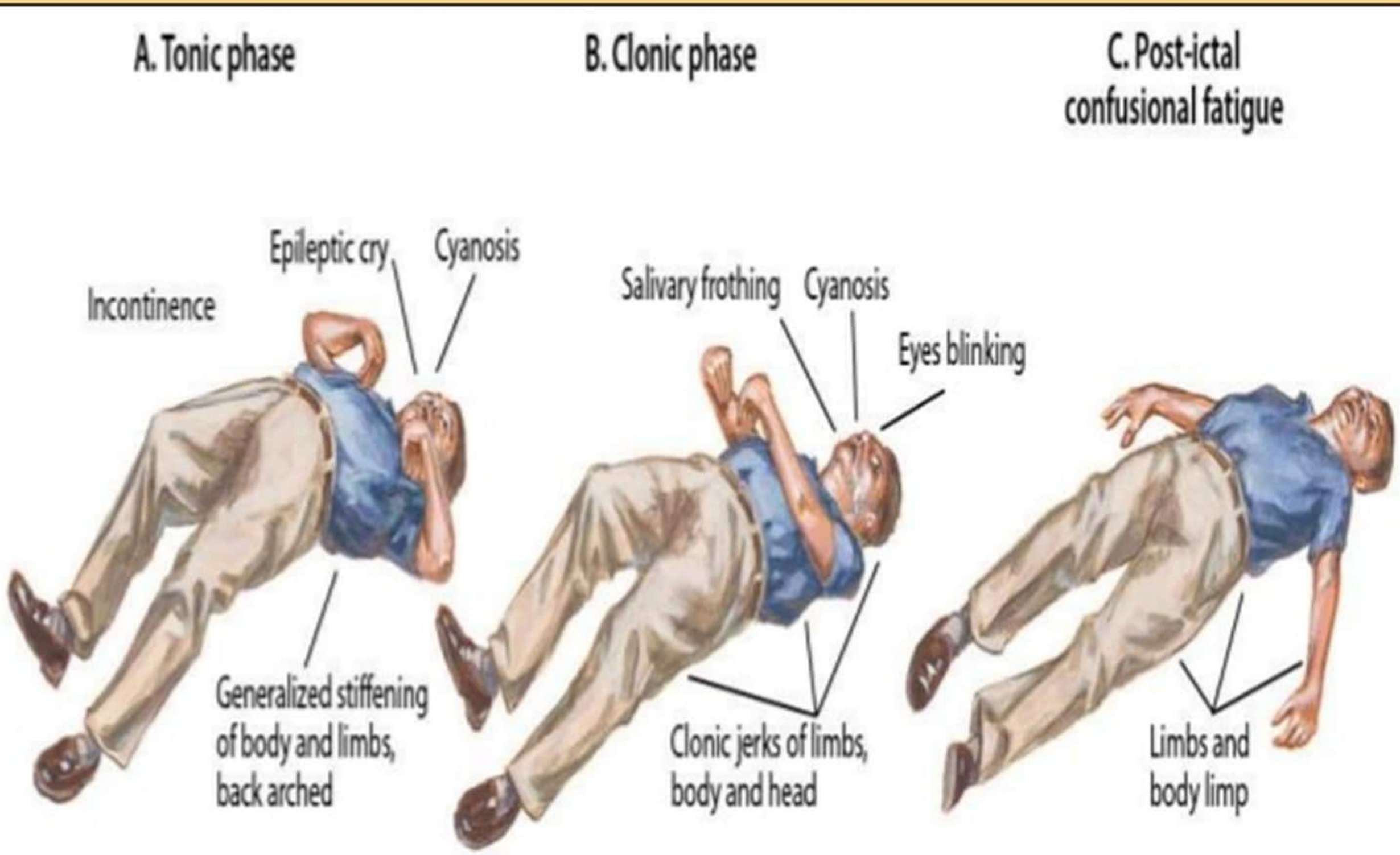

SEIZURES

GENERALIZED TONIC- CLONIC SEIZURE



DEFINITION

Seizure: A paroxysmal event due to abnormal excessive, hypersynchronous discharges from an aggregate of CNS neurons.

Epilepsy: *Recurrent* unprovoked seizure episodes due to a chronic underlying process.

Provoked seizure: Seizure episode secondary to an underlying primary medical condition.

Focal seizure: A seizure originating in networks limited to one cerebral hemisphere, which may or may not be associated with impairment of consciousness (previously termed “simple partial” and “complex partial”).

Generalized seizure: A seizure that rapidly engages bilateral neural networks. Sub-types include:

- Generalized tonic-clonic (“grand mal”): Abrupt loss of consciousness → diffuse muscle rigidity (tonic phase) → muscle jerk/twitching (clonic phase) → twitching movements end (postictal phase)
- Absence (“petit mal”): Sudden staring with impaired consciousness, may be associated with eye blinking or lip smacking, last 5-10 seconds and often in clusters of dozens to hundreds of times per day.

- Clonic: Rhythmic jerking muscle contractions.
- Myoclonic: Sudden brief muscle contractions either single or in clusters.
- Tonic: Sudden muscle stiffening, often with loss of consciousness and falling to the ground.
- Atonic (“drop”): Sudden loss of muscle control, collapse to the ground.

ETIOLOGY

Common causes of provoked seizures in:

- Drug withdrawal: alcohol, benzodiazepines, barbiturates, anti-epileptics
- Drug induced: illicits (cocaine, amphetamines, PCP), psychoactives (tramadol, lithium, antidepressants, antipsychotics, anesthetics), antibiotics (beta lactams, quinolones, acyclovir, isoniazid, ganciclovir, chloroquine, mefloquine, metronidazole), immunomodulators (cyclosporine, tacrolimus, interferons), contrast agents, theophylline, ephedra, gingko
- Electrolyte disturbance: hypoglycemia, nonketotic hyperglycemia, hypo/hypernatremia, hypo/hyperkalemia, hypo/hypermagnesemia, hypo/hypercalcemia
- Metabolic: uremic encephalopathy, hepatic encephalopathy, hyperthyroidism, dialysis disequilibrium syndrome, aminoacidopathy, urea cycle deficits
- Vascular: hypertensive encephalopathy, ischemic stroke, intracranial hemorrhage
- Malignant: mass effect, infiltration, hemorrhage
- Infective: meningitis, encephalitis
- Neurodegenerative: Alzheimer’s disease
- Autoimmune: encephalitis (including paraneoplastic), cerebral vasculitis, lupus encephalitis, neurosarcoidosis, neurobehcets, Hashimoto’s encephalopathy (steroid responsive encephalopathy)
- Misc: head trauma, febrile seizure, eclampsia

PATHOPHYSIOLOGY

Normal neuronal network becomes hyper-excitable (typically via injury) → lower seizure threshold → epileptogenic focus → changes in neuronal networks

DIFFERENTIAL DIAGNOSIS

- Syncope: vasovagal, cardiac arrhythmia, valvular disease, congestive heart failure, orthostasis
- Psychologic: Non-epileptiform seizure (pseudo-seizures), hyperventilation, panic attacks
- Metabolic: EtOH blackouts, delirium tremens, hypoglycemia, hypoxia, hallucinogens
- Neurologic: basilar migraine, confusional migraine, basilar TIA/insufficiency, narcolepsy/cataplexy, benign sleep myoclonus, tics, nonepileptic myoclonus, paroxysmal choreoathetosis

PATIENT HISTORY

Key past medical history: prior episode of seizure or loss of consciousness? History of renal, cardiac, or liver disease, substance use, immunosuppression or immunocompromise, rheumatologic disease, prior stroke or TIA, cancer?

Seizure episode history: Exposures and activities preceding the event, any prodromal symptoms (e.g. sensory changes, sense of déjà vu), types of and progression of motor movement, patient's level of consciousness throughout the event (solicit collateral history from witnesses if present)

Symptoms favoring seizure: prodromal (aura) symptoms, injury from falling (due to abolition of protective reflexes), urinary incontinence, a slow return of consciousness with subsequent confusion, headache and drowsiness

Historical criteria that distinguish syncope from seizures[1]

Symptoms favoring seizure:	Symptoms favoring syncope:
Wake with tongue cutting? +2	Lightheaded spells -2
Déjà vu or jamais vu? +1	Sweating before spell -2
Emotional stress associated with loss of consciousness? +1	Spell associated with prolonged sitting or standing -2
Head turning during a spell +1	
Unresponsive, unusual posture, limb movement, or amnesia? +1	
Confusion after a spell +1	

Sum score ≥ 1 → seizure, sum score < 1 → syncope – 94% sensitivity and specificity

PHYSICAL EXAM

DURING seizure-like activity: MD,Sun Bunlorn Page

- Finger stick glucose (if can be safely obtained)
- Eyes open or closed—if open at onset, more likely true seizure. If closed at onset or closed for long periods during seizure-like activity, more likely non-epileptiform (psychogenic)[2]

AFTER seizure-like activity has concluded:

- Post-ictal (i.e. delay to recovery of baseline mental status)
- Neuro: papilledema (concern for mass), focal exam (concern for stroke), CIWA to evaluate for alcohol withdrawal
- CV: Orthostatic VS, tachycardia, murmurs (valvular disease), S3 (decompensated CHF), carotid bruits (TIA)
- Pulm: consolidation or E-A egophony (pneumonia → meningitis?), wheeze (hypoxemia/COPD—theophylline tox)
- Abdomen: stigmata of cirrhosis (spider angioma, caput medusae, jaundice)

WORKUP

Lab: blood sugar, comprehensive metabolic panel, magnesium, complete blood count, arterial blood gas (hypoxia), urine toxicology, lactate, ethanol/methanol/ethylene glycol (if concern for ingestion), prolactin (not reliable to distinguish epileptic seizure from syncope, but useful in distinguishing from non-epileptic pseudoseizures), antiepileptic drug levels (if patient was taking previously)

12 Lead EKG: look for A-V block, bundle branch block, pre-excitation, LV hypertrophy, long QT, if suspicion for cardiac syncope is high consider **continuous telemetry**

Electroencephalogram: as soon as possible following a presumed convulsive episode, sleep EEG and sleep-deprived EEG may raise diagnostic yield, video monitoring may further raise diagnostic yield and aid in classification

Imaging: reserve for those with first unprovoked seizure or with a focal neurological deficit; **non-contrast head CT** if emergent, but **MRI seizure protocol** preferable if sub-acute

Lumbar puncture: if concern for meningitis/encephalitis

TRIAGE

Generally, ICU level of care is indicated if concern for status epilepticus or airway protection

TREATMENT

Approach to treatment of status epilepticus in adults

Note: the following is not for adult patients with focal seizures nor those with epilpesy syndromes with baseline EEG on the ictal-interictal continuum. Guidelines should not replace clinical judgement as individual co-morbidities and situation will influence treatment.

Within five minutes:

Airway, breathing, circulation, neurologic exam, begin timing seizure, monitor vital signs, supplemental oxygen via nasal cannula or face mask (consider intubation), EKG, fingerstick glucose (treat < 60mg/dL), IV access, STAT-BMP and CBC, Ca, Mg, blood gas, consider toxicology screen and AED levels

Give thiamine 100 mg IV, folate 1 mg, followed by amp of D50

Five - ten minutes:

IV Lorazepam 2 mg (may repeat up to max of 8mg)

OR

IM Midazolam 0.2 mg/kg up to 10mg (may repeat once)

OR

PR Diazepam PR 0.15 mg/kg up to 20mg (may repeat once)

FOLLOWED BY

IV Fosphenytoin 20 mg/kg at 150mg/min (can reload 10mg/kg after 10 minutes)

OR

IV Valproate 20-40mg/kg at 3mg/kg/min

OR

IV Levetiracetam 2500-4000mg at 500mg/min

OR

IV Phenobarbital 20mg/kg at 60mg/min

Within thirty minutes:

Intubate, upgrade to ICU level of care, prepare for continuous EEG monitoring

AND

Start continuous IV medication infusions:

IV Midazolam 0.15-0.2mg/kg load followed by 0.1-2.9 mg/kg/hr

OR

IV Propofol up to 10mg/kg/hr

Titrate t0 seizure suppression (or burst suppression)

COMMENTS

STATUS EPILEPTICUS can cause:

1. Temps of 100F
2. WBC counts >10,000
3. CSF protein up to 100 mg/dl
4. CSF WBC's up to 10/ml (when cultures and viral PCRs are negative ONLY; consider covering for infection until cultres and viral PCRs are negative)

References

1. Sheldon R et al: Historical criteria that distinguish syncope from seizures. *J Am Coll Cardiol* 40:142, 2002 [PMID:12103268]
2. Chung SS, Gerber P, Kirlin KA: Ictal eye closure is a reliable indicator for psychogenic nonepileptic seizures. *Neurology* 66:1730, 2006 [PMID:16769949]
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4. Harrison's *Principles of Internal Medicine*, 19th Edition
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6. McKeon A, Vaughan C, Delanty N: Seizure versus syncope. *Lancet Neurol* 5:171, 2006 [PMID:16426993]

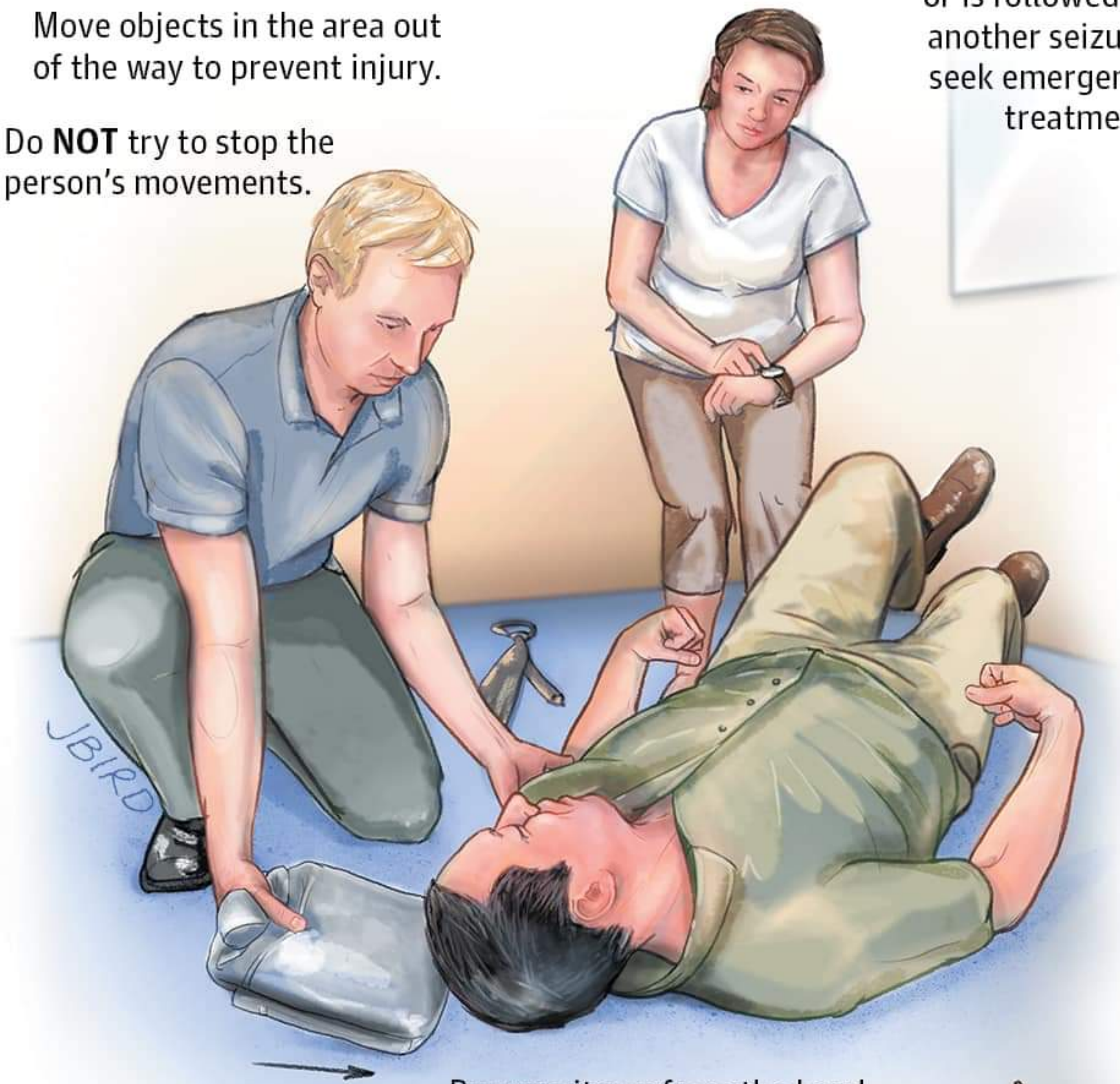
If you see someone having a tonic-clonic seizure

Try to lay the person on the floor and gently turn him onto his side.

Move objects in the area out of the way to prevent injury.

Do **NOT** try to stop the person's movements.

Time the seizure. If it lasts longer than 5 minutes or is followed by another seizure, seek emergency treatment.



Place something soft and flat under the head.

Remove items from the head and anything around the neck that might restrict breathing.

Do **NOT** put anything in the person's mouth.