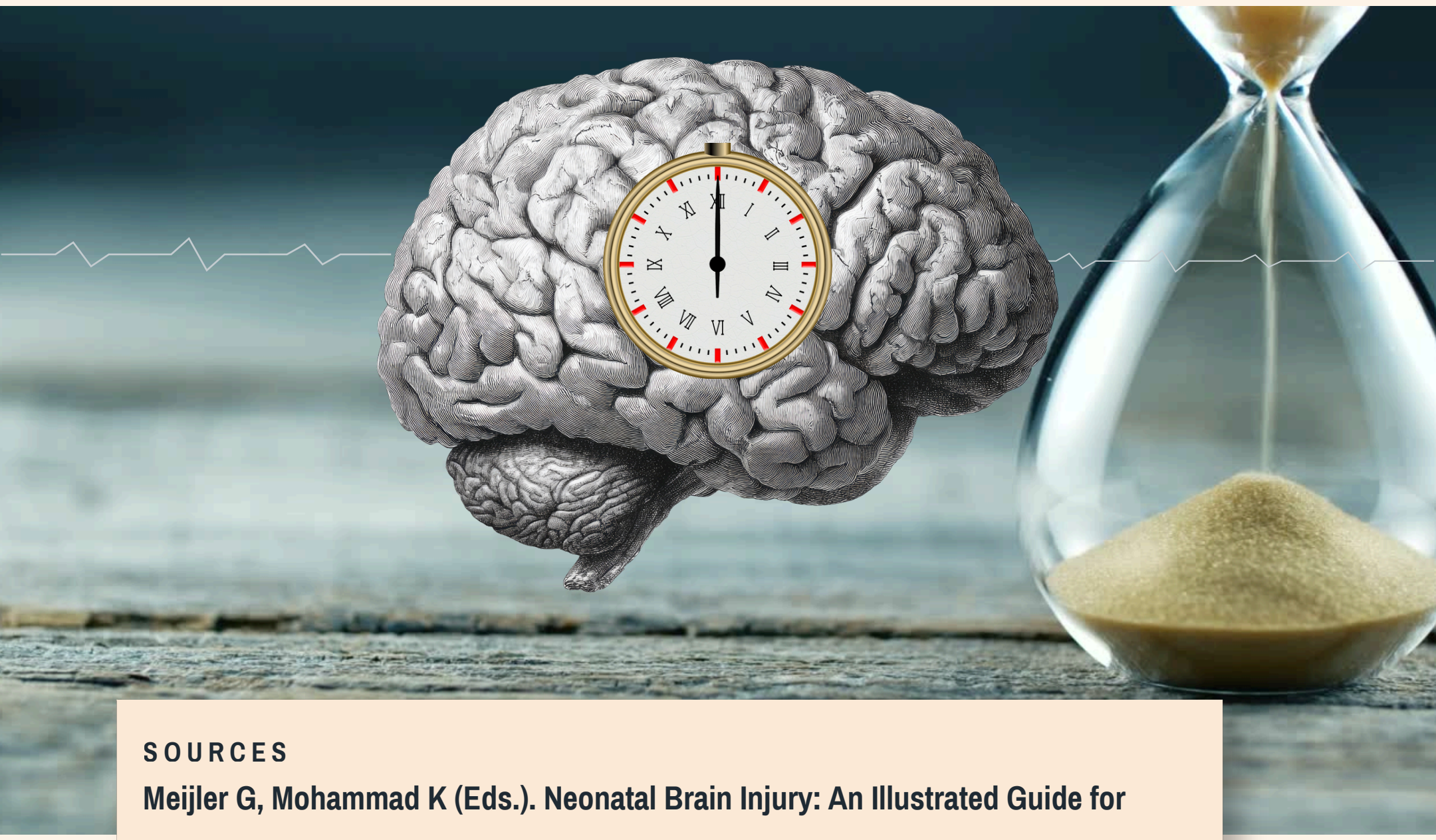
Neonatal seizures

Recognize, monitor, and treat within the first few hours.



SOURCES

Meijler G, Mohammad K (Eds.). Neonatal Brain Injury: An Illustrated Guide for Clinicians Counselling Parents and Caregivers. Springer, 2024. Open Access.

Glass HC et al. Safety of early discontinuation of anticonvulsants after symptomatic acute neonatal seizures. JAMA Neurology, 2021.

PATHOPHYSIOLOGY

Why does a newborn's brain **convulse so easily?**

Accelerated synaptic maturation

Excitatory synapses mature before inhibitory synapses.

Vascularization in development

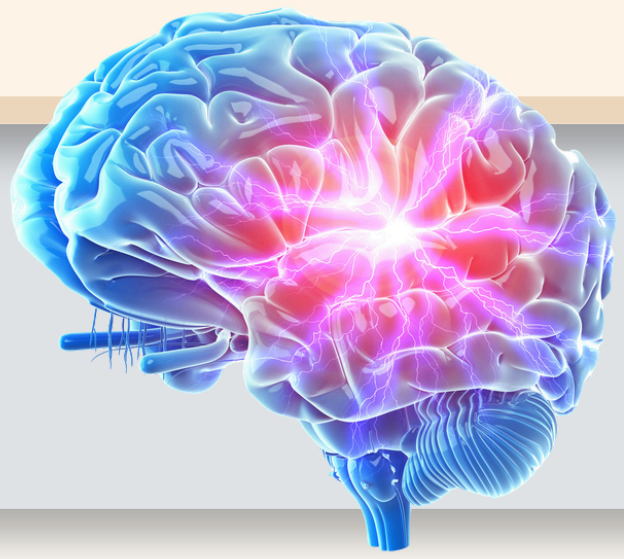
Poorly permeable and fragile border territories.

Cellular immaturity

Low metabolic reserves in the face of any insult.

Increased excitability

The seizure threshold drops in the presence of hypoxia, ischemia, and inflammation. Therefore, a seizure is often the first sign of a systemic or neurological insult.



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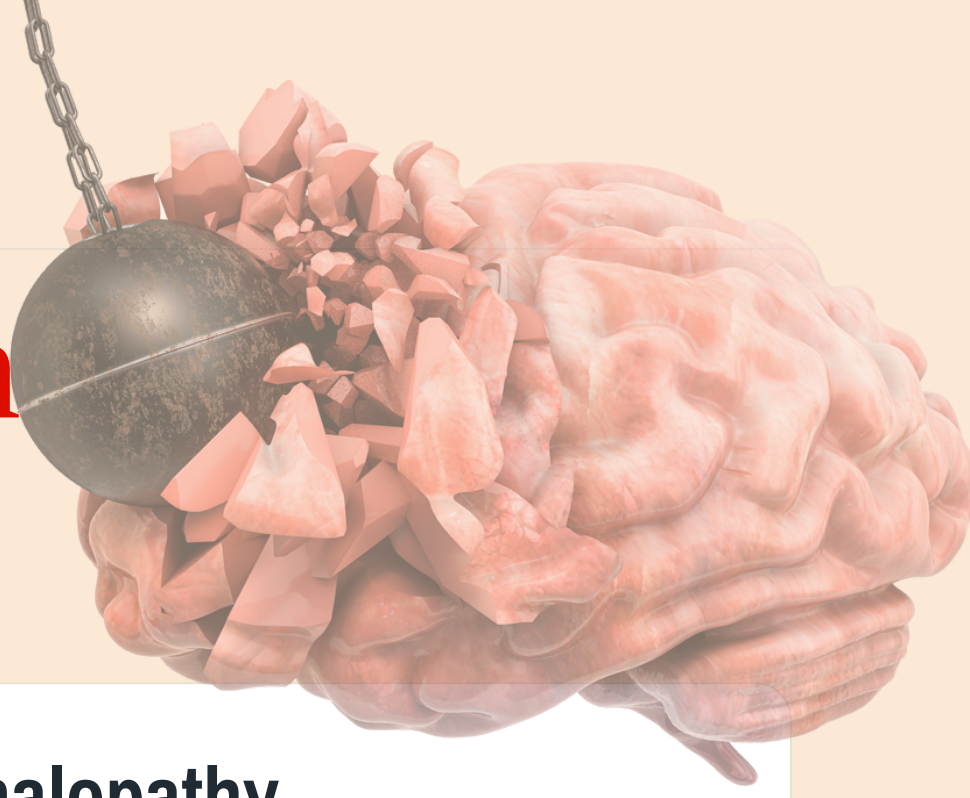
Etiology • Term Newborn

The **three main** causes



1 Hypoxic-ischemic encephalopathy

The most common cause in full-term newborns. Early seizures, typically within the **first 6 to 12 hours of life.**

2 perinatal ischemic stroke

Focal and brief seizures in the first 24 hours, in a baby who, outside of the seizures, is neurologically well — without obvious encephalopathy.

3 TSVC and lobar hemorrhage

Venous sinus thrombosis: late onset, **median of 10 days**, with crises or apneas. Lobar hemorrhage: focal supratentorial bleeding, beginning on the 1st day of the 1st week.

Always on the radar: CNS infections and genetic-metabolic disorders — inborn errors of metabolism, benign channelopathies (KCNQ2), and pyridoxine-dependent seizures.

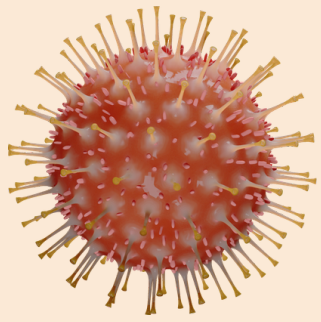
DIFFERENTIAL DIAGNOSIS

The **age at birth guides** the diagnosis.

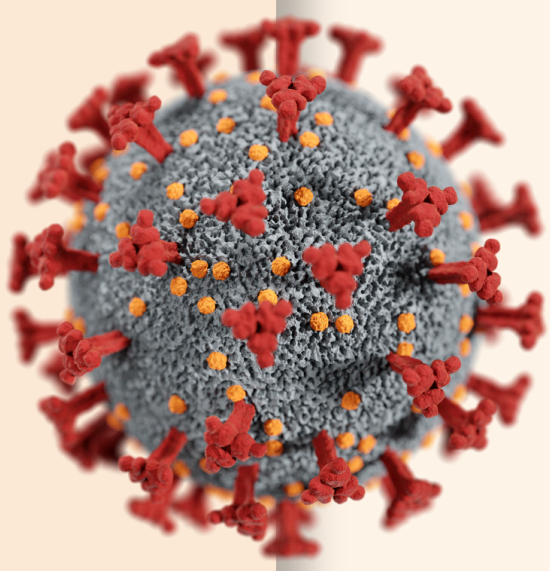
6–12 h — **Hypoxic-ischemic encephalopathy**
Most common cause in full-term newborns

< 24 h — **perinatal ischemic stroke**
Focal and brief seizures, baby doing well between them.

Day 1 — **Lobar hemorrhage**
Mechanical delivery or coagulation disorder



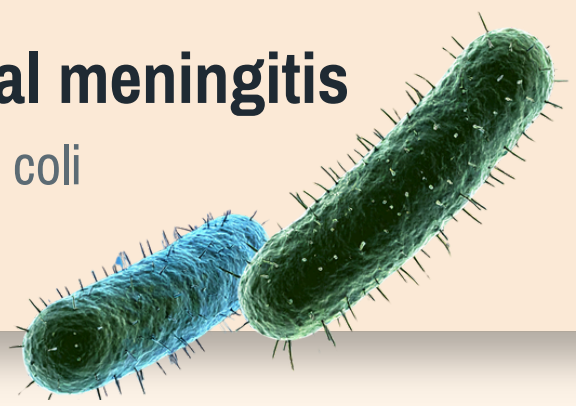
Days 4–6 — **Rotavirus**
The classic "fifth day fits"



~Day 10 — **Venous sinus thrombosis**
Seizures or apneas — median of 10 days

~Day 16 — **Enterovirus**
Late-window viral encephalitis

16th–19th day — **Herpes simples (HSV)**
Lethargy + seizures. Don't wait for the gallbladders.



Late — **Bacterial meningitis**
GBS or E. coli

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The fallacy of the clinical examination

Most crises are silent.

Most neonatal seizures are purely electrographic: they have no visible motor manifestations.

Subtle signs that pass by

Apnea, eye deviation, mouth automatism

...or absolutely nothing

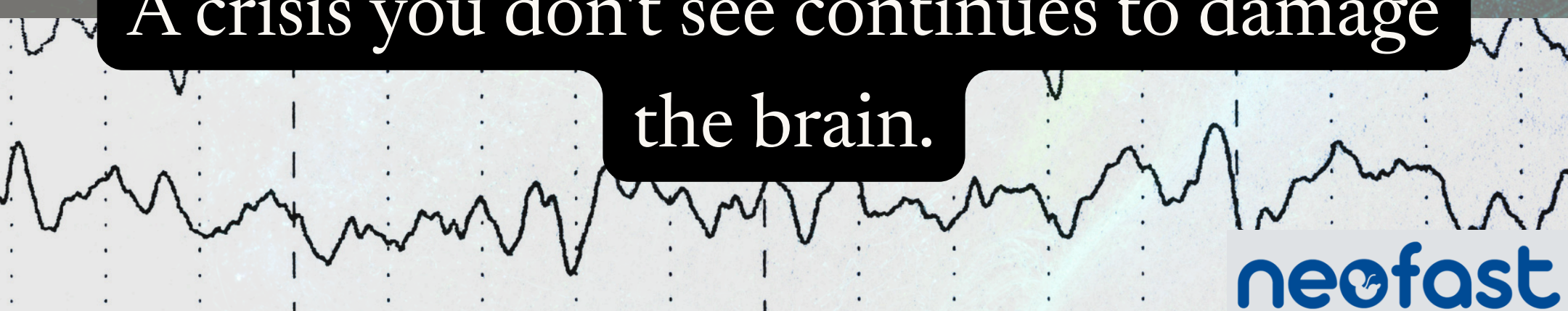
WHAT DECEIVES

Normal tremors and rhythmic movements in newborns are frequently **misinterpreted** as seizures and **treated unnecessarily.**

Electroclinical decoupling

After taking the anticonvulsant, the motor symptoms may disappear completely — while the electrical seizures, which are equally harmful to the brain, continue as part of the pattern.

A crisis you don't see continues to damage the brain.



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MONITORING

cEEG or aEEG? Both – for different things.

GOLD STANDARD

Conventional cEEG

- ✓ Detects brief (<30 s) and focal seizures.
- ✓ Evaluate the baseline layout.
- ✓ Guide to discontinuing medication

BEDSIDE

aEEG integrado

- ✓ **Long-term trends and sleep-wake cycles**
- ✓ Monitors asphyxia in the hypothermia protocol.
  It may fail in very brief or focal crises.

Maintain cEEG for 24 hours after the last seizure before considering complete control.

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MANAGEMENT · STEP 1

Stabilize the patient before discontinuing anticonvulsants.

Strict systemic stabilization **is mandatory** and comes before any drug escalation.

- ✓ **Normotermia**
- ✓ **Normoglicemia**

- ✓ **Normal voltage**
- ✓ **Electrolytes (calcium)**
- ✓ **Avoid hypocapnia — it exacerbates ischemia**

The window is the **first hour**.

Controlling clinical and electrical seizures quickly reduces the seizure burden (a variable independently associated with worse long-term outcomes).

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MANAGEMENT · STEP 2

The staircase: first and second row

Phenobarbital

1st LINE

20 mg/kg IV em 10–20 min

You can repeat 10–20 mg/kg, **maximum 40 mg/kg total**.

Maintenance **3–5 mg/kg/day** IV or PO, 12–24 h after the attack.

Monitor for sedation and respiratory depression.

Levetiracetam

2nd LINE

40–60 mg/kg IV em 15 min

Excellent safety profile, with no cardiorespiratory depression.

Maintenance dose: **20–60 mg/kg/day**, divided every 12 hours.

Phenytoin

2nd LINE

15–20 mg/kg IV tape, <1 mg/kg/min

Seizures refractory to phenobarbital. Requires cardiac monitoring (arrhythmia, hypotension) and a large-bore IV line (risk of necrosis).

Maintenance dose: **4–8 mg/kg/day.**

MANAGEMENT · STEP 3

Refractory and specific cases

Midazolam

REFRACTORY

0,05–0,15 mg/kg IV → 0,05–0,4 mg/kg/h

Slow bolus. High risk of hypotension and respiratory depression.

Option for neonatal status epilepticus.

Lidocaine

REFRACTORY

2 mg/kg IV em 10 min → 4–6 mg/kg/h

Reduce dose over 12–24 hours. Contraindicated in arrhythmias or if phenytoin has been used previously — added cardiotoxicity.

Carbamazepine

SPECIFIC

2–10 mg/kg/day orally

Choose, in low dose, for benign genetic channelopathies of childhood (KCNQ2 / KCNQ3).

Pyridoxine (B6)

TEST

100 mg IV, single dose under cEEG

Diagnostic-therapeutic test for pyridoxine-dependent seizure.

Respiratory support ready — risk of apnea.

IMAGE

Critical windows: **when to ask for what**

Hypoxic-ischemic encephalopathy

Ultrasound on admission and twice in the first week; MRI from the 4th to the 6th day (diffusion window); follow-up MRI during endotracheal infarction. The initial ultrasound may be normal in acute injury—the diffusion-weighted image (DWI) delineates the ischemic area.

Perinatal stroke and lobar hemorrhage

Ultrasound on admission, repeat in 24–48 h and 48–72 h; MRI in the 1st week; follow-up MRI at 3 months of corrected age.

Peri-intraventricular hemorrhage

Ultrasound (USc) during the first 3 days — the peak of bleeding.

With post-hemorrhagic dilation, repeat several times a week.

Meningitis and CNS infections

Ultrasound on admission and as the condition evolves; late monitoring after 2–3 weeks (E. coli) · MRI at the first sign of a complication.

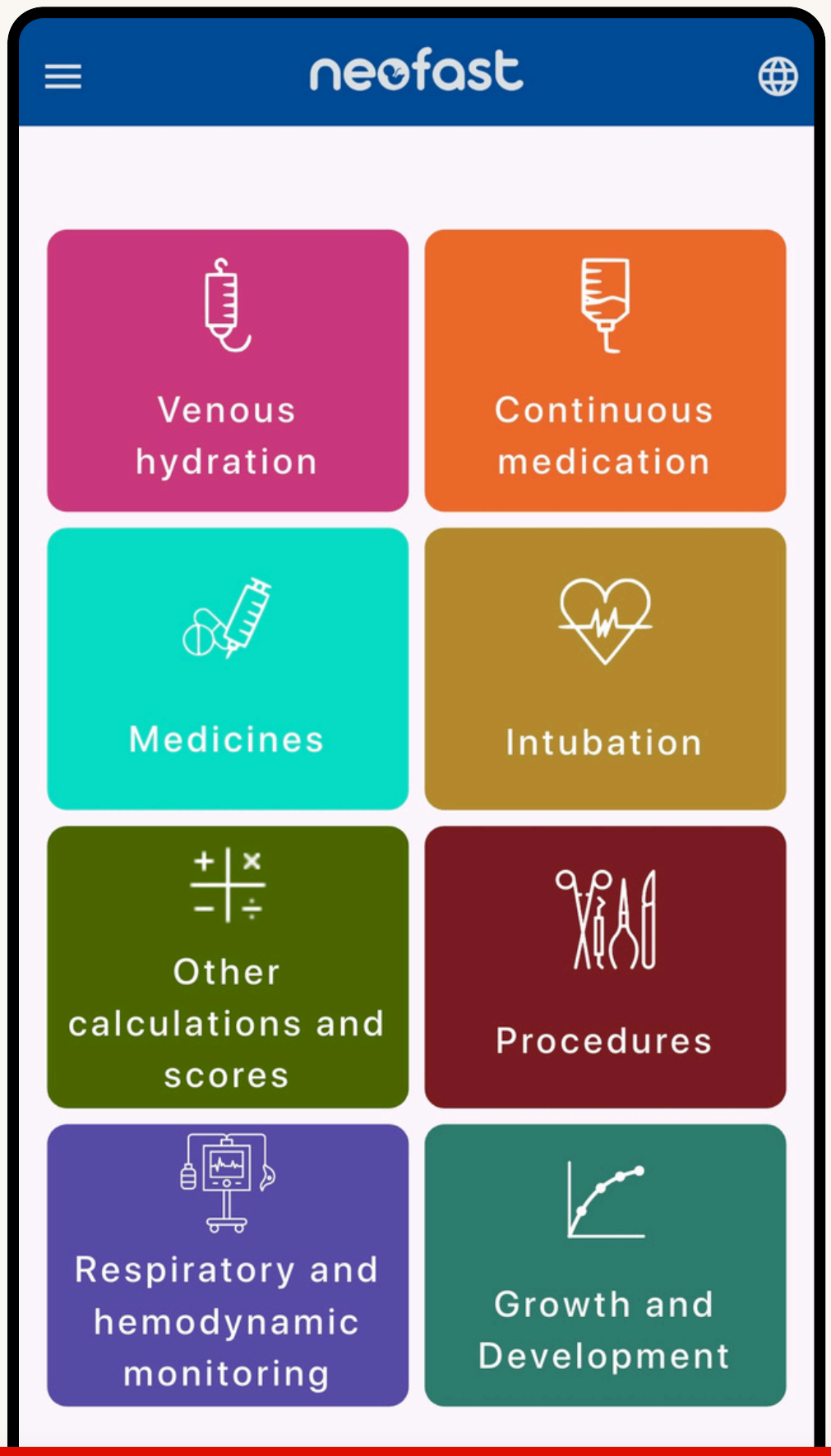
In extremely premature infants, serial ultrasounds are routine from birth until discharge or until the equivalent of term age.

IN PRACTICE

The correct calculation, at 3:00 AM PM

NeoFast solves the weight-based calculation directly on the shift: *loading dose*, *maintenance dose, and continuous infusion*, without the need for paper-based rule of three calculations.

- ✓ **Attack dose per weight**
- ✓ **Maintenance and interval**
- ✓ **Continuous infusion in mg/kg/h**



The dose you already know, calculated in seconds.

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FOR THE DUTY

Two things that almost everyone **gets wrong**.

1 **Hospital discharge without anticonvulsant** ✓

In acute induced seizures — asphyxia, perinatal ischemic stroke, isolated lobar hemorrhage, controlled infection — with the electrical seizures already resolved, anticonvulsants **should be discontinued before discharge.** **There is no benefit in maintaining it long-term, and early discontinuation avoids cognitive and behavioral toxicity in the developing brain. (Glass HC et al., JAMA Neurology, 2021)**

2 **PLIC is the predictor that matters.** ✓

In MRI scans at term-equivalent ages, the posterior limb of the internal capsule (PLIC) is the main prognostic predictor of motor function. Asymmetry or absence of normal myelination of the PLIC strongly predicts contralateral spastic hemiplegia.

Educational content. Does not replace your institution's protocol or individual patient assessment. Sources: Meijler & Mohammad (Eds.), Neonatal Brain Injury, Springer 2024 (Open Access) · Glass HC et al., JAMA Neurology, 2021.

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