"Neurulation (Week 3-8)"

Definition

Neurulation: Process in which the neural plate forms the neural tube.

- Timeline: 3rd to 8th week of development
- Clinical relevance: Most congenital anomalies (neural tube defects, organ malformations) occur during this period.

Stepwise Process of Neurulation

Step 1: Thickening of Ectoderm

- Signals from notochord & prechordal plate → overlying ectoderm thickens
- Result: Formation of neural plate
- Cells of neural plate → called neuroectoderm

Flowchart:

Notochord + Prechordal plate → Signal ectoderm → Thickened ectoderm → Neural plate → Neuroectoderm

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Step 2: Lengthening of Neural Plate and Body Axis

- Mechanism: Convergent extension
    - Cells move medial-laterally within ectoderm and mesoderm
- Regulation: Planar Cell Polarity (PCP) pathways
- Clinical relevance: VANG-like (VANGL) gene defects → disrupt PCP → neural tube malformations

Flowchart:

Neural plate → Convergent extension → Lengthened neural plate & body axis

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Step 3: Formation of Neural Folds and Neural Groove

- Lateral edges of neural plate elevate → neural folds
- Depressed midline → neural groove

Flowchart:

Neural plate lengthens → Lateral edges rise → Neural folds

Neural plate midline → Depressed → Neural groove

Step 4: Formation of Neural Tube

- Neural folds approach midline and fuse

- Fusion begins: Cervical region (5th somite level)
- Result: Neural tube formation

Flowchart:

Neural folds → Fuse at midline → Neural tube formed

Step 5: Formation and Closure of Neuropores

- Before fusion completion, two openings remain → neuropores

Neuropore	Location	Closure Day	Clinical Consequence if Not Closed
Anterior	Cranial end, connected to amniotic fluid	Day 25	Anencephaly

Posterior	Caudal end, connected to secondary yolk sac	Day 28	Spina bifida (lumbosacral)

Flowchart:

Neural tube (incomplete) → Neuropores: Anterior + Posterior → Close Day 25 & 28 → Complete neural tube

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High-Yield Points

- Neuroectoderm → all neurons and glial cells
- Notochord → inductive signals for neural plate formation
- Convergent extension → critical for neural tube elongation
- Neural tube defects: Common congenital anomalies
  - Anterior neuropore → anencephaly
  - Posterior neuropore → spina bifida

- Somite level of neural tube fusion initiation: 5th somite (cervical region)

Summary Flow of Neurulation

1. Notochord + prechordal plate → neural plate formation
2. Convergent extension → plate elongates
3. Lateral edges → neural folds; midline → neural groove
4. Neural folds fuse → neural tube
5. Neuropores close (anterior Day 25, posterior Day 28)

-> The End <-