AJNR

The Needed Studies Trying to Untangle the Complex Nature of Neonatal Intracranial Bleeds Occurring around Birth

L.A. Ramenghi

AJNR Am J Neuroradiol 2022, 43 (10) 1500-1501
doi: https://doi.org/10.3174/ajnr.A7651
http://www.ajnr.org/content/43/10/1500

The Needed Studies Trying to Untangle the Complex Nature of Neonatal Intracranial Bleeds Occurring around Birth

The challenge of understanding mechanisms beyond insults and the resulting brain lesions in term or near-term neonates facing delivery time is far from being fully untangled. We believe considering together near-term and term neonates is justified because major achievements in brain maturation have been obtained for fetuses after 34 weeks of gestation.[1] Karamian et al[2] produced this very useful and large single-center retrospective study on intracranial hemorrhages that we know are highly heterogeneous with a complex and often unclear nature. Data on the multicompartment character of intracranial hemorrhages emerges as one of the principal findings of the study, reinforcing a generic hemodynamic identity of these intracranial bleeds but minimizing the contribution of instrumented delivery and of coagulopathy favoring bleeding.

Intraventricular hemorrhages (IVHs) also remain well-represented in this population of neonates close to or at term gestation. IVH in very premature neonates is undoubtedly due to the vascular vulnerability at the caudothalamic notch of the remaining germinal matrix, so prone to bleed into the ventricles in the first 3–4 days of life, making obvious the origin of the IVH.[3] At term gestation, many cerebral developmental features are changing; the germinal matrix undergoes anatomic involution, though IVH also remains rather frequent in less premature neonates as this study confirms. Knowledge of the origin of IVH in such neonates near or at term is only based on pioneer and very old postmortem studies[4] showing the likely origin from the choroid plexus.

The present work further highlights the role of brain venous thrombosis phenomena, because we know IVH may disclose cerebral sinovenous thrombosis (CSVT) in term neonates[5] and also in near-term preterm neonates.[6] In these mildly premature neonates, a late appearance of IVH (in very preterm neonates IVH occurs in the first 3–4 days) reveals the phenomenon of progression of CSVT into the deep, venous system of the brain with frontal medullary vein involvement, an anatomic area that is the last one to mature.[1] In these neonates, thrombophilic abnormalities are more significantly represented.[7] Conversely, it is not so uncommon to also find medullary vein involvement in the brain of term neonates in the first days of life, mimicking local venous thrombotic phenomena without evident CSVT and potentially representing a different form of neonatal encephalopathy that we have already described.[8] These abnormalities despite possibly resulting in "linear" periventricular leukomalacia–like lesions, again atypically more frequent in the frontal part of the brain, represent a different entity from the better known white matter diseases of premature neonates first described by Banker and Larroche in 1962[9] and clinically identified exactly one hundred years before by William J. Little.[10]

We believe one of the major merits of the present study is to stress the important role of periventricular, medullary, and cortical vein involvement, a phenomenon described as thrombosis by the authors and perhaps a potential sign of a venous congestion in the pathogenesis of an intracranial bleed occurring around the time of labor and delivery. This sequence of events may reproduce what already observed decades ago for understanding the pathogenesis of IVH from the germinal matrix of premature neonates, originally thought to be an arterial kind of bleeding more than a venous one, the "venous hypothesis" we all trust currently.

REFERENCES

1. Childs AM, Ramenghi LA, Cornette L, et al. **Cerebral maturation in premature infants: quantitative assessment using MR imaging.** *AJNR Am J Neuroradiol* 2001;22:1577–82 Medline
2. Karamian AG, Yang QZ, Tam LT, et al. **Intracranial hemorrhage in term and late-preterm neonates: an institutional perspective.** *AJNR Am J Neuroradiol* 2022;43:1494–99 CrossRef
3. Tortora D, Severino M, Malova M, et al. **Differences in subependymal vein anatomy may predispose preterm infants to GMH-IVH.** *Arch Dis Child Fetal Neonatal Ed* 2018;103:F59–65 CrossRef Medline
4. Donat JF, Okazaki H, Kleinberg F, et al. **Intraventricular hemorrhages in full-term and premature infants.** *Mayo Clin Proc* 1978;53:437–41 Medline
5. Wu YW, Hamrick SE, Miller SP, et al. **Intraventricular hemorrhage in term neonates caused by sinovenous thrombosis.** *Ann Neurol* 2003;54:123–26 CrossRef Medline
6. Ramenghi LA, Govaert P, Fumagalli M, et al. **Neonatal cerebral sinovenous thrombosis.** *Semin Fetal Neonatal Med* 2009;14:278–83 CrossRef Medline

7. Ramenghi LA, Gill BJ, Tanner SF, et al. **Cerebral venous thrombosis, intraventricular haemorrhage and white matter lesions in a preterm newborn with factor V (Leiden) mutation.** *Neuropediatrics* 2002;33:97–99 CrossRef Medline
8. Arrigoni F, Parazzini C, Righini A, et al. **Deep medullary vein involvement in neonates with brain damage: an MR imaging study.** *AJNR Am J Neuroradiol* 2011;32:2030–36 CrossRef Medline
9. Banker BQ, Larroche JC. **Periventricular leukomalacia of infancy. A form of neonatal anoxic encephalopathy.** *Arch Neurol* 1962;7:386–410 CrossRef Medline
10. Little WJ. **On the influence of abnormal parturition, difficult labours, premature birth, and asphyxia neonatorum, on the mental and physical condition of the child, especially in relation to deformities.** *Trans Obstet Soc Lond* 1861–1862;293–344

L.A. Ramenghi
Istituto Pediatrico "G.Gaslini"
DINOGMI Department, University of Genoa
Italy

http://dx.doi.org/10.3174/ajnr.A7651