



NATIONAL PERINATAL ASSOCIATION

STUDENT SOCIETY NEWSLETTER

Neural Remodeling after Perinatal Stroke: A Bringer of Hope and Caution

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As the field of neonatology advances, more lives are saved that would otherwise have barely begun. However, many NICU patients unfortunately are predisposed to cerebral infarctions and consequently encounter varying degrees of lifelong disabilities, including cerebral palsy. Because infants' brains are very different from those of the classic elderly stroke patient, it follows that the aftermath is quite a distinct entity from adult stroke recovery. Namely, infants have increased neuroplasticity – the potential to rebuild after an injury. Neuroplasticity, however, can be for better or worse in the developing brains of infants and children. We will use the most common form of cerebral palsy resulting from perinatal stroke – the hemiplegic spastic type – as a framework in which to discuss the implications of this neuroplasticity on the development of perinatal stroke survivors.



But first, a basic review of neuroanatomy. Movement is controlled via the corticospinal tract (CST), whose presynaptic neurons originate in one of two motor cortices and terminate in the contralateral anterior horn of the spinal cord at their respective spinal levels. Thus, movement on a given side of the body is controlled by the opposite side of the brain – this is what we are taught in school, but it is a partial truth up until as late as 12 months of age. At birth, each motor cortex attempts to contribute presynaptic neurons to both CSTs, not just the contralateral one. This can be demonstrated on transcranial magnetic stimulation of infants in which unilateral cortical stimulation produces surprisingly similar bilateral motor neuron responses. All presynaptic fibers compete for resources and synapses with a finite number of postsynaptic fibers, and the contralateral fibers eventually dominate. This is not the case for perinatal stroke survivors with only one intact motor cortex, who typically go on to develop hemiplegic spastic cerebral palsy; in the absence of the infarcted motor cortex, the intact one is left to provide presynaptic fibers to both CSTs. This is by no means a compensatory mechanism for the loss of fibers from the infarcted cortex; in fact, there are theories that this aberrant innervation, not loss of default innervation, is to blame for the spasticity and incoordination seen in many of these stroke survivors.¹

One proposed way to clinically assess the severity of aberrant innervation (and thus, predict response to neurorehabilitation) is the observation of “mirror movements”, a common vestige of early

childhood that persists in unilateral perinatal stroke survivors. Mirror movements can be described as a phenomenon in which voluntary movement of a limb simultaneously produces involuntary mirrored movement of the contralateral homologous limb. Again, this is a normal phenomenon until about preschool age, but perinatal stroke survivors may never outgrow it due to the aforementioned reorganization of the CST and/or the stroke having affected those developing interhemispheric connections. These persistent mirror movements affecting the compromised limb even further impede activities of daily living beyond the challenges of simple weakness.

Seeing that neurological remodeling can and will occur in any case, how do we ensure that it happens to the benefit, not the detriment, of perinatal stroke survivors? Early intervention and “rehabilitative” (because we also are concerned about the development of skills that never existed before the stroke) therapy, even in infants who are too young to follow instructions, is key. Even typically developing infants must learn fine motor control and take about six months of life to learn basic fine motor skills, such as pincer grasp. One rehab method with rising evidence for both adult and perinatal stroke survivors is constraint-induced movement therapy (CIMT). Different versions vary in both their intensity and length, but the basic premise is casting, or some other restraint, of the intact limb to force the patient to use the hemiplegic limb. Compared to traditional OT and PT, these therapies have been associated with improved motor skills.² However, the optimal frequency and duration of the therapies have yet to be determined, and they often are more time-intensive than traditional therapy regimens.³ This logistical uncertainty, along with the supervision required to implement the therapy, has hampered insurance funding of CIMT. However, the development of home/school-based CIMT and OT have increased the practicality of these therapies. Further research and long-term follow-up, along with advocacy, will be necessary to make such interventions more widely available to our NICU graduates. What often makes these survivors inspiring is also the thing that requires long-term monitoring and guidance: their ability to not only survive, but to develop even in suboptimal conditions.



Medical School Reflections: OB/GYN Encounters

Shining Light into Darkness

Jessica Lee, MS3

The phone rang, breaking the silence of our shoebox sized team room as I looked over my patient note. My intern quickly answered, “Benign gyn, Alice speaking.” She roughly scribbled out something, nodding and listening to the person on the other end. I waited anxiously – it had been a slow morning on my second month of OB clerkship, and I was antsy to stretch my legs.

“Go Time!”

Alice popped up out of her seat. I followed her to the ER as she gave me a quick rundown: Karen was 24 years old and 11 weeks into her first pregnancy. She presented early to the ER that morning with bloody vaginal discharge. On pelvic exam, more was passed. We knew little else as we passed through the dim halls of the ER. I noticed a petite young female, resting on a cramped bed in the hall with her eyes tightly closed as we moved to the physician station just past her. Noticing us and drawing us to the side, the ER physician whispered that she suspected Karen had suffered a miscarriage. I sucked in a sharp breath. I’m sure Alice had seen plenty, but this would be my first, and I had little time to brace myself.

The ER physician guided us towards a sink a few steps away. Inside a pink rectangular bucket lay a bloody mess of stuff. Grabbing some gloves, Alice pushed aside some of the ick and revealed a sac that looked like a water balloon. Using two fingers, Alice gently broke through the membrane to reveal the tiny fetus. It was no bigger than a golf ball, grey, and still. I felt a glob rising in my throat and hot tears pricking my eyes. I had seen nothing like it before, and I wasn’t sure I wanted to look anymore. An eternity passed before anyone spoke, and I dreaded what would come next.

Alice and I walked mutely back towards our patient and woke her gently.

I stared helplessly, trying to express empathy and compassion through my eyes. With a tight stomach and lost words, I felt I would have botched absolutely everything if I tried to talk. I observed as Alice broke the news gently, kindly, making sure to not mince words but leaving space for Karen to respond, react, and guide it all. Karen broke down immediately, tears streaming down her face. Alice paused, waiting, allowing the shock and grief to run its course. Karen had many questions, but this one was seared into my head:

“Is this something I did?”

Firmly, Alice responded, “You did absolutely nothing. This was not your fault, and there was nothing you could have done differently.”

As a student, I get to work day in and out with some of the most kind and compassionate healthcare workers. I watch them care so hard, sacrifice so much, live the ups and downs alongside their patients. Healthcare isn’t just a system or a machine- it’s people. The ones I have the privilege and honor to work with try their hardest to not only care for and treat their patients but to honor them as people as well. I watched with pride as Alice shone a little light into the darkness that Karen was brought into that day. I believe healthcare providers share in both the triumphs and the darkest moments of patients’ lives. That isn’t solely a platitude; people like Alice make it real.



Holding Baby G

Emile Gleeson, MS4

What do you say to the proud new dad of a barely-alive baby? Do you congratulate him?

I can't say what I'm really thinking: Hope your baby lives long enough to meet her mother.

I met Mrs. G on the Labor and Delivery unit when she was admitted for contractions in active labor. She and her husband were lovely people, polite to everyone and endlessly excited to meet their daughter. I could barely believe that the happy couple I met in the labor room was the same that I had been reading about a few moments earlier in Mrs. G's chart. Just a few weeks prior, Baby G had been diagnosed with a terminal genetic condition; even if born alive, she would be unlikely to survive for more than a few days. The parents had received extensive counseling on their options for the birth and immediate postpartum care for Baby G. While many couples in this position choose to focus the birth plan on the mother's comfort, providing only palliative care to their terminally-ill infant, Mr. and Mrs. G had their hearts set on getting to hold their baby alive.

The mood in the labor and delivery lounge was grim as we discussed Mrs. G's case and communicated to our neonatal colleagues the parents' desire for full resuscitative efforts. No one was excited about delivering or resuscitating a baby that would likely only live for a matter of days, but we also were determined to serve Mrs. G as best as we could and to provide her with the care that she wanted. Mrs. G had one wish – to hold her baby alive.

As her labor progressed, we anxiously tracked her fetal tracing and cervical changes, praying that she would deliver quickly and easily. But after six hours of stalled cervical dilation and a progressive increase in fetal heart rate decelerations, the likelihood of Baby G surviving the stress of a vaginal delivery were dwindling. If Mrs. and Mr. G wanted Baby G born alive, it was time to discuss a C-section. For a healthy baby, this would have been a routine conversation, but the stakes were

higher for a terminally ill one. While the C-section would still pose all the risks of major abdominal surgery to Mrs. G, she had a significantly decreased chance of getting a live baby out of the procedure. And even if Baby G was born alive, we knew she would not likely live for long. In short, the C-section seemed a dangerous gamble for an uncertain prize. To the dismay of the obstetrician on call, Mrs. G elected to move forward with the procedure, and so we moved her to the operating room and prepared for surgery.

As if the stakes weren't high enough, Mrs. G's epidural stopped providing adequate analgesia during the operation, and she had to quickly be transitioned to general anesthesia. She would not be awake to see her baby's birth. We managed to get Baby G out of the uterus alive and immediately handed her over to the neonatal response team. As we worked to stop Mrs. G's uterine bleeding and close her abdomen, the neonatal team worked to resuscitate Baby G. The baby was placed on CPAP to help her breathe, and she was eventually stable enough to be transferred to the NICU. Mr. G was able to hold Baby G briefly in the operating room, but Mrs. G was still sedated at the time.

After completing the surgery and transferring Mrs. G to recover in the PACU, I passed Mr. G in the hallway. Normally I would have congratulated a new father with a big smile, but in this case, that felt very wrong. Condolences weren't appropriate either, as his baby was, for now, alive. All I could think was how hard I was hoping that Baby G would live long enough for Mrs. G to wake up from anesthesia and make it over to the NICU to finally hold her. We had put Mrs. G through a major surgery because she wanted so badly to hold her little girl. If the baby died before meeting her mother, would all of this – the trauma of surgery, the frightening experience of losing epidural anesthesia with an open abdomen – have been worthwhile?

So, what was I supposed to say to Mr. G?

I looked at him and smiled. "Your daughter is beautiful."

"Thank you." He smiled back, with tears in his eyes.

Works Referenced

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3. Sakzewski, L., Ziviani, J., & Boyd, R. N. (2013). Efficacy of Upper Limb Therapies for Unilateral Cerebral Palsy: A Meta-analysis. *Pediatrics*, 133(1). doi:10.1542/peds.2013-0675

