Is Myelination in Infancy Delayed Following Long-gap Esophageal Atresia Repair? Preliminary Qualitative Assessment Using T1-weighted MRI

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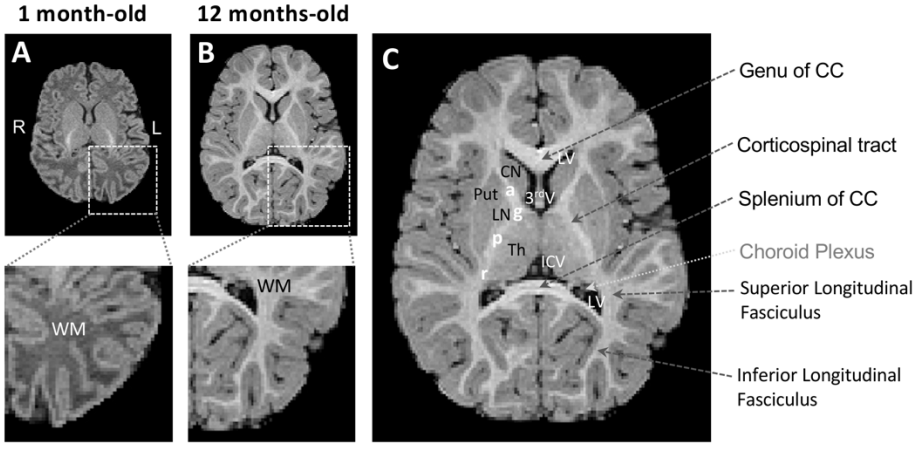
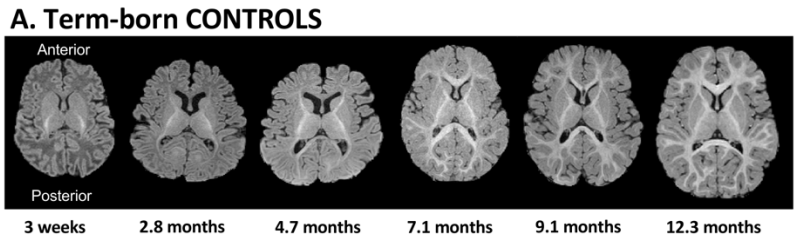
Introduction: It is well known that brain's tissue contrast is reversed on T1-weighted images in infants younger than 4 months of age [1]. This tissue reversal – characterized by white matter presenting as gray and gray matter as white, is caused by the incomplete myelination of the neonatal and early infant brain. Previously, we reported global brain atrophy [2, 3] with quantitatively smaller corpus callosum [4] in a pilot cohort of critically ill infants following repair of long-gap esophageal atresia (EA) with Foker process [5]. Our study goal was to qualitatively assess the timeline of white matter to gray matter tissue contrast reversal in infancy in a selected cohort of infant patients. We hypothesized that critically ill term-born and premature patients following surgical repair of long-gap EA would exhibit prolonged contrast reversal on T1-weighted brain MRI when compared to term-born controls.

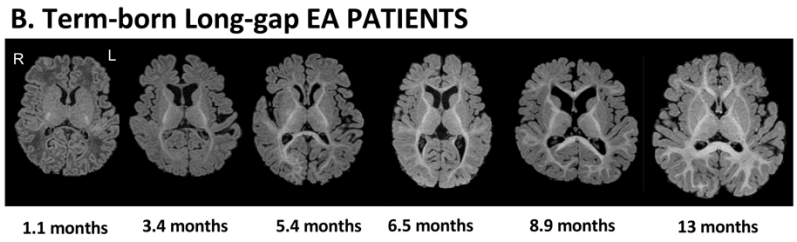
Methods: This is a cross-sectional pilot study in term-born control infants (n=21), and term-born and premature patients (n=13/group) <1-year corrected age following completion of long-gap EA repair via Foker process [5] that underwent non-sedated research MRI. T1-weighted structural brain MRI images were qualitatively evaluated by two blinded investigators for characteristics of brain tissue contrast as: (i) reversed, (ii) transitional – predominantly reversed (with some adult-like tissue contrasts), (iii) transitional – predominantly adult-like tissue contrast (with some white matter/gray matter reversal), and (iv) expected adult-like tissue contrast (white matter lighter than gray matter). Data were presented as frequency/group.

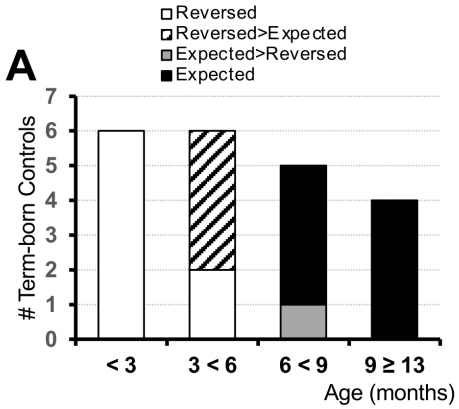
Results: Tissue contrast reversal is present across the first 4 months of corrected age similar to controls. However, our preliminary results show longer period of transition to the expected adult-like tissue contrast. Specifically, transitional pattern of tissue contrast spans 4-10 months of age in term-born patients, in comparison to period of 4-6 months in control infants. Results for the premature patient group are inconclusive since data points are missing for ages >8 months.

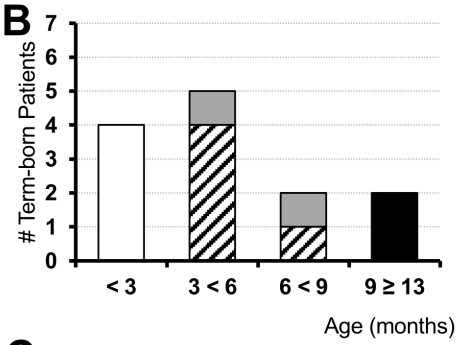
Conclusions: Our preliminary qualitative analysis of tissue contrast reversal timeline in T1-weighted structural MRI implies a delay in myelination following complex perioperative critical care for long-gap EA. This preliminary data adds to previously reported globally decreased brain size in term-born and premature infants following long-gap EA repair [2-4]. In the light of prolonged survival of critically ill infants born with long-gap EA [6], future studies should include comprehensive diffusion tensor image (DTI) analysis including its impact on short- and long-term neurobehavioral outcomes.

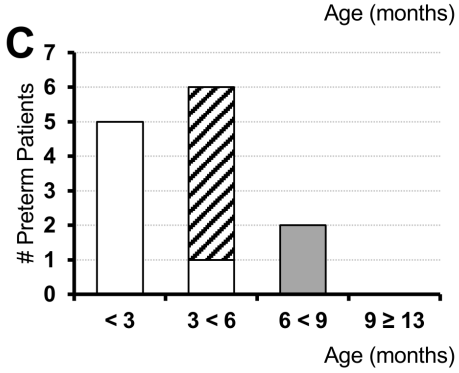



A. Term-born CONTROLS
Anterior
Posterior
3 weeks
2.8 months
4.7 months
7.1 months
9.1 months
12.3 months


B. Term-born Long-gap EA PATIENTS
R
L
1.1 months
3.4 months
5.4 months
6.5 months
8.9 months
13 months


A
Reversed
Reversed>Expected
Expected>Reversed
Expected
Term-born Controls
0
1
2
3
4
5
6
7
< 3
3 < 6
6 < 9
9 ≥ 13
Age (months)


B
Term-born Patients
0
1
2
3
4
5
6
7
< 3
3 < 6
6 < 9
9 ≥ 13
Age (months)


C
Preterm Patients
0
1
2
3
4
5
6
7
< 3
3 < 6
6 < 9
9 ≥ 13
Age (months)