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COMBINED PROTON MAGNETIC RESONANCE SPECTROSCOPY AND NEAR-INFRARED SPECTROSCOPY MEASUREMENTS OF CEREBRAL BLOOD VOLUME, OXYGENATION, CYTOCHROME OXIDASE, AND INTRACELLULAR METABOLITES DURING PERINATAL HYPOXIA-ISCHAEMIA

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Background: Hypoxic-ischaemic (HI) neonatal encephalopathy (NE) is associated with high mortality and morbidity rates worldwide. The magnetic resonance spectroscopy (MRS) Lactate/N-acetylaspartate (Lac/NAA) peak-area ratio predicts long term neurodevelopmental outcome.

Aims: To investigate brain haemodynamic and metabolic changes during transient HI using simultaneous proton (1H) MRS and broadband near-infra-red spectroscopy (NIRS) in a newborn piglet pre-clinical model.

Methods: MRS and NIRS data were acquired simultaneously in 6 healthy newborn anaesthetised male piglets (aged < 24 hr) during, and up to 90 min after transient HI.

Results: A swift decline in oxygenation (Hbdiff) upon induction of HI, and associated reduction of cytochrome-c-oxidase ($_{ox\text{-}red}$CCO), was accompanied by increased Lac/Naa (Fig 1A-D). Upon resuscitation there was a hyperaemic phase in 4 out of 6 animals with $_{ox\text{-}red}$CCO and Lac/Naa recovering to baselines. During recovery $_{ox\text{-}red}$CCO and Lac/Naa correlated linearly (p=< 0.0001; Pearson correlation) (Fig. 1D). Two piglets showed no post HI hyperaemic response and incomplete $_{ox\text{-}red}$CCO recovery.

Conclusions: The linear relationship between declining Lac/Naa and increasing $_{ox\text{-}red}$CCO after HI suggests mitochondrial utilisation of Lac, instead of pyruvate, as a substrate at least during oxidative energy metabolism recovery. Complementary 1H MRS and NIRS may improve our understanding of cerebral energy metabolism pathways and the response of the newborn brain to HI and govern early interventional therapies.

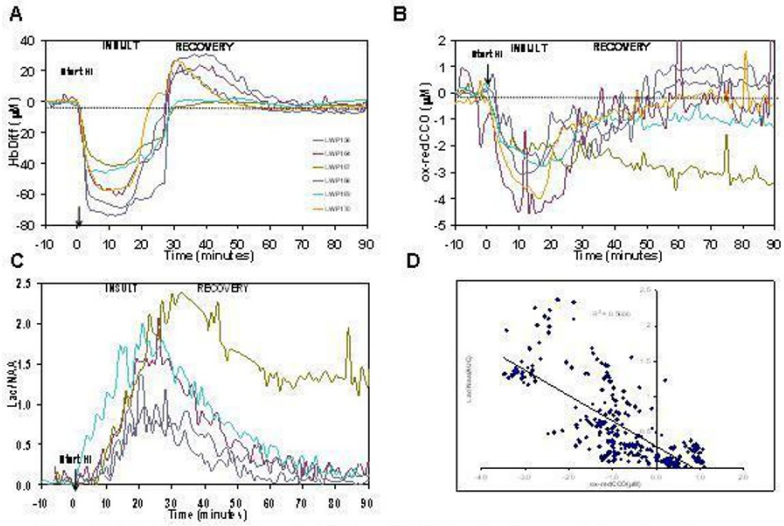

Figure 1 Relationship of haemodynamic (NIRS) and MRS 1H Lac/Naa changes during an hypoxic ischaemic insult and recovery. A-C; changes in oxygenation (HbDiff), ox-red CCO and Lac/Naa during insult and recovery. D; Correlation of ox-red CCO vs Lac/Naa during recovery phase

[Figure 1 Relationship of haemodynamic (NIRS) and]