Supervisor: Dr Don Sharkey

Project title: Computational modelling of stress associated newborn brain injury

Theme: Newborn outcomes

Keywords: premature, newborn, brain injury, modelling

Fee Band: Laboratory based research

Available to home & EU students/International students

In the UK, like other countries such as USA and Australia, the centralisation of neonatal intensive care in large tertiary units (NICU's) has resulted in reduced mortality but not significant morbidity. Data from Australia suggests there is 4-fold increase in death for those ELBW infants transferred between tertiary neonatal units within the same city (Melbourne). Furthermore, data from the USA, where 69,000 neonatal transports occur each year, have demonstrated a significant increase in severe intraventricular haemorrhages (IVH) in transported infants. Severe IVH is associated with a poor neurological outcome including cerebral palsy. Many of the ELBW infants are transferred within a few hours of life in order to receive specialist care and services. However, it is the first few days of life that represent the greatest risk of developing an IVH with up to 50% developing IVH before 3 days, if severe 75% could go on to develop cerebral palsy.

Newborn ambulance transport exposes the baby to excessive vibration and noise far beyond what is considered safe for adults. Few studies have explored the stresses experienced by ELBW infants during inter-hospital transport and certainly none have examined the impact on the developing brain, physiological parameters and biochemical markers. Furthermore, the repeated exposure to vibration, noise and multi-directional inertial forces have not been quantified in relation to the clinical markers previously discussed

This study will be the first to establish the impact of inter-hospital transport on the ELBW infant. Physiological, biochemical and computational brain analyses will be undertaken.

This engineering/mathematical modelling project will allow head accelerations to be compared to current injury thresholds for both linear and rotational acceleration injury. Head and whole body vibration exposure limits have not been documented for such young babies; this work will provide the first insights into this area. A finite element model of the infant head will be developed so that shear deformations within the ventricles and meninges can be predicted (from head acceleration data) and analysed with clinical measures.