

Brain Foundation Gift Essay
Disorder: Traumatic Brain Injury
Turning the Lights On In The Golden Hour

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There is a condition that counts as the leading cause of death in children in the developed world(1). Actually, a condition that does not just affect children, but where the majority of victims are young men. It is traumatic brain injury (TBI), meaning any injury to the brain after an accident. Of course, medicine has been working hard to improve our options for dealing with this. Despite this, the all cause mortality from severe TBI in developed countries has remained around 30-35%, although superior prehospital resuscitation, better options for operation, enhanced intensive care and evidence-based management guidelines are all available.

The tragedy of TBI is not just the impact it has on young lives. TBI can leave victims with permanent deficits, impacting on their cognitive, behavioural, emotional and social function for the rest of their life(2). Some of those injured will need care for the rest of their lives. Recent analysis indicates that the cost added to Australia each year to look after those people for the rest of their lives amounts to \$8.6 billion each year(3). TBI is a problem that touches more than just the victims and their families.

Once the initial injury has occurred, there are a variety of insults that may worsen the extent of the brain injury. These "secondary insults" include low oxygen levels, low blood pressure, low blood sugar levels and either high or low carbon dioxide levels. Given how important these factors are, it seems like common sense to try and make sure that as many factors are made as normal as possible as quickly as possible. This would mean trying to provide high level care at the accident scene so we could provide the brain with the energy and nutrition it needs to prevent worsening of the injury and allow it to recover.

There are two key challenges with achieving this. The first is that there is often a delay of an hour or so until the patient reaches the hospital where advanced interventions such as ventilation, blood transfusion and testing can occur. In this “golden hour”, the options for providing the brain what it needs are limited. The other is that we do not have a monitor that we can use before we get to the hospital that provides direct information about what is happening with the brain. So it is hard to be sure what is occurring in the brain, and therefore what the brain needs. It is a little like working with the lights off.

When it comes to trying to assess whether the team treating the patient is providing all the necessary nutrients to the brain, the only guidance we have is that we should measure the amount of oxygen being carried in the blood, and that the blood pressure should be regularly checked(4). Although useful, this does not tell us what is happening in the brain itself, so we hope that by making these monitor values normal, we are doing the best that we can for the brain. These suggestions for prehospital monitoring have not changed in more than 10 years.

There are some other options for monitoring the brain once the patient reaches the hospital. These include monitoring the pressure in the head, monitoring oxygen levels in the veins leaving the head with jugular venous bulb oximetry or monitoring chemical levels in the brain with cerebral microdialysis(5-7). However, they all require time consuming, invasive and technical interventions that are not feasible in the prehospital arena.

A newer form of monitoring is available called Near-Infrared Spectroscopy (NIRS) which can be used to shine light directly into the brain tissue(8). The light reflected provides information about the amount of oxygen being delivered to the brain and its use. Measures of the amount of blood in that area of the brain are also displayed. This form of non-invasive monitoring offers the possibility that treating teams could monitor changes in the brain in real time and adjust their clinical treatment accordingly. This may therefore offer the chance to prevent secondary insults worsening brain injury.

There is already information that NIRS tissue oximetry monitoring can help provide information about where bleeding has happened in the brain when compared to imaging studies in the hospital(9). Large scale studies demonstrating that this form of monitoring can be used to predict patient outcomes or correlate with underlying brain pathophysiology have not been conducted at this stage. Investigating these associations may provide new insights into what is actually happening in the brain in the moments after injury and provide guidance for future efforts to individualise early patient care. It would be like turning on the lights to show the treating team what the brain needs.

TBI is both common and devastating. If we are to give patients the best chance of walking out of the hospital to the life they had planned, a renewed focus on the “golden hour” is essential to making progress. Newer technologies that can reveal what is actually happening in the brain may be the next step to improving the future for those suffering these injuries.

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