Licox® Brain Tissue Oxygen Monitoring System

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***Abstract*—Cerebral hypoxia is an independent predictor of unfavorable outcome and death in patients with head injury. The Licox Brain Tissue Oxygen Monitoring System (Licox) is used to identify patients at risk for developing cerebral hypoxia or hypoxia by measuring interstitial brain tissue oxygenation ($P_{bt}O_2$) and brain temperature (°C). This information allows clinicians to adjust a patients medical therapy in order to improve $P_{bt}O_2$ in an attempt to improve patient outcome.**

I. Introduction

Head trauma patients can have varying etiologies of the trauma including traumatic brain injury, subarachnoid hemorrhage, ischemic strokes or hemorrhagic strokes. Despite the various etiologies one common complication is cerebral hypoxia and/or cerebral ischemia. Cerebral hypoxia has been shown to worsen outcomes of patients with head injury and using a Licox monitor has been shown to reduce the amount of hypoxia and improve outcome in small studies. Presently the methods of monitoring cerebral ischemia and intracranial pressure do adequately address the complexity of what is going on in a damaged brain. While often patients present with brain lesions that current medical treatment can do little to reverse the penumbra area of the lesion is a target area for clinicians to save and therefore improve morbidity and mortality. The Licox monitor gives clinicians vital information about the oxygenation of the brain tissue in the penumbra region.

II. Methods

The Licox monitor is a polarographic electrode, which continuously measures real time $P_{bt}O_2$ in blood or tissue. The monitor works by inserting the probe into the brain tissue in an area chosen by the neurosurgeon, typically the pneumbra area, through a burr hole and into the white matter of the brain tissue. O_2 diffuses through a permeable membrane surrounding the probe. Once inside the probe the O_2 enters into an electrolyte solution within the probe which creates an electrical current within the solution proportional to the O_2 tension of the blood/tissue being measured. The probe is able to measure an area of 18 mm^2. This charge carried to the external Licox monitor display which converts the electrical current to mmHg and displays the $P_{bt}O_2$. The unit is calibrated with each use through a "smart card" that is found on the packaging of the catheters themselves and inserted into the external monitor prior to use.

III. Uses

The use of Licox monitor in clinical practice is typically reserved for the most severe brain injuries (Glascow Coma Scale < 8 or patients at high risk for vasospasm). The application of the Licox monitor in clinical practice allows clinicians to adjust the medical management of the patient in response to the local $P_{bt}O_2$ measured the monitor. A normal $P_{bt}O_2$ is 25-35 mmHg. If the $P_{bt}O_2$ is below goal level adjustments can made to the patients ventilator settings to increase oxygenation of the hemoglobin in the blood and ultimately oxygen delivery to the area of brain tissue being monitored. A low $P_{bt}O_2$ reading by the Licox monitor could also instigate an increase in the vasopressor medications these patients in an attempt to deliver more blood flow and hence more oxygen to the damaged brain. Increasing the oxygen delivery to this area of damaged but salvageable tissue can help save this tissue and decrease morbidity.

Licox Brain Tissue Oxygen Monitoring System
Left: probe (one for bolt insertion , one for tunneling method)
Right: Licox external monitor

IV. Discussion

The Licox Brain Tissue Oxygen Monitoring System gives clinicians another tool to determine what is happening in a local area of brain tissue. The continuous monitoring tools available to clinicians monitor what is happening in the brain is currently limited only to intracranial pressure (ICP) monitoring. Unfortunately ICP monitoring while useful is not likely to be sensitive enough to be useful in salvaging the penumbra. While $P_{bt}O_2$ monitoring has it's limitations including invasive monitoring and inconsistent clinical trial results it offers another tool to help brain injured patients and the first tool available to continuously monitor local brain tissue.

References

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