Near-infrared spectroscopy

Near-infrared spectroscopy (NIRS) is an inexpensive, portable, noninvasive method that does not require advanced expertise and can be used at the bedside for critically ill patients without moving them to the radiology department. NIRS can detect and monitor the multiple critical parameters including cerebral oximetry, temperature, intracranial pressure (ICP), temperature, and cerebral blood flow (CBF). NIRS can be valuable for a wide variety of neurocritical diseases and conditions such as ischemic and hemorrhagic strokes, severe traumatic brain injury (TBI), brain tumors, and perioperative neurosurgery. Though NIRS has been studied extensively in multiple neurocritical conditions, more evidence on its application is needed [1)].

It is a linear correlation for frontal NIRS cerebral oxygenation measurements compared with Regional cerebral blood flow on CT perfusion imaging. Thus, frontal NIRS cerebral oxygenation measurement may serve as a useful, noninvasive, bedside intensive care unit monitoring tool to assess brain oxygenation in a direct manner [2)].

Yagi et al. monitored CBO in 20 patients with cardiac arrest by NIRS. On the arrival of patients at the emergency department, the attending physician immediately assessed whether the patient was eligible for this study after conventional advanced life support and, if eligible, measured CBO in the frontal lobe by NIRS. They found that in all patients, the cerebral blood flow waveform was in synchrony with the chest compressions. Moreover, the tissue oxygenation index increased following cardiopulmonary bypass (CPB) in patients undergoing CPB, including one patient in whom CBO was monitored using the NIRO-CCR1. In addition, although the NIRO-CCR1 could display the pulse rate (Tempo) in real-time, Tempo was not always detected, despite the detection of the cerebral blood flow waveform. This suggested that chest compressions may not have been effective, indicating that the NIRO-CCR1 also seems useful to assess the quality of CPR. This study suggests that the NIRO-CCR1 can measure CBO during CPR in patients with cardiac arrest as effectively as the NIRO-200NX; in addition, the new NIRO-CCR1 maybe even more useful, especially in prehospital fields (e.g. in an ambulance), since it is easy to carry [3)].

A pilot study aimed to investigate the utility of near-infrared spectroscopy/indocyanine green (NIRS/ICG) for examining patients with occlusive cerebrovascular disease. Twenty-nine patients with chronic-stage atherosclerotic occlusive cerebrovascular disease were included. The patients were monitored using NIRS at the bedside. Using ICG time-intensity curves, the affected-to-unaffected side ratios were calculated for several parameters, including the maximum ICG concentration (ΔICGmax), time to peak (TTP), rise time (RT), and blood flow index (BFI = ΔICGmax/RT), and were compared to the affected-to-unaffected side ratios of the regional cerebral blood flow (rCBF) and regional oxygen extraction fraction (rOEF) obtained using positron emission tomography with 15O-labeled gas. The BFI ratio showed the best correlation with the rCBF ratio among these parameters ($r = 0.618$; $P = 0.0004$), and the RT ratio showed the best correlation with the rOEF ratio ($r = 0.593$; $P = 0.0007$). The patients were further divided into reduced rCBF or elevated rOEF groups, and the analysis revealed significant related differences. The present results advance the measurement of ICG kinetics using NIRS as a useful tool for the detection of severely impaired perfusion with reduced rCBF or elevated rOEF. This

method may be applicable as a monitoring tool for patients with acute ischemic stroke [4].

1)
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