Brain monitoring set-up and Evolution of SEPs in asphyxiated new borne

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Abstract

Treatment of neonatal hypoxic-ischaemic encephalopathy with therapeutic hypothermia significantly improves later outcomes, but at the same time delays early prognostication possibilities with amplitude-integrated EEG leaving no apparent alternative bedside methods for early outcome prediction. Somatosensory evoked potentials (SEPs), traditionally recorded using only a few scalp electrodes, are known to be highly predictive of outcome during the first days or even hours of life in asphyxiated neonates treated in normothermia. In general, in these settings normal SEPs predict favourable and bilaterally absent SEPs unfavourable outcome. These earlier studies did, however, report a few neonates with bilaterally absent SEPs and a good outcome. Though extremely rare, such cases have possibly discouraged wider use of SEPs in outcome prediction after perinatal asphyxia. Recent studies recording SEPs concomitantly with whole-scalp EEG, however, reported no "false bilaterally absent" SEPs and suggested that SEPs do offer an additional method for early outcome prediction at bedside not only in normothermia but also in hypothermia-treated neonates. At the same time, the availability of neonatal SEPs is generally limited to office hours even in the few hospitals where they are offered. Consequently, use of SEPs in acute circumstances such as perinatal asphyxia is virtually non-existent. On the contrary, aEEG brain monitoring is widely used and available at any time. Even though the aEEG electrodes - commonly placed at P3, P4, F3, and F4 – are not located right over the sensorimotor area [vs. CP3 and CP4 electrodes recommended for median nerve SEPs and applied by most of the previous neonatal studies], they are still located bilaterally anterior and posterior to the central sulcus and thus bipolar montages between these electrodes catch the tangentially oriented dipolar source at area 3b of the primary somatosensory cortex (SI) in the central sulcus which produces the earliest cortical SEP (named N1 or N20 in the literature. Thus, the earliest cortical SEP components (SI response) could be recordable by complementing routine aEEG with median nerve stimulation. To establish a novel clinical routine that would be widely available in neonatal intensive care units (NICUs), we set out to study whether SI SEPs can be reliably detected in asphyxiated new borne using only the four scalp electrode locations routinely applied in aEEG brain monitoring. We also assessed in real life settings of the NICU how many averages are typically needed for a reliable interpretation of cortical SEPs as compared to a "ground truth" obtained using an excess number of averages and high number of electrodes.