Cerebral cortex activity in freely moving sheep using a wireless CW fNIRS system: preliminary results

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Abstract: Functional near-infrared spectroscopy (fNIRS) was recently applied in studies involving animals, showing great potential as, to date, this is the only technique that can be used to non-invasively measure hemodynamic brain responses in freely moving animals [1–3]. The aim of this study was to evaluate the cerebral activity of freely moving sheep undergoing different tasks (motor and somatosensory). Four one-year-old Sarda ewes were exposed to two different stimuli: a motor task (walking), and a sudden noise. To measure the changes of oxyhemoglobin ([ΔO_2Hb]) and deoxyhemoglobin ([ΔHHb]) concentration, a mobile and miniaturized wireless CW fNIRS system (Octamon, Artinis Medical Systems, The Netherlands) was used. Sensors were applied on the forehead of the sheep depilated head and held in place with a customized head cap (Fig.1(a)). Four transmitters and two receivers (four channels in total), with pairs of transmitter-receiver at short (10 mm) and long (30 mm) distance, were used to cover the left and right hemisphere of the sheep head. The intensity of the light after transmission through tissue was recorded. The optical density was converted into [ΔO_2Hb] and [ΔHHb] by the modified Lambert-Beer law. Our result of the motor task showed a decrease of [ΔO_2Hb] and increase of [ΔHHb] in both hemispheres when sheep were walking (Fig.1(b)). For the sudden noise test, both hemispheres showed a transient decrease when the stimulus began, followed by a gradual increase in [ΔO_2Hb] concentration (Fig.1(c)). Our preliminary results suggest that fNIRS has the potential to non-invasively measure cerebral cortex activity in free moving sheep undergoing different tasks. Combining behavioral indicators with these innovative measurements will strengthen knowledge on animal cognition and perception of different environmental situations, thus enhancing their welfare. This work was supported by MIUR-PRIN2015 (Grant 2015Y5W9YP).

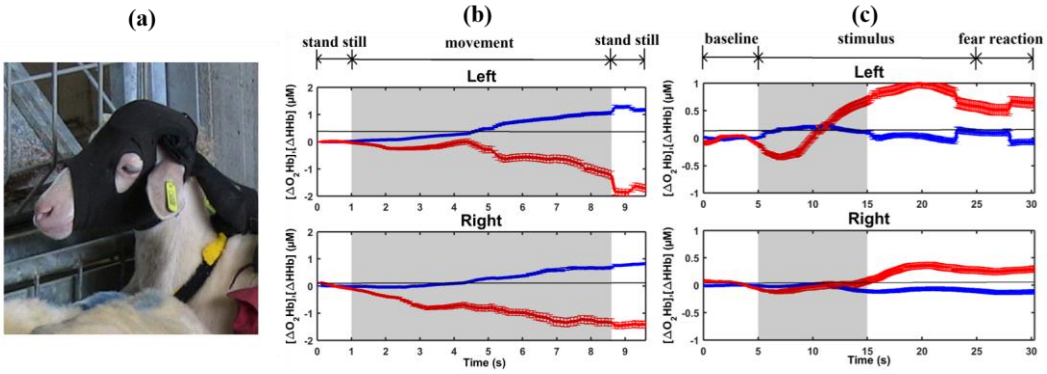

Fig. 1 (a) Cap used to hold the fNIRS sensor. (b) Mean concentration ± SD of [ΔO_2Hb] (in red) and [ΔHHb] (in blue) for left/right hemisphere of four sheep during the motor task. (c) Mean concentration ± SD [ΔO_2Hb] (in red) and [ΔHHb] (in blue) for the left/ right hemisphere of four sheep during the sudden noise test.

References:

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[3] Kim HY, Seo K, Jeon HJ, et al, *Molecules and Cells* 40, 523-532 (2017).