# Recording of the spinal neurovascular response triggered by a non-noxious peripheral nerve stimulation in patients with diabetes mellitus

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## Abstract

**Background:** Chronic and neuropathic pain are frequent and difficult to treat complications in Diabetes mellitus(DM). These sensory disfunction are not only induced by sensory, motor and autonomic peripheral nerve fibers lesions but also by spinal dorsal horn neuronal network alterations. Functional near-infrared spectroscopy(fNIRS) is used for the evaluation of brain cortical activity measuring changes on oxyhemoglobin($O_2Hb$) induced by the neuronal activity. We implemented a fNIRS technique to evaluate the spinal cord neurovascular response(NVR) triggered by peripheral nerve stimulation. **Objective:** To characterize changes in the spinal NVR in DM patients using fNIRS. **Methods:** Non-invasive, spinal fNIRS technique was implemented with 8 recording channels located at vertebral levels in 19 type 2-DM patients(more than 14 years of diagnosis) and 37 healthy volunteers. Single electrical pulse was applied to the left median nerve at the wrist skin. Median nerve conduction velocity(NCV) was also evaluated. **Results:** DM patients show lower amplitude values of NVR in all vertebral levels compare to the healthy group. The DM patients show normal median NCV. Other NVR parameters such as rise-time and duration were also abnormally reduced. These findings are consistent with the notion of a diffuse functional deterioration of the spinal neural-vascular-coupling process, but also of a disfunction of the spinal dorsal horn neuronal network associated to long lasting DM. **Conclusion:** The results strongly suggest the sensibility of the implemented spinal fNIRS to detect spinal functional changes in DM patients, mainly characterized by reduced amplitude, rise-time and duration of the spinal NVR triggered by median nerve electrical stimulation.

## Aim

Characterize changes in the spinal NVR in DM patients using fNIRS

## Methodology

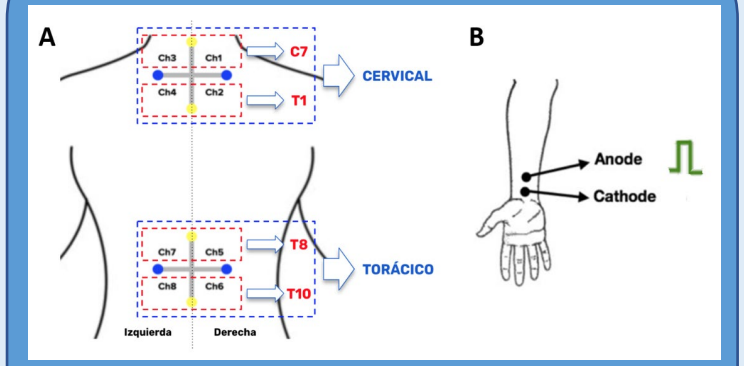


**Figure 1. Schematic of surface optodes positioning.** (A) Yellow dots are laser light emitters and blue dots are optical receivers. Ch: channel. (B) Superficial electrical stimulation configuration in the left median nerve, with square pulses.

## Results

| Clinical data | Diabetic Group (19) | Control Group (n=37) |
|---|---|---|
| Gener (F, %)) | 14 (73%)* | 15 (36%) |
| Age (years) | 66.8±17.3* | 35.6±17.3 |
| Height (cm) | 159.1±8.8* | 169.1±9.8 |
| Weight (kg) | 72.0±11.2 | 72.5±14.8 |
| BMI (kg $m^{-2}$) | 28.4±3.4 | 25.2±4.2 |
| Primary Pathologies | Mellitus diabetes | No disease |
| Median NCV ($m.s^{-1}$) | 48.3±4.4 | 49.8±3.5 |

**Table 1:** clinical and anthropometric measurements of patients with diabetes mellitus (DM) compared with the control group (CG). F: Woman; M: Man; BMI: body mass index; NCV: nerve conduction velocity.

## Results

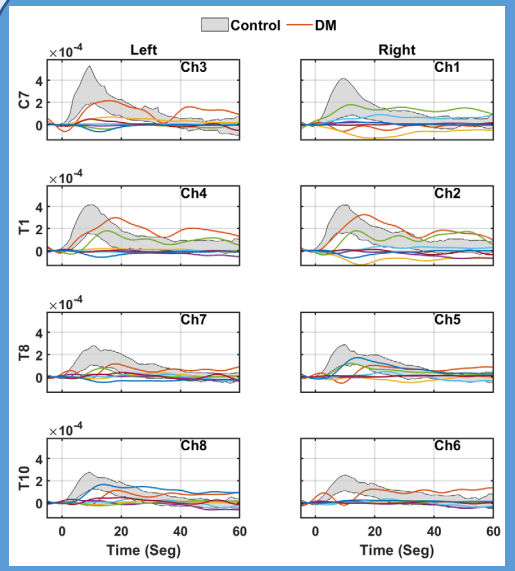


**Figure 2:** NVR registration by fNIRS in the eight-channel scheme for Long ISI protocol. Each channel measures the amplitude of the oxyhemoglobin signal versus the recording time, where zero of the time axis (sec) corresponds to the peripheral stimulation elicited in the left wrist. The recording line of each patient corresponds to the average of the 3 pulses of the protocol. While the gray area shows the 20-80 percentile of the average response of each individual in the control group. Ch: channel

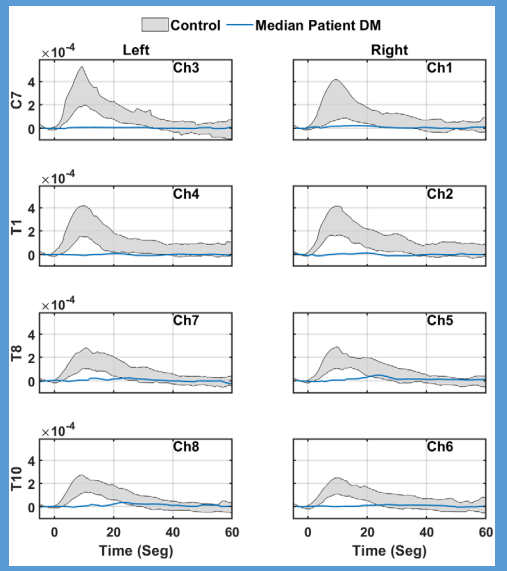


**Figure 3:** NVR registration by fNIRS in the eight-channel scheme for Long ISI protocol. Each channel measures the amplitude of the oxyhemoglobin signal versus the recording time, where zero of the time axis (sec) corresponds to the peripheral stimulation elicited in the left wrist. The blue registration line corresponds to the average of the patients with DM. While the gray area shows the 20-80 percentile of the average response of each individual in the CG. Ch: channel

**Conclusion:** The results strongly suggest the sensibility of the implemented spinal fNIRS to detect spinal functional changes in DM patients, mainly characterized by reduced amplitude, rise-time and duration of the spinal NVR triggered by median nerve electrical stimulation.

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