

# **SHERPA\_Everest'2017 Project: ECG findings in Caucasian and Sherpa mountaineers at Mt. Everest Base Camp (5,364 m)**

Marc Abuli<sup>1</sup>, Oriol Sibila<sup>2</sup>, Gonzalo Grazioli<sup>3</sup>, Ángel Martínez<sup>4</sup>, Sanjeeb Bhandari<sup>5</sup>, Yogesh Subedi<sup>5</sup>, Devish Pyakurel<sup>6</sup>, Emma Roca<sup>7</sup>, Eduardo Garrido<sup>8</sup>, Antoni Bayés-Genís<sup>1</sup>, José Manuel Soria<sup>4</sup>.

1. Servei de Cardiologia. Hospital Germans Trias i Pujol. Badalona.
2. Servei de Neumologia. Hospital de la Santa Creu i Sant Pau (IIB\_Sant Pau). Barcelona.
3. Servei de Cardiologia. Aptima Centre Clinic. Terrassa.
4. Unitat de Genomica de Malalties Complexes. Institut de Recerca Hospital de la Santa Creu i Sant Pau (IIB\_Sant Pau).Barcelona.
5. Mountain Medicine Society of Nepal.
6. Samyak Laboratory. Kathamandu. Nepal.
7. Universitat Politècnica de Catalunya. Barcelona
8. Departament d'Hipobarria i Fisiologia Biomèdica. Universitat de Barcelona.

More than 25 million of humans live permanently at very-high altitudes, and every year around 140 million of lowlanders travel to mountainous areas that exceed 2,500 meters of altitude, for work, recreational or sport purposes. The cardiovascular system experiments functional and morphological adaptations to some altitude environmental factors, particularly hypobaric hypoxia. Exposure to that condition stimulates the adrenergic tone, induces the development of pulmonary hypertension, as well as a profound hypoxaemia during sleep or by means of vigorous exercise. Changes in all the ECG waves are frequently observed; also ectopic beats during rest or physical exercise, and bradyarrhythmias especially during sleep. The ECG alterations were more pronounced when more altitude is achieved, but in contrast to this fact, the Himalayan natives show minor incidence and intensity of these ECG abnormalities, even at extremely-high altitudes, due to his well-adaptation to chronic hypoxia.

We have collected standard 12-lead ECGs during rest in 19 Caucasian mountaineers (C) and 15 Sherpas (S) situated at the Mt. Everest base camp (5,364 m) after a short acclimatization-period (9 days) during trekking through the Solo-Khumbu Valley (Nepal). Among all the ECG variables analyzed (statistical t-Student), only significant differences were observed in heart rate (HR). The average ( $\pm$ SD) HR in C was  $66.2\pm 12.7$  bpm and in S was  $78.5\pm 11.6$  bpm ( $p:0.004$ ). The QRS axis were  $47\pm 24.6^\circ$  in C and  $59\pm 21.7^\circ$  in S, and statistical differences were not found ( $p: 0,138$ ). Arterial blood oxygen saturation during resting conditions was estimated by means of fingertip pulse plethysmography (SpO<sub>2</sub>) and its average value was  $83.1\pm 5\%$  in C and  $82.8\pm 3.9\%$  in S, showing no statistical difference ( $p:0.873$ ).

Paradoxically, our observation reflects that S had a higher basal HR respect to C (subjects under sub-acute hypoxia condition). Both groups did not show any sign of right ventricle overload, as could be expected particularly in the C individuals. The higher HR observed in S could not be related with a lower SpO<sub>2</sub> in this group. The identification of the physiological mechanisms that underlie these minor ECG differences observed in HR between both populations could be explained by means of psychological stressor factor experimented by the S group in front of the medical procedures. Other ECG changes, like is the case of inverted T waves, right bundle branch block, second-degree atrioventricular block, extreme QRS axis deviations, and atrial or ventricular arrhythmias were not detected in both groups. This could be justify because the altitude achieved and the time remained at the same during the tests performed not seems to be enough to produce severe ECG changes, frequently found in those lowlanders exposed during many weeks at an altitudes above 5,500 m, and therefore subjected to a longer and greater degree of environmental hypoxia.

—This study belongs to a cardiopulmonary, physiologic, clinical and genetic project performed in Caucasian and Sherpa mountaineers. The «*Sherpa EVEREST Project 2017*» is supported by Fundació La Caixa. With our gratitude to Ferran Latorre—.