Acclimatization and Associated Changes in Phonocardiographic Recordings During a High-Altitude Climb

To the Editor:

In a previous edition of the *Revista Española de Cardiología* Journal,[1] we commented on the importance of the early diagnosis of complications relating to hypoxia in a high-altitude climb, with potentially fatal consequences in just a few hours when the lack of altitude acclimatisation is a key catalytic factor. Echocardiographic findings of cardiac function in patients with acute mountain sickness show a significant increase in pulmonary systolic pressure, in comparison to that observed in well acclimatised subjects.[2] Due to the lack of hospital resources in hostile environments,[3-5] acclimatisation control and early diagnosis of pulmonary arterial hypertension are extremely useful.

The analysis of phonocardiographic changes in the intensity of S1 and S2 heart sounds are quantified using the relationship between their respective acoustic intensities via the S2/S1 ratio, and it can be seen that the increase in this relationship always occurs in parallel to a decrease in the value of SaO_2.

With the aim of confirming this observation, the clinical and phonocardiographic changes of 2 mountain climbers were monitored via satellite throughout their second attempt to scale Broad Peak, a mountain in Pakistan measuring 8047 m during the summer of 2007.

Phonocardiographic signals were obtained using a high-spec electronic phonendoscope,[6] designed entirely by the authors of this study, and the signals were then registered on a laptop computer in base camp and on a PDA in the high altitude camps. These signals, together with the pulsioximetry values and other data of clinical importance, were sent via satellite to the medical team using a Web interface and a data compression algorithm developed for this purpose.[7]

Statistical analysis of the data was carried out using the Pearson correlation coefficient between the average S2/S1 ratio for each register and SaO_2 values and other parameters, over a total of 14 ratios for each subject. Following a prior baseline examination carried out on each subject at an altitude of 50 m above sea level, phonocardiographic data and recordings were taken at different altitudes up to 7100 m.

Upon analysing the relationship between the S2/S1 ratio values and the SaO_2 values for each mountaineer, correlation indexes were obtained of –0.79 and –0.91, where the negative value indicates that these parameters develop in different directions.

Studying the data in detail we can see that, due to the normal altitude acclimatisation process, the progress of both parameters on successive days at the same altitude differs; whilst the SaO_2 increases (Figure 1A) as a consequence of acclimatisation and it stabilises at 88% and 89%—figures clearly lower than the baseline values—the S2/S1 ratio decreases in both subjects (Figure 1B) until it reaches values similar to the baseline ones. This indicates that certain mechanisms for altitude acclimatisation do not depend solely on SaO_2.

If, for the correlation analysis of SaO_2 parameters and S2/S1 ratios, only the first of the recordings obtained at each different altitude are taken, which to some extent corrects the effect of altitude adaptation, the correlation indexes increase very significantly until they reach -0.92 and -0.96

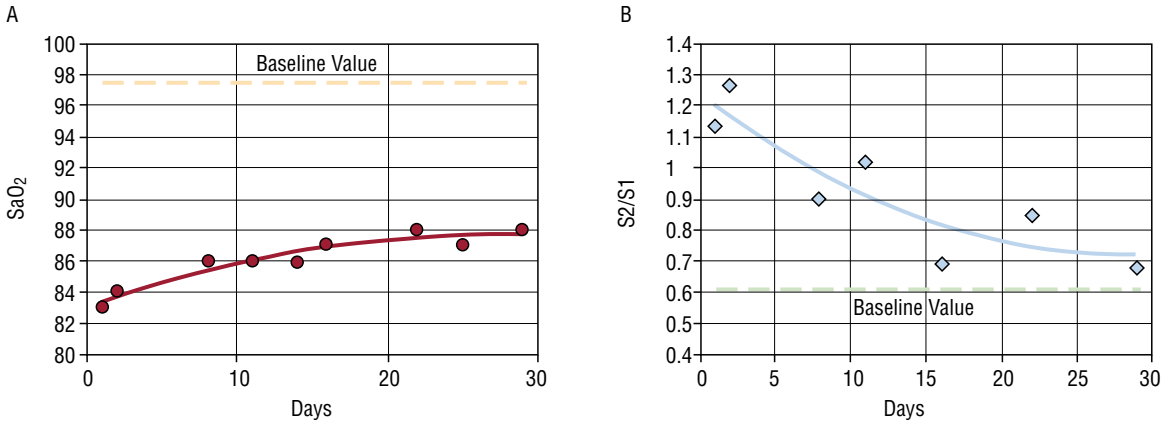

Figure 1. Development in base camp of SaO2 (A) and S2/S1 ratio (B).

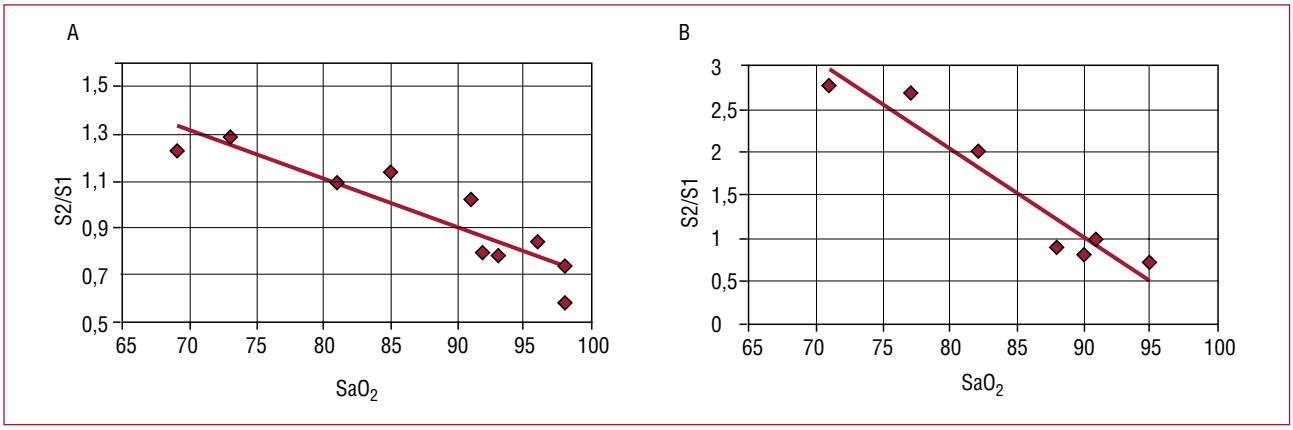

Figure 2. S2/S1 ratio compared to SaO_2 and linear regression lines of the subjects 1 (A) and 2 (B).

respectively; their corresponding linear regression lines are shown in Figure 2. These results not only confirm the strong relationship between SaO_2 and the S2/S1 ratio, but they also reveal the dependency on the degree of altitude acclimatisation, and very possibly on the HAP values, that S2/S1 ratios appear to have.

This study has been partially financed by the Spanish Ministry of Education and Science (MEC) and by the European Regional Development Fund (FEDER) in the project TIN2006-15460-C04-04.

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