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 SaO2.

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 pulsoximetry 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 SaO2 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 SaO2 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 SaO2 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 SaO2.

If, for the correlation analysis of SaO2 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).](image-url)
Recurrent Embolism Due to Thoracic Aortic Thrombus Detected by Transoesophageal Echocardiography. Which Treatment Is Currently the Most Appropriate?

To the Editor:

We present the case of a 50-year-old woman whose only signs of cardiovascular risk were smoking and morbid obesity (body mass index = 53). The patient was admitted for vascular surgery due to acute arterial ischaemia in the left lower extremity and obstruction of the external iliac artery was observed. The patient was treated with intra-arterial fibrinolysis, which was efficient initially but early reocclusion followed.

With the aim of localising possible sources of embolism, a transoesophageal echocardiography was carried out which showed a complex aortic atheroma with mobile thrombus at the thoracic aortic level behind the exit of the left subclavian (Figure 1). The thoracic computerised tomography showed an extension of the thrombus to the infradiaphragmatic aorta, reaching close to the coeliac trunk (Figure 2).

Surgical treatment was offered as the first therapeutic option, which the patient rejected, so oral anticoagulation treatment was initiated. Subsequent development was marked by peripheral recurrent embolisms in the same extremity despite adequate therapeutic INR values. Amputation of the extremity was eventually required.

Thrombi in the thoracic aorta are an uncommon condition associated with atherosclerotic lesions, ulcers, or aortic dilations and they are a potential source of embolisms.

respectively; their corresponding linear regression lines are shown in Figure 2. These results not only confirm the strong relationship between SaO₂ 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.

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