Cardiac Response to Acoustic Noise in Belugas

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It is known that continuous noise may cause health issues to humans and land mammals, including cardiovascular diseases. The objective of this report is to summarize the cardiac response in 5 captive belugas to different types of acoustic noise, including an octave band noise (9.5-108 kHz, 140-175 dB, 1-100 min) and several types of low-frequency anthropogenic noise (ships, airguns, and military sonars; 0.1-5 kHz, 140-175 dB, 1-30 min).The cardiac response of belugas to the onset of noise resembles the "acoustic startle response" featuring either heart rate (HR) tachycardia or bradycardia. The most expressed recorded tachycardia manifested a HR acceleration greater than twofold of the baseline level for a period of >5 min without evidence for habituation over several consecutive presentations. It was recorded in one-year-old calf when exposed to an octave band acoustic noise (19-27 kHz, 150-165 dB). The spectral analysis of HR variability revealed the features of stress as described in humans and land mammals. A less pronounced response was observed in older belugas. A similar tachycardiac response was recorded in belugas when exposed to shipping noise, whereas the magnitude of the response quickly attenuated after several presentations. The bradycardiac response in belugas represents a sharp HR deceleration (as low as 8 beats/min) at the noise onset followed by a period of reduced HR (<20 beats/min) and recovery to the normal arrhythmic HR pattern while the noise still continued. Exposure to midfrequency sonar and seismic noise also tended to cause apneas and bradycardia in belugas. As in the case of the shipping noise, the magnitude of cardiac response to sonars and airguns was generally less pronounced when compared with the octave band noise at the same intensities. The response to continuous noise may include a decrease in the HR variability and the disappearance of respiratory sinus arrhythmia (a respiratory act without an increase in instantaneous HR). In conclusion, the cardiac response of belugas to acoustic noise is highly variable. It clearly has all the features of startle and stress response. The magnitude of the response depends on the animal's age, health, and prior experience as well as the parameters of the noise. Continuous noise may cause prolonged alteration of the normal HR pattern and the health effects of such long changes of HR are not known. HR can be used as a measure of physiological response to fatiguing acoustic noise in the beluga and other cetaceans.