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The effects of slight and rapid pressure oscillations on the pars flaccida in gerbil and rabbit ears

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It is generally accepted that the pars flaccida (PF) takes part in the regulation of very small pressure variations in the middle ear (ME). However, it is unclear how important the participation of the PF is for the physiology of the ME as well as for the physiology on the whole.

The aim of the study was to clarify whether the PF is capable of reacting to slight air pressure oscillations (PO) with amplitudes and frequencies typical for natural atmospheric pressure fluctuations in the far infrasound frequency range (APF), which constitutes the common noise in the atmosphere. If so, the PF can play an important role in the overall physiologic regulation processes, which make humans susceptible to far infrasound APF.

The linear displacements of points near the center of the PF in response to periodic PO with different amplitudes (from 4 to 105 Pa) and frequencies 200, 100, 50 and 10 mHz) were measured in vitro in four ears of gerbils and four ears of rabbits by means of laser Doppler vibrometry. The index of the PF reactivity to PO (R_a) was determined as the ratio of the amplitude of the PF oscillations (PFO) to the amplitude of the PO. All kinds of PO applied caused PFO in all the ears of gerbils and rabbits. The amplitude of the PFO increased when the amplitude of the PO was increased. In gerbils, a decrease in R_a with the increase in amplitude of the PO was observed and associated with a non-linear S-shaped curve of the PF displacement as a function of the pressure change. The S-shape was most pronounced at higher PO amplitudes, and the curve was straightening with a decrease in PO amplitude. In the range of the lowest amplitudes of the PO (4-20 Pa), where the curve had no S-shape, R_a proved to be 1.4 times higher than in the range of highest amplitudes of PO (90-105 Pa). Considering that the natural level of APF usually is within the range of ± 20 Pa, this fact points to an important contribution of the PF to the air pressure dynamics in the ME of gerbils. In rabbit ears the curves did not have the S-shape and the clear tendency of R_a to decrease with an increase in PO amplitude also was not revealed.

We observed a clear hysteresis in the PF displacement with respect to different directions of the pressure change at all kinds of PO applied to the ME in all the ears. The index R_a was lower (about four times) and the hysteresis slope was wider in rabbits than those in gerbils, which points to less reactivity and mobility of the PF in rabbits. Our findings are in line with the suggestion that the PF might play an important role in the regulation of transtympanic pressure variations in respect of ME adaptation to natural levels of slight APF.