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Distinct hydrogen peroxide-induced constriction in multiple mouse arteries: potential influence of vascular polarization

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Abstract:
It is a matter of controversy whether the reactive oxygen species hydrogen peroxide (H_2O_2) contributes to tone in the vasculature as a vasodilator or vasoconstricting factor. To address this, we hypothesized that H_2O_2 can constrict quiescent, non-preconstricted blood vessels, but that the contractile response may be different across various vessel beds. As this variable response may be related to the quiescent state of polarization, we further tested whether partial KCl depolarization would unmask or potentiate H_2O_2-induced constriction. We harvested thoracic and abdominal aorta, the carotid and superior mesenteric artery from mice and placed them in myograph systems to measure contractile responses. Under quiescent conditions without pre-contraction, we found that H_2O_2-contracted abdominal aorta with a peak of 21 ± 4.9% of the reference constriction to 100 mM KCl ($p < 0.05$), the thoracic aorta contracted by 9.1 ± 3.6% ($p < 0.05$), the carotid artery contracted by 5.1 ± 1.9% ($p < 0.05$), but there was no contraction in the mesenteric artery at any concentration of H_2O_2 tested in the quiescent state. If the quiescent vessels were then partially depolarized using 30 or 100 mM KCl, we found a significant potentiation of the contractile response to H_2O_2 of 3–7 fold in each of the abdominal, thoracic and carotid vessels, and an unmasking of a significant (71 ± 6.9%, $p < 0.05$) contractile response to H_2O_2 in the mesenteric artery. Thus, we found large variations in the ability of H_2O_2 to constrict these quiescent arteries, but partial KCl depolarization either significantly exaggerated the H_2O_2-induced constriction, or in the otherwise refractory mesenteric, revealed an H_2O_2-provoked vasoconstriction. Thus, H_2O_2 is a vasoconstrictor in quiescent or partially depolarized vessels. We conclude that H_2O_2 elicits distinct constrictor effects across different vascular beds, and this may be due to their underlying state of polarization.

Key words:
hydrogen peroxide, vasoconstriction, aorta, mesenteric artery, carotid artery, polarization, mouse