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Intracellular pH regulation of mesenteric arteriolar smooth myocytes of rat

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Intracellular pH(pH_i) is strictly regulated since it is related to various cellular events such as contractility, signal transduction, ion regulation, cell volume, and energy production etc. In physiological conditions, pH_i of arteriolar smooth muscle faced substantial pressure to be changed during the regulation of blood flow. Therefore it is very important to know the regulatory mechanisms of pH_i. Since primary defense of pH_i change is intracellular buffer, we measured intracellular intrinsic buffering power (β_i) using series of NH_4^+ prepulse technique. We found that β_i had tendency to increase as pH_i increased. It was very peculiar result since many reports of β_i from various cell types showed that β_i increased as pH_i decreased. We investigated acid recovery mechanisms in CO_2/HCO_3^--free Hepes buffered conditions. When we induced intracellular acidosis using NH_4Cl-prepulse technique, pH_i was recovered to the initial pH_i. This recovery was completely blocked by the removal of extracellular Na^+. And also, Na^+-H^+ exchange inhibitor, 30 uM HOE694 and 100 uM cariporide could also completely inhibit the recovery from acidosis. Therefore, in Hepes buffered conditions, acid recovery seemed to be mainly occured by Na^+-H^+ exchanger. In 5 % CO_2/HCO_3^- buffered conditions, extracellular Na^+ removal could also completely block acid recovery. 100 uM cariporide alone could not inhibit acid recovery. When we added a putative Na^+-HCO_3^- symport blocker, S0859 from aventis, the acid recovery was completely inhibited. In 5 % CO_2/HCO_3^- buffered conditions, therefore, $[Na^+]_o$-dependent, HCO_3^--dependent acid recovery mechanism is operating in addition to Na^+-H^+ exchange. Since it was not clear whether it is Na^+-HCO_3^- symport or $[Na^+]_o$-dependent Cl^--HCO_3^- exchange, we tested the way of mechanism from alkaline recovery experiment. If $[Na^+]_o$-dependent, Cl^--HCO_3^- exchange is present in smooth myocytes, extracellular removal of Na^+ must reduce the recovery from alkalosis, but Na^+_o removal had no effect on recovery from alkalosis. Extracellular removal of Cl^- could completely block the recovery from alkalosis caused by acetate-prepulse technique in 5 % CO_2/HCO_3^- buffered conditions. And also, in CO_2/HCO_3^--free, Hepes buffered conditions, extracellular removal of Cl^--removal blocked the recovery from alkalosis. Therefore alkali recovery mechanisms are Cl^--dependent and partly HCO_3^--dependent and partly HCO_3^--independent. In conclusion, arteriolar smooth myocyte has Na^+-dependent acid recovery mechanisms such as Na^+-H^+ exchange and Na^+-HCO_3^- cotransport and Cl^--dependent alkali recovery mechanisms which are partly HCO_3^- dependent and HCO_3^--independent. It needs further study to clarify alkali recovery mechanisms.