

Ca²⁺ waves are organized among hepatocytes in the intact organ

M. H. Nathanson, A. D. Burgstahler, A. Mennone, M. B. Fallon, C. B. Gonzalez, and J. C. Saez

Abstract

Hormone-induced increases in cytosolic Ca²⁺ (Cai²⁺) begin as Cai²⁺ waves in cells isolated from most types of tissue (1, 11), but whether such waves actually occur in vivo is unknown. To investigate this, we examined vasopressin-induced Cai²⁺ signals in hepatocytes within the perfused rat liver. Using confocal fluorescence video microscopy, we found that increases in Cai²⁺ began as waves that usually originated in hepatocytes near central venules, then spread opposite to the direction of blood flow, to hepatocytes near portal venules. We used immunocytochemistry to determine that the liver vasopressin V1a receptor is most concentrated among hepatocytes in the pericentral region, providing the mechanism by which Cai²⁺ waves originate there. Pericentral-to-periportal Cai²⁺ waves may direct peristaltic flow of bile, since Cai²⁺ induces contraction of the apical pole of hepatocytes and since peristaltic contractions in liver also occur in a pericentral-to-periportal direction. The organization of Cai²⁺ waves among cells in intact tissue may be a means by which an integrative, organ-level response is provided in response to hormonal stimuli.