Potassium Channels Couple to 1,25(OH)2 Vitamin D3 Rapid Responses and Secretion in Immature Sertoli Cells

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Letter to Editor

The well-known effect of the active form of vitamin D3, 1,25(OH)2 vitamin D3 (1,25-D3), on calcium metabolism, cell proliferation and differentiation is mediated by genomic and nongenomic action [1,2]. The wide 1,25-D3 receptors distribution and the expression of 1α-hydroxylase in the male reproductive tract reinforces a pivotal role of this hormone for the active and complete spermatogenesis [3-5].

The Sertoli cell in the seminiferous tubules provides structural and nutritional support for the healthy development of germ cells [6]. The secretory functions of Sertoli cell depend on the activation of ionic channels which are regulated by 1,25-D3 rapid responses to induce exocytosis of a fluid rich in ions, proteins and growth factors critical for male fertility [7,8]. Studies carried out by our group over the last years have revealed important aspects regarding the effects of 1,25-D3 stimulation of calcium influx by different ionic channels and signal transduction pathways, including cross talk by second messengers modulating the channel activities [9].

The electrophysiological properties of Sertoli cells indicate that the precise control of the electrochemical gradient is involved in the maintenance of the secretory process [7,9]. The addition of high K+ in the extracellular media caused a strong depolarization of Sertoli cells followed by repolarization with the efflux of potassium ions through the voltage-gated K+ channels. In the presence of 1,25-D3, the efflux of K+ ions was recorded after 10 minutes of incubation and it was blocked by TEA, indicating a secretory activity of Sertoli cell through the Ca2+-regulated secretory pathway.

Our new data shows the stimulatory effect of 1,25-D3 on whole-cell K+ currents inhibited by tetraethylammonium, TEA, a broad-spectrum blocker of potassium channels indicating a repolarization of the Sertoli cell after stimulus. Stimulus-secretion coupling in Sertoli cells involves multiple ionic channels that regulate the plasma membrane potential, intracellular calcium and secretion. Repolarization of the membrane potential is mediated by several K+-selective ionic channel proteins such as ATP sensitive potassium channel (KATP), voltage-gated channels (Kv), and Ca2+-activated K+ channels (KCa).

In summary, our results demonstrate for the first time that nongenomic 1,25-D3 potentiation of potassium currents couple to exocytosis in primary culture of Sertoli cells. This effect appears to involve Ca2+ influx leading to K+ efflux and repolarization. We conclude that the steroid hormone 1,25-D3 appears to play a functional role in male fertility via stimulation of Sertoli cell secretory activities in the testis.

References

