

# Apoptosis, necrosis and autophagy are influenced by metabolic energy sources in cultured rat spermatocytes

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Apoptosis, necrosis and autophagy are mechanistically related processes that control tissue homeostasis and cell survival. In the testis, germ cell death is important for controlling sperm output, but it is unknown whether or not germ cells can switch from apoptosis to necrosis, as has been reported in other tissues. Furthermore, autophagy has not been reported in spermatogenesis. Spermatocytes (meiotic cells) and spermatids (haploid cells) use lactate rather than glucose as their primary substrate for producing ATP. The metabolism of glucose, but not lactate, reduces ATP levels and increases intracellular  $[H^+]$  and  $[Ca^{2+}]$ , both of which are associated with apoptosis and/or necrosis in somatic cells. In this work, we evaluated whether different energy sources, such as lactate or glucose, can influence spermatocyte death type and/or survival in primary cultures. Spermatocytes cultured for 12 h without an energy source died by necrosis, while spermatocytes cultured with 5 mM glucose sho