As testes become warmer, testicular blood flow increases to prevent testicular hypoxia

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High ambient temperatures have deleterious effects on semen quality in male mammals, including those in Canada. The situation is becoming increasingly common, due to effects of climate change, with negative effects on reproduction in both domestic and nondomestic species. In bulls, testes are 3-4ºC cooler than the body core temperature. However, if testicular temperature is increased (e.g. fever or hot weather), semen quality declines (more abnormal sperm and decreased motility). The long-standing view is that bull testes have an O_2 supply that is barely adequate, increased testicular temperature increases O_2 demand, but blood flow does not change and consequently, testicular hypoxia causes poor semen quality. Our objective was to assess blood flow and O_2 delivery when testes were warmed. Eight rams were anesthetized to allow monitoring of testicular blood flow and collection of blood samples. Testes were placed inside a double-walled glass container, with warm water circulated between the walls. As testicular temperature increased from 33 to 40ºC, there were increases in testicular blood flow (13.17 ± 2.7 vs 17.72 ± 3.2 ml/min/100 g of testes; mean + SEM; $P<0.05$), O_2 extraction (31.2 ± 5.0 vs 47.3 ± 3.1%; $P<0.0001$) and O_2 consumption (0.35 ± 0.04 vs 0.64 ± 0.06 mL/min/100 g of testes; $P<0.0001$). There was no evidence of anaerobic metabolism, based on a lack of change in lactate, pH, HCO3-, and base excess. Therefore, increased testicular blood flow appeared to compensate for increased metabolism as testes became warmer. In conclusion, these data challenged the paradigm regarding scrotal/testicular thermoregulation, as acute testicular hyperthermia increased blood flow and O_2 delivery and uptake, with no indications of hypoxia.

Implications: Sperm quality and fertility are important for semen used domestically or exported. These studies provide insights into how increases in testicular temperature affect testicular blood flow and oxygen delivery.