

The effect of hypertonic saline infusion on plasma electrolytes and immune function in humans

Jens Aage Kølsen Petersen

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Official opponents: Anders Larsson, Hans Jørgen Nielsen, and Marianne Hokland.

Tutor: Else Tønnesen.

Correspondence to: Jens Aage Kølsen Petersen, Department of Anaesthesia and Intensive Care, Viborg County Hospital, DK-8800 Viborg.

E-mail: jaakp@dadlnet.dk

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ABSTRACT

The PhD dissertation is based on three original studies. The investigations were carried out at the Department of Anesthesia and Intensive Care, Viborg County Hospital, DK.

Hypertonic saline (7.5%) solutions with or without colloids are easy to transport, quick to administer, and rapidly restore the macro- and microcirculation. Furthermore, previous studies found hypertonicity to affect immune responses in intact laboratory animals and in human blood cell cultures. It was shown that hypertonicity transiently suppressed neutrophil granulocytes and at the same time up-regulated immunologic protection furnished by lymphocytes. We performed the studies to test the hypothesis that infusion of a clinically relevant dose of hypertonic saline modifies the immune response to tissue injury in humans.

First, we measured the consequences of hypertonic saline infusion on plasma electrolytes and acid base balance. In a randomized double-blind study, we infused four ml/kg/10 min of 0.9% or 7.5% NaCl to 14 women scheduled for hysterectomy. The dose of hypertonic saline is the current recommended dose for resuscitation of trauma patients. We found an approximately 10 mM-increase in plasma $[Na^+]$ and $[Cl^-]$; a 0.6 mM-increase in plasma $[K^+]$; and a slight mixed metabolic and respiratory acidosis. No serious side-effects were observed.

Next, we studied the effect of hypertonic saline infusion on markers of the immune function. The study population was expanded to 20 patients but otherwise the design was the same as above. Compared to normal saline, infusion of hypertonic saline temporarily increased the number of B-cells in peripheral blood by 25%; caused an 18%-increase in plasma elastase, a marker of neutrophil degranulation; and decreased the number of circulating neutrophils. No effects were detected in the number of T-cells; the number or cytotoxicity of the NK-cells; the mitogen-induced lymphocyte proliferation, neutrophil chemotaxis; or the cytokines $TNF\alpha$, $IL-1\beta$, $IL-6$, $IL-8$, $IL-1ra$, or $IL-10$.

Finally, we investigated if infusion of hypertonic saline modified the immune response to abdominal hysterectomy. Sixty-two women were randomized to preoperative single-blinded infusion of 7.5% NaCl, 0.9% NaCl, both 4 ml/kg, or 0.9% NaCl 32 ml/kg over 20 min. Surgery induced well-known changes in the cellular immune response during and up to 48 hours after surgery which were unrelated to the tonicity or volume of the infused fluids.

Thus, as opposed to animal and cell culture studies, the immune modulating properties of hypertonic saline seem limited in clinical practice, and it is unlikely that infusion of hypertonic saline in the current recommended dose will significantly reduce complications due to dysfunction of the immune system.