

# Acute and Chronic Effects of Intravenous Hypertonic Saline Solution and Rehydration Fluid on Plasma Electrolyte Concentrations and Renal Function in Holstein Steers

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## Introduction

Intravenous (IV) administration of 7.0-7.5% hypertonic saline solution (HSS) is commonly used in dehydrated dairy cows with endotoxic shock and endotoxemia associated with environmental mastitis. Cows are given an IV empirical dose of one to two liters of HSS (4-5 ml/kg BW) followed by immediate access to drinking water and supportive therapy (anti-inflammatory drugs, oxytocin and frequent milk-out for mastitis). Intravenous small-volume HSS, in conjunction with voluntary oral water consumption, is purported to totally alleviate dehydration without the need for large-volume IV balanced replacement fluids. Use of HSS as the resuscitation fluid for hypovolemia associated with hemorrhagic shock or with loss of vascular tone, as in sepsis or neurogenic shock, remains controversial. HSS resuscitation may detrimentally affect renal function and survival when used in dehydrated patients. This study was conducted to determine detrimental effects on renal function using HSS as the resuscitation fluid in dehydrated cattle.

## Materials and Methods

Thirteen clinically normal Holstein steers were fasted for 72 h to assess the affects of IV 7.2% HSS (5 ml/kg BW) on plasma and urine electrolyte concentrations and renal function during and after dehydration. Steers were randomly assigned to be rehydrated at 40 ml/kg BW with either an oral water load (OWL) or oral water/electrolyte (OWE) solution containing dextrose, NaCl, KCl, MgSO<sub>4</sub>, and CaCl<sub>2</sub>. Oral rehydration immediately followed IV administration of HSS. Plasma and urine samples were collected hourly for 5 h to establish baseline (B) values during normal hydration, during

dehydration (D) and after acute (A) rehydration on Day 3, and chronic (C) values on day 13. Samples were analyzed for hematocrit (Hct), hemoglobin (Hgb), plasma total protein (TPP), glucose, Na, K, Cl, urea nitrogen (UN), and creatinine. Inulin (Inutest®) and p-aminohippurate were infused as an IV bolus for markers of glomerular filtration rate (GFR) and effective renal blood flow (ERBF), during periods B, D, A, and C.

## Results and Conclusions

Dehydration, as determined by increasing Hct, was present during period D (30.7% vs B = 26.6%;  $P < .05$ ). Hydration returned to B levels during periods A and C. Dehydration did not affect plasma K, glucose, creatinine, TPP, Hgb, or urine creatinine and UN. Dehydration increased ( $P < .05$ ) plasma Na (from 139 to 157 mmol/l), Cl (from 105 to 119 mmol/l), and UN (7.9 to 19.0 mg/dl). Acute rehydration decreased ( $P < .05$ ) K and Cl from 4.0 to 3.4 and 119.5 to 111.7 mmol/l, respectively. Acute rehydration increased ( $P < .05$ ) urine Na (from 101 to 191 mmol/l) and Cl (from 165 to 209 mmol/l) and decreased K (from 156 to 71 mmol/l). GFR and ERBF were not significantly different between OWL or OWE treatments or between measurement periods for either rehydration method. Treatment with HSS only affected urine Na, increasing ( $P < .05$ ) from 58 to 223 mmol/l. There was no difference between rehydration with either OWL or OWE. From this study it was concluded that HSS resuscitation with oral rehydration does not cause detrimental effects to renal function in cattle. Voluntary oral rehydration with either plain water or an oral electrolyte solution had similar effects on plasma and urine electrolyte concentrations.