

# Inducing Shunt Independency in Patients with Intraventricular Hemorrhage Hydrocephalus with Hypertonic Saline

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## Abstract

IVH can result in hydrocephalus as well as direct brain injury, so EVD (external ventricular drainage) insertion can be life saving in this condition. Considering complications of replacing EVD by permanent VP shunt in these patients we present a new method for inducing shunt independency after EVD removal. Hypertonic saline infusion (3%) initiated within 48 h after symptom onset at the rate of 12 mL/h. Plasma sodium and osmolality levels were controlled at least every 8 h and the infusion rate was adjusted until the targeted plasma sodium level of 145 to 150 mmol/L and a serum osmolality of 310 mOsmol/kg to 320 mOsmol/kg were reached leading to EVD removal without shunt dependency In six patientes .

**Keywords:** Hydrocephalus; Hypertonic saline; Shunt independency

## 1. Introduction

Intraventricular hemorrhage (IVH) is a source of main morbidity and mortality and is a self-determining predictor of poorer prognosis after germinal matrix hemorrhage (GMH) in neonates [1,2] and intracerebral hemorrhage (ICH) in adults [3,4]. IVH is frequent in neonates and commonly happens due to GMH. The rate of GMH-IVH is upper in very low birth weight (VLBW, birth weight <1500 grams) infants and, despite of the frequency of IVH in this category has declined in current years, in general the number of preterm infants who live is growing. 22% of VLBW infants show GMH-IVH with 25%

evolving ventricular dilation. 34% of those with determined ventricular dilation will need surgical approach with a reservoir or a shunt [2].

Adults usually affected with ICH in a rate of 12-15/100,000 cases yearly [5] and IVH take place in 42% to 52% of those with spontaneous, non-traumatic ICH [3,4,6,7]. Hydrocephalus grow in up to 67% of patients with intraventricular extension of ICH [3,4] and is itself related to a higher mortality [8]. The volume of blood contained within the ventricles was also freely related to a worse Glasgow Coma Scale [9]. IVH in adults can take place secondary to expansion of ICH, aneurysmal SAH, vascular malformations and trauma. ICH with intraventricular extension is more probable if the hemorrhage happens recently [6].

IVH can result in both instantaneous obstructive hydrocephalus and delayed communicating hydrocephalus in along with direct brain injury [10].

In this article we address IVH hydrocephalus patients underwent EVD insertion and post operatively received hypertonic saline (3%) to induce shunt independency after removing EVD.

IVH related to hemorrhagic stroke result in elevated intracranial pressure (ICP) by mass effect from hemorrhage or related hydrocephalus as result of ventricular outflow obstruction. Increased ICP in the secondary to cerebrovascular accident is commonly cured both medically and surgically.

Objective: The present study was undertaken to evaluate the prognosis of patients who underwent external ventricular drainage for IVH mostly right frontal EVD at the Kocher's point followed by induced shunt independency through using HS infusion. Hypertonic saline (HS) solutions have been announced as a likely option for treatment of cerebral edema [11] and are now increasingly being applied for treatment of traumatic brain injury or brain ischemia, generally as repeated use of boluses [12]. However, best dosage and concentration of HS, as well as timing and application program, are still unknown. In current studies, continuous use of HS was probed in patients with traumatic brain injury [13] or acute liver failure [14] and positive effects on ICP-lowering properties were reported. also, no major side effects were detected in critically ill patients with severe stroke or traumatic brain injury cured with continuous 3% HS infusion [15].

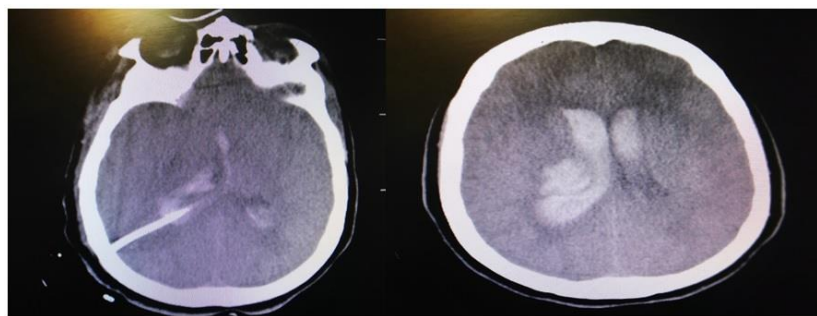
Hypertonic saline (HS) solutions have been presented as a promising option for treatment of cerebral edema [16] and are now progressively being applied for treatment of traumatic brain injury or brain ischemia, primarily as repeated usage of boluses [17]. However, ideal dosage and concentration of HS, as well as timing and application schedule, are still unknown. In recent studies, continuous application of HS was examined in patients with traumatic brain injury [18] or acute liver failure [19] and positive effects on ICP-lowering features were reported. Furthermore, no main side effects were detected in critically ill patients with severe stroke or traumatic brain injury treated with continuous 3% HS infusion [20].

In adults with severe ICH who are increasingly susceptible to expansion of space-occupying brain edema, it may be beneficial to start an early continuous hyperosmolar infusion to reach a prompt and persisting osmotic gradient, thus possibly reducing perihemorrhagic edema development. The purpose of this article was to study the implication of continuous HS

infusion on the development of shunt independency after EVD insertion in IVH hydrocephalus patients. Hypertonic saline infusion (3%) initiated within 48 h after symptom onset at the rate of 12 mL/h.

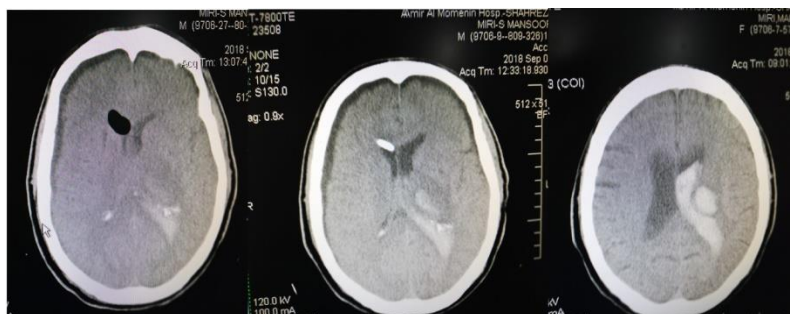
Plasma sodium and osmolality levels were monitored every 8 h and the infusion rate was modified until the optimal plasma sodium level of 145 mmol/L to 150 mmol/L and a serum osmolality of 310 mOsmol/kg to 320 mOsmol/kg were reached leading to EVD removal without shunt dependency in six critical IVH hydrocephalus patients .

1. A 53-year-old female patient with right thalamus ICH and IVH presented with left hemiparesis and confusion (GCS 9/15) underwent EVD insertion.after hypertonic salin infusion (3%) according to protocol for 96 h and clinical monitoring EVD was closed for 48 h because of clinical stability it was removed and two days later discharged (FIG. 1)



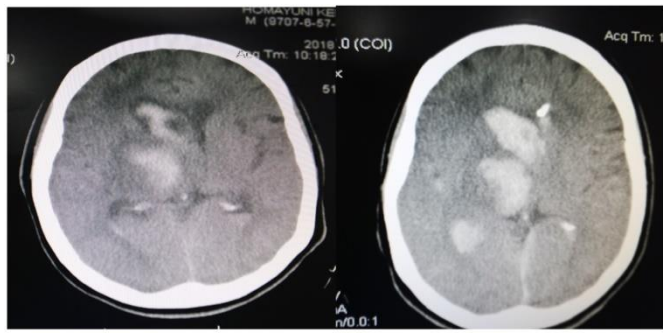
**FIG. 1. ICH in right thalamus and IVH hydrocephalus.**

2. 62-year-old male patient with left thalamus ICH and IVH presented with hemiparesis and confusion ( GCS 11 /15) underwent EVD insertion.after hypertonic salin infusion (3%) according to protocol for 72 h and clinical monitoring EVD was closed for 48h because of clinical stability it was removed and two days later discharged with good condition. (Figure 2)



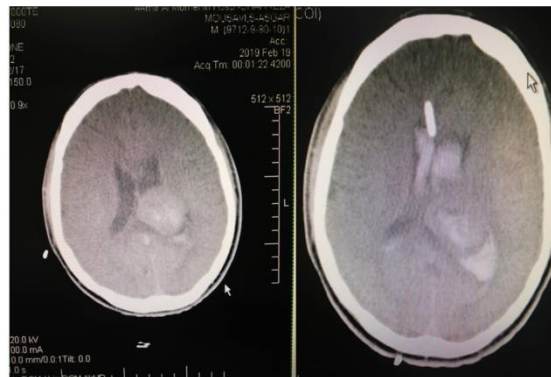
**FIG. 2. ICH in left thalamus and IVH hydrocephalus.**

3. 59-year-old female patient with right thalamus and caudate ICH and IVH presented with hemiparesis and confusion (GCS 7/15 ) underwent EVD insertion after hypertonic saline infusion (3%) according to protocol for 72 h and clinical monitoring EVD was closed for 48 h because of clinical stability it was removed and one day later discharged (FIG. 3).



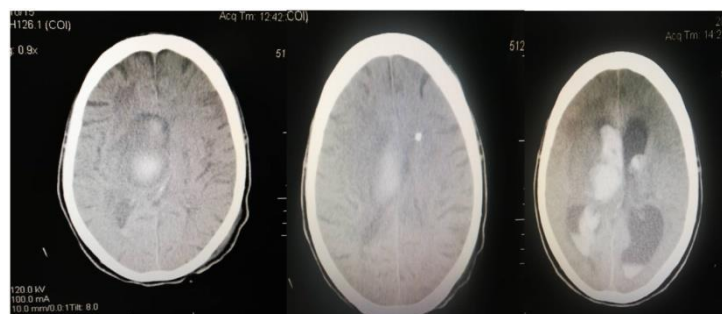
**FIG. 3. ICH in right thalamus and caudate and IVH hydrocephalus.**

- 18-year-old male patient with left thalamus tumor presented with ICH and IVH presented with confusion (GCS 12/15) underwent EVD insertion after hypertonic saline infusion (3%) according to protocol for 96 h and clinical monitoring EVD was closed for 48 h because of clinical stability it was removed and two days later discharged with good condition and referred to stereotactic ward for brain biopsy (FIG. 4).



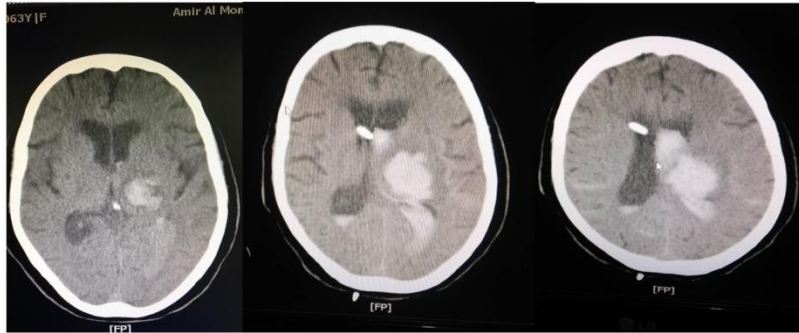
**FIG. 4. Left thalamus tumor and IVH hydrocephalus.**

- 60-year-old female patient with right thalamus ant caudate ICH and IVH presented with hemiparesis and confusion (GCS 7/15) underwent EVD insertion after hypertonic saline infusion (3%) according to protocol for 72 h and clinical monitoring EVD was closed for 48 h because of clinical stability it was removed and 3 days later died because of CHF and cardiopulmonary arrest (FIG. 5).



**FIG. 5. Right thalamus ant caudate ICH and IVH hydrocephalus.**

6. 62-year-old female patient with left thalamus ICH and IVH presented with hemiparesis and confusion (GCS 7/15) underwent EVD insertion after hypertonic saline infusion (3%) according to protocol for 72 h and clinical monitoring EVD was closed for 48 h and later removed because of clinical stability and one day later discharged (FIG. 6).



**FIG. 6. Left thalamus ICH and IVH hydrocephalus.**

All six patients except one who die because of previous CHF history recovered and discharged in follow up visit three month later these patients didn't show any symptom of ICP rising and get back to normal life. However this is the first study conducted to investigate of shunt independency induced to be saline hypertonic infusion but it can turn into an efficient approach in diminishing IVH hydrocephalus morbidity and mortality due to VP shunt surgery complications.

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