

Recognizing and Avoiding Significant Maternal Hyponatremia

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ABSTRACT

Hyponatremia during peripartum period is a recognized but underreported complication. Hyponatremia has significant adverse effects on mother as well as infant. Hyponatremia can be dilutional or nondilutional. Dilutional or hypervolemic hyponatremia is more common during the labor and postpartum period. The blood sodium concentration during pregnancy is lower, 130–140 mmol/L, which is being considered normal compared to 135–145 mmol/L in nonpregnant women. Thus, when the blood sodium level is below 130 mmol/L, we should consider it as hyponatremia of pregnancy. Oxytocin can play a major role to cause dilutional hyponatremia if large volumes of hypotonic fluids are consumed or infused intravenously simultaneously. Hyponatremia during labor is such a complex problem that it can be the result of several factors. In hyponatremia, there is progressive dysfunction of the neurological system, which in association with cerebral edema results in various symptoms. Symptoms may vary from headache, nausea, vomiting, lethargy, muscle cramps, and disorientation, progressing to seizures, coma, respiratory arrest, and death. A proper clinical history and various blood tests including serum sodium are important to diagnose the severity of hyponatremia. Women in labor should be advised to drink water only up to their thirst impulse; excessive fluid intake should be avoided. The treatment depends on cause, severity, and duration of hyponatremia, as well as clinical status of patient, and associated comorbidities. Once acute water intoxication and hyponatremia have been diagnosed, it is necessary to correct the hyponatremia by water restriction and to watch sodium concentration in the blood. Severe hyponatremia (sodium <125 mmol/L + symptoms) is a medical emergency. The primary idea of treatment should be to improve symptoms instead to normalize the blood sodium level.

Keywords: Fluid balance, Fluid restriction, Hyponatremia, Labor, Oxytocin, Peripartum.

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INTRODUCTION

Hyponatremia during peripartum period could also be a recognized but underreported complication. Hyponatremia has significant adverse effects on mother as well as infant. Therefore, it is important to be prepared for developing hyponatremia, identifying its occurrence, and beginning immediate treatment. It is vital that we understand physiology and pathophysiology of fluid and electrolyte balance during pregnancy. Hyponatremia can be dilutional or nondilutional. Dilutional or hypervolemic hyponatremia is more common during labor and postpartum period.¹ Development of dilutional hyponatremia during labor and thereafter is most of the time hypotonic hyponatremia, which occurs if woman drinks fluid which is not rich in sodium. This ultimately ends up in dilution of the blood and fall in the blood sodium level.²

FLUID AND ELECTROLYTE BALANCE IN PREGNANCY

Pregnancy may be a state of hypervolemia. At term, the total fluid retention in body is about 6.5 L with active retention of sodium and potassium is 900 mEq and 350 mEq, respectively.³ Thus, normal pregnancy is a state of positive sodium and water balance. The blood sodium concentration during pregnancy is lower, 130–140 mmol/L, which is being considered normal⁴ compared to 135–145 mmol/L in nonpregnant women.⁵ Thus, when the blood sodium level is below 130 mmol/L, we should consider it as hyponatremia of pregnancy.

The important causes of sodium retention and volume overload are as follows:³

- Changes in maternal osmoregulation
- Increased estrogen and progesterone
- Increase in renin-angiotensin aldosterone system (RAAS) activity

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- Increased aldosterone and deoxycorticosterone
- Control by arginine vasopressin (AVP) from endocrine gland
- Atrial natriuretic peptide

PATHOPHYSIOLOGY OF HYPONATREMIA DURING PREGNANCY

Oxytocin is released from the posterior pituitary gland. It is structurally identical to antidiuretic hormone (ADH). Thus, oxytocin acts as an antidiuretic at high concentration. During first and second trimester of pregnancy, water excretion in pregnant and nonpregnant women is more or less similar. However, in third trimester, pregnant women excrete small amount of fluid, which ends up in fluid retention.^{6,7} In labor, the amount of oxytocin secreted from the body is larger, and synthetic oxytocin is usually administered intravenously for induction or augmentation of labor. Oxytocin can play a big role to cause dilutional hyponatremia if large volumes of hypotonic fluids are consumed or infused intravenously simultaneously.⁸ This can be worsened in late pregnancy by a

reduced ability to excrete excess water. Labor itself does not induce hyponatremia, but it can be one of the predisposing factors to its occurrence. Labor stimulates pain, nausea, and mental stress, which successively increases the secretion of ADH. Antidiuretic hormone increases the permeability of the collecting ducts of the kidney. Water is retained in much more than solute, which reduces plasma osmolality and predisposes to water intoxication if fluid intake is in high volume.⁹

There are different types of factors in charge for the pregnant woman to develop dilutional hyponatremia. These include increased intake of fluid, isotonic fluid supplementation, encouraging woman to drink more, and alterations in ADH.¹

RISK FACTORS FOR HYPONATREMIA IN PREGNANCY¹⁰

Hyponatremia during labor is such a complex problem that it could be the result of several factors.

Factors predispose to hyponatremia when woman is in labor include:

- A positive fluid balance over 1,500 mL
- Oxytocin infusion
- Insulin/dextrose infusion
- Medication such as antidepressants, diuretics, antiepileptic drugs, antipsychotic drugs, amlodipine, and proton pump inhibitors (e.g., omeprazole).

SIGNS AND SYMPTOMS OF HYPONATREMIA

Manifestations of hyponatremia rely on the level of sodium concentration in the blood and speed at which the sodium level drops. Acute water retention, in the absence of underlying medical condition predisposing to salt loss, is rare and typically because of polydipsia. In hyponatremia, there is progressive dysfunction of neurological system, which in association with cerebral edema leads to various symptoms.¹¹ Symptoms of hyponatremia are mostly caused by change in plasma osmolality. Brain is not able to adapt to rapid osmotic changes.

Symptoms are often many ranging from headache, nausea, dizziness, general discomfort, drowsiness, coma, and seizures. Hyponatremia during labor can be fatal. If the sodium level in the blood is greater than 125 mmol/L, patients may be asymptomatic; however, with the fall in the sodium level, symptoms may vary from headache, nausea, vomiting, lethargy, muscle cramps, and disorientation, progressing to seizures, coma, respiratory arrest, and death.¹² Symptoms of hyponatremia, sometimes, may appear when sodium concentration is 120 mmol/L or may be less. However, the baseline sodium level in the blood and the rate at which that falls is even more important than the baseline value of serum sodium.¹³

Early symptoms do not seem to be specific to hyponatremia, and they may be confused with common symptoms of pregnancy, labor, or some common conditions such as preeclampsia (Table 1).²

DIAGNOSIS OF HYPONATRAEMIA IN LABOR

Clinical History

A proper clinical history is very important to diagnose the severity of hyponatremia. Patient should be asked about nature, severity, and duration of symptoms, urine output, diarrhea/vomiting, fluid/plain water intake, presence of any underlying pathology such as preeclampsia, and if she has been taking any medicines. Other causes of hyponatremia should always be taken into account.

Table 1: Diagnosis of hyponatremia in labor

<i>Early symptoms</i>	<i>Late symptoms</i>
Headache	Muscle cramps
Lethargy	Drowsiness
Anorexia	Disorientation
Nausea	Agitation
Apathy	Confusion
	Hallucination
	Seizures
	Depressed reflexes
	Respiratory arrest
	Reduced conscious level
	Coma
	Death

Laboratory Investigations

Routine blood tests and biochemical profile include full blood count, urea and electrolytes, liver function tests, renal function tests, serum calcium, and blood sugar. Tests for the blood and urine osmolality and urine sodium are also useful to know the explanation for hyponatremia.

PREVENTION AND MANAGEMENT OF HYPONATREMIA IN LABOR

A laboring woman with neutral fluid balance is less likely to develop hyponatremia. Women who are in labor should be advised to drink water only up to their thirst impulse; excessive fluid intake should be avoided. Women who drink fluid up to 1 L in labor will have 1% chance of developing hyponatremia at delivery. However, this may increase to 5% and 26%, respectively, if woman drinks fluid between 1 and 2 L, and above 2.5 L therein order.¹⁴

Urinary ketones, in labor, commonly occur because of the rise in physical stress level. It is not known what are the consequences of urine ketones on the mother and baby when woman is in labor, and it is additionally unclear whether rise in urinary ketones could be a normal physiological response or it should be treated (Toohill et al. 2008). Ketones in urine should not be treated with fluid alone, but with sugary food and drinks.¹⁰

The treatment depends on cause, severity, and duration of hyponatremia as well as clinical status of patient and associated comorbidities such as preeclampsia, diabetes, and heart disease during which the fluid is replaced accordingly. Oxytocin-induced hyponatremia should be corrected by limited fluid intake and/or stopping oxytocin drip. Hypertonic saline is often infused to correct hyponatremia, if required, in combination with loop diuretic.¹⁵

Fluid Balance and Sodium Monitoring [The Regulation and Quality Improvement Authority (RQIA) - Guideline and Audit Implementation Network (GAIN)]

Hyponatremia and extracellular fluid overload in labor is not only harmful to mother but also to neonate as well. The risks and severity of respiratory illness to newborn increase due to hyponatremia. Not only that but weight gain within the initial few days after the birth of babies with respiratory distress syndrome may result in rise in the development of chronic lung disease.¹⁶

Once acute water intoxication and hyponatremia have been diagnosed, it becomes vital to treat hyponatremia by water restriction and to observe sodium concentration in the blood.

- Educate women about the importance of drinking to thirst and proper fluid balance monitoring during labor.
- Women should be encouraged to observe and record oral fluid intake, urine output, and any fluid loss such as vomiting every 4 hours.
- If positive fluid balance exceeds 1,500 mL, the blood should be tested for the sodium level. If the result is within the normal range (≥ 130 mmol/L), the woman may stay under midwifery-led care, a regional fluid balance chart should be commenced, and therefore, the peripartum sodium monitoring pathway should be followed.²
- If the sodium level is less than 130 mmol/L or if sodium testing is not readily available, the on-call obstetric registrar should be contacted and the clinical judgment is used, particularly with reference to parity and progress in labor to come to a decision on whether transfer to labor ward is required.²

Women require sodium monitoring is that if:²

- She is on an oxytocin infusion
- She is in labor and requires intravenous infusion of insulin and dextrose.
- She has been found to own serum sodium concentration below 130 mmol/L for any reason.
- Her fluid balance is positive, greater than 1,500 mL.

SODIUM MONITORING (FLOWCHARTS 1 AND 2)²

Flowchart 1: Flow diagram for management of hyponatremia

130 or greater	125-129	Below 125
<ul style="list-style-type: none"> • Repeat sodium 8 hrly • If positive fluid balance exceeds 1500 mL, a sodium should be checked • If sodium has changed by more than 1 mmol per hour then repeat sodium 4 hourly (e.g. 10 mmol over 8 hrs) 	<ul style="list-style-type: none"> • Repeat sodium 4 hrly • Fluid restrict to 80 mL/hr • Continue oxytocin • Inform paediatric team of delivery 	<ul style="list-style-type: none"> • Repeat sodium 2 hrly. • Fluid restrict 30 mL/hr • Stop oxytocin • Inform obstetric and anaesthetic teams • Treat if significant symptoms present • Check plasma and urinary osmolality and consider discussion with medical team • Inform paediatric team of delivery

Flowchart 2: Flow diagram for management of hyponatremia

Delivery or completion of oxytocin infusion Most recent sodium result (mmol/L)		
130 or greater	125-129 and asymptomatic	Below 125 or symptomatic <130
<ul style="list-style-type: none"> • No further testing necessary unless clinically indicated 	<ul style="list-style-type: none"> • Repeat sodium within 8 hrs • Observe for symptoms • Continue fluid balance monitoring • No fluid restriction necessary unless otherwise indicated 	<ul style="list-style-type: none"> • Fluid restrict 30 mL/hr • Repeat sodium within 4 hrs • Observe for symptoms • Continue fluid balance monitoring • Inform obstetric and anaesthetic teams • Treat if severe symptoms present

MANAGEMENT OF SEVERE HYPONATREMIA (FIG. 1)¹⁰

Severe hyponatremia (sodium <125 mmol/L + symptoms) is a medical emergency. The primary idea of treatment should be to boost symptoms instead to normalize the blood sodium level. In other words, the aim should be to treat the symptoms, not the blood reports. If the sodium level is less than 120 mmol/L, inform intensive treatment unit (ITU) whether or not asymptomatic. If there is no improvement in the sodium level despite treatment, then inform ITU.

CONCLUSION

Dilutional (hypervolemic) hyponatremia is more common during the labor and postpartum period. Proper clinical history, laboratory

**If sodium <125 mmol/L
+
Symptoms of severe hyponatraemia
headache, confusion, reduced GCS, seizures**

Urgent senior obstetric and anaesthetic review and refer to intensive treatment unit senior medical staff should give 150 mL 2.7% sodium chloride (hypertonic saline) over 20 minutes via large bore cannula or central line
Level 2 care (on labor ward or critical care unit)
Check sodium concentration
If no improvement in symptoms or deterioration consider further 150 mL 2.7% sodium chloride (rarely needed as patients self correct rapidly after delivery)
Continue fluid restriction and 2 hourly sodium monitoring until asymptomatic
Aim to increase sodium by no greater than 10mmol/L in 24 hours

Fig. 1: Management of severe hyponatremia

investigation, monitoring of blood sodium and fluid balance during labor help to prevent significant consequences of maternal and neonatal hyponatremia.

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