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Review Article

Review on Kalemic Conditions in Pregnancy

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Abstract

Hypokalemia and hyperkalemia, are common electrolyte electrolyte diseases related to changes in potassium intake, excretion, or transcellular shifts. Hypokalemia is commonly induced by diuretics and gastrointestinal losses, whereas hyperkalemia is typically caused by kidney disease, hyperglycemia, and pharmaceutical use. The aetiology of kalemia can range from minor to severe, and it can be caused by diet, drugs, or another disease. Symptoms of hypokalemia include sinus bradycardia, ventricular tachycardia or fibrillation and acute muscle weakness, gestational hypertension, adrenal insufficiency, and renal failure are the symptoms associated with hyperkalemia. Chronic kidney disease and intrauterine fetal death are life-threatening complications associated kalemia in child bearing mother. The medical profile remitted promptly on potassium intake for hypokalemia or increase potassium excretion for hyperkalemia. This review gives an insight into the causes, symptoms, complications as well as pharmacological and non-pharmacological treatments of Kalemic conditions in pregnancy. This review also reported some cases of hypo and hyperkalemia in pregnancy in both human and animals.

Keywords: Hypokalemia, Hyperkalemia, Pregnancy, Potassium.

INTRODUCTION

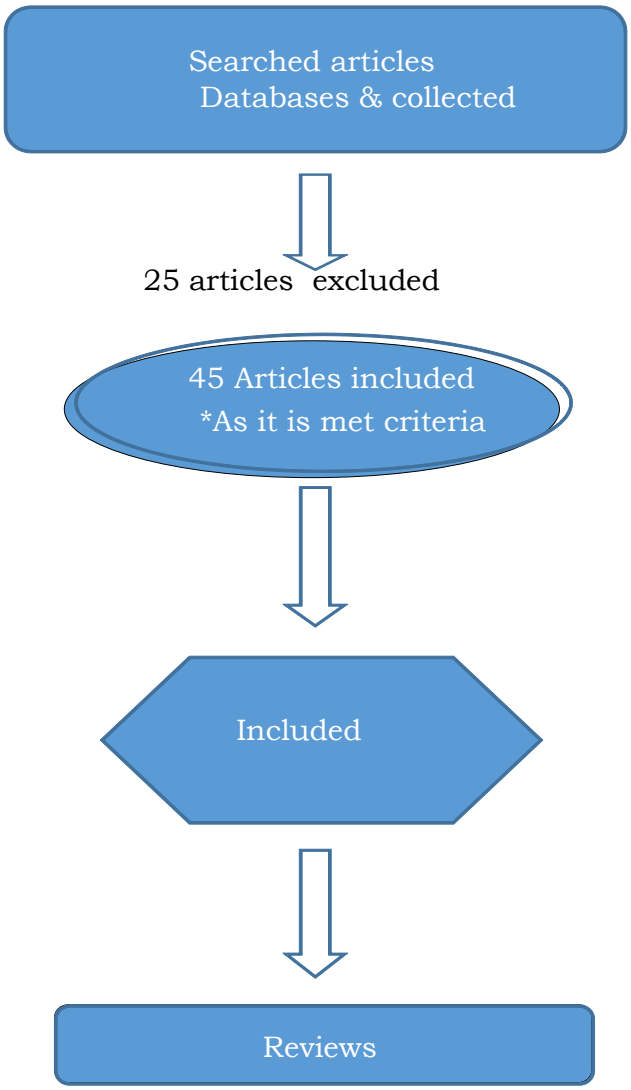
Women in the reproductive age range can develop general muscular weakness and fatigue even though they are quite normal during pregnancy, sometimes it may emerge due to hyper &hypokalemia. Distributions of potassium [k+] were in accordance with the distribution of water in the body. Total body water was assessed to be disbursed in two important compartments: two-third in intracellular [k_i] and one-third inextracellular [k_e] which is the major extracellular cation. The normal k+ concentration in the body was estimated to be 3.5 to 5.0 mmol/l. Even though 2% of total body k+ is posted ke, small modification in extracellular potassium has an important impact upon the ratio of ki/ke as well as on membrane potential.[1, 2]

Potassium is essential to control water and mineral equivalence all over the body. High levels can also disturb the equivalence of other minerals in the body and cause muscle problems throughout the body. It can also affect the heart's ability to function properly. Potassium disorders are common and it may result in life threatening cardiac conditions and neuromuscular dysfunction. Hypokalemia and hyperkalemia be the prevalent electrolyte disorders caused by change in k^+ intake, altered excretion or trans cellularshift.[3]

Mammalian pregnancy offers the fetus, the advantage of a controlled environment during a critical period of growth and development.[4] The control is provided primarily by the homeostatic mechanism. The present studies mainly concentrate on the effects of potassium and sodium deficiencies.[5] Preeclampsia, a pregnancy specific syndrome is the leading cause of maternal and fetal morbidity or mortality. Electrolyte like calcium [ca^{2+}], magnesium [mg^{2+}], sodium [Na^+] and potassium illustrate a significant role in preeclampsia.[6] Potassium deficient diets results in hypokalemia appeared at the end of pregnancy.[7] In present, many cases of hypokalemia developed in pregnancy as a results of persistent vomiting has been reported.[8]

DATA SOURCE AND SEARCH STRATERGY

The databases such as PUBMED, SCOPUS, ELSEVIER, EMBRACE, etc. were explored by utilizing the appropriate Medical Subject Headings (MeSH) terms, including all subheadings, and this was integrated with a keyword search. Searchword comprehended 'nausea and vomiting', 'vomiting', 'nausea', 'hyperemesis', 'morning sickness', 'antiemetic agent', 'fluids' and 'hydration' and 70 articles were obtained from the databases. From 70 articles 45 articles met the criteria and assessed, other 25 articles were excluded as it consist of the complications present in pregnancy other than kalemic conditions. After that, they were extracted the contents and a review was prepared on kalemic condition in pregnancy.



**CRITERIA:* Complications present in pregnancy other than kalemic conditions.

EPIDEMIOLOGY OF HYPOKALEMIA AND HYPERKALEMIA

Hypokalemia results from abnormal losses, Tran's cellular shifts or insufficient intake of potassium rich foods. Hypokalemia is frequently asymptomatic, particularly when the disorder is lenient.[9] Maternal hypokalemia is an electrolyte abnormality seen in majority of pregnancies whereas hyperkalemia is caused by excess potassium intake, impaired potassium excretion or Trans cellular shifts. The etiology of hyperkalemia is often multifactorial with impaired renal function.[10]

Hypokalemia [serum potassium level <3.6mEq/l] occurs up to 21% hospitalized patients and 2%to 3% of outpatients. Hyperkalemia[serum potassium level greater than 5mEq/l in adults, >5.5mEq/l in children and >6mEq/l in neonates] take place up till 10% hospitalized patients and approximately 1% of outpatients.

CAUSES OF HYPOKALEMIA AND HYPERKALEMIA IN PREGNANTS

Drugs causing Hypokalemia and Hyperkalemia

Hypokalemia*:* The liberation of epinephrine can further markedly lower the serum potassium concentration.[11] Consumption of enormous chloroquine furthercauses hypokalemia by hampering k^+ from exiting cells. Verapamil insobriety has also been supported to cause severe Hypokalemia.[12] The major root of Hypokalemia in Clinical Practice are drugs [diuretics, antimalarial agents and hypertensive agents] and gastrointestinal loss secondary to diarrhea and/or vomiting. The etiology of hypokalemia may be varied ranging from congenital to acquired causes. The medications which are having a major impact over the serum potassium level are NSAIDS, beta blockers, heparin. Medical conditions such as magnesium deficiencies, leukemia's, Cushing diseases and other adrenal disorder are the other leading causes of hypokalemia.

Hyperkalemia*:* Angiotensin -converting enzyme inhibitor and angiotensin receptor blockers, NSAIDS, potassium sparing diuretics, trimethoprim, digoxin, beta blockers, and heparin can causes hyperkalemia.

Food causing Hypokalemia and Hyperkalemia

Hypokalemia: In general, the hypokalemia of potassium losing diseases improves with pregnancy. By contrast, hypokalemia developed in patients increasing potassium requirements during pregnancy.[13] Hypokalemia results from decreased food intake, malnutrition, alcoholism, insufficient intake of potassium rich foods among hospitalized patients.[3] Hypokalemia myopathy is a potential intricacy of Clay eating; the clay binds to the potassium which results in the

hypokalemia myopathy. Dextrose stimulates insulin secretion which exacerbateshypokalemia.[3]

Hyperkalemia: Ingestion of potassium containing foods such as banana or orange juice, carbohydrate containing foods and other potassium supplements.

Other causes

Hypokalemia: Exercise, hunger, cold, changes in humidity, sickness, extra sleep, stress or fatigue, changes in activity level.

DISEASED CONDITIONS

Hypokalemia and hyperkalemia happens due to an unanticipated Tran's cellular shift of potassium from the extracellular to intracellular compartments.[1, 2]

Hypokalemia: Hypomagnesaemia can cause resistant hypokalemia.[4] Type 1and type 2 renal tubular acidosis's, intrinsic renal transport detects, familial renal tubular diseases were associated with hypokalemia. Malnutrition, dehydration and cellular breakdown results in potassium release from the cell. The potassium is excreted in urine. [8]

Hyperkalemia: The hyperkalemia was unexpected and was attributed to a defect in renal potassium excretion.[14,15] Patients with advanced chronic kidney disease can develop acute hyperkalemia. Patients with chronic kidney disease were more prone electrolytic imbalance.[16] Intravenous potassium intake increases the risk of hyperkalemia.[17] Acute kidney injury, chronic kidney disease, cirrhosis, congestive heart failure, long standing hypertension, diabetes mellitus, autoimmune disease, and primary glomerulopathy leads to hyperkalemia. Hypoglycemia, eosinophilia, lymphocytosis and adrenal insufficiency is correlated with laboratory finding of hyperkalemia.[18]

DIAGNOSIS

The diverseness of the etiology makes it harder to diagnose and control the underlying conditions. The diagnosis should be authenticated with a respect serum potassium measurement. The most common accurate method is a urine potassium collection; normal kidneys excrete not more than 15-30mEq/l of potassium per day in response to hypokalemia.

ECG manifestation, serum magnesium levels, serum glucose and physical examination is often normal provocative testing but is not considered as first line method of diagnosis.[17] Potassium challenge tests risk hyperkalemia arrhythmia, simple exercise challenge.[19] Baseline electrocardiography should be acquired as up to 50% of kalemia patients with Gitelmansyndrome [GS] have QT interval prolongation. Central venous access and cardiac telemetry should be considered.[20] There is no such electrolyte monitoring method are used for the detection of kalmia condition in pregnancy. The physical investigation should be done including assessment of blood pressure and intravenous volume status to identify potential causes of kidney perfusion which can lead to hypokalemia.[17]

NORMAL LIMITS OF POTASSIUM IN PREGNANT WOMEN

The normal potassium level in the blood stream is 3.5 to 5 millimoles per liter. First trimester is the important period, because the symptoms may go unnoticed by the emesis of pregnancy and childbirth stress.[18] Acute renal problem is commonly caused by septic abortion in early pregnancy and by toxemia of pregnancy, hemorrhage during pregnancy and ischemic acute tubular necrosis in late pregnancy. [21, 22]

A tabulation showing the normal range of potassium in three trimesters is as follows:

S.N.	Trimester	Normal Range of Potassium (Mmol/L)
1.	First	3.6 to 5
2.	Second	3.3 to 5
3.	Third	3.3 to 5.1

SYMPTOMS

The happening of myopathy in pregnant women is more often to concern.[23] Seizures, muscle weakness, cramps, episodic tenancy and paresthesia were reported in pregnant women.[24, 25]

Hypokalemia: Arrhythmias correlated with hypokalemia comprises of sinus bradycardia, ventricular tachycardia or fibrillation and torsade de pointes. Sinus arrest, a systole neurologic signs of hypokalemia includes generalized weakness and decreased deep tendon reflexes. [17]

Hyperkalemia: Gastrointestinal disturbances such as vomiting, diarrhea, ulcerative colitis and malabsorption and renal disorders like diabetes mellitus, ketoacidosis, and parenteral fluid treatment. [26, 27, 28]

COMPLICATIONS

Pregnant females with facilitated chronic kidney disease and intrauterine fetal death should undergo early termination of pregnancy, which can be a life-threatening complication for the child-bearing mother.[16]

Hyperkalemia: The hyperkalemia was unexpected and was attributed to a defect in renal potassium excretion.[29] Gitelman syndrome [GS] increased the risk of intrauterine growth retardation, oligohydramnios and abortion together with maternal morbidity and thus stressed the importance of close follow up of pregnancy women with GS.[30] Persistent vomiting was studied for abnormalities in serum k^+ concentrations. The entire patient in the hyperkalemia exhibited lethargy, listlessness, apathy, mental depression and cardiac arrest.[8] Acute renal failure [ARF] is a rare but an important complication during pregnancy. In acute renal failure electrolyte abnormalities were seen in 75.68% and they were hypernatremia in 14.63%, hypernatremia in 36.59%, and hyperkalemia in 9.76% and hypokalemia in 14.63%.[31] Preeclampsia is the typical medical complication of pregnancy.[32]

Hypokalemia: Serum calcium, magnesium, potassium and increased level of sodium in patient of preeclampsia and hypokalemia, hypocalcaemia, hypomagnesaemia and hypernatremia were seen in preeclampsia women.[33] Low in potassium complementary with the participant's routine sodium intake caused retention and an elevation of blood pressure.[34] GS is a milder disorder associated with hypokalemia and hypocalcemia rather than hypercalciuria has proven to be caused by mutation in the gene.[35] Hypokalemic paralysis during pregnancy has a infrequent event. It exhibit as an acute muscular weakness accompanying with low potassium level. [31]

More than 90% affected women reports an increase in incursion frequently during pregnancy while roughly 80% report an improvement muscle weakness during attacks, 70% reported worsening of muscle stiffness during attacks. Hypertension and hypokalemia may exacerbate postpartum due to removal of the progesterone effect, progesterone has an anti-mineralocorticoid effect at the renal tubules, hypertension and hypokalemia may make better during pregnancy.[36]

TREATMENT

Hypokalemia Treatment during Pregnancy

Behavioral and environment management, trigger recognition and dietary moderation may be helpful along with drug to maintain the potassium level within normal limit in familial conditions.[37] The acute episode may be managed with intravenous potassium replacement and maintenance with oral potassium supplement. A simple blood test performed during pregnancy can detect low potassium levels. An ECG can detect irregular heartbeats. The treatment primarily focused on two aspects: restoring normal potassium levels in the bloodstream and reducing the risk of further potassium shortage. The following are the steps taken to restore potassium levels in the blood:

Potassium Rich Food

Bananas, tomato, spinach, white bean, mushroom, salmon, avocados, yoghurt, potatoes, and other potassium-rich foods can be included in your diet. It will assist in naturally increasing potassium levels during pregnancy.

Increasing Electrolyte Intake

Increasing electrolyte intake to 2000 mg per day will aid in maintaining potassium levels as blood volume rises.

Oral Potassium Supplements

For mild-moderate hypokalemia, oral potassium replacement therapy will suffice (2.5 to 3.5 millimoles per liter). Potassium supplements come in a variety of shapes and sizes, including capsules, pills, powder, and liquid. Potassium is easily absorbed when taken orally. The dosage is determined by the individual's needs. The best treatment for hypokalemia is acetazolamide. Dose: 125mg-1000mg per day, split into two doses.[38]

Intravenous Administrating

If the potassium level is below 2.5 millimoles per litre, more aggressive treatment, such as intravenous potassium delivery, is required. The mainstay of therapy is still oral potassium and magnesium supplements.[39, 40] Potassium can irritate the veins to a great extent. As a result, to reduce cardiac aggravation, the surgery is normally performed under constant observation. For parenteral use, the potassium chloride concentration should not exceed 3 gm per liter of fluid. Continue to employ parenteral potassium treatment until oral feeding is acceptable.[8] Magnesium infusion is another treatment option for hypokalemia, as it reduces potassium excretion via an unclear mechanism. The discontinuing magnesium infusion will alter the electrolytes changes.[41, 42] Patients with potassium-losing disorder such as primary hyperaldosteronism may become normokalaemia in pregnancy. [43, 44]

Hyperkalemia Treatment during Pregnancy:

- Going on a low-potassium diet
- Stopping or changing medications that are contributing to the hyperkalemia
- Avoid rest after exercise.
- Avoid carbohydrate rich food.
- Avoid milk products, nuts, beans, legume, potatoes, bananas, avocados, salty foods, fast foods, processed meats, whole grains, tomatoes, vegetable juices.
- Avoid dehydration as it can disrupt the electrolyte balance and can cause hyperkalemia
- Patients should be well accomplished about the safe and appropriate use of potassium.[19]
- ***Drugs include:*** Patiromer, Sodium polystyrene sulfonate, Sodium zirconium cyclosilicate and Dichlorphenamide.
- Patiromer dose: 8.4-25.2 gm per day, Maximum : 50.4 gm per day orally
- Sodium polystyrene sulfonate dose: 15 gm once daily orally
- Sodium zirconium cyclosilicate (ZS-9) is a new treatment option for hyperkalemia. It's a non-absorbable, insoluble chemical that's used to collect potassium ions. It's a powder that you combine with water and take orally. In the GI tract, the agent binds potassium and allows for fecal excretion in exchange for sodium and hydrogen ions. In the presence of other ions, it was discovered to be potassium selective. The molecule is thought to work soon after ingestion and continues to work while it passes through the gastrointestinal tract. Initially 10gm per oral thrice daily, Maintenance dose 5gm, maximum 15 gm per day.
- Dichlorphenamide dose: 50 mg per oral per day or every 12 hrs, not to exceed 200mg per day.
- Preventive therapy for individual with hyperkalemic periodic paralysis [HPP] consist of frequent meal rich in carbohydrates and exclude potassium rich medication and foods.[36]

CASE REPORTS

A 38 year old women with asymptomatic long-standing hypokalemia, who took up medical attention during a high risk pregnancy [she had two previous miscarriages] and was found to have GS.[10]

A 30 year old, 24 weeks pregnant patient with hypertension, type 2 diabetes admitted to observation amenity with back pain, hypokalemia, consulted to help access the reason of hypokalemia.[45]

A 37 year old African American woman at 26 weeks of gestation was admitted to hospital for abdominal pain. The patient was undergone emergency C-section as the fetal movement and fetal heart sounds was not heard. The author's hypothesize that the worsening of hyperkalemia condition in the patient with advanced chronic kidney disease was due to potassium leakage from intrauterine fetal demise into the maternal circulation by uterine rupture. [16]

The pregnant patient with gestational age of 16 week was admitted to the accident and emergency ward with the complaint of seizure and was found to have GS and Barffer syndrome are shown among the cause of hypokalemia.[10]

KALEMIC CONDITIONS -A VIEW ON ANIMALS

DOG: There is an uphill chemical concentration gradient for potassium between the maternal and fetal side of the placental circulation. This gradient can be of conspicuous proportion is seen in the dogs that were defective in potassium. The result of study strongly suggests the probability of an active mechanism for the transport of potassium from mother to fetus. [46]

RAT: Potassium-deficient mothers were evidently ill towards term, with ruffled fur, sluggish behavior and severe anorexia. Reductions in maternal potassium in the pregnant rat would be expected to cause a collapse in plasma osmolality and a parallel change in the fetus.[7]

CONCLUSION

Present world with improved technology makes it possible to diagnose and reduce the frequency and occurrence of hypokalemia and hyperkalemia. But a number of complicated case were reported, especially the obstetrical patient under certain circumstances is particularly susceptible to alterations in potassium metabolism. A myriad of questions encircling the management of this condition remains extemporized. It hopes that combined efforts of various researches, provide counseling regarding knowledge about the cause, diagnosis, management of disease among patients will reduce the progression of disease and its complication in this aspect. Life-style modification and naturopathy will ensure safer treatment of both hypo and hyperkalemia in pregnancy.

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CONFLICT OF INTEREST

There are no conflicts of interest to declare.

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