A DISSERTATION ON

“Clinical Profile of

Hypokalemic Periodic Paralysis ”

Dissertation Submitted To

THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY,

In partial fulfillment of the rules and regulations, for the award of the

M.D. DEGREE IN GENERAL MEDICINE

BRANCH –I

Reg No: 200120103004

GOVT.CHENGALPATTU MEDICAL COLLEGE & HOSPITAL,

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MAY 2023

CERTIFICATE

This is to certify that the dissertation titledon **CLINICAL PROFILE OF HYPOKALEMIC PERIODIC PARALYSIS**is the bonafide original work of **Dr.BANOTH NARESH,** in partial fulfilment of the requirements for **M.D. Branch-1 (General Medicine)** Examination of the Tamil Nadu Dr.M.G.R. Medical University to be held in May 2023. The period of study was from January 2021 to December 2021.

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This is to certify that dissertation on **CLINICAL PROFILE OF HYPOKALEMIC PERIODIC PARALYSIS** is a bonafide work performed by **Dr.BANOTH NARESH** postgraduate student of General medicine, Chengalpattu medical college, Chengalpattu, under my guidance and supervision in fulfilment of regulations of The Tamil Nadu Dr. M.G.R Medical University for the award of M.D. Degree during the Academic period 2020-2023.

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DECLARATION

I, **Dr.BANOTH NARESH,** solemnly declare that dissertation titled **"STUDY ON CLINICAL PROFILE OF HYPOKALEMIC PERIODIC PARALYSIS"** a bonafide record of work done by mein the Department of Internal Medicine Government Chengalpattu Medical College and Hospital during January 2021 to December 2021 under the guidance of **Prof.Dr.R.NARMADHALAKSHMI,M.D, Dch,** Professor of General Medicine, Government Chengalpattu Medical College and Hospital, Chengalpattu. This dissertation is submitted to Tamil Nadu Dr. M.G.R. Medical University, in partial fulfilment of the University regulations for the award of M.D. Degree (Branch 1) General Medicine- May 2023.

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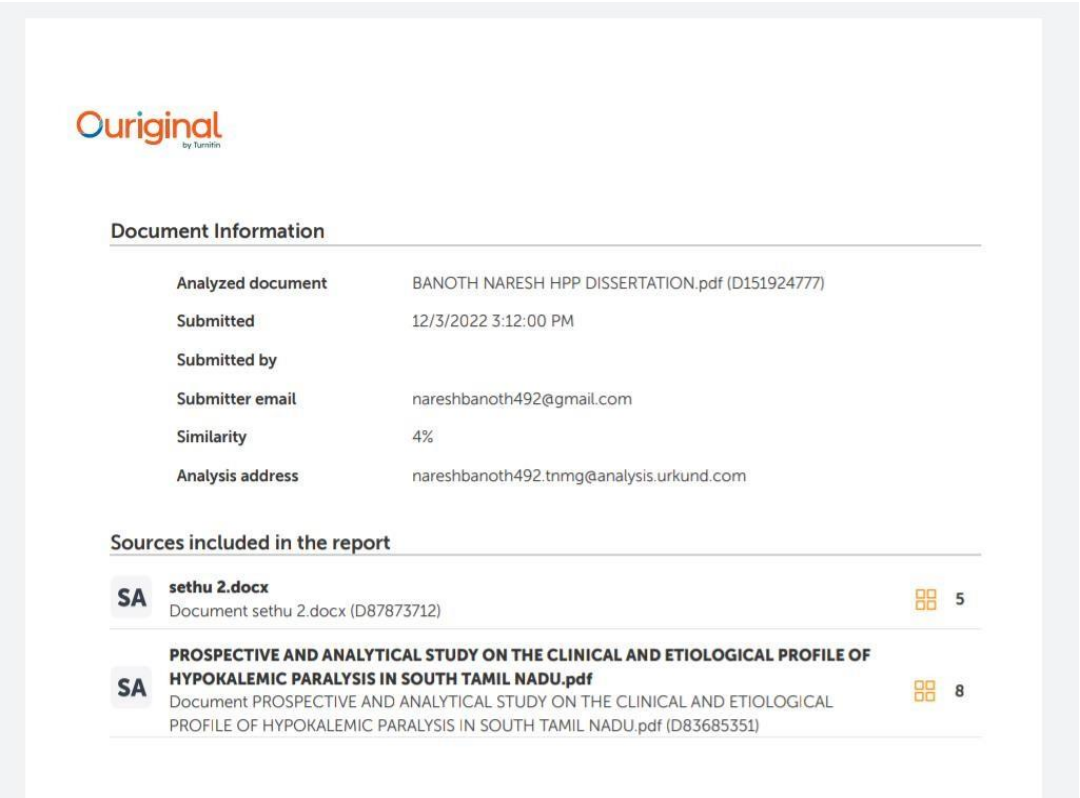
Urkund



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APPROVAL FROM COLLABORATING DEPARTMENT

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Through proper channel,

Respected sir/ Madam,

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I joined M.D GENERAL MEDICINE in the academic year 2019-2020 I am planning to do a study **" clinical profile of hypokalemic periodic paralysis in tertiary care center "** among patients taking treatment at CMCH, Chengalpattu, request you to grant me the permission to do the study.

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ABSTRACT

BACKGROUND: Multiple electrolyte problems, such as hypokalemia, hyperkalemia, hypercalcemia, and hypo or hypermagnesemia, are linked to muscle weakness. However, hypokalemia turns out to be the most common reason for periodic paralysis. A group of different illnesses known as acute hypokalemic paralysis appear with sudden muscular weakness and can present a life-threatening risk. complications resulting from respiratory failure or cardiac arrhythmias.

AIM: To Assess the clinical profile of hypokalemic periodic paralysis patient withreference to the clinical presentation and to assess the etiological factors and metabolic profile of all patients presenting with Hypokalemic periodic paralysis and to assess patient's outcome with treatment.

MATERIALS AND METHODS: 51 Patients admitted with acute onset of flaccid weakness and documented serum potassium of < 3.5mEq/l during the episode were included in the study. Clinical data collected included age, gender, ethnic origin, history of symptom evolution, triggering variables such as high carbohydrate intake in the previous 24 hours, alcohol usage, and treatment received. Any family history of similar disease was investigated, and reports of weakness, thyroid disease, diarrhoea, vomiting, hypertension, bone pain, fractures, dry mouth, dry eyes, and renal disease were documented. The use of diuretics, 2 agonists, decongestants, insulin, laxatives, and antipsychotics was observed. Caffeine and herbal medication use were restricted. Anthropometry, pulse, blood pressure, anaemia, and thyroid status were all tested. A thorough neurological examination was carried out. Schirmer's test was performed on a subset of patients. The parameters considered were age, sex, past history, family history, precipitating factors, Serum potassium levels, ECG changes, treatment outcomes.

RESULTS: Around 50% cases were in their 3rd decades , 25% of cases were in their 2nd decade. Around 75% are males and 25% are females. About 40% of the cases were found to have suffered similar attacks in the past. Good carbohydrate diet followed by sleep was found to be the risk factor in manypatients. About 72% of the patients had presented with Quadriparesis / plegia. Maximum number of patients had serum potassium levels between 2-3 meq/L. 11 Patients had normal ECG despite of weakness. Despite the use of various treatment methods, oral potassium chloride alone wasused to treat nearly 82% of patient.

CONCLUSION: Our study showed that Incidence ratio is M: F = 3:1 and 40% have had similar attacks in the past. Flaccid quadriparesis was the most common mode of presentation. About 37% of the patient had first degree relative with similar attacks. Most of the patient had serum potassium level between 2 to 3 meq/L. ECG abnormalities was observed in 80% of the patients. Most of these patients were treated with oral potassium chloride alone. Outcome was good in all patients.

KEY WORDS: Hypokalemic periodic paralysis, acute flaccid paraly

CONTENTS

INTRODUCTION

INTRODUCTION:

Multiple electrolyte problems, such as hypokalemia, hyperkalemia, hypercalcemia, and hypo or hypermagnesemia, are linked to muscle weakness. However, hypokalemia turns out to be the most common reason for periodic paralysis

A group of different illnesses known as acute hypokalemic paralysis (HP) appear with sudden muscular weakness and can present a life-threatening risk. complications resulting from respiratory failure or cardiac arrhythmias that result in hypokalemia mortality and morbidity, even though there are numerous possible causes of considerably fewer conditions can be diagnosed with hypokalemia than Hypokalemic periodic paralysis (HPP) occurs when there is a brief shift of potassium into cells, whereas non-HPP occurs when there is a significant deficit of potassium due to a variety of etiologies. The differential diagnosis in a patient with HP can be difficult due to the heterogeneity of its etiologies.

Following the identification of the voltage-dependent adult human skeletal muscle channel, distinct gene lesions in various channel structural regions were found to be predominantly responsible for the potassium-sensitive periodic paralysis. The most frequent genetic cause of hypokalemic periodic paralysis is autosomal dominant mutations in the CACNAIS gene4, which codes for the a1 subunit of L-type calcium channels. The SCN4A gene2, which codes for the skeletal sodium channel, is the source of type II

hypokalemic periodic paralysis.

The case study that is thoroughly discussed in the pages that follow will provide some knowledge about preventing acute incidents of hypokalemic periodic paralysis, recognising it at the first sign of it, and treating it quickly to prevent further injury to the muscle and save the patient.

A muscle biopsy can be used to diagnose myopathic forms, which typically present with increasing muscular weakness without a history of episodic paralysis.

Due to the minor elevated risk of malignant hyperthermia in these patients and their family members who have the mutations during the peri-operative period, this will further highlight the significance of family history and previous experiences with similar weakness.

AIM AND OBJECTIVES

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1. To Assess the clinical profile of hypokalemic periodic paralysis patient with reference to the clinical presentation
2. To assess etiological factors and metebolic profile of all patients presentation with Hypokalemic periodic paralysis.
3. To assess patient outcome with treatment

REVIEW OF LITERATURE

REVIEW OF LITERATURE

"The stability of the internal environment is the key requirement to a free and independent life" wrote Claude Bernard. With 50grammes of body storage,potassium is the most prevalent cation in the human body.adult mmol/kg. Kalaemia is a condition in which less than 2% of K+ is found extracellularly. kept within the specific range of 3.5-5.0 mmol/L. normal people consuming Due to short-term transcellular K+ storage, 80–100 mmol of K+ per day are maintained in balance.K+ shifts controlled by aldosterone, insulin and adrenergic catecholamines (receptors), which stimulate the sodium channel to promote cellular K+ absorption 90% of the ingested K+ is excreted in the urine through the Na+/K+-ATPase pump the remainder in the stool (1)

Although other systems, such as the cardiovascular and gastrointestinal, may also be impacted, the neuromuscular system exhibits the most obvious clinical signs of hypokalemia or potassium depletion. While substantial and generalised skeletal muscle weakness is typical with more severe potassium depletion, some patients complain of muscular weakness, particularly in the lower extremities. Hypokalemia that is extremely severe may cause practically complete paralysis of the respiratory, bulbar, and cranial muscles. There have been reports of deaths due to arrhythmia and respiratory failure.

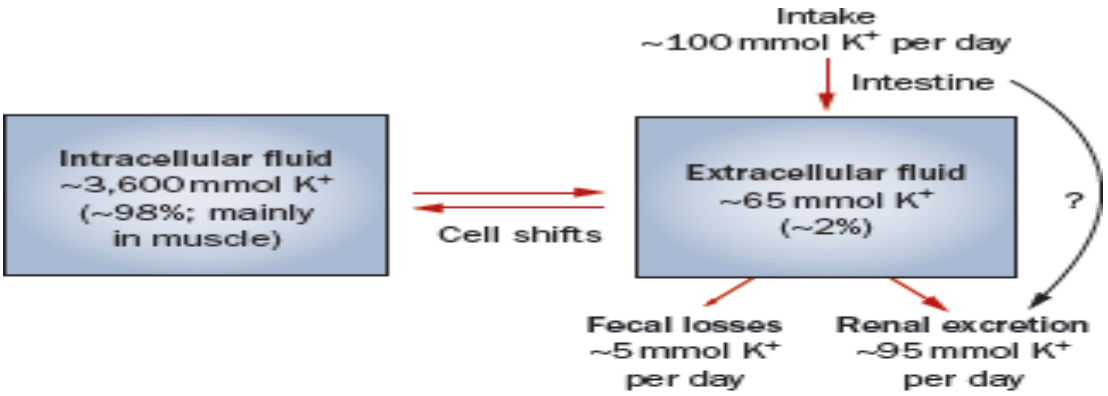


Figure 1 | Distribution of K^+ in the body. Approximately 98% of the body's K^+ is located in the intracellular fluid, mainly in skeletal muscle, and only approximately 2% is located in the extracellular fluid. The pool of K^+ in the extracellular fluid is determined by input from the gastrointestinal system and output in the urine and stools, as well as the distribution between the extracellular fluid and the intracellular fluid compartments. A novel hypothesis is that the gut can somehow signal to the kidneys to excrete K^+ abruptly when sudden gastrointestinal K^+ loads occur. Abbreviation: K^+, potassium.

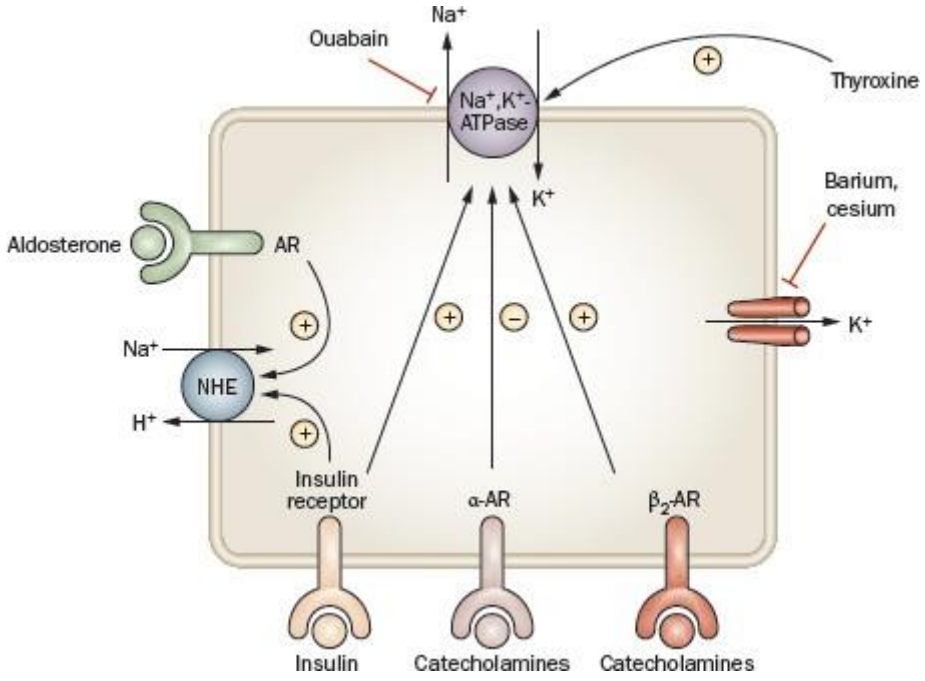


FIGURE 2(2):K+ cellular changes A simplified schematic illustrating the key transporters, such as the Na+,K+-ATPase "sodium pump," K+ channels, and NHE, that are involved in the distribution of K+ across cell membranes The substances that cause cellular shifts in K+ by acting on these channels and transporters are also displayed.

Abbreviations: H+, hydrogen; K+, potassium; Na+, sodium; NHE, sodium/hydrogen exchanger; AR, adrenergic receptor; 2-AR, 2-adrenergic receptor; AR, aldosterone receptor.

The illness has been noted everywhere in the world. There are essentially two types of periodic paralysis.

1.primary

2. Secondary

First-degree periodic paralysis (also known as channelopathies)

Here,the diagnosis is supported by the patient's medical history and verified by an accurate electrolyte evaluation.

It is classified as

1. Hypokalemic periodic paralysis
2. Hyperkalemic periodic paralysis
3. Anderson’s disease
4. Paramyotonia congenital

The differences between the various form of channelopathies are given in table-I.

Genetics and Inheritance(3)

Calcium Channel –

• Voltage-Dependent, L Type,
• Skeletal Muscle Dihydropyridine-Sensitive, Alpha-1 Subunit
• CACNA1S Gene map locus 1q32
• Seven Mutations described to Date: ARG1239HIS, ARG528HIS , ARG528GLY , ARG1239GLY , ARG1086CYS & ARG1086HIS

Sodium Channel –

• Voltage-Gated, Type IV,

• Alpha Subunit;

• SCN4A; Gene map locus 17q23.1-q25.3

• Six mutations described to date: ARG669HIS , ARG672HIS, ARG672GLY , ARG672SER , DIII-S4 ARG1132Q and alpha subunit, between 4th/5th transmembrane segments, domain III SCN4A,Pro1158Ser.

Potassium channel-

• Inward-rectifying potassium channel Kir2.1

• KCNJ2 gene; Gene map locus 17q24.3;

• More than 20 mutations described

Differential diagnosis for secondary hypokalemic periodic paralysis

1. Thyrotoxic periodic paralysis

2. Periodic Paralysis secondary to renal potassium wastage

3. Periodic Paralysis secondary to gastrointestinal loss

Hypokalemia secondary to gastrointestinal loss:

1. Laxative abuse

2. severe or chronic diarrhea

3. Villous adenoma

4. congenital chloride losing diarrhea

Hypokalemia secondary to Renal loss:

1.Hypertension. alkaline urine, metabolic alkalosis:

1. Primary hyperaldosteronism

2. Liquorice ingestion

3. Excessive diuretic therapy

4. Excessive mineralocorticoid therapy for Addison's disease

2. Normotension , alkaline urine, metabolic alkalosis

Hyperplasia of the juxta glomerular apparatus with

Hyperaldosteronism

3. Alkaline Urine, metabolic acidosis:

Renal Tubular acidosis
1. Primary

2. Secondary

4. Acidic Urine , Metabolic acidosis:

Chronic ammonium chloride ingestion

Recovery phase of diabetic ketoacidosis

Recovery phase of acute tubular necrosis

5. Antibiotic Therapy:

Amphotericin B

Gentamycin

Carbenicillin

Ticarcillin

others

Pharmacological agents

1. Beta Agonists

2. Insulin

3. Barium

4. Epinephrine and norepinephrine

5. Glucocorticoids

6. Thiazide

TABLE-I

THE CHANNELOPATHIES

Channel affected	Sodium	Sodium	Calcium	Potassium
disease	Hyperkalemic Periodic Paralysis	Paramyotonia Congenita	Hypokalemic Periodic Paralysis	Anderson disease
Inheritence	Dominant	Dominant	Dominant	Dominant
Gene	SCN4A	SCN4A	DHP receptor	KCNJ2
Channel Protein	Alphasubunit	Alpha subunit	Dihydropuridine receptor Inward	Rectifying K' Channel
Myotonia (electrical)	+/-	++	-	-
Myotonia (Clinical)	+/-	-	-	-
Episodic Paralysis	+++	+/-	+++	+
Onset	First decade	Birth	Latechildhood to third decade	childhood
Precipitating factors Increases with exercise	-	+++	-	+
Appears after exercise	++	-	++	-
Fasting	+	-	-	-
Carbohydrate load	-	-	+	-
Potassium load	++	+/-	-	-

THE CHANNELOPATHIES

Cold	+	+++	+	-
Pregnancy	++	-	+	?
Warm-up phenomenon	+	-	-	-
involvement of cranial muscles	+	++	-	++
muscle hypertrophy	-	-	-	-
permanent myopathy	++	-	++	+
Serum ck during attack	Increased	Increased 5 to 10 times	Normal to Slightly increased	Normal
Serum K during attack	Increased	Normal	Decreased	High, low or normal
Serum K between attacks	Normal	Normal	Normal	Normal
Significant myopathy	++	-	++	Tubular aggregates
Treatment	during attack glucose and calcium for prevention – acetazolamide CHO, Low K diet	Mexiletine if needed for myotonia	KCL during and acetazolamide between attacks	acetazolamide

K - Potassium

CHO - carbohydrate

+ mild

++ moderate

+++ severe

Pathophysiology

It is unclear what causes the disorder's pathogenesis. This kind of channelopathy affects the skeletal muscles. Skeletal muscle dihydropyridine receptor calcium channel (CACNL1A3), tetrodoxin-sensitive voltage-sensitive sodium channel (SCN4A), and potassium channel have all been shown to contain many mutations (Kir2.1). Nevertheless, isolated occurrences without a confirmed mutation have been observed.

The voltage-gated pentameric L type Ca2+ channel complex, commonly known as the dihydropyridine receptor, is composed primarily of Cav1.1 and is situated in the transverse (t) tubular system. The Ca2+ released from the sarcoplasmic reticulum triggers the contractile apparatus after a t-tubular action potential activates the Ca2+ release channel (also known as the ryanodine receptor) via Cav1.1. Clinically, the hypokalemic PP types 1 and 2 are comparable, and the mutations in both relevant channels are all found in the voltage-sensing S4 segments; those in SCN4A are in domain 2, while those in Cav1.1 are in either domains 2 or 4. Functionally, the inactivated state is maintained in Na+ channel mutants while Ca2+ channel mutants have decreased channel availability. (4)

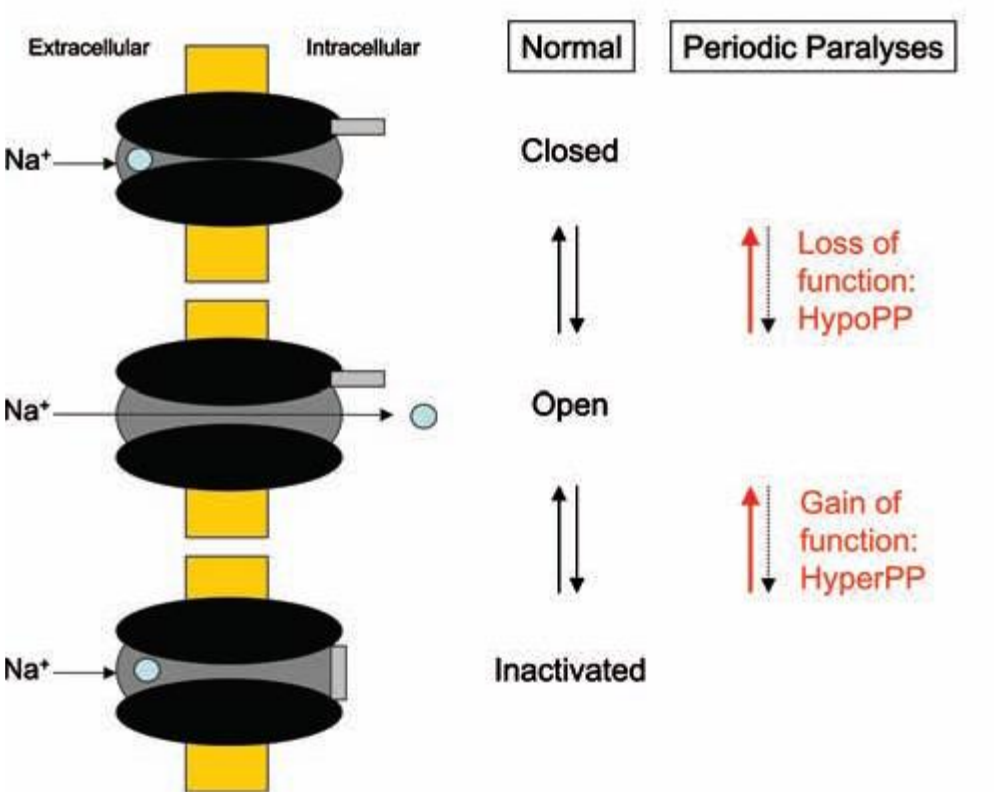


Fig.3 Voltage-gated ion channel function in normal and pathological conditions; physiologically, Na+ voltage-gated channels switch between three different states(closed, open and inactivated) according to time and membrane potential variations.When the channels are open, there is an inward Na+ current and acompensatory K+ outward current (not represented) responsible for the generation and transmission of the action potential. In the case of hyperkalaemic periodic paralysis (HyperPP), mutations affecting the tertiary structure of the protein reduce the affinity of the fast inactivation particle(corresponding to the intracellular protein loops between transmembrane domains III and IV ofNav1.4) for his docking site. In these situations, Nav1.4 channels stay preferentially in their open, activated state (gain-of-function defect) causing a Na+ inward current, a sustained membrane depolarization and the release of K+ from muscular cells. By contrast, in the case of hypokalaemic periodic paralysis (HypoPP), mutated channels remain closed after membrane depolarization (loss of- function defect), causing a lack of action potential initiation/ transmission responsible for muscle inexcitability.

Till date 7 mutations have been described in a1 subunit of CACNLIA3 thus accounting for approximately 55-70% of all hypokalemic periodic paralysis.

These includes

ARG1239HIS

ARG528 HIS

ARG528GLY

ARG1239GLY

ARG1086CYS

ARG1086HIS

Other mutations involve sodium – channel2 voltage gated, type IV a subunit. The gene has been mapped to chromosome 17q23.1-q25.3. This account for approximately 8 – 10% of hypokalemic periodic paralysis type II

Five mutations described to date that includes

ARG669HIS

ARG672HIS

ARG672GLY

ARG672SER

PRO1158SER

There is some indication that people with this sodium channel mutation have different phenotypes from those with the more prevalent CACNAIS variant. Myalgias following paralytic events, tubular aggregates instead of vacuoles in muscle biopsies, and symptoms getting worse when taking acetazolamide are all signs of these forms of mutation (sternbery et al. 2001)

Thyrotoxic periodic paralysis

Pathophysiology:

Hyperthyroidism results in hyperadrenergic state. β2 adrenergic stimulation increases the activity of Na+ ,k+ -ATPase pump.

Thyroid hormone per se increases the activity of Na+ ,k+ -ATPase pump.

Hyperinsulinemia observed in patients with acute attack of TTP indirectly also stimulates Na+ ,k+ -ATPase pump

TPP attacks occur only when thyrotoxicosis is present. Attacks can be induced by insulin and carbohydrate administration in hyperthyroid patients with a history of TPP, but not in TPP patients who have become euthyroid. Paralytic attacks can recur with relapse into a thyrotoxic state, and can be induced by exogenous thyroid hormone

CLINICAL FEATURES

- In two-thirds of instances and in one-third of cases, hypokalemic periodic paralysis is inherited as an autosomal dominant7 condition.
- Males are more frequently affected than females, with a male to female ratio of 3 or 4:1.

- Adolescence is typically when attacks start.
- Rarely does it begin beyond 40 years.

- Attacks can happen every day or every year.
- single incident can linger for hours if it's moderate or days if it's severe.

- With age, the frequency of attacks tends to decrease.
- Frequently precipitated by sleep or rest after exercise, alcohol or high carbohydrate meal and almost never occur during exercise.

- The limb muscles are more affected than the trunk muscles and proximal muscles are more affected than the distal ones

Hypokalemic periodic paralysis is characterized by two forms :

1. Paralytic form

2. Myopathic form

PARALYTIC FORM:

A number of prodromes, such as extreme appetite, thirst, dry mouth, palpitations, sweating, diarrhoea, vomiting, and a feeling of exhaustion or fatigue, may come before the weakness. Usually, when a patient wakes up, their limbs are either mildly or severely feeble. However, daytime attacks can also happen, particularly after a large meal.

Paralysis occurs in various sites. Proximal muscles may be more vulnerable than distal ones, and limbs are affected earlier and frequently more severely than truncal muscle. In most cases, the arms are weakened before the legs, but this is not always the case. The muscles of the eyes, face, tongue, pharynx, larynx, diaphragm, and sphincters are those that are most prone to escape, however occasionally even these may be affected. Tendon reflexes are diminished or eliminated during an assault, and cutaneous responses may also vanish.

Sensation is kept intact. Strength typically recovers quickest to the muscles that were least impacted as the attack diminishes.

Headache and fatigue. The attack may be followed by diuresis and occasionally diarrhoea. In fact, there is no clinical or EMG evidence of myotonia.

The atypical forms of presentation include:

1. Weakness of one limb or certain group of muscle

2. Bibrachial palsy

3. Transient weakness during accustomed activities.

MYOPATHIC FORM:

This form, which affects around 25% of those who are affected, causes gradual fixed muscle weakness that starts at very different ages as exercise intolerance mostly in the lower limbs. It happens without showing any paralytic symptoms, and it might be the only sign of hypokalemic periodic paralysis.

Trigger for hypokalemic periodic paralysis that has been identified

1. High carbohydrate diet
2. Large meals
3. salt
4. Sleep after unaccustomed exercise.
5. Medications
   eg: diuretics, insulin

These patients' skeletal muscle's resting membrane potential (RMP) has been altered, and when potassium levels drop, the RMP drops to -50 MV, at which point the muscles be

DIFFERENTIAL DIAGNOSIS:

The differentiation between different type of periodic paralysis are

Periodic paralysis can be readily distinguished from

Guillian – Barre syndrome

The type of weakness is typically ascending, and an earlier infectious episode may be present. The levels of potassium may not be low. The CSF analysis will be helpful**.**

Poliomyelitis
There may be more asymmetrical, preceding gastrointestinal symptoms.

Cataplexy:
It is caused by emotion and lasts only a few seconds or minutes.

Sleep Paralysis.
The episodes are very brief

Myasthenia gravis
Ocular involvement more common

Hysterical Paralysis.

Fig 3: Appoach to a patient with hypokalemia and paralysis (5)

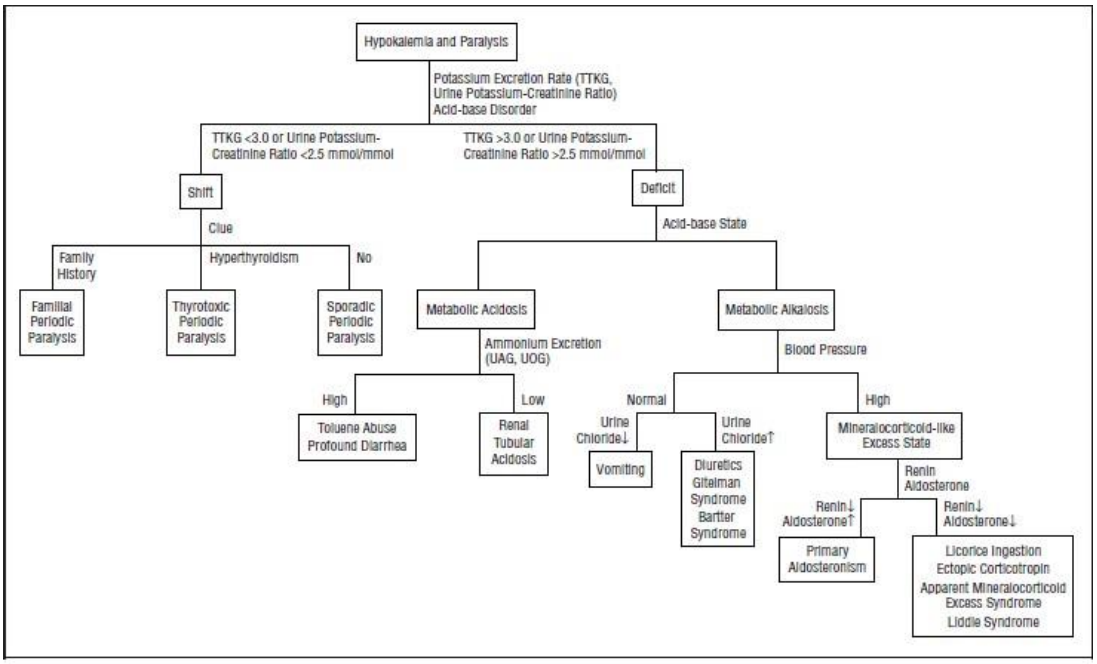


Figure 4. Algorithm for an approach to patients with hypokalemia and paralysis in the emergency department. UAG indicates urine anion gap (sodium + potassium − chloride); UOG, urine osmolar gap ([measured − calculated] osmolality/2); and TTKG, transtubular potassium concentration gradient.

Approach to the patient with hypokalemic palaysis

Failure to distinguish HPP from non-HPP may lead to overly aggressive treatment Of an apparent potassium deficit, with rebound hyperkalemia on recovery. In retrospective studies by Manoukain and Lin and colleagues, rebound hyperkalemia occurred in 30% to 42% of patients with HPP, especially if more than 90 mmol of potassium chloride was given within 24 hours14. Hence diagnosis of the etiology is important.

Diagnosis for the cause of hypokalemia is based mainly on determining if there is a net loss of K+ or only a transcellular shift. Diagnostic tests Serum K+ Blood urea nitrogen, Serum creatinine Acid-base status Urinary Potassium Transtubular potassium concentration gradient (TTKG) and Urinary Potassium creatinine ratio (K+ /C) Thyroid function tests – if features suggestive of a transcellular shift

Diagnostic tests

Serum K+

Blood urea nitrogen,

Serum creatinine

Acid-base status

Urinary Potassium

Transtubular potassium concentration gradient (TTKG) and

Urinary Potassium creatinine ratio (K+ /C)

Thyroid function tests – if features suggestive of a transcellular shift

Three urinary indices of renal response to hypokalemia can be easily measured:

spot urine potassium concentration,

TTKG,

Urine potassium creatinine ratio

The spot urine potassium concentration is lower in the HPP than the non HPP (<15-20 mmol/L) however,there can overlapping values because polyuria is common in patients with hypokalemia . The polyuria may be due to thirst or defective renal concentration in patients with chronic hypokalemia; this leads to a low value for the urine potassium concentration even if significant renal potassium wasting is present.

The TTKG is a semiquantitative index for events in the lumen of the cortical collecting ducts, because it adjusts for the plasma potassium concentration and for water reabsorption in the medullary collecting ducts. Although calculating the TTKG is a reliable way to distinguish between HPP and non-HPP, a TTKG is invalid if the Uosm is lower than the Posm in a patient.

The potassium- creatinine ratio is independent of the Uosm. Urine potassium-creatinine ratio less than 2.5 mmol/mmol and TTKGs less than 3.0 in hyperosmolar urine are reliable cutoff values to differentiate between patients with HPP and non-HPP

Hypokalemia secondary to K+ loss

Based on clinical characteristics including blood pressure and history suggestive of the etiologies listed below, as well as by examining the patient's acid-base balance and urinary K+ loss, hypokalemia secondary to K+ loss can be distinguished. Because K+ depletion can result in polyuria and a relatively low K+ concentration (20mmol/l) could nonetheless imply significant urine K+ loss, determining the urinary K+ concentration alone may be misleading. A more accurate method of assessing the excretory process is provided by the TTKG.(6)

Utilizing the following formula, the transtubular K+ concentration ([K+]) gradient (TTKG) is determined.

TTKG = [urine K+/plasma K+] / [urine osmolality/plasma osmolality]

The following studies may be carried out in order to distinguish between different causes of renal K+ wasting

Urinary pH

Ammonium loading test

Alkaline phosphatase

Creatinekinase

24 h urinary calcium, inorganic phosphate, and creatinine

Serum and urinary electrolytes – Na , K, Cl, Ca, Phosphate,Mg

Urinary aminoacids

Seumaldosterone and renin levels

DIAGNOSIS:

When a typical paralytic attack occurs, low or low normal serum potassium is shown, and secondary causes of hypokalemia are ruled out. The fact that the measurement of serum potassium is inaccurate is a significant limitation in the use of serum potassium to provide a trustworthy indication of real moderate hypokalemia. During the collection of venous blood samples, potassium may unintentionally be released from intracellular compartments, liberated from platelets, as the blood coagulates before the sample is centrifuged, or due to moderate hemolysis.

These elements can increase serum potassium by at least.5 mmol/l.

Additionally, acidosis, renal failure, tissue damage, and potassium release can all hide a true potassium deficit.

Electrocardiogram changes in hypokalemia

- Flattening or inversion of ‘T’ waves
- ST segment depression
- Pseudo-P-pulmonale
- Prominence of ‘U’ waves
- **QU** interval prolongation
  Wide QRS complexes

  Prolonged QT interval
- Prolonged PR interval
- Atrial and ventricular extrasystole

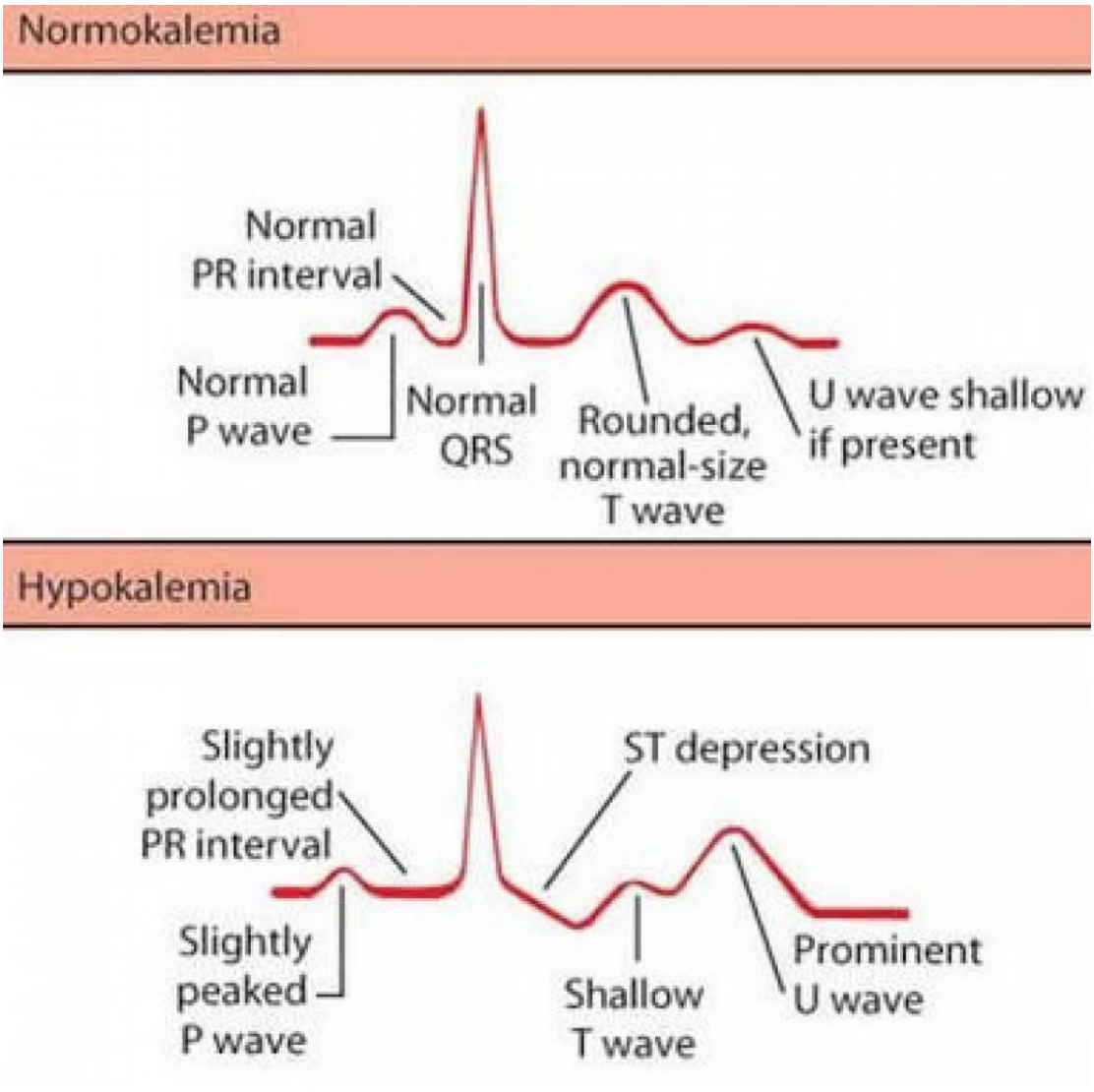


Figure 3:ECG changes in hypokalemia

Electromyogram:

This disease causes muscle weakness that is accompanied by a reduction in the amplitude and eventually loss of muscle action potentials. Strong voluntary effort or even supramaximal peripheral nerve stimulation are unable to excite the muscles in this disease. Loss of motor unit potentials and the failure of action potentials to propagate over the surface of fibre are preceded by a drop in strength. Despite the sarcolemma's failure to propagate impulses, the polarisation potentials of muscle fibres as determined by intracellular recordings first appear to be normal. As K goes into the muscle fibre, one would anticipate that it would become hyperpolarized, but it instead becomes depolarized. The latter alteration is attributed by Rudel and colleagues to an elevated Na conductance.

Histopathological alteration in hypokalemic periodic paralysis (8)

A vacuolarmyopathy is the syndrome's histological characteristic (Goldflam 1895). This can occur in primary or secondary periodic paralysis, however it does so more frequently in the former. Compared to acute paralysis, the vacuolation is more frequently linked to the chronic myopathy that results from repeated assaults (Klein et al 1960, Mc Ardle 1963 Samaha 1965, Resnick& Engel 1967). The vacuoles are often found in the centre of the muscle fibres; there may be more than one vacuole present in a fibre in a single plane of sectioning, however this is uncommon.

A thin membrane places boundaries on some vacuoles. Some are loculated, and others have finely ground material that exhibits a glycogen positive stain. According to research using electron microscopy, the sacrcoplasmic reticulum and transverse tubules' membrane organelles proliferate and degenerate to produce the vacuoles.

Malignant hyperthermia (MH) (9)

There is evidence that it is related to hypokalemic periodic paralysis. All patients With hypokalemic periodic paralysis should be thought of as having a significantly elevated chance of developing this potentially fatal surgical complication. A consistently high CK may indicate a propensity to malignant hyperthermia.

PROVOCATIVE TESTING IN PATIENTS WHO HAVE A SUSPICION

OR

WHO MAY HAVE A PERIODIC PARALYSIS

INITIAL THERAPY: Following an overnight fast, oral glucose between 1 and 5 g/kg is administered over three minutes (maximum of 100 gms)

Monitoring
(pt.atrest)

- For baseline measurements of potassium, sodium, chloride, and glucose, free flowing arterialized blood will be drawn every 30 minutes for the first three hours and then every hour for the next five.
- Depending on the muscle group used during an attack, the strength of 4 to 6 different muscles will be evaluated at 30-minute intervals.
- If available, continuous monitoring or ECG monitoring every 30 minutes is used.

Comment
The greatest rise in serum glucose typically occurs concurrently with or immediately after the minimum in serum potassium after oral glucose. Following oral glucose loading, potassium levels normally don't drop below 3.5 mmol/L. Treat any onset of weakness as hypokalemic periodic paralysis.

Following the initial test, intravenous glucose with insulin can be administered if there are no signs of weakness or bad reactions, and if there are no medical contraindications.

After an overnight fast, continuously inject over the course of an hour a glucose load of 3 g/d (maximum 200 g) in water. After the start of the glucose infusion, 30 minutes later, a bolus of IV insulin is administered (.1unit/kg).

Provocative hormone infusion testing with specialised protocols comprise

Initial insulin dose for the two-hour euglycemic insulin infusion was 20mu/m2/min.

Epinephrine intrabrachial arterial infusion

Comment:
The benefit of these tests is that they result in a more consistent, regulated drop in circulating potassium for either the entire body (euglycemic insulin infusion) or just the tissues in the forearm (e.g., intra brachial epinephrine infusion).

MOLECULAR GENETIC TESTING:

In 80% of patients who meet clinical diagnostic criteria, this finds disease-causing mutations in CACNAIS or SCN4A.

Management

Treatment of Periodic paralyses

Patients with FPP and TPP have normal levels of potassium in their bodies. Therefore, rather than restoring the potassium shortfall, the goal of potassium supplementation is to normalise the plasma potassium level. Depending on potassium levels, ECG abnormalities, and muscle strength, oral potassium supplementation (0.2-0.4mmol/kg) every 15 to 30 minutes is the initial treatment for acute bouts of FPP.

In cases where patients are vomiting or unable to swallow, intravenous therapy is required. A wide range of medications, including acetazolamide (125–1000 mg/day), spiranolactone (25–100 mg/day), and triamterine (25–100 mg/day), have been effective in the prevention of repeated episodes(10).

According to a research by Lin et al., patients with TPP who received intravenous potassium chloride supplementation at a rate of 10meq/h had an average recovery time that was two times shorter than that of controls. However, in 70% of patients receiving potassium chloride treatment, rebound hyperkalemia developed. Rarely did patients who received 50 mmols or fewer suffer hyperkalemia. Low doses seem to be effective while also significantly lowering the risk of hyperkalemia.

Propranolol 3–4 mg/kg orally seemed to be effective without resulting in rebound hyperkalemia.

By inhibiting the activity of the Na+, k+-ATPasepump(11), propranolol successfully prevents recurring episodes. Because potassium levels are normal during the interattack period, regular potassium chloride supplementation is ineffective.Acetazolamide will not be taken because it can cause TPP attacks to repeat often.

Management of Hypokalemia secondary to potassium loss

Any loss of potassium, whether renal or non-renal, must be replaced, underlying cause must also be treated, to stop further loss.and the Every 15 to 30 minutes, depending on potassium levels, ECG abnormalities, and muscle strength, administer oral potassium supplements (0.2–0.4 mmol/kg).

In cases where patients are vomiting or unable to swallow, intravenous therapy is required. A wide range of medications, including acetazolamide (125–1000 mg/day), spiranolactone (25–100 mg/day), and triamterine (25–100 mg/day), have been effective in the prevention of repeated episodes.(7)

Treatment of Proximal RTA

To avoid development retardation, children should receive treatment. Because bicarbonate is quickly eliminated in urine, alkali must be given in high doses daily, 5 to 15 mmol/kg/day. To lower the quantity of bicarbonate needed, a thiazide diuretic might be combined with minimal salt. As a result of increased renal potassium loss from bicarbonaturia(12), potassium needs rise during alkali treatment. Because adults rarely have systemic metabolic problems or bone disease, they are typically not treated as aggressively as children when they have proximal RTA.

Treatment of Distal RTA

Alkali solution and potassium supplementation are used to treat distal RTA. To maintain the bicarbonate level above 18mEq/L, the dose ranges from 0.5 to 2 mmol/kg/day. Shohl'ssolution(12) or sodium bicarbonate are two common forms of alkali supplementation. In 1000ml of distilled water, 98 grammes of hydrated sodium citrate and 140 grammes of citric acid are dissolved. If hypokalemia correction is necessary, potassium citrate may be used instead of sodium citrate. In addition to correcting acidosis, calcium and vitamin D are essential components of therapy for patients with osteomalacia**.**

Treatment of Bartter syndrome

Two key components make up the therapeutic care of Bartter syndrome: Replacement therapy and pharmacological use are the two main facets of the therapeutic care of Bartter syndrome, respectively.

Salt and potassium should be consumed in large quantities. It is typically necessary to take potassium supplements. In individuals with prenatal Bartter's syndrome in particular, nonsteroidal anti-inflammatory medications (NSAIDs) are helpful because they lower prostaglandin production. For all forms, indomethacin (1 to 3 mg/kg every 24 hours) (13) or ibuprofen are frequently used, and the first reaction is good in all types, while prenatal Bartter responds better**.**

Patients who experience periods of dehydration, electrolyte imbalance, or concurrent illness may pass away if they are not treated. With the right therapy, the majority of kids experience clinical improvements and catch-up growth; pubertal and mental development are typically typical. The necessity for counselling is

ongoing. Renal function may gradually deteriorate as a result of chronic tubulointerstitial nephropathy brought on by ongoing hypokalemia, hypercalciuria, and nephrocalcinosis.(14)

Treatment of Gitelman's syndrome

Gitelman's syndrome is mostly treated with replacement therapy, which necessitates lifelong magnesium supplementation. By partially reversing hypomagnesaemia, magnesium administration in the form of MgCl2 both delays the onset of tetany and makes up for continued kidney chloride losses. The renin-angiotensin axis, urinary Ca excretion, and acid-base state are all fixed. In some cases, potassium salts and/or anti-aldosterone medications like spironolactone or amiloride may be needed to treat hypokalemia.(15)

Treatment of Liddle's syndrome

Restriction of salt intake and K+ supplements make up the treatment. Triamterene directly blocks the apical Na+ channels, increasing the excretion of Na+ and K+ in the urine and lowering blood pressure. Blood pressure and K+ levels are both returned to normal by amiloride. The majority of patients still experience growth retardation, nevertheless. There is a need for lifetime therapy because the pathogenetic condition cannot be improved with aging.(16)

PREVENTION OF ATTACK:

In the management of hypokalemic periodic paralysis, diet has not gotten as much attention. An increased focus on food is highly justified given its potential to minimise the frequency of paralytic bouts, as well as its potential to delay or prevent irreversible muscle paralysis and, in certain cases, reduce the need for medication. The secret to dietary management of these illnesses may turn out to be dietary fat. One frequently forgets that dietary fat is crucial for maintaining health because of all the negative emphasis on fat and cholesterol consumption. The fact that eating fat slows stomach emptying is a crucial aspect that is sometimes disregarded. Meals with more fat reduce the speed at which other food components are transported from the stomach to the small intestine, which reduces the chance that a meal would suddenly release all of its carbs into the blood.

The digestion and absorption of simple sugar and even carbohydrates without the presence of fat is quick. The main triggers for insulin secretion are carbohydrates and the byproducts of protein digestion. Both of these triggers increase the amount of insulin that is released into the bloodstream.An essential factor in energy metabolism and nutritional management of channelopathies such hypokalemic periodic paralysis is insulin balance.Research has linked the aetiology of hypokalemic periodic paralysis to ATP-sensitive potassium channels, and carbohydrate loading is a well-known trigger for paralytic attacks in periodic paralysis.

A low-sodium diet (160 meq/day) and avoiding large meals are some of the additional dietary precautions. The patient should stay away from the cold as well because it will lessen the frequency of assaults.

GENETIC COUNSELLING:

The inherited form of hypokalemic periodic paralysis is autosomal dominant. The majority of people with hypokalemic periodic paralysis have a parent who is affected. Unknown is the percentage of instances brought on by a denova gene mutation. A proband's children have a 50% chance of inheriting the mutation. Depending on the causal mutation, penetration in females can be as low as 50% and is typically over 90% in males. Requests for prenatal testing for illnesses like hypokalemic periodic paralysis that don't impact the intellect and have some treatment are not advised, even if the disease-causing mutation has been found in the Prohand.

PRE OR POST OPERATIVE PARALYSIS

Precautions should be made while administering anaesthetic to people who have hypokalemic periodic paralysis due to the possibility of paralysis occurring before or after the anesthesia. These individuals should be treated with non-triggering anaesthetic techniques because they are prone to malignant hyperthermia.
General recommendations for perioperative care include close control of plasma potassium concentration, avoiding high salt and glucose loads, eating a diet low in carbohydrates, maintaining body temperature, maintaining acid-base balance, and using neuromuscular blocking agents with caution while continuously monitoring neuromuscular function

MATERIALS AND METHODS

Study population

Patients admitted in medical and general wards of chengalpattu medical college And hospital,chengalpattu, from january 2021 to december 2022.with acute onset of flaccid weakness and documented serum potassium of < 3.5mEq/l during the episode were included in the study. Patients with renal failure(serum creatinine>1.5 mg/dl) were excluded

STUDY DESIGN: prospective observational study

SAMPLE SIZE : 51

Period of study: January 2021 to December 2022

Evaluation

Clinical data collected included age, gender, ethnic origin, history of symptom evolution, triggering variables such as high carbohydrate intake in the previous 24 hours, alcohol usage, and treatment received. Any family history of similar disease was investigated, and reports of weakness, thyroid disease, diarrhoea, vomiting, hypertension, bone pain, fractures, dry mouth, dry eyes, and renal disease were documented. The use of diuretics, 2 agonists, decongestants, insulin, laxatives, and antipsychotics was observed. Caffeine and herbal medication use were restricted. Anthropometry, pulse, blood pressure, anaemia, and thyroid status were all tested. A thorough neurological examination was carried out. Schirmer's test was performed on a subset of patients.

PARAMETERS CONSIDERED FOR ANALYSIS WERE

1. Age
2. Sex
3. Past history of similar episode / episodes
4. Family history of similar episodes
5. Precipitating factor if any
6. Serum potassium level on admission
7. Electrocardiographic changes
8. Treatment
9. Outcome

CLINICAL PROFILE OF HYPOKALEMIC PERIODIC PARALYSIS

Name: Age: Sex: IP No:

DOA : DOD:

CLINICAL CONTRIBUTORS

Mode of onset of weakness:

whether paraplegia or quadriplegia :

Ascending / Descending paralysis:

Time of onset of weakness:

Symmetric involvement :

Associated cranial nerve involvement:

Sensory system involvement:

Symptoms of autonomic system involvement :

Respiratory muscle dysfunction :

Precipitating factors:

Prodromal symptoms:

History of diarrhea , vomiting

History of drug intake:

History of Diabetes, kidney disease:

History of thyroid disease:

Past history of similar episodes:
Number of episodes:
onset of first episodes:

Family history of similar episode:

CLINICAL EXAMINATION:

Whether Paraparesis / plegia:

Quadriparesis / plegia:

Cranial nerve involvement:

Involvement of neck muscle:

Reflexes :

Single breath count:

Evidence of myotonia :

LAB DATA
HB%

TC

DC

ESR

Renal function test.

Blood sugar

Urea

Sr. creatinine

Electrolytes

ABG

Urine analysis – Sodium

Potassium

ECG in all leads

CXR PA view

Echocardiogram

USG – Abdomen

Thyroid function test

Serum CPK

THERAPEUTIC CONTRIBUTORS:

Pottasium supplementation
- Oral
- Intravenous
- Others

Recovery time.

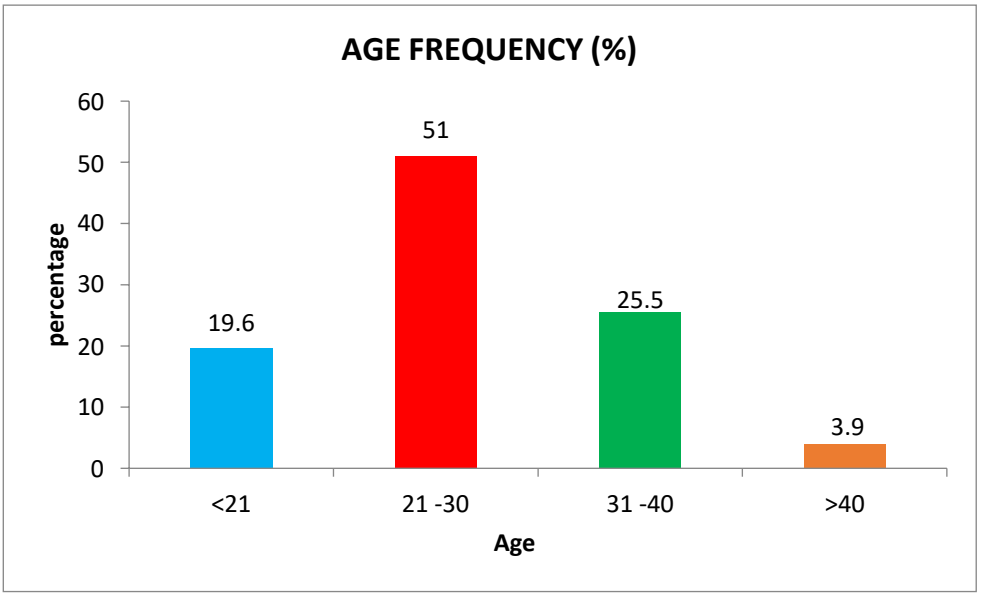
Mortality

RESULTS AND OBSERVATION

AGE FREQUENCY

AGE	FREQUENCY	PERCENTAGE
<21	10	19.6
21 -30	26	51
31 -40	13	25.5
>40	2	3.9
TOTAL	51	100.0

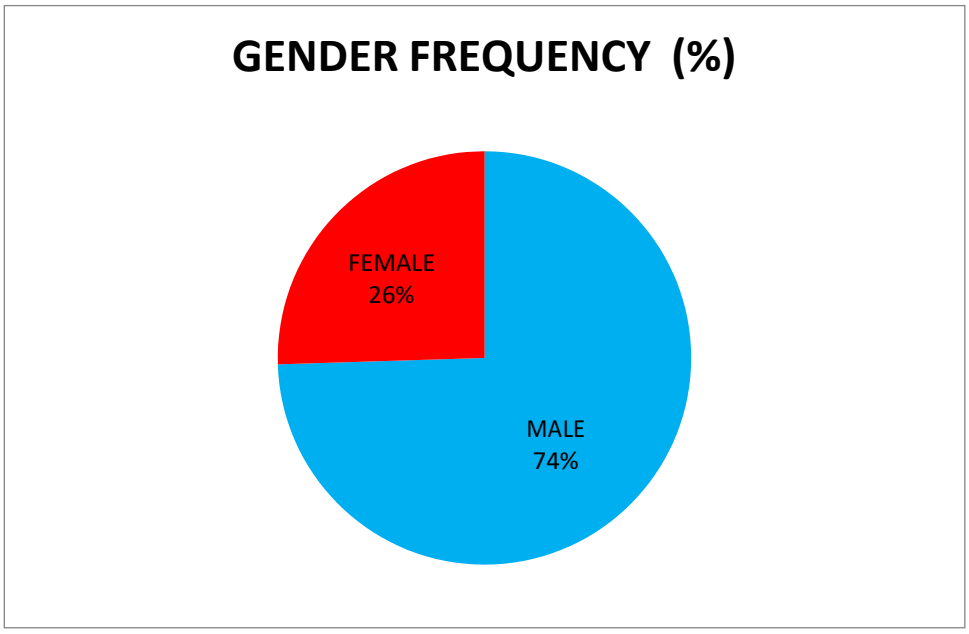
Around 50% cases were in their 3rd decades 25% of cases were in their 2nd decade



GENDER FREQUENCY

GENDER	FREQUENCY	PERCENTAGE
MALE	38	74.5
FEMALE	13	25.5
TOTAL	51	100.0

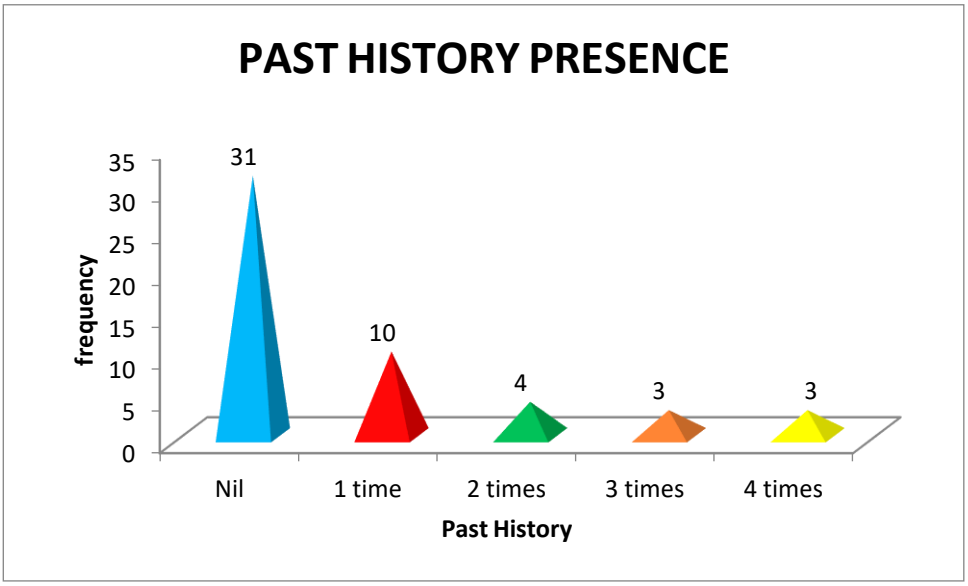
Ratio :M : F =3:1



PAST HISTORY

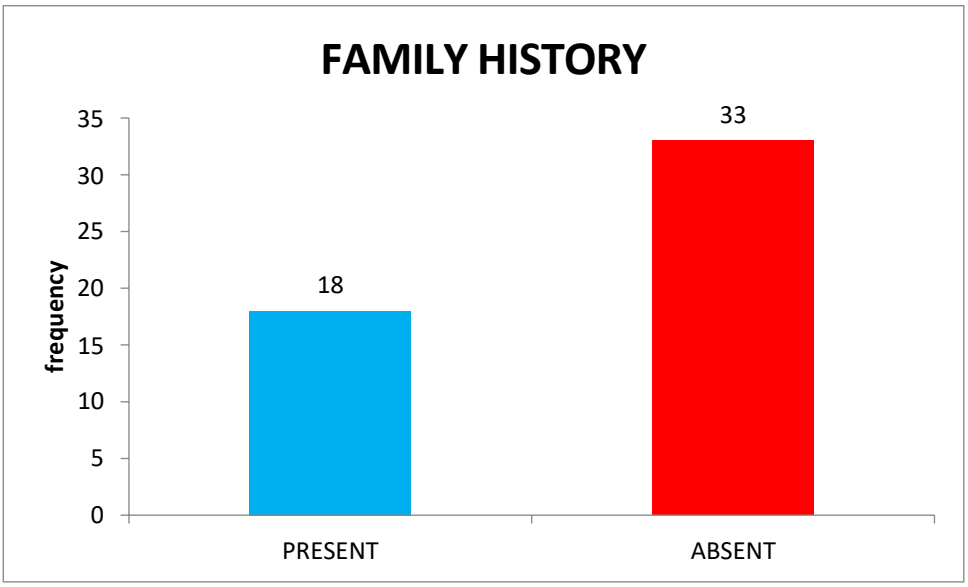
PAST HISTORY	FREQUENCY	PERCENTAGE
Nil	31	60.7
1 time	10	19.6
2 times	4	7.9
3 times	3	5.9
4 times	3	5.9
TOTAL	51	100.0

About 40% of the cases were found to have suffered similar attacks in the past.



FAMILY HISTORY

FAMILY HISTORY	FREQUENCY	PERCENTAGE
PRESENT	18	35.3
ABSENT	33	64.7
TOTAL	51	100.0

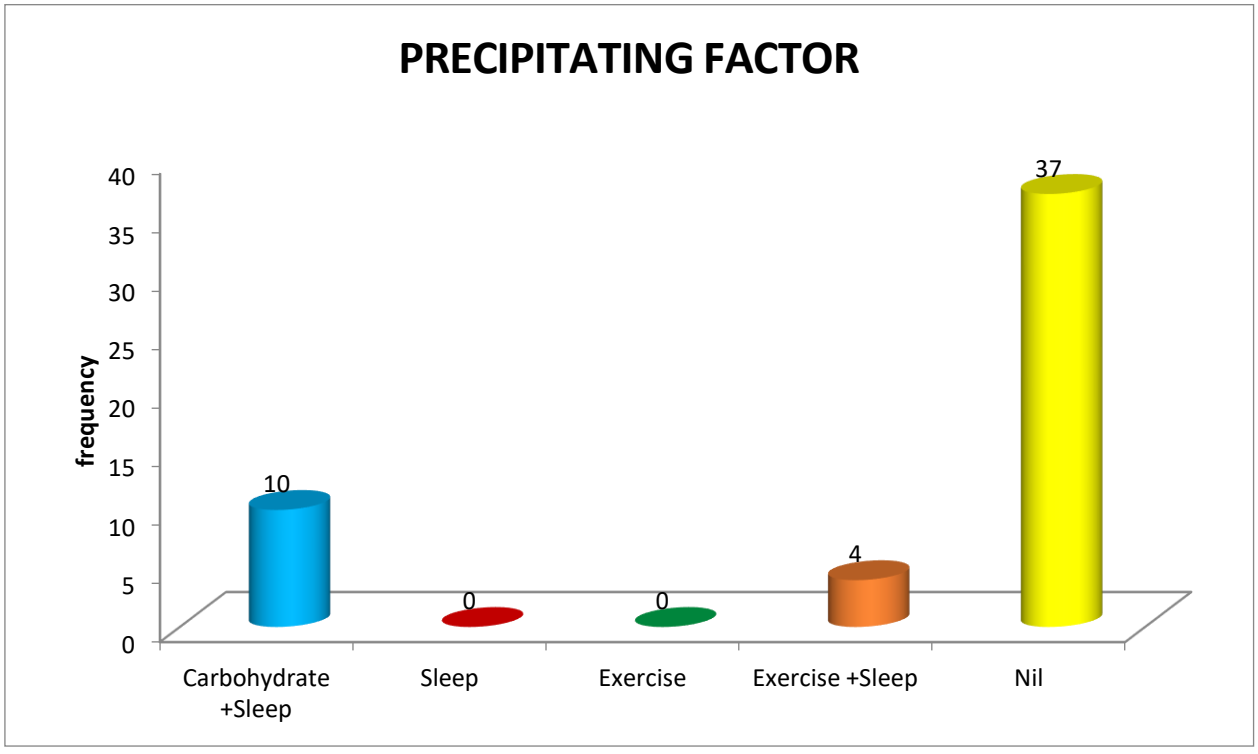


About 35% of the total number of patients had first degree relatives with similar problem.

PRECIPITATING FACTOR

PRECIPITATING FACTOR	FREQUENCY	PERCENTAGE
Carbohydrate +Sleep	10	19.6
Sleep	-	-
Exercise	-	-
Exercise +Sleep	4	7.9
Nil	37	72.5
Total	51	100.0

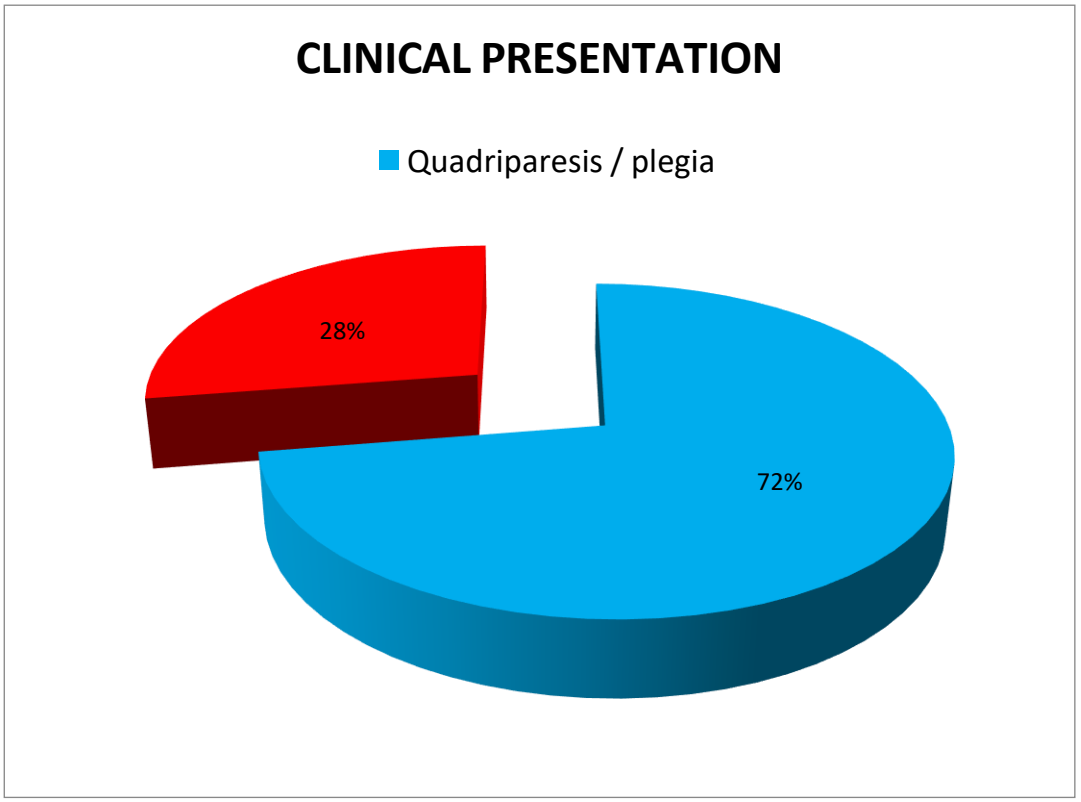
Good carbohydrate diet followed by sleep was found to be the risk factor in many patients.



CLINICAL FEATURES

CLINICAL FEATURES	FREQUENCY	PERCENTAGE
Quadriparesis / plegia	37	72.5
Paraparesis /plegia	14	27.5
Total	51	100.0

About 72% of the patients had presented with Quadriparesis / plegia



POTASSIUM LEVEL IN SERUM

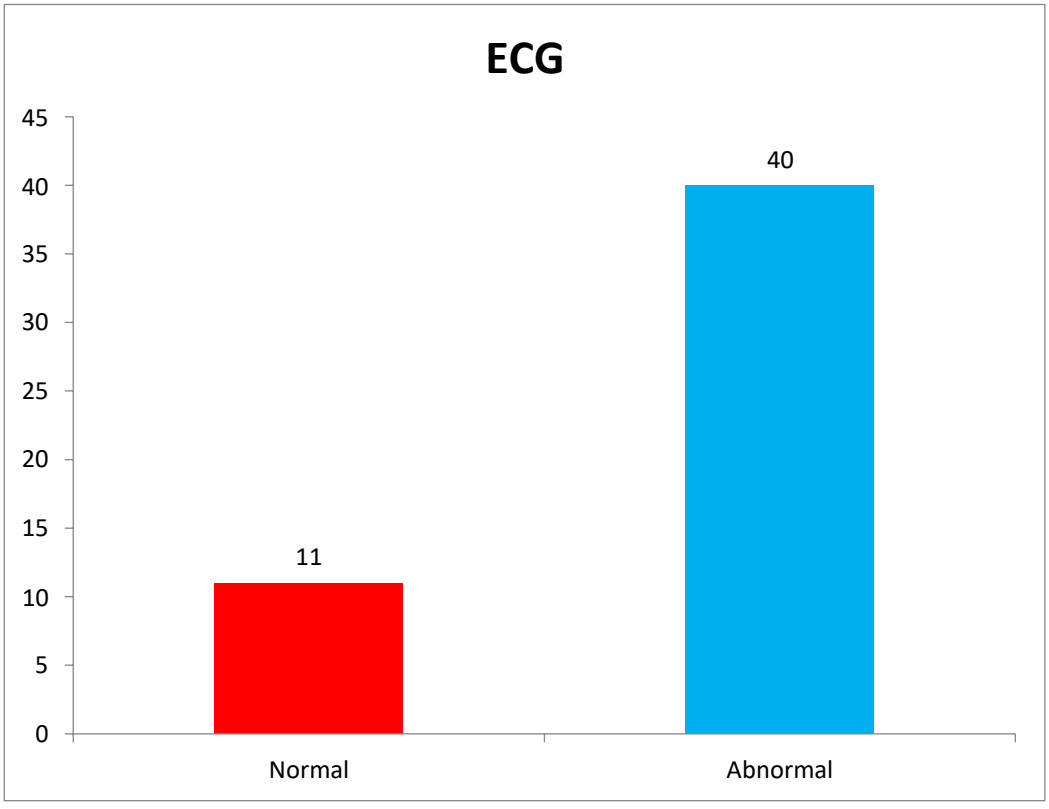
POTASSIUM LEVEL IN SERUM meq/L	FREQUENCY	PERCENTAGE
1 - 2	6	11.8
2.1 – 3.0	28	54.9
3.1 – 3.5	12	23.5
3.6 – 4.0	4	7.8
>4	1	2.0
TOTAL	51	100.0

Maximum number of patients had serum potassium levels between 2-3 meq/L

ECG

ECG	FREQUENCY	PERCENTAGE
Normal	11	21.6
Hypokalemia changes	40	78.4
TOTAL	51	100.0

11 Patients had normal ECG despite of weakness.



TREATMENT

TREATMENT	FREQUENCY	PERCENTAGE
Oral KCL	42	82.4
Oral KCL + IV KCL	7	13.7
Oral KCL + Acetazolamide	2	3.9
TOTAL	51	100.0

Despite the use of various treatment methods, oral potassium chloride alone was used to treat nearly 82% of patients.

RELEVANCE OF CLINICAL MANIFESTATIONS WITH POTASSIUM LEVELS

CLINICAL	POTASSIUM meq/L					TOTAL
	1- 2	2.1 -3.0	3.1 – 3.5	3.6 – 4.0	>4	
Quadriparesis	4 7.8%	20 39.2%	10 19.6%	2 3.9%	1 2.0%	37 72.5%
Paraparesis	2 3.9%	8 15.7%	2 3.9%	2 3.9%	-	14 27.5%
TOTAL	6 11.8%	28 54.9%	12 23.5%	4 7.8%	1 2.0%	51 100.0%

p- value = 0.695

not significant

RELEVANCE OF POTASSIUM LEVEL AND ECG

ECG	POTASSIUM meq/L					TOTAL
	1- 2	2.1 -3.0	3.1 – 3.5	3.6 – 4.0	>4	
Normal	-	5 9.8%	3 5.9%	3 5.9%	-	11 21.6%
Hypokalemia changes	6 11.8%	23 45.1%	9 17.6%	1 2.0%	1 2.0%	40 78.4%
TOTAL	6 11.8%	28 54.9%	12 23.5%	4 7.8%	1 2.0%	51 100.0%

p- value = 0.061

not significant

AGE BY GENDER

AGE (yrs)	MALE	FEMALE	TOTAL
<21	8 15.7%	2 3.9%	10 19.6%
21 – 30	19 37.3%	7 13.7%	26 51.0%
31 – 40	10 19.6%	3 5.9%	13 25.5%
>40	1 2.0%	1 2.0%	2 3.9%
TOTAL	38 74.5%	13 25.5%	51 100.0%

TREATMENT BY POTASSIUM LEVELS

TREATMENT	POTASSIUM meq/L					TOTAL
	1- 2	2.1 -3.0	3.1 – 3.5	3.6 – 4.0	>4	
Oral KCL	1 2.0%	24 47.1%	12 23.5%	4 7.8%	1 2.0%	42 82.4%
Oral KCL + IV KCL	5 9.8%	2 3.9%	-	-	-	7 13.7%
Oral KCL + Acetazolamide	-	2 3.9%	-	-	-	2 3.9%
TOTAL	6 11.8%	28 54.9%	12 23.5%	4 7.8%	1 2.0%	51 100.0%

p- value = <0.001 significant

DISCUSSION

According to the literature, the age at which hypokalemic periodic paralysis manifests itself is frequently in the second decade (17). However, the most common age group in this study is in their third decade. The following is presentation in their second decade, and less frequently in their fourth decade. After the fourth decade, the disease becomes less common. Only one patient in this study presented with symptoms of hypokalemic periodic paralysis after the fourth decade, despite the fact that cases have been reported in the seventh decade as well, as evidenced by a case report published by Decaux O, Poinsingnon Y, Rosenbaum D, Sternberg B, DouissiereJardel J.

This variation may be due to the fact that children under the age of 14 are referred to the Institute of Child Health in Chengalpattu, and that the frequency of attacks decreases with age, and that the majority of these patients have a history of similar episodes that they ignored or treated elsewhere. This could limit the study of age-adjusted data using literatures. As a result, evaluating the prior history of a similar problem is critical.Malesare more typically affected than females, with around three males impacted for every female case. This is due to the fact that penetrance (18) is thought to be mild in females, as supported by a study by Kawamura S,Ikeda Y, Tomita K. Watanabe N,Sekik.Another important consideration is that females may have a very mild condition, and hence the signs are not always visible.The majority of the patients have first-degree relatives who have experienced comparable events. In my study, almost 35% of the individuals (19) had a family history of such incidents.

DesilvaHJ,Senanayake N conducted a research in which 40% of patients had a family history of hypokalemic periodic paralysis.

As previously stated, these patients may experience recurring periods of flaccid weakness. The patient will be completely normal in between attacks. Although the exact elements that govern the frequency of attacks are unknown, certain situations can cause acute episodes in specific patients

A high carbohydrate diet followed by a good night's sleep are common triggering factors. The less usual presentation has been that the patient goes to bed after a long day and a large dinner. When he wakes up in the morning, he is unable to move either his lower limbs or both upper and lower limbs. As a result, these patients should avoid large meals in favour of frequent modest ones. Despite what has been described in the literature, no patient in our study group experienced weakness during or shortly after exercise.

Regarding clinical presentation, a large number of these patients showed flaccid quadriparesis or plegia. Some of the patients exhibited flaccid paraplegia or paresis when they first arrived. The majority of the patient had plantar reflexes that could not be elicited and depressed tendon reflexes. No patient has ever experienced sensory sensations related to the bladder or the bowel.

Every patient's illness was different in length, but most needed between 12 and 24 hours to recover. Only two patients experienced flaccid weakness for 48 hours.

The majority of patients had weak muscles in their necks. However, none of the patients experienced issues breathing or swallowing. In addition, none of the patients experienced any cranial nerve issues.

A low potassium level during the episodes supports the diagnosis of hypokalemic periodic paralysis. Ninety percent of the 51 individuals had low serum potassium levels. It has been noted that patients have experienced paresis attacks even when their serum potassium levels are below normal.

Most of the cases in our case study had serum potassium levels between 2 and 3 meq/L, although few patients had levels between 1 and 2 meq/L.

In 78% of the patients, hypokalemic periodic paralysis was detected on the electrocardiogram(20). T wave absence and pronounced U wave appearance were the most frequent findings. The ST segment was depressed in some of the patients. Despite having low serum potassium levels, electrocardiograms were normal in 22% of individuals. Therefore, one should be aware that the ECG and serum potassium levels are not always correlated.

According to my research, there is no connection between the level of serum potassium and the severity of the attack. Additionally, there is no connection between the initial serum potassium levels and the length of the weakness.

None of the patients had any prior surgical experience. The attending surgeon and anaesthetist should be made aware of the patient's elevated risk of developing malignant hyperthermia, a potentially fatal anesthesia-related complication. Additionally, the patients received this counselling.

According to the study, several therapy strategies have been employed by various clinicians. No one protocol has been adhered to. The most popular form of treatment has been oral potassium chloride or a mix of potassium chloride and acetazolamide. K+Cl has been administered intravenously to 7 people.

All patients are advised to consume a lot of orange juice and tender coconut, which is said to have a potassium content of 70 meq/L.

Any presentation's outcome has generally been positive.

However, a different period of time was needed for full recovery. This would result from three things.

1. Absence of any particular protocol for treatment to be followed.
2. The potassium level at the time of presentation
3. The genetic variations.

However, it is critical to treat hypokalemia as soon as possible, or else the patient may develop complications.

1. cardiac arrhythmias
2. Respiratory paralysis
3. Muscle fiber can suffer damage leading ultimately to progressive muscle weakness.

CONCLUSION

ON HYPOKALEMIC PERIODIC PARALYSIS

- Incidence ratio M: F = 3:1
- 40% have had similar attacks in the past
- Flaccid quadriparesis was the most common mode of presentation
- About 37% of the patient had first degree relative with similar attacks
- Most of the patient had serum potassium level between 2 to 3 meq/L
- ECG abnormalities was observed in 80% of the patients
- Most of these patients were treated with oral potassium chloride alone
- Outcome was good in all patients

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MASTER CHART

S.NO	NAME	AGE	SEX	IP NO	PAST HISTORY	FAMILY HISTORY	PRICIPITATING FACTOR	CLINICAL PRESENTATION		SERUM POTASSIUM LEVEL	T3 (nmol/l)	T4 (nmol/l)	TSH mIU/l	ECG	Treatment		OUTCOME
								quadriparesis	paraparesis						Oral KCl	Others	
1	Dhayalan	30	M	1357995	+	-	-	+	-	2.3	78	4.2	4.8	+	+	*acetazolamide*	Recovery
2	Prakash	27	M	204521	-	+	+	+	-	2.5	96	3.5	3.2	+	+		Recovery
3	Silamburasan	24	M	1376849	-	-	-	+	-	3.5	102	5.6	4.2	+	+		Recovery
4	Murugannanthan	20	M	20309	+	+	-	+	-	2.1	85	4.3	3.3	+	+		Recovery
5	Purushothaman	36	M	1350541	+	-	-	-	+	2.4	102	5.6	3.6	+	+		Recovery
6	Masilamani	35	M	1375786	+	+	-	+	-	2.4	86	4.1	4.2	+	+		Recovery
7	Methaji	24	M	1350774	-	-	+	+	-	2.3	75	4	4.4	+	+	IV KCL	Recovery
8	Dilli	20	M	1366522	-	-	-	+	-	2.8	75	4	3	+	+		Recovery
9	Kanniyappan	28	M	20498	+	+	-	+	-	3.4	78	5.2	3.4	+	+		Recovery
10	Ezumalai	18	M	1381642	+	-	-	+	-	2.6	82	5.6	4.4	+	+		Recovery
11	Ravi	30	M	20419	+	-	+	+	-	2	95	5.3	4.1	+	+	IV KCL	Recovery
12	Balu	21	M	1369201	-	-	+	-	+	3.8	82	7.2	4.6	+	+		Recovery
13	vijay	14	M	1372189	-	+	+	-	+	2.7	96	5.2	3.8	+	+		Recovery
14	Pazhani	25	M	20752	-	-	-	+	-	2.9	89	3.9	4.4	-	+		Recovery
15	Tamilvendhan	35	M	1359439	+	-	-	-	+	2.2	78	4	4	+	+	*acetazolamide*	Recovery
16	jayakumar	16	M	20476	-	+	+	+	-	2	112	5.8	3.2	+	+	IV KCL	Recovery
17	Mohan	25	M	1377436	+	+	-	+	-	2.2	78	5.2	4	+	+		Recovery
18	Velumalai	30	M	1376104	-	-	-	-	+	2.4	96	4.5	4.6	-	+		Recovery
19	Santhosh	33	M	1366262	-	-	-	-	+	3.6	98	5.2	4	-	+		Recovery
20	Soloman	30	M	1376688	-	+	-	+	-	3.2	89	5.6	3.8	+	+		Recovery
21	Nadhiya	28	F	1357865	+	-	-	+	-	2.3	79	7	3.3	+	+		Recovery
22	jayakumari	37	F	1377278	+	-	+	+	-	2.7	88	5.6	5	+	+		Recovery

23	Shalini	22	F	1379421	+	-	-	+	-	2.2	96	4.5	4.4	+	+	IV KCL	Recovery
24	Laxmi	28	F	137701 2	-	+	-	+	-	3.4	95	3.8	4	+	+		Recovery
25	Saraswathi	36	F	136867 2	+	-	-	-	+	2.3	82	4	3.8	+	+		Recovery
26	Chellamal	28	F	130425 4	-	+	-	+	-	3.4	95	3.8	4	+	+		Recovery
27	Priyadharshini	36	F	20942	+	-	-	-	+	2.3	82	4	3.8	+	+		Recovery
28	Gomathi	20	F	135520 1	-	-	-	+	-	1.8	89	5.4	3.5	+	+	IV KCL	Recovery
29	Shanthi	22	F	138852 0	-	+	-	+	-	3.1	102	5.6	3.8	+	+		Recovery
30	Malathi	35	F	136866 0	+	-	+	+	-	3.2	96	7.5	4	-	+		Recovery
31	Jennisree	28	F	21847	-	-	+	-	+	2.3	85	6	3.1	+	+		Recovery
32	Bhavani	41	F	132045 1	+	-	-	+	-	1.8	103	4.2	4	+	+	IV KCL	Recovery
33	Valli	28	F	137150 1	-	-	+	-	+	3.4	84	5.4	4.2	-	+		Recovery
34	Koteshwaran	28	M	136038 0	-	-	-	+	-	3.9	85	5.2	3.8	-	+		Recovery
35	Shankar	25	M	136727 8	-	+	-	+	-	4.1	98	3.9	4.4	+	+		Recovery
36	Kumaran	20	M	136686 6	20	+	-	+	-	3.5	81	4	4	+	+		Recovery
37	Raji	22	M	130612 0	-	-	-	+	-	3.6	78	5.8	3.2	-	+		Recovery
38	Armugam	30	M	136919 8	+	+	-	+	-	2.4	92	5.2	4	+	+		Recovery
39	Vijay	30	M	137018 7	+	-	-	+	-	2.2	88	4.5	4.6	+	+		Recovery
40	Jagadheshan	21	M	136809 9	-	+	+	+	-	2.7	101	5.2	4	-	+		Recovery
41	Subramani	27	M	136911 8	-	-	-	-	+	1.9	80	5.6	3.8	+	+		Recovery
42	Elumalai	29	M	137106 0	-	-	-	+	-	3.4	92	7	3.3	+	+		Recovery
43	Saravanan	32	M	135888 2	-	-	-	+	-	2.2	85	5.6	5	+	+		Recovery
44	Dhanushkuma r	38	M	127592 5	+	-	-	-	+	3	90	4.5	4.4	-	+		Recovery
45	Perumal	32	M	135753 4	-	-	+	+	-	2.8	101	3.8	4	+	+		Recovery
46	Dass	26	M	134819 0	-	+	+	+	-	3.4	96	4	3.8	-	+		Recovery

47	Chandran	43	M	1302951	+	-	+	-	+	2.6	87	5.6	4	+	+		Recovery
48	Kanagaraj	36	M	1267440	-	+	-	-	+	1.9	92	4.8	4.3	+	+	IV KCL	Recovery
49	Rajesh	29	M	1277964	+	-	-	+	-	3	86	5	3.9	+	+		Recovery
50	Suresh	36	M	1396761	-	-	-	+	-	2.8	79	4.2	4.2	+	+		Recovery
51	Kannan	35	M	1361580	-	+	-	+	-	3.1	83	5	4.5	+	+		Recovery