

## Movable-Weaning off an Electrocardiographic Phenomenon in Hypocalcemia (Changeable Phenomenon or Yasser's Phenomenon of Hypocalcemia)-Retrospective-Observational Study

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**Keywords:** *Movable-Weaning off an Electrocardiographic Phenomenon; Yasser's Phenomenon of Hypocalcemia; Changeable Phenomenon Hypocalcemia; Tetany*

### Abstract

#### Background

Hypocalcemia is a famous serious electrolyte disorder characterized by calcium deficiency. It is recently associated with specific electrocardiographic changes such as both wavy triple and double electrocardiographic signs (Yasser signs).

#### Method of Study and Patients

The study was observational and retrospective for 43 cases. The study was carried out at Fraskour central hospital and the physician outpatient clinic. The author reported the 43-cases thorough nearly 24-months, started from December 3, 2018, and, ended on October 29, 2020. Wavy triple sign or Yasser sign of hypocalcemia was the target. Manifested or latent tetanies were fundamental cases. Intravenous and oral calcium was used.

## Results

The age Mean was: 36.4 years, with the dominant female sex (67.44%). The main presentations in the study were carpopedal spasm (55.81%) vs. Parathesia and tingling (44.19%). Hyperventilation syndrome (60.47%) and malnutrition (9.3%) are the most frequent risk factors. Manifested tetany was the most common diagnosis (55.81). The patterns of Movable phenomenon were: regressive (30.23%), weaning-off (20.93%), progressive (13.95%), changeable (13.95%), variable: 4.56%, reversed (4.56%), regressive characteristic (2.33%), unknown (2.33%), reversed with progression (2.33%) changeable with regression, (2.33%), and intermittent with regression (2.33%).

## Conclusions

Movable-weaning off an electrocardiographic phenomenon in hypocalcemia (changeable phenomenon or Yasser's phenomenon of hypocalcemia) is defined according to the author's opinion in the study as a novel electrocardiographic phenomenon characterized by serial dynamic changes in present in all cases of either Wavy triple or double electrocardiographic signs (Yasser signs) of hypocalcemia. Movable-weaning off an electrocardiographic phenomenon is a guide for both Wavy triple or double electrocardiographic signs (Yasser signs) of hypocalcemia. Don't angry if the staring electrocardiography or the last one was normal.

## Abbreviations

ABG:	Arterial blood gases
Ca <sup>++</sup> :	Calcium
ECG:	Electrocardiographic
ED:	Emergency Department
IC:	Intracellular
ICU:	Intensive care unit
IV; IV:	Intravenous
HF:	Heart failure
POC:	Physician outpatient clinic
RBS:	Random blood sugar
SR:	Sarcoplasmic reticulum

## Introduction

### Historical Bit and Hypocalcemic Definition

The term of the latent type was elicited in the medical research in 1945 [1,2]. Hypocalcemia is a common biological and clinical disease. It is a more broad variable in severity; starting from being asymptomatic presentation in the mild cases extending to an acute fatal crisis in the most severe cases [3,4].

## Calcium and Its Metabolic Role

Calcium ( $\text{Ca}^{++}$ ) plays a vital structural role in the integration of myocardial function, cardiac output, and vascular tone [5]. Calcium carries essential in the cellular mechanisms of myocardial contraction [3,6]. Calcium is a vital ion in many biochemical cycles such as cardiac automaticity; excitation with contraction coupling in myocardial, smooth, and skeletal muscle; blood coagulation; neural conductivity; synaptic propagation; hormone production, and mitosis. Calcium is considered the main intracellular (IC) messenger needed for standard cellular activity and several enzymatic functions [7]. Calcium poses a pivotal effect in tissues and organ injury in cases of ischemia, hypoxia, reperfusion, and toxic cell death [5]. Contraction of smooth-muscles is linked to vibration in the IC  $\text{Ca}^{++}$  level [7]. Serum  $\text{Ca}^{++}$  level is commonly organized within a narrow range (2.1 to 2.6mmol/L). Parathyroid hormone (PTH), vitamin D, and calcitonin are considered calcium-regulating hormones. These metabolic pathways essentially occur in the bowel, kidneys, and skeleton [8,9]. Approximately half of the total serum  $\text{Ca}^{++}$  is protein-bound but and the remaining half is free ionized calcium which is physiologically active [9]. So, serum calcium levels are usually corrected on consideration of the albumin level [8].

## The Ionized Calcium

The ionized  $\text{Ca}^{++}$  is the vital physiological component that essentially indicates tight monitoring to assess physiologically active calcium levels [5]. Total  $\text{Ca}^{++}$  in serum is ranged from 8.8 to 10.4mg/dl. Free ions,  $\text{Ca}^{++}$  bound to albumin, and diffusible complexes are the main components. The concentration of free calcium ions (4.8mg/dl) commonly affects several cellular processes. It is under closed hormonal control, especially via PTH. In a patient with hypocalcemia, the serum albumin is necessary for the assessment of actual hypocalcemia in the opposite of “factitious” hypocalcemia which is only associated with decreased the total  $\text{Ca}^{++}$  [10]. Ionized  $\text{Ca}^{++}$  poses a critical function in organizing myocardial contractility. On the occurrence of the cardiac action potential, ionized  $\text{Ca}^{++}$  enter IC via depolarization exciting  $\text{Ca}^{++}$  channels. An IC ionized  $\text{Ca}^{++}$  activates calcium output from the sarcoplasmic reticulum (SR). Calcium combined with the myofilaments proteins molecules especially, troponin C which is a trigger for the contraction of myocardium [6,11]. The plasma ionized  $\text{Ca}^{++}$  concentration is preferably maintained in a narrow range ( $1.0 \pm 1.25\text{mmol}$ ). This is happening despite a wide variation in the intestine and bony  $\text{Ca}^{++}$  input. Maintenance of this range is essentially achieved by the action of three calciotropic hormones: parathyroid hormone, calcitriol, and calcitonin [7]. Lethal hypocalcemic consequences commonly happen if the serum ionized  $\text{Ca}^{++}$  concentration diminishes to below 2mg/d [7]. A bad prognosis was frequently recorded with ionized hypocalcemia [5]. A significant improvement in cardiac output was observed after calcium administration in the patients of severe ionized hypocalcemia (>30% decrease) [5].

## Etiology of Hypocalcemia

Hypoparathyroidism, vitamin D, and albumin deficiency are the most common involved causes of hypocalcemia [4,12]. Others causes include: End-stage renal disease or end-stage hepatic disease, pseudo hypoparathyroidism or pseudopseudo hypoparathyroidism, metastatic or heavy metals e.g.,  $\text{Cu}^{++}$  and  $\text{Fe}^{++}$ , parathyroid gland carcinoma, eating disorders, magnesium changes, sclerotic bony metastases, hungry bone syndrome, after parathyroidectomy, phosphate IV infusion, citrated massive blood transfusions, severe critical

disorders, Fanconi syndrome, after exposure of parathyroid glands to radiation, renal failure, pancreatitis, calcium antagonists toxicity, rhabdomyolysis, tumor lysis syndrome, nutritional deficiency [3,4,12,13], drug-induced such as cinacalcet [14], 5-fluorouracil (5-FU) with leucovorin [15], high-dose of IV zoledronic acid [4,5,13,16], acid phenobarbital [17], phenytoin [17], denosumab [18], fosfocarnet [12], and Na<sup>+</sup> phosphate preparations [19,20]. Falsely decreasing levels of CA<sup>++</sup> due to albumin deficiency should be excluded by serial monitoring of ionized CA<sup>++</sup> [7]. Decreasing levels of ionized CA<sup>++</sup> commonly happens in sepsis, pancreatitis, magnesium deficiency, post-massive transfusions, post-neck operations, post-cession of cardiopulmonary bypass in cardiovascular surgery, and after starting of extracorporeal membrane oxygenation (ECMO) [5]. The symptoms are usually consistent with the proportion and promptness of the diminish in serum CA<sup>++</sup> [7]. Respiratory alkalosis post-hyperventilation, decreasing of potassium, adrenaline, after psychogenic stress, and decreasing of magnesium may cause the symptoms of hypocalcemia [10,21].

### **Clinical Effects of Hypocalcemia and Diagnosis**

Hypocalcemia in an emergency setting may be causing severe symptoms indicating hospital admission [4,6,8]. But, the cases of gradually developing hypocalcemia are mostly will be asymptomatic [4,6,8]. Severe and acute hypocalcemia may be associated with Chvostek and Trousseau's sign [6]. Broad-spectrum of hypocalcemic signs and symptoms were recorded. It is including numbness, muscle spasms, cramps, lassitude, weakness, tetany, circumoral numbness, fits, laryngospasm, bronchospasm, decreasing of blood pressure, decreasing of heart rate, digitalis intolerance, tachycardia, heart failure (HF), sudden cardiac death, hyperactive reflexes, neuromuscular irritability, cognitive deterioration, and personality disorders [4,7-9,13,22]. The tingling sensation is the main presentation in hypocalcemia [6]. The diagnosis of latent tetany is linked to the clinical signs accompanied by hypocalcemia in the presence of both Chvostek and Trousseau signs. The expression "latent tetany" is quite mysterious [7]. Chvostek and Trousseau signs can be induced in cases of hypocalcemia [4,13]. Diagnosis is usually confirmed with either corrected CA<sup>++</sup> or ionized CA<sup>++</sup> level [4].

### **Hypocalcaemia and Cardiovascular System**

Acute hypocalcemia is a predisposing factor for syncope, HF, and angina [23]. Calcium giving in cases of severe ionized hypocalcemia (of >30% decrease) may be causing a marked amelioration in cardiac output [5]. Calcium supplementation may correct a biochemical abnormality and thereby improve cardiovascular status; in contrast, excessive calcium influx into the cells may contribute to cellular damage associated with hypoxia [5]. An intense extracellular (EC) hypocalcemia corrupt myocardial contraction because the SR can't preserve enough quantity of Ca<sup>++</sup> ion to start myocardial contraction [6]. The decreasing of cell membrane potential is occurring in hypocalcemia. There is a rise in cell membrane permeability and cellular muscle enzyme leakage [24]. Anyway, the increased cardiac enzymes are often restored to normal level post-treatment of hypocalcemia [6]. Severe ionized hypocalcemia ( $\leq 40-50\%$  of normal) is accompanied by diminishing ventricular contractility, decreasing of heart rate, and dysfunction of vascular tone, and hypotension [5].

## ECG Abnormalities in Hypocalcemia

The old non-specific ECG sign of hypocalcemia remains the QTc prolongation which is directly linked to the grade of hypocalcemia and inversely linked to the serum Ca<sup>++</sup> level [25]. Hypocalcemia is a well-established cause of QT prolongation through the extension of the plateau phase of the cardiac action potential [26,27]. Hypocalcemia causing QTc prolongation is a risk to serious ventricular arrhythmias [28]. Thus, it is causing Ca<sup>++</sup> ion channels to be still open for a longer time, allowing a late Ca<sup>++</sup> cellular inlet and the generation of early after-depolarization [29,30]. If the threshold for depolarization is reached, new action potentials are induced, initiating a tachycardia and re-entry. Torsades de pointes (TdP) and ventricular fibrillation (VF) are serious arrhythmic complications of hypocalcemia [31]. QT prolongation ST-intervals elongation, T-wave inversion, and decreasing heart rate are the ECG findings visible with hypocalcemia [4,7]. The most common mechanisms of these ECG abnormalities are coronary artery spasm [32]. Changes in the contour of the T-waves may be seen in all cases [26]. The U-wave is frequently absent or unidentifiable [33]. Hypocalcemia may be inducing HF, elevation in cardiac enzymes, and ST-segment alterations that simulate acute ST-segment elevation myocardial infarction (STEMI) [34]. Interestingly, the patients may possess clinical and severe hypocalcemia without diagnostic ECG changes [33]. The physician should understanding that the ECG may be normal during lethal hypocalcemia. So, normal ECG cannot exclude this condition [7].

*Wavy triple an Electrocardiographic Sign (Yasser Sign)* is a new diagnostic sign originative in hypocalcemia. *Wavy double an electrocardiographic sign* also was reported in hypocalcemia that was commonly observed with either increasing or decreasing in the heart rate [35,36].

The analysis for this sign in the author interpretations are based on the following;

1. Different successive three beats in the same lead are affected.
2. All ECG leads can be implicated.
3. An associated elevated beat is visible with the 1<sup>st</sup> of the successive 3 beats, a depressing beat with the 2<sup>nd</sup> beat, and isoelectric ST-segment in the 3<sup>rd</sup> one.
4. The elevated beat is either accompanied by ST-segment elevation or just a rising beat above the isoelectric line.
5. Also, the depressed beat is either associated with ST-segment depression or just a depressing beat below the isoelectric line.
6. The configuration for beat depressions, beat elevations, and isoelectricities of ST-segment for the successive three beats are changeable from case to case. So, this arrangement non-conditional.
7. Mostly, there is no participation among the involved leads. The author suggested that the Wavy triple an electrocardiographic sign not conditionally included in an especial coronary artery for the affected leads [35].

## Laboratory Workup in Hypocalcemia

An initial obtaining of electrolytes profile such as serum  $\text{Ca}^{++}$  levels serum, magnesium, phosphate levels with arterial blood gas analysis, and albumin are essential workup to correctly diagnose and treat the underlying electrolyte disorders. Calcium therapy should be immediately given without waiting for all laboratory results especially if there are fits, asthmatic presentation, laryngospasm, and cardiac arrhythmias [10]. The ECG is a helping diagnostic tool. Plain radiography or computed tomography (CT) scans are sometimes supportive in the cases of rickets and osteomalacia [12]. Ionized  $\text{Ca}^{++}$  is the choice way for diagnosing hypocalcemia. A serum  $\text{Ca}^{++}$  level less than 8.5mg/dL or an ionized  $\text{Ca}^{++}$  level less than 1.0mmol/L is true hypocalcemia [12].

## Prognostic Importance

Delayed in the identification of the cause and treatment of hypocalcemic emergencies can lead to remarkably in both morbidity or death [37]. Ionized hypocalcemia is commonly detected in critically-ill patients<sup>5</sup>. The poorer prognosis is seen in the cases of ionized hypocalcemia [5].

## Hypomagnesaemia and the Significance

It is important to note that hypomagnesemia may present with the same constellation of symptoms and signs. So, preferably, serum  $\text{Mg}^{++}$  levels must also be monitor in all symptomatic patients. The maintenance correction of hypocalcemia should be parallel with the management of hypomagnesemia [10]. Chronic hypocalcemia is linked to either mild symptoms of neuromuscular irritability or quite asymptomatic [21]. Chvostek, Trousseau, and Erb sign are helping tests for elicit latent tetany [10]. Associated hypomagnesemia should be considered in every patient of hypocalcemia [10,38]. Severe hypomagnesemia can be causing resistant hypocalcemia for both calcium and vitamin D [12].

## Emergency Management of Hypocalcemia

Management should be included in the patient's symptoms and signs of hypocalcemia [10]. The treatment of hypocalcemia is linked to the etiology, the degree, the existence of symptoms, and progression of hypocalcemia developing [12]. Acute hypocalcemia is exceedingly mild and needs only supportive management and additional workup monitoring [12]. Intravenous calcium is injected if serum  $\text{Ca}^{++}$  levels decrease to below 1.9mmol/L, or ionized  $\text{Ca}^{++}$  levels are below than 1mmol/L, or if patients presented without symptoms [4]. Hypocalcemic cases must be supported with oral calcium supplements and calcitriol (0.25 to 1 $\mu\text{g}$ /day) as indicated [4]. Oral calcium, vitamin, and correction of hypomagnesemia should be considered in management [10]. Calcium administration may correct a biochemical defect with improving cardiovascular effects. This happens in opposite of, excessive  $\text{Ca}^{++}$  cellular influx which may contribute to cellular damage with hypoxia [5]. Calcium Supplementation in hypocalcemic cases may be accompanied by hemodynamic amelioration [5]. Calcium injection to cases of severe ionized hypocalcemia (>30% decrease) may be causing progress in cardiac output [5]. Correction of  $\text{Ca}^{++}$  deficiency maybe not adequate for the restoration of myocardial function [6]. Serum ionized  $\text{Ca}^{++}$  is usually corrected within two weeks post-calcium supplement [6]. Unfortunately, there is no approved precise formula for the assessment of serum

Ca<sup>++</sup> level in acute hypocalcemia [10]. Starting management of acute hypocalcemia with calcium should be without waiting for the serum Ca<sup>++</sup> levels [10]. Measuring of ionized Ca<sup>++</sup> should be considered when associated with acute or severe hypoalbuminemia [10].

The following formula [10] that can estimates the amount of Ca<sup>++</sup> bound to protein: % protein-bound Ca = 8 (albumin, g/dl) + 2 (globulin, g/dl) + 3

Correction of hypoalbuminemia is used to determine the corrected serum Ca<sup>++</sup> levels. The correction is to add 1mg/dl to the serum Ca<sup>++</sup> level for each 1g/dl by which the albumin level is under 4g/dl [10]. Acute symptomatic hypocalcemia with serum Ca<sup>++</sup> under 7.0mg/dl, and ionized Ca<sup>++</sup> under 3.2mg/dl must be managed immediately with IV calcium [38]. Calcium gluconate is the drug of choice over calcium chloride. Calcium gluconate can be causing slight tissue necrosis if there are extravasations. The initial 100 to 200mg of elemental calcium (1-2 ampoules of 10% calcium gluconate [93mg/10ml ampoule]) must be given over 10-20 minutes. Calcium IVI should be diluted in 50 to 100ml of saline or dextrose solution to prevent any vein irritation [10]. Both calcium carbonate and calcium citrate possess the biggest amount of elemental calcium (40% and 28%, respectively). They are easily absorbed and the preferred supplements [22,39,40]. The standard doses of calcium supplement are ranging from 1 to 2g of elemental calcium 3 times daily (level III evidence) [22]. Elemental calcium supplements can be initiated at 500 to 1000mg TDS with upward titration (level III evidence) [22]. All ECG abnormalities are often reversed post-calcium and calcitriol supplementation (level II evidence) [27]. IV calcium is given if serum Ca<sup>++</sup> levels decrease below 1.9mmol/L, or ionized Ca<sup>++</sup> levels are under than 1mmol/L, or if there are no symptoms (level III evidence) [8,9,41]. Prompt correction of calcium deficiency can be inducing cardiac arrhythmia [8,42]. Cardiac monitoring during IV calcium administration is vital, especially if the patient on digoxin medications (level III evidence) [8,22,43]. Chronic therapy fulfills persistent normalization of the ECG [44]. The clear improvements in the ECG abnormalities will be happening post-replacement of calcium and vitamin D [32].

## Method of Study and Patients

My study was an observational retrospective for 43 cases. The study was done in Fraskour central hospital and the physician outpatient clinic (POC). The author reported the 43-cases thorough nearly 24-months, started from December 3, 2018, and, ended on October 29, 2020. Wavy triple an electrocardiographic sign (Yasser Sign) of hypocalcemia was the target. Manifested or latent tetanies were fundamental cases. Intravenous and oral calcium was used. (Table 1).

**Table 1:** Showing remarks of the study method and data

Issue	Definition
Title	Movable-weaning off an electrocardiographic phenomenon in hypocalcemia (changeable phenomenon or Yasser's phenomenon of hypocalcemia)
Estimated enrollment	43 participants

Study type	Observational
Observational model	Case-only
Time	Retrospective
Study date	Thorough nearly 24-months started from December 3, 2018, and, ended on October 29, 2020

### Suggesting Hypothesis and Research Objectives

**Suggesting Hypothesis:** Wavy triple and double electrocardiographic signs (Yasser signs) can be movable from lead to lead through the ECG of hypocalcemia.

**The Research Objectives** to evaluate this hypothesis might include: What is Movable-weaning off an electrocardiographic phenomenon in hypocalcemia (changeable phenomenon or Yasser's phenomenon of hypocalcemia)? How can Movable-weaning off an electrocardiographic phenomenon do improvement in the management of hypocalcemia? Is the study propped by previous publicized literature studies? Is there a relationship between Movable-weaning off an electrocardiographic phenomenon and the improvement in the management of hypocalcemia? What are the magnitude of Movable-weaning off an electrocardiographic phenomenon and adverse effects in the study?

All the above criteria were assessed in parallel to the clinical status.

**Simple randomization was used in the assignment of patients for** Wavy triple and double electrocardiographic signs (Yasser signs).

**The Patient's informed consent** was taken.

### Eligibility Criteria

**Inclusion Criteria:** All cases with Wavy triple and double electrocardiographic signs (Yasser signs). Patients' ages started from 16 and up to 72 years old.

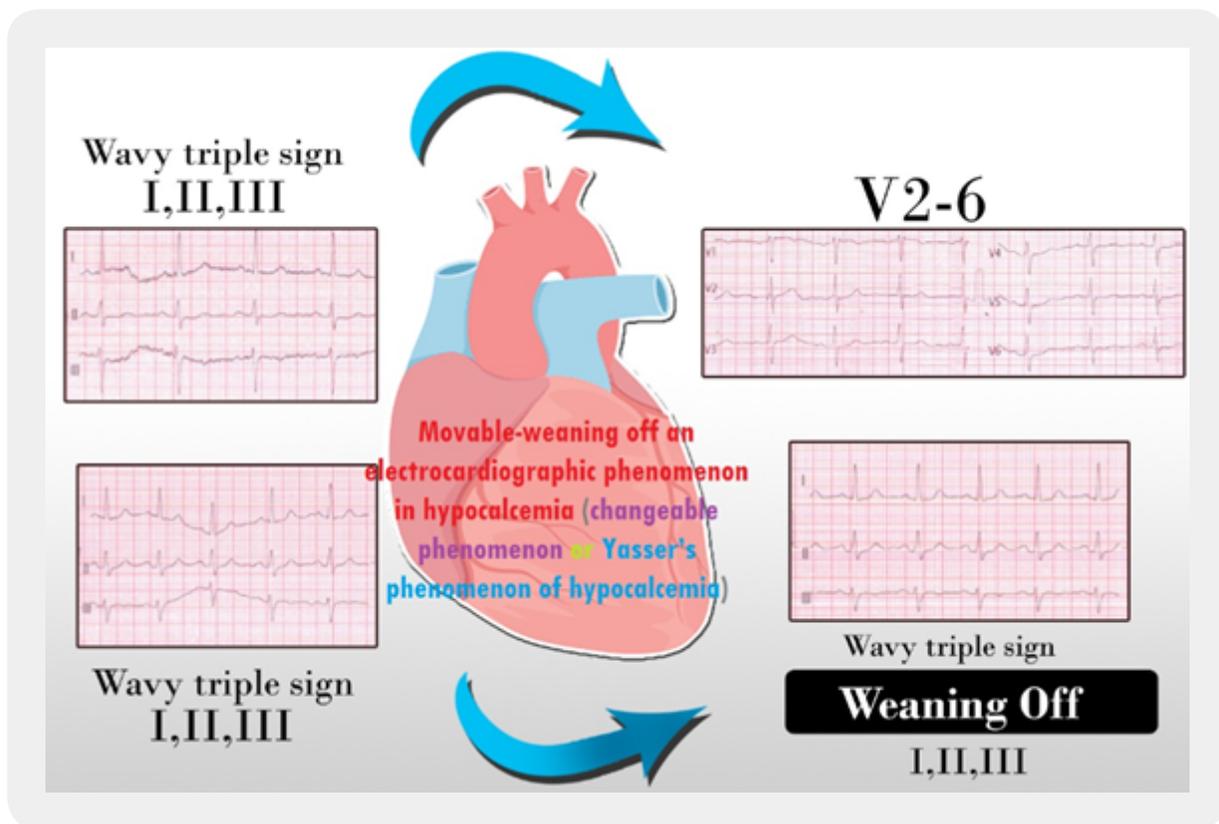
### Exclusion Criteria

1. ECG artifact.
2. Ischemic heart disease and myocardial infarction

### Case Presentations

The study was observational and retrospective for 43 cases. The study was carried out at Fraskour central hospital and the physician outpatient clinic. The author reported the 43-cases thorough nearly 24-months, started from December 3, 2018, and, ended on October 29, 2020. Manifested or latent tetanias were fundamental cases. Most cases had been investigated for hypocalcemia that was undergoing serial ECG

copies. Some cases were missed in investigations during the study due to many causes. ECG tracings were done before and after calcium supplementation. Most cases were follow up for total and ionized calcium, and other electrolytes before and after calcium supplementation. Random blood sugar was done for all cases. Arterial blood gases (ABG), troponin test, serum albumin, and echocardiography were done in elected cases. Some of the cases were admitted to the internal ward. Few cases were admitted or present in the ICU. The remaining cases were managed in POC with later follow up. The serial ECG tracings are compared and examined for the new phenomenon-in hypocalcemia; “Movable-weaning off an electrocardiographic phenomenon in hypocalcemia (changeable phenomenon or Yasser’s phenomenon of hypocalcemia)” (Figure 1). Suspected cases of hypocalcemia but without associated carpopedal spasm was undergone inducible clinical tests for latent tetany such as Chvostek and Trousseau’s sign. Initial IV or later oral calcium supplementation was given. Only one to two calcium gluconate ampoule 10ml 10% over IV over 10-20 minutes were the taken emergency doses in the study. Initial oral calcium supplements were only supplied for mild cases or cases of latent tetany. The oral calcium and vitamin-D preparation were supplied after discharge for all the cases. For more details on general, clinical, and laboratory data for the cases see (Table 1 and 2).



**Figure 1:** The case graphical article example for Movable-weaning off an electrocardiographic phenomenon in hypocalcemia (changeable phenomenon or Yasser’s phenomenon of hypocalcemia).

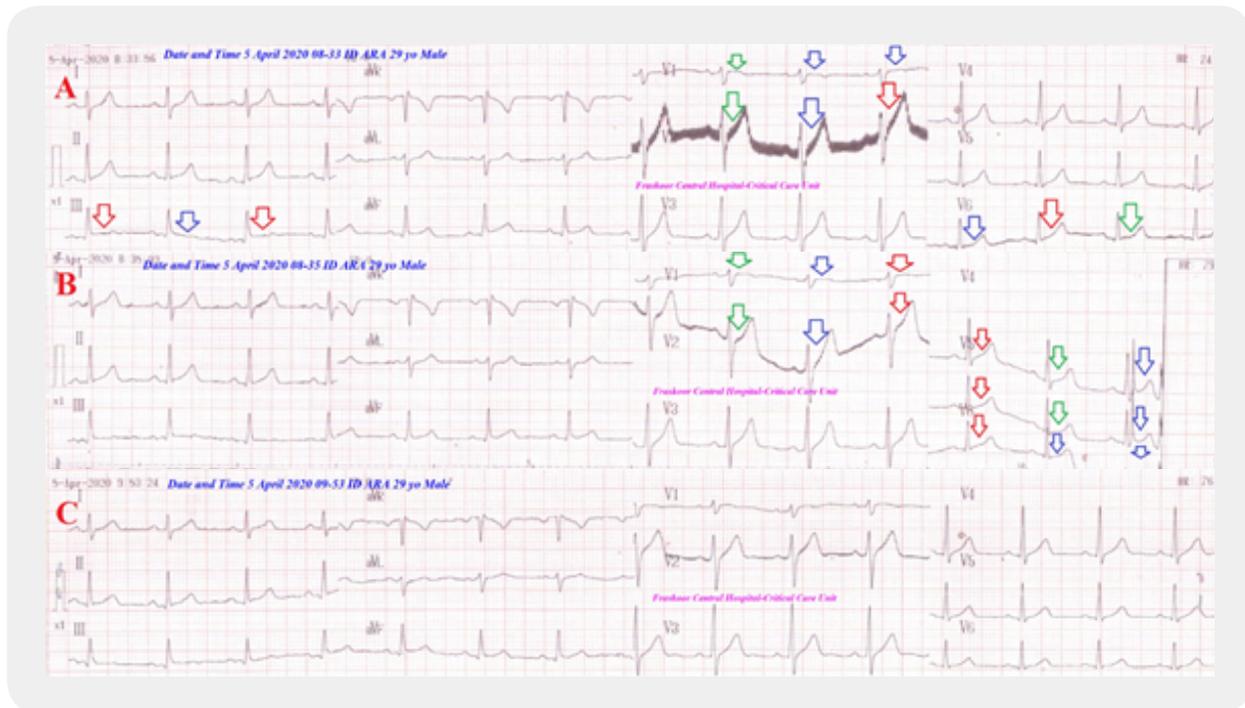
**Table 2:** Summary of the history, clinical, and management Data for all the study cases.

Case No.	Age Per year	Sex	The main presentations	BP mg Hg	Pulse bpm	RR	Associated RF	Severity of Movable phenomenon	Number of given CA amp.	Type of tetany	Pattern of Movable phenomenon
1.	29	M	Parathesia	90/60	74	32	DKA	Mild	Oral Ca	Latent tetany	Weaning-off
2.	65	M	Tetany	130/70	80	26	Malnutrition	Severe	2	Manifested tetany	Changeable
3.	18	M	Tetany	140/80	96	36	Coffee	Severe	2	Manifested tetany	Variable
4.	34	F	Tetany	110/70	80	38	HVS	Severe	1	Manifested tetany	Regressive
5.	16	F	Tetany	100/60	120	32	HVS	Severe	1	Manifested tetany	Progressive
6.	32	F	Tetany	90/70	100	34	HVS	Severe	2	Manifested tetany	Regressive
7.	21	F	Tetany	110/70	90	26	HVS-Coffee	Severe	2	Manifested tetany	Reversed+progressive
8.	45	F	Parathesia	110/80	92	30	HVS	Mild	Oral Ca	Latent tetany	Weaning-off
9.	60	F	Parathesia	140/80	68	24	Malnutrition	Mild	Oral Ca	Latent tetany	Changeable
10.	51	M	Tetany	110/70	66	36	HVS	Severe	2	Manifested tetany	Progressive
11.	17	F	Tetany	130/80	84	22	HVS	Severe	1	Manifested tetany	Regressive
12.	37	F	Tetany	100/60	84	38	HVS	Severe	2	Manifested tetany	Regressive
13.	25	M	Tetany	140/90	88	26	HVS	Severe	2	Manifested tetany	Changeable+regressive
14.	75	F	Parathesia	100/60	102	25	Malnutrition	Mild	Oral Ca	Latent tetany	Regressive
15.	55	M	Parathesia	120/70	90	22	COVID-19	Mild	Oral Ca	Latent tetany	Progressive
16.	38	F	Parathesia	100/80	94	28	HVS	Mild	Oral Ca	Latent tetany	Changeable
17.	38	F	Parathesia	130/90	78	24	HVS	Mild	Oral Ca	Latent tetany	Weaning-off
18.	31	F	Parathesia	120/80	84	26	HVS	Mild	Oral Ca	Latent tetany	Regressive
19.	43	F	Parathesia	110/60	96	28	HVS	Mild	Oral Ca	Latent tetany	Changeable
20.	18	F	Tetany	100/70	78	36	HVS	Severe	2	Manifested tetany	Progressive
21.	29	F	Tetany	140/80	92	24	HVS	Severe	2	Manifested tetany	Variable
22.	72	M	Parathesia	150/90	74	22	Preoperative	Mild	Oral Ca	Latent tetany	Regressive
23.	25	F	Tetany	100/70	76	30	HVS	Severe	1	Manifested tetany	Regressive
24.	30	F	Tetany	110/70	93	38	HVS	Severe	1	Manifested tetany	Regressive
25.	54	F	Tetany	90/70	124	37	Ditiazem	Severe	2	Manifested tetany	Progressive
26.	22	F	Tetany	110/70	96	30	HVS	Severe	1	Manifested tetany	Regressive
27.	19	F	Tetany	130/80	70	27	HVS	Severe	1	Manifested tetany	Intermittent+regressive
28.	55	M	Parathesia	160/80	130	40	COVID-19	Mild	Oral Ca	Latent tetany	Regressive
29.	17	F	Tetany	120/90	68	33	HVS	Severe	2	Manifested tetany	Regressive characteristic
30.	26	F	Tetany	90/70	100	28	Pregn-Maln	Severe	2	Manifested tetany	Progressive
31.	63	M	Tetany	140/90	72	27	Malnutrition	Severe	2	Manifested tetany	Changeable
32.	55	F	Parathesia	110/70	80	35	HVS	Mild	Oral Ca	Latent tetany	Weaning-off
33.	23	F	Tetany	100/60	86	32	HVS	Severe	2	Manifested tetany	Regressive
34.	24	F	Tetany	130/80	82	26	HVS	Severe	1	Manifested tetany	Regressive
35.	25	F	Parathesia	140/70	90	30	Thyroiditis	Mild	Oral Ca	Latent tetany	Weaning-off
36.	23	M	Parathesia	110/60	94	28	Preoperative	Mild	Oral Ca	Latent tetany	Changeable
37.	60	M	Parathesia	160/90	66	22	CRF-Malnu	Mild	Oral Ca	Latent tetany	Weaning-off
38.	17	F	Parathesia	110/70	86	29	HVS	Mild	Oral Ca	Latent tetany	Weaning-off
39.	22	F	Parathesia	120/80	78	33	HVS	Mild	Oral Ca	Latent tetany	Reversed
40.	35	M	Parathesia	140/80	82	36	HVS	Mild	Oral Ca	Latent tetany	Reversed
41.	56	M	Tetany	160/90	66	30	Maln-coffee	Severe	2	Manifested tetany	Weaning-off
42.	42	F	Parathesia	90/70	87	26	HVS	Mild	Oral Ca	Latent tetany	Weaning-off
43.	23	M	Tetany	150/90	100	38	Addict	Severe	2	Manifested tetany	Unknown

Addict\*\*: Marijuana, BP: Blood Pressure, Ca: Calcium, DKA: Diabetic ketoacidosis, ECG: Electrocardiography, F: Female, HVS: Hyperventilation syndrome, M: Male, Malnut: Malnutrition, Pregn.: Pregnancy, RA: Risk factor, RR: Respiratory rate

### Case No. 1

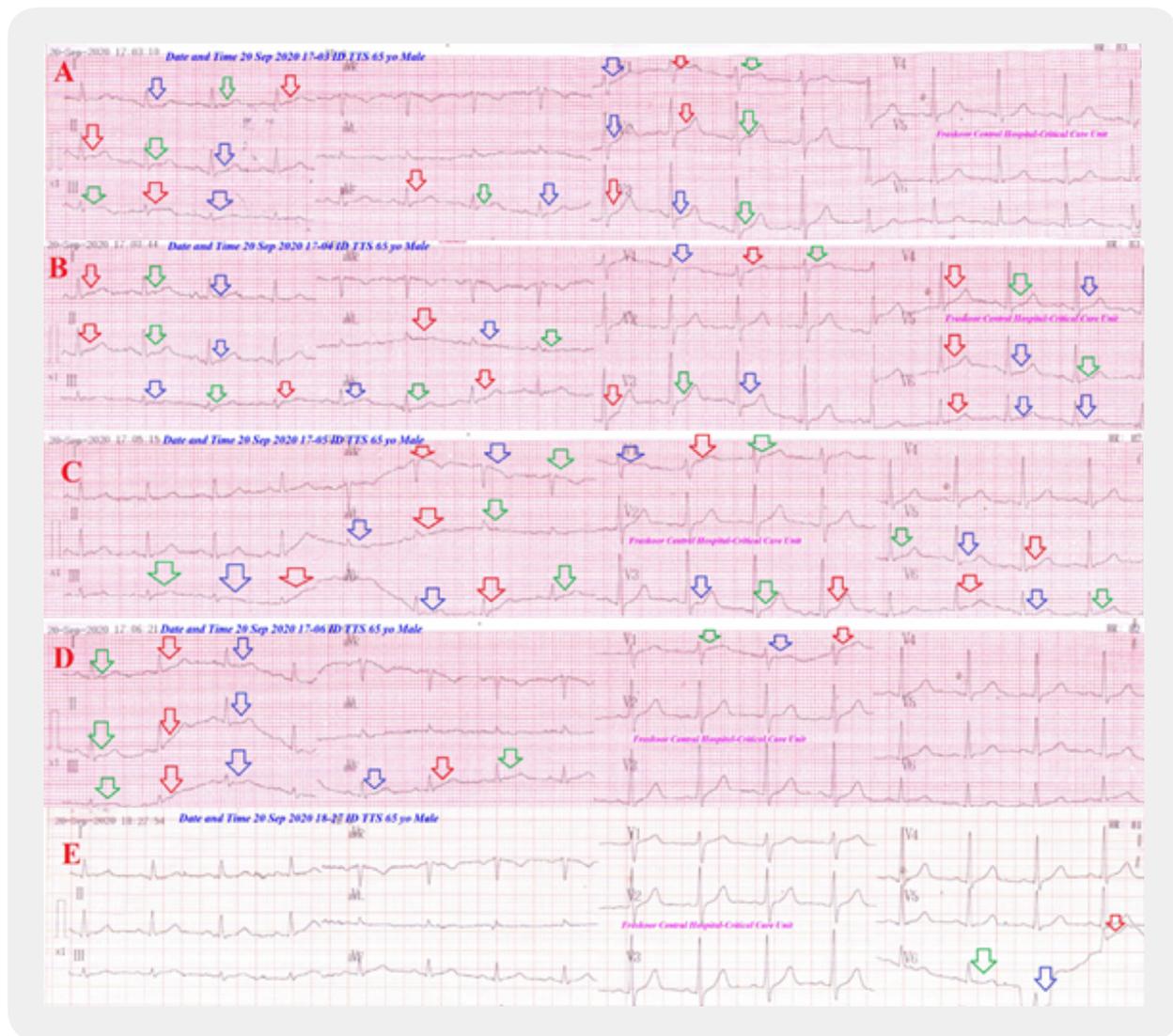
A 29-year-old married male carpenter Egyptian patient was admitted to the ICU due to diabetic ketoacidosis and tachypnea. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and **Weaning-off pattern** of the movable phenomenon. Clinical and ECG recovery had occurred (Figure 2).



**Figure 2:** Serial ECG tracings; A-tracing of the presentation showing "Wavy triple sign" in III, V1,2, and V6 leads. B-tracing was done within 2 minutes of A-tracing showing "Wavy triple sign" in V1,2,4,5, and V6 leads. C-tracing was done within 78 minutes of B-tracing showing no "Wavy triple sign". Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

## Case No. 2

A 65-year-old married male carpenter Egyptian patient presented to the ED with hypoglycemia, tetany, tachypnea, and chest pain. The patient had a long history of malnutrition due to poverty. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-E) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Changeable pattern** of the movable phenomenon. Clinical and ECG recovery had occurred (Figure 3).

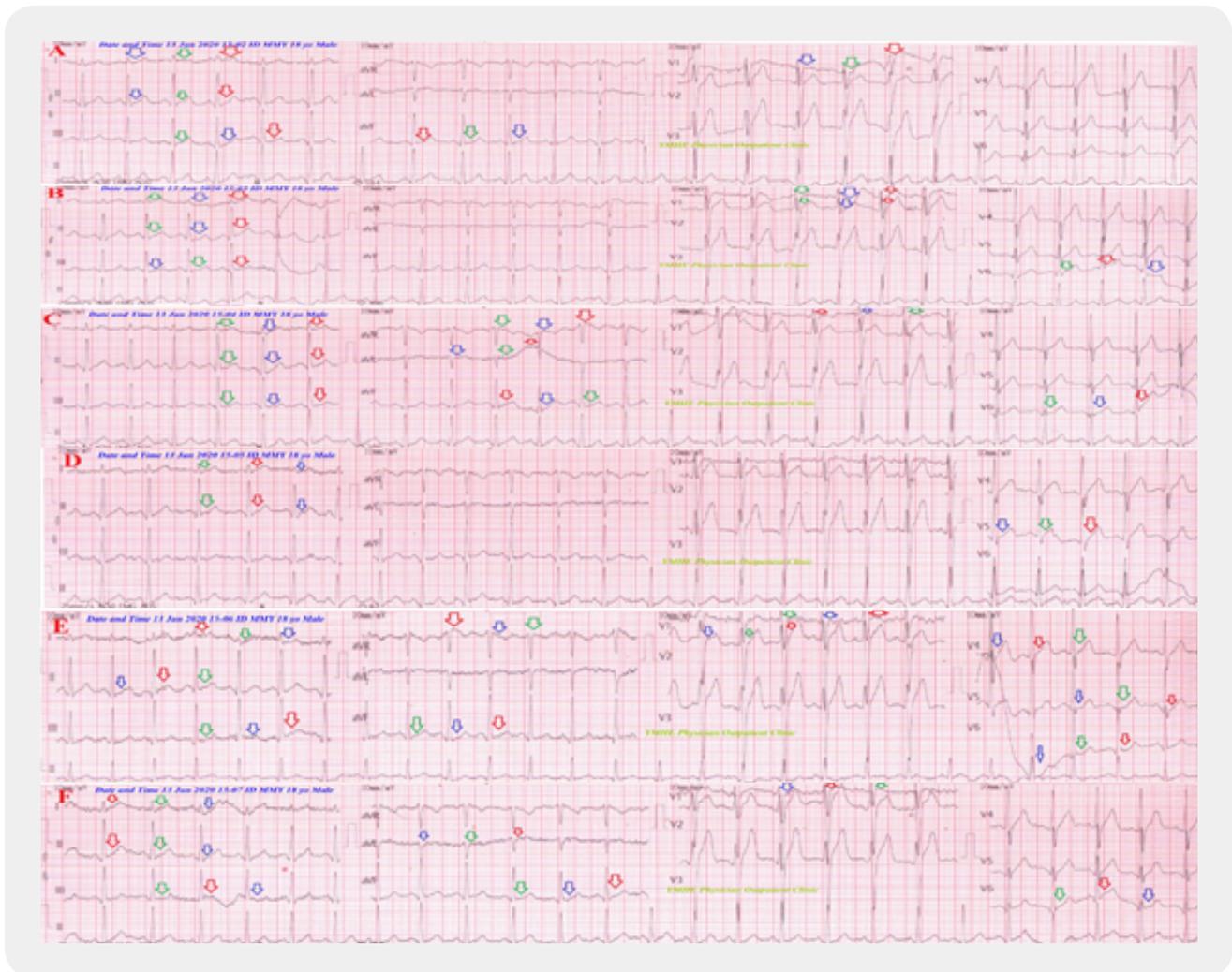


**Figure 3:** Serial ECG tracings; A–tracing of the presentation showing “Wavy triple sign” in I, II, III, aVF, V1, V2, and V3 leads. B–tracing was done within 1 minute of A–tracing showing “Wavy triple sign” in all ECG leads except aVR and V2. C–tracing was done within 1 minute of B–tracing showing “Wavy triple sign” in all ECG leads except I, II, V2, and V4. D–tracing was done within 1 minute of C–tracing showing “Wavy triple sign” in I, II, III, aVF, and V1 leads. E–tracing was done within 80 minutes of D–tracing and after calcium injection showing “Wavy triple sign” in only V6 lead. Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

### Case No. 3

A 18-year-old single student male Egyptian patient presented to the POC with hyperventilation syndrome and tetany. The relatives gave a long history of malnutrition and heavy coffee drinking. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-F) showing an

electrocardiographic wavy triple sign of hypocalcemia and a **Variable pattern** of the movable phenomenon. Clinical and ECG recovery had occurred (Figure 4).



**Figure 4:** Serial ECG tracings; A–tracing of the presentation showing “Wavy triple sign” in I, II, III, aVF, and V1 leads. B–tracing was done within 1 minute of A–tracing showing “Wavy triple sign” in I, II, III, V1, 2, and V6 leads. C–tracing was done within 1 minute of B–tracing showing “Wavy triple sign” in I, II, III, aVR, aVL, aVF, V1, and V6 leads. D–tracing was done within 1 minute of C–tracing showing “Wavy triple sign” in I, II, and V5 leads. E–tracing was done within 1 minute of D–tracing showing “Wavy triple sign” in I, II, III, aVR, aVF, V1, 4, 5, and V6 leads. F–tracing was done within 1 minute of E–tracing showing “Wavy triple sign” in I, II, III, aVL, aVF, V1, and V6 leads. Red arrows = elevated beats, green arrows = isoelectric beats, and blue arrows = depressed beat.

#### Case No. 4

A 34-year-old married Egyptian housewife female patient presented to the POC with tetany and

Yasser Mohammed Hassanain Elsayed (2021). Movable–Weaning off an Electrocardiographic Phenomenon in Hypocalcemia (Changeable Phenomenon or Yasser’s Phenomenon of Hypocalcemia)–Retrospective–Observational Study. *CPQ Medicine*, 11(1), 01–35.

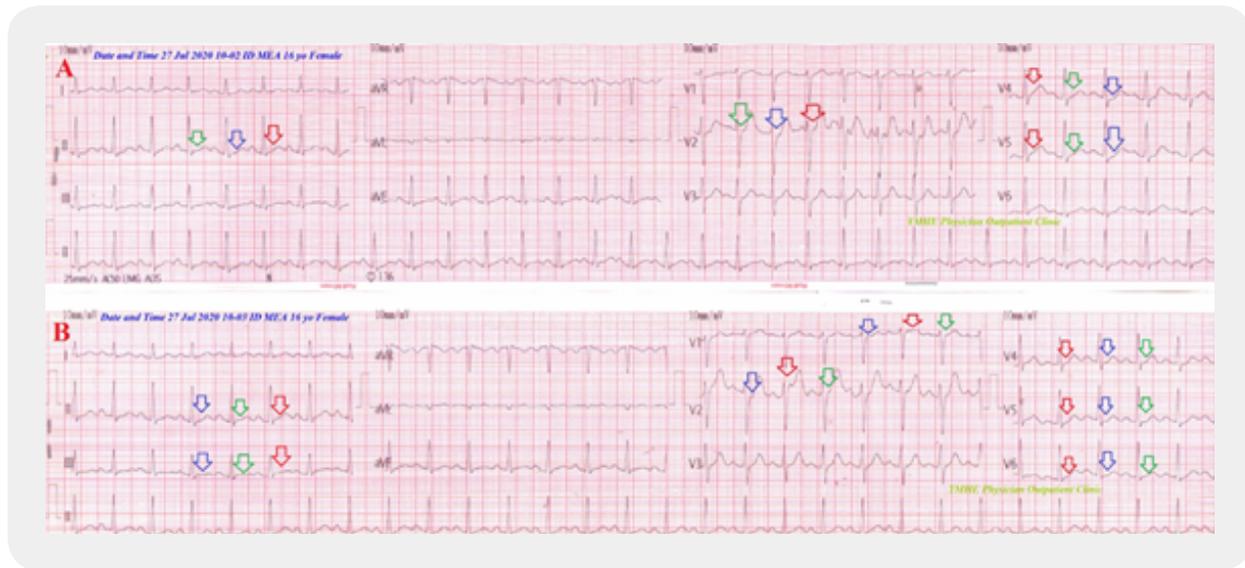
hyperventilation syndrome. The relatives gave a long history of malnutrition. One-calcium gluconate ampoule (10ml 10%) over IV over 10 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred (Figure 5).



**Figure 5:** Serial ECG tracings; A-tracing of the presentation showing” Wavy triple sign” in V4, 5, and V6 leads. B-tracing was done within 1 minute of A-tracing showing” Wavy triple sign” in V4 and V6 leads. Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

### Case No. 5

A 16-year-old single Egyptian student female patient presented to the POC with tetany and hyperventilation syndrome. The patient gave a recent history of psychological troubles. one-calcium gluconate ampoule (10ml 10%) over IV over 10 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Progressive pattern** of the movable phenomenon. Complete clinical and electrocardiographic recovery had happened (Figure 6).



**Figure 6:** Serial ECG tracings; A-tracing of the presentation showing "Wavy triple sign" in V4, 5, and V6 leads. B-tracing was done within 1 minute of A-tracing showing "Wavy triple sign" in V4 and V6 leads. Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

### Case No. 6

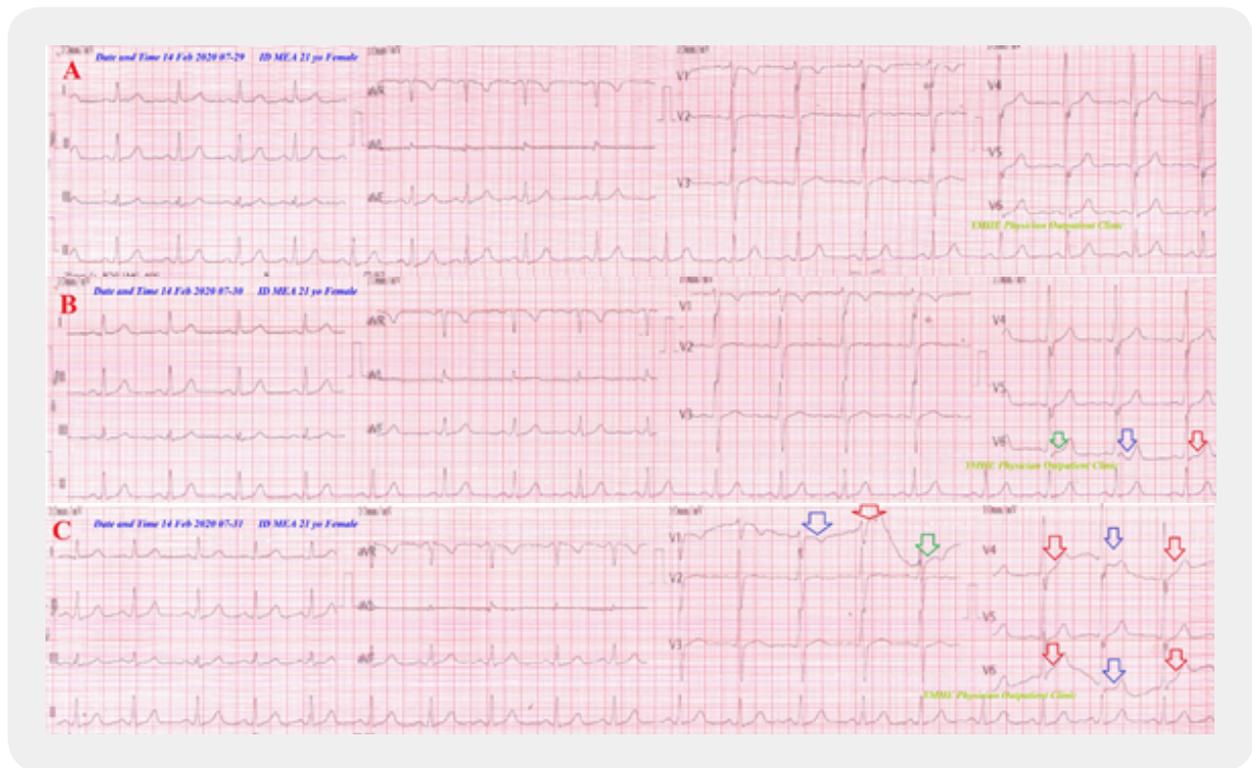
A 32-year-old married Egyptian housewife female patient presented to the ED with tetany and hyperventilation syndrome after suicidal attempt with dextromethorphan HCL syrup. The patient gave a recent history of psychological troubles. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred (Figure 7).



**Figure 7:** Serial ECG tracings; A-tracing of the presentation showing "Wavy triple sign" in all ECG except II lead. B-tracing was done within 1 minute of A-tracing showing "Wavy triple sign" in III, aVL, aVF, V1, 3, 4, and V5 leads. Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

### Case No. 7

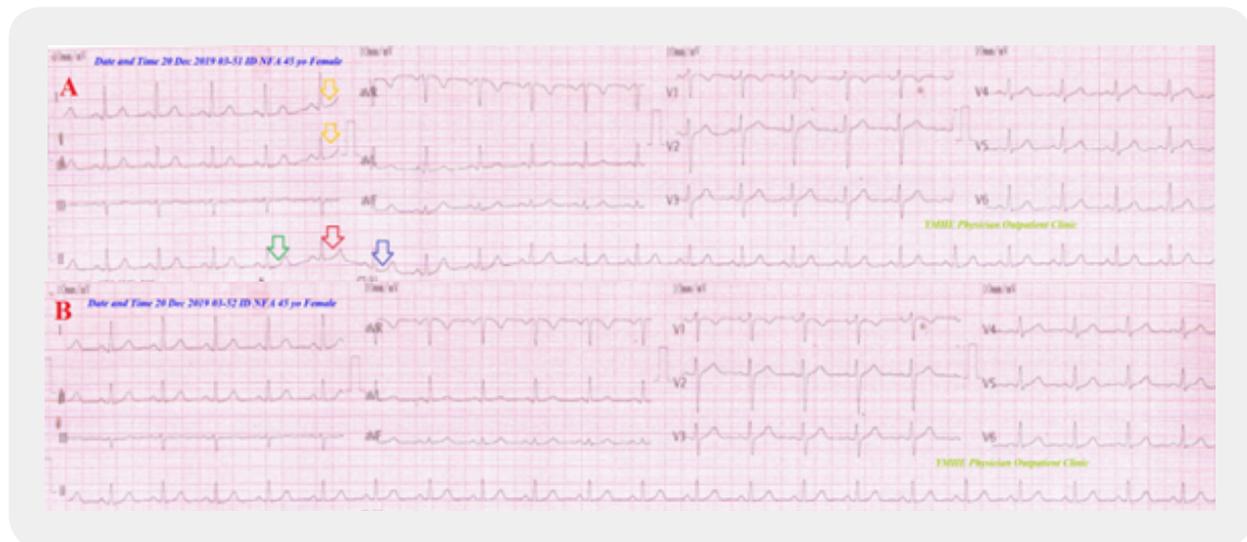
A 21-year-old single Egyptian student female patient presented to the POC with tetany and hyperventilation syndrome. There was a recent history of psycho-familial troubles. She gave a history of heavy coffee drinking. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-C) showing **electrocardiographic wavy double and triple signs of hypocalcemia** and a **Reversed and progressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred (Figure 8).



**Figure 8:** Serial ECG tracings; A-tracing of the presentation showing no "Wavy triple sign". B-tracing was done within 1 minute of A-tracing showing "Wavy triple sign" in V6 lead. C-tracing was done within 1 minute of A-tracing showing "Wavy triple sign" in V1 and "Wavy double sign" V and V6 leads. Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

### Case No. 8

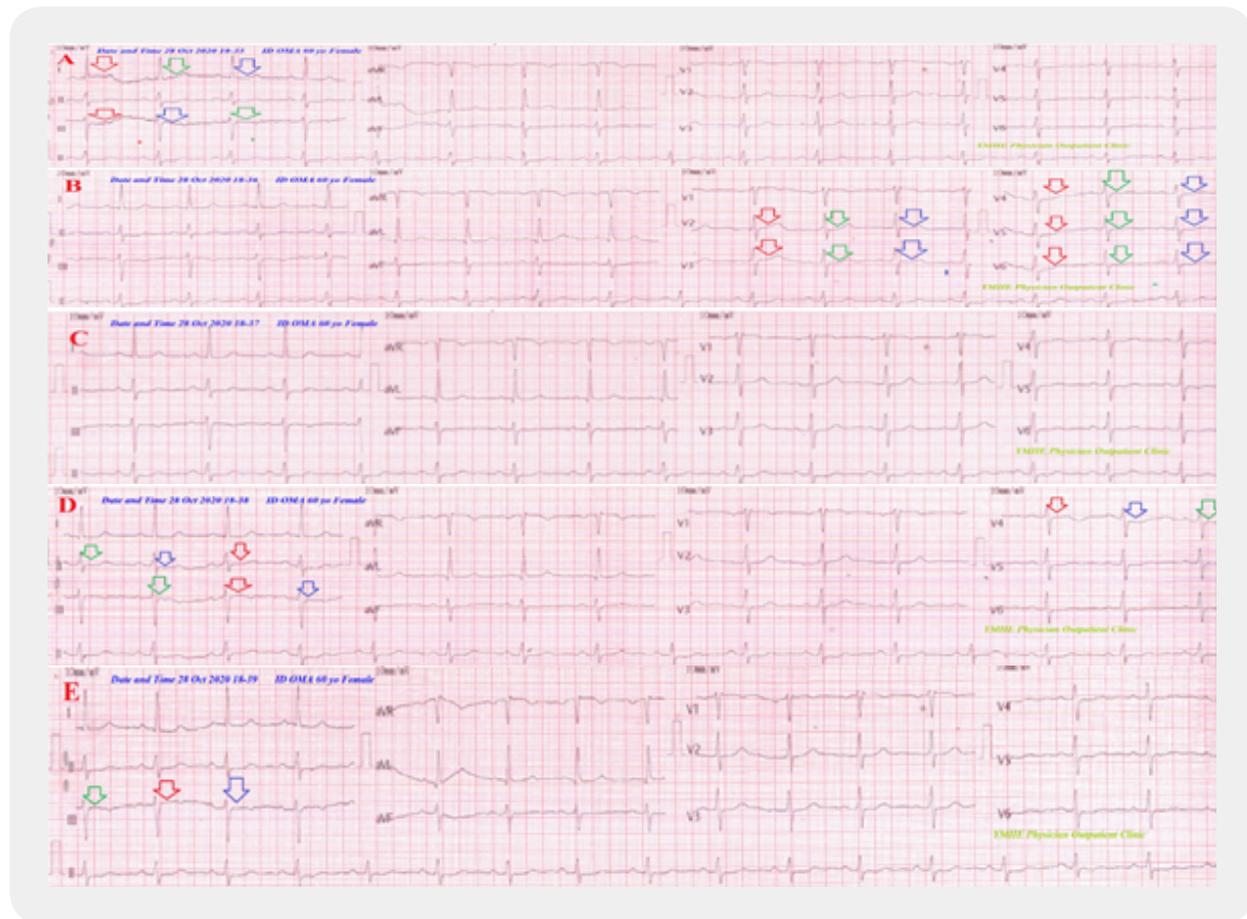
A 45-year-old married Egyptian female patient presented to the POC with hyperventilation syndrome. There was a recent history of financial stress. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing wavy triple sign of hypocalcemia in ECG strip II with a Weaning-off pattern of the movable phenomenon (Just touch pattern). Clinical and ECG recovery had occurred (Figure 9).



**Figure 9:** Serial ECG tracings; A-tracing of the presentation showing "Wavy triple sign" only in ECG strip II lead. There are Just touch in I and II leads (golden arrows). B-tracing was done within 1 minute of A-tracing showing no "Wavy triple sign". Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

### Case No. 9

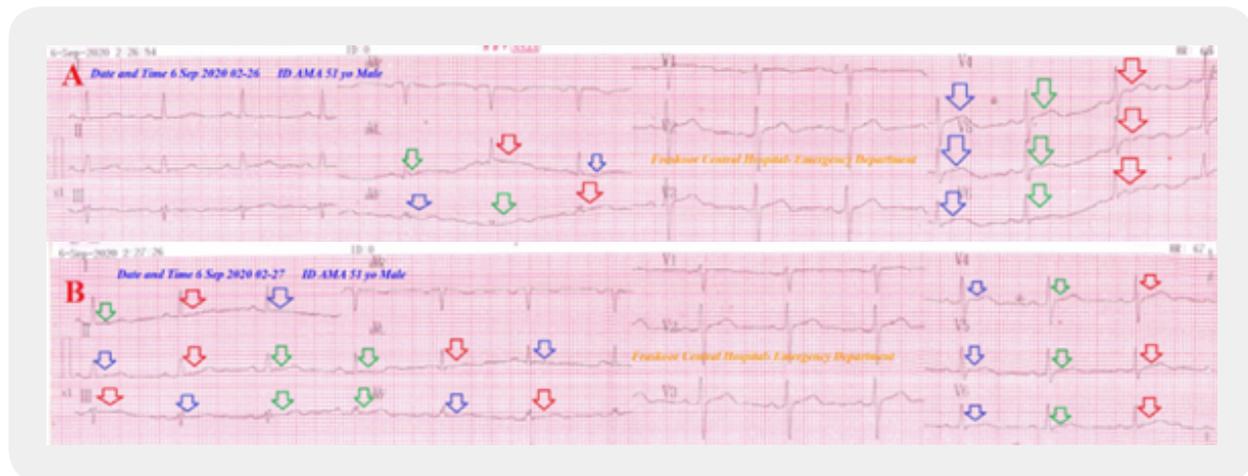
A 60-year-old married Egyptian housewife female patient presented to the POC with tachypnea and hyperventilation syndrome. The patient gave a history of poor nutritional status, hypertensive, and heart failure. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and an **Interchangeable pattern** of the movable phenomenon. Clinical and ECG recovery had occurred (Figure 10).



**Figure 10:** Serial ECG tracings; A-tracing of the presentation showing “Wavy triple sign” in I and III leads. B-tracing was done within 1 minute of A-tracing showing “Wavy triple sign” in V2-6 leads. C-tracing was done within 1 minute of B-tracing showing the disappearance of the above “Wavy triple sign”. D-tracing was done within 1 minute of C-tracing showing “Wavy triple sign” in II, III, and V4 leads. E-tracing was done within 1 minute of C-tracing showing “Wavy triple sign” in III lead. Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

### Case No. 10

A 51-year-old married Egyptian officer male patient presented to the ED with tetany and hyperventilation syndrome. The patient gave a recent history of work psychological stress. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Progressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred (Figure 11).



**Figure 11:** Serial ECG tracings; A–tracing of the presentation showing “Wavy triple sign” in aVL, aVF, V4, V5, and V6 leads. B–tracing was done within 1 minute of A–tracing showing “Wavy triple sign” in I, II, III, aVL, aVF, V4, V5, and V6 leads. Red arrows =elevated beats, green arrows = isoelectric beats, and blue arrows =depressed beat.

### Case No. 11

A 17-year-old single, student, Egyptian female patient presented to the emergency department (ED) with carpopedal spasm and hyperventilation syndrome. The patient gave a recent history of socio-familial stress. One-calcium gluconate ampoule (10ml 10%) over IV over 10 minutes was taken. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

### Case No. 12

A 37-year-old married Egyptian housewife female patient presented to the ED with tetany, dizziness, and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

### Case No. 13

A 25-year-old married Egyptian painter male patient presented to the POC with tetany and hyperventilation syndrome. The patient gave a recent history of psychological stress. He is a heavy coffee drinker. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Changeable and regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 14**

A 75-year-old married Egyptian housewife female patient presented to the POC with marked tachypnea and palpitations. The patient gave a history of poor nutritional status, hypertensive crises, and heart failure. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 15**

A 55-year-old married Egyptian carpenter male patient presented to the POC with marked tachypnea chest pain, and palpitations. The patient gave a recent history of COVID-19 with a history of hypertensive crises. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Progressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 16**

A 38-year-old married Egyptian housewife female patient presented to the POC with tachypnea and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and an **Interchangeable pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 17**

A 38-year-old married Egyptian housewife female patient presented to the POC with tachypnea and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Weaning-off** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 18**

A 31-year-old married Egyptian housewife female patient presented to the POC with tachypnea and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 19**

A 43-year-old married Egyptian housewife female patient presented to the POC with tachypnea, tetany, and psychogenic hemiplegia. The patient gave a recent history of psycho-familial stress. He was tested for

latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and an **Interchangeable pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### Case No. 20

A 18-year-old single, student, Egyptian female patient presented to the emergency department (ED) with carpopedal spasm and psychogenic hyperventilation syndrome. The patient gave a recent history of socio-familial stress. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Progressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### Case No. 21

A 29-year-old married, teacher, Egyptian female patient presented to the POC with carpopedal spasm and psychogenic hyperventilation syndrome. The patient gave a recent history of socio-familial stress. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Variable pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### Case No. 22

A 72-year-old married, farmer, Egyptian male patient presented to POC with tachypnea. The patient present for preoperative preparation for benign prostatic hypertrophy. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### Case No. 23

A 25-year-old married Egyptian housewife female patient presented to the POC with tachypnea and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. One-calcium gluconate ampoule (10ml 10%) over IV over 10 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### Case No. 24

A 30-year-old married Egyptian housewife female patient presented to the POC with tachypnea and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. One-calcium gluconate ampoule (10ml 10%) over IV over 10 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 25**

A 54-year-old married Egyptian housewife female patient presented to the ED with tetany, angina, and hyperventilation syndrome. The patient gave a recent history of swallowing a heavy dose of oral diltiazem. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Progressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 26**

A 22-year-old married Egyptian housewife female patient presented to the ED with tetany and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. One-calcium gluconate ampoule (10ml 10%) over IV over 10 minutes was taken. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 27**

A 19-year-old single Egyptian student female patient presented to the POC with tetany and hyperventilation syndrome. The patient gave a recent history of psychological stress. One-calcium gluconate ampoule (10ml 10%) over IV over 10 minutes was given. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and an **intermittent and regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 28**

A 55-year-old married Egyptian carpenter male patient presented to the POC with severe tachypnea. The patient was admitted to the ICU due to COVID-19 pneumonia. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 29**

A 17-year-old single Egyptian student female patient presented to the ED with tetany and hyperventilation syndrome. The patient gave a recent history of psychological stress. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was taken. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Regressive with a characteristic pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 30**

A 26-year-old married Egyptian housewife pregnant female patient presented to the POC with tetany and hyperventilation syndrome. There is a long history of malnutrition. Two-calcium gluconate ampoules (10ml

10%) over IV over 20 minutes was given. Serial ECG tracings (A-B) showing a wavy triple sign of hypocalcemia and a **Progressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### **Case No. 31**

A 63-year-old married Egyptian fisherman male patient presented to the ED with tetany and hyperventilation syndrome. There was a long history of malnutrition. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-B) showing both **wavy double and triple sign of hypocalcemia** and a **Changeable pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### **Case No. 32**

A 55-year-old married housewife Egyptian female patient presented to the POC with hyperventilation syndrome. There was a recent history of the socio-familial event. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing wavy triple sign of hypocalcemia with a **Weaning-off pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### **Case No. 33**

A 23-year-old married housewife Egyptian female patient presented to the POC with hyperventilation syndrome. There was a recent history of the socio-familial event. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was taken. Serial ECG tracings (A-B) showing a wavy triple sign of hypocalcemia with a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### **Case No. 34**

A 24-year-old married housewife Egyptian female patient presented to the POC with tetany and hyperventilation syndrome. There was a recent history of the socio-familial event. One-calcium gluconate ampoule (10ml 10%) over IV over 10 minutes was given. Serial ECG tracings (A-C) showing wavy triple sign of hypocalcemia with a **Regressive pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### **Case No. 35**

A 25-year-old housewife, married, Egyptian female patient presented to the POC with tachypnea. The patient gave a history of inflammatory thyroiditis with hypocalcemia. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **weaning-off pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 36**

A 23-year-old single student male Egyptian patient presented to the POC with hyperventilation syndrome. The patient presented for preoperative preparation. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-C) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Changeable pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 37**

A 60-year-old farmer, married, Egyptian male patient presented to ED with chest pain and tachypnea. The patient gave a history of chronic renal impairment and malnutrition. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Weaning-off pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 38**

A 17-year-old single Egyptian student female patient presented to the POC with tachypnea and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Weaning-off pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 39**

A 22-year-old married Egyptian housewife female patient presented to the ED with tachypnea and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. She was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Reversed pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 40**

A 35-year-old governmental officer, married, Egyptian male patient presented to POC with tachypnea. The patient gave a recent history of psycho-familial stress. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Reversed pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

**Case No. 41**

A 56-year-old a married Egyptian farmer male patient presented to the POC with tetany, palpitations, and hyperventilation syndrome. The patient gave a long history of malnutrition and heavy coffee drinking. Two-

calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was taken. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Weaning-off pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### Case No. 42

A 42-year-old married Egyptian housewife female patient presented to the POC with tachypnea and hyperventilation syndrome. The patient gave a recent history of psycho-familial stress. He was tested for latent tetany which was positive. Oral calcium-vitamin D tab was prescribed for two weeks. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and a **Weaning-off pattern** of the movable phenomenon. Clinical and ECG recovery had occurred.

#### Case No. 43

A 23-year-old single Egyptian Coffee-maker male patient presented to the ED with tetany and hyperventilation syndrome. The patient gave a recent history of psychological stress. He is a marijuana abuse. Two-calcium gluconate ampoules (10ml 10%) over IV over 20 minutes was given. Serial ECG tracings (A-B) showing an electrocardiographic wavy triple sign of hypocalcemia and an **Unknown pattern** of the movable phenomenon (due to missed lead). Clinical and ECG recovery had occurred.

## Results and Findings

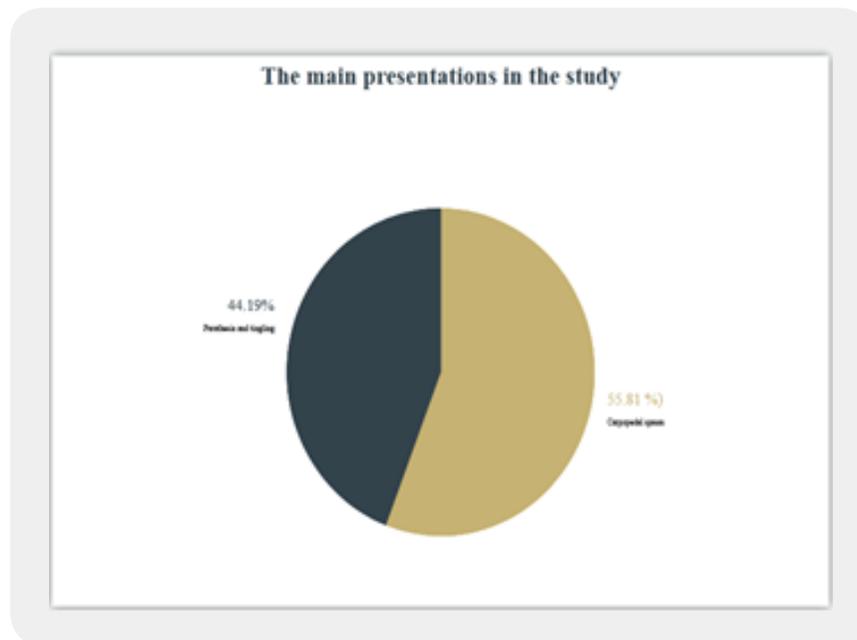
*Table 3: Laboratory data for the cases of the study*

Case no.	Ionized Ca <sup>++</sup> mmol/l	Na <sup>+</sup> mmol/l	K <sup>+</sup> mmol/l	Mg <sup>++</sup> mmol/l	S creatinine mg/dl	RBS mg/dl	S albumin mg/dl	ABG	Troponin test
1	0.7	131	5	0.9	0.8	Hi	3.8	RA*	-
2	0.5	139	3.7	1	0.99	45	4.1	-	-VE
3	0.55	141	3.9	0.8	1.1	117	3.8	-	
4	-	-	-	-	-	-	-	-	-
5	0.8	136	3.6	0.7	1.01	111	3.5	-	-
6	0.6	144	3.9	1.0	1.6	87	3.7	-	-
7	0.4	136	4.7	0.8	1.03	101	3.4	-	-
8	-	-	-	-	-	-	-	-	-
9	0.74	141	3.6	0.9	1.1	128	4.0	-	-
10	-	-	-	-	-	-	-	-	-
11	0.7	136	3.6	1	.7	166	3.8	-	-
12	-	-	-	-	-	-	-	-	-
13	0.6	135	4.1	0.8	0.9	105	3.7	-	-
14	0.89	139	4.8	1.01	0.8	99	3.6	-	-

15	0.76	145	3.7	0.9	1.2	124	3.5	-	-
16	0.8	138	4.3	0.7	0.9	98	3.6	-	-
17	0.9	140	3.5	1	0.78	72	3.8	-	-
18	-	-	-	-	-	-	-	-	-
19	0.7	143	3.9	0.8	1.3	84	3.5	-	-
20	0.5	139	3.6	0.9	1.2	100	4	-	-
21	0.66	135	4.8	0.7	1.1	91	3.8	-	-
22	0.8	138	3.6	1	0.9	114	3.6	-	-
23	-	-	-	-	-	-	-	-	-
24	0.6	137	3.9	1	1.4	98	3.7	-	-
25	-	-	-	-	-	-	-	-	-
26	0.8	135	3.6	0.8	1.2	75	3.5	-	-
27	0.6	144	3.8	0.7	1.04	81	3.9	-	-
28	0.7	141	5	0.9	0.7	78	3.7	-	-
29	0.5	137	4.2	0.7	1.4	90	3.5	-	-
30	0.8	145	3.7	0.8	1.1	97	3.5	-	-
31	0.54	137	3.9	1	1.3	68	4	-	-
32	-	-	-	-	-	-	-	-	-
33	0.6	144	4.5	0.9	0.9	94	3.7	-	-
34	0.75	136	4.1	0.8	1.1	87	3.5	-	-
35	0.9	143	4.6	0.7	1.2	101	3.6	-	-
36	0.7	135	3.8	0.9	0.9	152	3.9	-	-
37	0.8	138	4	0.8	1.3	81	3.5	-	-
38	0.74	136	3.7	0.7	1.3	123	3.7	-	-
39	0.68	139	5	0.9	1.2	108	4	-	-
40	0.81	137	5.1	1	0.97	84	3.6	-	-
41	0.5	135	4.8	0.8	1.1	69	3.9	-	-
42	0.7	142	3.7	0.9	1.4	93	4	-	-
43	-	-	-	-	-	-	-	-	-

ABG: arterial blood gases, Ca<sup>++</sup>: calcium, Na<sup>+</sup>: sodium K<sup>+</sup>: potassium, Mg<sup>++</sup>: magnesium, RA: respiratory alkalosis, RBS: random blood sugar

- **Age Averages in the Study;** Mean: 36.4, Median: 31, Mode: 17.
- **Sex in Both Groups: Female (F)** 67.44% (29 cases) vs. Male (M) 32.56% (14 cases)
- **The Main Presentations in the Study were** carpopedal spasm (55.81%) vs. Parathesia and tingling (44.19%) (Figure 12).

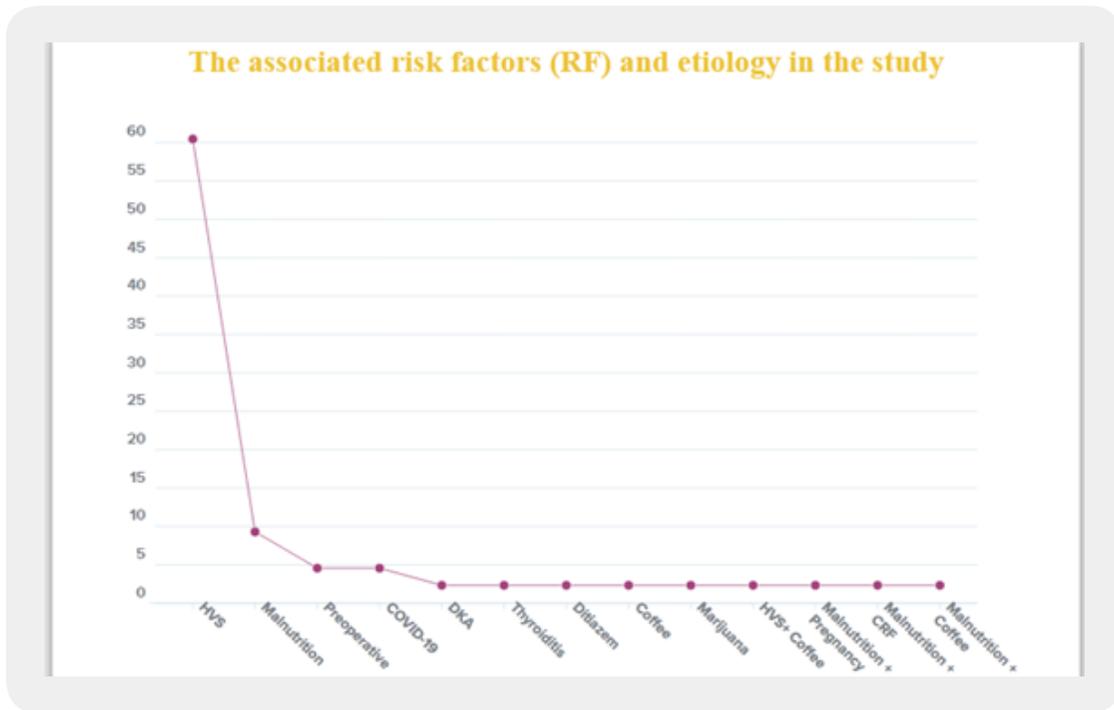


*Figure 12: Pie chart showing the main presentations in the study*

• **Respiratory Rate (RR) Averages in the Study;** Mean: 30, Median: 30, Mode: 26.

• **The Associated Risk Factors (RF) and Etiology in the Study;**

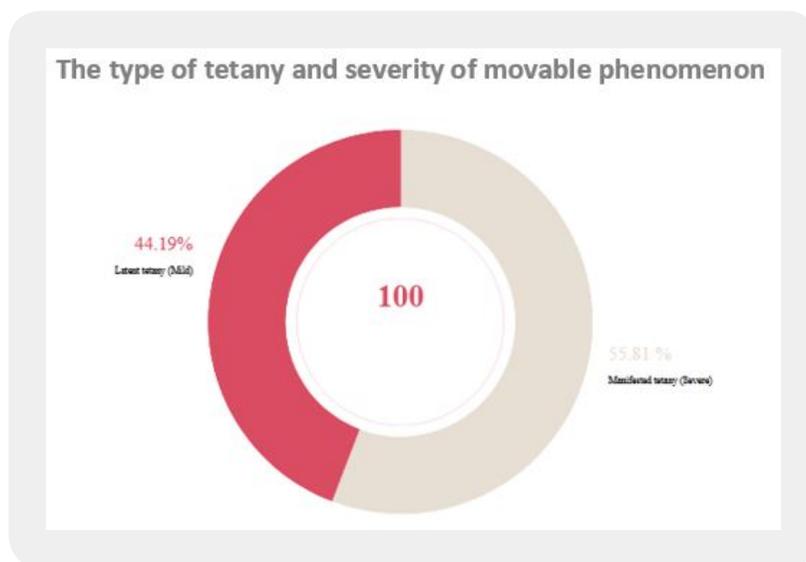
- HVS: 60.47% (26 cases)
- Malnutrition: 9.3% (4 cases)
- Preoperative: 4.56% (2 cases)
- COVID-19: 4.56% (2 cases)
- DKA: 2.33% (1 case)
- Thyroiditis: 2.33% (1 case)
- Diltiazem : 2.33% (1 case)
- Coffee: 2.33% (1 case)
- Marijuana: 2.33% (1 case)
  - Combined RF:
    - HVS+ Coffee: 2.33% (1 case)
    - Malnutrition + Pregnancy: 2.33% (1 case)
    - Malnutrition + CRF: 2.33% (1 case)
    - Malnutrition + Coffee: 2.33% (1 case) (Figure-13).



**Figure 13:** Line chart showing the associated risk factors (RF) and etiology in the study

**• The Type of Tetany and Severity of Movable Phenomenon;**

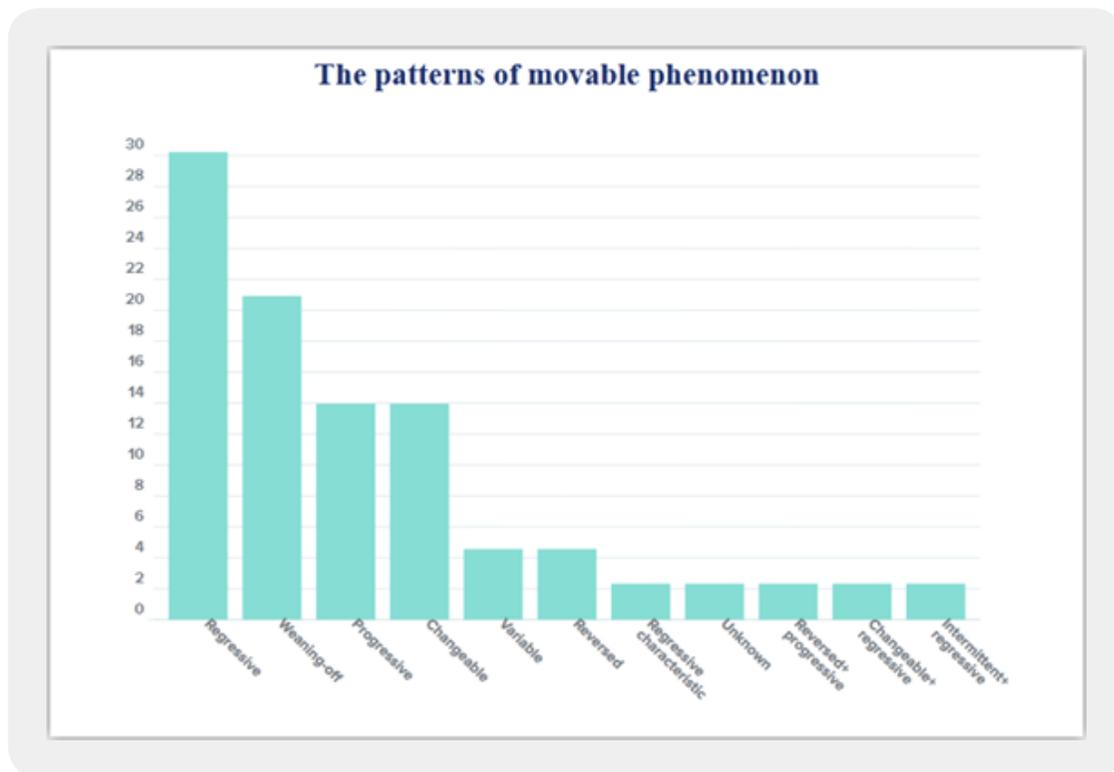
- Manifested tetany (Severe): 55.81% (24 cases)
- Latent tetany (Mild): 44.19% (19 cases) (Figure-14).



**Figure 14:** Donut chart showing the types of tetany and severity of movable phenomenon in the study.

**• Pattern of Movable Phenomenon:**

- Regressive: 30.23% (13 cases)
- Weaning-off: 20.93% (9 cases)
- Progressive: 13.95% (6 cases)
- Changeable: 13.95% (6 cases)
- Variable: 4.56% (2 cases)
- Reversed: 4.56% (2 cases)
- Regressive characteristic: 2.33% (1 case)
- Unknown: 2.33% (1 case)
- Reversed+ progressive: 2.33% (1 case)
- Changeable+ regressive : 2.33% (1 case)
- Intermittent+ regressive: 2.33% (1 case) (Figure-15).



*Figure 15: Bar chart showing pattern of Movable phenomenon in the study*

- **The wavy triple sign is a positive and triple sign** in 95.35% (41 cases) but it is combined both wavy triple and wavy double in 4.65% (2 cases).

## Discussion

1. Movable-weaning off an electrocardiographic phenomenon in hypocalcemia (changeable phenomenon or Yasser's phenomenon of hypocalcemia) is defined according to the author's opinion in the study as a novel electrocardiographic phenomenon characterized by serial dynamic changes in either Wavy triple or double electrocardiographic signs (Yasser signs) of hypocalcemia.
2. The dynamic changes either progression, regression, changeable, variable, weaning-off, or reversed.
3. The target was in the author's opinion was the Wavy triple and double electrocardiographic signs (Yasser signs) which can be movable from lead to lead through the ECG of hypocalcemia.
4. Serial ECG tracings are an essential tool for understanding the new phenomenon and its verifications.
5. Movable-weaning off electrocardiographic phenomenon is a directory for the course of both Wavy triple or double an electrocardiographic signs (Yasser signs) of hypocalcemia.
6. The patients was secondly classified according to "Pattern of extension of Movable-weaning off an electrocardiographic phenomenon;
  - **Regressive:** It is defined as decreasing the number of affected leads with either Wavy triple or double electrocardiographic signs (Yasser signs) in the subsequent ECG tracings.
  - **Progressive:** It is defined as an increasing number of affected leads with either Wavy triple or double electrocardiographic signs (Yasser signs) in the subsequent ECG tracings.
  - **Weaning-off:** It is defined as an immediate disappearance of Wavy triple or double electrocardiographic signs (Yasser signs) in the final ECG tracing after their presence in the previous tracings before using the calcium therapies.
  - **Reversed:** It is defined as an immediate absence of Wavy triple or double electrocardiographic signs (Yasser signs) in the first ECG tracing but secondly appear in the subsequent ECG tracings
  - **Just Touch Pattern:** It is defined as the total absence of Wavy triple or double electrocardiographic signs (Yasser signs) in all ECG tracings but only intermittently appear in ECG strip.
  - **Changeable:** It is defined as a wide change in Wavy triple or double electrocardiographic signs (Yasser signs) from one ECG tracing to another.
  - **Regressive characteristic:** It is defined as a regressive pattern but with variation in a magnitude in ST-segment elevation due to repolarization pattern.
  - **Variable:** It is defined as a wide variation through all ECG tracings.
  - **Reversed+ Progressive:** It is defined as an immediate absence of Wavy triple or double electrocardiographic signs (Yasser signs) in the first ECG tracing but with a progressive pattern.
  - **Changeable+ Regressive:** It is defined as a changeable pattern but with regression.

- **Intermittent+ Regressive:** It is defined as a regressive pattern but with an intermittent variation.
- **Unknown:** It is defined an unknown pattern due to a missed lead so, the positive or negative for this lead will be to change the type of pattern.

## Conclusions

- Movable-weaning off an electrocardiographic phenomenon in hypocalcemia (changeable phenomenon or Yasser's phenomenon of hypocalcemia) is defined according to the author's opinion in the study as a novel electrocardiographic phenomenon characterized by serial dynamic changes in present in all cases of either Wavy triple or double electrocardiographic signs (Yasser signs) of hypocalcemia.
- Movable-weaning off an electrocardiographic phenomenon is a guide for both Wavy triple or double electrocardiographic signs (Yasser signs) of hypocalcemia.
- Don't angry if the staring electrocardiography tracing or the last one was normal.
- Further investigations for the "Movable-weaning off an electrocardiographic phenomenon in hypocalcemia (changeable phenomenon or Yasser's phenomenon of hypocalcemia) for more evaluation and assessment are recommended.

## Conflicts of Interest

There are no conflicts of interest.

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