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THE ROLE OF FRONTAL P-WAVE AXIS IN DIFFERENTIATING OBSTRUCTIVE FROM RESTRICTIVE LUNG DISEASES

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Abstract

BACKGROUND

COPD is associated with a number of alterations in electrocardiograms (ECGs), including the frontal P-wave axis, which is the most popular and widely recognized, and it involves shifting the P-wave axis verticalization, which is more than +60º, is strongly indicative, is believed to be caused by hyperinflated lungs, and fails to cause lung illnesses that limit airflow.

OBJECTIVES

This study aims to delineate the role of the ECG in identifying changes in the direction of the P-wave from the front, depending on the type of chronic obstructive or restrictive lung disease.

THE PATIENTS AND METHODS : At Iraq's AL-Yarmouk Teaching Hospital for Medicine in Baghdad spanning the months of April 2013 through January 2014. heart rhythms were investigated in a study of 80 patients who had pulmonary function tests; 40 of those patients underwent these tests in a sequential fashion forty consecutive patients with chronic obstructive pulmonary disease and illnesses affecting the airways that are too compressed. We estimated the P-wave axes to within a half-degree margin and assigned them to the following categories: vertical ($\geqslant +60^{\circ}$), intermediate ($>+40^{\circ}$ to $<+60^{\circ}$), and horizontal. $\leqslant +40$ degrees.

RESULTS

P-wave axes for restrictive and obstructive types of lung disease dissimilar ($P < 0.001$). There were 38 out of 40 ECGs in individuals who had P-wave axes that were vertical, ranging from $\geqslant +60^{\circ}$ to $+90^{\circ}$ in patients with obstructive lung disorders. P-wave axes were present in 24 out of 40 patients suffering from restrictive lung disorders. Only 24 patients had P-wave axes that were not

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more than 40 degrees horizontal, while 12 patients had axes between 40 and 60 degrees. of which just four were perpendicular to the ground.

CONCLUSION: The frontal P-wave axis works wonders in the identification of the course of chronic obstructive ornon obstructive.

AIM OF THE STUDY

was to evaluate the value of variations in the P-wave axes as an easy, quick, and straightforward way to classify the patients in comparison to individuals who do not have airway blockage

Keywords: Obstructive lung disease, restrictive lung disease, frontal P-wave, axis, pulmonary function test.

INTRODUCTION

The frontal P-wave is a useful diagnostic tool for obstructive and restrictive lung diseases. Lung function evaluation, axis: a brief overview. The vast majority of respiratory illnesses can be categorized into three main types.

Classes: (1) disorders that cause airway obstructions; (2) diseases that cause airway constriction; and (3) anomalies of vascular. When assessing the majority of patients, the method to taking a detailed medical history is the first step in treating a patient with a respiratory illness. With an emphasis, the specific pathophysiology can be better classified with the use of a physical examination. Following this, a large number of patients will have chest x-rays, pulmonary function tests, a battery of serologic or microbiological tests, examinations of blood and sputum, and medical diagnosis [1]. Anatomically and functionally, the heart and lungs are identical. The heart and lungs have similar connections, making it common for one to influence the other during illness. This ECG record is relevant to the issue at hand in a special way, and not merely because it mirrors some of the heart activity and the fact that a large portion of the cardiac potential has to go via the lung path for the recording electrodes to traverse the tissue [2].

1-1. OBSTRUCTIVE LUNG DISEASES

COPD is becoming an increasingly important issue in public health. It is anticipated that COPD will move up the global burden of disease rankings to number five and jump from number six to number three worldwide leading killer, as shown in research released by the Global Health Organization/World Bank [3]. One disease state is chronic obstructive pulmonary disease (COPD). defined by a non-reversible restriction of airflow. COPD symptoms: The anatomically defined condition known as emphysema is marked by the damage and lung alveoli expansion; a clinically recognized condition known as chronic bronchitis, which is characterized by long-term coughing up of mucus; and bronchiolitis, a disease of the tiny airways that affects which tiny airways are constricted. People with chronic obstructive pulmonary disease (COPD) have persistent airflow obstruction. COPD does not diagnose people with persistent bronchitis who don't have persistent airflow obstruction.

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Chronic obstructive pulmonary disease (COPD) is primarily caused by tobacco use. Less than 10% of forced expiratory volume decreases at a faster pace in 20% of smokers. less than one second (FEV1). The amount of pack years has a direct correlation to this decline. puffing away. The mortality rate from chronic obstructive pulmonary disease (COPD) is ten times higher for smokers compared to nonsmokers [1]. The risk is 1.5–3 times higher for people who smoke pipes and cigars compared to nonsmokers. Tobacco use elevated the risk of chronic obstructive pulmonary disease (COPD) in individuals with alpha-1 antitrypsin, not enough. Oxidants, nitrogen oxides, hydrocarbons, and other air pollutants: Sulfur dioxide worsens chronic obstructive pulmonary disease (COPD). Workplace hazards, other variables, such as infections and genetics (alpha-1 antitrypsin deficiency), connected to the development of chronic obstructive pulmonary disease (COPD)[1].

1-2. RESTRICTIVE LUNG DISEASES

their lung volume goes down because of changes in pneumonia, pleural effusion, chest wall disease, or neuromuscular apparatus. From a physiological standpoint, restricted lung disorders are defined by decreased many names for the same concept: total lung capacity, vital capacity, or resting lung volume. Normal airway resistance and maintained airflow are accompanying features. What is known as the Functional Residual Capacity [5] was assessed. Diagnostic accuracy relies on high-resolution computed tomography chest imaging. Each type of interstitial lung disease exhibits a distinct pattern, which requires investigation. Has irregularities [5]. There are a lot of diseases that might lower lung capacity, and some of them could be classified into two categories according to their physical make-up [5]. The first category includes disorders affecting the lung parenchyma or intrinsic lung illnesses. It's possible for these illnesses to cause scarring or inflammation in the lungs (called idiopathic pulmonary fibrosis) or pneumonitis, which is when fluids and foreign matter build up in the air sacs. Some of these illnesses may be described in accordance with the following etiological variables: • Acute interstitial pneumonia and other idiopathic interstitial pneumonias, pulmonary fibrosis (often interstitial pneumonitis), lymphocytic pneumonitis affecting the interstitial spaces, pneumonitis affecting the desquamative spaces, and nonspecific infection of the interstitial lung tissue [5]. Conditions involving the blood vessels and collagen, such as scleroderma, polymyositis, and systemic conditions such as ankylosing spondylitis, rheumatoid arthritis, and lupus erythematosus, can lead to airway narrowing (ALD) [5]. • Medication and various forms of therapy (such as phenytoin, nitrofurantoin, amiodarone, gold, cyclophosphoamide, radiotherapy, bleomycin, and methotrexate [5]. Sarcoidosis is one instance of a primary or undifferentiated disease that can cause lung lymphangioleiomyomatosis, lung langerhan cell histocytosis, respiratory infections including eosinophilic pneumonia, lung alveolar proteinosis, and pulmonary vasculitis Organizing pneumonia with cryptogenic features[5]. • Exposure to inorganic dust (such as silicosis, asbestosis, pneumoconiosis, talk,) the coal worker's pneumoconiosis, berylliosis, and hard metal fibrosis lung illness [5]. • Inhalation of organic dust (e.g., avian lung disease, bagassosis, and farmer's lung). Additionally, there is the mushroom worker lung, which can cause hypersensitivity pneumonitis. to blame [5]. Secondly, there are diseases that do not originate within the parenchyma, alternatively known as extrinsic disorders. Sides of the body: The respiratory pump consists of the pleura and respiratory muscles.

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In order for ventilation to be effective, they must operate normally. Injuries to these parts can lead to airway constriction, compromised ventilator performance, and ultimately, respiratory collapse. These conditions can be described in accordance with the following etiological factors: kyphosis can be idiopathic in nonmuscular disorders of the chest wall. It can either directly or indirectly lead to restrictive lung disease. The leading reasons for polio and muscular dystrophy are examples of neuromuscular diseases that can cause secondary kyphoscoliosis. Ankylosing spondylitis, fibrothorax, obesity, significant pleural effusion, and the procedure known as thoracoplasty [5]. • Weakness in the respiratory muscles is a symptom of neuromuscular disorders, which are caused by phrenic neuropathy, quadriplegia, or myopathy caused by viral or metabolic factors [5]. 1-3.

1-3. THE CLINICAL VALUE OF THE ECG IN NONCARDIAC CONDITIONS

When it comes to diagnosing cardiac disorders, the electrocardiogram (ECG) is a must-have instrument. However, there are a number of noncardiac diseases that can cause abnormalities in an electrocardiogram (ECG), interfering with the differential diagnosis of main cardiac pathology, including electrocardiograms (ECGs). Issues that are commonly observed include problems related to electrolytes, pulmonary drug-related, hypothermia, embolism, and illnesses affecting the central nervous system factors [6]. Understanding the electrocardiogram (ECG) signature of noncardiac diseases in detail can assist doctors in identifying and treating life-threatening diseases more quickly. If the electrocardiogram (ECG) is misread, the patient could end up receiving the wrong treatment. alternatives, at great personal risk [6]. The most common electrocardiogram (ECG) findings in emphysema are: • The P-wave axis moving to the right, with a noticeable P wave in the lower leads, and the P wave in lead I and aVL is flattened or inverted [6]. • Shifting the QRS axis to the right, at an angle of +90º from the vertical axis or beyond deviance [6]. •The PR and ST segments "sag" because to the atrial depolarization that is too severe. under the starting point [6]. • Quarterly resonant sinus complexes with low voltage, most commonly in the left pericardial leads (V4 to Vol. 6 [6]). • The heart beats in a clockwise direction, with the R/S transition points in the symptoms of a persistent S wave in V6 or not, along with pericardial leads. Potentially fulfill the "SV1-SV2-SV3" pattern, in which the lack of the R wave leads from V1 to V3 [6]. Multifocal atrial tachycardia is a condition [6]. Additional alterations, such as P, occur with the development of cor pulmonale (pulmonale caused by enlarged right atrium, right ventricles, and right axis fluctuation) [7].

1-4. MEAN FRONTAL P-WAVE AXIS

In sinus rhythm, the sinoatrial node sets the heart's beat, and the mean P-wave axis, which shows atrial depolarization, is tilted to the left and downward. In healthy adults, the average apparent frontal P-wave axis is thought to fluctuate contained within a small range, from more than 40 degrees to less than 60 degrees. The P-wave is consistently positive in this regard. aVL, III, and I leads [7]. Alterations in electrocardiography in people with both chronic and acute lung illness have occurred since Winternitz initially characterized the P pulmonale in 1935 [10]. The average frontal lobe became more vertical in 1948, as shown by Zuckerman and colleagues. pulmonary artery in chronic obstructive pulmonary disease [11]. Several researchers have since examined ECG correlations with lung roles in long-term pulmonary illness. By utilizing the P-wave axis and using configuration criteria, a blinded researcher achieved a 93% success rate in 100 participants [12]. Employees Spodick and colleagues researched One hundred thirty-one adults diagnosed with pulmonary emphysema and evaluated electrocardiograms (ECGs) using fractional volume cardioversion (FVC) intervals of 2 seconds. The verticalization of the Pwave was shown by them. Axis P pulmonale was significantly associated with worsening obstruction and strangled choke [13]. 1. Five Study Objectives: 1. To show how a certain pattern of chronic obstructive pulmonary disease (COPD) or constrictive along the electrocardiogram's mean frontal P-wave axis.

PATIENTS AND METHODS

The AL-Yarmouk Teaching Hospital's Department of Medicine was the site of this research. Hospital in Baghdad, Iraq, from April 1, 2013, until January 31, 2014. The goal and procedures of the study were explained to patients who agreed to participate. approach to the research and obtaining participants' informed permission. **2- 1. patients** ..We evaluated the pulmonary function of 80 ICU patients, including 40 with obstructive lung disease and 40 with restricted lung disease. Age > 45 years and a normal sinus rhythm on the electrocardiogram were requirements for inclusion. A lung disease called restricted lung illness was found. The pulmonary function test had two conditions: the Forced Vital Capacity (FVC) had to be less than 80% of what it should be, and the FEV1/FVC had to be less than 1. high-resolution computed tomography chest images with a predictive value of 70% or higher, and in order to validate the diagnosis of interstitial lung disorders, radiologist reports were accessible. in accordance with its unique radiographic pattern, such as reticular marking, ground glass, or nodules [5]. Patients with chronic obstructive pulmonary disease who met the criteria set out by the worldwide effort for this study took PFT, chronic obstructive pulmonary disease (GOLD), and other factors into account. denoted by an FEV1/FVC < 70% [1]. All patients had to be 45 or younger (due to the fact that a vertical P wave is an exclusion criterion). An axis could be a typical occurrence in individuals in their youth and health [2–8–9]; those patients with severe valvular heart disorders, those whose heart rhythms are not sinus or pacing, and echocardiograms performed by a specialist can detect dilated chambers and hypertrophy [2, 8]. **2-2. methods..** ECGs and PFTs were examined separately in 80 patients who had the procedure in a successive fashion. We collected forty PFTs from patients with obstructive lung disorders and another forty from patients with restrictive lung disorders. The PFTs were collected no more than six months ago, beginning on the day of the electrocardiogram. Educate yourself. The values of FEV1, VC, and FEV1/FVC are calculated using a spirometry test. We performed the spirometry maneuvers three times and acknowledged the highest value. Patients and Methods in Chapter 2 7 The expected values for FEV1, VC, and FEV1/FVC were presented as a percentage. worth for every single patient. The electrocardiograms were taken while the patient was reclining comfortably on a hospital bed or couch. the floor. A rhythm strip of 12 seconds or more was acquired from a conventional 12-lead electrocardiogram. Each patient underwent this process. The frontal P-wave axis was determined to within five degrees by taking into consideration the Baxley's hexiaxial P-wave amplitudes in leads I, III, aVL, and aVF useful diagram. It was deemed excessively vertical if the axis was more than +60°. We used the conventional approach in this investigation [14, 15]. An alternative method for determining the P-wave axis is as easy as using an electrocardiogram (ECG). A larger P-wave amplitude in lead III

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compared to lead I, and/or when the P-wave amplitude is greater than or equal to 60 degrees, as seen by a negative P-wave in lead aVL, if lead III is equivalent to lead I, and if the P-wave in aVL is flat or equiphasic, then there is a P-wave. along the axis of rotation from +40° to +60°, and a reduced P-wave amplitude in lead III compared to in the P-wave axis is less than or equal to +40° [4] and/or lead I and a positive P-wave in aVL. The three categories of electrographic data were determined by the presence or absence of a frontal P wave. The axis can be either vertical (≥+60°), intermediate (>+40° to <+60°), or horizontal (≤+40°). categories [14, 15].

APPENDIX: QUESTIONNAIRES

- NAME:
- DATE:
- AGE:
- SEX:
- CONSENT:
- MEDICAL HISTORY:

- CHEST EXAMINATION:

- PFT RESULT:
  - FEV1:
  - FEV1/FVC:
  - TLC:
- ECG:
  - RHYTHM:
  - P-WAVE AXIS:

- OTHERS (i.e. Chest X-ray or CT, Echocardiography):

2-3. statistical analysis

In order to analyze the data, the statistical software SPSS—Twenty (SPSS, version 20). The data was displayed using basic statistics like percentage, mean, and frequency. measure of dispersion (SD) and range (lowest to highest values). To see how statistically important different percentages were, a chi-square test (α2-test) and either Fisher's correction or Yet's adjustment were used. Whenever possible, conduct an exact test. We considered a statistical significance whenever the P value was less than 0.05 or equal to it.

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RESULTS

A total number of 80 patients (42 females and 38 males), 40 patients (34 females and 6 males) with restrictive lung diseases, and 40 patients (32 males and 8 females) with obstructive lung diseases were enrolled in the study.

Both groups (restrictive and obstructive) are well matched regarding the age and sex distribution.

The mean ± SD for age were 54.6±4.9 and 55.9±6.8 for patients with the restrictive and obstructive lung diseases respectively (Table 3-1).

		Restrictive Pulmonary Disease		Obstructive Pulmonary Disease		P value
		No	%	No	%	
Age (years)	<50	6	15.0	8	20.0	0.217
	50--54	10	25.0	8	20.0	
	55--59	16	40.0	6	15.0	
	=>60	8	20.0	18	45.0	
	Mean±SD (Range)	54.6±4.9 (47-63)		55.9±6.8 (45-65)		
Gender	Male	6	15.0	32	80.0	0.0001*
	Female	34	85.0	8	20.0	

Table(3-1) Distribution of cases according to the age and gender in relation to restrictive or obstructive lung diseases.

*Significant using Pearson Chi-square test at 0.05 level.

There was a clear difference between the P-wave axes distribution between the patients with restrictive and obstructive lung diseases (Figure 3-1). The mean ±SD for P-wave axis were 42.0±11.1 and 71±5.9 for patients with restrictive and obstructive lung diseases respectively (Table 3-2). Thirty-eight of forty patients with obstructive lung disease the P-wave axis were vertical (≥+60°) and two was in the intermediate range (>+40° to <+60°). Among those with restrictive disease, only four were in the vertical range (≥+60°), twelve were in the intermediate range (>+40° to <+60°), and most twenty-four were in the horizontal range (≤ +40°), differences in distribution were significant (P<0.001)

(Table 3-3)

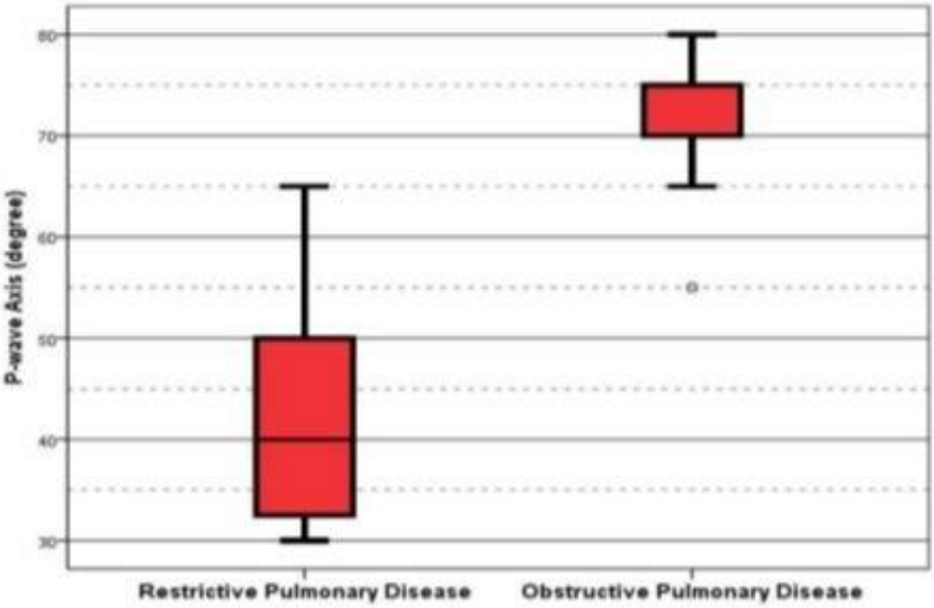

Figure (3-1) P-wave axis distribution in restrictive and obstructive lung diseases

		Restrictive Pulmonary Disease		Obstructive Pulmonary Disease		P value
		No	%	No	%	
P-wave Axis (degree)	<40	16	40.0	-	-	
	40--	12	30.0	-	-	
	50--	8	20.0	2	5.0	
	60--	4	10.0	4	10.0	
	70--	-	-	28	70.0	
	=>80	-	-	6	15.0	
	Mean±SD (Range)	42.0±11.1 (30-65)		71.8±5.9 (55-80)		0.0001*

Table (3-2) The mean P-wave axis in patients with restrictive and obstructive lung diseases.
*Significant using Students-t-test for difference between two independent means at 0.05 level.

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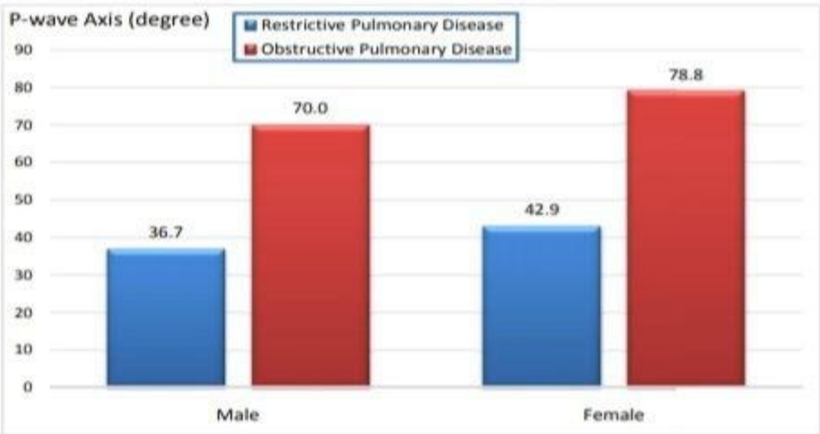
		Restrictive Pulmonary Disease		Obstructive Pulmonary Disease		P value
		No	%	No	%	
P-wave Axis (degree)	Vertical (≥+60°)	4	10.0	38	95.0	0.0001*
	Intermediate (>+40° to <+60°)	12	30.0	2	5.0	
	Horizontal (≤+40°)	24	60.0	-	-	

Table (3-3) The significant effect of obstructive lung disease on the verticalization of the P-wave axis, this effect not seen with restrictive lung disease.
*Significant using Pearson Chi-square test at 0.05 level.

In both females and males, the obstructive lung disease shift the P-wave axis toward the vertical range, with no verticalization in patients with restrictive lung disease. Figure (3-2), demonstrates the distribution of cases of restrictive and obstructive lung diseases according to the gender in relation to the P-wave axis.



Figure(3-2) Distribution of cases of restrictive and obstructive lung diseases according to the gender in relation to the P-wave axis.

The mean ±SD for P-wave axes in patients with obstructive lung disease were 70.0±5.2 and 78.8±2.5 for males and females respectively. But in the patients with restrictive lung disease, the mean ±SD for P-wave axes were 36.7±2.9 and 42.9±11.7 for males and females, respectively (Table 3-4).

		P-wave Axis (degree)		P value
		Restrictive Pulmonary Disease	Obstructive Pulmonary Disease	
Gender	Male	36.7±2.9	70.0±5.2	0.0001*
	Female	42.9±11.7	78.8±2.5	0.0001*
	P value	0.379	0.004*	
Data were presented as Mean ±SD				

Table(3-4) The mean P-wave axis in patients with restrictive and obstructive lung diseases for both genders.

*Significant using Students-t-test for difference between two independent means at 0.05 level.

DISCUSSION

There is a strong relationship between the verticalization of the frontal P-wave axis and its association with emphysema and has been the subject of substantial prior research [2, 8–14]. And when the frontal P-wave axis becomes more vertical, there is a correlation between an increase in the level of diaphragmatic depression [14], degree of airway blockage [9, 13], and measurement of illness using radiographs [16, 18]. The P-wave axis and its possible mechanisms: Patients with obstructive pulmonary disease verticalize because their lungs get too inflated. The diaphragm then descends. The right atrium is strongly attached to the diaphragm by a pericardial ligament. This seems to explain why these things happen: as the diaphragm flattens out, the right atrium deforms or moves downwards. When someone has lung disease, the opposite of what normally happens in the restrictive P-wave axis happens: it turns horizontal. This is matched by the atrium rising to the right through the diaphragm at a high level [14]. Randomized controlled trial of patients among patients with obstructive pulmonary disease (COPD) as contrasted to those with simply restrictive P-wave axis to align with diaphragmatic level, allowing patients with restricted patients with lung illness and a high diaphragm exhibited P-waves that were horizontal and shifted to the left, while patients suffering from obstructive lung illness and a low diaphragm tended to have P-wave axes that were vertical [14]. There was also the possibility that the change in the P-wave axis was caused by a weakened electrical impulse conductor due to an expanded lung and that intrudes upon the heart and major arteries, altering the typical routes for conductance. As a result, the heart's structure remains unchanged, on top of which the vertical P-wave axis is more imaginary than actual [17]. In their research, Baljepally et P-wave axis >60° was determined to be sensitive and specific for emphysema, according to al. That's 89% and 96%, respectively, according to the data [8]. Chhabra et al. conducted an additional investigation on sensitivity, and using a vertical P-wave axis to diagnose emphysema had a specificity of 94.7% and 86.4% in that order [9]. Historical correlation analyses [8, 9] make it crystal evident that a P-wave axis that is vertical on an ECG stands head

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and shoulders above the others. Acute emphysema diagnosis is both sensitive and specific [8, 9]. This study's findings compare the frontal P-wave axis in individuals with completely individual pulmonary, obstructive, or strictly restrictive lung disease examinations, and further testing (such as high-resolution CT scans) validated the results. These findings show that there are significant variations in their axial distributions. In obstructive lung illness, the P-wave axis display the anticipated nearly all cases (95%) exhibited verticalization (≥+60°), whereas patients with restricted diseases were focused on the ranges from horizontal (≦+40) to intermediate (>+40° to <+60°) to 60% and 30%, correspondingly. What differentiates these distributions from one another reached an extremely significant level ($p<0.001$). Within the common intermediate range, the distribution of the restricting group is typical participants, but mostly exhibited a flatter profile that was clearly differentiated from nearly all patients with chronic obstructive pulmonary disease who were vertically oriented [14, 15]. There was less of a correlation between the precise horizontalization and the real axis. just as the more concentrated vertical axis in the obstructive lung disease patients. In many patients with restricted lung disease, the P-wave axis overlaps within the typical upper bound of the P-wave axis; it is not sufficient as a standalone metric in cases of restricted lung disease [15]. Limitations: There are a few restrictions on this study: 1. The P-wave verticalization method only detects obstructive lung disease. when the patient's electrocardiogram shows a normal sinus rhythm. Needless to say, there is an unusually high incidence of atrial arrhythmias in people with multifocal chronic obstructive pulmonary disease and similar instances of tachycardia. The principle in question is inapplicable since the P-wave axis is not constant. 2. Emphysema was not diagnosed in the group of patients with obstructive lung disease. All of the individuals included in the study had high-resolution computed tomography scans for the purpose of diagnosis, which are recognized to exhibit enhanced sensitivity and specificity for emphysematous alterations in structure. 3. Everyone who participated in the study had a preexisting condition of obstructive and restrictive lung disorders, with the availability of pulmonary function tests and other further examinations (such as high-resolution computed CT scans); then the electrocardiographic criteria' specificity in identifying any of these categories was not possible to quantify in this investigation.

CONCLUSION

1. When looking at an ECG, the vertical P-wave axis (≥+60°) is a useful adult obstructive lung disease trademark.
2. The P-wave axis provides a quick, easy, and basic classification method. This applies to individuals suffering from chronic lung illness, those with an obstructive pattern, and anyone without, regardless of their location.

3. RECOMENDATIONS

If the patient is in good health, the variations in the P-wave axis will be easier to see. In a subsequent investigation, controls will be incorporated. We will educate Iraqi medical professionals on the P-wave axis and the basic axis calculation method, especially for hospital-based projects that require research techniques like PFT.

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