Prevalence of Ventricular Late Potentials in Patients with COPD

KRONİK OBSTRÜKTİF AKCİĞER HASTALIKLI OLGULARDA VENTRİKÜLER GEÇ POTANSİYELLERİN PREVALANSI

Serap BİLEN*, Can HAMSİCİ**, Erdoğan İLKAY**, Çiğdem BİBER*, Sinan ÇOPUR*
Özcan ÇENELİ**, Yurdanur ERDOĞAN*

* Ataturk Chest Diseases and Surgery Center,
** First Aid and Traumatology Hospital, Ankara, TURKEY

Summary

In electrocardiogram (ECG), late potentials (LP) in the last 40 msec of QRS complex were evaluated on 30 stable chronic obstructive lung disease (COPD) patients by using high resolution and signal average ECG (SAECG) technics.

Patients were divided into two groups according to pulmonary function levels as mild-moderate (group A) and, severe (group B) obstructive.

No patient had ischemic heart disease and had received anti-arrhythmic drugs for at least seven days before the study. Blood teophillin levels were in normal ranges. In each case filtered QRS time (fQRS) at 40-250 frequency intervals, frequency square root voltage at the last 40 msec of QRS ($RMS_{40}v$) and duration of signals with high frequency and low amplitude of filtered QRS under 40uV ($HFLA_{40}D$) were recorded.

When there were at least two conditions of fQRS>120 msec $RMS_{40}v$<25uV, $HFLA_{40}D$>35 msec. LP was accepted as positive. Seven patients had LP positivity and they were in group B. Ventricular tachycardia! attack were observed in only one patient with LP positive while it cou/dn't be detected in LP negative patients. In follow up period sudden death was observed only in one patient.

In conclusion a correlation was detected between the LP positivity and severity of COPD. It was suggested that a long period of follow up is needed to define prognostic importance of LP positivity in COPD.

Key Words: Ventricular late potential, COPD, Arrhythmias

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Özet

EKG'de QRS kompleksinin son 40 msn'de görülen geç potansiyeller (GP), yüksek rezolüsyon ve sinyal ortalama/ı EKG tekniği kullanılarak 30 stabil kronik obstruktif akciğer hastalıklı (KOAH) olguda incelendi.

Olgular solunum fonksiyon testlerine göre hafif-orta (A) ve ileri (B) derecede obstruktif olarak gruplandırıldı. Olguların hiç birisinde iskemik kalp hastalığı yoktu, en az 7 gündür antiaritmik tedavi almıyorlardı ve kan teofilin düzeyleri normal sınırlar içerisindeydi. Her olgu için 40-250 frekans aralığında filtre edilmiş QRS süresi (fQRS). filtre edilmiş QRS'in son 40 msn'deki karekök voltajı ($RMS_{40}v$) ve filtre edilmiş QRS'in 40uV altındaki düşük frekanslı, yüksek amplitüdlü sinyallerin süresi ($HFLA_{40}p$) kaydedildi.

fQRS>120 msn. $RMS_{40}v$<25uV, $HFLA_{40}D$>35 msn değerlerinden en az ikisinin olması halinde GP (+) kabul edildi. Olguların 7'sinde (%23) GP (+)'di ve GP (+) olan olguların tümü B grubunda yer almaktaydı. GP (+) olguların I 'inde (%14) ventriküler taşikardi (VT) atakları gözlenirken, GP (-) olgularda VT tesbit edilmedi. İzlem süresince GP (+) olan I olguda ani ölüm görüldü.

Sonuç olarak GP (+)'liği ile KOAH'ın şiddeti arasında bir korelasyon olduğu ve GP (+)'liginin KOAH'daki prognostik öneminin belirlenmesi için olguların uzun süreli izlenmesinin gerektiği düşünüldü.

Anahtar Kelimeler: Ventriküler geç potansiyeller, KOAH, Aritmi

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Cardiac arrhythmias are seen very often and their type and frequency have a wide distribution in chronic obstructive lung disease (COPD) (1-4). The factors causing arrhythmias include ischemic cardiac disease with COPD, hypertension, hypoxemia, metabolic and acid-base disorders, diabetes mellitus, renal insufficiency and drugs used for COPD (1-8). It was reported that hospitalized COPD patients had high mortality when they had ventricular arrhythmias (1). In order to decrease the mortality rate from ventricular arrhythmias many methods

Correspondence: Serap BİLEN
Kennedy Cad. 30/3
Kavaklıdere 06660 Ankara, TURKEY

have been developed. These methods are being used to detect the patients who have sudden cardiac death risk. To assess ventricular arrythmias and sudden death risk, Ho Iter monitorisation, programmed electrical stimulation and late potential analyses can be used.

In the last 20 years, many researchers recorded electrical activities with high frequency and low amplitude at the end of QRS complex in animals with experimental myocardial infarction and patients with chronic ventricular tachycardia (9,11,13). The microvolt level waves were called as LR Formerly LP was recorded with endocardial and cpicardial mapping invasively but now it can be detected on the body surface by high resolution and signal average ECG (SAECG) techniques (9,11,16).

The aim of this study is to detect ventricular late potential prcvalance and its prognostic importance by using high resolution and signal average ECG technique on hospitalized and stable COPD patients.

Materials and Methods

This study was performed in the Atatürk Chest Disease and Surgery Center and Cardiology Department of First Aid and Traumatology Hospital, between July 1994-September 1995, on thirty hospitalized COPD patients (14 female and 16 male). Mean age of the group was 32±0.4 and age range was between 29-81 years.

In each patient, physical examination, complete blood chemistry, urine analysis, and arterial blood gases analysis were performed. Telcradiograms, ECG with 12 derivations and pulmonary function tests were also obtained.

COPD diagnosis was performed by using history, physical examination, x ray, and pulmonary function test findings.

All of the patients' ECGs were in normal sinusal rhythm and they didnot take antiarrhythmic drug for at least 7 days. No patient gave a history of angina pectoris, previous MI, and coronary bypass surgery. In all cases left ventricular functions were normal according to echocardiography and myocardial ischemia was not detected by myocardial perfusion scanning. Those cases with systemic diseases like hypertension, malignancy, renal or hepatic insufficiency, diabetes mellitus were excluded from the study. None of the patients gave history of smoking for the last two years. Pulmonary function tests were performed by using Vitalograph Alpha Comprehensive spirometry. FEV,, FEF^s, PEF and FEV,/FVC were used to determine the groups. Patients were divided into two groups as mild-moderate and severe obstructive diseases. Holter ECG monitorizations were performed on every patient in a 24 hour period consecutively for three days. Records were taken on modified V, V_5 D_5 derivations and analysed by using Delmar Model 262 spectra scan system. Ventricular arrhythmias were classified by Mycrburg classification (15).

Marquette Electronics Inc. Case system was used to record the ventricular late potentials. In each patient, ECG was recorded in the supine position after 15 minute rest period by using high resolution SAECG technique. ECG was recorded on sinusal rhythm and standart bipolar x,y,z axis. Positive electrods x,y and z were positioned at the fourth intercostal space in left midaxiller line, V3 localization or proximal left leg and V2 localization respectively. G (Ground) was placed on the right eigth rib. Negative electrods x,y and z were positioned at 4^{th} intercostal space in right midaxiller line, on the manibrium and posterior of V2 localization respectively. Recording signals using these electrods were augmented by an amplificator with 3 channels. Mean of 250 QRS complex from xyz derivations were calculated by computer. Digital filters with 40-250 Hz permeability limits were used for cancelling unwanted low or high frequency potentials. Signals passing through filters with two directions were turned into vectorial amplifiers by square root of $x^2+y^2+z^2$.

At least 250 cardiac beats were filtered on 40-250 frequency intervals. Square root voltages in the last 40 msec of QRS complex, duration of signals with high frequency and low amplitude and filtered total QRS duration were calculated by computer. LP was accepted positively when there were at least two of these parameters: fQRSD>120 msec, $HFLA_{40}$>35 msec and RMS_{40}V<25 uV (19,20).

In the study, relation between the prevalancc of LP and ventricular tachycardia and sudden death

risks were investigated. The effect of pH, $Pa0_2$ and $PaCO_2$ to LP positivity and LP distributions in patients with mild-moderate and severe obstructive diseases were evaluated statistically.

Statistical analyses were performed using the Mann-Whitney U Fisher's exact chi-square and McNemar's test.

Results

Table 1 presents the results and the comparisons of the groups mild-moderate (A) and severe (B). Between the two groups pulmonaiy function test results, arterial blood pH, and $Pa0_2$ values showed statistically significant differences (respectively $p<0.001$, $p<0.05$, $p<0.01$) while $PaC0_2$ values had no significance ($p>0.05$). Blood potassium

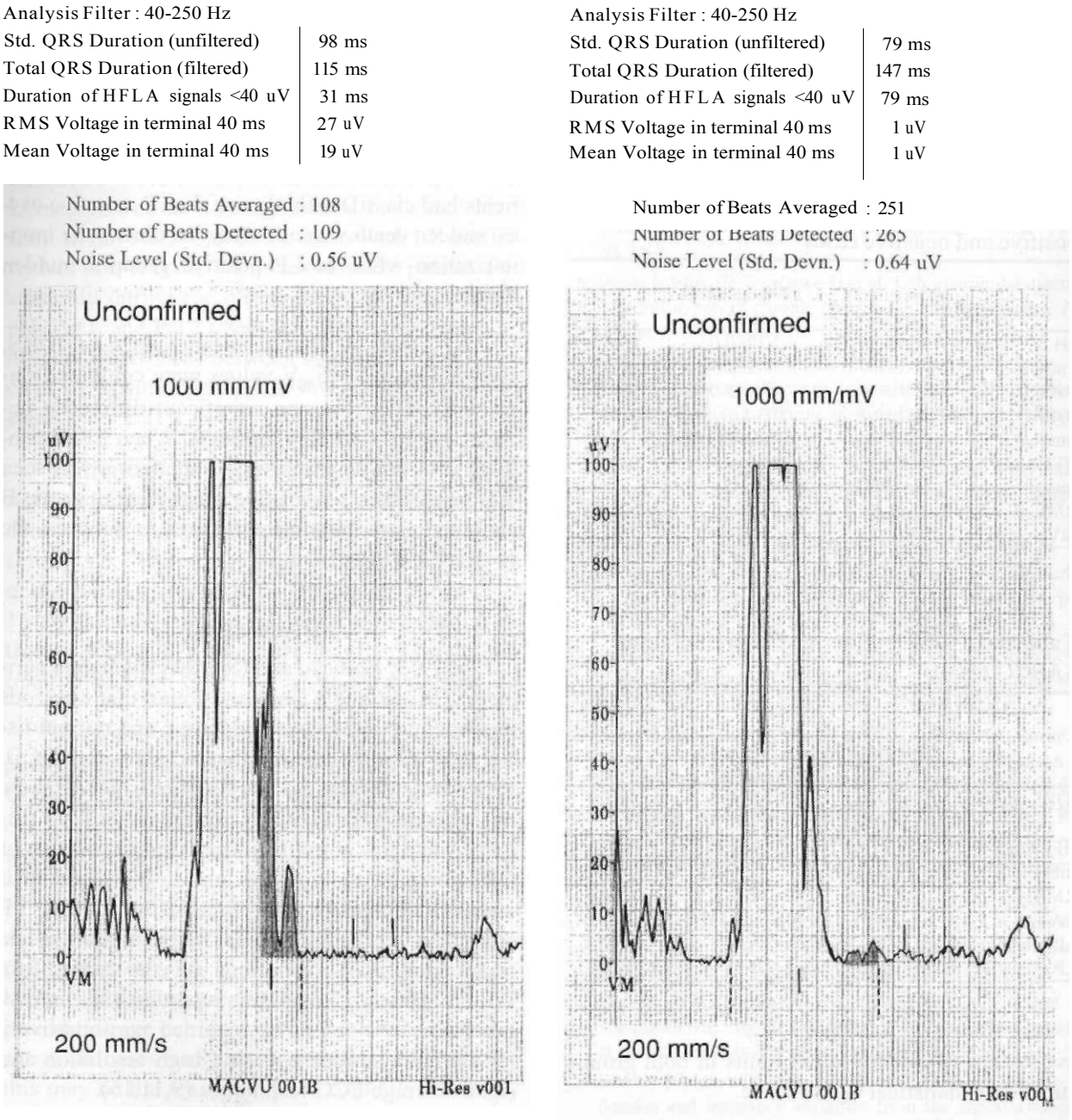

Figure 1. An example of LP negative (left side) and LP positive (right side) cases.

Table 1. Comparisons of mild-moderate and severe obstructive group results.

	Mild-Moderate (A) (n=12)	Severe (B) (n=18)	p
Age (year)	44.2±2.6 (32-60)	57.9±3.3 (29-81)	<0.01
Sex (M/F)	3/9	13/5	<0.05
Arterial blood pH	7.4±0.01	7.38±0.01	<0.05
$Pa0_2$ (mmHg)	63.4±2.7	52.2±2.4	<0.01
$PaC0_2$ (mmHg)	39.5±2.5	44±2.4	>0.05
FEV, (%)	64.6±2.7	31.3±2.7	<0.001
FEF_{25-75} (%)	61 ±3.2	12.7±3.0	<0.001
PEF (%)	60±2.5	33.4±2.3	**0.001**
FEV,/FVC	63.6±1.8	40.3±1.2	**0.001**
K^+ mEq/L	4.1±0.1	4.4±0.1	>0.05

Table 2. Comparisons of the results from LP positive and negative cases

	LP (positive) (n=7)	LP (negative) (n=23)	p
pH	7.39±0.01	7.39±0.0	>0.05
PaO,	54.6±3.8	57.3±2.4	>0.05
$PaC0_2$	42.9±3.8	41.9±2.0	>0.05
fQRSD (msec)	129.8±9.8 (107-179)	103.U1.5 (87-116)	O.001
$HFLA_{40}D$ (msec)	53.3±9.5 (36-79)	26.6±1.6 (19-42)	O.0001
$RMS_{40}V$ (11V)	14±3.8 (1-24)	50.7±5.1 (27-113)	O.0001

Table 3. LP distributions and high resolution SAECG results

	Mild-Moderate (A) (n=12)	Severe (B) (n=18)	p
fQRS (msec)	104.2Ü.5 (94-112).	1 12.4±5.2 (87-179)	>0.05
$HFLA_{40}D$ (msec)	29.3Ü.9 (23-41)	36±5.1 (12-99)	>0.05
$RMS_{40}V$ (uV)	49.5±7.5 (27-103)	37.2±6.5 (1-113)	>0.05
LP (positive)	0	7	O.05
LP (negative)	12	1 1	O.05

levels were found in normal limits in both groups and had no statistical significance.

Late potentials were positive in 7 of 30 cases. In Figure 1, ECG samples of LP positive and LP negative cases are presented. High resolution SAECG values of the patients with positive or negative late potentials were shown in Table 2. SAECG parameters were significantly different between groups with LP positive and LP negative. Ventricular arrhythmias which were detected in cases were classified by Myerburg classification (15).

In one of seven cases with LP positivity (14%), non-chronic VT attack (Class D) was detected during Holter ECG monitorisation. In the remaining 6 cases with LP positivity, 3 cases were in class A, 2 cases in B, and one case in C respectively. In 23 cases with LP negativity, 5 cases had no arrhythmias, while 18 cases had class A (9 cases) class B (6 cases) and class C (3 cases) arrhythmias. No patients had class D arrhythmias. In LP negative cases, sudden death was not observed during the monitorization while in LP positive group 1 sudden death occurred.

In groups A and B, mean values of fQRS, $HFLA_{40}D$ and $RMS_{40}V$ values were compared statistically. There was no significant difference between groups (p>0.05) (Table 3). When LP distribution in A and B group was evaluated, it was seen that all of seven LP positive cases were in group B and there was significant difference between the groups (p<0.05) (Table 3).

Discussion

In 1973, Boincau and Cox investigated experimental MI on dog's heart and found that electrods on ischemic field between necrotic and normal tissue draw asynchronic fragmantcd activation ECG. However electrods on normal field didnot show this phenomenon (9). This activity with high frequency and low amplitude was at the last section of QRS complex and could extend to ST segment. It was called as LP late potential (9-11,13). LP recordings on the body surface were similar to late fragmented ECG recordings on the heart (26). While formerly LP could be recorded only on myocardium, now it can be recorded non-invasively on the body surface by using high resolution and signal average ECG techniques (9,11,16).

Ventricular LP was a useful method of detecting the patients with the risk of sudden death and

chronic VT attack. Until today usually the risk groups after infarction have been investigated (12,14,17,18). After MI, LP prevalance had been found between 21-55% (19-21). In our study LP prevalance was investigated on hospitalized patients with stable COPD and it was found to be 23%. This rate was very high and similar to post MI LP prevalance rate. The results from available studies show that chronic VT attack rates in the first year were between 14-29 in cases with MI and LP positivity while they were only between 0.8-4.5% in cases with LP negativity (20). We couldn't find any cases with chronic VT attack. After MI, non-chronic VT attack rates were between *1-22%* of cases and related with increasing rates of sudden death and cardiac mortality (21-23). It was reported that 40-3.6% of LP positive cases and 0.4-3% of LP negative cases were candidates for sudden death (20). In our study one of the cases with LP positivity had non-chronic VT attacks and the patient died suddenly during the observation period. Although pH, $Pa0_2$ and PaCO-, values of patients had no significant differences between groups, all of the cases in LP positive group had severe obstructive disease.

Holford and Mithoefer performed Holter monitorization for 72 hours and found aniiythmia incidence as 89% in hospitalized COPD patients. In the follow up, after discharging from hospitals 15 deaths were recorded and they reported that 11 of 15 deaths were sudden and unexpected. Based on these findings they suggested that there might be a relation between sudden death and arrhythmias (2).

In another prospective study sudden and unexpected death were found approximately 10% in 200 COPD patients (24-25). In our study we followed our patients between 9 to 12 months and one case with LP positivity died.

Our patients didnot show myocardial ischemia at myocardial perfusion scintigraphy. But this method has only 50-79% sensitivity even all vascular beds in the heart arc evaluated individually (27). In addition we couldn't perform exercise ECG because all cases had obstructive disease. Therefore this may be the reason why we couldn't detect any ischemic finding in our patients and this may explain why we found 7 LP positive cases.

In conclusion the results of this study suggests that there may be a correlation between LP positivity and severity of COPD but this correlation must be confirmed other studies with more patients and long time follow up is necessary to determine the prognostic importance of LP positivity in COPD.

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