韓國農村醫學會誌 : 第25券 第1號 2000
Korean J of Rural Med Vol. 25, No. 1, 23~27, 2000

Erythrocyte Cholinesterase Activity and Demographic Factors in Healthy Human

Won-Jin Lee*, Cheong-Sik Kim, Jin-Seok Kim[1)], Soung-Hoon Chang
Department of Preventive Medicine, College of Medicine, Konkuk University
Department of Occupational Medicine, College of Medicine, Soonchunhyang University[1)]

적혈구 콜린에스테라제 활성도와 인구학적 특성

건국대학교 의과대학 예방의학교실, 순천향대학교 의과대학 산업의학과[1)]
이원진*, 김청식, 김진석[1)], 장성훈

= 국문초록 =

적혈구 콜린에스테라제 활성도와 성, 연령, 키, 몸무게, 음주 및 흡연력 등 인구학적 특성과의 관련성을 살펴보기 위해서, 두 곳의 농약 사업장 근로자 52명과 의과대학생 51명 등 총 103명을 대상으로 현장 검사용 기계를 이용해 2000년 1월부터 2월까지 적혈구 콜린에스테라제 활성도를 측정하였다. 조사 대상자는 남성이 89명(86.4%), 여성이 14명(13.6%)였으며 평균 연령은 각각 31.8±11.4, 27.1±10.0 세였다. 측정된 적혈구 콜린에스테라제 활성도의 평균값은 남성에서 34.7±3.9 U/g hemoglobin, 여성에서 34.0±4.0 U/g hemoglobin으로 군간 유의한 차이가 없었다. 한편 적혈구 콜린에스테라제 활성도와 조사된 모든 인구학적 변수들간에는 유의하지 않은 매우 낮은 상관성만이 관찰되었다. 결론적으로 적혈구 콜린에스테라제 활성도는 혈장 콜린에스테라제 활성도와는 달리 성, 연령, 키, 몸무게 등 인구학적 변수와 상관성을 보이지 않는다고 판단되었다.

KEY WORDS :Erythrocyte cholinesterase, Demographic factors, Human

INTRODUCTION

Cholinesterase, or more properly acetylcholinesterase, is an enzyme necessary for nerve impulse transmission. If the activity of this enzyme is reduced below a critical level by pesticides exposure, nerve impulses to the muscles can no longer be controlled, resulting in serious consequences and even death. So workers who apply pesticides should be monitored by measuring acetylcholinesterase(Herdrich, 1998).

Acetylcholinesterase is present in both

*Corresponding author(E-mail : wonjin.lee@kku.ac.kr)

red blood cells and plasma. The red blood cell acetylcholineserase is called erythrocyte cholinesterase and typically used as a good marker of chronic exposure, whereas the plasma cholinesterase used short-term indicator (Brown, 1999). It is known that plasma cholinesterase activity can be affected by many physiological and pathological conditions such as age, sex, obesity and liver disease (Brock and Brock, 1993). Erythrocyte cholinesterase activity also has great inter-individual variations according to their individual factors. Reliable knowledge of normal inter-individual variations in healthy individuals is crucial for interpretation of observed level of cholinesterase in environmental medicine. However relating individual factors with erythrocyte cholinesterase activity has not been reported.

To determine whether the main demographic factors such as age, sex, height, weight, smoking and alcohol consumption, are correlated with erythrocyte cholinesterase activity in healthy human, we measured erythrocyte cholinesterase activity by using the field kit in healthy workers and medical students.

MATERIALS AND METHODS

Subjects

Two groups of healthy individuals were recruited including: 1) 52 healthy workers in two pesticide manufacturing factories located in Tajeon and Chechen; and 2) 51 healthy medical students on a voluntary basis from January to February 2000. They were interviewed information on age, sex, height, weight, recent medical history, smoking and alcohol consumption. Among the study subjects, who have liver disease, were excluded.

Measurement of erythrocyte cholinesterase activity

Erythrocyte cholinesterase activity was measured by finger-stick kit according to the manufacturer's specification (EQM Research Inc, 1999). Finger-stick samples were collected by swabbing the fingertip with alcohol, allowing the site to air dry for 1 minute, piercing the finger with a lancet, and then filling a 10 ul capillary pipette. At this time, we filled second drop of blood after cleaning first drop of blood. This sample was combined with a buffered solution and inserted into the previously standardized machine. Four drops of reagent solution were then added to the diluted blood, and the sample was reinserted into the machine. After 130 seconds, hemoglobin-corrected erythrocyte cholinesterase activity(U/g hemoglobin) results were displayed.

Statistical analysis

Continuous data are summarized as mean±SD. To determine whether there was statistical significance in erythrocyte cholinesterase activity with demographic factors, we performed Pearson correlation test by using the SPSS version 7.5. We considered P value of 0.05 as the criterion for statistical significance.

Table 1. Demographic characteristics and erythrocyte cholinesterase activity in the study subjects

Characteristics	Male(N=89)	Female(N=14)
Age(years)**	31.8±11.4	27.1±10.0
Height(cm)**	172.0± 5.2	160.7± 3.0
Weight(kg)**	67.8± 8.3	48.6±15.1
Body Mass Index(kg/cm^2)**	22.9± 2.5	18.9± 6.0
Smoking(pack-year)**	8.0± 8.4	0.0± 0.0
Alcohol(g/day)**	18.8±22.3	4.5± 4.2
AchE(U/g Hgb)	34.7± 3.9	34.0± 4.0

pack-year = ((Number of cigarettes/day)/20) × (total duration of smoking).
AchE = erythrocyte cholinesterase activity
** P < 0.01 by t-test.

Table 2. Correlation matrix of erythrocyte cholinesterase, age, height, weight, BMI, smoking and alcohol consumption in whole study subjects(N=103)

Variables	Age	Height	Weight	BMI	Smoking	Alcohol(g/day)
AchE(U/g Hgb)	-0.055	-0.004	-0.018	-0.022	0.165	0.056
Age(year)	-	-0.232*	0.101	0.241*	0.765**	0.144
Height(cm)	-	-	0.765**	0.182	0.044	0.170
Weight(kg)	-	-	-	0.910**	0.168	0.127
BMI(kg/m^2)	-	-	-	-	0.186	0.066
Smoking(pack-year)	-	-	-	-	-	0.369**

* P < 0.05, ** P < 0.01 by Pearson correlation.

RESULTS

The demographic characteristics and erythrocyte cholinesterase activity are represented as means and standard deviation(Table 1). The study population was predominantly male(86.4%), and average mean age of male was 31.8±11.4 (mean±SD) years, whereas 27.1±10.0 in female. The average erythrocyte cholinesterase activity was 34.7±3.9 U/g hemoglobin in male and 34.0±4.0 U/g hemoglobin in female respectively. All of characteristics were statistically significant between male and female group, except erythrocyte cholinesterase activity.

We observed none of variables were significantly correlated with the erythrocyte cholinesterase activity(Table 2). Age was positively correlated to BMI (r=0.241) and smoking(r=0.765). Alcohol consumption was positively correlated with smoking (r=0.369). But the Pearson correlation coefficient between erythrocyte cholinesterase activity and age(r=-0.055), height(r=-0.004) and weight(r=-0.018)

were very non-significant.

DISCUSSION

This study in healthy workers and medical students shows that erythrocyte cholinesterase activity does not significantly correlated with demographic factors, such as age, sex, BMI, smoking and alcohol consumption habits.

Previous study (Brock and Brock, 1993) discussed the factors affecting plasma erythrocyte cholinesterase activity in human. They showed that the plasma erythrocyte cholinesterase activity was significantly correlated with genetic phenotype, age, sex, height and weight in 1,091 health individuals.

But we observed erythrocyte cholinesterase activity, which is used as more reliable biomarker for exposure to organophosphates than plasma cholinesterase, does not significantly correlated with age, sex, height and weight. To our knowledge, this is the first report of describing the correlation with erythrocyte cholinesterase activity and demographic factors. The reason for the discrepancies between our study and other may be due to differences in cholinesterase type. But at present, no sufficient explains have yet been suggested why erythrocyte cholinesterase activity is not significantly correlated with demographic factors, whereas plasma cholinesterase activity is correlated with age, sex, height and weight.

Anyway, no correlation with erythrocyte cholinesterase activity and demographic factors imply that erythrocyte cholinesterase activity can be more accurate biomarker than plasma cholinesterase activity, that means erythrocyte cholinesterase activity reflects more objectively the biologic changes when they are exposed to pesticides regardless of their age, sex, height and weight.

One limitation of our study is small sample size. It can be caused small correlation coefficients. This limitation should compensate further studies which having large population. Using the field kit instead of conventional laboratory method can be another controversy of this study. But London(1995) already insists that field kit, which is same to our study, erythrocyte cholinesterase activity estimation is sufficiently repeatable. And Tharr(1998) said the specificity of the finger-stick test kit is 100 percent, assuming that the laboratory method is a gold standard.

In summary, we can not find the significant correlation erythrocyte cholinesterase activity with demographic factors in our study subjects.

ACKNOWLEDGEMENTS

We thank the workers and medical students for their wholehearted co-operation.

REFERENCES

1. Brock A, Brock V. Factors affecting

inter-individual variation in human plasma cholinesterase activity: body weight, height, sex, genetic polymorphism and age. Arch Environ Contam Toxicol 1993;24(1):93-99
2. Brown AE, Miller M, Keifer M. Cholinesterase monitoring-A guide for the health professional. Pesticide information leaflet 1999;30:1-5
3. EQM Research Inc.: Test-Mate ChE Cholinesterase Test System (Model 400), Instruction Manual. EQM Research Inc., Cincinnati, OH, 1999
4. Herdrich N. Cholinesterase field-test kit shows good potential. Agrichemical & Environemntal News. 1998;152:13-15
5. London L, Thompson ML, Sacks S, Fuller B, Bachmann OM, Myers JE. Repeatability and validity of a field kit for estimation of cholinesterase in whole blood. Occup and Environ Medicine 1995;52:57-64
6. Tharr D. Rapid assessment of organophosphate-induced cholinesterase depression: A comparison of laboratory and field kit methods to detect human exposure to organophosphates. Appl Occup Environ Hyg 1998;13(5):265-268