

Blood cholinesterase levels in the elderly and newborn

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Abstract

The spectrophotometric method of Ellman was used to determine cholinesterase (ChE) levels in plasma and whole blood in elderly patients and umbilical cord blood of newborn infants. The mean \pm SD for plasma and whole blood ChE levels were 2.24 \pm 0.58 micromol/min/ml and 4.38 \pm 0.65 micromol/min/ml respectively in a group of healthy elderly patients (n=25). The mean \pm SD for plasma and whole blood ChE levels were 2.23 \pm 0.77 and 3.31 \pm 0.56 respectively in cord blood of healthy full term newborn infants (n=25). In a group of healthy adult blood donors' the general mean \pm SD for plasma and whole blood ChE have been shown to be 2.71 \pm 0.75 and 4.87 \pm 0.73 micromol/min/ml respectively.

Statistical analysis revealed that the mean levels of plasma and whole blood ChE in elderly, newborn infants and adults were different ($p < 0.001$). However, there was no statistical difference between the mean level of plasma ChE in elderly and cord blood but each shared statistically significant difference when compared to the mean level in adults. The mean activity of whole blood ChE in the 3 groups was different from one another. Theoretically, decreased levels of ChE would suggest a careful assessment of drugs that are hydrolysed by ChE.

Key words: Cholinesterase, elderly, cord blood.

INTRODUCTION

Cholinesterase is a group of enzymes which hydrolyzes acetylcholine and some other esters. There are two related enzymes that have the ability to hydrolyze acetylcholine. Acetylcholinesterase or "true" ChE hydrolyses acetylcholine which is released at nerve endings. Degradation of acetylcholine is necessary for depolarization of the nerve so that it can be repolarized in the next conduction event. Although the red blood cell is rich in this enzyme, measurement of whole blood ChE is also useful because procedures using whole blood are more practical than those using separated erythrocytes. The other ChE, plasma ChE or pseudocholinesterase, has no defined biological role. However, to the anaesthesiologist, decreased ChE activity, either on a quantitative or qualitative basis, can theoretically cause prolonged postoperative paralysis and respiratory failure in the patient exposed to succinylcholine (a muscle relaxant), during anaesthesia and surgery.

Studies on ChE activity in cord blood of newborn infant have been reported to be significantly lower than in adults.² However, other authors observed no difference of abnormally low ChE levels between adults and preterm or term infants.³ As data on plasma and

whole blood ChE levels in elderly and newborn infants are not available locally, the present study was undertaken to determine the enzyme levels in the extremes of age (elderly and newborn infants) and to compare the results with the ChE levels in adult blood donors reported recently in an earlier paper.¹

MATERIALS AND METHODS

This study was carried out in the University Hospital, Kuala Lumpur. Consent was obtained from the Obstetric and Gynaecology Department and mothers who donated the umbilical cord blood of the newborn infants. Consent was also obtained from elderly subjects before venous samples were collected.

Twenty-five samples of cord blood were collected from 25 healthy full term newborn infants who were delivered spontaneously by the vaginal route. Their mothers were healthy and were not on medication. Two ml of cord blood were dispensed into EDTA treated sterile containers (Vacutainer). The first 3 samples of cord blood were selected into the sample everyday (Monday to Friday).

Twenty-five samples of venous blood were also collected in Vacutainers from 25 elderly patients (more than 65 years old) scheduled for elective cataract surgery. They were without

medical illness and were not on any medication. The first three elderly patients were selected into the sample on every elective ophthalmic operation list (Tuesday and Thursday).

The 50 samples of blood were sent to the laboratory, Department of Anaesthesiology, University of Malaya. Whole blood and plasma ChE levels were analysed on the day of collection of blood samples.

Reagents and equipment

Acetylthiocholine iodide, butylthiocholine iodide, di-sodium hydrogen orthophosphate and 5,5'-dithiobis-(2-nitrobenzoic acid)(DTNB) were purchased from Sigma Chemical Company, St. Louis, Mo., USA. Enzyme reaction was recorded on a Perkin-Elmer Lambda 3B UV/VIS spectrophotometer (double beam). A Beckman pH meter was used for pH measurements.

Assay method

The enzyme assays were carried out using a modification of the Ellman spectrophotometric technique as outlined in a previous study.¹ It involved the liberation of thiocholine from the substrate molecules by the action of the enzyme and the reaction of thiocholine with DTNB to produce a complex and free yellow coloured 5-thio-2-nitrobenzoate anion. Acetylthiocholine was the substrate for whole blood ChE while butylthiocholine served as the substrate for plasma ChE. Enzyme activity was expressed in micromol/min/ml.

Statistical methods

The following methods were used to analyse the data:

- (1) The one-way ANOVA for independent samples.
- (2) The Newman-Keuls Multiple Range Test to test significant difference between pairs of means.

All tests were based on the .5% level of significance.

RESULTS

The mean values of plasma and whole blood ChE in elderly patients, cord blood of newborn infants and adults are shown in Table 1. The general mean values of ChE in adults were obtained from a recent study on ChE levels in healthy adult blood donors.¹

The one-way ANOVA test showed that there was a difference between elderly, newborn and adults with respect to the mean values of plasma as well as whole blood ChE activity.

The interpretation using the Newman-Keuls Multiple Range Test was as follows: (1) There was no difference between the mean levels of plasma ChE in elderly and cord blood samples but there was a difference between the mean levels in elderly and adult samples as well as between the mean levels in cord blood and adult samples. (2) There was a difference among the mean levels of whole blood ChE in elderly, cord blood and adult samples compared with one another.

TABLE 1: Plasma and whole blood cholinesterase levels in elderly, newborn cord blood and adult samples

	Elderly (n=25)	Newborn (cord blood) (n=25)	Adults* (n=407)	Statistical data
Plasma ChE	2.24+/-0.58 (1.18-3.32)	2.23+/-0.77 (1.05-3.86)	2.71+/-0.75 (1.02-4.95)	F=9.10 df=2/454 p<0.001
Whole blood ChE	4.38+/-0.65 (2.93-5.35)	3.31+/-0.56 (2.42-4.58)	4.87+/-0.73 (3.06-7.53)	F=59.26 df=2/454 p<0.001

ChE = Cholinesterase; ChE activity in micromol/min/ml; Data are mean+/-SD, with range in parenthesis.
* General means of adult values were obtained from: Chan L, Balaskaran S, Delilkan AE, Ong LH. Blood cholinesterase levels in a group of Malaysian blood donors. *Malays J Pathol* 1994; 16(2): 161-4.

DISCUSSION

Inter- and intra-variations of plasma ChE activity exist in healthy populations.⁴ The influence of age on ChE activity had been observed primarily in newborn when compared to adults.² Reported levels of ChE in healthy term newborn infants and in infants up to 4 months of age range from 50 - 75% of normal adult values.^{5,6}

The lower mean values of ChE activity in cord blood and elderly samples may reflect smaller liver cell mass in newborn infants and the elderly. Investigators had reported low serum ChE and albumin concentrations in cord sera which might indicate lower liver function in this period of life.²

Theoretically, lower mean values of ChE in the elderly and newborn as compared to adults suggest careful assessment of drugs hydrolysed by ChE. However, it may not be clinically significant. An example is the use of succinylcholine (a muscle relaxant) in anaesthetic practice where it is unlikely to be followed by prolonged respiratory distress or apnoea in newborn and elderly patients after surgery.

ACKNOWLEDGEMENTS

The author wishes to thank VP Voo and KY Chew, Department of Anaesthesiology, for their technical assistance; Professor V Sivanesaratnam, Department of Obstetric and Gynaecology, for supplying blood samples; and LH Ong, Department of Social and Preventive Medicine, for his help in statistical analysis.

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