

# **Pyridoxal Phosphate, Tryptophan, and Tyrosine in Blood and Cerebrospinal Fluid in Elderly Patients**

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## ABSTRACT

In a material of 74 elderly patients with cerebral symptoms, most of them on account of atherosclerosis, deficiency of pyridoxal phosphate is uncommon: only ten had extremely low plasma levels. Nine of the patients had rather high levels of serum tryptophan. This might depend upon poor metabolization when pyridoxal phosphate is available in insufficient supply. In addition mean values are given for tryptophan, tyrosin and serotonin in this group of patients.

## INTRODUCTION

Vitamin B<sub>6</sub> in its active form pyridoxal 5-phosphate (Pal-P) participates in many enzymatic reactions involving amino acid transaminations and decarboxylations. Pal-P is necessary for the normal metabolism of tryptophan and for the conversion of tyrosin to tyramin among many other reactions. For the normal metabolism of the brain Pal-P is of great importance, e g the decarboxylation of tryptophan to serotonin. Hence it might be of interest to determine the level of Pal-P in plasma and cerebrospinal fluid in patients with cerebral symptoms, and in addition in certain cases also both tryptophan and serotonin.

## MATERIAL AND METHODS

The patients have all been treated in the department of geriatrics. They were admitted for diagnosis or treatment of Parkinsonismus or for the examination of the dynamics of CSF according to Katzman in suspected hydrocephalus. Most of the patients were rather old, none was completely bedridden. No dietary history for the period before hospitalization is available. The examination of blood and CSF was performed one of the first days in hospital.

Pyridoxal phosphate was determined according to a modification of a method previously described (9). Tryptophan, serotonin and tyrosin were

determined in serum and cerebrospinal liquor with a combination of high performance liquid chromatography methods previously described (2, 3, 12, 13). Free forms of the compounds in serum were determined after separation from protein by Millipore filter (Ultrafree, Anticonvulsant, 40,000 NMWL, 25 mm, DROO 631 00).

#### RESULTS

As has been shown earlier (8) Pal-P in plasma is decreasing with increasing age. In our group of patients some very low levels were encountered. One patient had indetectable values and at the same time hypomagnesiemia. A relationship between low Pal-P and low magnesium has been reported earlier (1). One patient with a very high level of Pal-P, 179 nmol/l, in addition had diabetes, a disease which usually leads to low or normal levels of Pal-P (11). Among our patients there was no tendency to lower levels with increasing age. See Fig. 1.

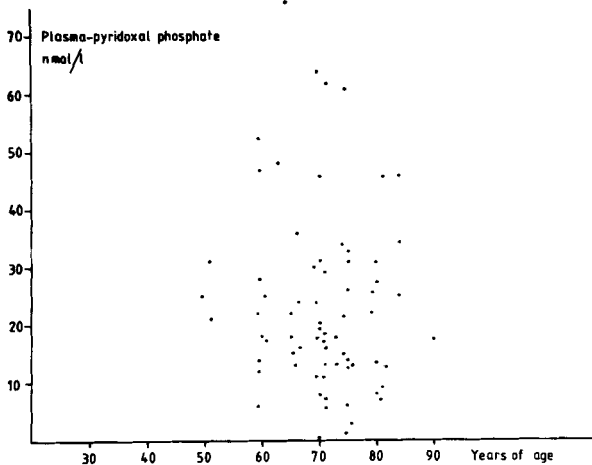


Fig. 1. Pyridoxal phosphate in plasma in relation to age.

In calculations of mean values and standard deviations different statistical methods might be used. We have chosen to utilize a special graph paper for normal (gaussian) probabilities. The cumulative form of the distribution is used. The values for the analyses are plotted on the abscissa in arithmetic form and the number of subjects as the percentage of total in logarithmic along the ordinate. This allows a given set of data to be plotted and a normal distribution is immediately seen, Fig. 2 (10). If the data are derived from different groups, i.e. from healthy controls and from sick persons different distributions are detected in

the graph.

The level of Pal-P in plasma is in the majority of cases 1-3 times the level in CSF, with some exceptions where there were extremely low values in the CSF. In our material there is a slight preponderance of women among those with high levels of Pal-P in plasma, and for men among those with the lowest levels. This might depend upon unsatisfactory diets in elderly men with atherosclerosis. The opposite distribution is seen regarding tryptophan in serum - among those with levels above 7.5  $\mu\text{mol/l}$  there were 8 men and one woman. The quotient between tryptophan in serum and plasma Pal-P is in our material 411 for men and 231 for women as an average. This might depend upon low levels of Pal-P in the men preventing tryptophan to be metabolized further to serotonin.

The probability graphs for tryptophan show a regular gaussian distribution. The values found are given in Table 1. The relation between total and free tryptophan is around 10 and between free serum tryptophan and CSF tryptophan 2-3.

Tyrosin showed about the same levels for total and free in serum and about 7 times as much in serum as in CSF. The analyses of serum serotonin show virtually no difference between free and total (Table 1).

Table 1. Concentration levels of pyridoxal phosphate, tryptophan, tyrosin and serotonin in blood and cerebrospinal fluid calculated from a cumulated graphic plotting technique described in text.

	Number of patients	Mean value	range (mean value $\pm$ 1 SD)
P-Pal-P	74	15	5.8 - 20.3 nmol/l
Sp-Pal-P	69	6	3.3 - 7.3 nmol/l
S-Tryptophan, free	59	4.6	3.1 - 6.0 $\mu\text{mol/l}$
S-Tryptophan, total	61	43	10 - 53 $\mu\text{mol/l}$
Sp-Tryptophan	57	1.7	1.0 - 2.4 $\mu\text{mol/l}$
S-Tyrosin	32	78	56 - 102 $\mu\text{mol/l}$
S-Tyrosin, free	31	74	53 - 95 $\mu\text{mol/l}$
Sp-Tyrosin	30	11.4	3.6 - 14.1 $\mu\text{mol/l}$
S-Serotonin	33	0.46	0.25 - 0.65 $\mu\text{mol/l}$
S-Serotonin, free	31	0.36	0.19 - 0.57 $\mu\text{mol/l}$
Sp-Serotonin	17	0.044	0.025 - 0.068 $\mu\text{mol/l}$

Fig. 3 shows the values for plasma Pal-P with two straight lines disclosing two groups of data, one with a mean of 15 nmol/l and the other representing higher levels. The same is seen when the data for analyses of spinal fluid Pal-P is plotted.

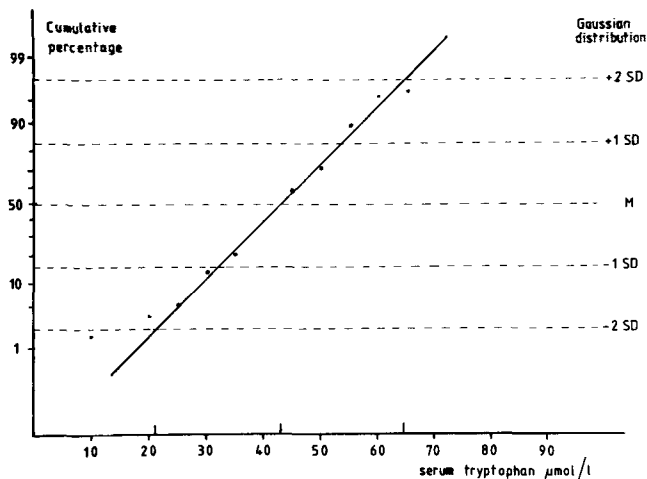


Fig. 2. A cumulation of the tryptophan concentrations in serum is presented to the left in a logarithmic scale along the ordinate and compared with a gaussian normal distribution to the right. The result indicates one homogenous population.

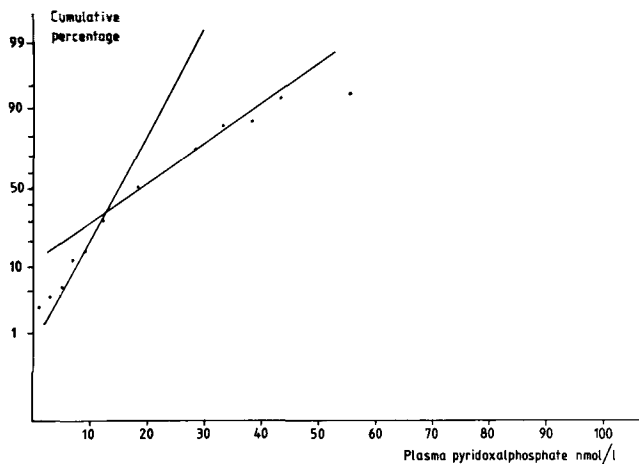


Fig. 3. Pyridoxal phosphate concentration in plasma described as in Fig. 2 showing results indicating two populations in the material.

With increasing age there is a tendency to lower levels of Pal-P according to previous reports. In this material this tendency could not be found, although many values are lower than what is considered normal in healthy subjects. In this laboratory the normal levels are 20 - 60 nmol/l. In elderly patients with atherosclerosis sick enough to be admitted to a geriatric ward, the diet probably has not been adequate in all cases. Hence the low levels of Pal-P, at least partly, could be ascribed to low intakes of vitamin B<sub>6</sub>. This might also explain the relatively high levels of tryptophan in some men.

Whereas the plasma levels of Pal-P are on the lower side, the levels in CSF are high compared to what was found in a series of patients from another part of Sweden. In adult patients with celiac disease a significantly higher concentration of Pal-P was found in CSF than in a control material of neurological patients of the same age (7). Our method of determination Pal-P is not the same as was used in this study, which might explain some of the difference, but could not explain all. They found in CSF  $0.60 \pm 0.34$  ng/ml which is the same as 2.4 nmol/l, thus rather low values compared to ours.

The levels of tryptophan in serum and CSF are within the same range as has been found by others as are the levels for serum serotonin and tyrosin (4, 5, 6).

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