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# Utility of Serum and CSF Lysosomal Hydrolases in Neurological Disorders - A preliminary report

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## *Abstract*

Serum and cerebrospinal fluid levels of β -galactosidase, n-acetyl- β -glucosaminidase and acid phosphate were analysed in patients with various neurological disorders. Both galactosidase and NAC-glucosaminidase were assayed by using very sensitive synthetic substrates of umbelliferyl conjugates. It is observed that CSF galactosidase was significantly decreased in the patient group especially in multiple sclerosis. Only tumour group showed decreased galatosidase both in serum and CSF. Due to individual variation of enzyme levels in patients group, especially in brain tumours, the utility of assay of these enzymes in CSF as a diagnostic tool is questionable.

Key words -

**Galactosidase,**
**Glucosaminidase,**
**Serum,**
**Cerebrospinal fluid,**
**Neurological disorders,**
**Tumours**

Several enzymes in serum and cerebrospinal fluid (CSF) have been studied in many neurological disorders like CPK in muscular dystrophy; LDH and transaminases in brain tumours and CNS infection. Yet the diagnostic value of enzyme estimation in CSF in neurological disorders remains controversial. Lysosomal enzymes like acid phosphatase, N-acetyl-glucosaminidase and β -galactosidase have been implicated in brain tumours [1], [2] and certain other neurological disorders [3], [4]. In order to assess the usefulness of the analysis of serum and CSF lysosomal acid hydrolases as a diagnostic tool in neurological disorders, this preliminary study was undertaken. Three lysosomal enzymes viz., β -galactosidase, n-acetyl- β -glucosaminidase and acid phosphatase were analysed in both serum and CSF of patients with various neurological disorders.

## Material and Methods

The test group consisted of twenty patients with brain tumours, ten each with multiple sclerosis (MS) and optic neuritis (ON) and twenty cases with CNS infection. The brain tumour group consisted of patients with low grade astrocytoma (10), malignant glioma (4) meningioma (4) and pituitary adenoma (2). A group of 10 patients with non-neurological complications were taken as controls. Blood and CSF was collected both from patients and controls. In both serum and CSF β -galactosidase, n-acetyl-β -glucosaminidase and acid phosphatase were assayed as described by Hulterberg and Olsson [4]. Beta-galactosidase was assayed by fluorometric method by using 4-methyl-umbelliferyl- β -D-galactopyranoside as substrate. The fluoroscence of 4-methyl-umbelliferone was measured at 448 nm, with an excitation wavelength of 365 nm. - glucosaminidase was assayed by colorimetric method using paranitrophenyl-2-acetamido-2-deoxy- β -D-glucopyranoside -a very sensitive sub-state. Acid phosphatase was assayed using paranitrophenyl phosphate (di-sodium salt) as substrate. The enzyme activities were expressed as micromoles of substrate split per minute liter of CSF or serum at 37° C.

## Results

The enzyme levels in serum are given in Table 1. Significantly decreased β -galactosidase levels were noted in patients with brain tumour and CNS infection. No significant variation was observed in the levels of n-acetyl-glucosaminidase and acid phosphatase in patient group when compared to controls. The enzyme levels in CSF in patients and controls is given in Table 2. It is observed that significantly decreased levels of β -galactosidase were noted in all patients, especially in multiple sclerosis. The levels of n-Ac-glucosaminidase were slightly increased in brain tumours and CNS infection, whereas acid phosphatase levels were significantly increased.

***Table 1 - Enzyme levels in serum .***

Micromoles of substrate split per minute per litre at 37 ° C

***°(mean ±SEM)***

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***Table 2 - Enzyme levels in CSF + (mean ±SEM)***

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## Discussion

From the enzyme levels noted in patients and controls, it could be seen that the activities of these

enzymes in blood and CSF are independent and that the CSF values of β -galactosidase are around 5% of that in serum, whereas CSF acid phosphatase values are 10% of serum values. N-acetyl-glucosaminidase in CSF is around 25% of that in serum. It has been reported that the origin of CSF lysosomal enzymes seems to be mainly from brain tissue, since even in altered blood-brain barrier state no consistent increase of these enzymes in CSF has been observed [4]. Due to very low CSF enzyme activity of galactosidase, a sensitive method employing a synthetic compound 4-methyl-umbeliferyl conjugate was used in this study.

In this study, it was observed that the tumour group showed significantly low levels of β -galactosidase both in serum and CSF. Patients with CNS infection also showed significantly low β -galactosidase in CSF and a slight decrease in serum. CSF β -galactosidase was decreased in patients with multiple sclerosis and this was significantly lower than in patients with optic neuritis. Only patients with brain tumours and CNS infection showed increased acid phosphatase in CSF. When the CSF enzyme values were correlated with different types of tumours, no significant correlation was observed though some tumours showed increased CSF acid phosphatase.

Increased acid hydrolases activity around the plaques in patients with multiple sclerosis has been reported by Einstein et al [5] and Hallpike and Adams [6], whereas Yates et al [3] have reported normal levels of lyososomal enzymes in CSF of MS patients. In this study we have observed significantly low levels of CSF β -galactosidase in MS. Similar results have been reported by Hulterbeg and Olsson [4]. No other enzyme has shown significant change either in CSF or serum. The enzyme activity in CSF is probably dependent on the clinical state of the patient when the CSF was drawn. These results noted in small groups of patients with MS need to be confirmed on a large number of patients in order to arrive at a meaningful interpretation. However this study shows that there is an involvement of lyososomal hydrolases in MS.

Lysozymes and lysosomal enzymes have been used in tumour diagnosis by many workers [1], [2], [7]. In this study the striking finding was the low serum level of β -galactosidase in the tumour group which is also reflected in CSF.

This preliminary investigation has shown some statistical difference between CSF lysosomal hydrolases in a small group of patients with different neurological disorders, especially in brain tumours, CNS infection acid hydrolases in neurological disorder may not be of diagnostic use, it will help in understanding some disease processes, when done at different stages of illness and on a large group of samples.

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