

BIOCHEMICAL DIFFERENCES BETWEEN THE LEFT AND RIGHT
HEMISPHERES ? PRELIMINARY OBSERVATIONS ON CHOLINE ACETYL
TRANSFERASE (CAT) ACTIVITY

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Comunicato e approvato nella Seduta del 16.6.1980
della Sezione di Firenze

Estratto dal Vol. LVI (1980) - fascicolo 21 del

BOLLETTINO DELLA SOCIETA' ITALIANA DI BIOLOGIA SPERIMENTALE

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Human brain does not have a perfect anatomic symmetrie and in particular it has been observed that the fissure of Sylvius and the posterior part of the first temporal gyrus are greater at the left than on the right side (1,2). Moreover some of the highest cortical functions such as language and memory are asymmetrically represented in the human temporal lobes (1).

Since it is known that the cholinergic system seems to be involved in memory and cognitive functions (3,4) we have considered the possibility of studying if also difference in choline acetyltransferase (CAT) activity may exist in the first temporal gyrus of human brain.

Material and Methods

Three brains of caucasian males, died without signes of neurologic diseases neither indication at necroscopy of CNS lesions, have been studied. The subjects were died suddenly from myocardial infarction, cardiac tamponade, acute polmonary edema. The subjects were of an average age ($\pm$ S.D.) of 67 ± 17 years and the brains were removed (average $\pm$ S.D.) 15 ± 2 hours after death and frozen at -50°C for no more than 2 weeks.

The study was carried out on the first temporal gyrus of the two hemispheres. The first specimen was punched out 1 cm rostrally to the intersection of an hypothetical line connect-

ing the fissures of Sylvius and Rolando and the following samples (punchers 2,3,4,5,6) at the distance of 1 cm from each other in rostro-caudal direction, at 0.5 cm below the fissure of Sylvius. Tissue cylindres of 2 mm in length were collected using a hollow puncher of 1.4 mm of internal diameter. The average ($\pm$ S.D.) of the fresh weight of all tissue cylindres was 2.87 ± 0.12 mg .CAT activity was assaied by the micro radio-chemical assay of Fonnum (5) and the total proteins were measured by the method of Lowrey (6).

Results

In the table are reported the CAT activity values obtained in the different areas of the first temporal gyrus of the two hemispheres. CAT activity shows a marked difference in all the samples examined, between the left and the right hemispheres, being the left always higher and in particular at the level of the punchers 4 and 5 ,i.e., 3 and 4 cm after the reference point. On the other hand, in the right hemisphere the lower values resulted at the level of the puncher 2 and 3. Finally, the average of the all CAT activity values obtained in the two temporal lobes shows a significantly greater enzymatic activity in the left hemisphere than in the right.

Discussion

A high precaution must be used in the extimation of enzymatic values obtained in post-mortem specimens of human brains. However CAT activity seems can be measured in human post-mortem samples, on the contrary of another cerebral enzymes, since the decline is slight and linear with time (7,8). On the other hand the very low variability of CAT activity values obtained between each brain permits to exclude an error in collecting

Punch	CAT activity (micromoles ACh Synth/h/100 mg prot.)									
	BRAINS						Average $\pm$ S.D.		P <	
	A		C							
			B		L		R			
1	2.41	1.53	1.48	0.96	1.81	0.94	1.91 $\pm$ 0.47	1.14 $\pm$ 0.33	0.005	
2	1.15	0.59	1.31	0.73	1.62	0.74	1.36 $\pm$ 0.23	0.68 $\pm$ 0.08	0.005	
3	2.08	1.59	1.90	0.63	2.00	0.65	1.99 $\pm$ 0.09	0.95 $\pm$ 0.54	0.01	
4	1.80	1.25	2.85	2.47	2.64	2.01	2.43 $\pm$ 0.55	1.91 $\pm$ 0.61	0.001	
5	1.65	1.03	2.84	1.13	2.43	1.82	2.30 $\pm$ 0.60	1.32 $\pm$ 0.43	0.005	
6	1.48	1.06	1.21	1.09	1.34	0.94	1.34 $\pm$ 0.13	1.03 $\pm$ 0.07	0.005	
	Average $\pm$ S.D.						1.89 $\pm$ 0.45	1.17 $\pm$ 0.41	0.001	

The specimens were punched at 0.5 cm below the fissure of Sylvius in the first temporal gyrus. The first specimen was punched out 1 cm rostrally to the intersection of an hypothetical line connecting the fissures of Sylvius and Rolando and the following samples were punched at 1 cm of distance from each other in rostro-caudal direction. CAT activity was assayed in the left and right first temporal gyrus of 3 caucasian males.

the specimens and/or in the activity assay.

Moreover the average of all CAT activity values obtained from all zones punched in the left and right first temporal gyrus (1.53 ± 0.38) appears even higher than that obtained in our previous study (9,10) in five "control brains" in the same temporal area (1.42 ± 0.14). This data and the clinical and autoptic reports allow to consider the CAT values as derived from "normal brains".

If these assumptions are correct, it seems reasonable to consider the asymmetries and the differences in CAT activity between the left and right temporal lobes as real. These asymmetries and differences are possibly indicative of a different morphological and/or functional state in the living brains. In this respect further indications should be obtained by studying the distribution of the CAT enzyme together with that of different cellular structures markers (proteolipid proteins, cerebrosides, DNA, RNA) in the cortical layers using the technique of Linderstöm-Lang and Mogensen (11) as modified for the study of nervous system by Pope et al. (12).

Acknowledgment. This study was supported by a Grant from CNR (Rome, Italy) N. 79.01817

Choline acetyltransferase (CHAT) activity was studied in different areas in the first temporal gyrus of left and right hemispheres of human brains.

The CHAT activity values obtained in all the samples from left hemisphere were significantly higher than in the right hemisphere. The biochemical data seems to suggest a possible morphological and/or functional differences between the two hemispheres.

1) Galaburda A.M., Le May M., Kemper T.L. and Geschwind N., Science, 24th Feb 1978, 199, 4311

2) Geschwind N., Scientific American, Sept. 1979

3) Crow T.J., Grove-White I.G., Brit. J. Pharmacol., 1973, 49, 322

- 4) Drachmann D.A., *Neurology*, 1977, 27, 783
- 5) Fonnum F., *Neurochem.J.*, 1975, 24, 407
- 6) Lowrey O.H., Rosenbrough N.J., Farr A.L., *J.Biol.Chem.*, 1953, 193, 265
- 7) Bowen M.D., Smith C.B., With P., and Davison A.N., *Brain*, 1976, 99, 459
- 8) Sorbi S., Antuono P., Amaducci L., *It.J.Neurol.Sci.*, 1980, 2, 75
- 9) Antuono P., Sorbi S., Bracco L., Fusco T., Amaducci L., "Aging of the Brain and Dementia" Raven Press, New York, 1980, chap 16
- 10) Sorbi S., Amaducci L., *Riv.Pat.Nerv.Ment.*, 1979, 4, 171
- 11) Linderstrøm-Lang K., and Mogensen K.R., *C.R.Lab.Carlsberg Ser. Chim.*, 1938, 23, 27
- 12) Pope A., Cavennes W. and Livingstone K.L., *Arch.Neurol.Psychiat.*, 1952, 68, 425

Pervenuto in Redazione il 31 Luglio 1980.