

fondée sur une démonstration antérieure prouvant que pendant l'excitation les cations importants forment une seule couche à la surface fonctionnelle du nerf. La formule est employée pour calculer la distribution du chlorure. Le résultat est en accord avec les valeurs expérimentales publiées.

Effects of Chronic Lesions of the Peduncles on Cerebellum Cholinesterase Activity, in the Albino Rat

In a previous paper¹, the high true cholinesterase activity of cerebellum – predominantly localized in cerebellar cortex – has been related to cerebello-petal tracts, with the tentative purpose of applying available information on the ACh system in cerebellum to a cholinergic mechanism of afferent fibres. The hypothesis was supported by: (a) the differential distribution of true cholinesterase over the structurally uniform cerebellar cortex; (b) the sensitivity of some intracortical neurons to acetylcholine; (c) the presence of cholineacetylase in some cerebellar afferent systems.

The present paper concerns the fate of cerebellum cholinesterase after unilateral lesions involving, more or less extensively, cerebellar peduncles.

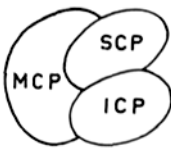







Adult albino rats of the Wistar strain were used throughout. Surgical procedure was performed aseptically, under nembutal anesthesia. Peduncles were approached from the IV ventricle, the extent and the location of the lesion being reconstructed on necroscopic examination. In a few animals only the opening of the IV ventricle was performed (sham operation).

Estimations of enzyme activity were carried out on the 10th day following the operation, by the Warburg manometric method, as previously described¹. The two halves of the cerebellum of operated animals were tested separately, while cerebella of controls were tested *in toto*, having previously stated the same level of activity in the two halves. All estimations were carried out in duplicate, using acetyl- β -methylcholine and butyrylcholine as 'specific' substrates for true (ChEI) and pseudo-(ChEII) cholinesterase, respectively. Fresh solutions of substrates were used in each experiment, the final concentrations being acetyl- β -methylcholine 0.03 M and butyrylcholine 0.01 M. Results are expressed as μ l of CO₂ evolved/h/g of wet weight of tissue.

The Table gives the results – both as absolute values and as per cent fall in activity – of seven animals out of a total of twenty operated. Results were consistent for similar types of lesions, and only the typical examples have been reported so as to summarize the course of events during progressive change of location and extent of peduncular lesion. Values refer to ChEI, no significant variation having ever been found in ChEII activity.

Unilateral lesions of cerebellar peduncles are followed by a fall in cerebellum ChEI content, the value depending on the extent and location of the lesion and reaching its maximum when all three peduncles are severed. Maximal drops in activity range around 60% in the ipsilateral side and 40% in the controlateral one, each peduncle contributing to a certain extent, as roughly indicated by results of partial lesions.

Table
True cholinesterase activity of rat cerebellum after unilateral lesions involving cerebellar peduncles

|  | Homolateral half | | Controlateral half | | Control (<i>in toto</i>) |
|---|------------------|-----|--------------------|-----|----------------------------|
| | Q MeCh | % | Q MeCh | % | Q MeCh |
| Sham operation | 1014 | | 1008 | | 994 |
| A  | 869 | -13 | 988 | -1 | 995 |
| B  | 785 | -24 | 1044 | 0 | 1030 |
| C  | 874 | -22 | 1024 | -8 | 1119 |
| D  | 468 | -52 | 860 | -12 | 977 |
| E  | 598 | -42 | 880 | -15 | 1030 |
| F  | 487 | -50 | 817 | -16 | 976 |
| G  | 388 | -63 | 635 | -39 | 1042 |

ICP = inferior cerebellar peduncle; MCP = middle cerebellar peduncle; SCP = superior cerebellar peduncle

Q MeCh = μ l CO₂/g wet weight of tissue/h with acetyl- β -methylcholine as substrate; % = fall in activity as per cent of the control tested in the same experiment, which was of the same litter of the operated animal

Figures for sham operation are the mean of three experiments. Drawings roughly indicate location and extent of lesions

The disappearance of ChEI – in cerebellum predominantly localized in the cortex¹⁻⁴ – is clearly related to the degeneration of afferent fibres (partially crossed), the efferent ones – almost entirely nuclear in origin – being out of question.

As to the behaviour of ChEI in Wallerian degeneration, afferent tracts to cerebellum seem then to resemble pre-

² A. S. V. BURGEN and L. M. CHIPMAN, *J. Physiol.* 114, 296 (1951).

³ S. C. SHEN, P. GREENFIELD, and E. J. BOELL, *J. comp. Neurol.* 102, 717 (1955).

⁴ G. B. KOELLE, *J. comp. Neurol.* 100, 211 (1954).

¹ L. SPERTI, S. SPERTI, and P. ZATTI, *Arch. ital. Biol. sper.* in press.

gangliar sympathetic⁵ rather than peripheral motor fibres⁶, the ChEI concentrated at the synaptic level being extensively involved as indicated by the high drops in activity.

The dependence of cortico-cerebellar ChEI activity from the integrity of afferent fibres closely agrees with histochemical data of a selective distribution of the enzyme in the cortico-cerebellar layers containing afferent terminals³⁻⁴. Both facts fit in with the above-mentioned information to support a possible cholinergic mechanism of some cerebellar afferent systems.

L. SPERTI and S. SPERTI

Istituto di Fisiologia e Istituto di Chimica Biologica dell'Università di Padova, June 18, 1959.

Riassunto

Lesioni unilaterali nell'ambito dei peduncoli cerebellari sono seguite, nel ratto, da una caduta dell'attività colinesterasica vera del cervelletto, che raggiunge i valori massimi del 60% nella metà ipsilaterale e del 40% in quella controlaterale nel caso di sezione totale dei tre peduncoli. In nessun caso l'attività della pseudo-colinesterasi è risultata significativamente modificata.

⁵ C. H. SAWYER and W. H. HOLLINSHEAD, *J. Neurophysiol.* 8, 137 (1945).

⁶ R. COUTEAUX, *Int. Rev. Cytol.* 4, 335 (1955).

Effects of Midline Cerebellar Splitting and of Lesions in Cerebral Cortex on Cerebellum Cholinesterase Activity, in the Albino Rat

Chronic unilateral section of rat cerebellar peduncles has been shown¹ to reduce true cholinesterase activity (ChEI) in both homolateral and controlateral halves of cerebellum, drop values ranging around 60% and 40% respectively. Results have been referred to the degeneration of afferent fibres ending in cerebellar cortex – where ChEI is highly concentrated²⁻⁵ –, a partial intracerebellar crossing⁶ possibly accounting for the controlateral effect.

Partial or total mid-sagittal division of cerebellum – involving only the fibres crossing the midline – has now proved to give, in the two halves of cerebellum, balanced drops of ChEI activity, approaching, when division is complete, the fall value previously obtained in the controlateral side of cerebellum. As in the case of lesions of cerebellar peduncles, no significant variation was ever found in pseudocholinesterase (ChEII) activity. Results, schematically represented in Table I, refer then only to ChEI, and are in each case the mean of the values obtained on the two halves of cerebellum, which never differed more than 3%.

¹ L. SPERTI and S. SPERTI, *Exper.* 15, 441 (1959).

² A. S. V. BURGEN and L. M. CHIPMAN, *J. Physiol.* 114, 296 (1951).




³ S. C. SHEN, P. GREENFIELD, and E. J. BOELL, *J. comp. Neurol.* 102, 717 (1955).

⁴ L. SPERTI, S. SPERTI, and P. ZATTI, *Arch. ital. Biol. sper.*, in press.

⁵ G. B. KOELLE, *J. comp. Neurol.* 100, 211 (1954).

⁶ J. JANSEN and A. BRODAL, *Aspect of Cerebellar Anatomy* (J. Grundt Tanum Forlag, Oslo 1954), p. 83.

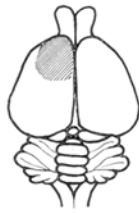
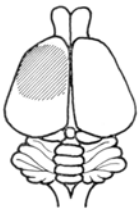
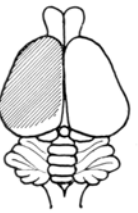
Table I
ChEI activity of rat cerebellum following mid-sagittal division

| | | |
|---|--|---|
|  |  |  |
| QEX 879 QCO 985 | -11% QEX 918 QCO 1080 | -33% QEX 653 QCO 976 |

Drawings outline the extension of the lesion

QEX, QCO = ChEI activity of the operated animals and of the controls, expressed as $\mu\text{l CO}_2/\text{g wet weight of tissue/h}$, with acetyl- β -methylcholine as substrate. Per cent falls in activity are also reported. In each experiment, the control was of the same litter as the operated animal

Table II
ChEI activity of rat cerebellum following more or less extensive ablations of cerebral cortex

| | | |
|--|---|--|
|  |  |  |
| QEX 1120(R) 0% 1145(L) +2% QCO 1125 | QEX 1010(R) -1% 979(L) -4% QCO 1018 | QEX 1150(R) +1% 1195(L) +5% QCO 1135 |

Drawings outline the cortical lesion

QEX, QCO = as defined in Table I. R and L between brackets indicate the right and left half of cerebellum

The drop in ChEI activity is only the consequence of the degeneration of afferent terminals in cerebellar cortex. Deafferentation of pontine neurons, relaying impulses from cerebral cortex, no longer reproduces the effects of section of middle cerebellar peduncle, containing pontocerebellar axons. Table II schematically represents the results of more or less extensive ablations of cerebral cortex: no variation in either ChEII or ChEI activity has ever been found in the two halves of cerebellum.

L. SPERTI and S. SPERTI

Istituto di Fisiologia e Istituto di Chimica Biologica dell'Università di Padova, June 18, 1959.

Riassunto

La divisione sagittale mediana del cervelletto è seguita, nel ratto, da una eguale diminuzione della attività colinesterasica vera nelle due metà del cervelletto, che raggiunge, nei casi di divisione completa, valori che si avvicinano a quelli osservati nella metà controlaterale per sezione totale, unilaterale, dei peduncoli.

Lesioni della corteccia cerebrale, anche se estese, non modificano l'attività colinesterasica vera del cervelletto.

In nessun caso vennero osservate modificazioni dell'attività pseudocolinesterasica.