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Comparative Cytoarchitectonic Studies on Posterior Transverse Temporal Gyral Cortex and Superior Temporal Gyral Cortex with the Effect of Aging and Brain Weight Increase in Human Brain[1]

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=Abstract=The cytoarchitecture of posterior transverse temporal gyral cotex (Brodmann's area 42) and superior temporal gyral cootex (Brodmann's area 22) were compared in terms of effect of aging and brain weight increase. Normal 294 cerebral hemispheres from 147 postnatal brains (85 male and 62 female) were used. Cortical thickness, relative total neuronal density (RTND), and relative total glial cell density (RTGD) were studied and compared in each age- or brain weight-group of both areas, except 0-1 year old age group and 300-800 gm brain weight group.

Cortical thickness of the two areas showed no significant difference in regard to age, side or sex. There was no significant difference between RTND of most of the age- or brain weight-groups of the two areas of the same side brains. RTGD of both areas was affected by aging and that of area 42 was higher than that of area 22.

Key words: ***Cytoarchitectonics, Posterior transverse temporal gyral cortex, Superior temporal gyral cortex***

INTRODUCTION

With the development of microscopy and histological technique, the cytoarchitectonics of the cerebral cortex was started by Meynert (1868) who established systemic analysis of layered pattern of the cerebral cotex. Brodmann (1908, 1909 and 1910) presented the cytoarchitectonic nature of all the cerebral cortical layers and divided them into 52 areas on the cerebrocortical mapping. Observations on cerebrocortical cytoarchitectonics had been reported by Vogt and Vogt(1919), Economo and Koskinas(1925), Conel(1939, 1941, 1947) and in our department by Seoung and Lee since 1963.

This work was performed to study the effect of aging and brain weight increase on the cortical thickness, neuronal and glial densities of area 22 and 42 of Brodmann and the cytoarchitectures of the two areas were compared.

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MATERIALS AND METHODS

147(85 male and 62 female) and 146(84 male and 62 female) normal brains were used to obtain slices of cerebral cortices of Brodmann's area 42 and area 22, respectively.

After cerebral hemisphres were divided longitudinally, samples were obtained from the junction area of the upper and the middle third of the summit of the posterior transverse temporal gyrus and superior temporal gyrus at the right angle to the long axis of each gyrus. Specimens were further fixed with 10% neutral formalin followed by paraffin embedding procedure. Paraffin blocks were sectioned with a thickness of 20 μm and stained with aqueous cresyl violet and hematoxylin. The thickness of each section was measured under x10 ocular lens with an attached micrometer and x10 objective lens.

The number of neurons or glial cells in a unit

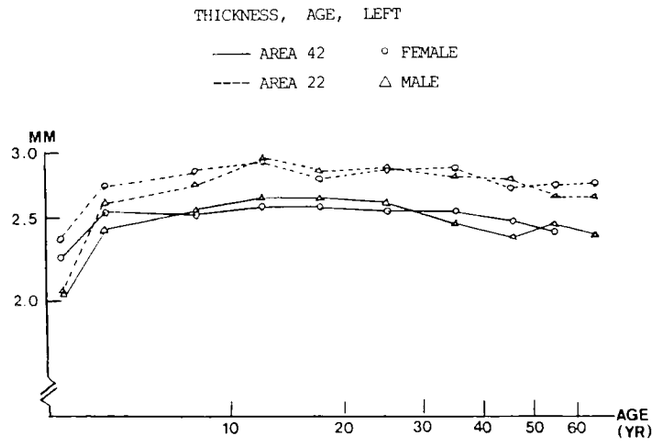

Fig. 1. Curves showing cortical thickness of both the areas and the sexes in each corresponding age group on the left.

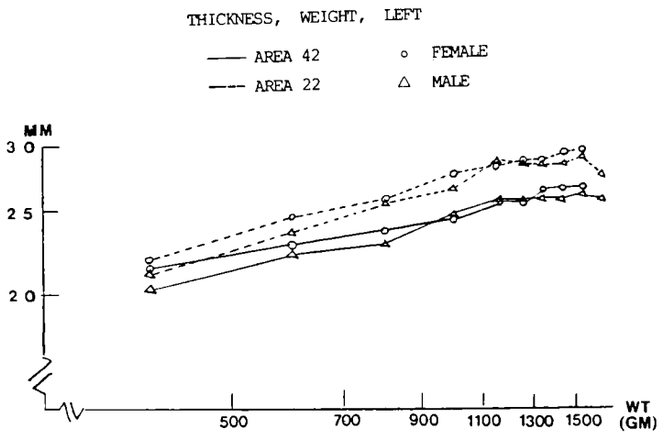

Fig. 2. Curves showing cortical thickness of both the areas and the sexes in each corresponding brain weight group on the left.

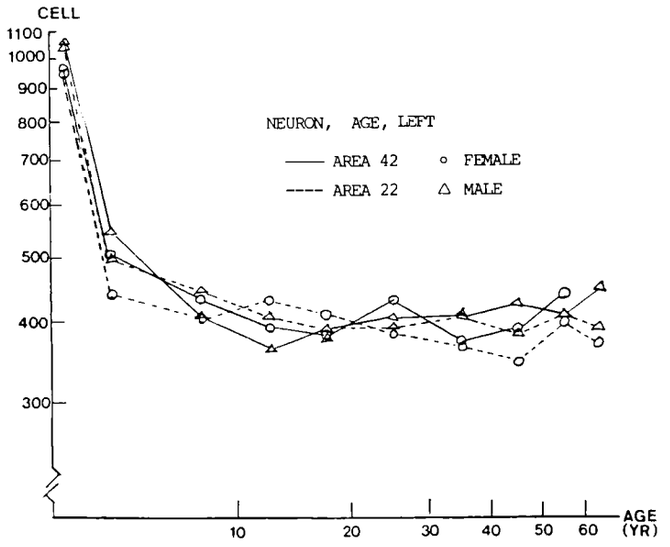

Fig. 3. Curves showing relative total neuronal densities of both the areas and the sexes in each corresponding age group on the left.

volume of cortex was computed from counts of nucleoli with the application of the Abercrombie (1946) correction. The counts were made using an eyepiece grid that enabled the image of the section to be divided into a number of strips of known width(100 μ), length(100 μ) and thickness(20 μ) under x10 ocular and x40 objective lenses, each strip being parallel to the pial surface. After the cell number in each strip with 20 x $10^4 \mu^3$ was multiplied by 5, the relative total neuronal or glial cell density(number of neurons of glial cells/unit volume of cortex) was computed. In the present study, the unit volume of cortex was taken as 0.001 mm^3 ($10^6 \mu^3$)(Sholl 1959).

Values, obtained by observation of posterior transverse temporal gyrus and superior temporal gyrus, were statistically processed for the biologic significance (Snedecor 1956; Alder and Rossler 1960). Adult averages indicates the mean vaues of the relative total neuronal or glial cell densities obtained from 21-50 age age groups which is the stable period of the cytoarchitecture of the cerebral cortex.

RESULTS

Cytoarchitectural comparison of posterior transverse temporal gyrus and superior temporal gyrus.

A. Cortical thickness

1. Age related cotrical tickness

Although Brodmann's area 22 showed mean value of the cortical thickness greater than area 42, statistically significant difference was not present between the two areas regardless of age, sex or side (Fig. 1).

2. Brain weight related cortical thickness

Successive increase of cortical thickness was noted in brains until 900 gm, but there's relatively no change in brains heavier than 900 gm. No significant difference was noticed between two areas regardless of age, sex or side (Fig. 2).

B. Neuronal density

1. Age related relative total neuronal density

Except 0-1 age group, there was no statistically significant differences according to the sex or side (Fig. 3).

2. Brain weight related relative toral neuronal de-

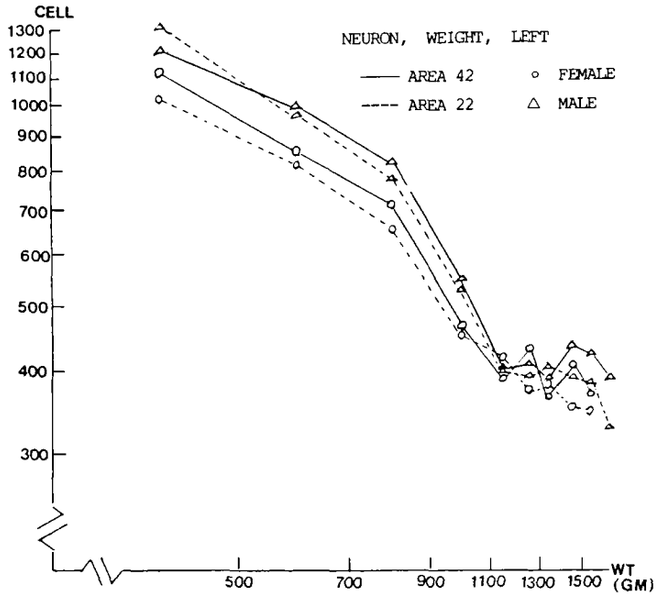

Fig. 4. Curves showing relative total neuronal densities of both the areas and the sexes in each corresponding brain weight group on the left.

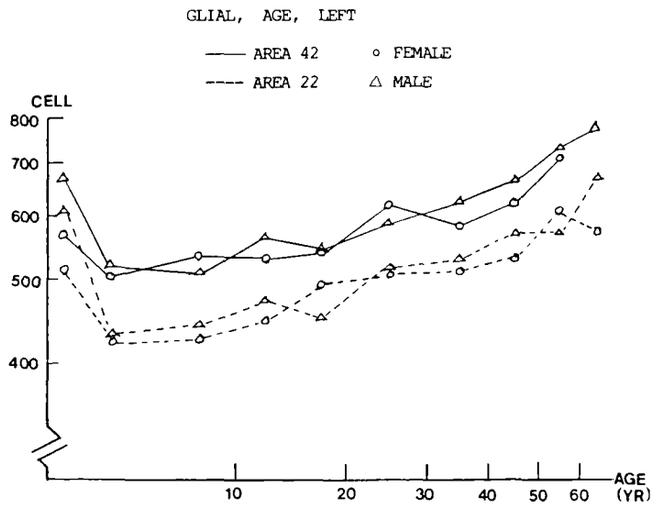

Fig. 5. Curves showing relative total glial densities of both the areas and the sexes in each corresponding age group on the left.

nsity.

In suckling age, both areas showed successive decrease of neuronal density until 900 gm group. But there was relatively no change in groups havier than 900 gm (Fig. 4).

C. Glial density

1. Age related relative total glial density

In both sexes and sides, area 42 showed higher RTGD value than that of area 22. Both areas also showed slight increment of RTGD since 2-year-old age group (Fig. 5).

2. Brain weight related relative total glial density

Until 900 gm, RTGD was successively decreasing, but after 900 gm, it was relatively constant in both areas (Fig. 6).

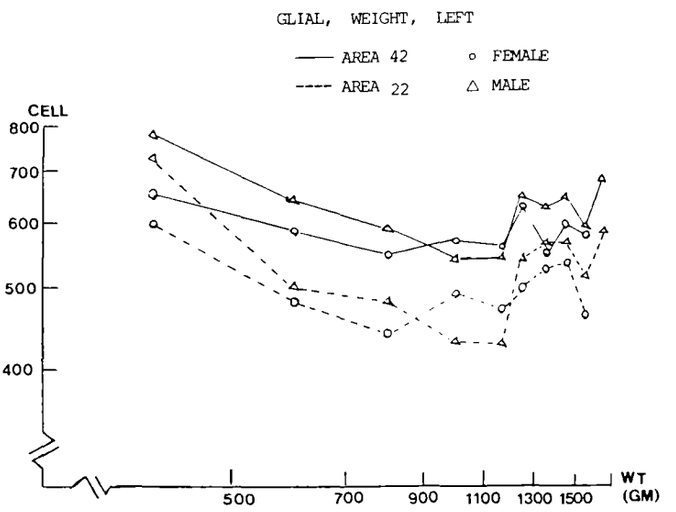

Fig. 6. Curves showing relative total glial densities of the areas and the sexes in each corresponding brain weight group on the left.

DISCUSSION

Since Brodmann presented the cytoarchitectonic nature of all the cerebral cortical layers and classified them as 52 areas on the cerebrocortical mapping in 1908, his classification has been used widely. Transverse temporal gyral cotex is a paired one located obliquely within the lateral fissure of the cerebral cortex. Of them, posterior transverse temporal gyral cotex is the secondary cortical auditory center. Superior temporal gyral cortex is located in the area posterior to the Brdomann's cortical area 38 and anterior to the Brodmann's cortical area 37.

Many investigators have studied the cortical thickness and neuronal cell density in man. Brodmann reported that the cortical thickness of temporal lobe was 2.97 to 3.81 mm. Economo and Koshikinas showed that the average of the cortical thickness of auditory center was about 2.91 mm. Their values are larger than those in the present study. There have been few reports about the development of cortical thickness in man. In the present study, the development of cortical thickness has reached to the ninty-eight percent of that of

adult within the age of ten. In the relationship between the brain weight and the cortical thickness, the latter gradually increased proportional to the brain weight before the brain weight 1199 gm group. And thereafter, irregular relationship was seen despite of the proportional tendency.

Generally it has been considered that there is no cell renewal of neuronal cells, although a few cell renewal in the cerebellum was observed. However, the number of glial cells increases gradually in the aging. In the present study, the distribution pattern of brain weight groups appeared to be irregular in comparison with that of age groups, especially in glial cell density. In this analysis, it is interesting that nueornal cell density was nearly constant and that glial cell density was influenced by aging in both area.

REFERENCES

Abercrombie M. Estimation of nuclear population from microtome section. Anat. Rec. 1946, 94:239-246

Alder HL, Rossler EB. Introduction to probability and Statistics. Chapter 8. Random sampling: Large sample thoery. pp. 96-106, W. H. Freeman and Co., San Francisco and London, 1960

Brodmann, K. Beitraege zur histologischen Lokalisation der Grosshirnrinde. VI. Die Cortexgliederung des Menschen J. Psych. Neurol. (Lpz). 1908, 10:231-246

Brodmann k. Vergleichende Localixationslehre der Grosshirnde in ihren Prinzipien dargestellet auf Grund der Zellenbaus. Bath., Lpz., 1909

Brodmann K. Feinere Anatomie des Grosshirns. Springer, Berlin. 1910, 1:207-307

Brody H. Organization of the Cerebral cortex. J. Comp. Neurol. 1955, 102:511-556

Conel J. The postnatal development of the human cortex. Vol. I:1939, Vol. II:1941, and Vol. III.:1947, Cambridge, Harvard Univ. Press.

Economo VCF. The cytoarchitectonics of the human cerebral cortex. Oxford Univ. Press. London. 1929, pp. 186

Economo VCF, Koskinas GNE. Die Cytoarchtektoniks der Hirnrinde des Erwachsenen. Springer. Wien U. Berlin. 1925

Kwun BD, seung KJ, Cha CI. Cytoarchitectonics and aging effects between rostral and caudal sulcar walls of postcentral gyral cortex in man. Seoul J. Med. 1984, 25:293-320

Lee HK, Rha BY, Seoung KJ. Studies on cytoarchitectonics on summit f rostral half of cingulate gyral cortex (Brodmann's area 240 in human brain. Korea Univ. Med. J. 1983, 20:85-109

Meynert T. Der Bau der Gross-Hirnrinde und seine oetlichen Verschidenheiten, nebst einem pathologischanatomischen Corollarium. IV-jahrschr. Psychiat. 1868, 1:381-403, 2:88-113

Seoung KJ, Hwang DH. Studies on cytoarchitectonics on summit of middle temporal gyrus(Brodmann's area 21) of human cerebral cortex. Seoul J. Med. 1980, 21:253-271

Seoung KJ, Hwang Dh. Studies on cytoarchitectnics of summit in posterior transverse temporal gyrus(Brodmann's area 42) of human cerebral cortex. Seoul J. Med. 1981, 22:155-172

Seoulng KJ, Lee KH. Studies on cytoarchitectonics of summit of cortex in anterior transverse temporal gyrus (Brodmann's area 41) from human brain. Seoul J. Med. 1982, 23:17-37

Seoung KJ. Studies on cytoarchitectonics at sulcal cortex of insular lobe in human brain. Seoul J. Med. 1983, 24:22-42

Sholl DA. A comparative study of the neuronal packing density in the cerebral cortex. J. Anat. 1959, 93:142-156

Snedecor GW. Statistical methods. Iowa State College Press., p. 36, 1956

Suh JK, Seoung KJ. Studies on the cytoarchitectonics of the superior temporal gyrus (Brodmann's cortical area 22) of Korean. Seoul J. Med. 1973, 14:312

Vogt C, Vogt O. Allgemeine Ergebnisse unserer Hirnforschung. Vierte Mitteilung: Die physiologische Bedeutung der architektonischen Rindenfelderung auf Grund neuer Rindenizungen. J. Psych. Neurol. (Lpz). 1919, 25:279-462

＝국문초록＝

後橫側頭回皮質 및 上側頭回 質間의 比較細胞構築學에서 加齡과 腦重의 影響에 關한 硏究

서울道榮病院 整形外科 및 서울大學校 醫科大學 解剖學敎室*

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初生兒에서 老齡에 이르는 韓人腦髓 147例(男性 85例 및 女性 62例) 294大腦半球로서 病變 혹은 奇形 없는것을 材料로 後橫側頭回(Brodmann 第42分野) 및 上側頭回(Brodman 第22分野) 兩皮質의 厚徑, 神經 및 膠質細胞密度差를 比較하고 加齡이 皮質細胞構築에 미치는 影響을 追究하였다.

1. 皮質厚徑은 兩分野間 同等年齡群間을 抱含하여 男女性 左右側間을 莫論하고 皮質間差나 加齡의 影響이 없었다.
2. 相對的 總神經細胞密度는 兩皮質間에 加齡影響은 없는 것으로 보았다.
3. 相對的 總膠質細胞密度는 兩皮質을 莫論하고 大體的으로 加齡影響을 받아 老齡에 이를수록 그 密度가 增加되는 것으로 보았고 兩皮質間 密度差는 없다고 보았다.
4. 成人諸平均値의 兩皮質値間에는 分布差異가 없었다.
5. 分析諸値의 兩分野各群을 通하여 男女性差는 없었고 또한 加齡의 性差도 없었다.