Sensitivity of Spinal Cords from Chick Embryos in Culture to Organic Mercury Compounds: Comparison with Dorsal Root Ganglia

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Organic mercury compounds are known to have a high level of toxicity on nervous system (STUDY GROUP OF MINAMATA DISEASE, 1968). TAKEUCHI et al.(1962) reported that striking features of Minamata disease in humans are preferential injury of both calcarine regions and degenerative disturbances, to a lesser degree, of other cortical areas. They reported further that the spinal cord and peripheral nerve showed only minor changes. However, it is not yet clear whether the different degree of injury is due to the difference of distribution of mercury compounds or due to that of the sensitivity of those regions to mercury compounds.

I have studied the toxic effects of various mercury compounds on dorsal root ganglia from chick embryos in culture (KASUYA, 1972). At the same time of the experiments, the effects of mercury compounds on spinal cords prepared from the same embryos had been tested by the same method with the study of dorsal root ganglia. This paper reports the results on spinal cords comparing with the data of dorsal root ganglia.

METHODS

Spinal cords obtained from 9-10 days chick embryos, from which dorsal root ganglia were also prepared, were sliced into particles of 1-2 mm^3, and were cultured by the method described before (KASUYA, 1972). The spinal cords were cultured on collagen-coated cover glass by the hanging-drop method in a medium containing balanced salt solution, bovine serum, bovine serum ultrafiltrate, chick embryo extract (1:1:1:1) and different amounts of mercury compounds. After incubation at 37° C for 72 hr, the explants were observed for outgrowth of fibers and for the presence of migrating cells using a phase contrast microscope.

Mercury compounds used are methylmercuric chloride (MMC), ethylmercuric chloride (EMC), ethylmercuric phosphate (EMP), and phenylmercuric chloride (PMC). The degree of toxicity of these compounds on spinal cords was determined based on the lowest dose for total inhibition

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and compared with that obtained on dorsal root ganglia.

RESULTS AND DISCUSSION

As shown in Fig. 1, MMC depressed the outgrowth of nerve fibers and other cells at a concentration of 10^{-6}M, and completely inhibited the outgrowth of the fibers and cells at a concentration of 2.5 X 10^{-6} M. Since MMC completely inhibited the outgrowth of nerve fibers and Schwann cells from dorsal root ganglia at a concentration of 5 X 10^{-6} M, spinal cord is more sensitive to MMC than dorsal root ganglion.

The lowest dose for total inhibition of EMC on spinal cords was 10 X 10^{-6} M, while that on dorsal root ganglia was 25 X 10^{-6} M.

EMP completely inhibited the outgrowth of nerve fibers and cells from spinal cords at 5 X 10^{-6} M, which was lower concentration than that on dorsal root ganglia.

PMC was more toxic on spinal cords than on dorsal root ganglia, since the lowest doses for total inhibition on spinal cords and dorsal root ganglia were 2.5 X 10^{-6} and 25 X 10^{-6} M, respectively.

UKITA et al. (1969) have reported that when ^{203}Hg-EMC was given to monkey by intraperitoneal injection, the radioactivity was conspicuous in the cerebral and cerebellar cortices, subcortical grey matter, various nuclei of the brain stem, and grey matter of the spinal cord. On the other hand, TAKEUCHI et al. (1962) have reported that the spinal cord and peripheral nerve showed only minor changes in the cases of Minamata disease. These reports indicate the difficulty to explain the different degree of injury in different areas of nervous system by the distribution of the chemicals. However, the results reported in this paper suggest that spinal cord is more sensitive than dorsal root ganglion to various kinds of organic mercury compounds.

SUMMARY

The lowest doses for total inhibition of MMC, EMC, EMP, and PMC on spinal cords from chick embryos in tissue culture were 2.5, 10, 5, and 2.5 X 10^{-6} M, whereas those on dorsal root ganglia were 5, 25, 10, and 25 X 10^{-6} M, respectively. From these results, it was presumed that spinal cord was more sensitive than dorsal root ganglion to these organic mercury compounds.

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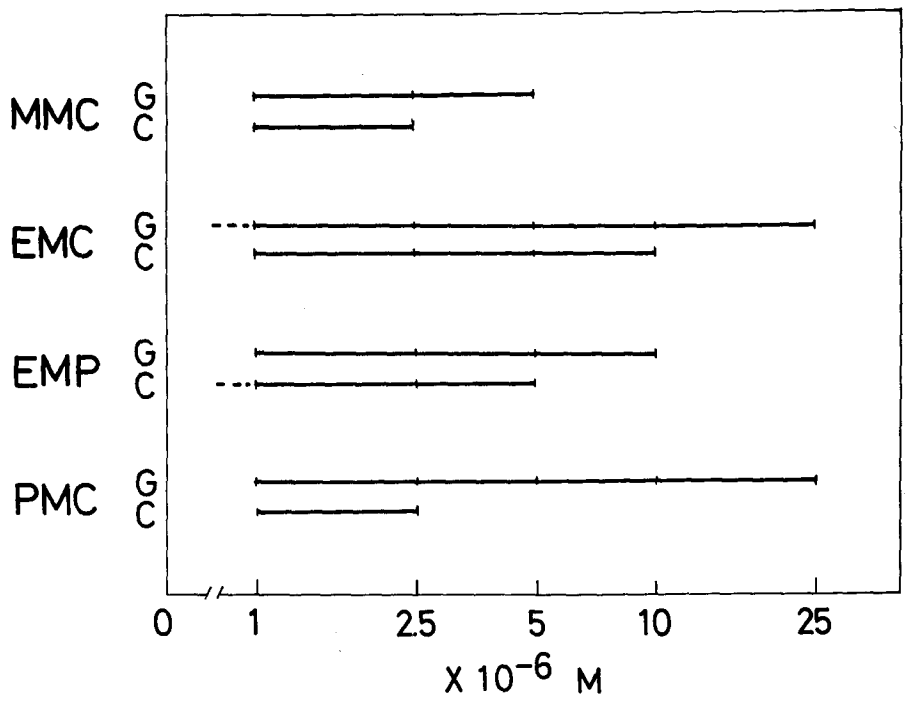

Fig.1. Toxicity of various mercury compounds tested on the outgrowth of nerve fibers and other cells from the explants of chick spinal cords.
G: Dorsal root ganglia;from KASUYA (1972).
C: Spinal cords.
The lowest dose for injurious effect is indicated by the value at the left side of each bar, while that indicated at the right refers to the lowest dose for total inhibition of outgrowth. Dotted lines show that the lowest dose for an injurious effect is less than the value at the left side of the bar.

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