

Activation of anaphylactic histamine release by calcium and strontium ions

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The anaphylactic reaction in guinea-pig chopped lung is dependent on the presence of calcium ions in the incubating medium (Mongar & Schild, 1958), and strontium can substitute for calcium in this system (Mongar, 1970). The present work describes the actions of calcium and strontium ions in the anaphylactic release of histamine from rat peritoneal mast cells, actively sensitized to egg albumin.

The dose-response relationship for calcium ions and histamine release was investigated, and the mean concentration required to produce 50% of the maximum response was 0.40 mg-ion/l. (range 0.35–0.45; five experiments). The maximum effect was achieved at a concentration of 1.0 mg-ion/litre. Varying the calcium ion concentration had no detectable effect on spontaneous release.

Strontium ions were capable of replacing calcium ions in the activation of histamine release. The mean concentration required to produce 50% of the maximum response was 3.2 mg-ion/l. (range 2.8–3.6; five experiments). The maximum effect was achieved with a concentration of 10.0 mg-ion/litre. Spontaneous release was found to be dependent on the concentration of strontium ions.

Magnesium ions were incapable of substituting for calcium in the activation of anaphylactic histamine release. In the presence of calcium ions, magnesium exerted a concentration-related inhibitory effect on histamine release. The dose-response curves for calcium in the presence of three concentrations of magnesium ions (3, 6, 9 mg-ion/l.) were used to obtain data for a plot of log (dose ratio – 1) against the log of antagonist concentration. The result was a straight line with a gradient of 0.9, and the pA_2 was determined as 2.03. The pA_2 for magnesium at the neuromuscular junction was calculated as 2.53 from the results of Dodge & Rahamimoff (1967).

Magnesium also acted as an antagonist to the effects of strontium, and the plot of log (dose ratio – 1) against the log of antagonist concentration was a straight line of gradient 1.17 and the value of pA_2 was found to be 1.97, which is similar to that obtained for calcium and suggests that calcium and strontium act on the same receptor.

In experiments in which the dose-response relationships for calcium and strontium were determined on a single population of cells it was found that the maximum effect obtainable with strontium ions (of the order of 50% release) was always greater than that obtainable with calcium ions (of the order of 20%). The dose-response curves for antigen were compared for cells suspended in (a) a medium containing sufficient calcium to give a maximum effect (1.0 mg-ion/l.) and (b) a medium containing a comparable amount of strontium (10.0 mg-ion/l.). At all antigen concentrations, a greater release of histamine was observed in the solution containing strontium.

The results can be explained by attributing to strontium a higher efficacy than calcium but a lower affinity for the receptor than calcium.

An M.R.C. grant supporting this work is gratefully acknowledged.

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