ASTER-INDUCED SURFACE CONTRACTILITY IN CLEAVING ECHINARACHNIUS PARMA EGGS IS ENHANCED BY NUCLEUS-ASSOCIATED MATERIAL

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Mitotic asters normally form and grow in the presence of nuclear material that may be released at the time of nuclear membrane breakdown. This relationship suggests that astral components could be derived from materials that originate from within the nuclear membrane and its immediate vicinity, as well as microtubules that are polymerized in association with pericentriolar material. The purpose of these experiments was to determine whether asters that develop in the absence of nuclear material have the same ability to cause surface contraction and furrows as normal asters.

Experimental cells were confined in silicone rubber capillary tubes. The lumen of the tubes was flattened so that the upper and lower surfaces were parallel, and its width was adjusted so that the cell edges were also 130 μ wide by 200 μ long with rounded ends. The part of the capillary wall that formed the flattened roof of the chamber was thin enough to allow deformation or perforation of sand dollar eggs by pressure exerted with glass tools.

A large perforation was made in the midpoint of the oblong confined egg by pressing a 113-124 μ glass ball downward. The operation was performed before prophase, and the hole, by chance, either separated the asters or displaced them to the same end of the cell. When the asters straddled the hole, acute furrow-like notches formed in the concave surfaces, usually in the planes of the astral centers. Notch formation was most pronounced or only developed in the surface affected by the aster that was associated with the nucleus. When both asters were on the same side of the hole, the outcome of the experiment depended on the location of the nucleus. Permanent furrows formed only when the asters were associated with the nucleus.

Repeated extrusion of eggs from the nozzle of a pipet before prophase frequently causes the asters that subsequently develop to be farther apart than normal. The nucleus is closely associated with only one of the asters, and the consequences of the altered relationship can be seen clearly in flattened capillaries. The first cleavage furrow appears later than in similarly treated cells with a normal mitotic apparatus. After cleavage each blastomere contains an aster, but in only one of the blastomeres is a nucleus reformed at interphase. In the second cleavage cycle the aster pairs that develop in each blastomere appear to be the same size. A permanent furrow develops only in the cell that contained a nucleus after the first cleavage. The cells without nuclear material developed only ephermeral furrows. The same relation between nuclear material and permanent furrows was also observed when the first cleavage aborted so that both asters were in the same cytoplasmic continuum. In the third cleavage only the progeny of the nucleated blastomere permanently divide.

These results demonstrate that normal permanent furrows require the combined effect of the asters and a factor associated with the nucleus.

Research was supported by National Science Foundation Grant DCB8404174.