THE EFFECT OF HEXYLENE GLYCOL ON CONTRACTILE RING BEHAVIOR IN DETERMINATE EGG DEVELOPMENT OF ILYANASSA OBSOLETA

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Our purpose is to understand the role of microtubules before and during cytokinesis, that phase of cell division in which the cell cytoplasm is divided, equally or unequally, between two daughter cells. When animal cells divide, they form a "contractile ring" (CR), comprised largely of F-actin microfilaments, in a band of cortical cytoplasm between the two newly formed daughter cell nuclei, in a plane perpendicular to the microtubular spindle. Formation of the spindle precedes formation of the CR; during cytokinesis, the cleavage furrow rapidly constricts around the spindle, compressing its component microtubules into a "midbody," a structure that may play a role in completing the final severing of the cleavage furrow neck.

At the time of first cleavage in the fertilized eggs of Ilyanassa obsoleta (Nassarius obsoletus), a common marine mudsnail, a second CR forms in the cell cortex at right angles to the cleavage furrow. This second ring, the polar lobe constriction, constricts the cell slowly during nuclear division (Phase I of constriction), and then at a sharply increased rate (Phase II) during the constriction of the actual cleavage furrow. Both CRs constrict until only very narrow necks of cytoplasm remain; the CR of the cleavage furrow then cuts through its neck completely, whereas the CR of the polar lobe constriction relaxes (thereby allowing a major portion of the cytoplasm of the fertilized egg to become part of only one of the two blastomeres). At the time when the polar lobe CR is maximally constricted, it encircles very few polymerized microtubules in the neck. In contrast, at the same time, in the same cell, and only a few micrometers away, the CR of the cleavage furrow encircles many microtubules (Conrad et al., 1991. J. Exp. Zool. (in press)).

We have demonstrated previously that treatment of Ilyanassa eggs with taxol causes microtubules to be present in high numbers in the polar lobe neck (as well as in the spindle) and to cause the polar lobe constriction to remain constricted, often resulting in the complete cleavage of the neck. To determine if these results were effects peculiar to taxol or, instead, arose from the experimentally-induced increase in the number of microtubules in the lobe neck, we treated Ilyanassa eggs with hexylene glycol, a compound that stabilizes microtubules, but by a mechanism distinct from taxol. Results indicated that, as with taxol, polar lobe necks that form in the presence of hexylene glycol fail to relax and, instead, proceed to cleave through the lobe neck, as would a cleavage furrow. Control and hexylene glycol-treated eggs were fixed for transmission electron microscopy and are being compared at present for their relative microtubule numbers in the polar lobe neck (as well as the spindle). These results suggest that two distinct, microtubule-stabilizing drugs both cause a constriction that would normally relax, instead, essentially to become a cleavage furrow, i.e., a positive, stimulatory result that may involve a causal relationship with the presence of microtubule bundles within the constriction. (Research supported by grants from NASA BioServe [NAGW-1197] and NSCORT (NAGW 2328].