Hooks and Eyes of Sperm and Eggs

Sperm of diverse animal groups, from sea urchins to hamsters, bind rapidly and tightly to an egg's surface during fertilization. Sperm, however, are particular in their attachments; they cling best to eggs of their own species. Specific molecules from both the sperm and the eggs dictate this selectivity, Victor D. Vacquier told a symposium audience at the meeting of the American Society for Cell Biology in San Diego. He and colleagues at the University of California at Davis have isolated both components of the bond. The researchers suggest that the interaction of sperm and eggs is a good model for recognition between other cells, as in liver, muscle and retina development.

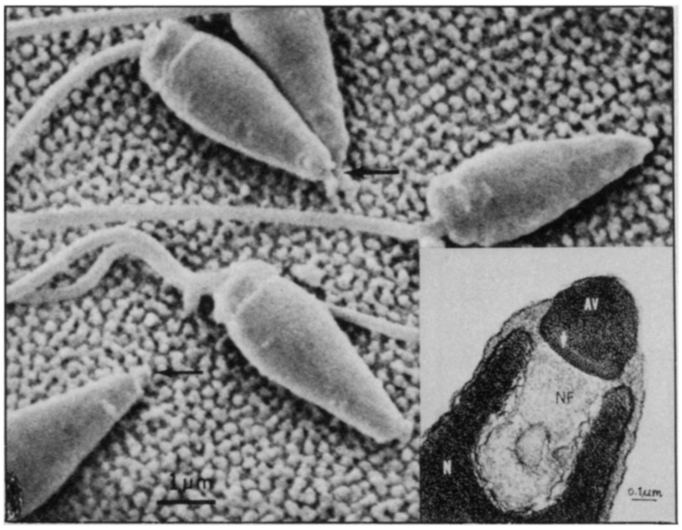
A packet of one sticking substance rides foremost in the head of the sea urchin sperm. Vacquier recounts that he discovered the trick to purifying those packets last winter while gazing at a Christmas tree. He pours disrupted sperm through a long tube filled with glass fibers, as from the angel hair decorating the tree. The compact granules slide through the fibers, while contaminating flagella catch in the tangle of glass threads.

Vacquier, working with Gary W. Moy and Charles G. Glabe discovered that the packets contain a single, medium-sized protein. When the researchers add the protein, which they named bindin, to unfertilized eggs, the eggs clump together. But the gluing ability is specific within species. Bindin from one type of sea urchin does not agglutinate eggs from another species.

Although the researchers describe bindin as a "glue," a collection of differently shaped hooks and eyes makes a better fastening model. The exact characteristics of both components determine the strength of the bond.

At the egg end of the interaction, Vacquier and colleagues have found another specific substance. This component of the egg's outer coat acts as a sperm receptor. It is a very large molecule containing both sugars and protein. The investigators suggest that bindin attaches to the sugar part of the membrane molecule. Like bindin, the receptor appears to be specific for the species. Isolated bindin attaches to isolated receptor from the same species more effectively than to that of a different species.

Discovering the exact differences between the bindins and between the receptors are the next steps in Vacquier's investigation. The researchers are in the midst of determining the amino acid sequence of the proteins. Only 2 of the 18 amino acids so far measured in bindin have differed significantly between sea urchin species. This winter the researchers hope to establish chemical differences between the receptors.



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Packets of "glue" (labeled A V in inset) ride at the tip of the sperm. These processes (black arrows) bind sperm to specific receptors on an isolated fragment of an egg's outer coat.

In the sequence of events that make up fertilization, bindin may do more than glue sperm to eggs. It may also signal the sperm and egg membranes to merge so that genetic material can pass from the sperm into the egg. "Bindin is at the proper place at the proper time," Vacquier reports of recent microscopic studies in which bindin was labeled with antibodies and the electron-dense material, horseradish peroxidase. The researchers plan soon to examine whether bindin in artificial membranes will stimulate membrane fusion.

Vacquier believes that bindin is used by all animal sperm that attach to eggs. His co-worker Brigitte Brandriff has already isolated a binding protein from oyster sperm.

Novel methods of contraception, not involving hormones, could result from these discoveries, Vacquier points out. If a human protein similar to sea urchin bindin could be isolated, it might become possible to immunize women against that sperm component. Antibodies would then attach to bindin, preventing the sperm from attaching to eggs. Such an approach would avoid a risk that arises in other immunological approaches to contraception. The antibodies would not be stimulated to attack any protein produced by the woman's own body. Alternatively, test tube studies made possible by these methods of isolating the binding components may suggest chemical or enzymatic ways to block attachment and fertilization. □

Schwann cells: Mixing and matching

A faulty electrical system may result from either a break in the conducting wire or from defective insulation. Similarly, some diseases of the human nervous system arise from problems with the biological insulation that allows rapid conduction of signals along the nerve cell's output branch, the axon. A technique that can wrap the insulation from humans around the nerve processes of a mouse was described by Albert J. Aguayo at the annual meeting of the Society for Neuroscience in Anaheim, Calif. (SN: 11/19/77, p. 344). Aguayo suggests this technique may lead the way to eventually replacing abnormal insulating tissue, repairing damaged nerves and reproducing human diseases for experimentation in animals.

Schwann cells are the agents of biological insulation studied by Aguayo and his colleagues at McGill University. These specialized cells wrap tight bands of membranes, called myelin, around individual axons of many nerve cells. However, Schwann cells loosely encircle axons of other nerve fibers.

Aguayo and colleagues transplant Schwann cells by grafting a section of a nerve, with its associated Schwann cells, between the segments of another cut nerve. The transplanted axon pieces deteriorate, and the cut axons grow into the tracts left in the graft. With this procedure, researchers can mix and match axons and Schwann cells.

This technique has already answered one question about which cell is calling the plays. The axon determines whether or not myelin will form. Schwann cells from an unmyelinated nerve will wrap myelin around a previously myelinated axon. This result eliminates the possibility of two different populations of Schwann cells—one for myelin and the other for the looser sheath. "Schwann