Spreading cancer: Step 1

Cells from a malignant tumor range throughout the body, starting cancerous growths in near and distant organs. It is known that the cells travel through the blood circulation system en route to those secondary sites, and now scientists at the University of Chicago have observed how those cells gain entry to the circulation system. They do not destroy a portion of blood vessel wall, but instead make a specific, temporary pore through it.

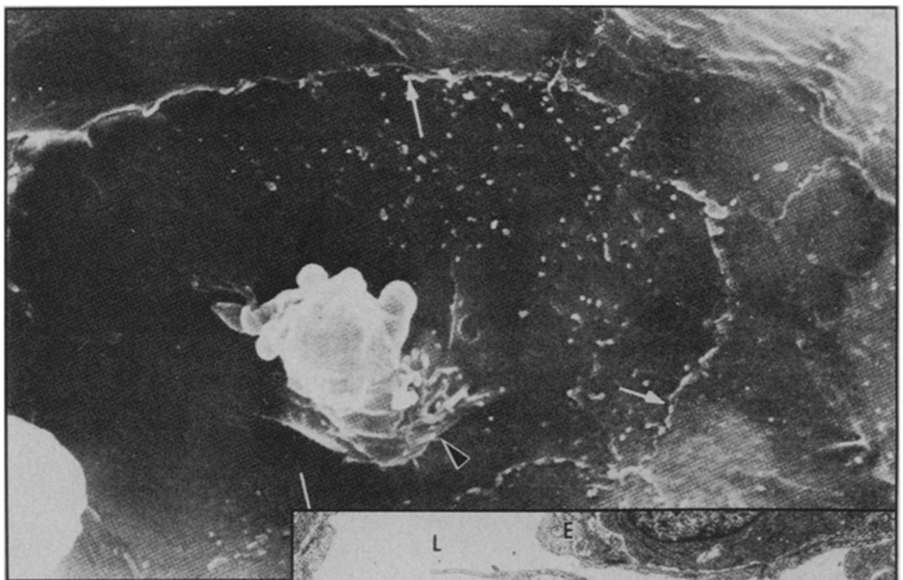
The malignant cells used in the experiment embarked on their journey through small vessels that carry blood away from the original tumor. A malignant tumor directs the growth of blood vessels into it and leaves them intact, even as it destroys nearby skin and muscle tissue.

Peter P. H. DeBruyn and Yongock Cho discovered that malignant cells enter small venous blood vessels through a closely fitted pore. Using two types of electron microscopy, the scientists found that the malignant cell squeezes through an opening in one of the endothelial cells that form the wall of the vein. No malignant cells were seen slipping between epithelial cells.

The migration pore seems to close after the malignant cell passes through; no vacant pores were observed. Occasionally DeBruyn and Cho saw in their micrographs three or four cells crowding simultaneously through the same channel.

"The entry of malignant cells into the circulation was not the result of the general invasive properties of malignant tumor cells, but the consequence of a specific action of the tumor cells," they explain in the May Journal of the National Cancer Institute.

The scientists used tumors resulting from administration of myelogenous leukemia cells under the skin. They point out that the malignant cells' migration into the blood vessel resembles passage of normal or leukemic blood cells through walls of cells in several places in the body. They suggest that the passage results from specific interactions of cell surface factors. Whether the entry of other types of malignant cells into the circulation follows the same pattern remains to be determined. □



JNCI, x 3100

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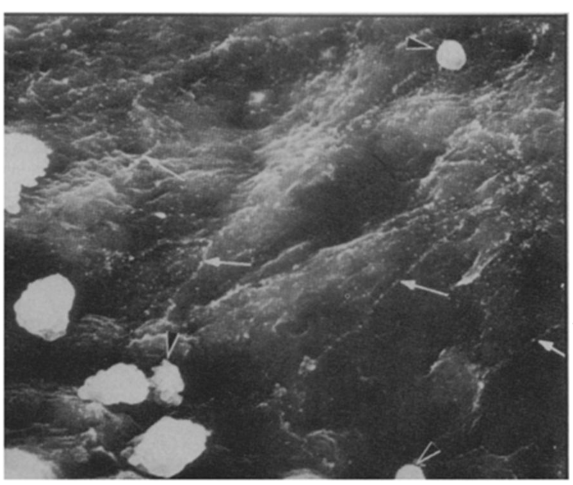
Tumor cell enters vein through rat vessel-lining cell. Transmission electron micrograph (right) shows a cell part way through pore (arrows). Scanning electron micrograph (lower left) shows three tumor cells entering wall (black arrowheads). White arrows mark junctions between vessel cells.



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Acid rain falling in a cloud chamber

Cloud chambers and lasers, teamed up, now can measure minuscule amounts of chemicals, including major air pollutants, report Howard Reiss and colleagues of the University of California at Los Angeles. The researchers have measured sulfuric acid at concentrations as low as one part per trillion.

Reiss has been studying how gaseous molecules cluster and grow into liquid droplets. Foreign molecules, for instance, can provide a center around which water vapor collects. The droplets scatter light differently than does water vapor, so with a laser beam the researchers can detect the number of droplets formed.

Sulfuric acid molecules, which like water have a negative charge at one end and a positive charge at the other, are excellent nucleation centers. Using a cloud chamber containing water vapor, Reiss and colleagues have studied how sulfur dioxide is converted into the pollutants sulfur trioxide and sulfuric acid. As sulfuric acid is produced it provides nucleation centers, and acid-centered water droplets are detected.

The technique also can be used to study other reactions whose products serve as nucleation centers. Ions, as well as molecules with strong dipoles, initiate droplet formation. But because the droplets are the same, no matter what the nucleus, scientists must depend on their knowledge of what chemicals they put into the chamber to know what molecules are at the centers of the drops. By applying an electric field, however, the researchers can differentiate between droplets forming around ions and around molecules with dipoles.

In another application of the cloud chamber technique, droplets give a clue to the character of reaction intermediates. Reiss's colleague Mostafa El-Sayed uses a cloud chamber filled with vapors of organic molecules, such as nonane and octane, instead of water vapor. A droplet forms any time chemicals in the chamber include a radical, a molecule with an unpaired electron. The radical joins the organic vapor molecules into dimers and trimers, and then the vapor starts condensing around them. The chemists pinned down the mechanism, El-Sayed says, by showing that compounds that scavenge radicals eliminate the condensation. With the technique, they have already demonstrated that the reactions of both benzaldehyde and acid aldehyde, after light absorption, do involve radicals.

Reiss expects the cloud chamber technique to be applicable to practical pollution problems, such as particulate formation in smog, and also to theoretical work on nucleation and fluids. □