Cardiomyocyte psychology

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Is it nature or nurture? Is it our parents, or our environment? Hair loss in men, breast cancer in women, skin pigmentation, and even straight or curly hair are all convincingly linked to the nucleotide sequences in our genomes. Conversely, Bandura's Social Learning Theory¹ in 1977 postulated that aggressive behavior is acquired from one's environment. A child is likely to turn out more collegial and personable if he or she grows up in a monastery than if his or her early development occurs in a maximum security prison.

In recent years, investigators who have aspired to build new hearts, instead of transplanting old ones, have focused on the cardiomyocyte as the “heart” of the heart. For years, we have successfully grown cardiac cells—that beat—in everything from blood agar to beer. The seemingly insurmountable hurdle has proved to be coaxing the cells to survive and fly in formation.

The article in this issue of the *Journal* by Vunjak-Novakovic² examines the 3 key components of tissue engineering: (1) the tissue engineering capacity of cells, (2) the biomaterial scaffolds that support and direct structural tissue formation, and (3) the environmental signals that promote these processes.

Historically, cardiac tissue engineering has focused on cell-based therapy directed at the diseased portions of the heart. This type of therapy has been disappointing, largely for lack of local cell survival and coordination of underlying mechanisms of function. Significant headway has been made with mesenchymal stem cells to treat ischemic injury; again, however, cell engraftment has been a formidable barrier. The idea that paracrine and environmental influences are paramount is currently emerging. Early successes in improving allogeneic cell retention with hydrogel glues

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Central Message

Baby cardiomyocytes need love.

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injected into the heart, accompanied by transient immunosuppression, have been promising.

Vunjak-Novakovic² explores the alternative that an appropriate cell supported environment may permit “cell-free” heart repair developed from cell-excreted factors. Follistatin is a ubiquitous glycoprotein that promotes muscle proliferation and differentiation in mice. With the focus currently diverting toward the cellular environment (“nurture”), the idea of providing regulatory cues with an epicardially derived follistatin has proved promising. Interestingly, follistatin released from a hydrogel patch has successfully induced proliferation of resident cardiomyocytes. Myocardial tissue engineering appears to be robustly influenced by environmental signals and controls whether cells, much like children, will survive and act either like serial murderers or monks. Baby cardiomyocytes require a warm, fuzzy environment if they are to grow up to be conscientious, contributing adults.

References

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