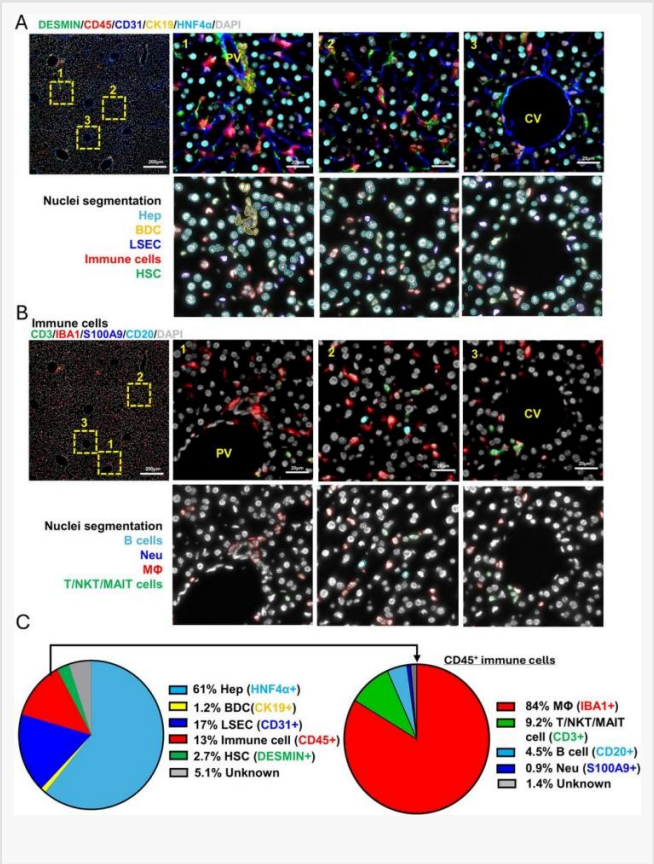
Mapping Liver Macrophages May Unlock New Therapies for Organ Repair

Study maps liver macrophage behavior after injury, showing role shifts that may guide therapies to boost repair.



CHANGCHUN, CHINA, September 1, 2025 /EINPresswire.com/ -- The liver is famous for its remarkable ability to regenerate, but that healing power depends heavily on the actions of its resident immune cells. A new study published in eGastroenterology spotlights macrophages, the liver's cleanup and repair specialists, revealing that these cells quickly adapt after injury to clear debris and support tissue recovery.

Researchers from the National Institutes of Health used advanced imaging and genetic sequencing techniques to explore how different types of macrophages behave in healthy and injured mouse livers. Their findings offer fresh insights into the liver's immune landscape and point to new ways of enhancing recovery after damage.

"We wanted to understand not just how many macrophages were present, but what they were doing and where they were located," said Dr. Feng.

The team employed a combination of multiplex immunofluorescence staining and single-cell RNA sequencing, technologies that allow for highly detailed mapping of cells and their gene expression patterns. In healthy livers, resident Kupffer cells dominated, making up more than 80 per cent of the immune cell population. These cells were not evenly distributed, clustering more densely around certain blood vessels and exhibiting high levels of phagocytosis, the process of engulfing pathogens and dead cells.

Injury dramatically altered this balance. Using models of acute liver injury, including exposure to concanavalin A and acetaminophen, the researchers observed a surge of monocyte-derived

macrophages infiltrating the liver. These newcomer cells were distinct from Kupffer cells in both location and function. Clustering around necrotic lesions, they expressed genes involved in debris clearance and tissue remodeling.

"We identified several populations of macrophages that seem specialized for different stages of injury response," said Dr. Feng.

Some monocyte-derived macrophages were rich in proteins that break down cellular debris, while others expressed markers associated with promoting tissue repair. A subset even showed high levels of endothelin converting enzyme 1, suggesting a role in controlling blood vessel behavior and fibrosis during healing.

Perhaps most intriguingly, the study captured how macrophages proliferate and die during injury. In healthy livers, macrophage turnover was low. But after injury, both proliferation and apoptosis rates increased dramatically, indicating that the liver rapidly remodels its immune workforce in response to damage.

"Seeing both expansion and attrition of macrophages in real time provides a more complete picture of how dynamic these cells are during liver injury and repair," said Dr. Feng.

The findings have promising implications for future therapies. Targeting specific macrophage populations could help accelerate liver healing or prevent fibrosis, a scarring process that can lead to chronic liver disease. By enhancing the functions of beneficial macrophages or limiting harmful ones, clinicians might be able to tip the balance toward recovery.

"Our next step is to test whether boosting certain macrophage populations can improve healing outcomes in chronic liver disease models," said Dr. Feng.

In addition to their therapeutic potential, the study's methods offer a blueprint for studying immune responses in other organs. Combining spatial mapping with genetic profiling could reveal how different cell types interact during disease processes elsewhere in the body.

While more work is needed to translate these findings into treatments, the study represents a leap forward in understanding the liver's immune choreography. By watching the liver's cleanup crews in action, scientists are uncovering new strategies to support the organ's legendary resilience.

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See the article:
Feng D, Guan Y, Wang Y, et al. Characterisation of macrophages in healthy and diseased livers in mice: identification of necrotic lesion-associated macrophages. eGastroenterology 2025;3:e100189. doi:10.1136/egastro-2025-100189

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