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Integrated Single-Cell and Plasma Proteomic Modeling to Predict Surgical Site Complications

A Prospective Cohort Study

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Introduction:

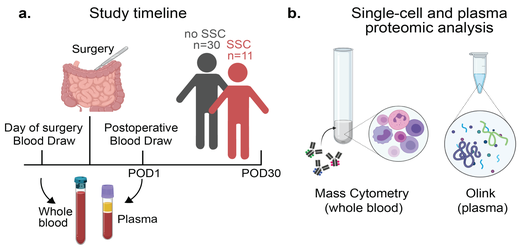
Surgical Site Complications (SSCs) may occur in up to 25% of patients undergoing bowel resection, resulting in significant morbidity and economic burden. However, the accurate prediction of SSCs remains clinically challenging. Leveraging high-content proteomic technologies to comprehensively profile patients' immune response to surgery is a promising approach to identify predictive biological factors of SSCs.

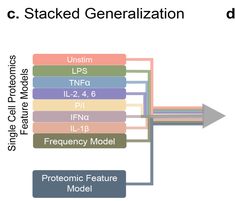
Hypothesis:

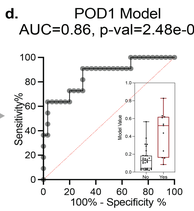
Single-cell and plasma proteomic elements of the host's immune response to surgery can accurately identify patients who develop a surgical site complication (SSC) after major abdominal surgery.

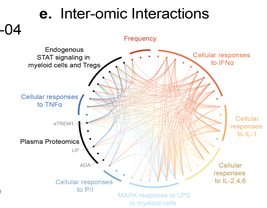
Methods:

Forty-one patients undergoing non-cancer bowel resection were prospectively enrolled. Blood samples collected before surgery and on postoperative day one (POD1) were analyzed using a combination of single-cell mass cytometry and plasma proteomics. The primary outcome was the occurrence of an SSC, including surgical site infection, anastomotic leak, or wound dehiscence within 30 days of surgery.









Main Finding:

The multiomic analysis of patients' immune response after surgery and immune state before surgery revealed systemic immune signatures preceding the development of SSCs.

Our results suggest that integrating immunological data in perioperative risk assessment paradigms is a plausible strategy to guide individualized clinical care.

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Results and Discussion:

A multiomic model integrating the single-cell and plasma proteomic data collected on POD1 accurately differentiated patients with (n = 11) and without (n = 30) an SSC [area under the curve (AUC) = 0.86]. Model features included coregulated proinflammatory (eg, IL-6- and MyD88- signaling responses in myeloid cells) and immunosuppressive (eg, JAK/STAT signaling responses in M-MDSCs and Tregs) events preceding an SSC. Analysis of the immunological data obtained ***before*** surgery also yielded a model accurately predicting SSCs (AUC = 0.82).