Immune Profile of Synovial Fracture Hematoma After Acute Interarticular Ankle Fracture

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INTRODUCTION: Interarticular ankle fracture (IAF) often lead to post-traumatic osteoarthritis (PTOA), which is associated with unfavorable long-term outcomes. The synovial fluid fracture hematoma (SFFH) that forms after IAF contains inflammatory mediators and cellular populations that may play a role in PTOA development. Previous studies have examined the fluctuations in inflammatory mediators in SFFH during early (0-3 days), intermediate (4-9 days), and late (>9days) periods after injury. This ongoing study aims to characterize the cellular immune population present in SFFH during the late-stage injury group (>9 days) and correlate it with the presence of inflammatory mediators and resulting cartilage damage.

METHODS: Seven patients with IAF underwent ankle aspiration at the time of surgical fixation to collect SFFH samples. Polychromatic flow cytometry was performed on resulting samples to determine the immune profile present within the injured joint.

RESULTS SECTION: The average age of the patients was 46 years, 43% had trimalleolar fractures, and SFFH was collected an average of 12.3 days after IAF (Table 1). Flow cytometry analysis gated on CD45+ cells (leukocytes) revealed that 70.1% were lymphocytes and 16.6% were monocytes. Among the CD45+ lymphocytes, 68.5% were CD3+ T cells, and 2.5% were CD19+ B cells. Further analysis of CD3+ T cells indicated that 57.5% were CD4+ and 32.6% were CD8+ (Figure 1). The presence of natural killer cells, myeloid-derived suppressor cells, and monocyte lineage cells was also detected within the SFFH.

DICSUSSION: Understanding the immune composition of the joint following IAF is crucial for effective management and prevention of PTOA after injury. This preliminary investigation highlights the predominance of CD3+ T cells in the late-stage immune response of IAF, with a higher incidence of CD4+ subtypes compared to CD8+. Further research is needed to elucidate the specific roles of these immune cell populations in PTOA development and to explore potential therapeutic interventions targeting the immune response in IAF patients.

SIGNIFICANCE / CLINICAL RELEVANCE: The clinical significance of this ongoing study lies in its focus on characterizing the immune cell populations present in the SFFH during late stage interarticular ankle fracture (IAF), a known precursor to post-traumatic osteoarthritis (PTOA). By understanding the immune landscape, this research opens avenues for targeted therapeutic interventions that could mitigate or prevent the development of PTOA, thereby improving long-term outcomes for patients with IAF.

IMAGES AND TABLES:

Table 1. Patient Demographics

Variable	N (%) / Mean ± SD
Age (years)	46.1 ± 15.4
Sex	
Female	5 (71%)
Male	2 (29%)
Fracture Type	
Trimalleolar	3 (43%)
Bimalleolar	2 (29%)
Fibular (+Deltoid Ligament Tear)	1 (14%)
Pilon	1 (14%)
Time from injury to aspiration (days)	12.3 ± 4.9

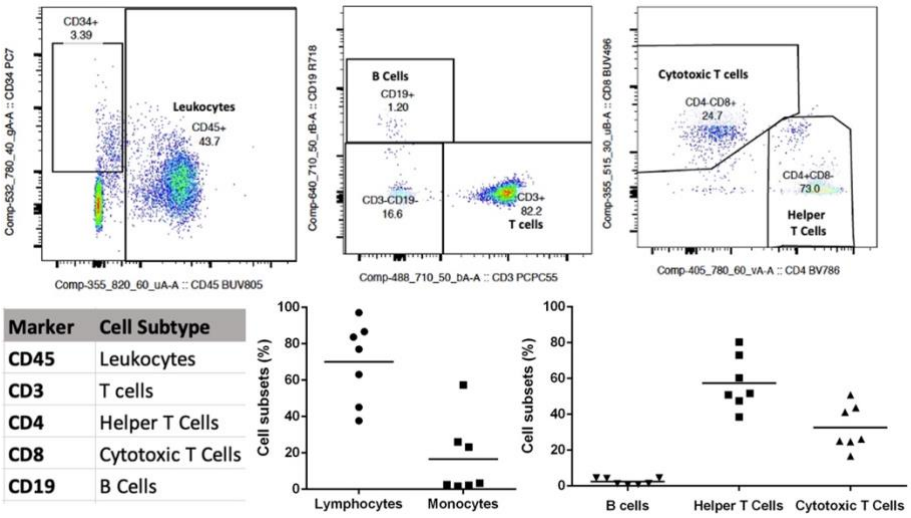

Figure 1. Flow Cytometry. Representative images of CD45+, CD3+, CD19+, CD4+ and CD8+ gates can be seen in the top row. Bottom left displays the makers and their corresponding subgroups. Dot plots represent presence of CD45+ gated subgroups (left) and CD3+ gated (right) subgroups within individual samples of SFFH.