



LIMITLESS

INFLAMMATION:

What it is. How it works. Why it helps and why it hurts.

PRESENTED BY

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Inflammation

- What is inflammation?
- How does inflammation work?
- How does inflammation help?
- Why does inflammation hurt?
- What is the role of exercise in creating acute inflammation and easing both acute and chronic inflammation?



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Too Much Of A Good Thing...

**TOO
MUCH**

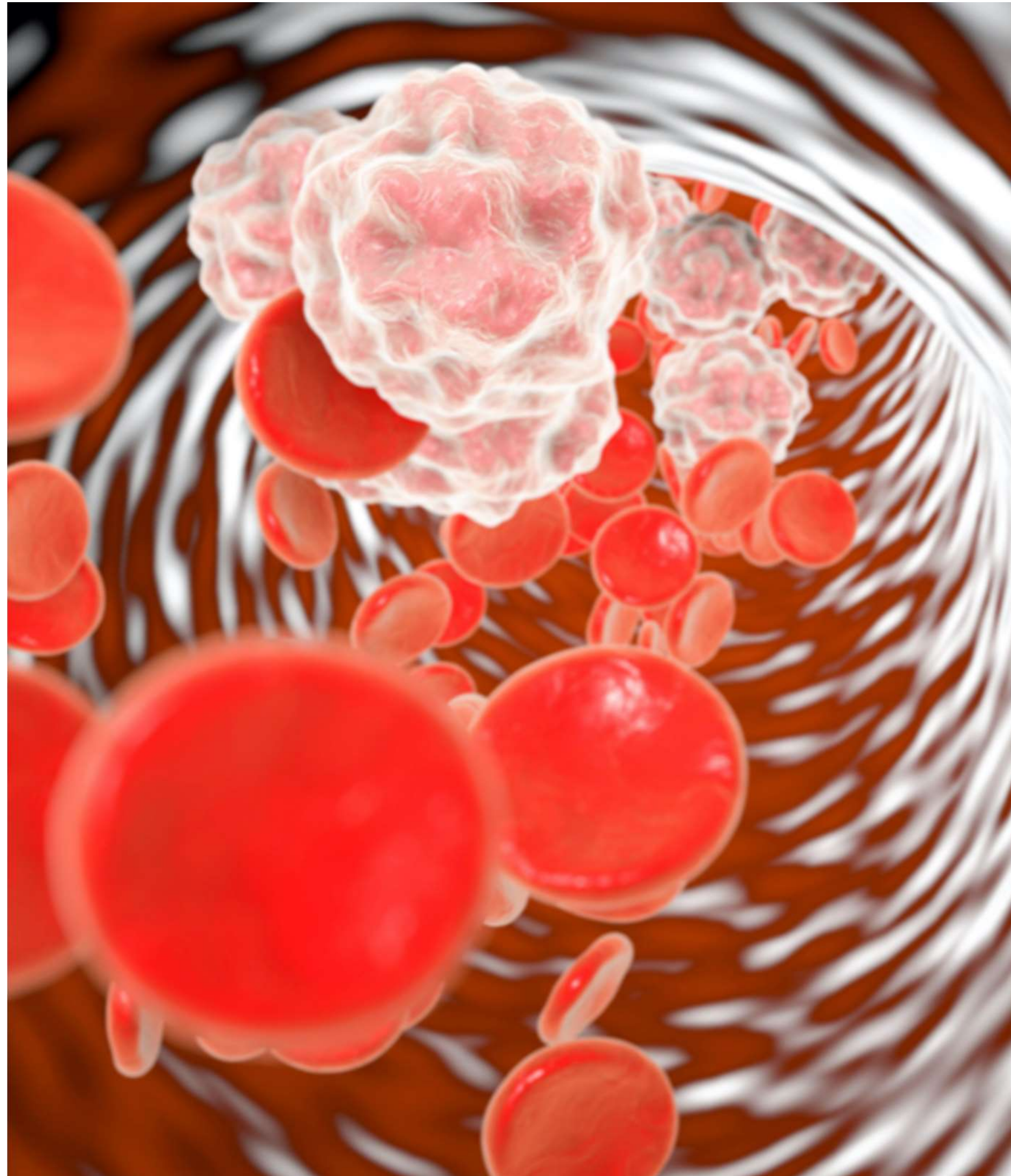
Inflammation is GOOD...

... until it isn't



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What is Inflammation?



Trauma to Vascularized Tissue

Regardless of the cause of injury

- Impact - bruising
- Mechanical – strains and sprains
- Chemical – topical or ingested
- Microbes – bacteria and viruses
- Radiation – sunburn

Similar to Hans Selye's General Adaptation Principle (GAS) regarding stress.



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Other Inflammatory Conditions



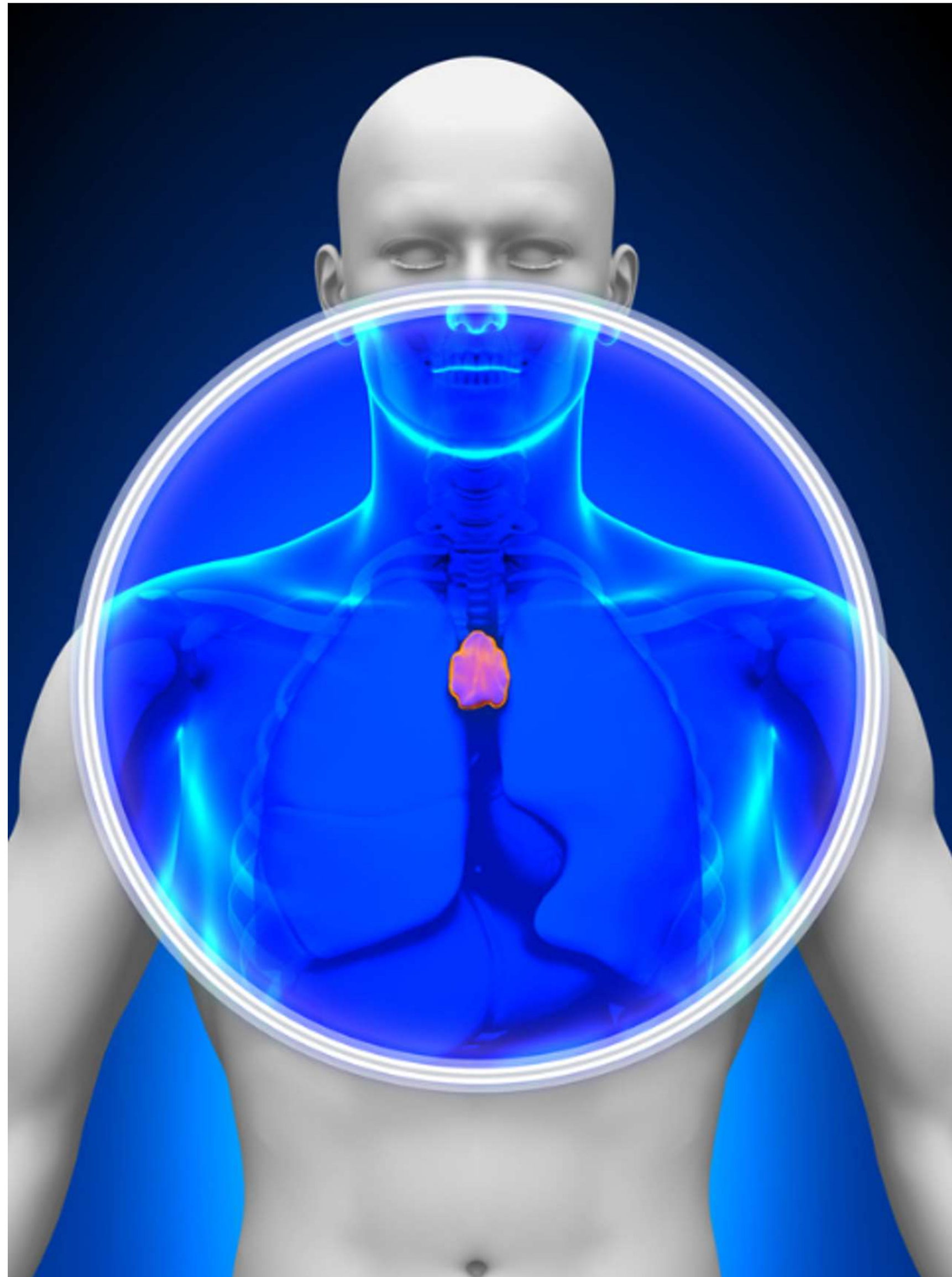
Clients may complain of...

- Arthritis
- Bursitis
- Tendonitis
- Appendicitis
- Infection
- Inflammatory bowel disease (IBD)
- Allergies
- AUTOIMMUNE DISEASES ... such as?



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Autoimmune Diseases...



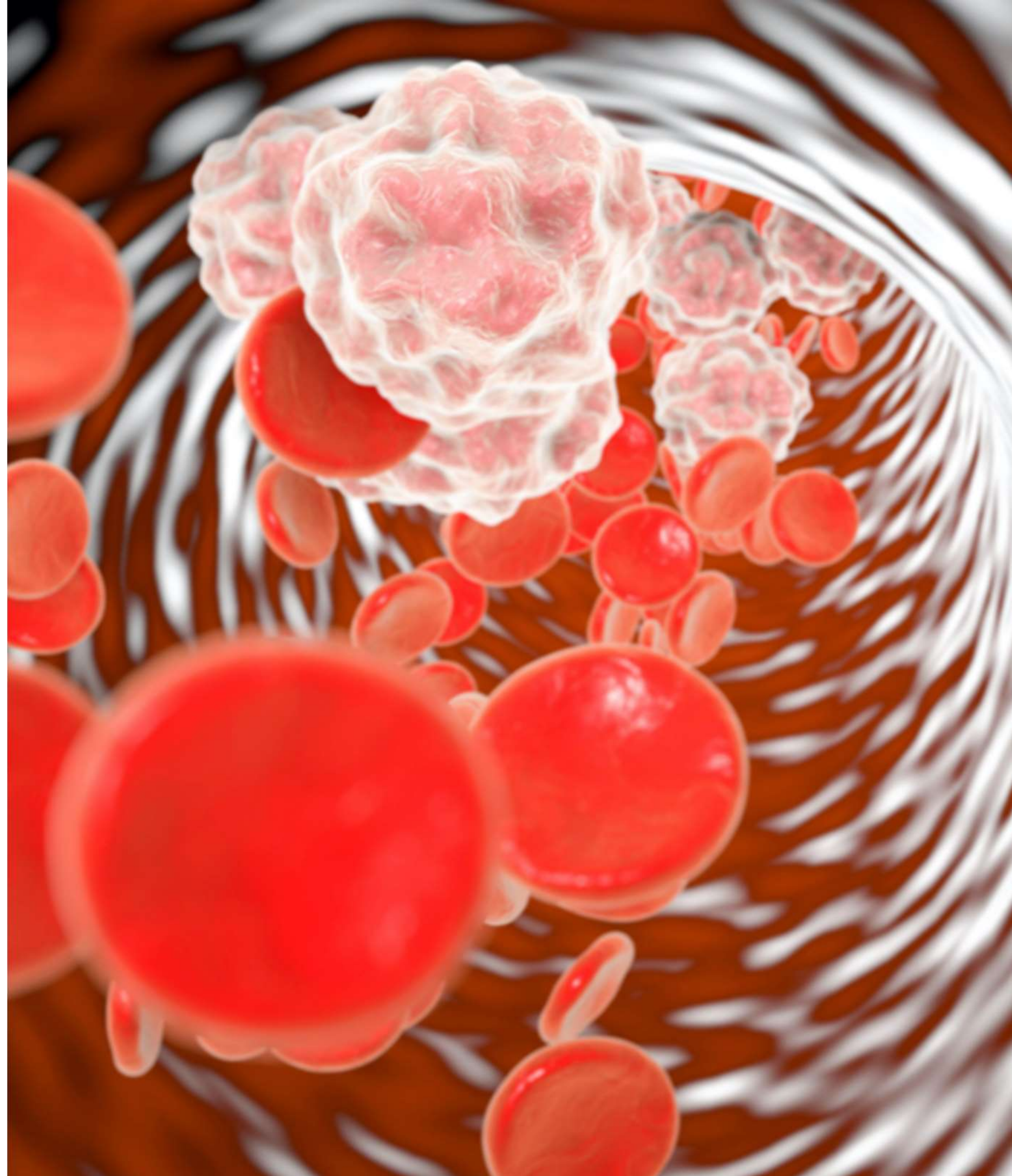
- Rheumatoid arthritis
- Type 1 diabetes
- Alopecia
- Lupus
- Multiple sclerosis
- Celiac disease

This is a response due to a failure of the thymus to recognize “self” during its mission to protect the body Against invaders. The protect cells are called T-cells Which are named after the thymus.



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What is the Purpose of Inflammation?



Protect the injured tissue by...

- Protect from damage
- Wall off damage
- Clear out damage
- Bring defense mechanisms to the area of injury

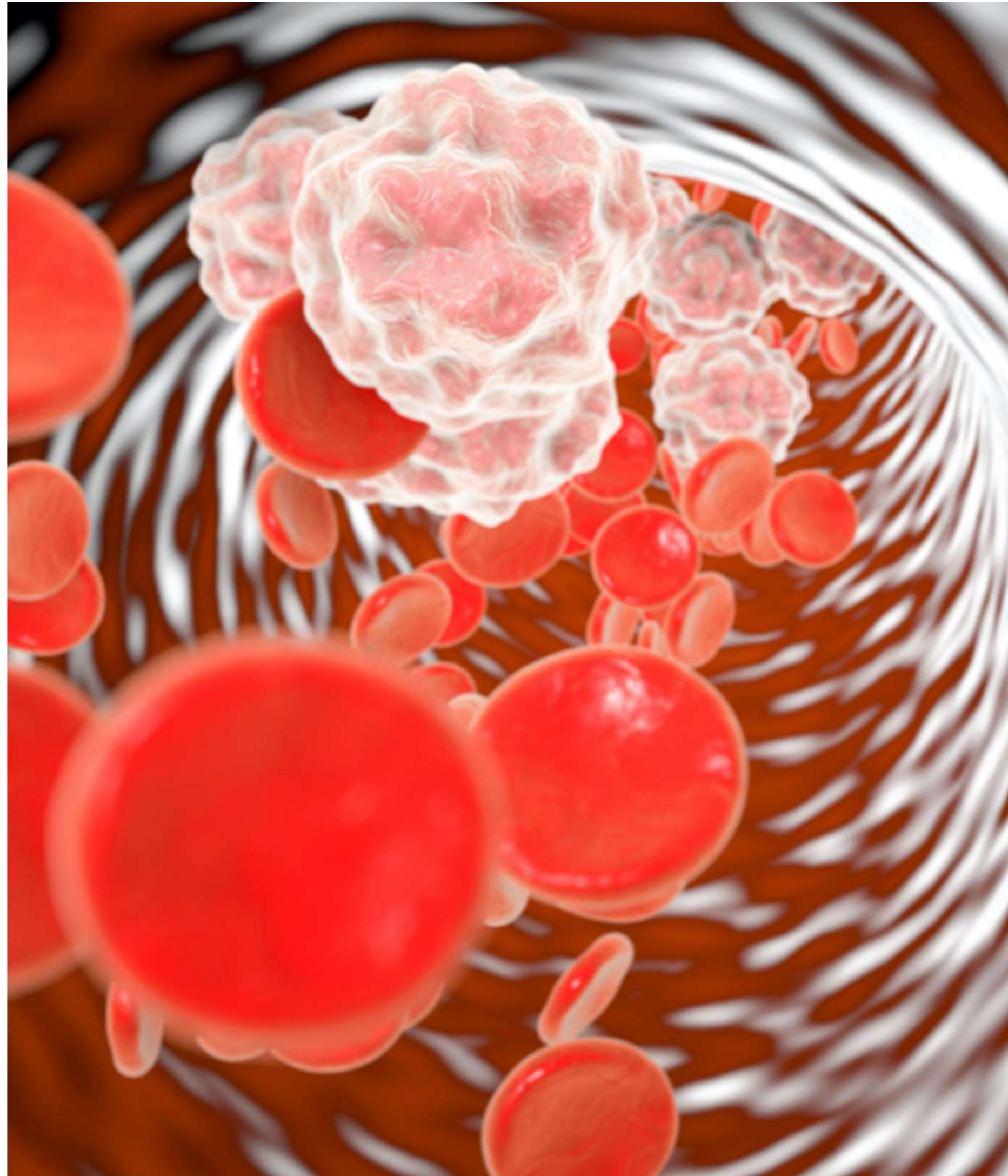


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What is the Purpose of Inflammation?

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INJURY – Impact: Kettlebell Wrist Bruise



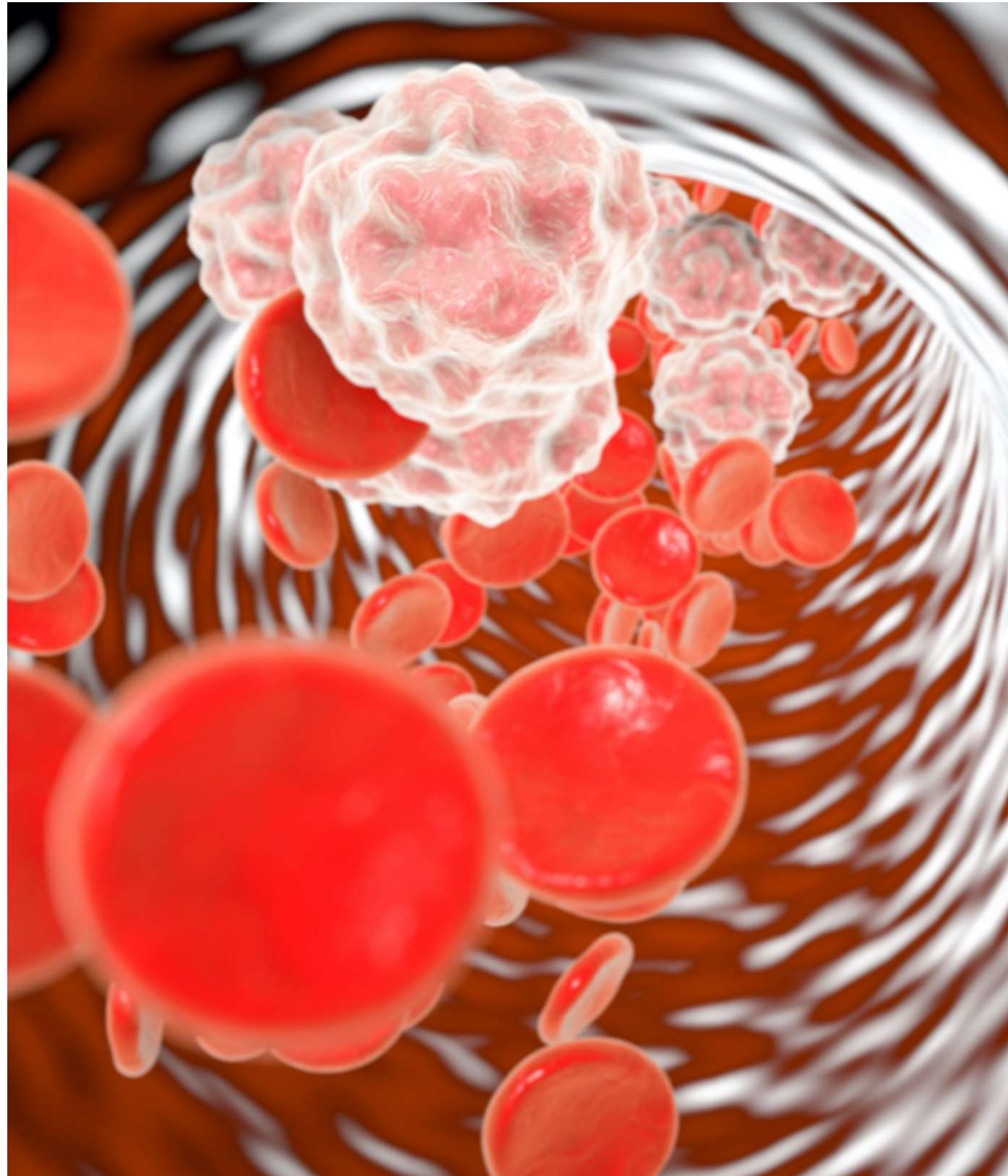
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INJURY – Impact: Kickboxing Loss



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Inflammatory Mediators



Messengers that promote inflammation

- Inflammatory Interleukins
- TNF (tumor necrosis factor)
- Catecholamines
- Inflammatory cytokines
- Inflammatory chemokines
- Histamines
- ROS
- Nitric Oxide (not nitrous oxide)
- Etc...

Acute Injury

Symptoms of Acute Injury

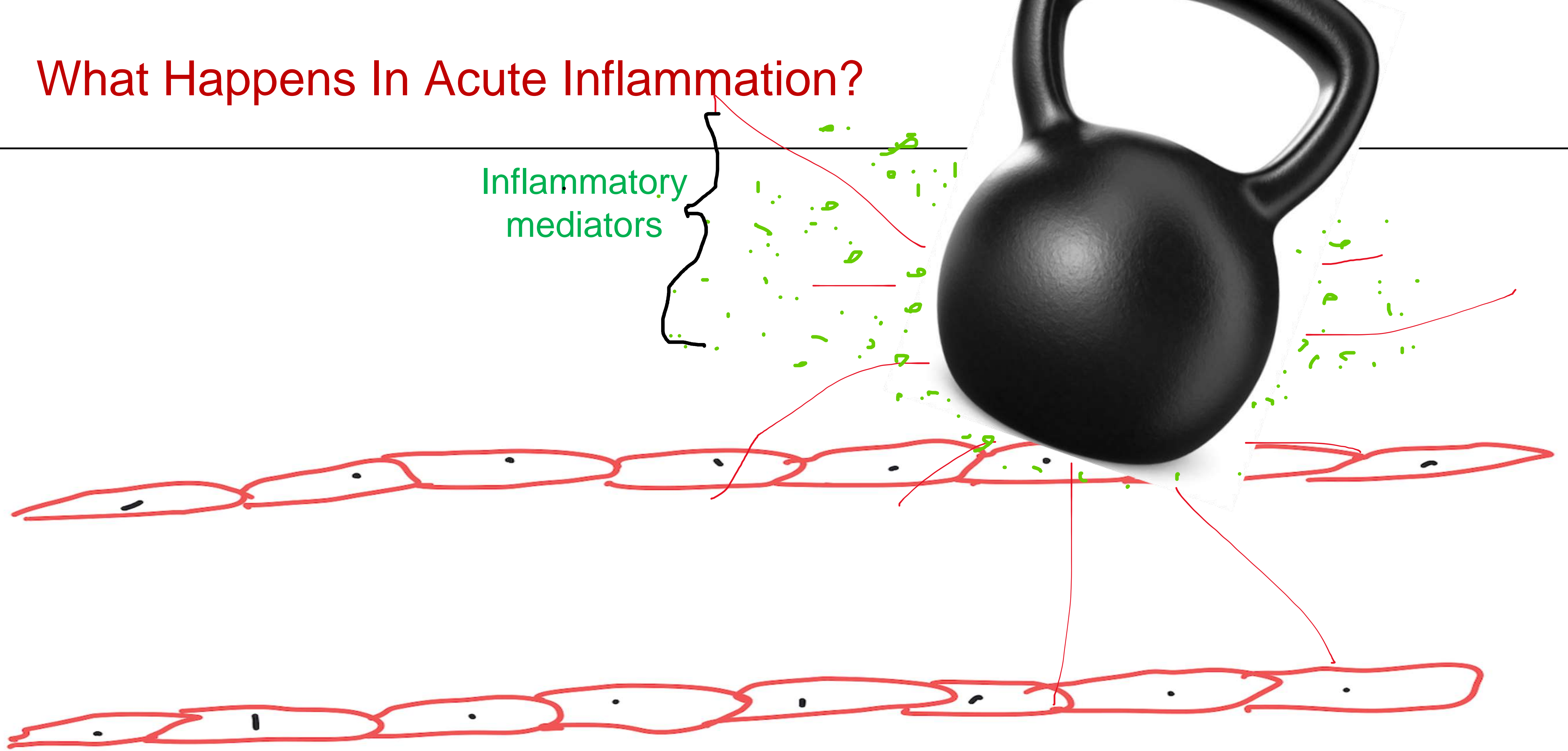
Example of Impact Trauma

- Redness (rubor)
- Swelling (tumour)
- Heat (calor)
- Pain (dolor)
- Loss of function (functio laesa)



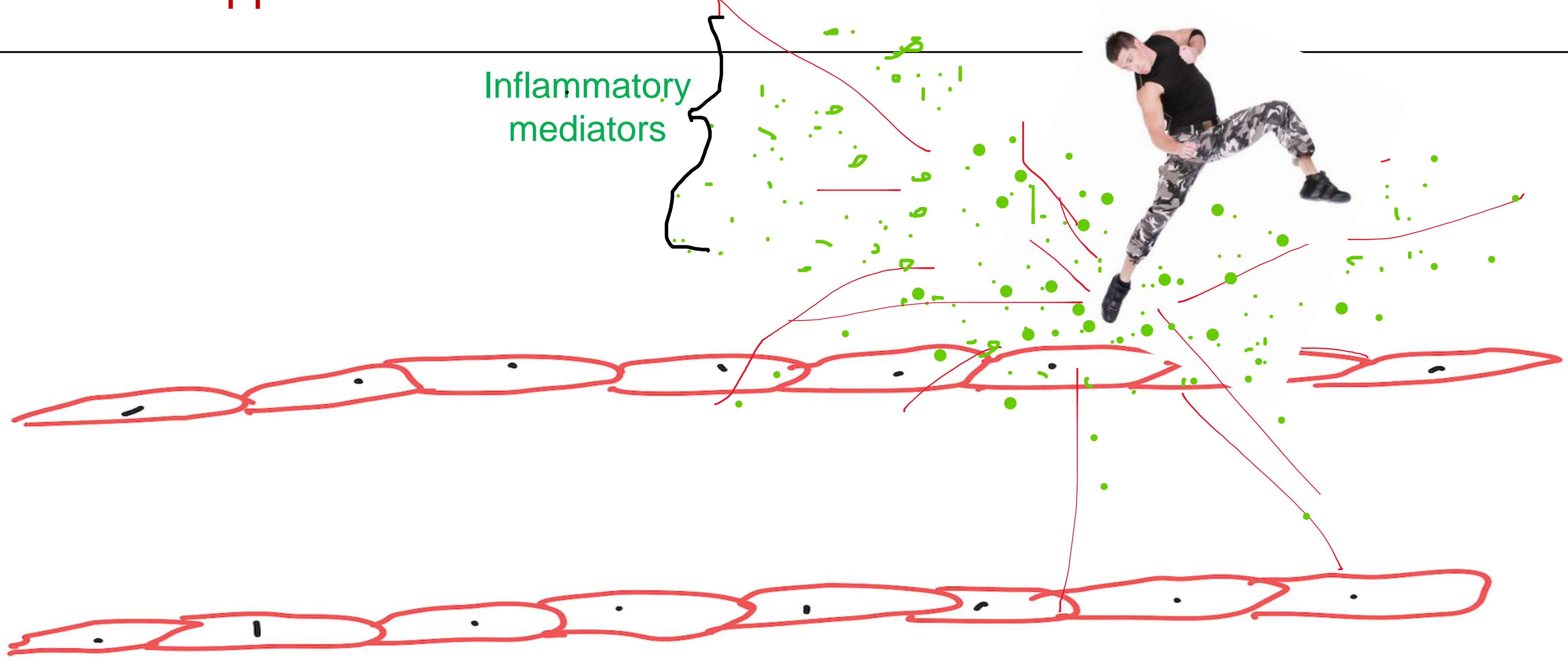
What Happens In Acute Inflammation?

Inflammatory
mediators

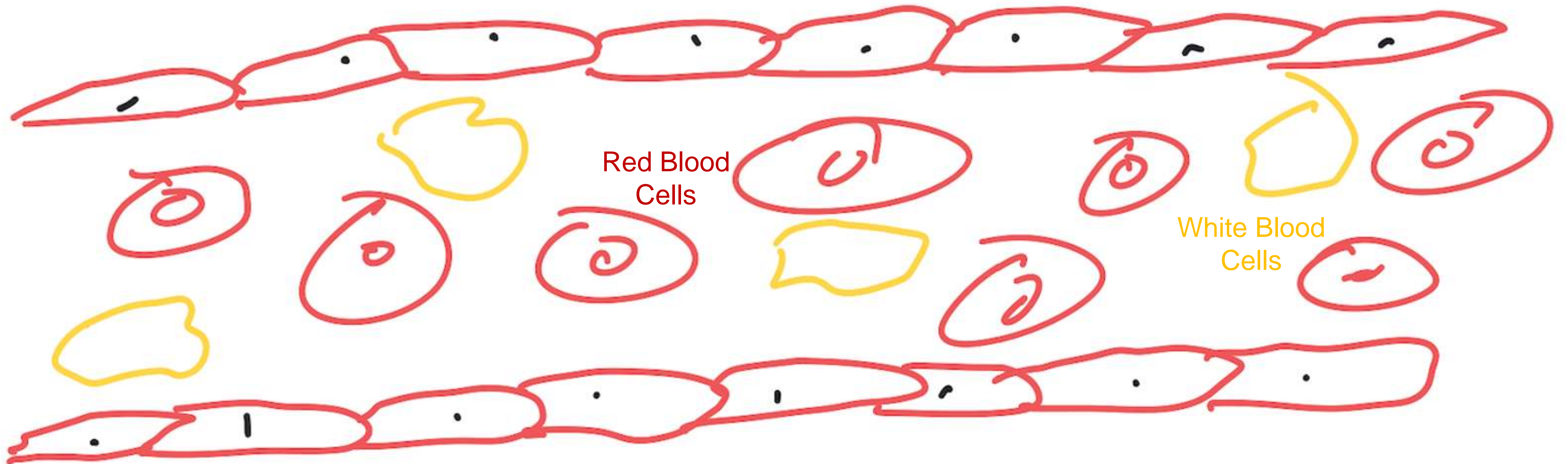


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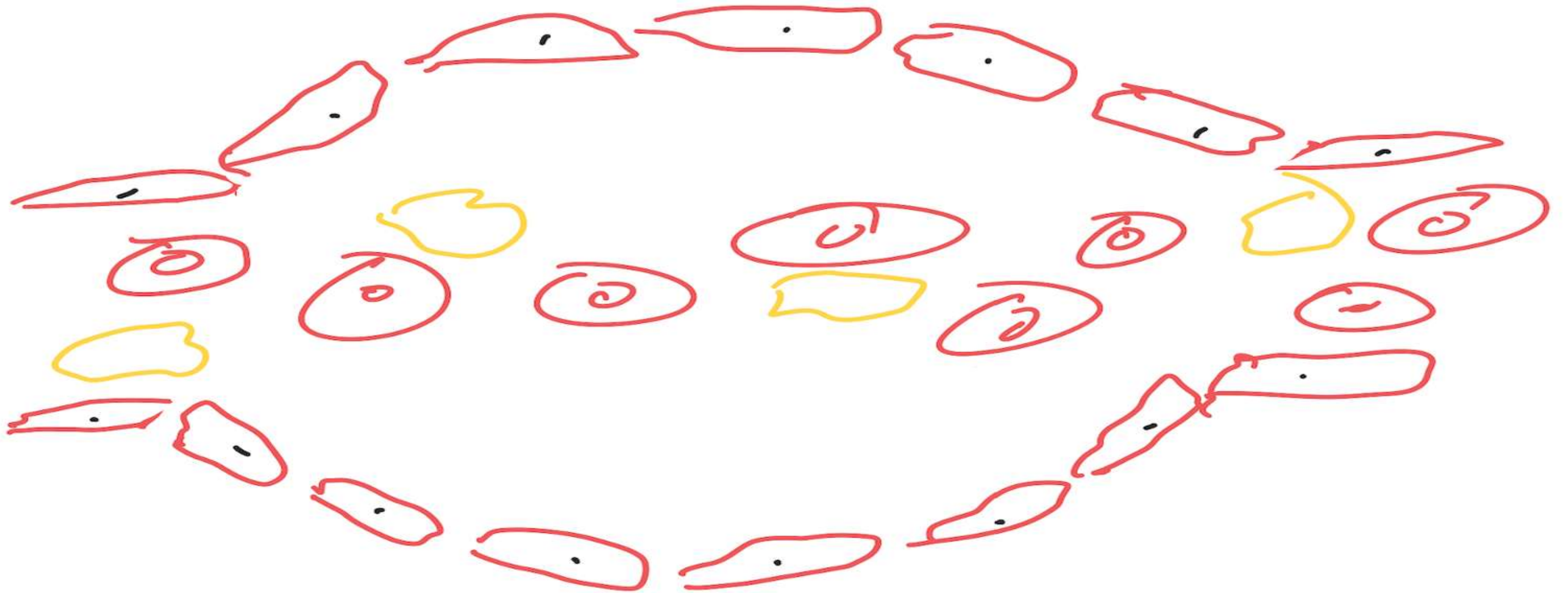
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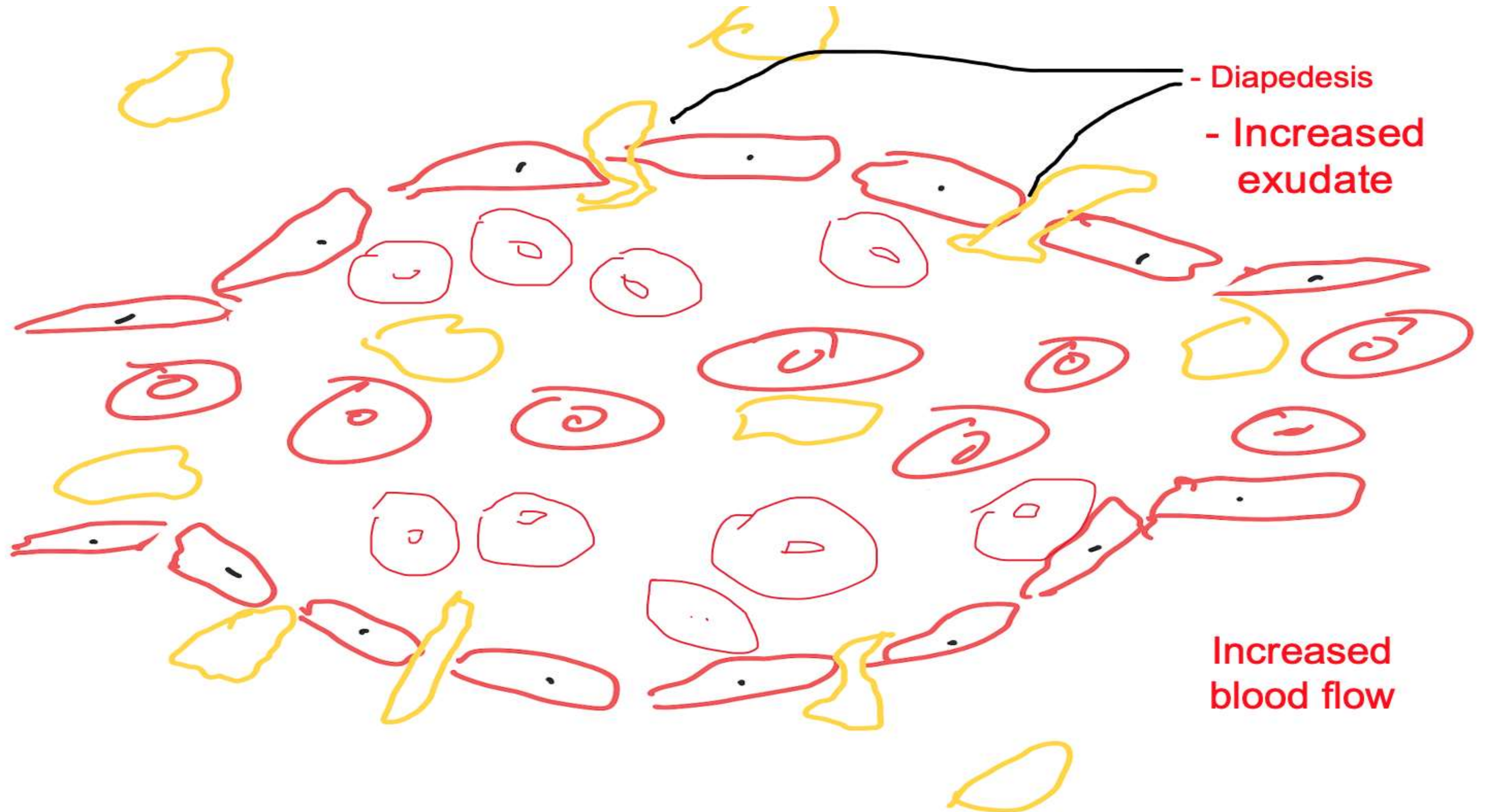
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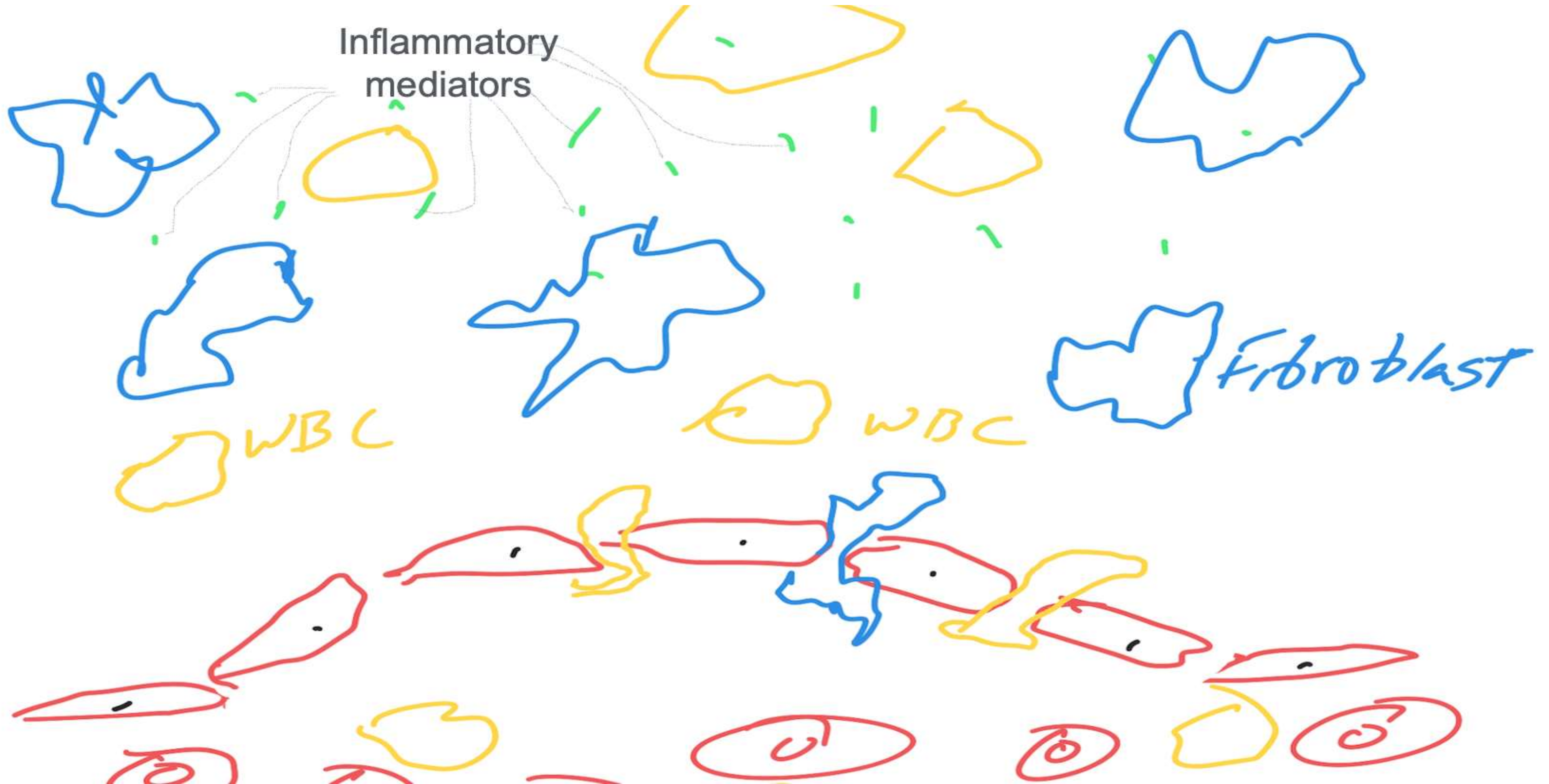
What Happens In Acute Inflammation?



What Happens During Inflammation?



What Happens During Inflammation?



Common Address for Local Inflammation



RICE

- R – Rest
- I – Ice
- C – Compress
- E – Elevate

- Reasons why it decreases inflammation...

- Reasons why it may not be the best choice...later... 😊



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What Does R.I.C.E. Do?



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FOUR Phases of Wound Healing

- Homeostasis
- Inflammation
- Proliferation
- Remodeling



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Homeostasis



- Equilibrium and Stability of interdependent variables



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Inflammation

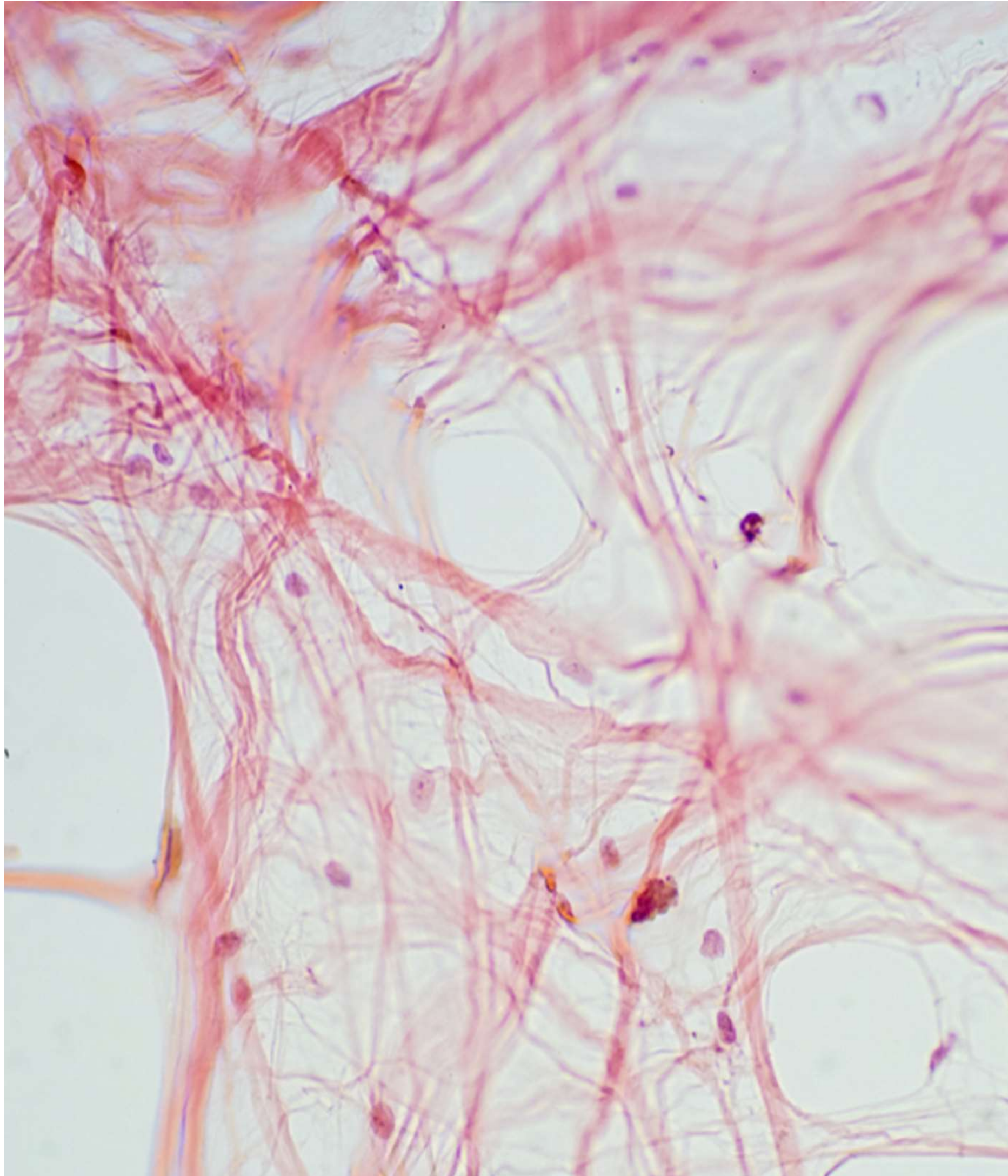
Landén, N. X., Li, D., & Ståhle, M. (2016). Transition from inflammation to proliferation: a critical step during wound healing. *Cellular and molecular life sciences : CMLS*, 73(20), 3861–3885. <https://doi.org/10.1007/s00018-016-2268-0>

- Phagocytosis of microbes
- Clearance of cellular debris
- Production of pro-inflammatory mediators
- Inflammation usually lasts 2-5 days (immune response lasts until wound is resolved)
- Neutrophils follow the chemokine gradient to the most concentrated area
- Monocytes differentiate into macrophages and “eat” debris and help healing in the next phase



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Proliferation Phase



Day 1 up to a month

- Continued healing does not equal continued inflammation
- Fibroblast (and macrophages) come in mass “granulation tissue”
- Lay down collagen matrix (randomly placed)
- Reconstruct damaged tissues
- Wound contraction takes place
- Restoration of vascular network “angiogenesis”

Remodeling Phase

Weeks to a year or more

(depending on wound size and type)

- Collage shifts into a different type which aligns fibers with tension
- Assist soft tissue realignment with stretching, contraction, weightbearing activities (Davis's Law)
- In bones it's called Wolff's Law
- Reduce the occurrence of scar tissue
- Scar tissue is considered only 80% at most the strength of the original tissue



Schilling J. A. (1976). Wound healing. *The Surgical clinics of North America*, 56(4), 859–874.
[https://doi.org/10.1016/s0039-6109\(16\)40983-7](https://doi.org/10.1016/s0039-6109(16)40983-7)

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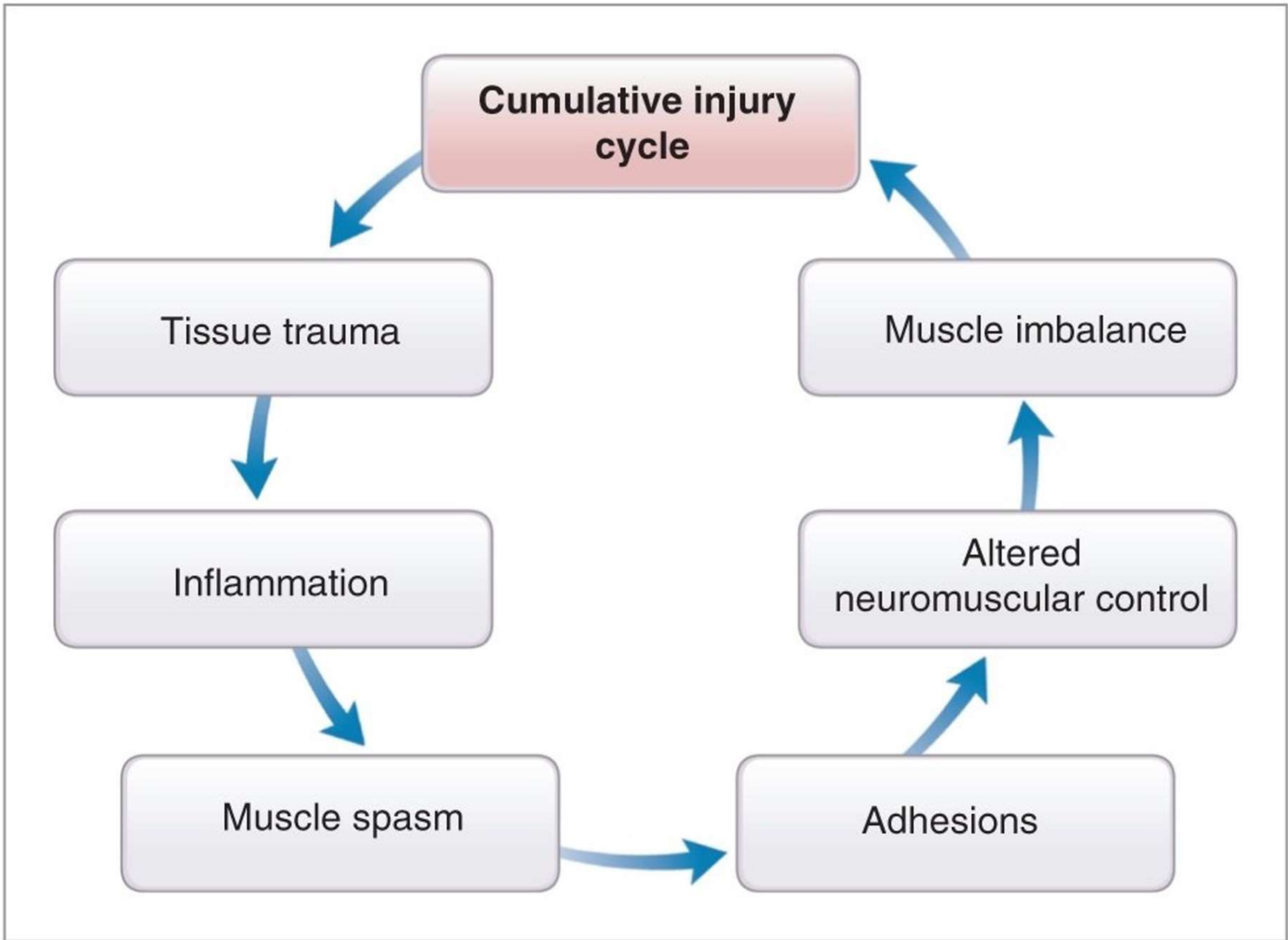
INJURY – What Did the KB Wrist Bruise Hurt?



- Pain is a protective mechanism to minimize additional damage
- Inflammation can increase pain due to swelling which can put pressure against already facilitated nerve endings
- Advanced acute phases lead to a loss of function
- My repeatedly strained calf muscle is not a chronic condition but a repeated acute trauma and reinjury ... which can lead to a chronic issue.



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Acute vs. Chronic Inflammation

Acute Inflammation:

- Fights infection
- Speed recovery
- Similar regardless of issue (trauma, antigens, burns, etc.)
- Redness
- Heat
- Swelling
- Pain
- Loss of function
- 1-3 days in the initial phases and up to a month



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Acute vs. Chronic Inflammation

Chronic Inflammation:

- Not enough inflammation to overcome (continued) trauma
- WBC end up attacking healthy tissues and organs
- Obesity is an inflammatory state
- Chronic inflammation is associated with
 - Heart disease
 - Diabetes
 - Cancer
 - Arthritis
 - Crohn's disease
 - IBS
- Testing for chronic inflammation – C-reactive protein
 - 1-3mg/liter shows low but likely continuous inflammation



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What About DOMS?

MacIntyre, D. L., Sorichter, S., Mair, J., Berg, A., & McKenzie, D. C. (2001). Markers of inflammation and myofibrillar proteins following eccentric exercise in humans. *European journal of applied physiology*, 84(3), 180–186.
<https://doi.org/10.1007/s004210170002>

- “The purpose of this study was to examine the time-course and relationships of technetium-99m (99mTc) neutrophils in muscle, interleukin-6 (IL-6), myosin heavy chain fragments (MHC), eccentric torque, and delayed onset muscle soreness (DOMS) following eccentric exercise...
- Blood draw at 0, 2, 4, 6, 20, 24, 48, 72 h, and 6 and 9 days
- The neutrophils were greater in the exercised muscle than the non-exercised muscle.
- The DOMS was increased from 0 to 48 h, eccentric torque decreased from 2 to 24 h, and myosin heavy chain fragments (MHC) peaked at 72 h post-exercise.
- Significant relationships were found between IL-6 and 2 h and DOMS at 24 h post-exercise and assessment of the magnitude of change between IL-6 and MHC.
- These findings suggest a relationship between damage to the contractile proteins and inflammation, and that DOMS is associated with inflammation but not with muscle damage.



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Chronic Inflammation and Exercise

Dimitrov, S., Hulteng, E., & Hong, S. (2017). Inflammation and exercise: Inhibition of monocytic intracellular TNF production by acute exercise via β_2 -adrenergic activation. *Brain, behavior, and immunity*, 61, 60–68. <https://doi.org/10.1016/j.bbi.2016.12.017>

Authors show that 20-minutes of moderate intensity treadmill walking may protect against chronic conditions with low-grade inflammation.



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Chronic Inflammation and Exercise

Hong, S., Dimitrov, S., Pruitt, C., Shaikh, F., & Beg, N. (2014). Benefit of physical fitness against inflammation in obesity: role of beta adrenergic receptors. *Brain, behavior, and immunity*, 39, 113–120.
<https://doi.org/10.1016/j.bbi.2013.12.009>

- “Evidence shows that both poor physical fitness and obesity are linked to low-grade inflammation and inflammatory diseases.”
- Among the overweight or obese participants, greater cardiorespiratory fitness was a strong predictor of lower levels of TNF and IL-1 β after controlling for the covariates.
- Cardiorespiratory fitness protects against obesity-related low-grade inflammation.
- Given the significance of beta adrenergic receptors (β -AR) function in pathogenesis of various diseases, clinical implications of its role in the fitness-inflammation association among the obese are profound.



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Chronic Inflammation and Exercise

Pinto, A., Di Raimondo, D., Tuttolomondo, A., Buttà, C., Milio, G., & Licata, G. (2012). Effects of physical exercise on inflammatory markers of atherosclerosis. *Current pharmaceutical design*, 18(28), 4326–4349. <https://doi.org/10.2174/138161212802481192>

- Regular exercise is an established therapeutic intervention with an enormous range of benefits.
- Findings confirm that physical activity induces an increase in the systemic levels of a number of cytokines and chemokines with anti-inflammatory properties.
- MYOKINES produced during muscular contractions ... contribute to provide anti-inflammatory actions.
- Analysis of available researches seem to confirm the efficacy of regular physical training as a nonpharmacological therapy having target chronic low-grade inflammation.
- Physical exercise could be considerate a useful weapon against local vascular and systemic inflammation in atherosclerosis.



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Regular Exercise for Disease Prevention and Treatment

Gleeson, M., Bishop, N. C., Stensel, D. J., Lindley, M. R., Mastana, S. S., & Nimmo, M. A. (2011). The anti-inflammatory effects of exercise: mechanisms and implications for the prevention and treatment of disease. *Nature reviews. Immunology*, 11(9), 607–615. <https://doi.org/10.1038/nri3041>

- “Regular exercise reduces the risk of chronic metabolic and cardiorespiratory diseases, in part because exercise exerts anti-inflammatory effects.”



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Better Immunology – Not Just Anti-Inflammatory

Pedersen, B. K., & Saltin, B. (2015). Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scandinavian journal of medicine & science in sports*, 25 Suppl 3, 1–72.

<https://doi.org/10.1111/sms.12581>

“This review provides the reader with the up-to-date evidence-based basis for prescribing exercise as medicine in the treatment of 26 different diseases.”

- Psychiatric diseases (depression, anxiety, stress, schizophrenia)
- Neurological diseases (dementia, Parkinson's disease, multiple sclerosis)
- Metabolic diseases (obesity, hyperlipidemia, metabolic syndrome, polycystic ovarian syndrome, type 2 diabetes, type 1 diabetes)
- Cardiovascular diseases (hypertension, coronary heart disease, heart failure, cerebral apoplexy, and claudication intermittent)
- Pulmonary diseases (chronic obstructive pulmonary disease, asthma, cystic fibrosis)
- Musculo-skeletal disorders (osteoarthritis, osteoporosis, back pain, rheumatoid arthritis)
- Cancer.



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Exercise and Parasympathetic Nervous System

Daniela, M., Catalina, L., Ilie, O., Paula, M., Daniel-Andrei, I., & Ioana, B. (2022). Effects of Exercise Training on the Autonomic Nervous System with a Focus on Anti-Inflammatory and Antioxidants Effects. *Antioxidants (Basel, Switzerland)*, 11(2), 350. <https://doi.org/10.3390/antiox11020350>

- Autonomic Nervous System
 - Sympathetic Nervous System
 - SNS has been shown to have both pro- and anti-inflammatory effects
 - Parasympathetic Nervous System
 - PNS has anti-inflammatory effects
 - Exercises conducted on a daily basis can cause the ANS to adapt to parasympathetic dominance.



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RICE vs MEAT



RICE vs MEAT



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Common Address for Local Inflammation



RICE

- R – Rest
- I – Ice
- C – Compress
- E – Elevate

- It seems to (only) delay inflammation. Once the tissues warm inflammation resumes.

- Update to RICE...



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Updated Address for Local Inflammation

MEAT

- M – Move
- E – Exercise
- A – Analgesics
- T – Treatment



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Inflammation Overview

What is inflammation?

- A protective response from the body to help protect and heal traumatized vascular tissue.

How does inflammation work?

- Inflammatory markers call WBCs and fibroblasts to the area to remove debris and protect the area.

How does inflammation help?

- Inflammation brings help for healing and starts the process of proliferation and remodeling

Why does inflammation hurt?

- There is already pain in the area plus swelling/edema as well increasing pain to minimize function as not to reinjure.

What is the role of exercise in creating acute inflammation and easing inflammation?

- New and intense exercise can lead to acute inflammation
- Moderate exercise can minimize systemic chronic inflammation



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Inflammation: What it is. How it works. Why it helps and why it hurts.

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