

# A vérlemezék szerepe az immunválaszban

Kappelmayer János

*Debreceni Egyetem,*

*Laboratóriumi Medicina Intézet*

## Immunsejtek versus alvadást elősegítő sejtek

Hemocyták:

alsóbb rendű szervezetek közös alvadást és immunválaszt generáló sejtek

Szolubilis elemek

Thrombocyták:

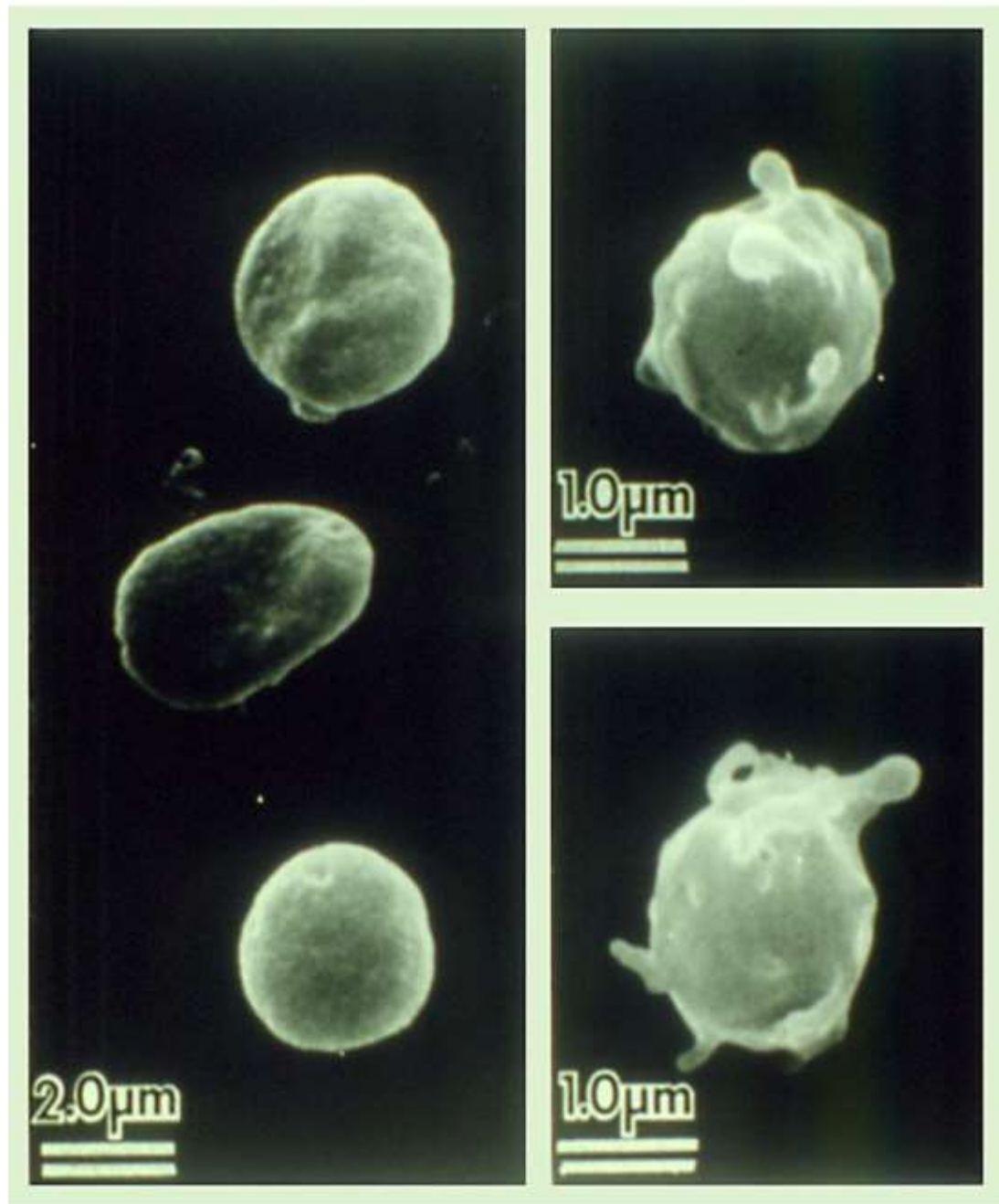
Mag nélküli sejt

Alvadási faktorok

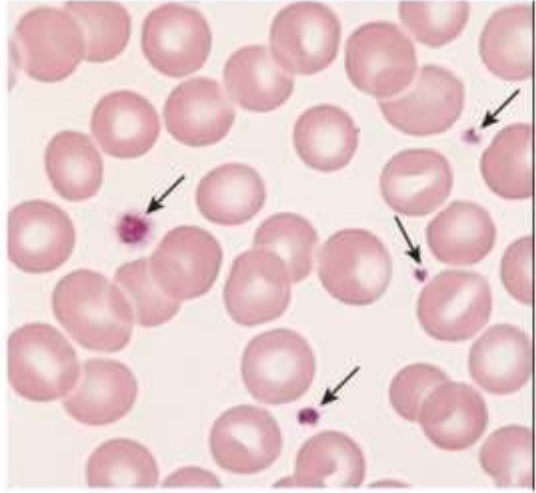
Veleszületett  
immunválasz sejtjei:

Granulocyták, macrophag

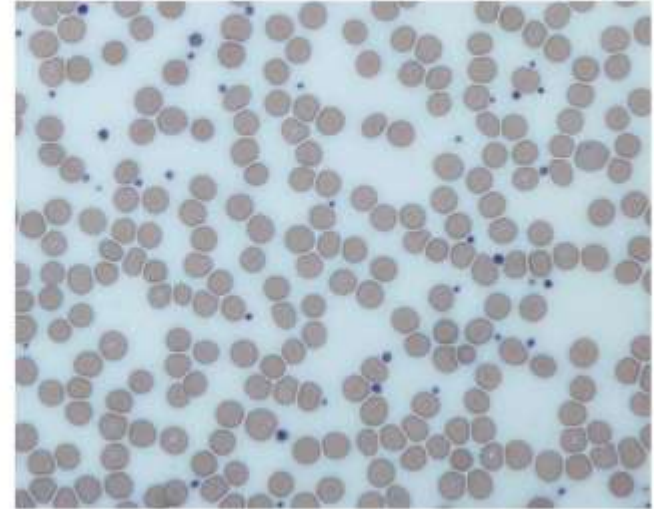
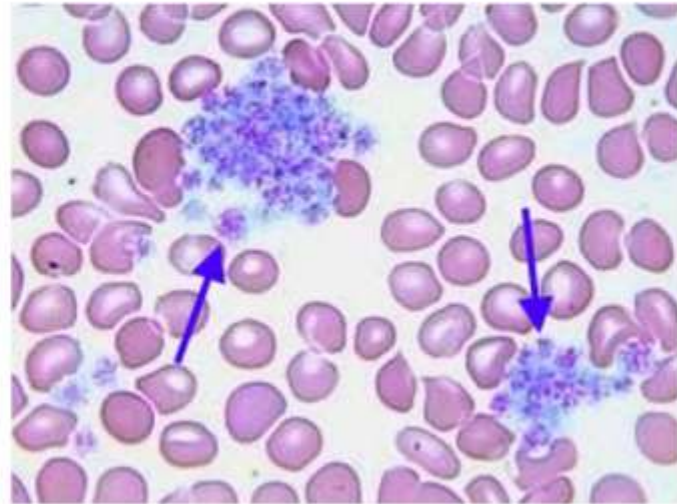
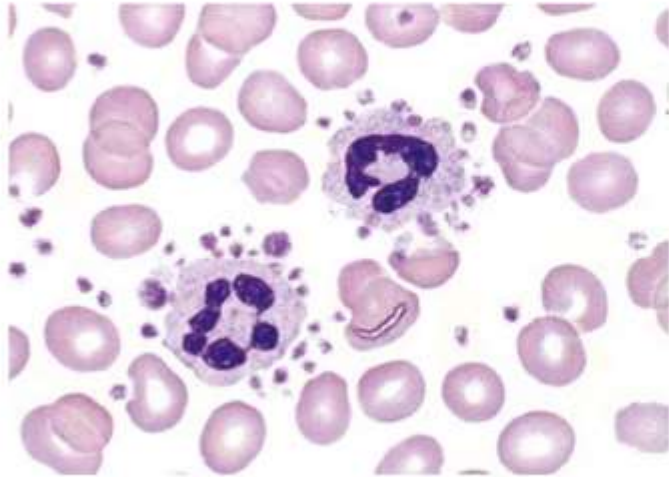
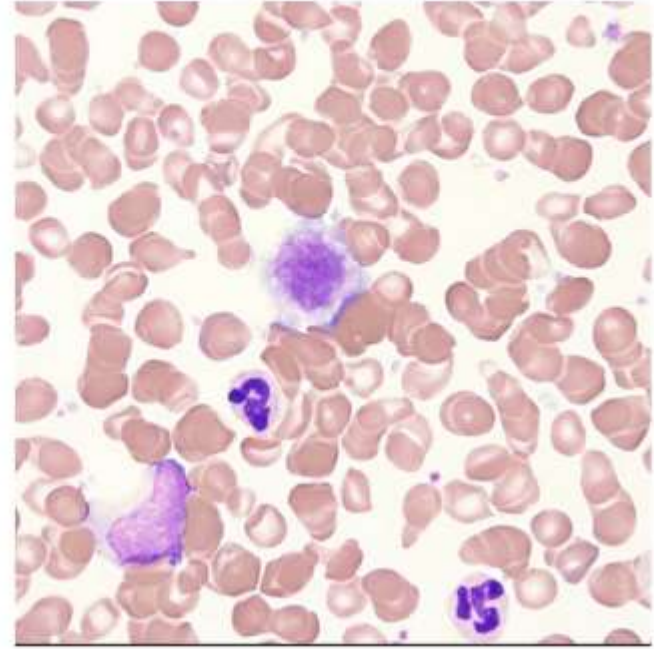
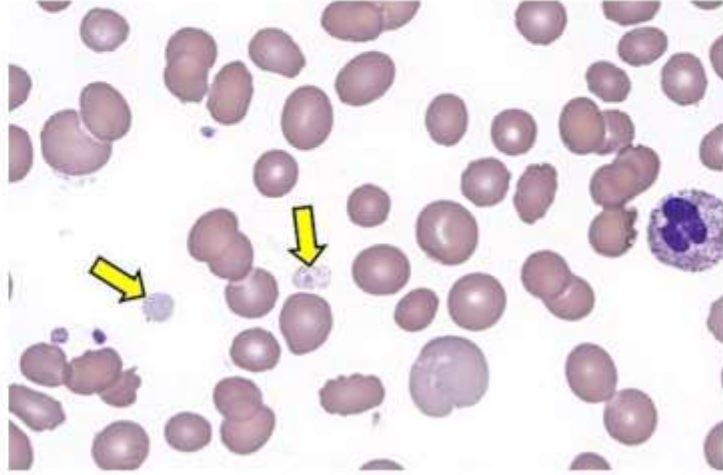
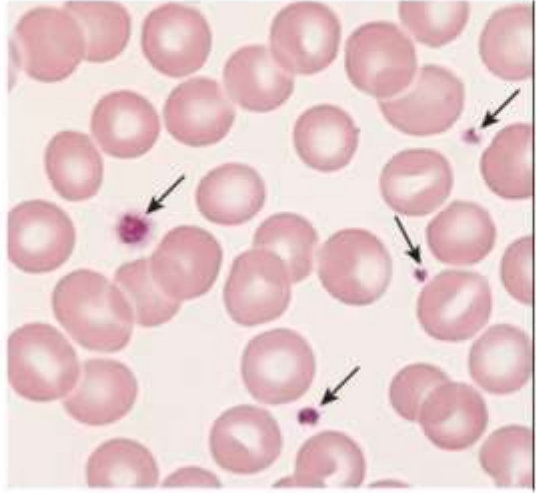
Komplement

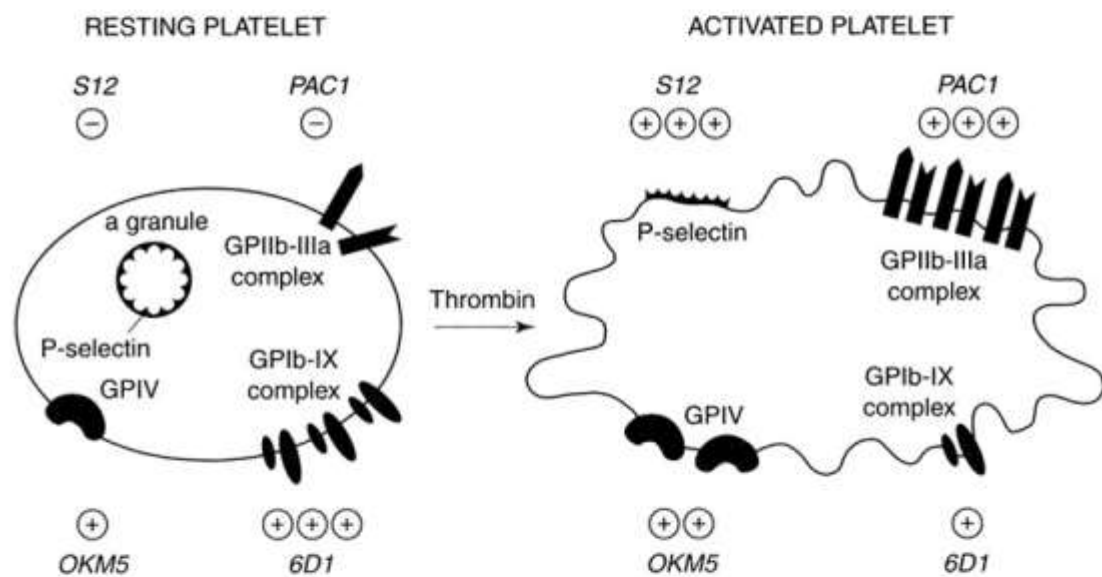


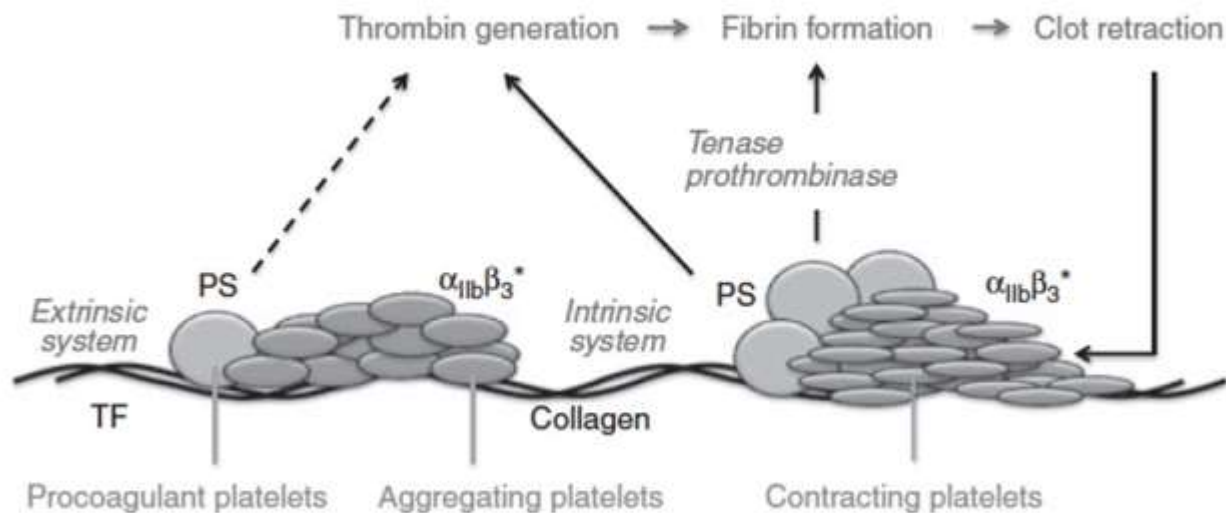
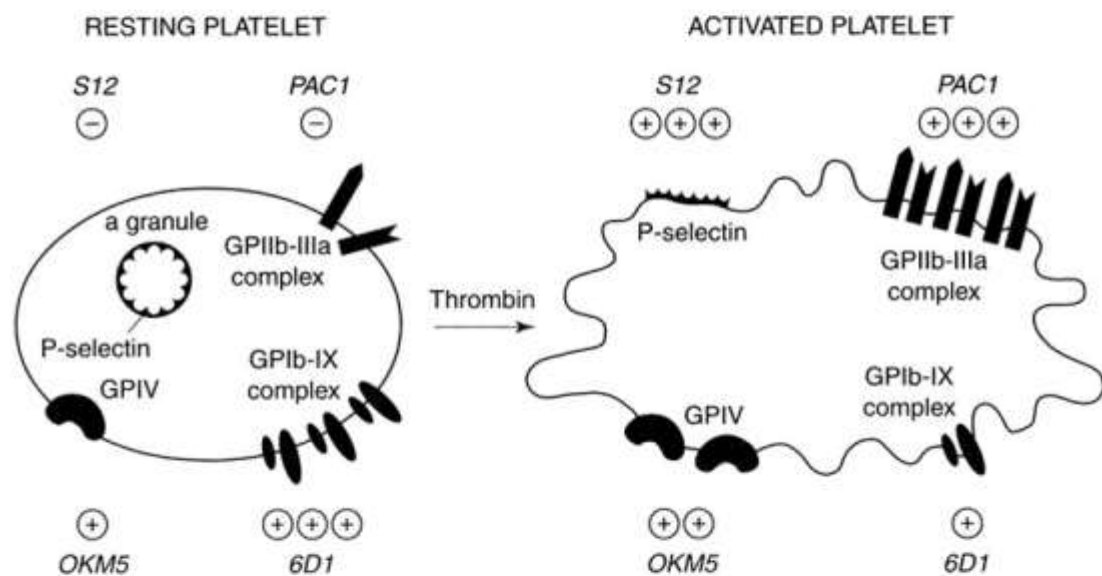
# Kóros thrombocyta morfológia



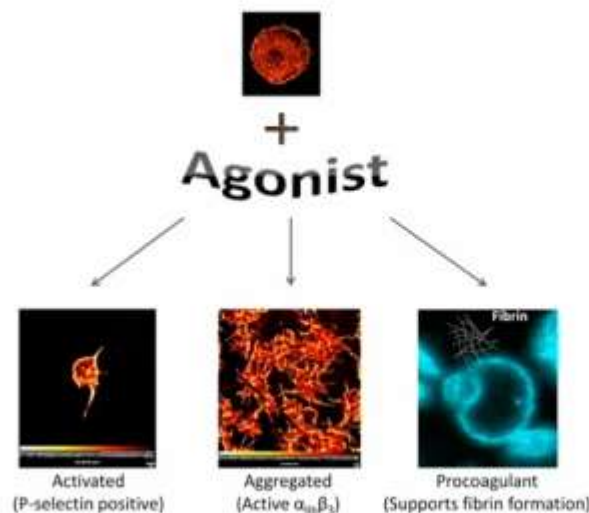
# Kóros thrombocyta morfológia





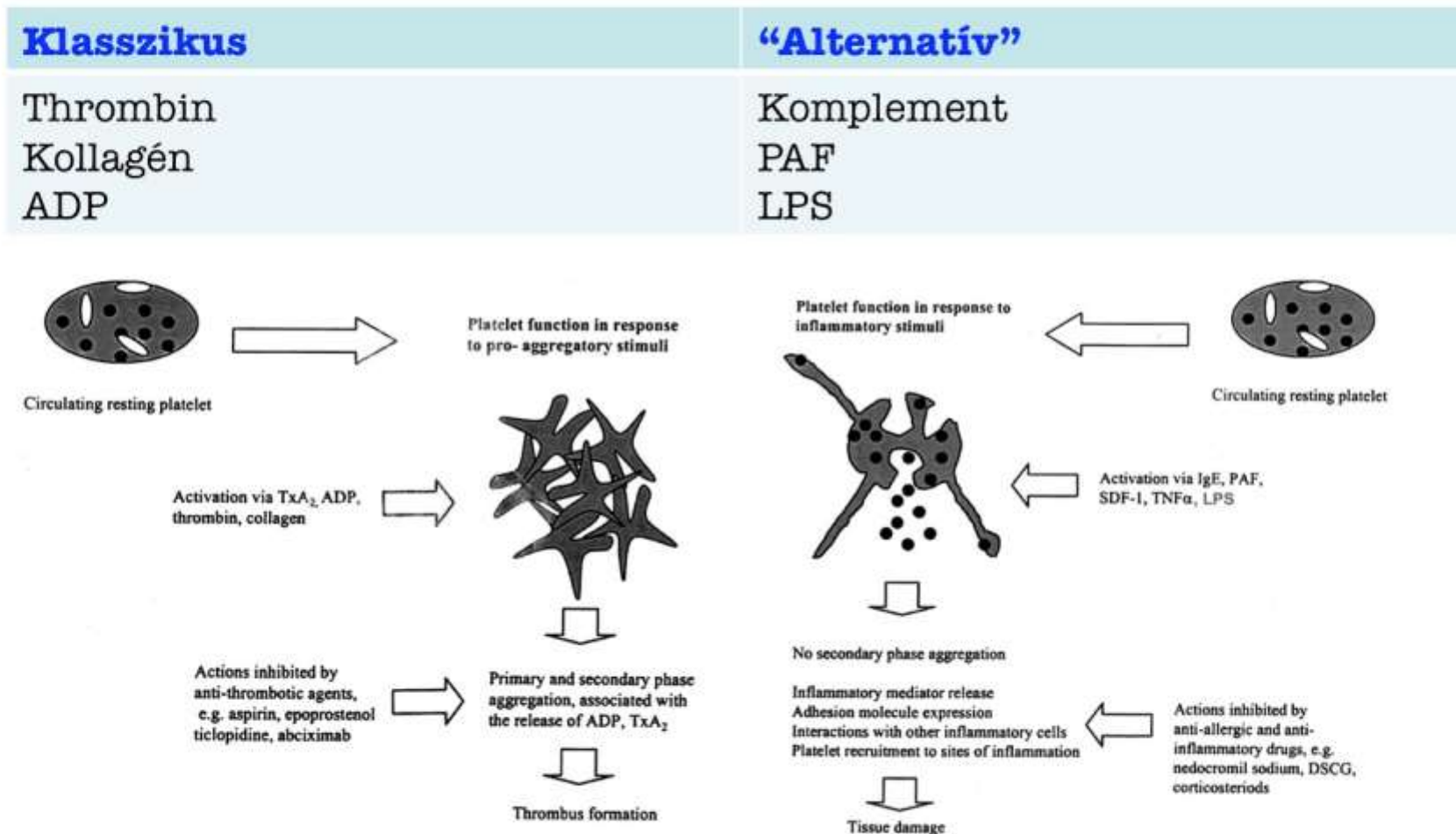


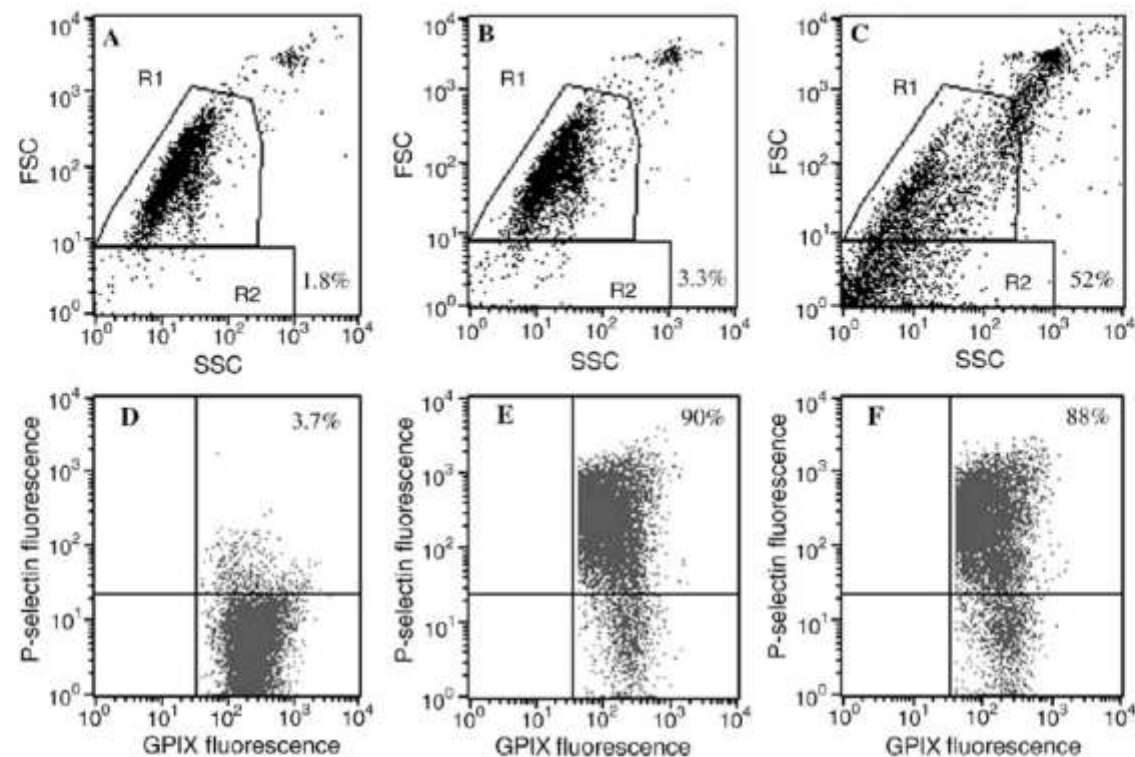
Different activated platelet subpopulations form with the same agonist stimulation



[Kirkpatrick Neurology 2017, Pasalic J Thromb Haemost. 2018]

# A thrombocyta aktiváció útvonalai

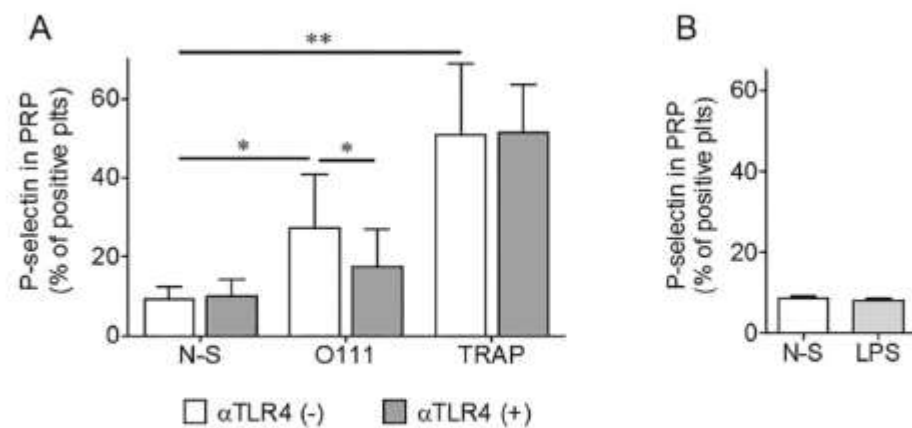




**Table 2** Different sensitivity of direct platelet activation markers.

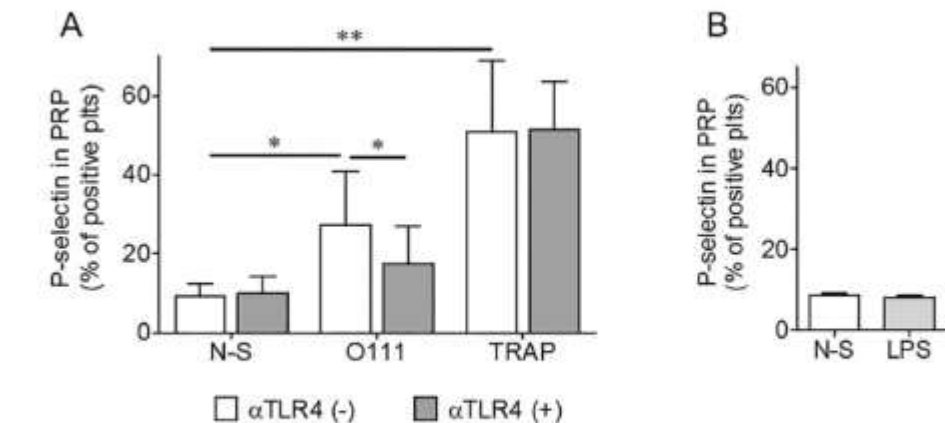
| Thrombin, U/ml | P-selectin, % | P-selectin MFI | GPIX MFI | Microparticle, % |
|----------------|---------------|----------------|----------|------------------|
| 0              | 2             | 60             | 182      | 2                |
| 0.01           | 8             | 65             | 163      | 2                |
| 0.02           | 20            | 69             | 171      | 2                |
| 0.03           | 48            | 116            | 109      | 2                |
| 0.05           | 66            | 142            | 124      | 3                |
| 0.1            | 85            | 168            | 110      | 9                |

Citrated whole blood sample was stimulated with increasing thrombin concentrations. P-selectin expression, the mean fluorescence intensity (MFI) of P-selectin staining, GPIX fluorescence and the percentage of events in the microparticle gate were registered. P-selectin expression was sensitive to even miniscule amounts of thrombin.



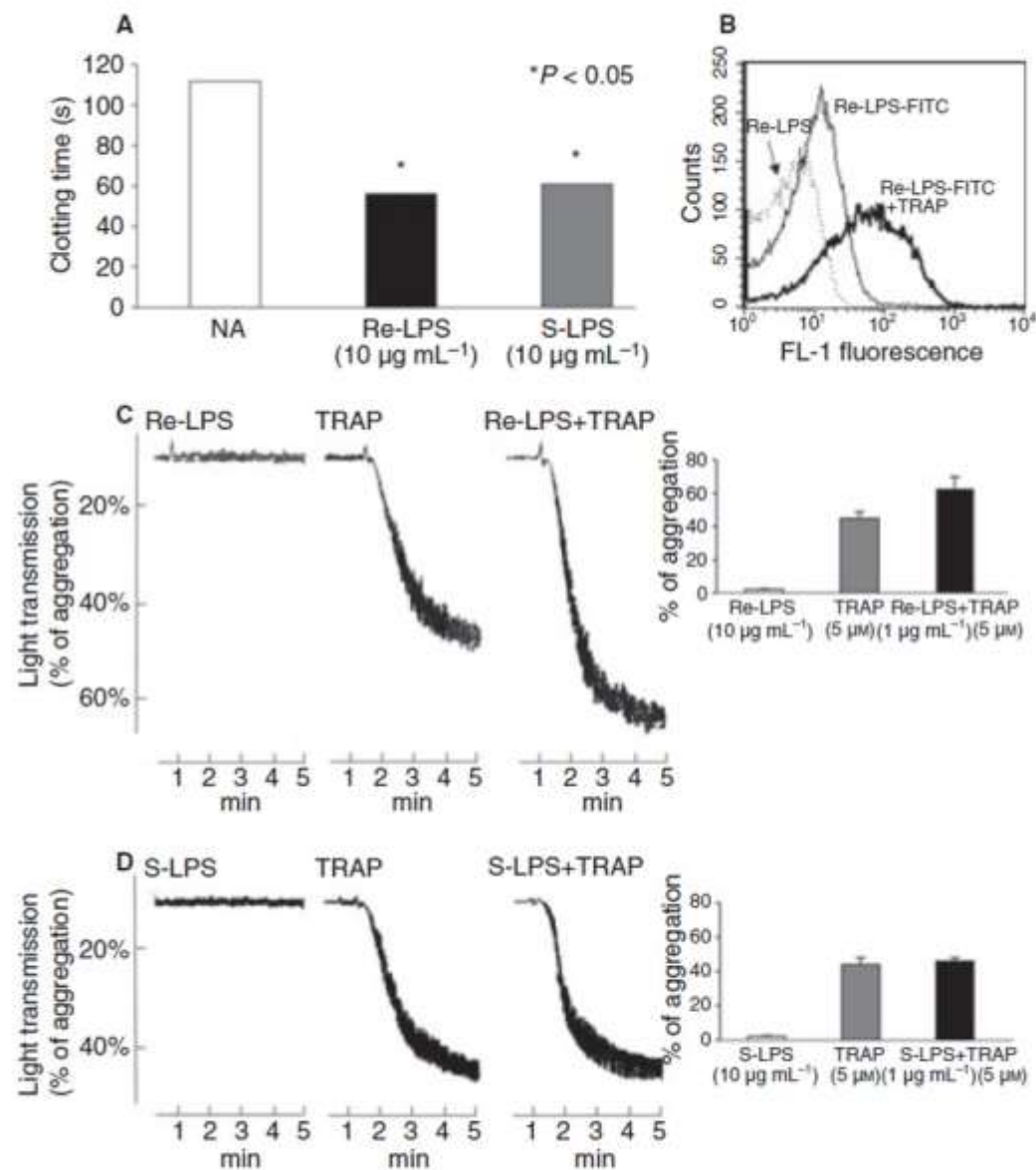
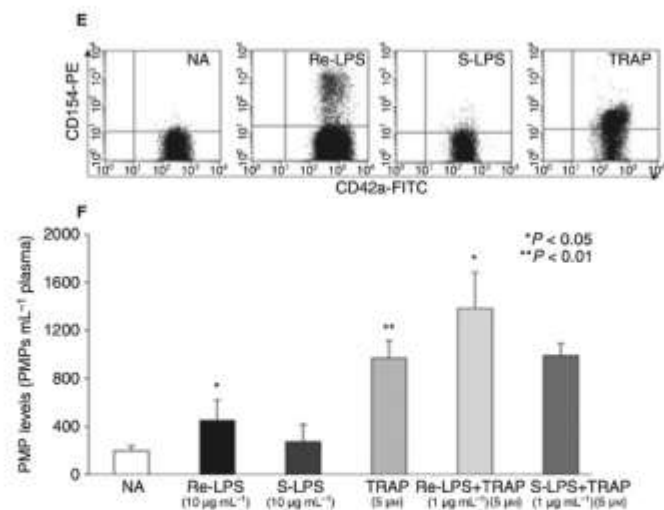
**Matus et al.**

PLOS ONE | <https://doi.org/10.1371/journal.pone.0185431> September 28, 2017

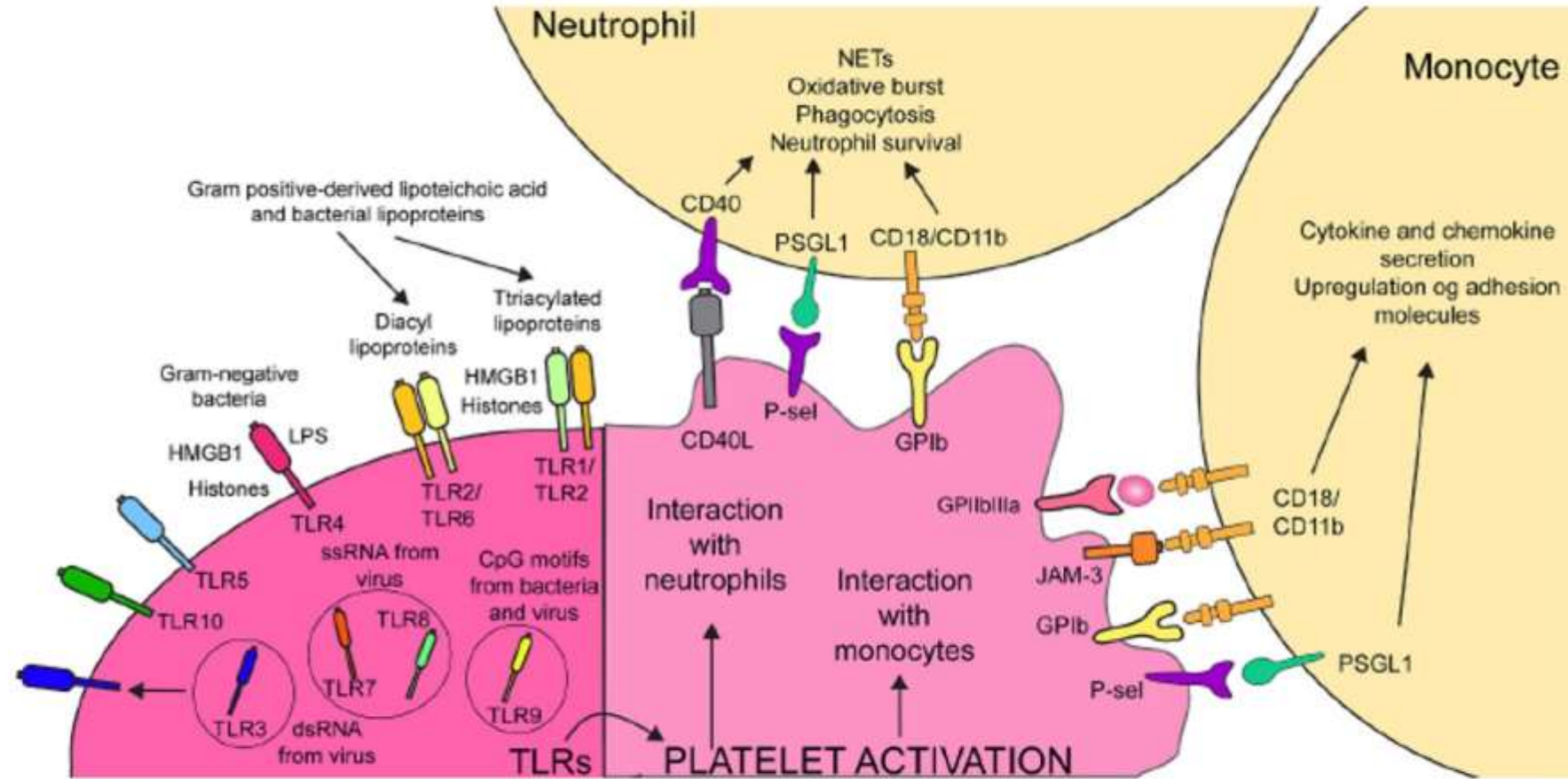


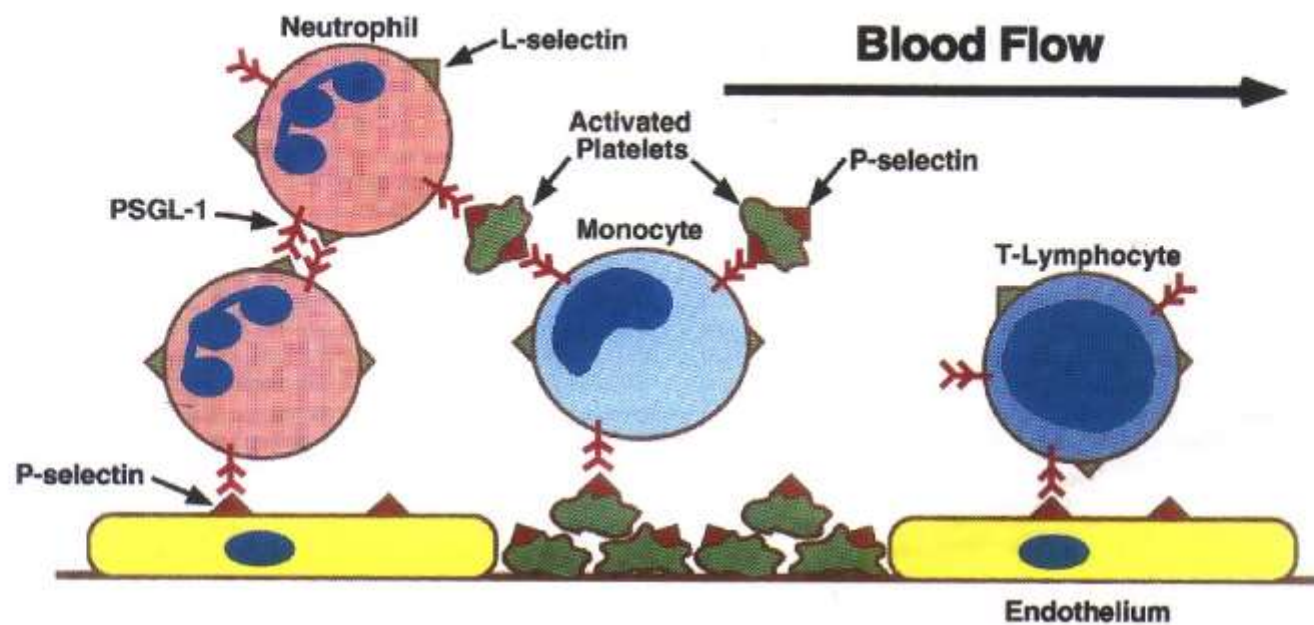
Matus et al.

PLOS ONE | <https://doi.org/10.1371/journal.pone.0185431> September 28, 2017

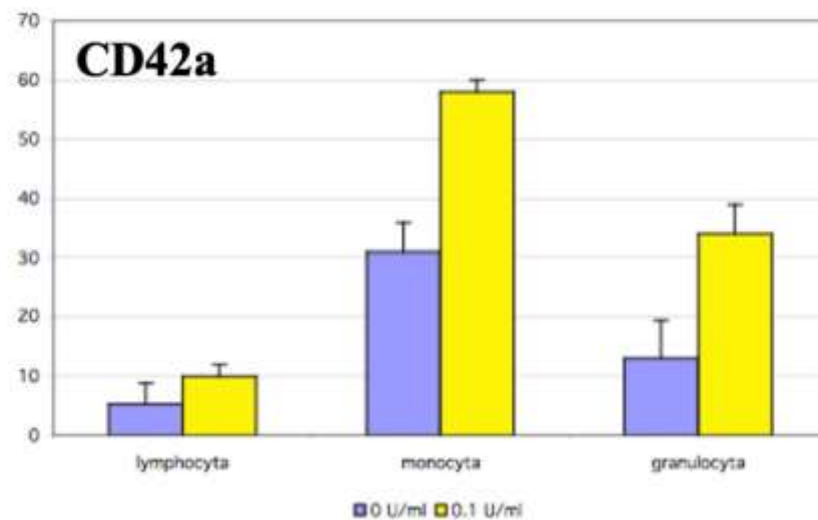


# Pattern Recognition Receptor





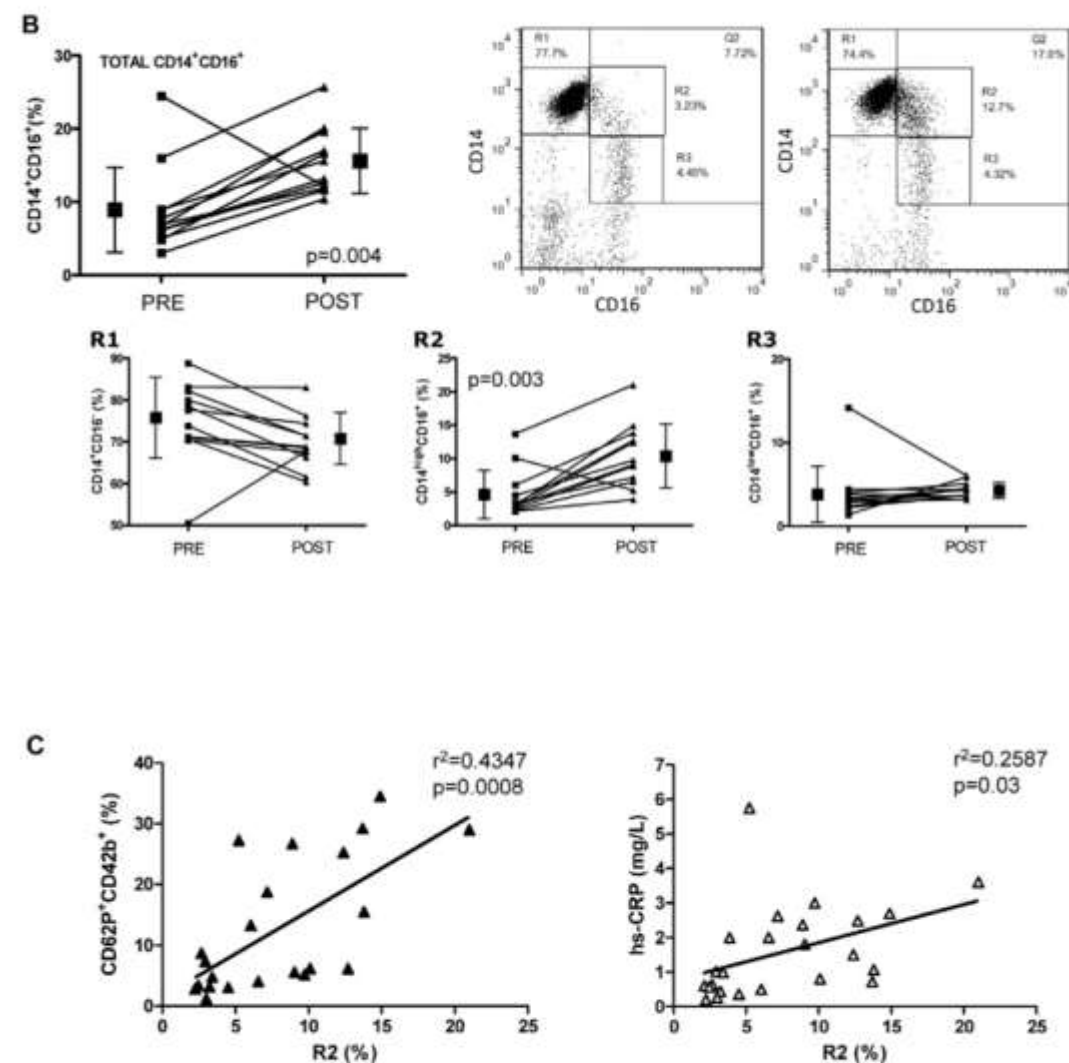
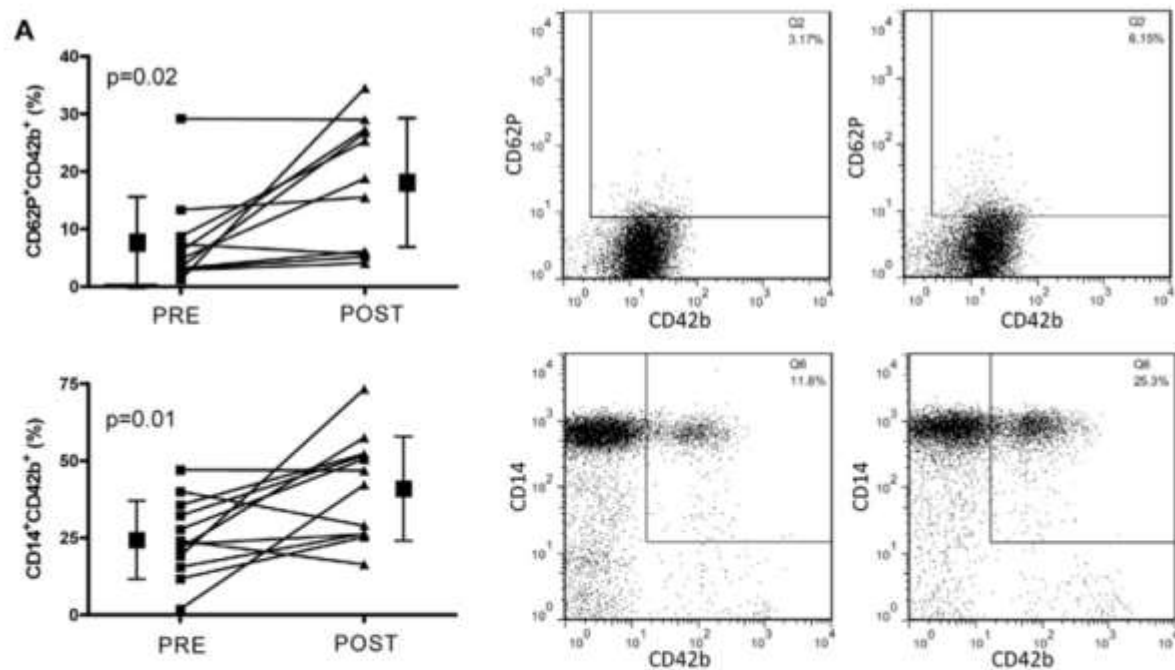
(%)

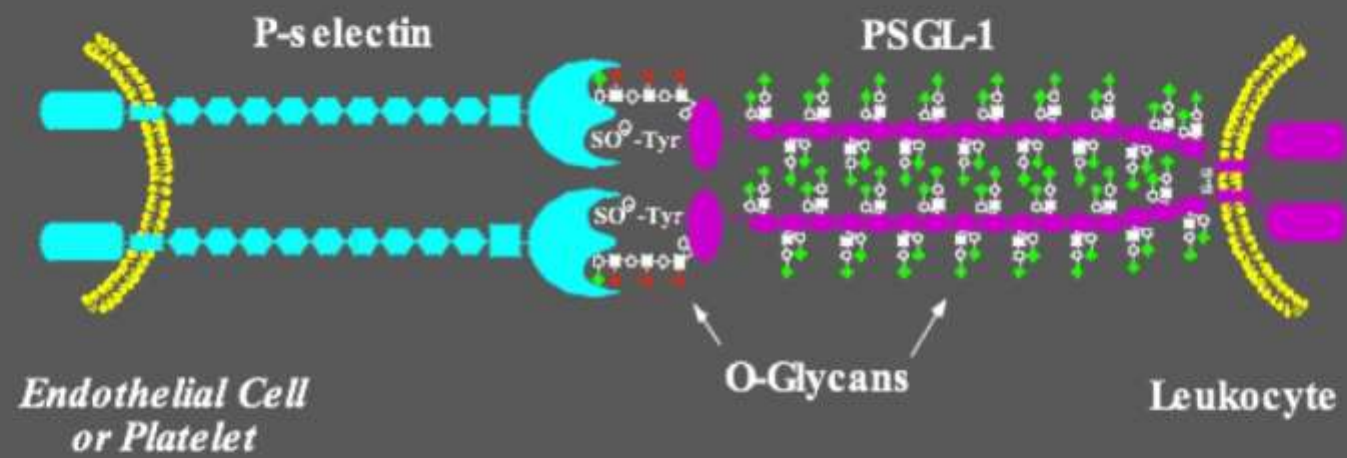


# Monocyte-Platelet Interaction Induces a Pro-Inflammatory Phenotype in Circulating Monocytes

Gabriella Passacuale<sup>1</sup>, Padman Vamadevan<sup>1</sup>, Luis Pereira<sup>1</sup>, Colleen Hamid<sup>1</sup>, Valerie Corrigan<sup>2</sup>, Albert Ferro<sup>1\*</sup>

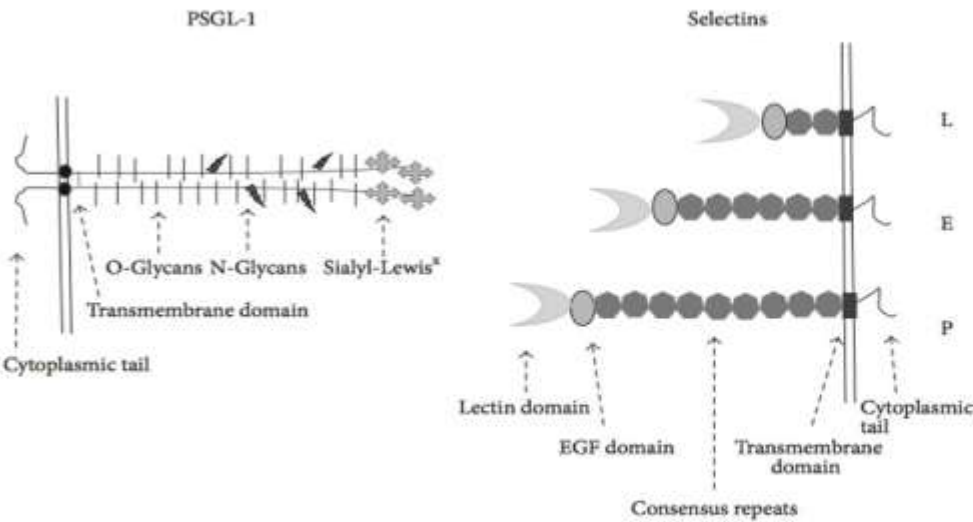
<sup>1</sup>Cardiovascular Division, Department of Clinical Pharmacology, King's College London, London, United Kingdom, <sup>2</sup>Academic Department of Rheumatology, King's College London, London, United Kingdom





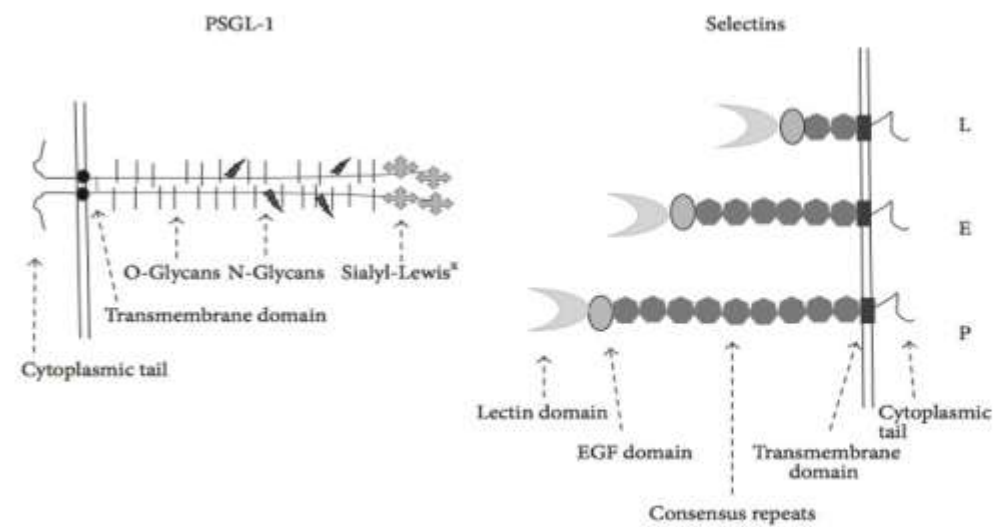
The Interaction of Selectins and PSGL-1 as a Key Component in Thrombus Formation and Cancer Progression

János Kappelmayer and Béla Nagy Jr.



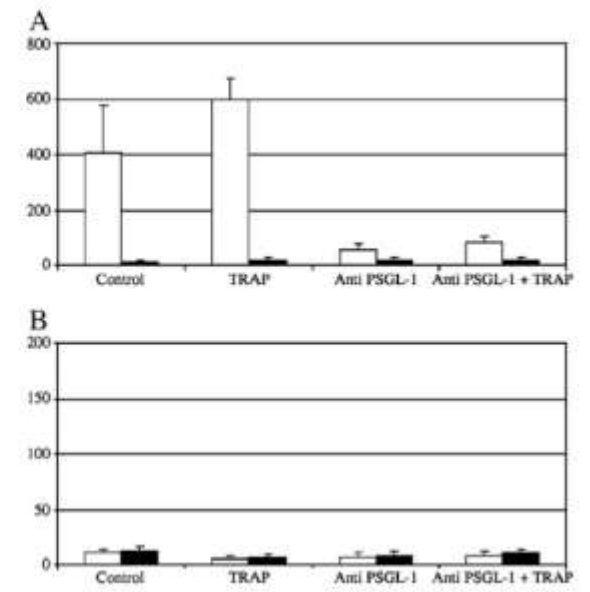
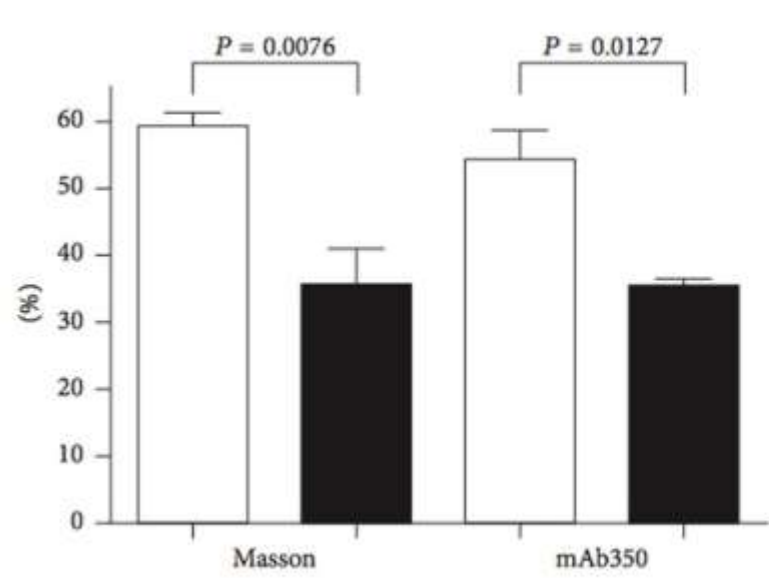
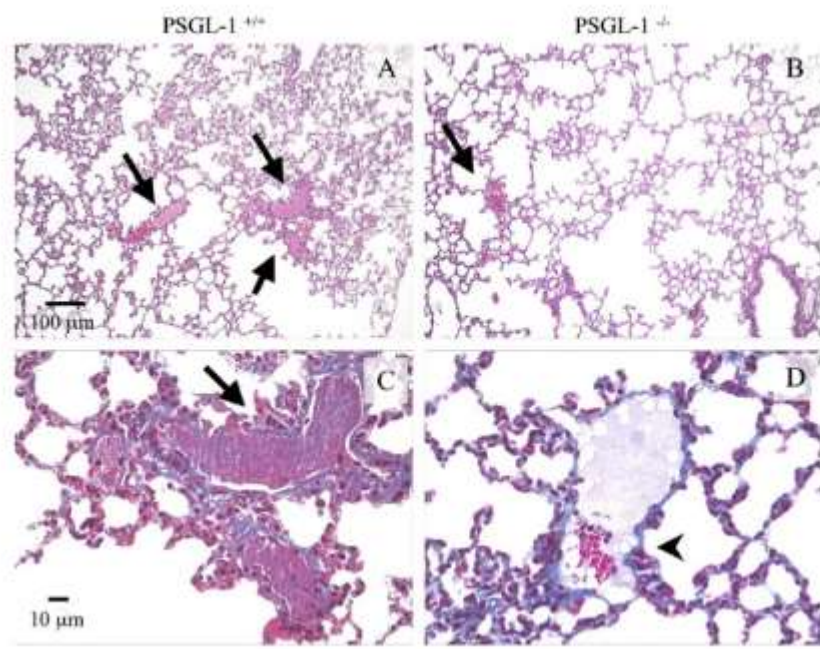
The Interaction of Selectins and PSGL-1 as a Key Component in Thrombus Formation and Cancer Progression

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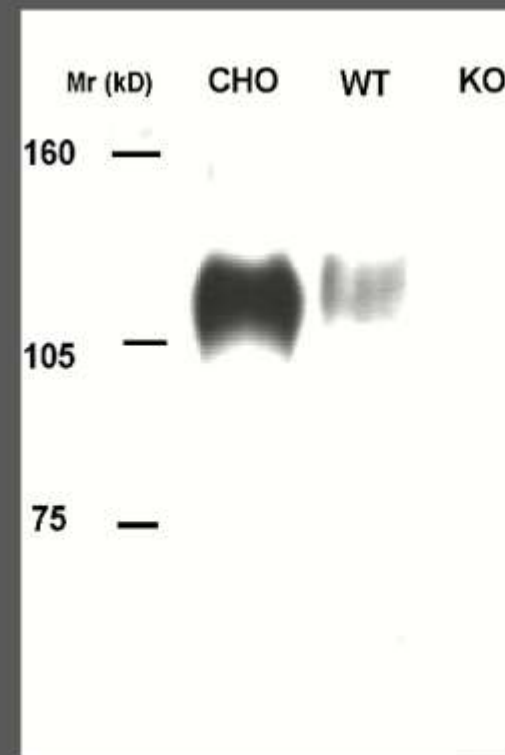
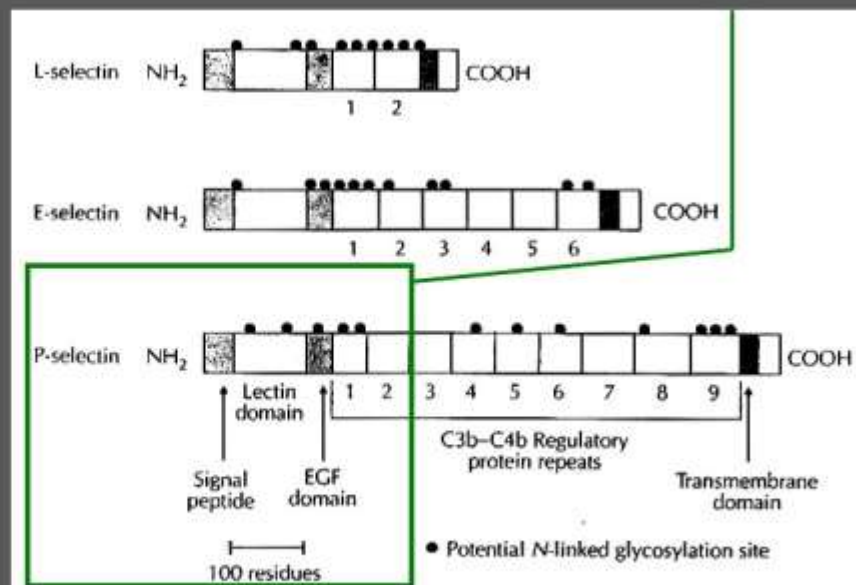


Lack of P-selectin glycoprotein ligand-1 protects mice from thrombosis after collagen/epinephrine challenge

Kornél Miszti-Blasius<sup>a</sup>, Ildikó Beke Debreceni<sup>a</sup>, Szabolcs Felszeghy<sup>b</sup>, Balázs Dezső<sup>c</sup>, János Kappelmayer<sup>a,\*</sup>

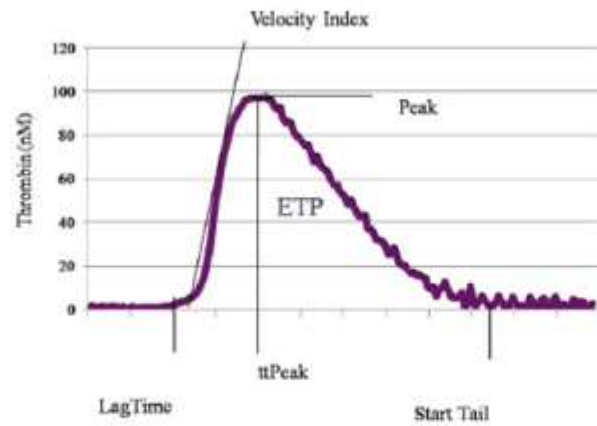


|                 | PSGL-1 +/+ | PSGL-1 -/- |  |
|-----------------|------------|------------|--|
| Psel-Ig chimera | +          | +          |  |
| Control IgG     | +          | +          |  |
|                 | H + M      | M          |  |



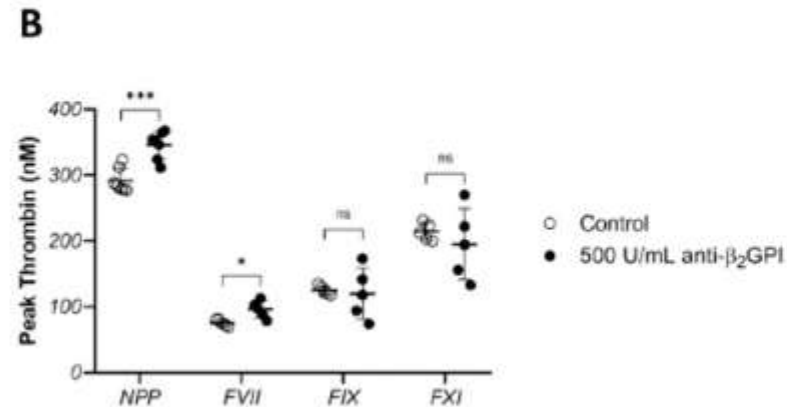
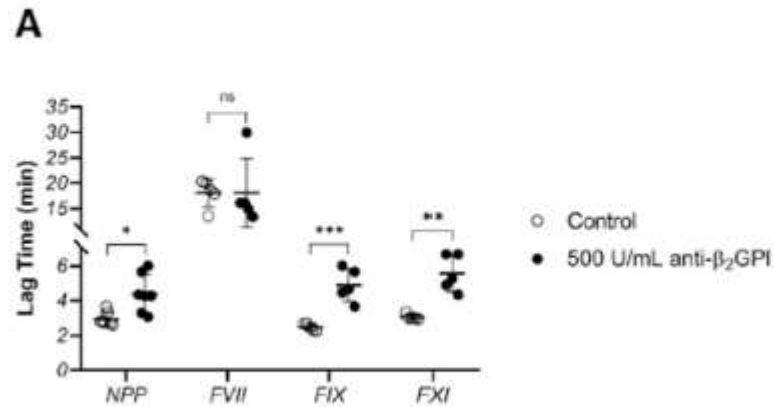
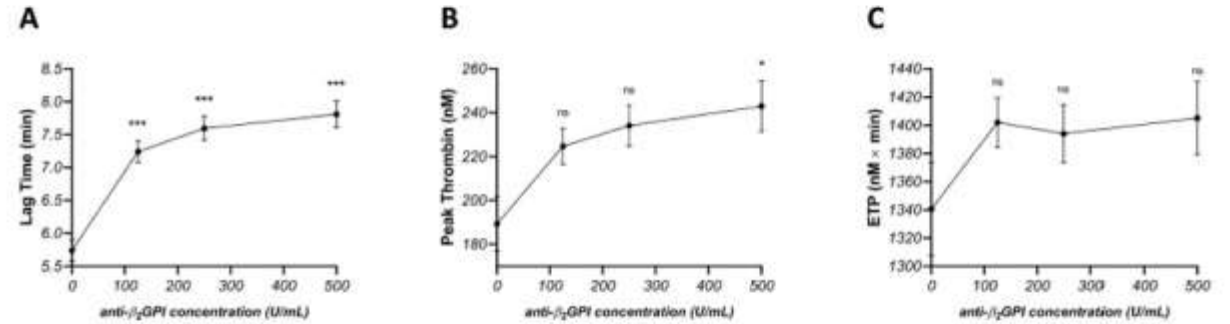
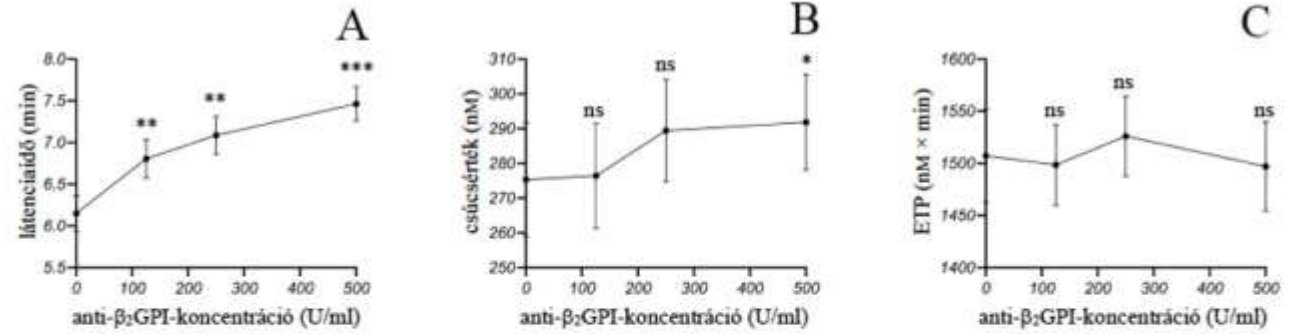
## Role of age and PSGL-1 in MP formation

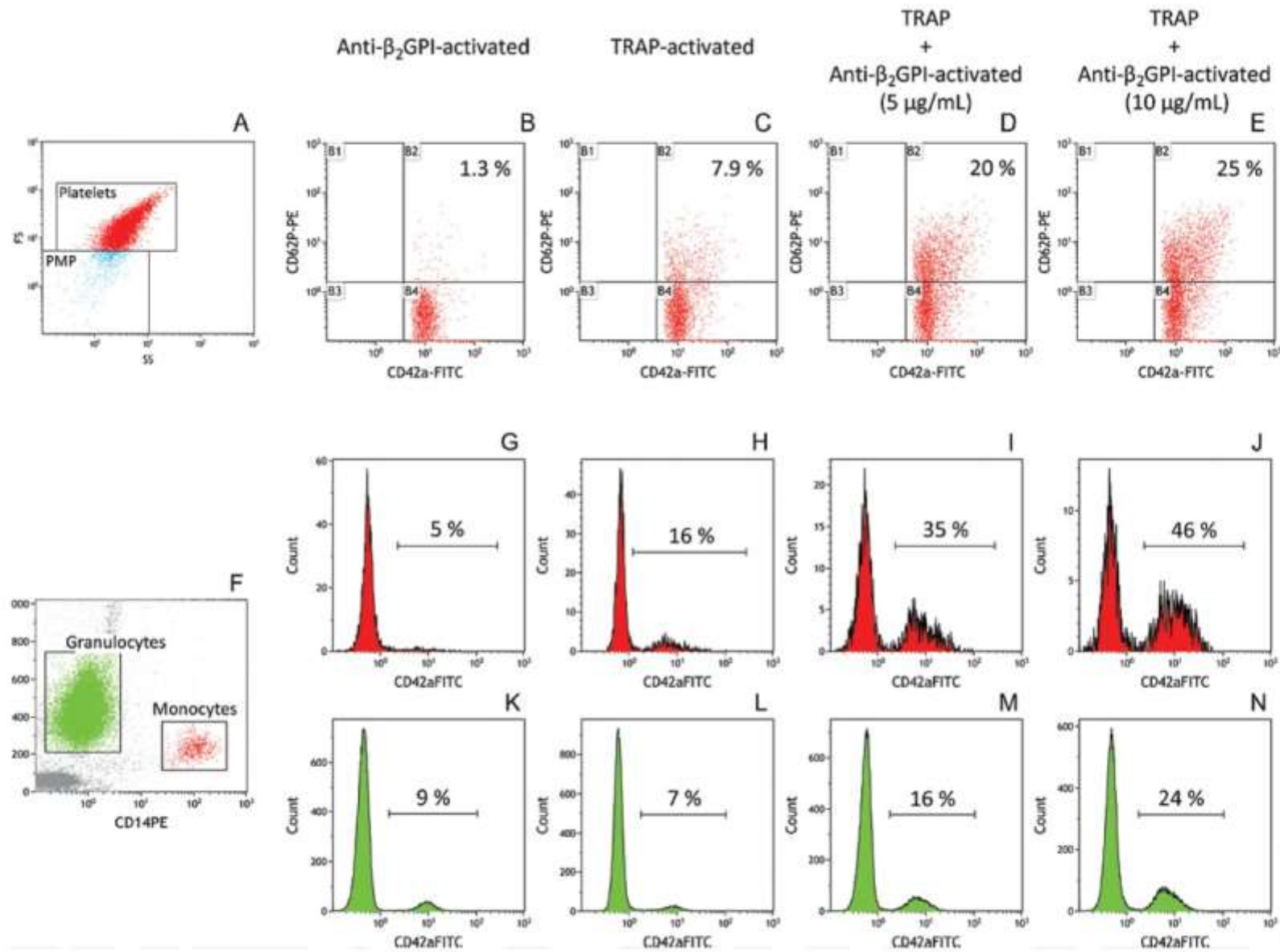
| <u>MP number</u>                       | PSGL-1 +/+    | PSGL-1 -/-     | p value |
|----------------------------------------|---------------|----------------|---------|
| 9-12 weeks                             | 12 173 ± 2243 | 14 399 ± 2746  | 0.54    |
| 17-20 weeks                            | 29 404 ± 2941 | 18 183 ± 1 532 | < 0.001 |
| <u>After administration of Psel-Ig</u> |               |                |         |
| MP number/ml                           | 833 ± 137     | 382 ± 101      | < 0.03  |
| TF (%)                                 | 7.3 ± 1.5     | 2.9 ± 0.3      | < 0.02  |



Anti- $\beta_2$ -glycoprotein I autoantibodies influence thrombin generation parameters via various mechanisms

Gábor Szabó<sup>a,b</sup>, Ildikó Beke Debreceni<sup>a</sup>, Tünde Tarr<sup>c</sup>, Pál Soltész<sup>d</sup>, Bjarne Østerud<sup>c</sup>, János Kappelmayer<sup>a,\*</sup>

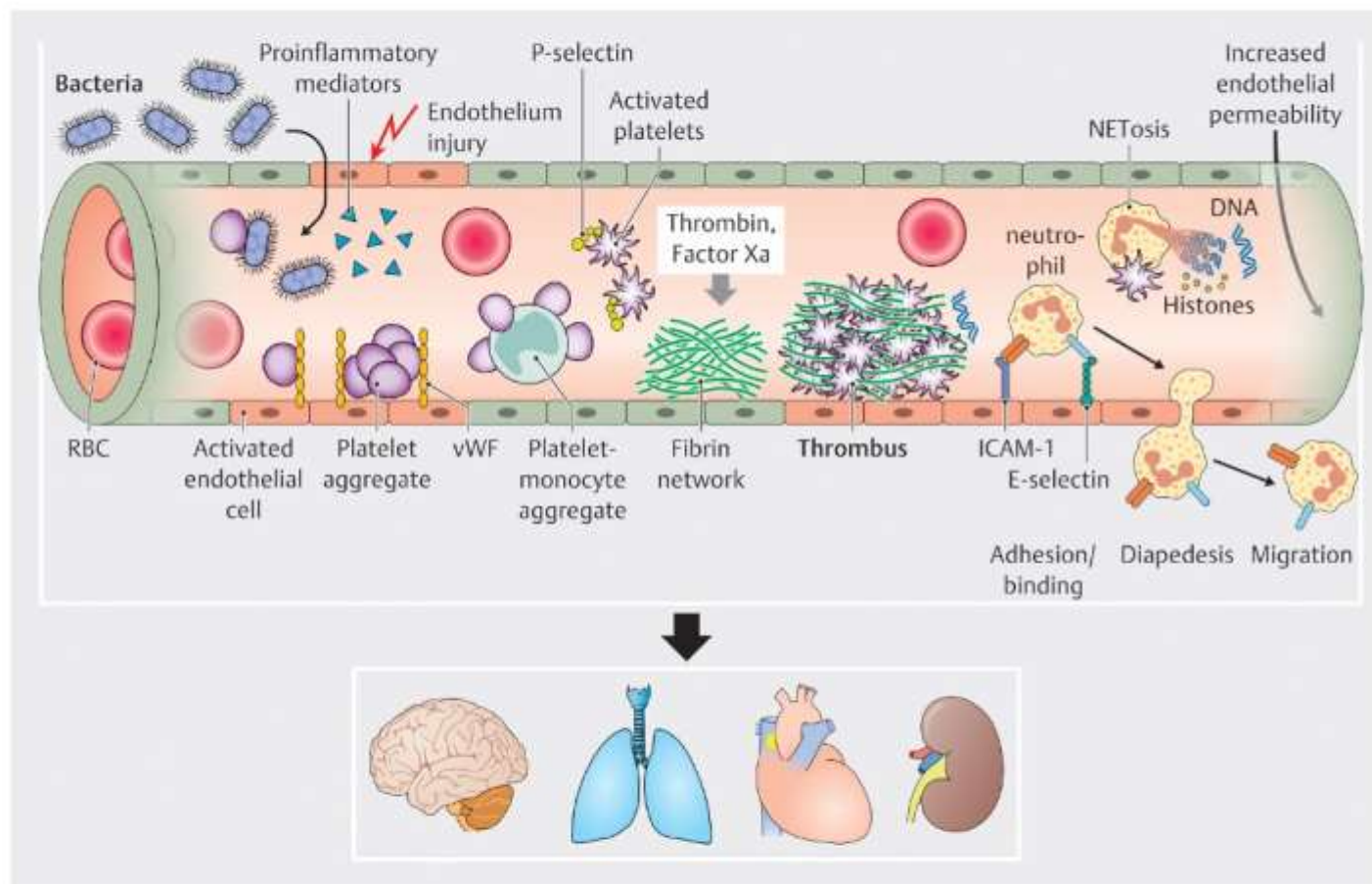


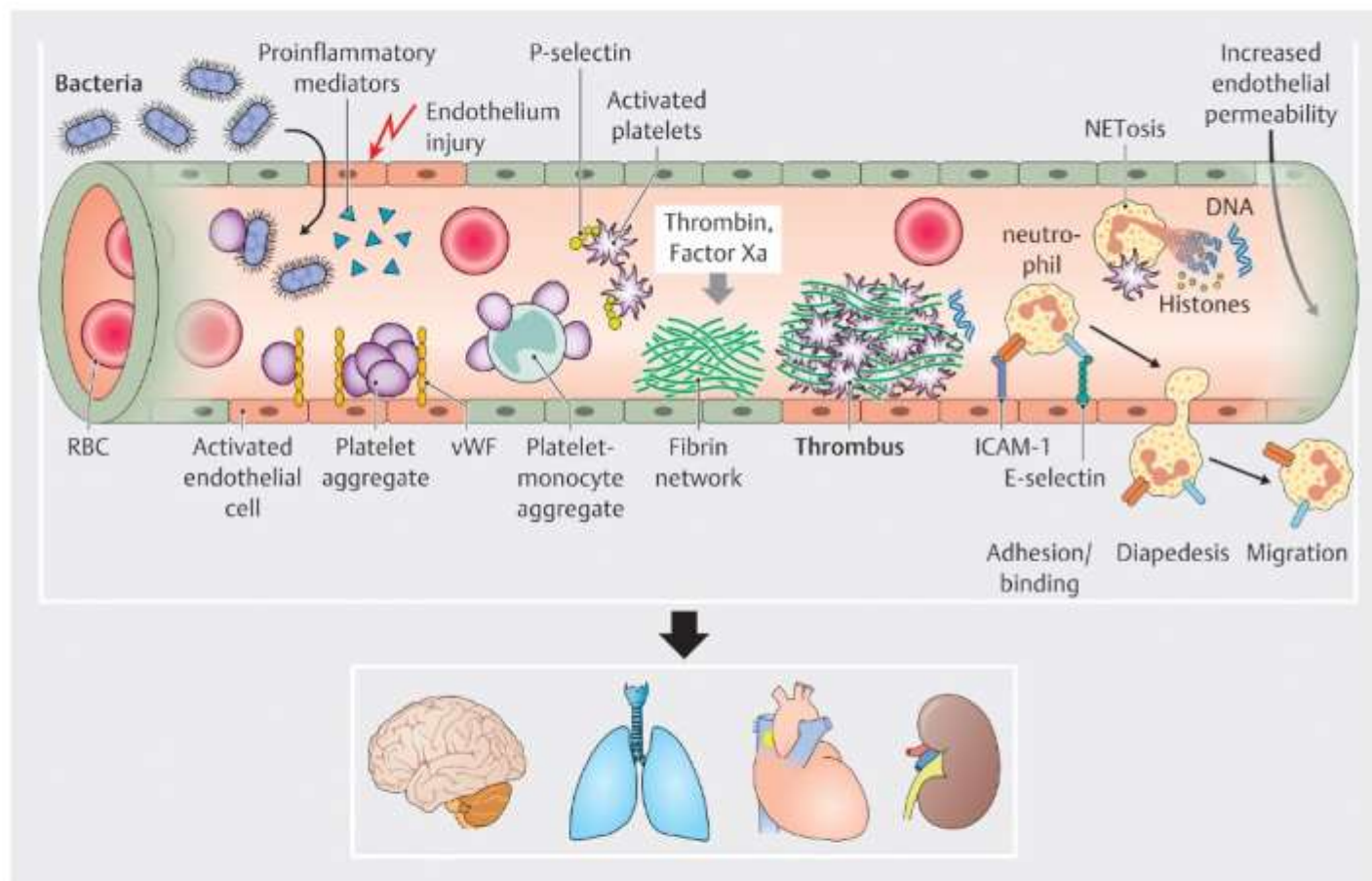


# Laboratory Approaches to Test the Function of Antiphospholipid Antibodies.

Szabó G, Antal-Szalmás P, Kerényi A, Péntes K, Bécsi B, Kappelmayer J.

*Semin Thromb Hemost.* 2022 Mar;48(2):132-144.





A klinikai mintákban a betegek számos egyidejű kórállapota és a szedett gyógyszerek jelentősen befolyásolhatják az eredményeket.

Experimentális körülmények között, a kórokozó kontrollált beadásával a stimulus standardizálható és a fenti körülmények kizárhatóak.





#### Point of Care Testing:

- Core temperature, heart rate, mean arterial pressure (PICCO device)

#### Citrated whole blood:

- Blood cell count (Siemens ADVIA 120, „Pig” software)
- Blood smear examinations – platelet morphology

#### PRP:

- **Platelet PS expression (Beckman Coulter FC 500 flow cytometer)**
- Thrombin generation (TS Fluoroskan Thrombinoscop)

#### PPP:

- Coagulation screening tests: PT, APTT, TT, fibrinogen (Siemens BCS)
- Thrombin generation (Fluoroskan) – double centrifugation!
  - in the presence of phospholipid and exogenous TF
  - in the absence of any added reagent
  - in the presence of phospholipid but without exogenous TF

#### ▪ In vitro experiments

**Effect of the plasma samples on washed human RBCs**



#### Point of Care Testing:

- Core temperature, heart rate, mean arterial pressure (PiCCO device)

#### Citrated whole blood:

- Blood cell count (Siemens ADVIA 120, „Pig” software)
- Blood smear examinations – platelet morphology

#### PRP:

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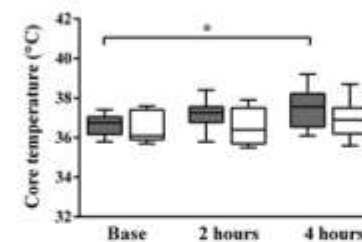
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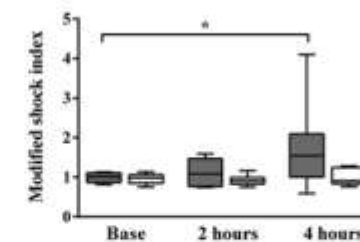
#### In vitro experiments

**Effect of the plasma samples on washed human RBCs**

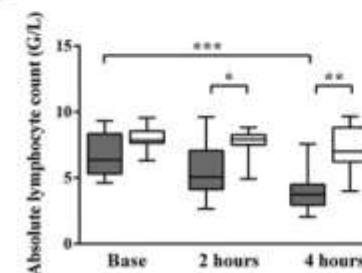
**A**



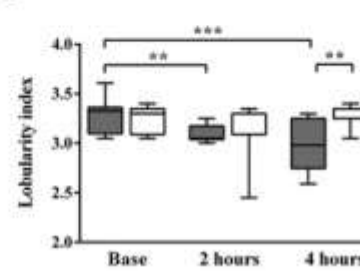
**B**

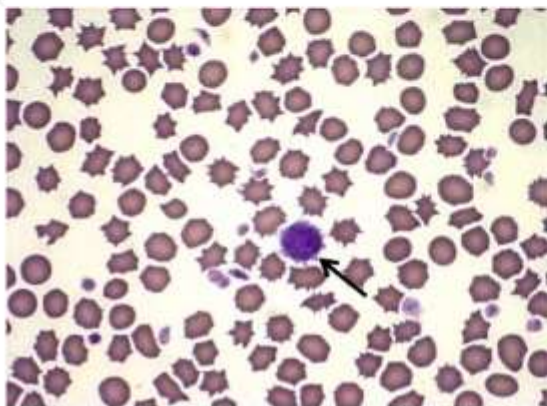
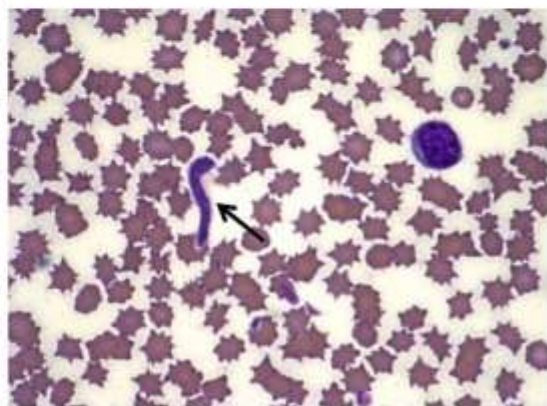
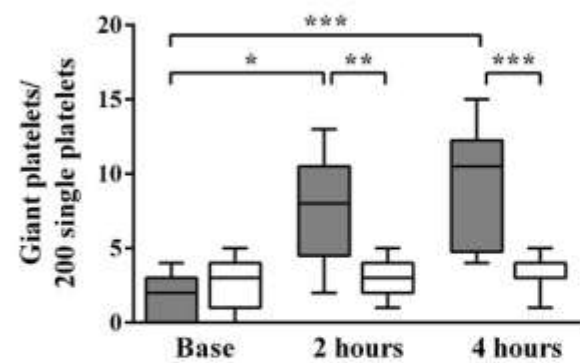
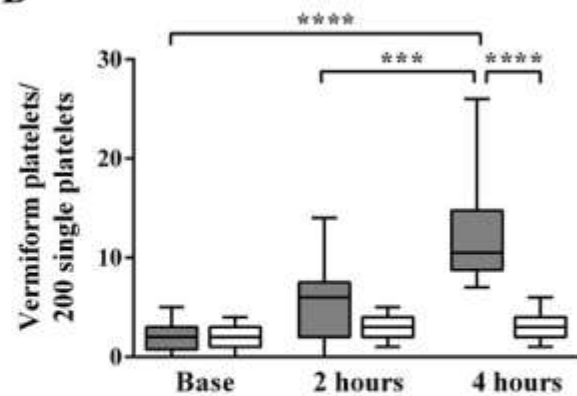


**C**

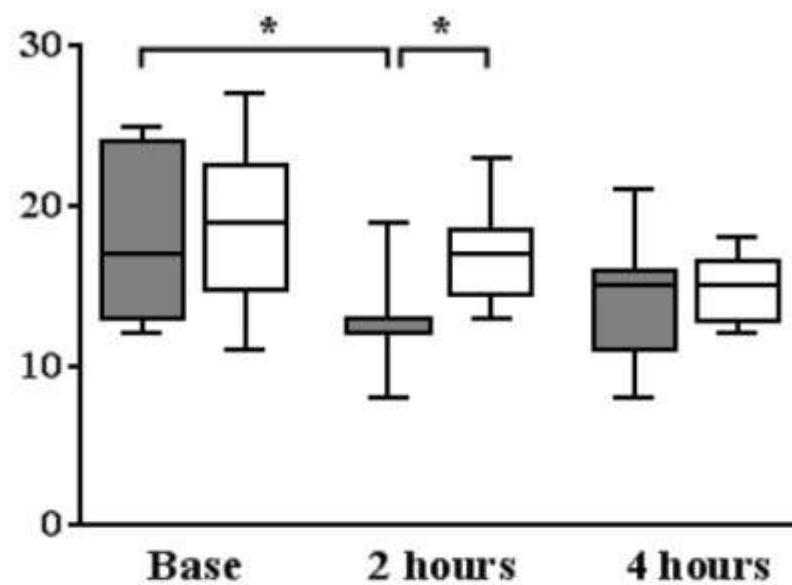


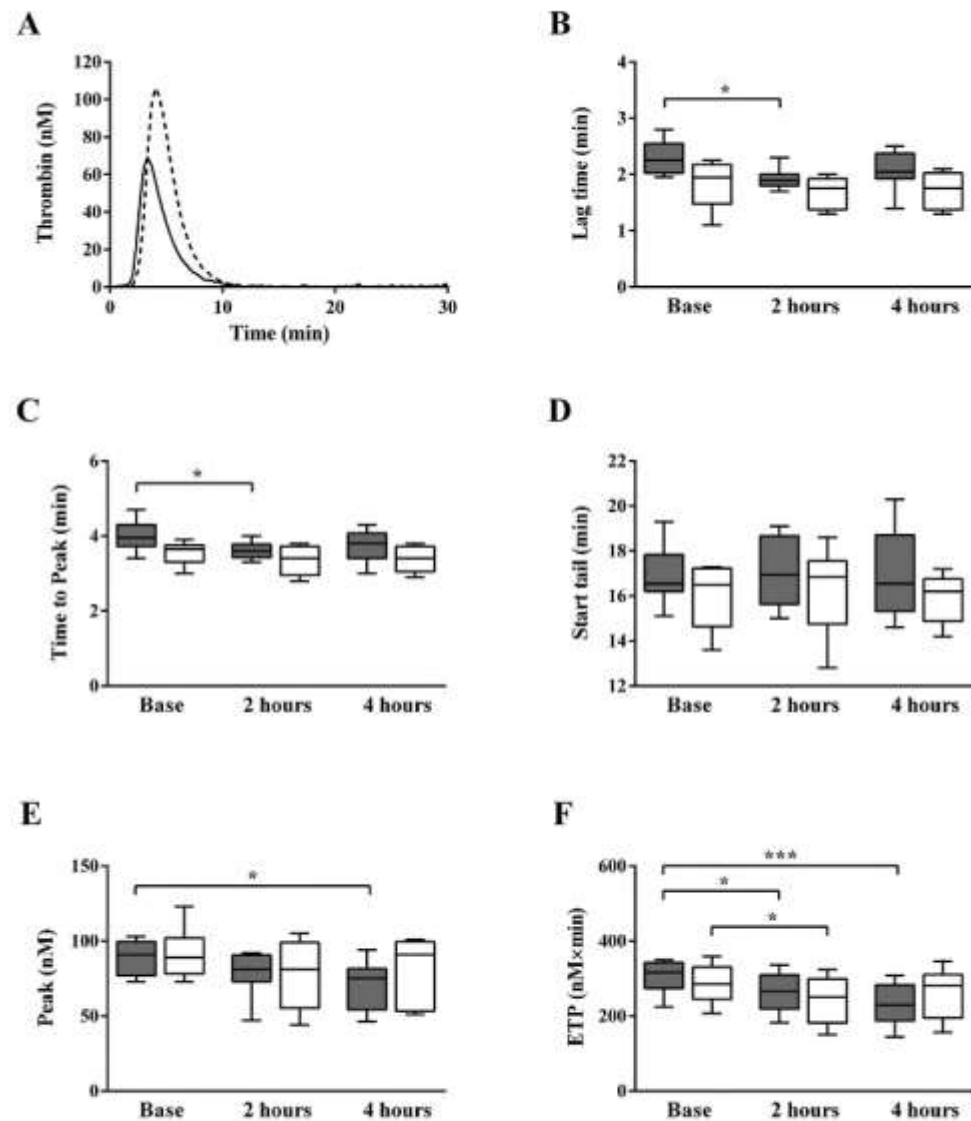
**D**



**A****B****C****D**

**Mitochondrion membrane  
depolarisation (FL1 MFI mean)**

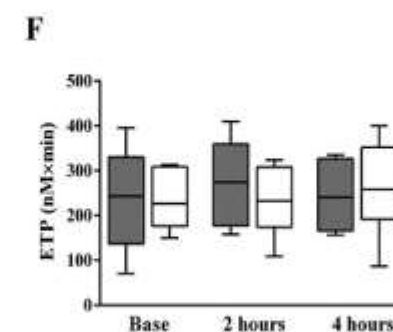
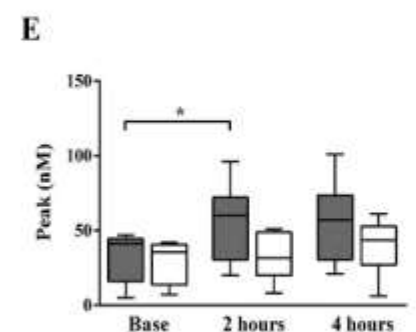
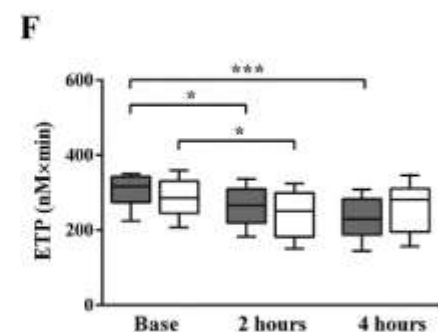
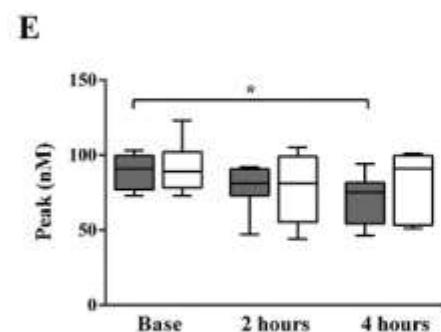
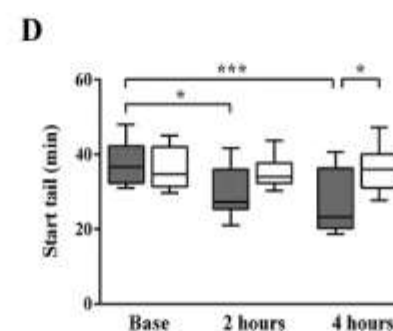
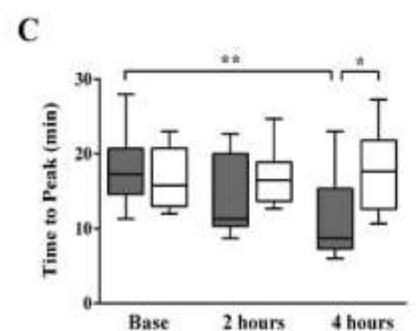
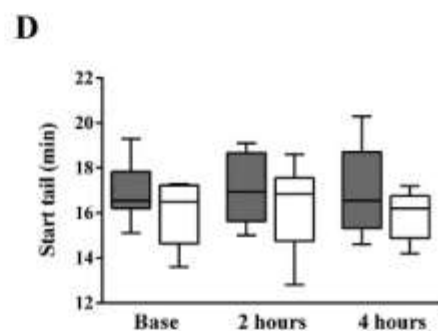
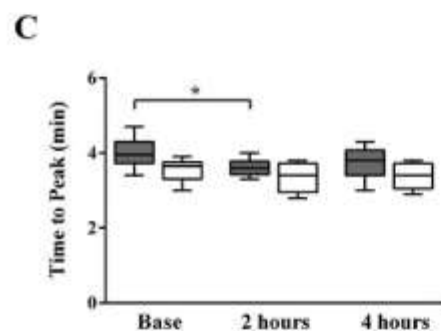
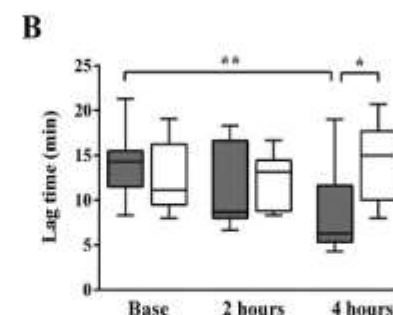
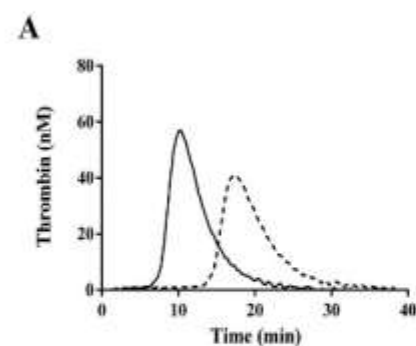
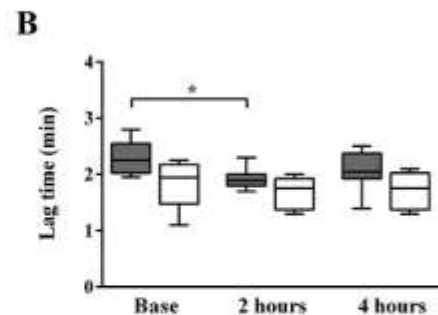
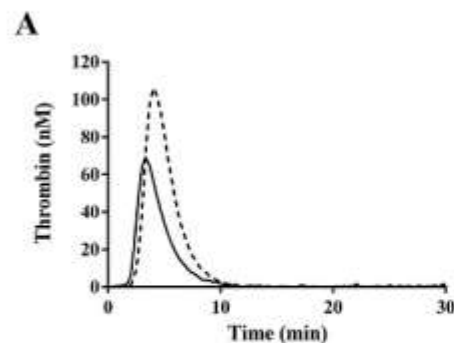




Characteristics of thrombin generation in a fulminant porcine sepsis model

Judit Tóth <sup>a</sup>, Ildikó Beke Debreceni <sup>a</sup>, Ádám Deák <sup>b</sup>, Katalin Pető <sup>b</sup>, Mariann Berhész <sup>c</sup>, Endre Hajdó <sup>c</sup>, Judit Szabó <sup>d</sup>, Norbert Németh <sup>b</sup>, Béla Pülesdi <sup>e</sup>, János Kappelmayr <sup>A\*</sup>





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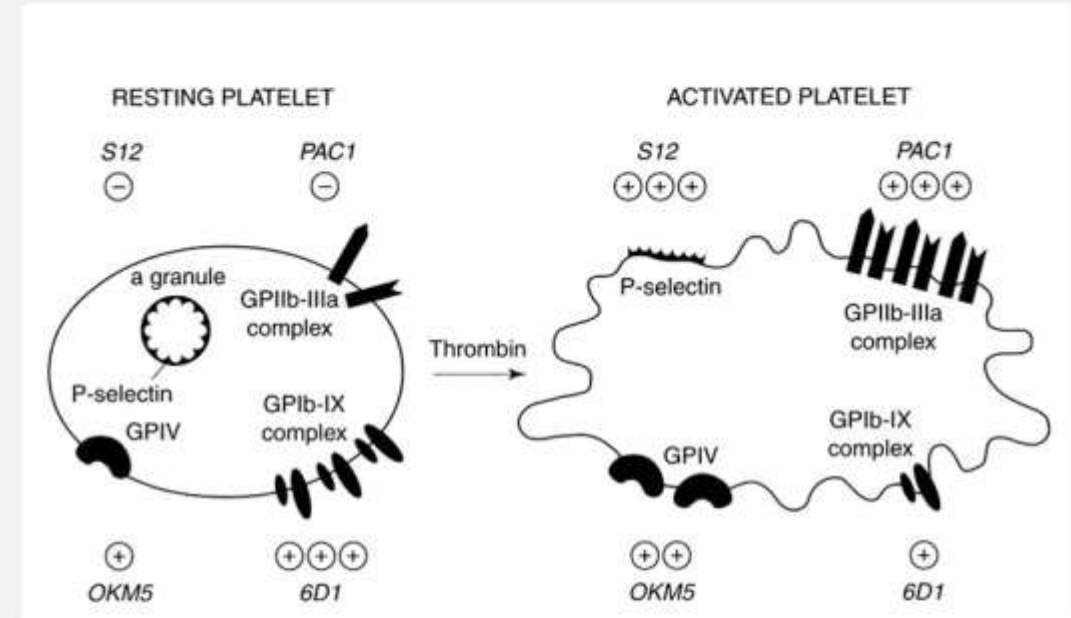
# A thrombocyták aktiváltsági állapotának jellemzői (Platelet Activation Status=PAS)

## Direkt tesztek:

- a P-selectin (CD62) expresszió
- a GPIX (CD42a) expresszió
- LAMP-3 (CD63) expresszió
- PS expozíció (annexin kötés)
- ligandkötés és konformáció
- a mikropartikula arány emelkedése
- Szolubilis markerek analízise (b-TG, PF4, sPsel)

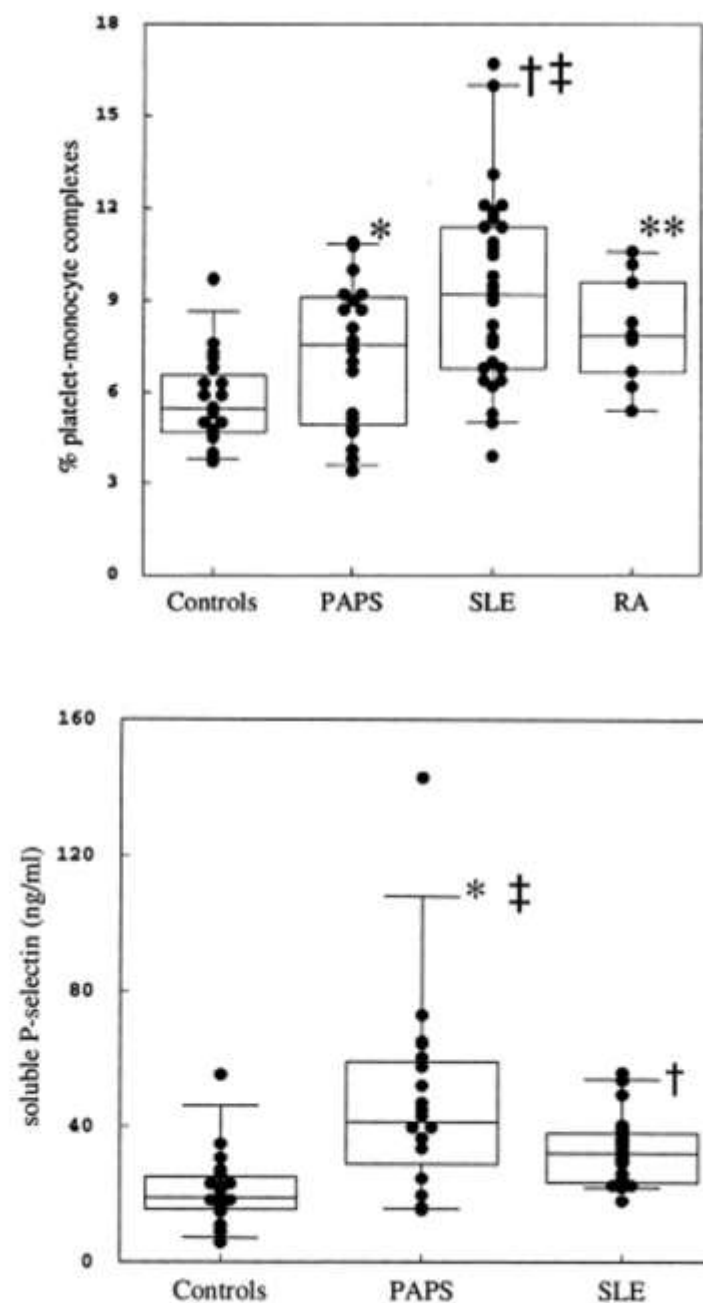
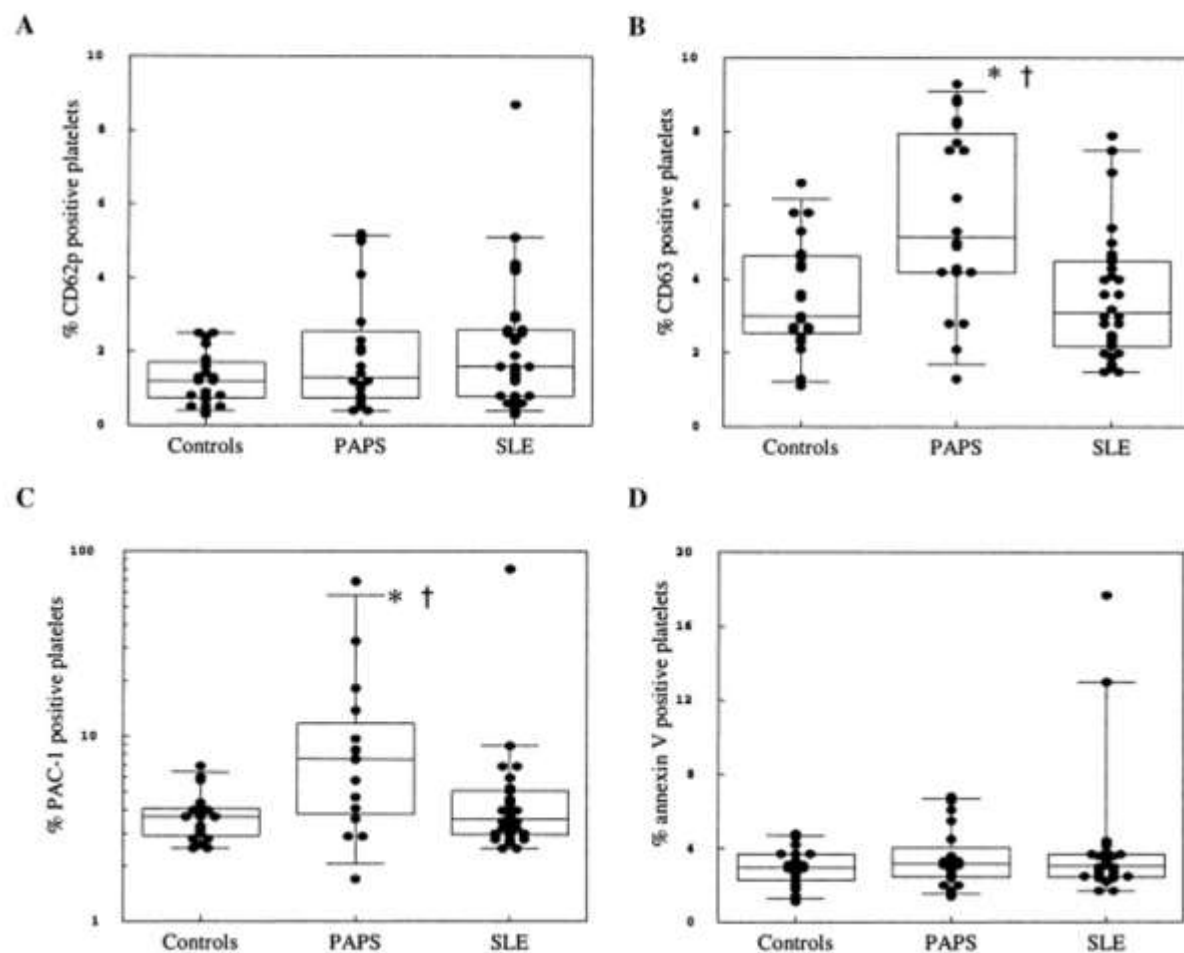
## Indirekt tesztek:

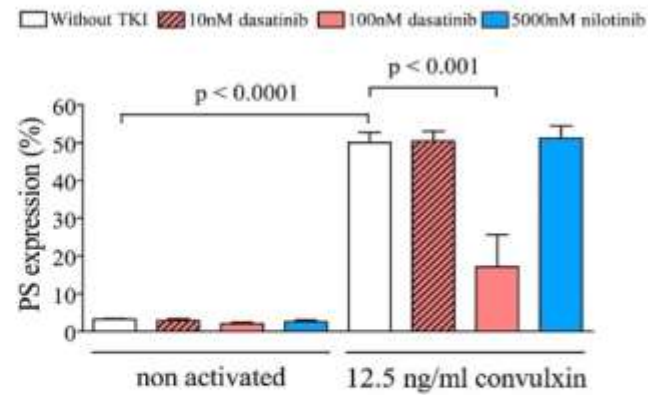
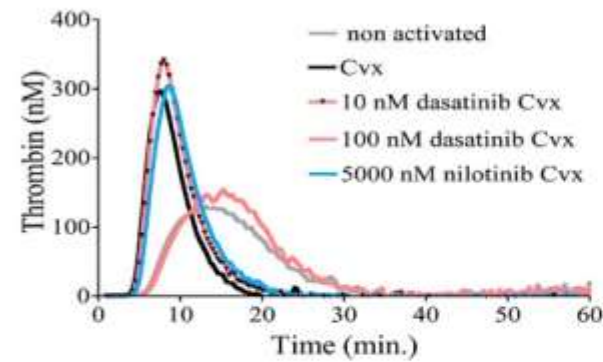
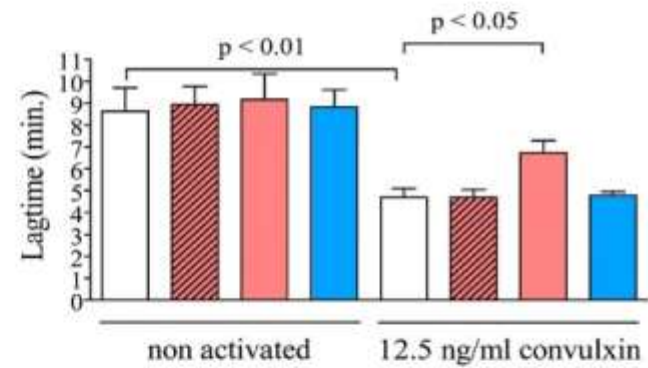
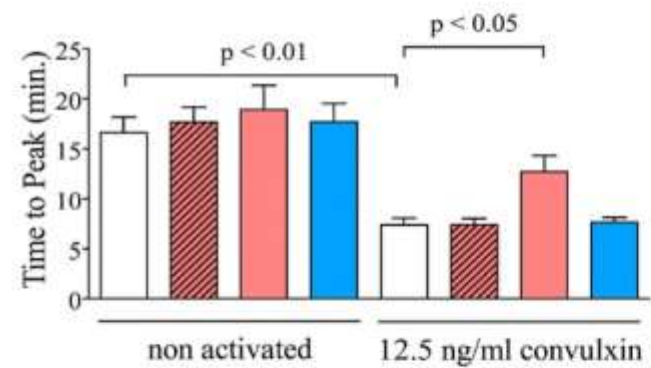
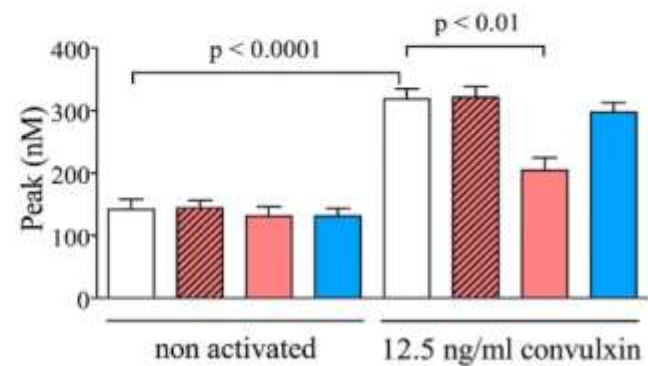
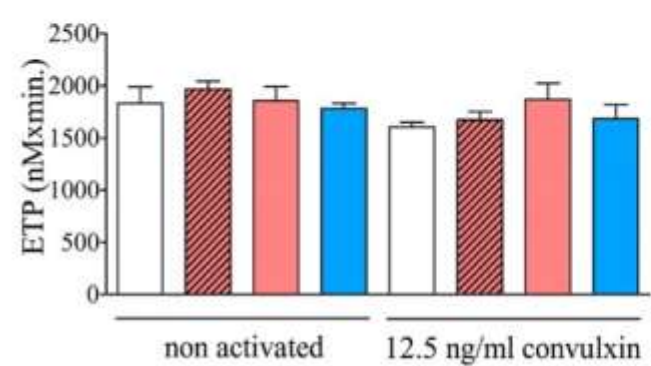
- a thrombocytá-leukocytá heterotipikus aggregátumok mennyiségének változása
- monocytá szöveti faktor (TF) expresszió vizsgálata

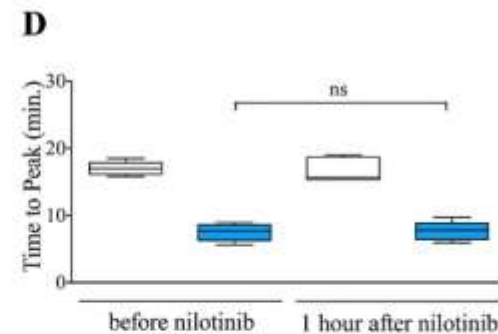
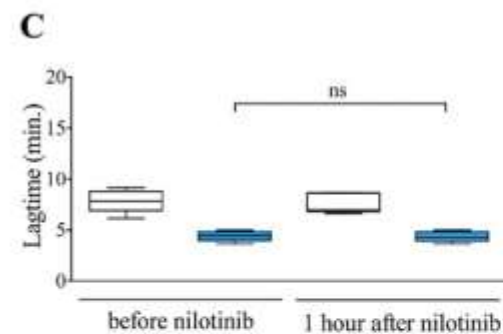
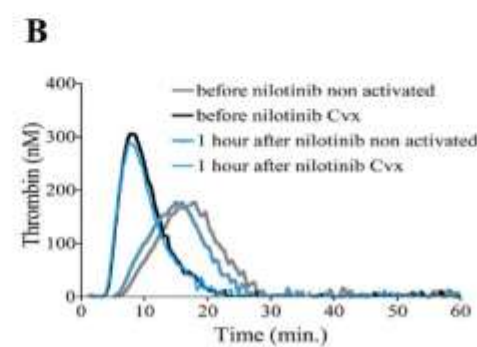
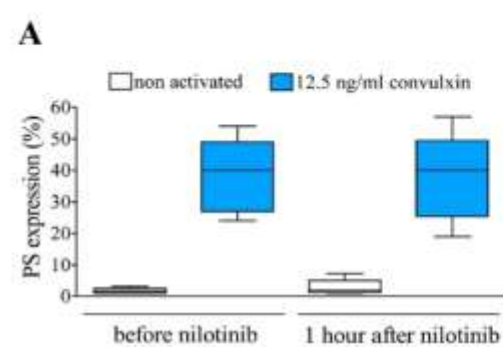
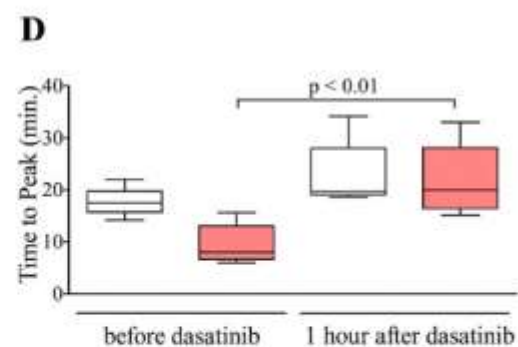
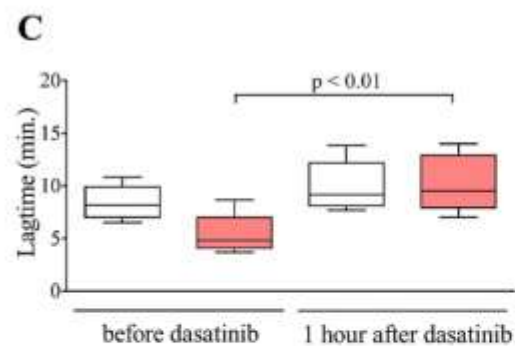
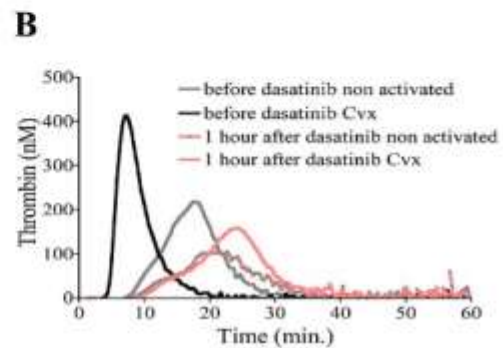
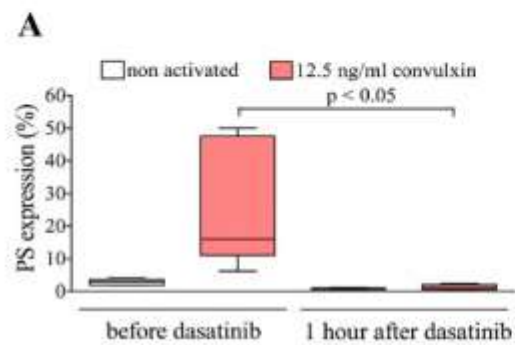


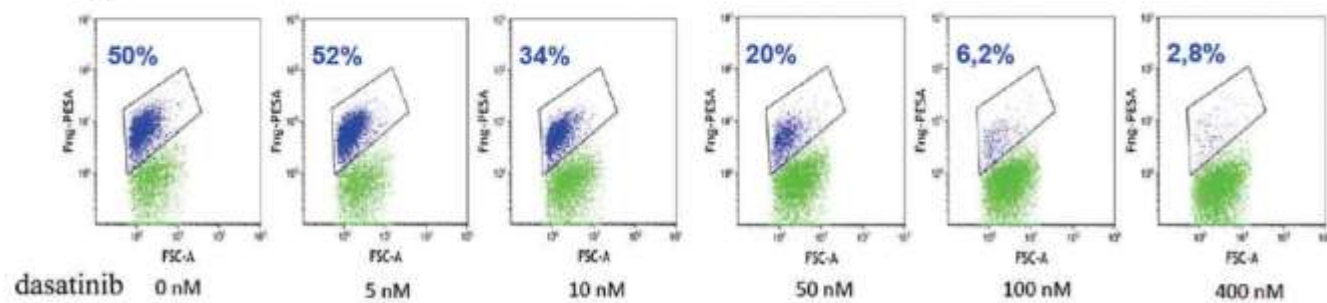
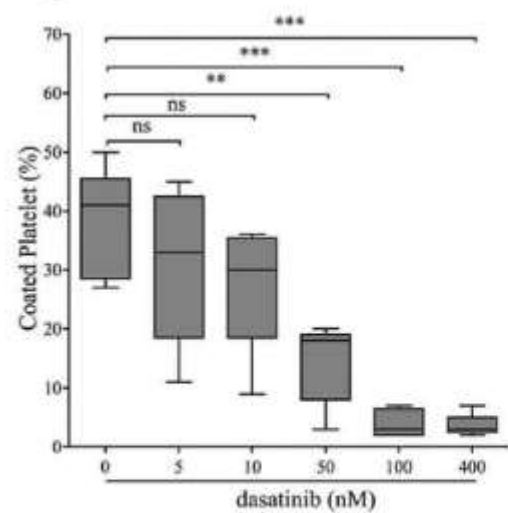
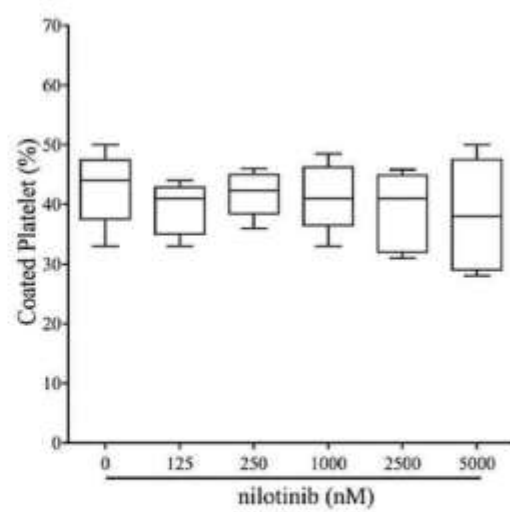
# Increased circulating platelet–leucocyte complexes and platelet activation in patients with antiphospholipid syndrome, systemic lupus erythematosus and rheumatoid arthritis

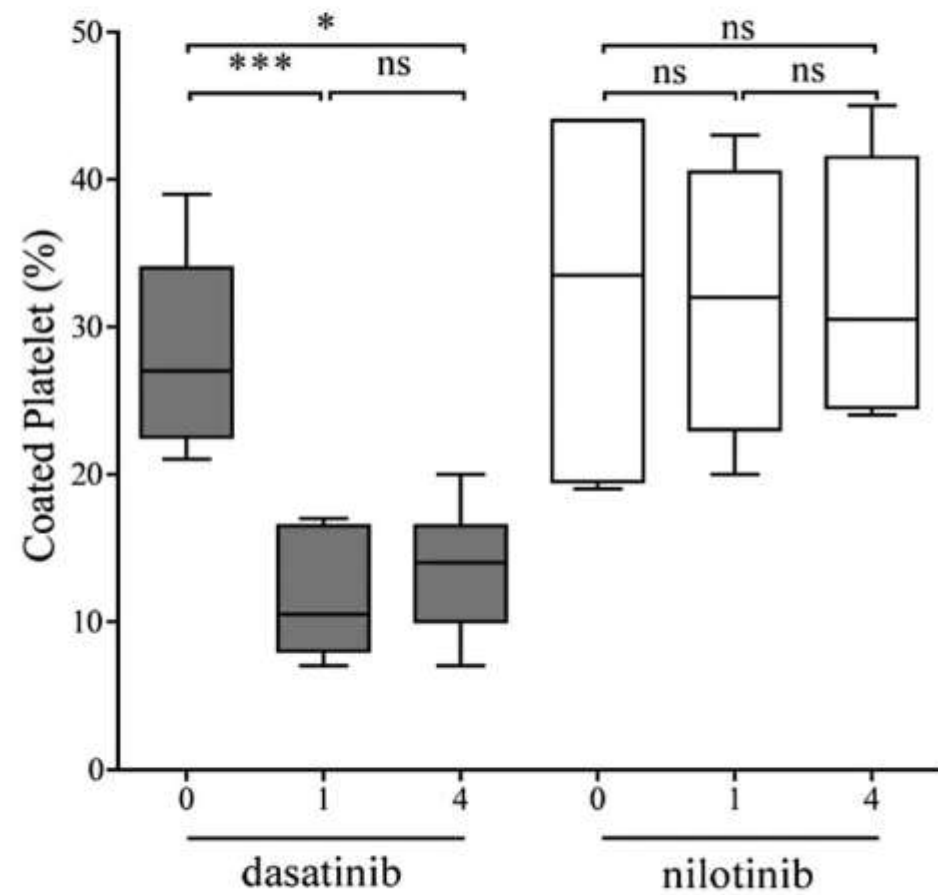
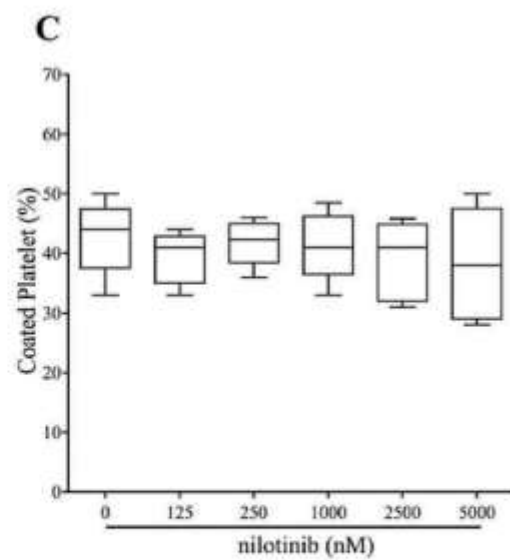
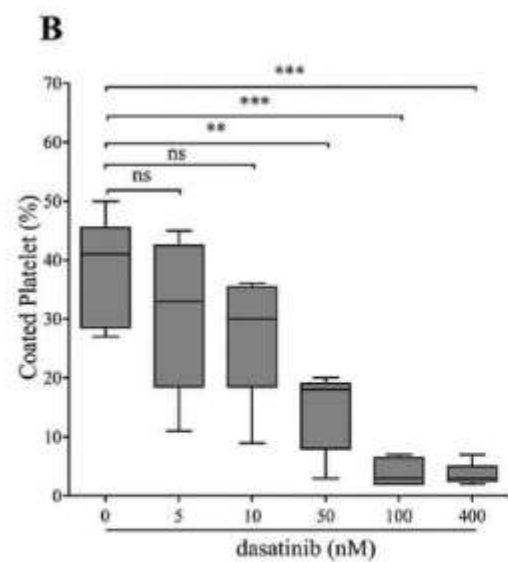
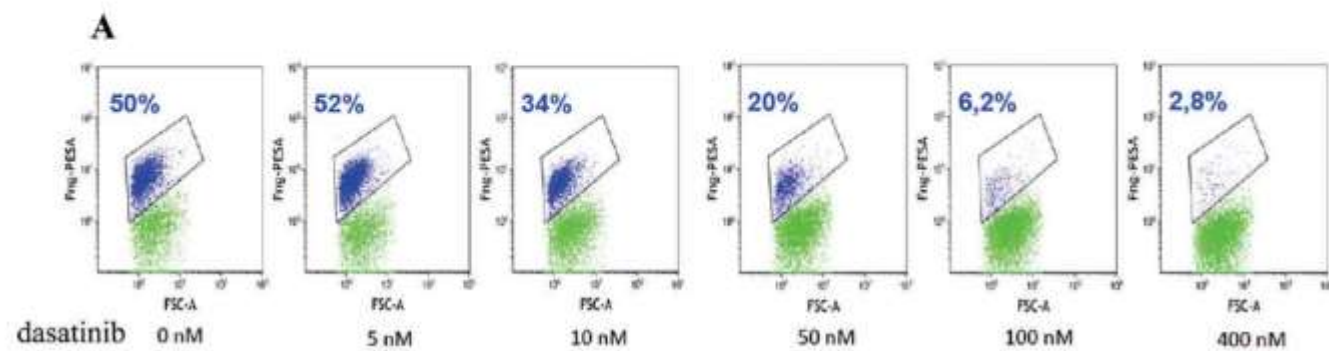
JOANNE E. JOSEPH,<sup>1</sup> PAUL HARRISON<sup>1</sup>, IAN J. MACKIE,<sup>1</sup> DAVID A. ISENBERG<sup>2</sup> AND SAMUEL J. MACHIN<sup>1,1</sup> *Haemostasis Research Unit and <sup>2</sup>Centre for Rheumatology, Department of Medicine, University College London, UK*



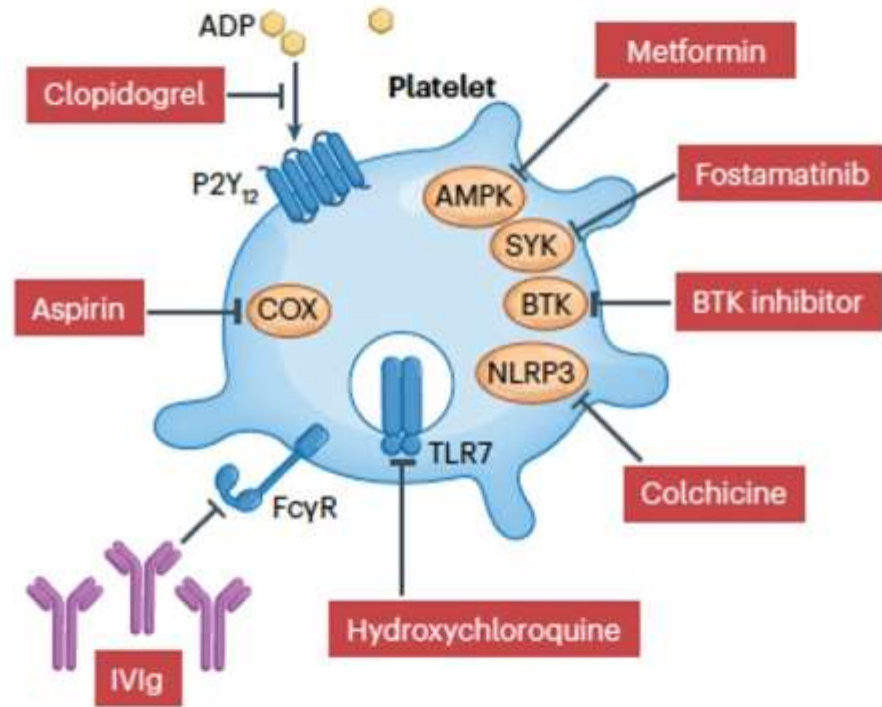
**A****B****C****D****E****F**



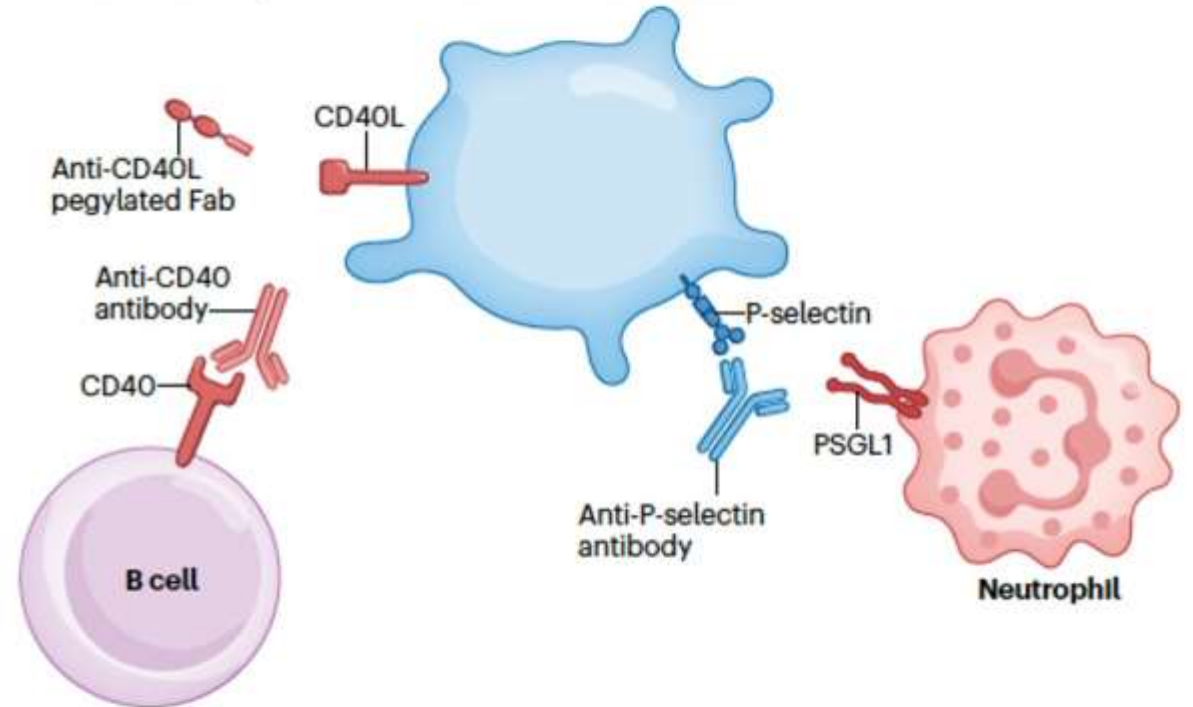
**A****B****C**



**a Inhibition of platelet activation**



**b Inhibition of platelet-immune cell interaction**



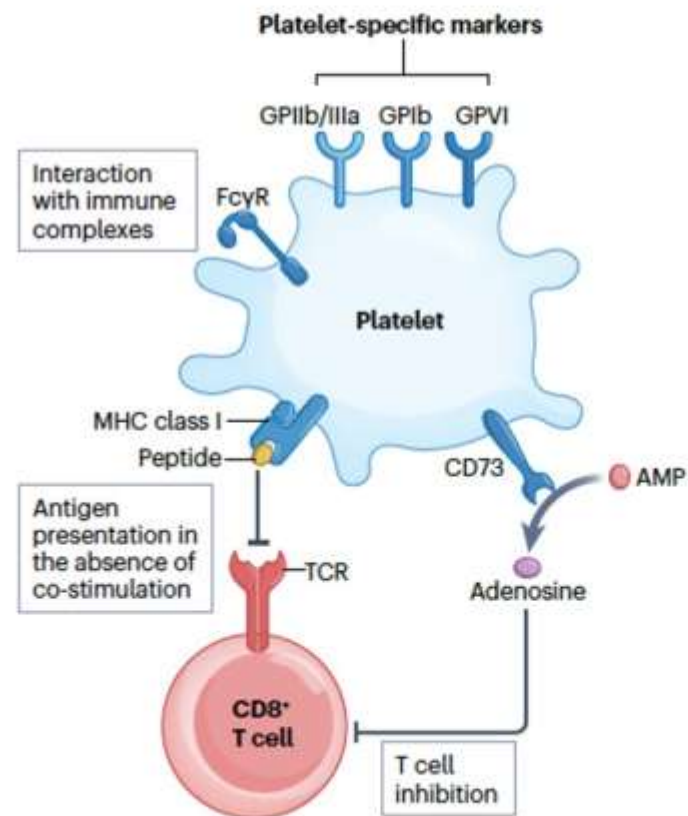
# The role of platelets in immune-mediated inflammatory diseases

Marc Scherlinger<sup>1,2,✉</sup>, Christophe Richez<sup>1,3</sup>, George C. Tsokos<sup>2</sup>, Eric Bollard<sup>4,5</sup> & Patrick Bianco<sup>3,6,✉</sup>

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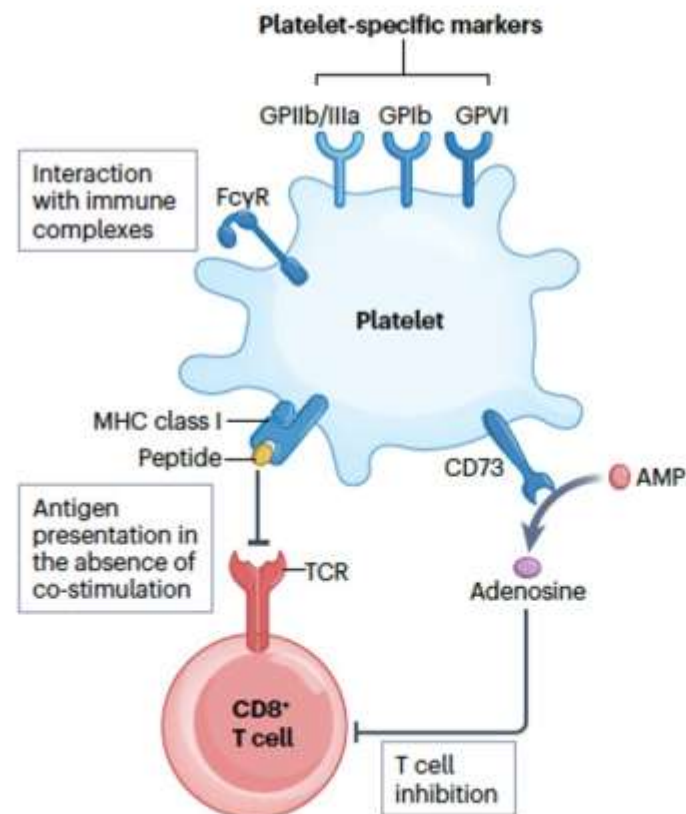
## a Resting platelets



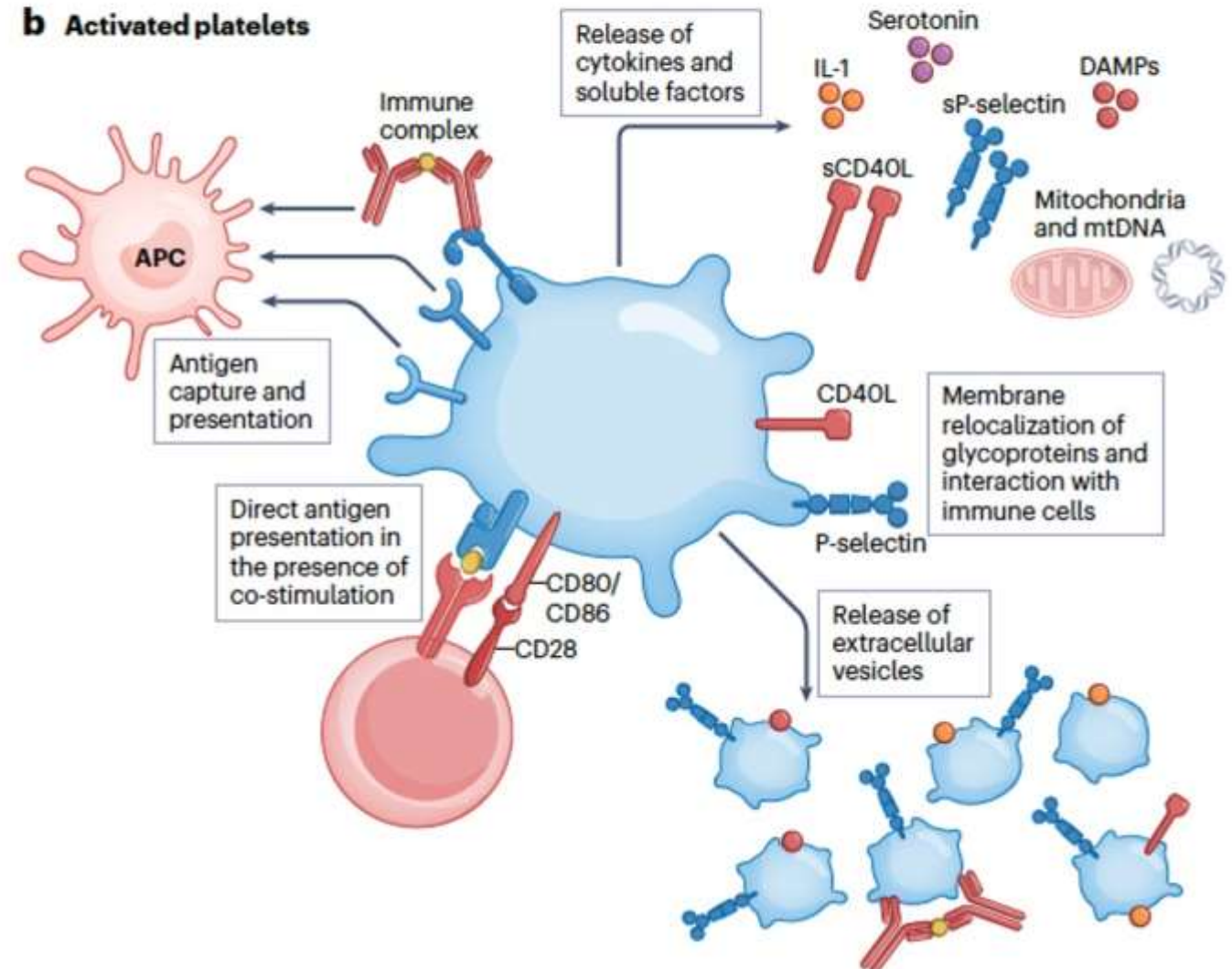
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## a Resting platelets



## b Activated platelets



## **Platelet-Rich Plasma for Rheumatoid Arthritis: A Case Series**

Dana Shively <sup>1</sup>, Neel Amin <sup>2</sup>

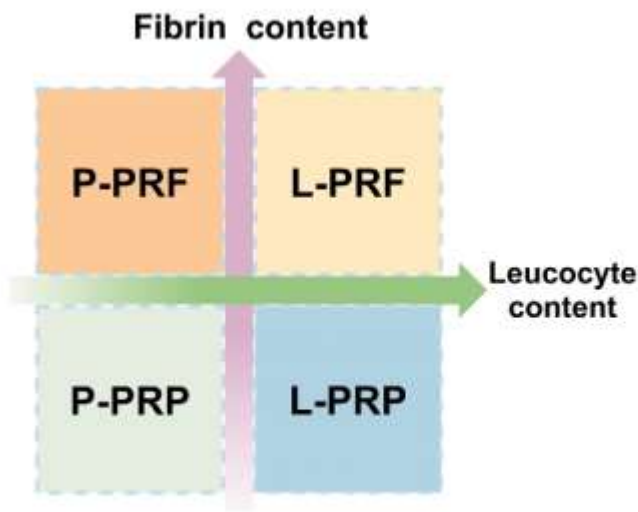
## **A Platelet's Guide to Synovitis**

Giacomo Cafaro MD, Elena Bartoloni MD, Alessia Alunno MD PhD, Onelia Bistoni BSc, Sabrina Cipriani PhD, Fabiana Topini PhD  
and Roberto Gerli MD  
Rheumatology Unit, Department of Medicine, University of Perugia, Perugia, Italy

### *Case Series*

## **Platelet Rich Plasma for Treatment of Rheumatoid Arthritis: Case Series and Review of Literature**

Humeira Badsha <sup>1</sup>, Ghita Harifi,<sup>1</sup> and William D. Murrell<sup>2,3,4,5</sup>



**Table 1. Overview of active ingredients of PRP**

| Growth factors | Origins                                                                                                    | Physiological effects                                                                                                                                         |
|----------------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PDGF           | Neuronal cells, astrocytes, oligodendrocytes, and vascular cells <sup>8</sup>                              | Induces stem cell differentiation, participates in neuroprotection, and promotes cell proliferation and migration <sup>9,10</sup>                             |
| TGF- $\beta$   | B cells, T cells, dendritic cells, macrophages <sup>11</sup>                                               | Promoting cell proliferation and differentiation, participating in tissue repair and fibrosis, and inhibiting the activation of immune cells <sup>12,13</sup> |
| VEGF           | Production by endothelial cells, smooth muscle cells, platelets, neutrophils and macrophages <sup>14</sup> | In charge of angiogenesis and vascular repair, indirectly promoting tissue repair and neuroprotection <sup>14</sup>                                           |
| IGF-1          | Hepatic stellate cells, osteoblasts, fibroblasts, macrophages <sup>15</sup>                                | Promotes growth, cell differentiation and cell proliferation <sup>16</sup>                                                                                    |
| bFGF           | Endothelial cells, bone cells <sup>17,18</sup>                                                             | Induction of neovascularization and neurotrophs <sup>19,20</sup>                                                                                              |
| EGF            | Endothelial cells, vascular smooth muscle cells, neutrophils, macrophages <sup>21</sup>                    | Promoting wound healing and anti-inflammatory <sup>22</sup>                                                                                                   |

**Table 3. The current status of PRP applications across various clinical departments**

| Departments                                | Diseases                                                                                                                                                                                                                                |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Orthopedic                                 | Osteoarthritis, tendinopathy of Achilles tendon, rotator cuff tear, peripheral nerve injury, fracture, etc. <sup>80-82</sup>                                                                                                            |
| Pain medicine                              | Radiculopathy, lumbago, phantom limb pain, etc. <sup>83-85</sup>                                                                                                                                                                        |
| Plastic surgery                            | Skin healing, autologous fat transplantation, cartilage rebuilding, etc. <sup>86,87</sup>                                                                                                                                               |
| Urology                                    | Erectile dysfunction, urethral stricture, hypospadias, prostatic hyperplasia, bladder contracture, peyronie disease, etc. <sup>88-90</sup>                                                                                              |
| Dermatology                                | Androgenetic alopecia, alopecia areata, alopecia cicatrisata, chronic vitiligo, chloasma, psoriasis, paronychia, acne scarring, skin aging, etc. <sup>91-94</sup>                                                                       |
| Ophthalmology                              | Xerophthalmia, corneal ulcers, etc. <sup>95,96</sup>                                                                                                                                                                                    |
| Otorhinolaryngology, Head and Neck Surgery | Tympanic membrane perforation, sensorineural hearing loss, perforation of nasal septum, leakage of cerebrospinal, dyssomnia, atrophic rhinitis, cicatricial stenosis of larynx, tracheal stenosis, tonsillectomy, etc. <sup>97,98</sup> |
| Oral and maxillofacial surgery             | Alveolar osteitis, gingivitis, periodontitis, osteonecrosis of jaw, oral implant, etc. <sup>99,100</sup>                                                                                                                                |
| Respiratory medicine                       | COPD, asthma, interstitial pulmonary fibrosis, etc. <sup>101</sup>                                                                                                                                                                      |
| Gynecology                                 | Intrauterine adhesion, premature ovarian failure, genital tract fistula, pelvic floor dysfunction, thin endometrium, repeated Implantation Failure, etc. <sup>102-104</sup>                                                             |
| General surgery                            | Anal fistula, etc. <sup>105</sup>                                                                                                                                                                                                       |
| Cardiothoracic surgery                     | Coronary artery bypass grafting, sternotomy complications, bronchial fistula, myocardial injury, etc. <sup>106-109</sup>                                                                                                                |

### The role of platelet-rich plasma in biomedicine: A comprehensive overview.

Zhang Z, Liu P, Xue X, Zhang Z, Wang L, Jiang Y, Zhang C, Zhou H, Lv S, Shen W, Yang S, Wang F. iScience. 2025 Jan 3;28(2):111705. doi: 10.1016/j.isci.2024.111705.

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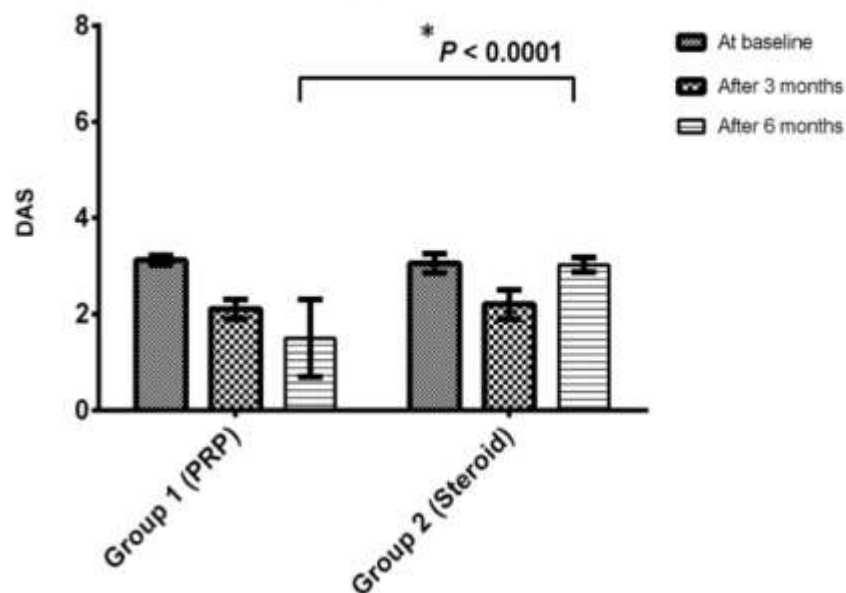
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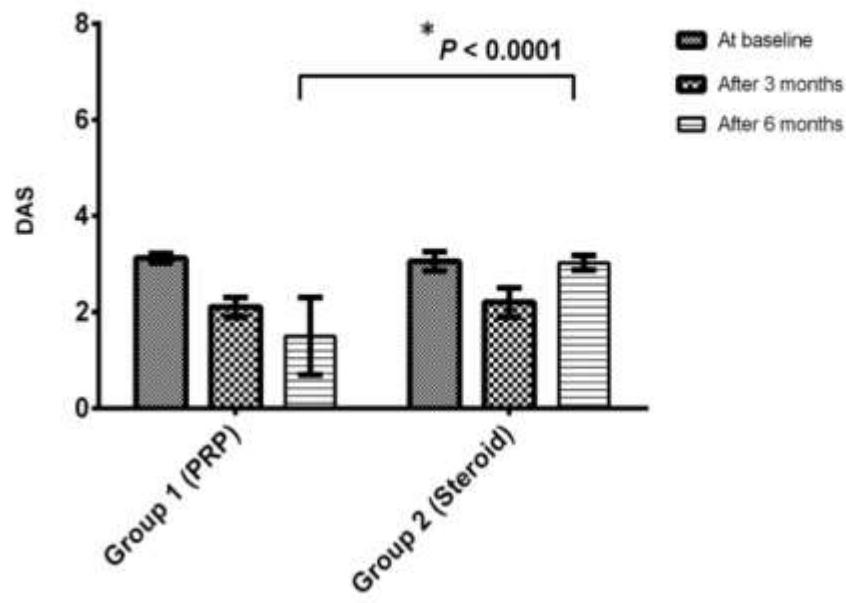
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A PRP egyfajta csodaszernek tűnhet  
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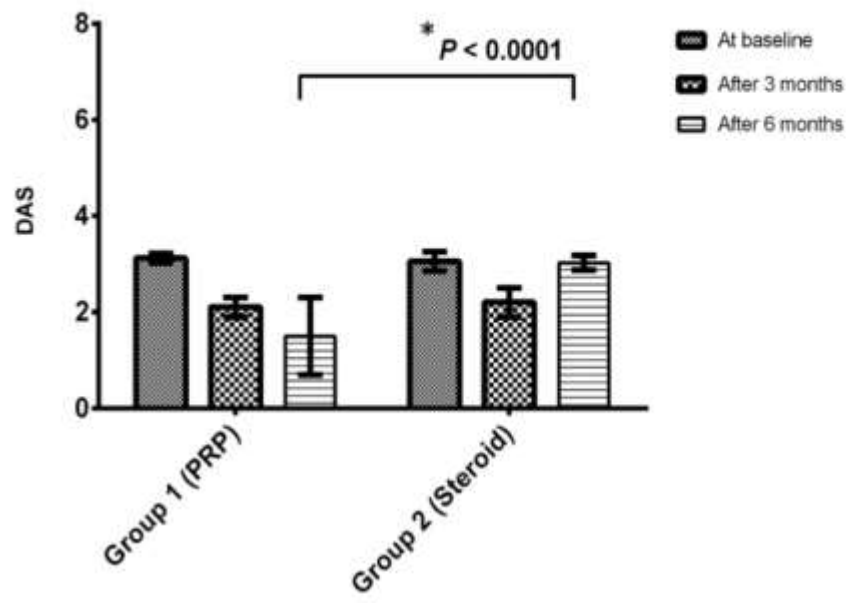
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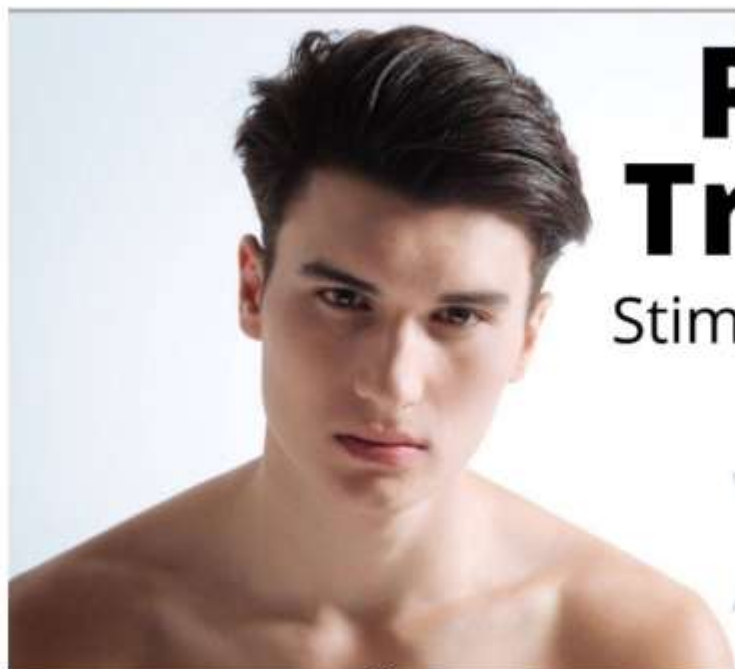
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# PRP Hair Treatment

Stimulate and Accelerate Hair Growth

Maxim Hair Restoration  
Manila, Philippines

A PRP egyfajta csodaszernek tűnhet  
Amitől nekem rögtön gyanússá válik

