Gene name: **ARG1**

External Ids for ARG1 Gene: HGNC: 663 NCBI Gene: 383 Ensembl: ENSG00000118520 OMIM®: 608313 UniProtKB/Swiss-Prot: P05089

NCBI Gene Summary: Arginase catalyzes the hydrolysis of arginine to ornithine and urea. At least two isoforms of mammalian arginase exist (types I and II) which differ in their tissue distribution, subcellular localization, immunological cross reactivity and physiologic function. The type I isoform encoded by this gene, is a cytosolic enzyme and expressed predominantly in the liver as a component of the urea cycle.

GeneCards Summary: ARG1 (Arginase 1) is a Protein Coding gene. Diseases associated with ARG1 include Argininemia and Urea Cycle Disorder. Among its related pathways are superpathway of L-citrulline metabolism and Innate Immune System. Gene Ontology (GO) annotations related to this gene include *manganese ion binding* and *arginase activity*. An important paralog of this gene is ARG2.

UniProtKB/Swiss-Prot Summary: Key element of the urea cycle converting L-arginine to urea and L-ornithine, which is further metabolized into metabolites proline and polyamides that drive collagen synthesis and bioenergetic pathways critical for cell proliferation, respectively; the urea cycle takes place primarily in the liver and, to a lesser extent, in the kidneys. (ARGI1_HUMAN,P05089)

Cellular localization: lysosome, cytosol, nucleus, extracellular.

Full Name: *Arginase 1*

Protein Type: Enzyme (cytosolic arginase)

🔬 Biological Function of ARG1

- ARG1 encodes the enzyme arginase 1, which catalyzes the conversion of L-arginine → urea + ornithine.
- It's a key component of the urea cycle, helping eliminate excess nitrogen.
- Tissue expression:
    - Highly expressed in the liver (for urea metabolism).
    - Also expressed in myeloid immune cells, particularly neutrophils, monocytes, and myeloid-derived suppressor cells (MDSCs).

🛠️ Major Immune-Related Functions of ARG1:

- **Regulates immune responses via L-arginine metabolism**:
    - Depletes extracellular L-arginine, which is essential for T cell proliferation.
    - Therefore, ARG1 acts as an immunosuppressive enzyme in inflamed tissues.

- **Suppresses T cell activity** by:
    - Inhibiting TCR signaling.
    - Reducing CD3ζ chain expression in T cells.
- **Promotes resolution of inflammation**:
    - Through modulation of macrophage and neutrophil function.

🦠 Role of ARG1 in Sepsis

ARG1 plays a dual and time-dependent role in sepsis:

Early Sepsis:

- Arginase-1 may help limit tissue damage by regulating excessive nitric oxide (NO) production (via competition with iNOS for arginine).
- Produced by activated neutrophils and monocytes as a regulatory mechanism.

Late/Severe Sepsis:

- Overexpression of ARG1 contributes to immune suppression:
    - Depletes arginine → suppresses T cell responses.
    - Leads to T cell exhaustion, impaired pathogen clearance, and secondary infections.
- Found in sepsis-associated myeloid-derived suppressor cells (MDSCs), which dampen adaptive immunity.

📈 Clinical Relevance of ARG1 in Sepsis

Diagnostic Role:

- ARG1 is strongly upregulated in sepsis — detectable in:
    - Whole blood
    - Neutrophil transcriptomes
    - Plasma protein levels
- Considered a marker of emergency myelopoiesis and innate immune activation.

Prognostic Role:

- High ARG1 levels are associated with:

    - Worse immune suppression
    - Poor lymphocyte recovery
    - Higher mortality rates
    - Organ dysfunction, especially related to endothelial damage and shock

Therapeutic Interest:

- Blocking ARG1 activity (such as, with small molecule inhibitors) is being explored to:
    - Preserve T cell function
    - Improve outcomes in sepsis-induced immune suppression, cancer, and chronic infections

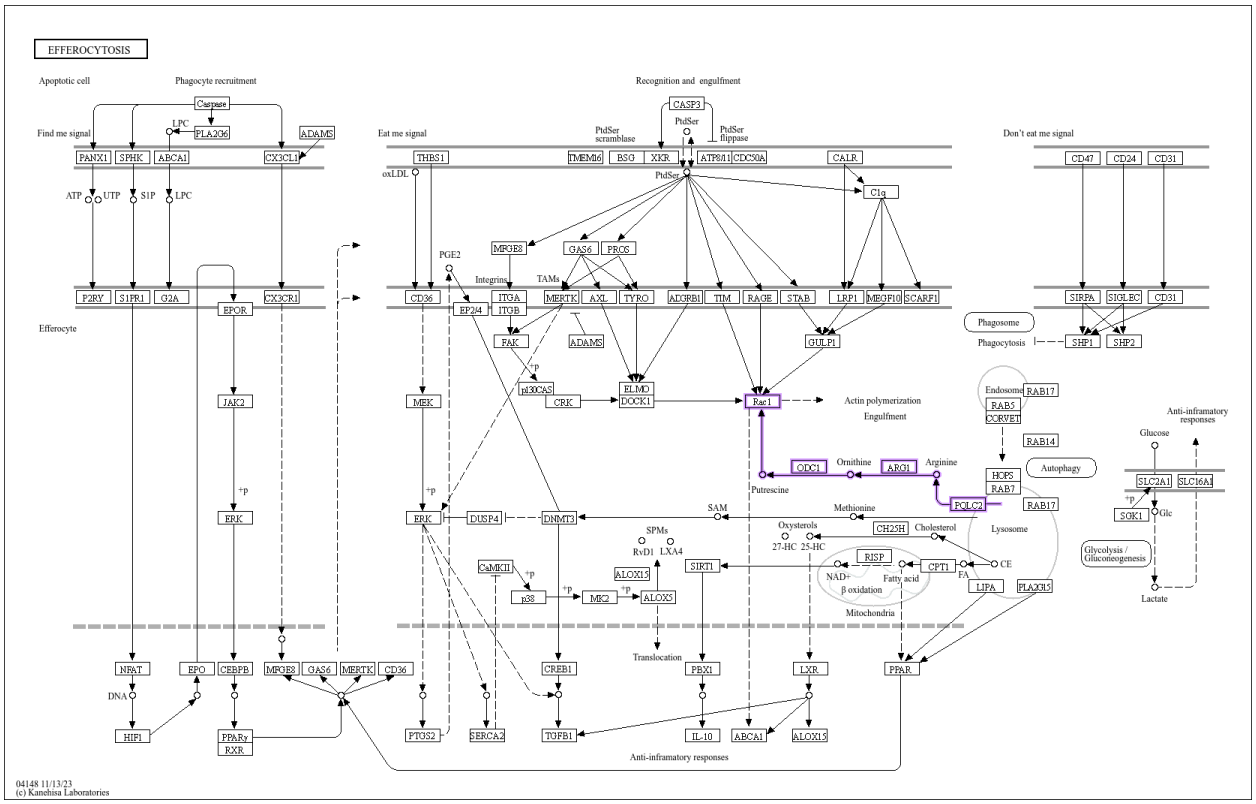
🔬 Pathways Involving ARG1

- **Urea cycle and nitrogen metabolism**
- **Amino acid metabolism** (especially L-arginine)
- **Regulation of T cell-mediated immunity**
- **Sepsis immunosuppression pathways** (via MDSC and neutrophil activity)

🧪 Supporting Literature

Doi: 10.3390/genes10121005
Doi: 10.1186/s40560-015-0124-1
Doi: 10.1186/s41065-022-00240-1
Doi: 10.1080/2162402X.2021.1956143

KEGG:



Enrichr-KG