

A Review on Comparative Study of Rheumatoid Arthritis and Gout in Birds and Human Beings

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Abstract

A common inflammatory musculoskeletal condition that affects joints including the fingers, wrists, and ankles is rheumatoid arthritis (RA). Its constant inflammation results in permanent joint damage and discomfort, demonstrating the necessity of early and suitable therapy. Another type of inflammatory arthritis called gout is brought on by high uric acid levels, which crystallize in joints and cause recurrent attacks. Gout mainly affects males in their middle years, although it can also affect women after menopause. A comparative look at the urea and uric acid cycles reveals how they manage nitrogenous waste. The urea cycle in humans converts toxic ammonia into urea for excretion, while the uric acid cycle breaks down purines, producing uric acid, which can lead to conditions like gout when not adequately excreted. In humans, the absence of uricase increases the risk of uric acid-related diseases like gout, highlighting the clinical importance of managing uric acid levels.

Keywords: Rheumatoid arthritis (RA) , Gout , Allantoin , Urea , Uric acid

I. INTRODUCTION

Rheumatoid arthritis (RA) is among the most common seditious musculoskeletal ails. It constantly affects the fingers, wrists, bases, and ankles. habitual inflammation causes common damage and unrecoverable abnormalities. The primary solicitude with RA is patient pain and associated negative health issues caused by habitual systemic inflammation. thus, prompt and sensible remedy of RA is vital. Unfortunately, individualities constantly defer carrying remedy from applicable and trained healthcare interpreters.[1]

The use of untrained healthcare interpreters who warrant understanding about RA constantly results in a detention in referral to a rheumatologist. In India, there are several reasons why treatment is delayed, including cases' faith in traditional mending styles, lack of access to good healthcare professionals, and detainments in rheumatology referrals. The maturity of cases have a preference for reciprocal drug, which is constantly tone- managed.[2,3] Gout is a kind of seditious arthritis that generally manifests as flare- ups lasting one or two weeks before going down. Frequently, a lower branch or big toe is where gout flares up. Gout is the result of a long- term accumulation of inordinate urate situations in the body, which can lead to the conformation of needle- shaped chargers in and around the joint. This causes common inflammation and arthritis. Urate situations in the body increase when the body either produces too important urate or eliminates too little of it. Nevertheless, a large chance of individualities with elevated serum urate situations don't progress to gout. The following fleshly corridor may be impacted by gout joints. Tendon pods are membranes that compass tendons. Feathers, as elevated uric acid situations might affect in order monuments. Gout affects a lot of people. It's more common in men than in women. The maturity of gout cases be in middle life. Women generally don't develop gout until after menopause, thus it tends to affect them latterly in life than it does men. The complaint is less common in youngish people, but when it does do, it generally gets worse.[3,4]

II. COMPARATIVE STUDY

Fig.1. Reactions of Urea Cycle [1]

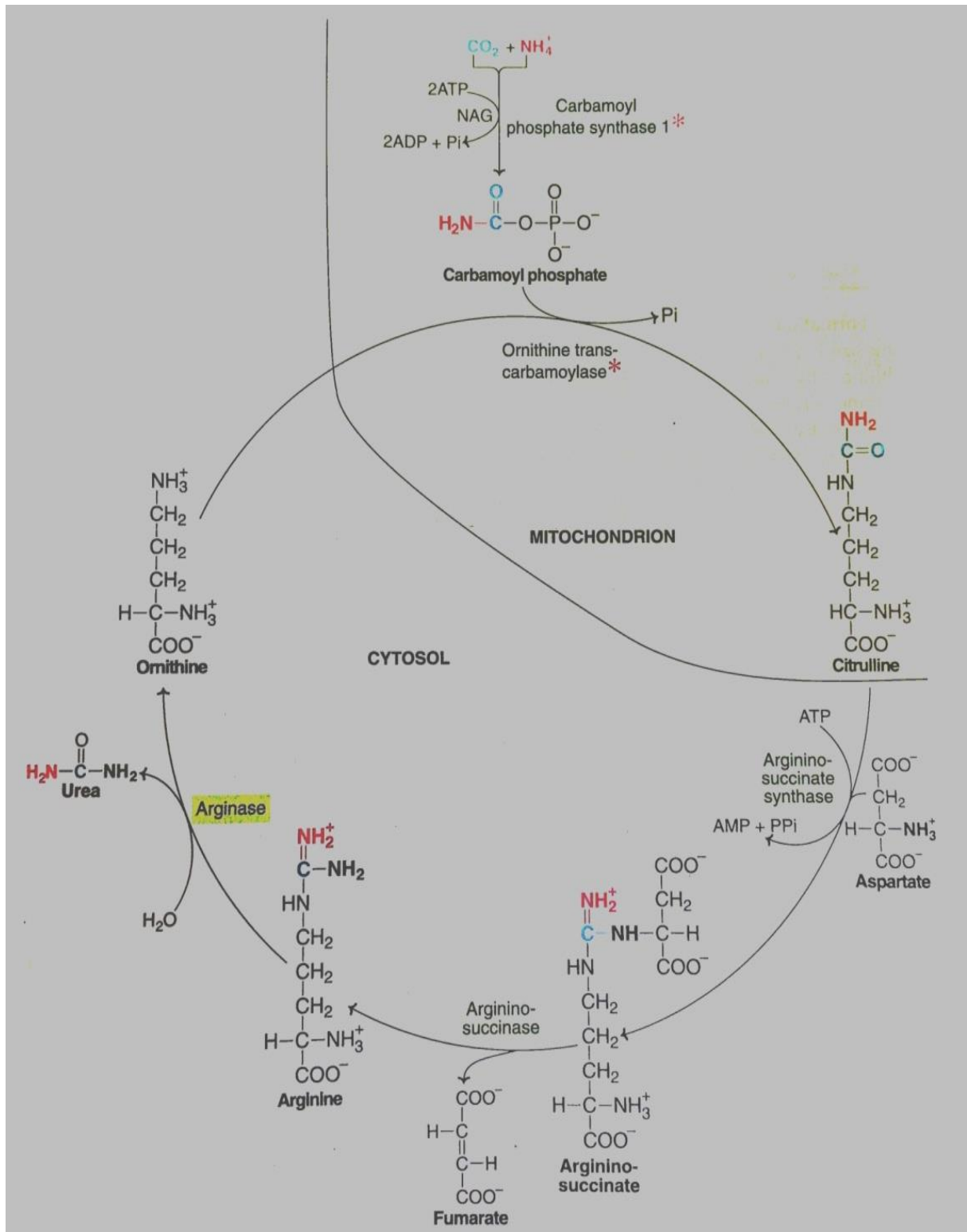
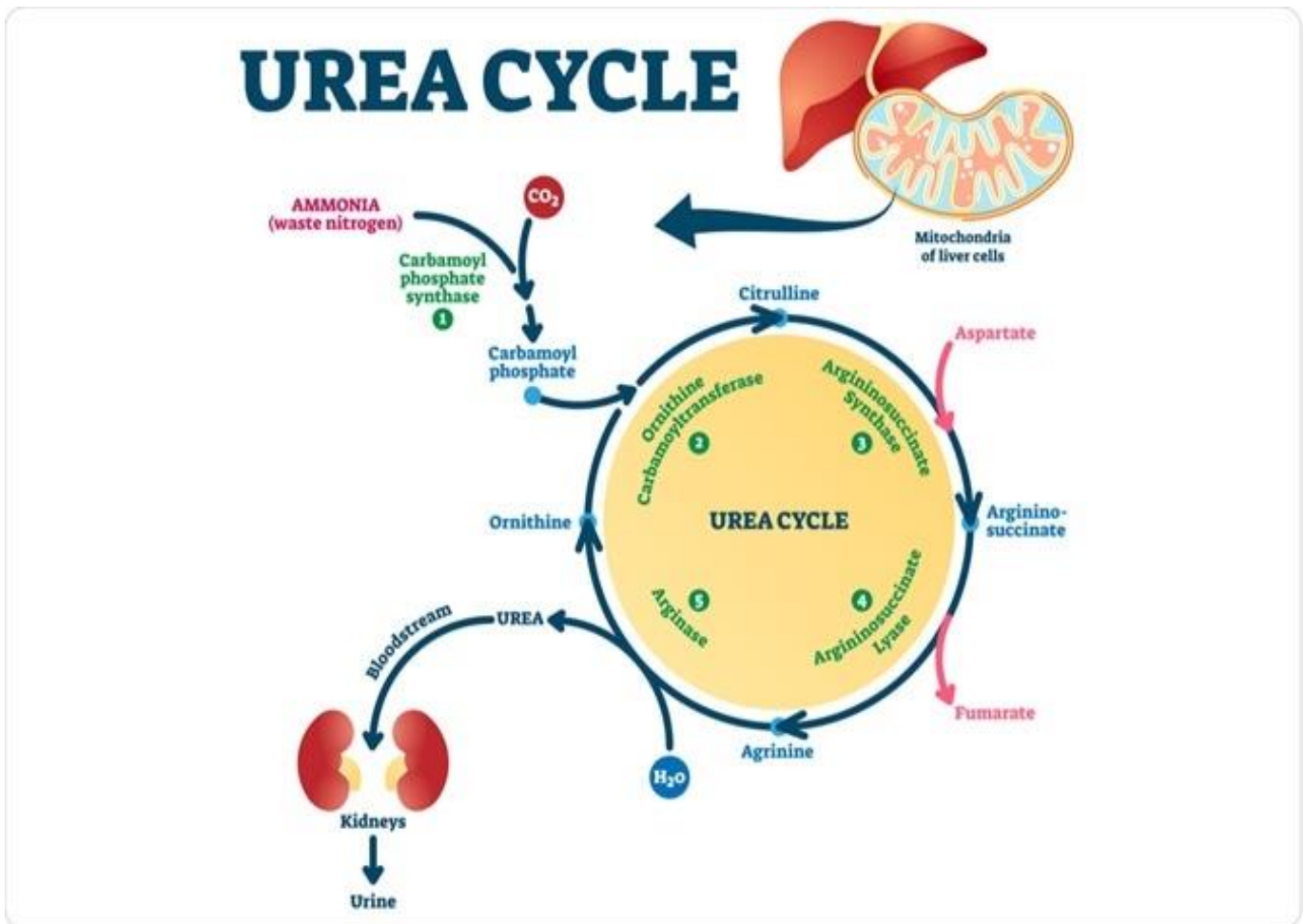


Fig. 2. Outline of Urea Cycle



The ornithine cycle, another name for the urea cycle, is a series of metabolic processes that mostly occur in the liver. Its principle role is to transform toxic ammonia, a byproduct of protein degradation, into urea, which the kidneys subsequently remove in urine. In species that digest a significant amount of protein, this cycle is especially important for ammonia detoxification.[6]

Key Steps in the Urine Cycle:

An essential step in the urine cycle

- **The Production of Ammonia:** Ammonia is produced by the breakdown of amino acids.
- **Carbamoyl Phosphate's structure:** Ammonia and bicarbonate combine in the mitochondria to produce carbamoyl phosphate, which is then intermediated by the enzyme carbamoyl phosphate synthetase I.
- **Citrulline's structure:** with the help of ornithine transcarbamylase (OTC), carbamoyl phosphate and ornithine react to create citrulline. Additionally, citrulline travels to the cytosol. The structure of argininosuccinate with the help of argininosuccinate synthetase, citrulline and aspartate combine to generate argininosuccinate.
- **Arginine's structure:** with the help of argininosuccinate lyase, argininosuccinate is broken down into fumarate and arginine.
- **Conformation of urea:** Arginase is an enzyme that breaks down arginine into urea and ornithine. Ornithine is recovered to resume the cycle once the urea is also expelled.[6]

Uric acid cycle overview:

The body breaks down purines, which are the building blocks of DNA and RNA, through a metabolic process called the uric acid cycle, also referred to as the purine degradation route. Uric acid is eventually produced as a result of it. Here is a summary of the cycle's main steps:

- **Breakdown of urine:** A series of enzyme reactions break down the purines, adenine and guanine. Adenine is converted to hypoxanthine and guanine to xanthine.
- **Xanthine Conversion:** Hypoxanthine is changed into xanthine by the enzyme xanthine oxidase. When xanthine oxidase further oxidizes xanthine, uric acid is created.
- **Formation of uric acid:** Uric acid is the final byproduct of purine metabolism and is discharged into the circulation.
- **Excretion:** The kidneys naturally eliminate uric acid by urine excretion. When uric acid synthesis surpasses excretion, it can accumulate in the body and cause gout or kidney stones.

In many mammals, the enzyme uricase degrades uric acid to produce allantoin. However, because humans lack this enzyme, purine metabolism in humans produces uric acid as the final product. Controlling the amount of uric acid in the body is critical in avoiding metabolic disorders caused by its development.[3]

CLINICAL RELEVANCE:

High levels of uric acid in the blood can lead to gout, a condition where uric acid crystals accumulate in joints, causing pain and inflammation. Uric acid is also excreted by some animals (like birds and reptiles) in the form of urate, which is less toxic and less soluble than urea.

Humans have relatively low activity of the enzyme uricase (which breaks down uric acid into allantoin), which is why uric acid tends to accumulate in humans.[6]

Why it doesn't occur in birds?

Because of many physiological, metabolic, and immune system distinctions between them and people, birds do not develop rheumatoid arthritis (RA) in spite of having elevated uric acid levels.

1. **Metabolic Process of Uric Acid:** Uric acid is the main waste product of nitrogen metabolism in birds. But in birds, uric acid is expelled in a solid or semi-solid form rather than answerable in the bloodstream as it's in humans. By doing this, uric acid chargers that can beget gout or arthritis in people are kept from accumulating in joints. birds have developed defense systems to repel increased uric acid attention without shaping into dangerous substances that might beget inflammation.[6]
2. **Differences in Immune System:** RA is an autoimmune complaint where the body's vulnerable system inaptly attacks the joints, leading to habitual inflammation. Birds may have vulnerable system characteristics that help similar autoimmune responses. Their vulnerable systems are structured else from mammals, which may make them less prone to autoimmune conditions like RA.
3. **Lack of Uricase in Humans:** Unlike birds, humans and some other mammals lack the enzyme uricase, which converts uric acid to allantoin. Although birds don't rely on uricase, their efficient excretion of uric acid prevents it from accumulating and causing joint problems. In humans, the lack of uricase makes us more vulnerable to uric acid buildup, leading to inflammatory conditions like gout, which can contribute to arthritis.[5]
4. **Bone and Joint Structure:** Birds have lighter skeletal systems designed for flight, which reduces mechanical stress on their joints. This might make them less prone to the wear-and-tear injuries that can trigger inflammatory responses in human joints, contributing to arthritis.
5. **Shorter Lifespans:** Many bird species have relatively short lifespans compared to humans, which reduces the likelihood of age-related conditions like RA [5].

Uricase enzyme role in mammals and birds:

A chemical called allantoin, which is further answerable in water, is created when uric acid is oxidized by the enzyme uricase, also known as urate oxidase. This promotes further effective nitrogenous waste excretion in several mammals. But uricase is non-functional or missing in birds.

- A. **Uric acid in birds:** Birds, unlike mammals, exclude nitrogenous waste substantially as uric acid. This process is an adaptation to water saving, particularly for organisms living in thirsty regions. Uric acid is less answerable in water than urea, thus it can be expelled as a solid or semi-solid paste with little water loss (white chargers are common in raspberry feces).[5]
- B. **Evolutionary aspect:** Birds, along with reptiles, have evolved to excrete uric acid to conserve water. The absence of a functional uricase enzyme in birds may be due to evolutionary changes that favor the excretion of nitrogenous waste in a lower poisonous and less water-ferocious form (uric acid), as opposed to urea or allantoin. For birds, this medium is essential, especially because it allows them to fly great distances without constantly drinking water.[5]

CONCLUSION:

Rheumatoid arthritis (RA) and gout are both forms of inflammatory arthritis with distinct causes and manifestations, yet both can lead to chronic pain and joint damage. The metabolic processes of the urea and uric acid cycles are critical for detoxification and waste elimination in humans. While the urea cycle converts ammonia into urea for excretion, the uric acid cycle breaks down purines, leading to the production of uric acid, which can accumulate if not properly excreted, resulting in gout or kidney stones. In contrast, birds have evolved to excrete uric acid in solid form, preventing similar conditions.

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