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Original Paper

URIC ACID TARGET ACHIEVEMENT AND FACTORS ASSOCIATED WITH TREATMENT OUTCOMES IN GOUT: A RETROSPECTIVE STUDY FROM A TERTIARY RHEUMATOLOGY CENTRE

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Gout is a chronic inflammatory arthritis caused by monosodium urate crystal deposition. Despite the availability of urate-lowering therapy (ULT), many patients fail to achieve target uric acid levels, leading to poor disease control. This study assessed uric acid target attainment and associated factors among gout patients in Latvia. A retrospective analysis was conducted on 503 patients diagnosed with gout at the ORTO Clinic (2013–2025). Data included demographics, ULT type (allopurinol or febuxostat), frequency of rheumatologist visits, and laboratory parameters at diagnosis and in 2023–2025. The uric acid target was defined as < 360 μmol/l. Of 503 patients (93.2% men; mean age 51.6 years), 80.5% received allopurinol and 15.9% febuxostat. Only 22.5% achieved the target; 50.7% did not, and 26.8% had no recent uric acid testing. Target achievement was significantly associated with older age (p = 0.028), more frequent follow-up (p = 0.015), and higher vitamin D levels (p = 0.047). Uric acid correlated positively with LDL (r = 0.190) and total cholesterol (r = 0.200), and negatively with vitamin D (r = –0.193). Uric acid targets remain poorly achieved in routine practice. Improved patient monitoring, follow-up frequency, and attention to modifiable factors such as vitamin D status may enhance treatment outcomes.

Keywords: *allopurinol, febuxostat, urate-lowering therapy, hyperuricaemia, treat-to-target.*

INTRODUCTION

Gout is a chronic inflammatory arthritis characterised by the deposition of monosodium urate crystals in joints and soft tissues, leading to inflammation of the joints and surrounding structures (including tendons, bursae, and other soft tissues), the formation of tophi, and complications affecting the cardiovascular and renal systems (FitzGerald, 2025).

Monosodium urate crystals form when chronic hyperuricaemia is present, defined as a serum uric acid concentration exceeding 360 μmol/l (6 mg/dl) according to the American College of Rheumatology (ACR (FitzGerald *et al.*, 2020)) and the European Alliance of Associations for Rheumatology (EULAR (Richette *et al.*, 2017)) guidelines, or exceeding 300 μmol/l (5 mg/dl) in patients with tophi or chronic gouty arthritis (EULAR).

Hyperuricaemia arises either from impaired renal excretion of uric acid (primary or secondary — due to chronic kidney disease, hypertension, obesity, and other clinical conditions, as well as drug- or toxin-induced causes such as thiazide diuretics, alcohol, low-dose aspirin, cyclosporine A, tacrolimus, beta-blockers, ACE inhibitors, etc.) or from increased uric acid production (primary metabolic disorders with enzyme deficiencies, or secondary causes such as obesity, psoriasis, carcinomas, myelo- or lymphoproliferative disorders, and other haematologic conditions, as well as drug- and diet-induced factors, including purine-rich foods, fructose, and ethanol) (Roddy *et al.*, 2014).

Medication adherence is the extent to which patients follow the prescribed regimen for taking their medications (Scheepers *et al.*, 2018).

Because gout is characterised by long asymptomatic periods, patients often discontinue or inconsistently use therapy, contributing to poor treatment outcomes. Although gout can be effectively managed — and potentially cured — through adequate use of prescribed urate-lowering therapy (e.g., allopurinol or febuxostat), many patients prematurely discontinue treatment, thereby increasing the risk of disease relapse. Studies have shown that only 10–46% of patients adhere to the prescribed regimen, taking the medication as instructed for at least 80% of the recommended duration (Sinnappah *et al.*, 2022).

This study aimed to evaluate uric acid target achievement and identify clinical and laboratory factors associated with treatment outcomes among patients with gout at the ORTO Clinic in Rīga, Latvia. We also examined associations among uric acid levels, demographic characteristics, clinical variables, and laboratory parameters, with a focus on differences between allopurinol- and febuxostat-treated patients.

MATERIALS AND METHODS

We conducted a retrospective study at the ORTO Clinic in Rīga, Latvia, including all patients diagnosed with gout who visited the clinic between 2013 and 2025. A total of 503 patients were included.

Collected data included patient age, sex, age at gout diagnosis, number of rheumatologist visits at the ORTO Clinic, and the urate-lowering medication prescribed (allopurinol or febuxostat). In addition, we obtained laboratory data from the time of initial gout diagnosis and from the most recent available blood test (between January 2023 and January 2025). These laboratory parameters included serum uric acid, estimated glomerular filtration rate (GFR), glucose, triglycerides, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, total cholesterol, alanine aminotransferase (ALT), and vitamin D.

The target serum uric acid concentration was defined as < 360 μmol/l (6 mg/dl). Data on the presence of tophi or chronic gouty arthritis were unavailable.

Comparisons between groups were performed using the Mann–Whitney U test, independent-samples t-test, or Pearson χ^2 test as appropriate. Associations were assessed with Spearman's rank correlation. A p-value < 0.05 was considered statistically significant. Analyses were conducted with IBM SPSS Statistics.

RESULTS

A total of 503 patients were included, comprising 469 men (93.24%) and 34 women (6.76%), with a mean age at diagnosis of 51.6 years (range 25–87). Most patients (80.5%) were treated with allopurinol, 15.9% with febuxostat, and 3.6% were not prescribed urate-lowering therapy but dietary recommendations. Allopurinol was prescribed more frequently to men than to women ($p < 0.001$) (Table 1).

Overall, 22.5% of patients achieved the target serum uric acid level (< 360 μmol/l), while 50.7% did not, and 26.8% had no available uric acid measurements during 2023–2025 (Table 2, Fig. 1). No significant difference in target achievement was observed between the allopurinol and febuxostat groups ($p = 0.355$).

Mean serum uric acid decreased from 474 μmol/l at diagnosis to 419 μmol/l in the most recent analysis. No significant differences were observed between treatment groups regarding disease duration ($p = 0.216$), uric acid level at diagnosis ($p = 0.284$), most recent uric acid level ($p = 0.429$), or vitamin D levels ($p = 0.432$) (Table 3). However, patients treated with febuxostat had significantly more rheumatologist visits per year compared with those receiving allopurinol ($p = 0.008$) (Table 3, Fig. 2). Patients who achieved the target serum uric acid level had significantly more frequent rheumatology visits ($p = 0.015$) and were older at diagnosis ($p = 0.028$). No significant differences were observed between male and female patients in the most recent uric acid levels ($p = 0.560$) or in visit frequency ($p = 0.157$).

Correlation analysis showed no significant association between uric acid levels and GFR, glucose, triglycerides, HDL

Table 1. Patient demographics and treatment distribution (n = 503)

Variable	Value
Age at diagnosis, mean (range), years	51.6 (25–87)
Sex, n (%)	
Men	469 (93.2)
Women	34 (6.8)
Urate-lowering therapy, n (%)	
Allopurinol	405 (80.5)
Febuxostat	80 (15.9)
No urate-lowering therapy prescribed	18 (3.6)

Table 2. Uric acid target achievement by treatment group

Category	All patients, n (%)	Allopurinol, n (%)	Febuxostat, n (%)	p-value
Achieved target (< 360 μmol/l)	113 (22.5)	87 (17.3)	24 (4.8)	0.355*
Did not achieve the target	255 (50.7)	209 (41.6)	39 (7.8)	
No measurement (2023–2025)	135 (26.8)	109 (21.7)	17 (3.4)	

* Comparison of uric acid target achievement between allopurinol and febuxostat groups (Pearson χ^2 test).

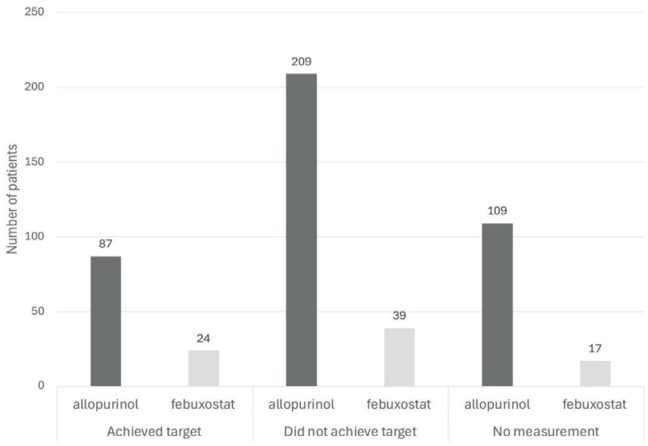

Fig. 1. Uric acid target achievement by treatment group.

cholesterol, or ALT. However, uric acid level correlated positively with LDL cholesterol (r = 0.190, p = 0.001) and total cholesterol (r = 0.200, p = 0.001), and negatively with vitamin D levels (r = –0.193, p = 0.002).

Finally, younger age at gout diagnosis was associated with higher uric acid levels at diagnosis (r = –0.118, p = 0.009).

DISCUSSION

In this retrospective study of 503 patients with gout, only 22.5% achieved the target serum uric acid level < 360 μmol/l, despite the availability of ULT. This rate of target attainment is consistent with previously reported adherence challenges in gout management, with studies indicating that only 10–46% of patients take ULT as prescribed for at least 80% of the time (Sinnappah *et al.*, 2022). Poor adherence remains a significant barrier to optimal disease control. It is necessary to investigate not only treatment adherence but also other factors contributing to the failure to achieve the target serum uric acid concentration. In a study comparing persistence rates between allopurinol and febuxostat in patients with gout, 46.8% discontinued ULT, with lower persistence in the allopurinol group than in the febuxostat group (Kim *et al.*, 2020).

Patients treated with febuxostat visited a rheumatologist more frequently than those receiving allopurinol. A similar pattern was observed among patients who reached the target uric acid concentration, suggesting an association between more frequent follow-up and a higher likelihood of achieving the target uric acid level. However, causality cannot be inferred. No significant differences in treatment outcomes

Table 3. Clinical characteristics and outcomes

Variable	Total (n = 503)	Allopurinol	Febuxostat	p-value
Mean duration since diagnosis, years	5.3	5.4	4.9	0.216*
Mean rheumatology visits per year (±SD)	0.55 (± 0.54)	0.55	0.66	0.008*
Serum uric acid at diagnosis, μmol/l, mean (±SD)	474 (± 108.45)	477	460	0.184*
Serum uric acid 2023–2025, μmol/l, mean (±SD)	419 (± 103.18)	421	408	0.429^{+}
Vitamin D level 2023–2025, nmol/l, mean (±SD)	32.49 (± 12.98)	32.24 (12.99)	34.44 (13.80)	0.432*
Age < 50 years at diagnosis, n (%)	243 (48.3)	207	24	0.101$^{\#}$
Age ≥ 50 years at diagnosis, n (%)	260 (51.7)	198	56	

SD, standard deviation.

* Mann–Whitney U test.

$^{+}$ Independent samples t-test

$^{\#}$ Pearson χ^2 test

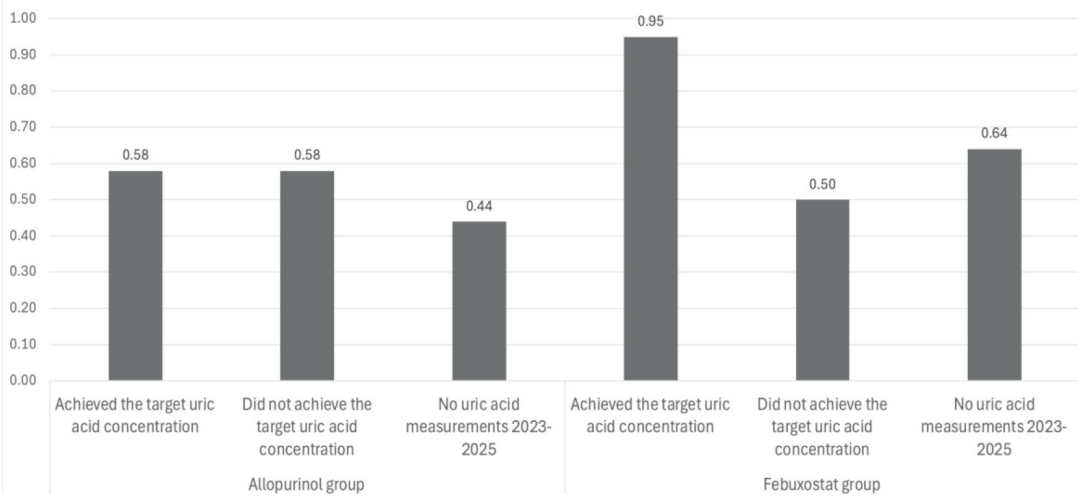

Fig. 2. Average number of rheumatologist visits per year.

or most recent uric acid levels were observed between the allopurinol and febuxostat groups. This suggests that both drugs can be effective when titrated appropriately, although differences in tolerability, comorbidities, and cost may influence prescribing decisions. Previous studies have reported that febuxostat is more effective than allopurinol in achieving the target serum uric acid concentration of < 360 μmol/l (Faruque *et al.*, 2013; Xie *et al.*, 2023). These discrepancies may, at least in part, be attributable to differences in the dosages of allopurinol and febuxostat used across studies. They may also be influenced by treatment duration and patient age. Moreover, because allopurinol cannot be administered at standard effective doses in patients with moderate to severe chronic kidney disease, febuxostat is more frequently prescribed in this subgroup, which may further contribute to the observed variation in outcomes (Kannuthurai *et al.*, 2023).

Achievement of the target uric acid concentration was significantly more common among older patients, suggesting lower baseline adherence among younger patients. This could be related to underestimating the risks and seriousness of the disease, reluctance to take daily medication for a condition with intermittent flares, and the presence of fewer comorbidities requiring regular medical appointments.

Laboratory correlations revealed that higher uric acid levels were positively associated with LDL cholesterol and total cholesterol, supporting previous studies that confirm the link between dyslipidaemia and gout, as both share pathophysiological pathways involving diet, comorbidities, and aging (Choi *et al.*, 2022).

A negative correlation was observed between serum uric acid and vitamin D levels, with higher vitamin D concentrations found among patients who achieved the target urate level. Vitamin D deficiency has been proposed as a potential risk factor for hyperuricaemia, possibly through its effects on systemic inflammation and on renal urate transporters, which may impair uric acid excretion. These findings suggest that vitamin D deficiency could represent a modifiable risk factor in the management of gout (Han *et al.*, 2025). This observation is consistent with previous studies that reported an association between low vitamin D levels and elevated serum uric acid concentrations (Charoenngam *et al.*, 2020). While our findings suggest a link between higher vitamin D levels and improved uric acid control, this should be considered a hypothesis-generating study. Our observational data cannot establish causation, and future studies are needed to determine whether vitamin D supplementation can improve gout outcomes.

Our results also highlight the considerable proportion of patients without recent uric acid measurements, indicating gaps in monitoring practices. Regular biochemical assessment is essential for guiding dose adjustments and ensuring treatment targets are met, as recommended by both ACR (FitzGerald *et al.*, 2020) and EULAR (Richette *et al.*, 2017) guidelines. Interventions to impove follow-up frequency, patient education, and shared care between rheumatologists and primary physicians could mitigate this problem.

This study did not include data on prescribed doses of allopurinol or febuxostat, which are critical for assessing treatment adequacy. Information on comorbidities such as chronic kidney disease, obesity, and alcohol use was also unavailable, which may confound the associations observed. Furthermore, more than one-quarter of patients lacked recent uric acid measurements, underscoring significant gaps in routine monitoring.

CONCLUSIONS

Our study demonstrates that achieving long-term uric acid targets in gout remains a significant challenge. Only 22.5% of patients reached the recommended serum uric acid level, while 26.8% had no recent laboratory measurements, and 50.7% did not meet the therapeutic goal. These findings indicate that effective disease control is still insufficient in routine clinical practice.

We observed a clear association between the frequency of rheumatology visits and treatment success. Patients treated with febuxostat tended to attend follow-ups more often than those receiving allopurinol, and those with more frequent clinical contact were more likely to achieve the target uric acid level. Although causality cannot be established, this pattern suggests that regular monitoring and physician engagement are important for maintaining urate control.

No significant differences in outcomes were observed between the two urate-lowering agents or between male and female patients. However, patients who reached the target urate level were generally older, while younger patients had higher uric acid concentrations at diagnosis, possibly reflecting differences in adherence or perception of disease severity.

Vitamin D levels showed an inverse association with uric acid, and patients who achieved the target had higher vitamin D concentrations. Positive correlations among uric acid, LDL, and total cholesterol further highlight the metabolic links commonly observed in gout. Overall, the results emphasise that gout management should extend beyond pharmacological treatment. Close collaboration between rheumatologists and general practitioners, together with consistent follow-up, lifestyle counselling, and management of metabolic risk factors, is essential to improve outcomes and achieve sustained uric acid control.

ETHICS

The study was approved by the Rīga Stradiņš University Research Ethics Committee, document No. 2-PĒK-4/780/2024.

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URĪNSKĀBES MĒRĶA LĪMEŅA SASNIEGŠANA UN AR TO SAISTĪTIE FAKTORI PODAGRAS PACIENTIEM: RETROSPEKTĪVA PĒTĪJUMA REZULTĀTI TERCIĀRĀ REIMATOLOĢIJAS CENTRĀ

Podagra ir hronisks iekaisīgs artrīts, ko izraisa mononātrija urāta kristālu izgulsnēšanās. Neraugoties uz urīnskābes līmeni pazeminošās terapijas (ULT) pieejamību, mērķa urīnskābes līmeņa sasniegšana bieži vien ir nepietiekama, un tas apgrūtina efektīvu slimības kontroli. Šī pētījuma mērķis bija izvērtēt mērķa urīnskābes līmeņa sasniegšanu un ar to saistītos klīniskos un laboratoriskos faktorus podagras pacientiem Latvijā. Retrospektīvā analīzē tika iekļauti 503 pacienti ar podagras diagnozi, kuri ārstēti ORTO klīnikā laika posmā no 2013. līdz 2025. gadam. Tika analizēti demogrāfiskie dati, lietotās ULT veids (allopurinols vai febuksostats), reimatologa vizīšu biežums, kā arī laboratoriskie rādītāji diagnozes noteikšanas brīdī un laika periodā no 2023. līdz 2025. gadam. Mērķa urīnskābes līmenis tika definēts kā < 360 μmol/l. No 503 pacientiem (93,24% vīrieši, 6,76% sievietes, vidējais vecums diagnozes noteikšanas brīdī 51,6 gadi) 80,5% tika nozīmēts allopurinols, 15,9% — febuksostats, bet 3,6% nesaņēma ULT. Mērķa urīnskābes līmeni sasniedza tikai 22,5% pacientu, 50,7% to nesasniedza, savukārt 26,8% pacientu nebija pieejami jaunākie urīnskābes mērījumi. Diagnozes noteikšanas brīdī vidējais urīnskābes līmenis bija 474 μmol/l; bet pēdējās analīzēs – 419 μmol/l (421 μmol/l allopurinola grupā, 408 μmol/l febuksostata grupā; $p = 0{,}429$). Mērķa līmeņa sasniegšana bija statistiski nozīmīgi saistīta ar lielāku pacientu vecumu ($p = 0{,}028$), biežākām reimatologa vizītēm ($p = 0{,}015$) un augstāku D vitamīna līmeni ($p = 0{,}047$). Urīnskābes līmenis pozitīvi korelēja ar zema blīvuma (ZBL) holesterīnu (r = 0,190, $p = 0{,}001$) un kopējo holesterīnu (r = 0,200, $p = 0{,}001$), bet negatīvi – ar D vitamīna līmeni (r = –0,193, $p = 0{,}002$). Mērķa urīnskābes līmeņa sasniegšana pacientiem ar podagru joprojām ir nepietiekama. Uzlabota pacientu uzraudzība, biežāka kontrole un lielāka uzmanība modificējamiem riska faktoriem varētu uzlabot ārstēšanas rezultātus.