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The British Society For Rheumatology guideline for the management of gout

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Published in:
Rheumatology

DOI:
[10.1093/rheumatology/kex156](https://doi.org/10.1093/rheumatology/kex156)

Publication date:
2017

Document Version
Peer reviewed version

[Link to publication in Discovery Research Portal](#)

Citation for published version (APA):

Hui, M., Carr, A., Cameron, S., Davenport, G., Doherty, M., Forrester, H., Jenkins, W., Jordan, K. M., Mallen, C. D., MacDonald, T., Nuki, G., Pywell, A., Zhang, W., & Roddy, E. (2017). The British Society For Rheumatology guideline for the management of gout. *Rheumatology*, *56*(7), e1-e20.
<https://doi.org/10.1093/rheumatology/kex156>

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British Society for Rheumatology and British Health Professionals in Rheumatology Guideline for the Management of Gout

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Short running title: BSR and BHPR Guideline for the Management of Gout

Scope and purpose

Background to the disease

Gout is the most common cause of inflammatory arthritis worldwide. In UK general practice, the overall prevalence has increased from 1.4% in 1999 to 2.49% in 2012¹, despite the availability of effective and potentially 'curative' urate-lowering drugs for more than 50 years and evidence-based British and European management guidelines for nearly a decade^{2;3}.

Clinical manifestations of gout resulting from monosodium urate (MSU) crystal deposition, include tophi, chronic arthritis, urolithiasis and renal disease as well as recurrent acute arthritis, bursitis and cellulitis. Gouty arthritis and tophi are associated with chronic disability, impairment of health-related quality of life (HRQOL)⁴⁻⁷, increased use of healthcare resources, and reduced productivity⁸. Gout is also frequently associated with co-morbidities such as obesity, dyslipidaemia, diabetes mellitus, chronic renal insufficiency, hypertension, cardiovascular disease, hypothyroidism, anaemia, psoriasis, chronic pulmonary diseases, depression and osteoarthritis¹ as well as with an increase in all-cause mortality (adjusted hazard ratio 1.13, 95% CI 1.08 to 1.18) and urogenital malignancy^{1;9}.

Sustained hyperuricaemia is the single most important risk factor for the development of gout. Hyperuricaemia occurs secondary to reduced fractional clearance of uric acid in more than 90% of patients with gout¹⁰. Age, male gender, menopausal status in females, impairment of renal function, hypertension and the co-morbidities that comprise the metabolic syndrome are all risk factors for incident

gout associated with decreased excretion of uric acid, as are the use of diuretic and many antihypertensive drugs, ciclosporin, low-dose aspirin, alcohol consumption and lead exposure. Tophi and chronic arthritis¹¹, alcohol consumption¹² and recent use of diuretic drugs¹³ are important risk factors for recurring flares.

Genome-wide association studies have identified a number of genes coding for urate anion transporters expressed in the proximal renal tubular epithelium, but these account for less than 5% of the variation in serum urate¹⁴. Serum urate levels are influenced by dietary intake and synthesis as well as by renal excretion. Diets high in red meat or seafood, and increased consumption of beer, spirits and fructose- or sugar-sweetened soft drinks are established risk factors for developing gout¹⁵⁻¹⁷. Single gene disorders associated with urate overproduction, hyperuricaemia and accelerated purine synthesis *de novo* (such as glycogen storage diseases and Lesch-Nyhan syndrome) are very rare causes of primary gout. Diseases (such as lympho- and myeloproliferative disorders and severe exfoliative psoriasis) and drugs (such as cytotoxics, vitamin B12 and ethanol) associated with increased cellular turnover and destruction can lead to secondary hyperuricaemia and gout.¹⁸ The identification of monosodium urate (MSU) crystals in joint and tissue samples remains the 'gold standard' for the diagnosis of gout. Although identification of urate deposits by dual-energy computed tomography (DECT)¹⁹ and ultrasound²⁰ are being used increasingly as an aid to the diagnosis of gout in research and hospital practice, joint aspiration or imaging to confirm crystal presence are rarely undertaken in primary care settings where the majority of patients with gout are managed. For diagnosis in clinical practice, clinical scores, without imaging or synovial fluid

analysis, have been proposed²¹ which include consideration of the patient's history and co-morbidities.

Need for revised management guideline

The British Society for Rheumatology/British Health Professionals in Rheumatology (BSR/BHPR) guideline for the management of gout was published in 2007². There are four broad reasons why a revised and updated guideline is now required. First, new pharmaceutical treatment options have become available and the evidence base for the efficacy and safety of available drugs has expanded. Second, the incidence, prevalence and severity of gout has increased¹ despite the availability of safe, effective and potentially 'curative' therapy. Third, research studies and audits have consistently shown that fewer than 50% of patients with gout seen in General Practice receive urate-lowering therapy (ULT)²²⁻²⁵ and that many patients with gout being treated with ULT in both primary^{1,26} and secondary care^{27,28} do not achieve reductions of serum uric acid levels (sUA) to the target level recommended in the BSR/BHPR (300 µmol/L) or EULAR (360 µmol/L) guidelines. Finally, as evidence has accumulated that the provision of information to patients with gout is sub-optimal²⁹ and qualitative studies have begun to define a range of patient and provider barriers to effective care³⁰⁻³², preliminary data are emerging which demonstrate that these barriers can be overcome, and outcomes improved, with better provision of information and a package of care based on guideline recommendations³³.

Other guidelines available

Recently published guidelines include the 2012 American College of Rheumatology Guidelines for the Management of Gout^{34,35} and the 2013 evidence-based recommendations for the diagnosis and management of gout by a multinational panel of rheumatologists participating in the 3e initiative³⁶. Other National and Regional guidelines include the US Government 2014 Agency for Healthcare Research and Quality (AHRQ) Guidelines for the Diagnosis and Management of Gout^{37,38}, and the Australian and New Zealand³⁹ and Portuguese⁴⁰ recommendations for the diagnosis and management of gout which arose from the 3e initiative.³⁶ Updated EULAR recommendations for the management of gout will be published in 2016.

Objective

This guideline aims to offer revised and updated, concise, patient-focused, evidence-based, expert recommendations for the management of gout in the UK.

Target Audience

The guideline has been developed to provide assistance to doctors and allied health professionals who treat and manage patients with gout in primary care and hospital practice. The guideline should also provide a helpful resource for patients and those responsible for commissioning care for patients with gout in the NHS.

Areas that the guideline does not cover

Evidence-based recommendations for the diagnosis and investigation of gout are not included in this guideline. Some recommendations for the diagnosis of gout are

addressed in the recent 3e recommendations for the diagnosis and management of gout³⁶ and EULAR recommendations for the diagnosis of gout³ are in the process of being updated.⁴¹

Stakeholder involvement

The guideline has been developed by a Multidisciplinary Working Group of rheumatologists (MH, MD, KJ, GN, ER), general practitioners (GD, CM), secondary care physicians with specialist experience in general internal medicine, clinical pharmacology (TM) and nephrology (SC), allied health professionals (AC, WJ), lay patients (HF, AP) and an epidemiologist with expertise in evidence-based medicine (WZ), on behalf of the BSR/BHPR Standards, Audit and Guidelines Working Group (SAGWG). The draft guideline was presented and discussed in open session by a multidisciplinary audience at the annual scientific meetings of the BSR in 2014 and 2016. The consensus recommendations were developed without any input from, or consultation with, any pharmaceutical company and potential conflicts of interest of all members of the working group have been fully declared. This guideline has been reviewed and endorsed by the Royal College of General Practitioners (RCGP).

Rigour of development

Scope of the guideline and strategy for guideline development

The scope of the revised guideline and the key clinical management questions that needed to be addressed were agreed by consensus at an initial face-to-face meeting of the guideline working group after detailed review of the published guideline and results of a systematic literature review. Seventeen clinical management questions

(Table I) were subsequently subjected to additional focussed systematic literature searches after transposition into 20 questions in Population, Comparator, Outcome, Time (PICOT) format⁴².

Systematic literature search

Systematic literature searches were undertaken by MH using Medline 1946 to present, Embase 1974 to present, PubMed from inception to present, the Cochrane Controlled Trials Register from inception to present and the ISI Web of Science and AMED databases 1985 to present. An initial literature search in March/April 2012 was updated in June 2015 (see appendix 1 for search strategy).

Inclusion criteria

Articles included were systematic reviews, randomised controlled trials (RCTs), uncontrolled trials, observational studies including cohort, case-control, and cross-sectional studies, or those where economic evaluation was made.

Exclusion criteria

Editorials, commentaries, conference abstracts and non-evidence based narrative/personal reviews were excluded. Studies of hyperuricaemia were included only if they related to the management of gout.

Delphi exercise to generate consensus recommendations

Concise consensus recommendations for the management of gout were developed. Members of the guideline working group were asked to generate a comprehensive

list of propositions for the management of gout based on available research evidence and their own clinical expertise after reviewing the published recommendations and the results of the systematic literature reviews. Following elimination of closely similar and overlapping recommendations, a preliminary list of 51 proposed recommendations included 13 for the management of acute gout, 15 recommendations relating to education, diet and lifestyle modification and 23 propositions for the management of recurrent, inter-critical and chronic gout. Consensus for 30 revised draft recommendations was reached after 3 rounds of a Delphi exercise conducted by email in which propositions with >60% of votes were accepted, those with <20% rejected and those attracting between 20 and 60% of votes reconsidered after amalgamations and minor rewording. The draft recommendations were presented for discussion and feedback at the annual scientific meeting of the BSR in 2014. Final consensus on the most appropriate wording for 21 recommendations was agreed at a second face-to-face meeting of the guideline working group after further minor amalgamations and discussion of the draft recommendations and the feedback from members of the BSR.

Level of Evidence (LoE)

The level of evidence in support of each recommendation was determined (*1a*: meta-analysis of RCTs, *1b*: at least one RCT, *IIa*: at least one well designed controlled study without randomisation, *IIb*: at least one well designed quasi-experimental study, *III*: at least one non-experimental descriptive study eg comparative, correlation or case-controlled study, *IV*: expert committee reports, opinions and/or experience of respected authorities)⁴³. Where a superior level of evidence was

found, eg a systematic review for a particular intervention, preceding studies regarding that intervention were not further analysed.

Strength of recommendation (SOR)

The SOR for each treatment recommendation by members of the guideline development group was graded anonymously on a 0 – 100 mm Visual Analogue Scale (VAS) by those present at the final face-to-face meeting and by the others via email.

The SOR for each management recommendation was based on the opinions of the guideline working group after considering the research evidence for efficacy, safety and cost-effectiveness of each treatment proposed, and the personal expertise of each member of the group.⁴⁴ This included considerations such as the experts' experience and perception of patient tolerance, acceptability and adherence to the treatment in question, as well as their expert knowledge of any logistic issues involved in the administration of the recommended treatment.

A simplified algorithm (Figure 1) illustrates the suggested care pathway.

Recommendations

Management of Acute Attacks

- I. Educate patients to understand that attacks should be treated as soon as an attack occurs and ensure that patients are aware of the importance of continuing any established urate-lowering therapy during an attack.**

LoE: IV

SOR: 90% (range 81-100)

The strength of recommendation for educating patients to understand the importance of treating acute attacks of gout as early as possible is largely based on common sense, patient experience and expert opinion because of the severity of pain experienced by patients with acute gout. Reduction of pain within 24 hours following treatment with a non-steroidal anti-inflammatory drug (NSAID)⁴⁵ and with colchicine⁴⁶ has, however, been demonstrated in two small placebo-controlled RCTs. The recommendation to continue treatment with urate-lowering drugs during acute gout flares is based on a widespread consensus of expert opinion^{2,34,47}, and qualitative studies that suggest that many patients are unaware of the need to do so^{30,31}.

II. Affected joints should be rested, elevated and exposed in a cool environment.

Bed-cages and ice-packs can be effective adjuncts to management.

LoE: Ib (ice-packs), IV (other)

SOR: 89% (range 54-100)

The recommendation to rest acutely affected joints is based on widespread patient experience and expert opinion. While there is evidence that urate crystal-induced experimental arthritis in dogs is aggravated by movement and ameliorated by rest⁴⁸ there have been no RCTs of rest undertaken in patients with gout. The recommendation for using ice is supported by a Cochrane systematic review of a single small RCT (n=19) in which topical ice was added to prednisolone and colchicine⁴⁹. In this trial, greater pain reduction (-3.3 cm, 95%CI -5.84 to -0.82 on 10

cm VAS) was observed with adjunctive use of ice packs without additional adverse events. Ice packs may be used as safe adjuncts to pharmacological treatment for acute gout, or when drugs are contraindicated because of multiple active co-morbidities.

III. An NSAID at maximum dose or colchicine in doses of 500 micrograms bd-qds are the drugs of choice when there are no contraindications. Choice of first line agent will depend on patient preference, renal function and co-morbidities. Patients on NSAIDs or COXIBs should be co-prescribed a gastro-protective agent.

LoE: Ia

SOR: 95% (range 80-100)

Khanna et al⁵⁰ recently published a systematic review which included 30 papers examining the management of acute gout. Although NSAIDs are used more often than colchicine in general practice²⁴, evidence that either are consistently more effective is lacking, so that choice should be determined by individual patient's preference as well as by renal function and co-morbidities.

The efficacy of NSAIDs is supported by a single placebo – controlled RCT of tenoxicam 40 mg daily⁴⁵. Most RCTs have been head-to-head comparisons with no single agent having greater efficacy. There is, however, widespread expert consensus that, where there is no contraindication to do so, NSAIDs should be prescribed at high dose when treating patients with acute gout because of the severity of the pain and inflammation^{2,3,35}. NSAIDs are, however, frequently contraindicated in patients with renal insufficiency, peptic ulceration or a history of previous upper

gastrointestinal haemorrhage or perforation. Selective cyclooxygenase (COX)-2 inhibitors such as etoricoxib have equal efficacy and better gastrointestinal tolerability than non-selective NSAIDs⁵¹ but there are ongoing uncertainties about their relative cardiovascular and renal toxicity with chronic administration⁵². Co-prescription of gastro-protection is recommended for patients treated with NSAIDs in accordance with NICE clinical guidelines⁵³.

For colchicine, Khanna et al found 2 placebo-controlled RCTs demonstrating statistical reduction in pain at 24 and 48 hours^{46,54}. Terkeltaub's study demonstrated that a low-dose colchicine regimen (1.2 mg followed by 0.6 mg after 1 hour) was equally effective, and was associated with much less nausea, vomiting and diarrhoea, than a high dose regimen of 4.8mg over 6 hours. A Cochrane review of the same two RCTs⁵⁵ also concluded that there was low quality evidence for the efficacy of low dose colchicine and for no additional efficacy with high doses which were significantly more likely to be associated with adverse effects (RR 3.00, 95% CI 1.98 to 4.54). In the absence of further trial evidence for the efficacy and safety of this proposed regimen, the BSR working group recommends treating acute gout with colchicine in doses of 500micrograms bd – qds when there are no contraindications to doing so. The maximum dosage of 500micrograms qds is, however, often limited by gastrointestinal side-effects, most frequently diarrhoea. Colchicine is contraindicated in patients with $eGFR < 10\text{mL}/\text{min}/1.73\text{m}^2$ and doses should be reduced in patients with $eGFR 10\text{-}50\text{ mL}/\text{min}/1.73\text{m}^2$ and in the elderly⁵⁶. Colchicine should also only be used with caution and at low doses in patients taking drugs which are potent inhibitors of cytochrome P450 3 A4 (eg cimetidine, clarithromycin, erythromycin, fluoxetine, ketoconazole, protease inhibitors, tolbutamide) or p-

glycoprotein (eg clarithromycin, ciclosporin, erythromycin)⁵⁷. Caution is also required when using colchicine in patients receiving statins, particularly in those with renal impairment, as there are case reports of myopathy and rhabdomyolysis following combined use of colchicine and statins⁵⁸⁻⁶⁰.

IV. Joint aspiration and injection of a corticosteroid are highly effective in acute monoarticular gout and may be the treatment of choice in patients with acute illness and co-morbidity. A short course of oral corticosteroid or a single injection of an IM corticosteroid are alternatives in patients who are unable to tolerate NSAIDs/colchicine and in whom intra-articular injection is not feasible. Such systemic therapy is also appropriate for oligo- or polyarticular attacks of gout.

LoE: Ib (oral),III (intraarticular, intramuscular), IV (oligo/polyarticular attacks)

SOE: 94% (range 83-100)

A Cochrane review in 2013⁶¹ found no RCTs of intra-articular steroid use for the management of acute gout. However, small observational studies, expert opinion and clinical experience suggest that intra-articular and intramuscular steroid injections can be very effective treatments for acute gouty arthritis⁶²⁻⁶⁴.

A Cochrane review of systemic corticosteroids⁶⁵ for acute gout included one randomised double-blind equivalence trial which showed that five-day courses of naproxen 500mg twice daily and prednisolone 35mg daily had equal efficacy⁶⁶.

V. In patients with acute gout where response to monotherapy is insufficient, combinations of treatment can be used.

LoE: IV

SOR: 80% (28-100)

This recommendation is supported only by expert opinion⁶⁷. A survey in 2006⁶⁸ found that the most commonly used combination agents are NSAIDs with either intra-articular corticosteroids, oral steroids, or colchicine.

VI. Interleukin-1 inhibitors may be considered in patients who have previously not responded adequately to standard treatment of acute gout (although not approved by NICE).

LoE: Ib (canakinumab, riloncept), III (anakinra)

SOR: 61% (range 8-100)

Anakinra, canakinumab and riloncept are three interleukin-1 (IL-1) inhibitors which have been investigated to some extent for the management of acute gout⁶⁹⁻⁷⁴.

In an RCT, the monoclonal anti-human IL-1 β antibody canakinumab (150 mg by subcutaneous injection) showed good efficacy in reducing pain and swelling when compared with 40mg intramuscular triamcinolone acetonide^{69,70}. Canakinumab is licenced for use in Europe by the EMA but not in the US by the FDA because of uncertainty about its risk/benefit ratio. There are currently no published RCTs for the use of anakinra, an IL-1 receptor antagonist, in patients with gout. However, an open label study using 100 mg sc on 3 consecutive days demonstrated pain relief in patients with gout who could not tolerate or had failed conventional treatment⁷² and a retrospective review of its use off-label in 26 patients suggested that it could be an effective and safe alternative treatment for acute gouty arthritis in medically

complex hospitalised patients who fail or cannot undergo more conventional therapy⁷³.

These findings and ongoing uncertainty concerning the efficacy and safety of IL-1 inhibitors are reflected in a recent Cochrane review⁷⁴. Neither anakinra, canakinumab nor riloncept are approved by NICE for use in the treatment of acute gout. Prescribers in the UK should be aware of the potential need to obtain approval for an individual funding request before these drugs should be used.

Modification of lifestyle and risk factors

VII. If diuretic drugs are being used to treat hypertension rather than heart failure, an alternative antihypertensive agent can be considered as long as blood pressure is controlled.

LoE: IV

SOR: 91% (range 85-100)

Thiazide and loop diuretics are used for a number of indications including the management of hypertension, heart failure and other causes of fluid overload.

Whilst diuretics have been found to be associated with an increased risk of gout with a rate ratio of 11.8 (95% CI 5.2-27.0)⁷⁵, blood pressure control may require a number of agents and often includes a diuretic⁷⁶. A systematic review published in 2012⁷⁷ attempted to assess the risk, but as the number of studies was few, it concluded that there was insufficient evidence to recommend the discontinuation of diuretics across all indications in patients with gout. A recent population-based case-control study using the General Practice Research Database demonstrated that while the

use of thiazide and loop diuretics were associated with the development of incident gout, the use of potassium-sparing diuretics was not⁷⁸.

VIII. All patients with gout should be given verbal and written information about:

the causes and consequences of gout and hyperuricaemia; how to manage acute attacks; lifestyle advice about diet, alcohol consumption and obesity; and the rationale, aims and use of urate-lowering therapy to target urate levels. Management should be individualised and take into account co-morbidities and concurrent medications. Illness perceptions and potential barriers to care should be discussed.

LoE: IIb

SOR: 96% (range 83-100)

There is growing evidence regarding the importance of education in gout. An observational, proof of concept, study³³ has demonstrated how education and individualised lifestyle advice along with urate-lowering therapy can achieve therapeutic targets. In this study of 106 participants, 92% achieved the therapeutic target, adherence at one year was excellent, and there were improvements in pain and other patient-centred outcomes.

Qualitative studies³⁰ suggest that an inadequate understanding of the causes and consequences of gout, belief that it is only a man's disease, and a stereotypical view of gout as being entirely self-inflicted through lifestyle abuse are important barriers to care. This may result in gout sufferers being hesitant in seeking medical advice and adhering to pharmacological treatments that are not well explained.

Other studies have shown that such negative views about gout and its treatment are

associated with lower adherence to ULT and sub-optimal control of disease^{32,79,80}. Patients who do not, or cannot, adhere to prescribed urate-lowering therapy are more likely to experience more gout attacks more frequently and in more joints. Such factors, as well as comorbid disease, have been found to be associated with poorer health-related quality of life (HRQOL)⁶. While patients are frequently interested in details of the influence of dietary constituents, they commonly also have important concerns relating to drug safety and drug interactions which are seldom adequately discussed³¹.

IX. In overweight patients, dietary modification to achieve a gradual reduction in body weight and subsequent maintenance should be encouraged. Diet and exercise should be discussed with all patients with gout, and a well-balanced diet low in fat and added sugars, and high in vegetables and fibre should be encouraged: sugar sweetened soft drinks containing fructose should be avoided; excessive intake of alcoholic drinks and high purine foods should be avoided; inclusion of skimmed milk and/or low fat yoghurt, soy beans and vegetable sources of protein and cherries, in the diet should be encouraged.

LoE: I (vitamin C and skimmed milk), III (others)

SOR: 92% (range 80-100)

A recent systematic review of predominantly observational studies⁸¹ identified a number of modifiable dietary factors which were associated with gout. Excessive consumption of meat, seafood, alcoholic drinks (especially beer and spirits), sugar-sweetened soft drinks and fructose-containing foods are all significant risk factors for incident gout. Episodic excessive alcohol consumption, regardless of type of alcohol

containing beverage, is also associated with an increased risk of recurrent gout attacks⁸². Low-fat dairy intake, folate intake, coffee consumption and diets high in dietary fibre appear to be associated with a reduced risk of incident gout as well as a reduction in risk of recurrent gout flares in some, but not all cases⁸³. Fruit consumption has been found beneficial and this may be related to consumption of vitamin C (see recommendation 19).

The urate-lowering effect of cherry was previously reported in healthy women⁸⁴. A case-crossover study conducted in 633 subjects with gout⁸⁵ found that consumption of cherry and cherry extract were associated with a statistically significant 35% lower risk of gout attacks when compared with no cherry intake. When cherry intake was combined with allopurinol use, the risk of gout attacks was 75% lower than during periods without either exposure (OR 0.25, 95% CI 0.15-0.42).

A Cochrane systematic review of the efficacy and safety of dietary supplements in patients with gout found only two RCTs, one for skimmed milk powder (SMP) enriched with glycomacropeptides (n=120) and the other for vitamin C (n=40)⁸⁶. Pain from self-reported flares was marginally less in those receiving enriched, compared with unenriched, SMP (mean difference -1.03, 95%CI -1.96 to -0.10), but enriched SMP was no better in reducing the mean number of acute attacks or the sUA. Vitamin C (500 mg/day for 8 weeks) reduced the sUA (-0.014 mmol/L) much less than allopurinol (-0.118 mmol/L) in patients with gout; and also less than the mean reduction of 0.02 mmol/L reported in the meta analysis of 13 RCTs of vitamin C administration in patients with hyperuricaemia who did not have gout⁸⁷. Vitamin C supplementation in this modest dose does not appear to have a clinically significant uricosuric effect in patients with gout⁸⁷. It is certainly insufficient

for use as monotherapy and a trial suggested that its efficacy as a urate lowering agent, even when used as an adjunct to standard ULT with allopurinol, was minimal.⁸⁸

- X. Patients with gout and a history of urolithiasis should be encouraged to drink >2litres of water daily and avoid dehydration. Alkalinisation of the urine with potassium citrate (60mEq/day) should be considered in recurrent stone formers**

LoE: IV

SOR: 57% (range 17-100)

While there are no published trials of prevention of urolithiasis in patients with gout and recurrent stone formation, there have been two recent systematic reviews and meta-analyses of RCTs of medical management of recurrent urolithiasis in all adults^{89,90}. There is moderate strength evidence from relatively poor quality RCTs for risk reduction with increased fluid intake (RR 0.45, 95% CI 0.24-0.84) and further reduction of risk with additional therapy with citrates (RR 0.25, 95% CI 0.14-0.44).

- XI. Cardiovascular risk factors and co-morbid conditions such as cigarette smoking, hypertension, diabetes mellitus, dyslipidaemia, obesity and renal disease should be screened for in all patients with gout, reviewed at least annually and managed appropriately**

LoE: III

SOR: 90% (range 77-100)

Co-morbidities associated with gout are well recognised^{81,91,92}. The need to manage these co-morbidities is also recognised but at present no prescriptive guidance exists. An RCT found that allopurinol slows the progression of renal disease in patients with chronic kidney disease and hyperuricaemia⁹³. The importance of screening for comorbidities is highlighted by a recent population-based study which has demonstrated gout to be an independent risk factor for mortality from coronary heart disease and renal disease⁹⁴.

Optimal use of urate-lowering therapies

XII. The option of ULT should be explained to patients when the diagnosis is confirmed and they are being given information about gout. Patients should be fully involved in the decision as to when to commence ULT. The importance of taking ULT regularly and continually to prevent the return of gout attacks should be explained. Patients should be supported during the process of lowering their serum uric acid levels as it can cause an increase in gout flares during this time.

LoE: Ib

SOR: 94% (range 82-100)

Reasons for full patient involvement have been discussed earlier in this guideline and are supported by preliminary evidence from a proof of concept study³³. Poor patient understanding of the need for ULT is not confined to the UK and has been documented in a large population-based observational study in the US⁸⁰, in a survey conducted in South China⁹⁵ and in a focus group qualitative study in New Zealand Maoris⁹⁶.

XIII. Urate lowering therapy should be discussed and offered to all patients who have a diagnosis of gout. ULT should particularly be advised in patients with: recurring attacks (≥ 2 attacks in 12 months); tophi; chronic gouty arthritis; joint damage; renal impairment (eGFR <60 ml/min); a history of urolithiasis; diuretic therapy use; primary gout starting at a young age.

LoE: Ia (attacks, tophi, chronic gouty arthritis, joint damage, renal impairment), III (urolithiasis), IV (diuretics, young age)

SOR: 95% (range 82-100)

Research evidence supporting the treatment of gout with ULT has increased considerably in the last decade. Treatment of patients with recurring attacks, tophi and chronic gouty arthritis is supported by three systematic reviews and meta-analyses⁹⁷⁻⁹⁹. However, the recommendation to consider treatment with ULT in *all patients with gout* is only based on expert opinion and increasing imaging evidence that gout is a chronic crystal deposition disease even at the time of the first attack¹⁰⁰. For patients known to have other pre-existing risk factors or co-morbidities when presenting with the first episode of gout, such consideration is particularly pertinent. The length of time between the first and subsequent episode of gout can vary considerably between individuals, but typically is less than 2 years. Over time, the inter-critical periods shorten and as good practice in patient education, it is worth having the discussion about treatment early in the course of the disease, always bearing in mind that this potentially 'curable' condition can have a significant impact on patient quality of life if left untreated^{5,6}. It is not recommended that asymptomatic hyperuricaemia is treated. However, the wisdom of the

recommendation that commencement of ULT should at least be considered after the first attack of gout is supported by observational data from the UK Clinical Practice Datalink which showed that less than half the patients with gout eligible for ULT were offered treatment²³.

Earlier recommendations to offer treatment with ULT only to gout patients with recurring acute attacks were supported by a health economic study in a Canadian healthcare setting which showed that only 62% of patients with gout had a second attack within one year and that treatment with ULT only became cost-effective (cost saving) in patients suffering more than 3 attacks per year¹⁰¹. This study, however, does not take into account the ongoing 'silent' deposition of crystals and the significant pain experienced by patients with each attack. Clinical experience and epidemiological studies^{102,103} also show that the risk of gout attacks rises sharply when the serum urate is very high (>500 µmol/L). However, the decision as to when to start ULT in any individual will also be influenced by the patient's co-morbidities, any potential contraindications, intolerance or drug interactions, as well as by consideration of the overall balance of risks and benefits and the patient's wishes.

A large population-based study has demonstrated that gout is an independent risk factor for mortality and specifically for death due to coronary heart disease and renal disease⁹⁴. Gout is a risk factor for the development of end-stage renal failure¹⁰⁴ and hyperuricaemia is an independent risk factor for renal impairment¹⁰⁵. There is now evidence from RCTs that allopurinol slows progression in hyperuricaemic patients with CKD^{93,106} and a recently published systematic review supports the concept that treating gout with ULT improves renal function⁵⁵.

Treatment of patients with gout and urolithiasis with ULT is supported by observational studies¹⁰⁷, while the recommendation to consider ULT in patients taking diuretic drugs is supported by 3 cohort studies and 4 case-control studies which demonstrated higher risks of gouty arthritis in users compared with nonusers of diuretics⁷⁷.

The recommendation to treat patients with primary gout at an early age with ULT is largely based on expert opinion. A number of rare monogenic disorders associated with inborn errors of purine metabolism^{108,109}, glycogen storage diseases¹¹⁰ or uromodulin mutations associated with decreased fractional urate excretion¹¹¹ can result in the development of gout at an early age. A retrospective study of patients seen by rheumatologists in Taiwan suggested that the age at which gout presents was falling¹¹² and heritability accounts for 35% of gout risk in men and 17% in women in Taiwan¹. Common dysfunctional variants in the ABC G2 urate transporter may be important causes of early onset gout in Japanese males¹¹³ and in Han Chinese¹¹⁴ but evidence from twin studies in the US suggest that while genetic factors have an important influence on serum urate levels and hyperuricaemia, lifestyle and environmental factors are more important risk factors for primary gout, outside the context of the rare single gene disorders¹¹⁵.

XIV. Commencement of ULT is best delayed until inflammation has settled as ULT is better discussed when the patient is not in pain.

LoE: IV

SOR: 94% (range 87-100)

Although a small RCT has shown that commencement of allopurinol during an acute attack was not associated with a significant increase in daily pain, recurrent flares or inflammatory markers¹¹⁶ the working group thought that postponing detailed discussion of long term ULT until a time when the patient was no longer in pain would allow the information to be better absorbed. However, in patients in whom attacks are so frequent to make this difficult, the findings of this trial support initiation of ULT before inflammation has resolved.

XV. The initial aim of ULT is to reduce and maintain the sUA at or below a target level of 300 µmol/L to prevent further urate crystal formation and to dissolve away existing crystals. The lower the sUA the greater the velocity of crystal elimination. After some years of successful treatment, when tophi have resolved and the patient remains free of symptoms, the dose of ULT can be adjusted to maintain the sUA at or below a less stringent target of 360µmol/l to avoid further crystal deposition and the possibility of adverse effects that may be associated with a very low sUA.

LoE: III (sUA target<300 µmol/L), IV (subsequent dose adjustment to sUA<360 µmol/L)

SOR: 97% (range 90-100)

The target sUA of <300µmol/l recommended in the previous BSR/BHPR guideline² remains the recommended target to prevent crystal formation and recurrent flares¹¹⁷. Evidence that greater velocity of crystal elimination is associated with a lower sUA is derived from observational data^{118,119}. The recommendation for ULT dose reduction to the less stringent target of sUA below 360 µmol/L once the patient

is stable to avoid further crystal deposition and the possibility of adverse effects that may be associated with a very low sUA is based on expert opinion, a reasoned proposal for such a two stage approach¹¹⁹ and caution in the light of studies which have shown a possible association between low sUA levels and progression of neurodegenerative disorders such as Parkinson's disease¹²⁰, dementia¹²¹, Huntingdon's disease¹²² and amyotrophic lateral sclerosis¹²³. One study showed an increased risk of incident Parkinson's disease in men with sUA <300µmol/L compared with those with sUA 300-500µmol/L¹²⁴.

XVI. Allopurinol is the recommended first-line ULT to consider. It should be started at a low dose (50-100mg daily) and the dose then increased in 100mg increments approximately every 4 weeks until the sUA target has been achieved (maximum dose 900mg). In patients with renal impairment smaller increments (50mg) should be used and the maximum dose will be lower, but target urate levels should be the same.

LoE: Ib (dose escalation),III (dose adjustment for renal function)

SOR: 97% (range 88-100)

Research evidence for the efficacy and safety of allopurinol has been studied in a recent systematic review¹²⁵. Eleven trials involving a total of 4531 patients compared allopurinol in various doses with placebo (two trials); febuxostat (four trials); benzbromarone (two trials); colchicine (one trial); probenecid (one trial); continuous versus intermittent allopurinol (one trial) and different doses of allopurinol (one trial). In double blind RCTs, allopurinol given in a fixed dose of 300mg daily was more effective than placebo¹²⁶ but less effective than febuxostat 80 mg or 120 mg

daily^{126,127}. However, these trials, and observational studies of gout being treated in UK General Practice,³³ have shown that many patients do not achieve reductions of sUA to target levels recommended by the BSR (300 µmol/L)² or EULAR (360 µmol/L)³ when treated with allopurinol in doses of 300mg or less daily. Recent data from the Nottingham proof of concept study³³ and from the FAST trial¹²⁸ have confirmed that gradual up-titration of allopurinol is effective in lowering sUA to target levels and generally well tolerated. The median dose of allopurinol found to be required to achieve the less stringent therapeutic sUA target of ≤ 360 µmol/L in >90% of the Nottingham patients was 400mg/day. While we await direct comparison between allopurinol and febuxostat (and other ULTs) using recommended, best practice, up-titration regimens rather than fixed doses, allopurinol should remain the first option. The recommendation that allopurinol should be the first-line ULT to consider is further supported by health economic studies^{129,130}.

Although well tolerated by the majority of patients, allopurinol is rarely (~0.1-0.4%) associated with severe, potentially life-threatening, cutaneous adverse reactions (SCAR) including toxic epidermal necrolysis (TEN), hypersensitivity drug reactions with rash, eosinophilia and systemic symptoms (DRESS) or Stevens-Johnson syndrome with vasculitis, liver and renal toxicity¹³¹. Allopurinol should not be used in people carrying the variant allele HLA-B*5801¹³² as the risk of SCAR during treatment with allopurinol is greatly increased (OR 73)¹³³. Screening patients of Korean, Han Chinese and Thai descent for HLA-B*5801 before considering ULT with allopurinol has been recommended³⁵ because of the high frequency (6 – 12%) of this allele in these ethnic groups compared with < 2% in Caucasian populations.

Based on reports of a relationship between the use of full dose allopurinol and the development of allopurinol hypersensitivity in patients with renal impairment previous recommendations were to dose allopurinol according to creatinine clearance (CrCl)¹³⁴. Unfortunately subsequent observational studies showed that dose-adjustment according to CrCl seldom resulted in adequate reduction of sUA in patients with gout and renal insufficiency¹³⁵, and a case-controlled study showed no evidence of a reduction in frequency of allopurinol hypersensitivity in patients dosed according to CrCl¹³⁶. More recently, studies by Stamp *et al* have suggested that lowering the starting dose of allopurinol appropriate to the level of renal function (Table 2) reduces the risk of allopurinol hypersensitivity¹³⁷, and that subsequent gradual increase in the dose above the dose based on CrCl resulted in reduction of sUA to target levels in most patients without any increase in toxicity¹³⁸.

XVII. Febuxostat can be used as an alternative second line XO inhibitor for patients in whom allopurinol is not tolerated or whose renal impairment prevents allopurinol dose escalation sufficient to achieve the therapeutic target. Start with a dose of 80mg daily and, if necessary, increase after 4 weeks to 120mg daily, to achieve therapeutic target.

LoE: Ia

SOR: 90% (range 63-100)

Systematic reviews and meta-analyses^{97,99} of randomised controlled trials^{126,127,139}, amongst other RCTs, have demonstrated the efficacy of febuxostat in reducing sUA levels, and reducing the risk of gout flares. When compared to a fixed dose of 300mg

of allopurinol, febuxostat (80mg and 120 mg/day) was more effective in reducing the sUA to <360mmol/L (RR 1.56; 95% CI 1.22-2.00)) but not the risk of gout flares (RR 1.16 95% CI 1.03-1.30)⁹⁷. There was heterogeneity in the dosages of febuxostat and allopurinol used, the length of time patients had had gout, the length of follow up, and whether prophylaxis was used.

Febuxostat is generally well-tolerated and can be used in doses of 80mg or 120mg daily in elderly patients¹⁴⁰ and others with mild – moderate renal impairment (GFR > 30 ml/ min/ 1.73m²). There are currently insufficient data available on its use in patients with more severe CKD. Severe cutaneous hypersensitivity reactions to febuxostat^{141,144} are very unusual but the risk of SCAR or DRESS with febuxostat in patients with previous allopurinol hypersensitivity has still to be established. Treatment with febuxostat in patients with ischaemic heart disease or congestive cardiac failure is currently not recommended^{143,144} but large scale RCTs are currently in progress in Europe¹²⁸ and North America¹⁴⁵ to establish and compare the cardiovascular safety of febuxostat and allopurinol in patients with gout, high cardiovascular risk and co-morbidities.

Health economic studies have shown that febuxostat is cost-effective as a second-line ULT^{129,130}. In the UK, NICE have recommended the use of febuxostat only when allopurinol is contraindicated or not tolerated¹⁴⁴ while the Scottish Medicines Consortium (SMC) accepts febuxostat as a suitable second-line ULT when treatment with allopurinol is inadequate, not tolerated, or contraindicated¹⁴⁶.

XVIII. Uricosuric agents can be used in patients who are resistant to, or intolerant of, xanthine-oxidase inhibitors. The preferred drugs are sulfinpyrazone (200-800

mg/day) or probenecid (500-2000mg/day) in patients with normal or mildly impaired renal function, or benzbromarone (50-200mg/day) in patients with mild-moderate renal insufficiency.

LoE: Ia

SOR: 92% (range 82-100)

Uricosuric drugs were the first agents to be used for ULT more than 60 years ago¹⁴⁷. Their efficacy and safety for ULT is supported by a recent systematic review and meta-analysis¹⁴⁸ of two RCTs comparing benzbromarone with allopurinol, two RCTs comparing benzbromarone with probenecid and one non-randomised case-controlled trial (CCT) comparing probenecid with allopurinol; and a cohort study examining probenecid¹⁴⁹, but there have been no placebo-controlled RCTs of the three drugs which are currently approved for use as ULT in patients with gout in Europe (sulfipyrazone 200-800mg od, probenecid 250-500mg qds, benzbromarone 50-200mg od). In an RCT of patients who did not tolerate allopurinol 300mg/day well or achieve target sUA, benzbromarone 200mg/day was found to be more effective and better tolerated than probenecid 2g/day¹⁵⁰, and benzbromarone 200mg daily was approximately equipotent with allopurinol 600mg/day in lowering sUA to target in another RCT¹⁵¹. All uricosurics are contraindicated or need to be used with great caution in patients with urolithiasis or severe renal impairment. Clinical experience indicates that sulfipyrazone and probenecid have limited efficacy in patients with mild or moderate renal insufficiency (GFR < 60 ml/min) but benzbromarone has been shown to maintain uricosuric efficacy when the GFR is as low as 20ml/min¹⁵². Probenecid and benzbromarone are only available for the treatment of patients with gout in the UK on a named patient basis, and patients

requiring these unlicensed drugs should be under the care of a rheumatologist. The use of benzbromarone was restricted in Europe following rare reports of severe hepatotoxicity, mainly from Asian countries. Patients treated with benzbromarone should have liver function tests monitored but the risk of serious hepatotoxicity in patients receiving the benzbromarone in Europe is estimated as approximately 1 in 17,000¹⁵³.

XIX. Losartan and fenofibrate should not be used as a primary ULT but where treatment for hypertension or dyslipidaemia, respectively, are required, they may be considered as they have a weak uricosuric effect. Vitamin C supplements (500mg – 1500mg daily) also have a weak uricosuric effect.

LoE: III

SOR: 89% (range 63-100)

Unlike ACE inhibitors, beta blockers and other angiotensin II receptor blockers used for treating hypertension, losartan 50 mg od has been shown to have mild uricosuric effects in patients with gout¹⁵⁴; and the use of losartan was associated with a significantly reduced risk of incident gout (RR 0.81, 95% confidence interval 0.70 to 0.94) in a large community-based UK case-control study using data from The Health Improvement Network (THIN)¹⁵⁵.

The lipid-lowering agent fenofibrate has been shown to be uricosuric¹⁵⁶ and to have a modest additional urate-lowering effect in gout patients being treated with allopurinol^{157,158}. Losartan (50mg od) and fenofibrate (300mg od) were both found to have some additional urate-lowering efficacy when administered to gout patients receiving ULT with allopurinol or benzbromarone in one small study¹⁵⁹.

A meta-analysis of 13 RCTs found that sUA can be lowered by vitamin C supplementation in patients without gout and that sUA reductions were greater in trials administering vitamin C >500mg/day⁸⁷. A single RCT in patients with gout showed that vitamin C (500 mg/day for 8 weeks) reduced the sUA (-0.014 mmol/L) much less than allopurinol (-0.118 mmol/L)⁸⁸. Vitamin C supplements in this modest dose only have a very weak uricosuric effect in people with gout which is insufficient for it to be used as substitute monotherapy for allopurinol or other licenced ULT. Moreover, the study of Stamp suggests that in this dosage it is also unlikely to be a clinically useful adjunct to standard ULT with allopurinol⁸⁸. No studies have been undertaken to assess whether vitamin C supplementation is effective in reducing the incidence of recurrent gout attacks.

XX. A uricosuric agent can be used in combination with a xanthine oxidase inhibitor in patients who do not achieve a therapeutic serum urate target with optimal doses of monotherapy.

LoE: III

SOR: 88% (range 71-100)

Enhancement of uric acid excretion and reduction of sUA in patients with tophaceous gout by combined treatment with sulfinpyrazone and allopurinol was first demonstrated nearly 50 years ago¹⁶⁰. Observational studies by Perez-Ruiz and colleagues have shown that the velocity of tophus volume reduction in patients with chronic tophaceous gout could be accelerated with more profound reduction of sUA by combined treatment with allopurinol and benzbromarone¹¹⁸. They subsequently demonstrated that even gout patients that are primary overproducers of urate, with

apparently increased urine uric acid excretion, also have evidence of defective fractional urate clearance¹⁶¹ and may therefore respond to addition of a uricosuric drug if their sUA is not reduced to target levels with a xanthine oxidase inhibitor alone. More recent observational studies have also shown that combined treatment with allopurinol and benzbromarone was more effective in lowering sUA than either agent alone¹⁶². A recent single case report has demonstrated effective lowering of sUA in a patient with gout and chronic renal failure with addition of a combination of allopurinol and febuxostat to benzbromarone when combination of a single xanthine oxidase inhibitor with benzbromarone was ineffective¹⁶³. Most recently phase III trials of a new selective uric acid reabsorption inhibitor, lesinurad, have shown it to be effective in doses of 200mg od and 400mg od in lowering the sUA to target levels in combination with allopurinol in patients with gout that have not responded adequately to allopurinol ≥ 300 mg daily (≥ 200 mg in moderate renal impairment)¹⁶⁴. Its use for this indication has recently been given FDA and EMA approval and marketing authorisation.

XXI. Colchicine 500micrograms bd or od should be considered as prophylaxis against acute attacks resulting from initiation or up-titration of any ULT and continued for up to 6 months. In patients who cannot tolerate colchicine, a low-dose NSAID or Coxib, with gastroprotection, can be used as an alternative providing there are no contraindications.

LoE: Ib

SOR: 86% (range 29-100)

Prophylaxis against acute flares in patients initiating ULT has been the subject of two recent systematic reviews^{125,165}. There is more evidence from RCTs to support the use of colchicine, than for NSAIDs, for flare prophylaxis. In a 6-month placebo-controlled RCT in patients with gout receiving probenecid for ULT, the flare rate was reduced from 6 to 2.3 flares per annum in patients receiving colchicine 500micrograms daily¹⁶⁶. In another 6-month placebo-controlled RCT in patients initiating allopurinol at a dose of 100mg od followed by up-titration in 100mg increments, flares occurred in 33% of patients given colchicine 500micrograms bd for flare prophylaxis compared with 77% of those treated with placebo¹⁶⁷. An investigator-initiated re-analysis of gout flare data from the three Phase III trials of febuxostat found that flare prophylaxis for up to 6 months with colchicine 600micrograms od or naproxen 250mg bd, during the initiation of ULT with febuxostat or allopurinol, appeared to provide greater benefit than flare prophylaxis for 8 weeks, with no increase in adverse events¹⁶⁸. There is little other research evidence to help determine the optimal duration of prophylaxis. A systematic review¹²⁵ identified a single RCT comparing three treatment groups given colchicine 1000micrograms daily for 3-6 months, 7-9 months and 10-12 months¹⁶⁹. By 12 months, recurrent acute gout was reported by 54%, 28% and 23% respectively. Adverse events did not differ between the three groups. However, the risk of bias was high.

Long-term prophylaxis with colchicine or NSAIDs in patients with gout always demands a careful consideration of the overall benefit to risk balance in individual patients, and especially in those with co-morbidities and potential for drug interactions. When using Cox-2 selective or non-selective NSAIDs the risks of upper

GI bleeds and cardiovascular risk should be considered, and gastro-protection with a proton pump inhibitor is recommended. Although usually well-tolerated, possible side-effects of long-term colchicine include diarrhoea, nausea/vomiting, marrow suppression, myopathy, and rhabdomyolysis.

The use of flare prophylaxis is particularly important when ULT is initiated with febuxostat, as the lowest available starting dose in the UK (80 mg) lowers the serum acid level to a greater degree than the starting dose of allopurinol (100 mg), and the risk of precipitating a gout flare is consequently greater⁹⁷.

There is no research evidence to support the use of corticosteroids for flare prophylaxis.

IL-1 inhibitors have also been investigated for use for flare prophylaxis¹⁶⁹⁻¹⁷² but none are currently approved for this indication by the EMA or FDA and it is likely that the costs of these biologics will preclude their use for this indication in patients with gout in the UK NHS. In a phase 2 trial of various doses of canakinumab and colchicine 500micrograms od in over 400 patients initiating treatment with allopurinol, the mean number of flares per patient after 4 months was less in the canakinumab treated patients at all doses > 50mg but there was no evidence of a dose response and there were more infections in the canakinumab treated patients (18%) than in those given colchicine prophylaxis (12%)¹⁶⁹.

Management points in special groups

Patients with renal insufficiency

Chronic kidney disease (CKD) and nephrolithiasis are very common in patients with gout. A recent systematic review and meta-analysis of epidemiological and

observational studies suggested that the overall prevalence of CKD (\geq stage 3; $\text{GFR} < 60 \text{ ml/min/1.73m}^2$) in patients with gout was 24% compared with 8.5% in the non-gouty population, and the prevalence of self-reported nephrolithiasis was 14%¹⁷⁴. This presents physicians with important challenges in managing patients with gout, and management of gout in patients with renal impairment has been the subject of two recent systematic reviews and a guideline from the US National Kidney Foundation^{175,176}.

For the management of acute gout, the dose of oral colchicine should be reduced in patients with $\text{eGFR} 10\text{-}50 \text{ ml/min/1.73m}^2$ but is contraindicated in patients with more severe renal impairment ($\text{GFR} < 10 \text{ ml/min/1.73m}^2$). High dose NSAIDs should not be used even in patients with moderate renal impairment^{177,178}. Although the efficacy of corticosteroids in those with CKD has not been evaluated in RCTs¹⁷⁵, clinical experience suggests that they can be effective and safe for managing acute gout in patients with severe renal impairment or in other patients in whom colchicine and NSAIDs cannot be used. Intra-articular triamcinolone hexacetonide (40mg for large joint, 10-20mg for smaller joints) is often recommended if only one or two joints are inflamed, or a 7 – 14 day course of oral prednisolone (30 - 40mg tapering to nothing), if multiple joints are involved or if arthrocentesis is not possible.

Guidelines for the use of allopurinol, febuxostat and uricosuric drugs in patients with renal impairment have been discussed following recommendations 16, 17 and 18.

Flare prophylaxis with colchicine or NSAIDs in patients with gout and renal insufficiency initiating ULT needs to be undertaken with great caution as the risks of colchicine toxicity, especially myopathy, are increased in patients with renal

impairment¹⁷⁹ and NSAIDs can cause acute kidney injury and further impair renal function in patients with CKD¹⁸⁰. Prophylaxis with low-dosage colchicine, adjusted for renal function, is believed to be a safer option than low-dose NSAIDs^{175,176}. Based on pharmacokinetic data in patients with CKD¹⁸¹ it is suggested that there is no need for reduction in colchicine dosage (500micrograms od or bd) for flare prophylaxis in patients with mild renal insufficiency (eGFR >60ml/min/1.73m²) but the dose should be limited to 500micrograms od in those with a eGFR of 30-60ml/min/1.73m² and to 500micrograms every 2-3 days with eGFR10-30ml/min/1.73m²,¹⁸² and avoided altogether if eGFR<10 ml/min/1.73m². Although it is usually recommended that NSAIDs should be avoided in all patients with renal impairment, a recent systematic review and meta-analysis of observational studies found no evidence of accelerated CKD progression in patients with moderate to severe renal impairment treated with low dose NSAIDs (OR: 0.96; 95% CI 0.86-1.07)¹⁷⁷.

Severe refractory tophaceous gout

Patients with severe symptomatic tophaceous gout in whom hyperuricaemia cannot be controlled with standard ULTs alone, or in combination, should be referred to a rheumatologist. Pegloticase, a polyethylene glycol modified mammalian uricase can be effective in such patients^{183,184}, although not approved by NICE. The drug is administered by IV infusion (8mg in 250ml normal saline over 2 hours) every 2 weeks by physicians with experience and facilities for dealing with infusion reactions and patients should be pre-treated with antihistamines and steroids to reduce the risk of infusion reactions, in addition to low dose colchicine or NSAIDs for flare prophylaxis. Despite heavy pegylation, pegloticase is immunogenic. SUA should be measured

before each infusion, and treatment discontinued if the sUA is $>360\mu\text{mol/L}$ as transient responders (about 50%) appear to be at increased risk for infusion reactions and anaphylaxis. Pegloticase is contraindicated in patients with G6PD deficiency because of the risk of haemolysis and extra caution is required in patients with congestive heart failure. Pegloticase has FDA approval and EMA marketing authorisation in Europe but has not been approved by NICE or the SMC because of concerns about toxicity and cost. Rasburicase, a recombinant *Aspergillus flavus* uricase which is licenced for the treatment and prophylaxis of tumour lysis syndrome, but not for gout, has also been used successfully in some patients with severe refractory gout¹⁸⁵ despite its greater potential immunogenicity. Prescribers in the UK should be aware of the potential need to obtain approval for an individual funding request before these drugs should be used.

In pregnancy

Apart from patients with familial juvenile hyperuricaemic nephropathy¹⁸⁶, gout is very uncommon in pre-menopausal women and in pregnancy¹⁸⁷ and so data are sparse. Conservative measures including ice are safe for managing acute attacks. NSAIDs can be used in the mid-trimester¹⁸⁸. Steroids are generally safe to use in pregnancy¹⁸⁹ and the recommendations for lifestyle modifications including the dietary changes discussed previously are also safe.

The safety data for colchicine during pregnancy are largely derived from studies of its use in Familial Mediterranean Fever¹⁹⁰ although there are also some reports of chromosomal damage. High concentrations of colchicine can be found in breast milk and so colchicine is best avoided when breast feeding.

Allopurinol and febuxostat have not been adequately tested during pregnancy. Probenecid was used extensively in the past during antibiotic treatment of infections in pregnant women without any reported foetal toxicity.

Applicability and utility

Statement of potential organisational barriers to introduction

Despite the increasing prevalence of gout and the availability of effective and potentially 'curative' ULT for more than 50 years, its management remains poor with only 40% of patients with gout ever receiving ULT.¹ Inadequate provision of information to patients²⁹ has been identified as one of the key barriers³⁰⁻³² to effective management of gout. There is preliminary evidence that patient adherence to ULT and lowering of sUA to target levels can be achieved with better provision of information and a package of care based on guideline recommendations³³. Effective provision of information and monitoring of treatment to achieve target sUA levels requires regular ongoing clinical review. However, anecdotal reports suggest that some secondary care organisations prohibit follow-up of patients with gout, insisting on discharge with a treatment plan to primary care where treatment is known to be sub-optimal. Furthermore, although approximately 20% of people presenting with their first attack will have a second episode within 12 months,¹⁹¹ patients often do not consult for subsequent attacks so practitioners may not be aware of recurrent attack frequency and the need for ULT, highlighting the case for discussing ULT early in the course of disease.

Potential cost-implications for implementation of the guideline

Although there are few cost-effectiveness studies in gout, the guideline takes these into account. The guideline recommends allopurinol as the first-line ULT which is inexpensive and likely to be tolerated and effective in the vast majority of patients with gout. The cost-effectiveness of febuxostat as a second-line ULT has been established and our guidance for its use concords with its NICE and SMC approval.^{129,130,144,146} The guideline does include recommendations for unlicensed or non-NICE approved use of pegloticase and IL-1 inhibitors although the need to use these drugs is likely to be rare and individual clinicians are advised to consider local arrangements for funding individual funding requests if using these drugs.

Summary of changes in the revised recommendations

This guideline contains several important changes from the 2007 BSR/BHPR guideline². The importance of patient education and provision of information about gout and its treatment are strongly emphasised in the updated guideline (recommendations 1,8,9,12,13,14). It is now recommended that an NSAID or colchicine are both drugs of choice for acute gout when there are no contraindications and that the choice of first line agent should be determined by renal function, co-morbidities and patient preference (recommendation 3). Combinations of NSAIDs with corticosteroids or colchicine can be used for acute attacks where response to monotherapy is insufficient (recommendation 5), and interleukin-1 inhibitors may be considered in patients who have not responded adequately to standard treatment (recommendation 6).

The revised guideline emphasises that all patients with gout should be screened for cardiovascular risk factors and co-morbid conditions such as cigarette smoking,

hypertension, diabetes mellitus, dyslipidaemia, obesity, and renal disease at least annually and treated appropriately (recommendation 11). It is now recommended that the option of ULT should be explained and offered to all patients with gout as part of their education about the condition and that patients are fully involved in the decision as to when to commence ULT (recommendations 12 and 13). Although the revised guideline still recommends reduction of sUA with ULT to a target of 300µmol/L, ULT dose adjustment to the less stringent sUA target of 360µmol/L is now recommended after some years of successful ULT when tophi have resolved and the patient remains symptom free (recommendation 15). It is now recommended that in patients with renal impairment the maintenance dose of allopurinol need not be strictly limited according to the creatinine clearance. The starting dose should, however, be low and then carefully increased with smaller increments (50mg) until the target sUA of 300µmol/L is reached (recommendation 16). Febuxostat can be used as an alternative second-line XO inhibitor for patients in whom allopurinol is not tolerated or whose renal impairment prevents allopurinol dose escalation sufficient to achieve the therapeutic target (recommendation 17). For patients with severe symptomatic tophaceous gout in whom hyperuricaemia cannot be controlled with standard ULTs alone, or in combination, treatment with pegloticase can be considered by physicians with experience and facilities for dealing with infusion reactions.

Questions for audit and recommendations for future clinical research can be found in appendices 2 and 3. An audit tool is available on the website of the British Society for Rheumatology.

Conflicts of interest

G.D. has received honoraria for *ad hoc* advisory board meetings relating to gout from AstraZeneca. M.D. has received honoraria for *ad hoc* advisory boards relating to osteoarthritis and gout from Ardea Biosciences, AstraZeneca, Nordic Biosciences and Roche; AstraZeneca are funding a Nottingham University investigator-led non-drug study on gout. T.M. leads a university-sponsored clinical trial (Febuxostat v. Allopurinol Streamlined safety Trial (FAST)) funded by Menarini. G.N. has undertaken paid consultancy for Savient, is a member of the Independent Disease Monitoring Committee for trials of lesinurad (Ardea/AstraZeneca), and has received honoraria for advisory boards from Menarini and research funding from Menarini for the FAST trial. W.Z. has received honoraria or speaker fees from Daiichi Sankyo, AstraZeneca, Biobarica and Hisun. All other authors have declared no conflicts of interest.

Funding statement

No specific funding was received from any bodies in the public, commercial or not-for-profit sectors to carry out the work described in this manuscript.

Reference List

- (1) Kuo CF, Grainge MJ, Mallen C, Zhang W, Doherty M. Rising burden of gout in the UK but continuing suboptimal management: a nationwide population study. *Ann Rheum Dis* 2015;74:661-667.
- (2) Jordan KM, Cameron JS, Snaith M et al. British Society for Rheumatology and British Health Professionals in Rheumatology guideline for the management of gout. *Rheumatology (Oxford)* 2007;46:1372-1374.
- (3) Zhang W, Doherty M, Bardin T et al. EULAR evidence based recommendations for gout. Part II: Management. Report of a task force of the EULAR Standing Committee for International Clinical Studies Including Therapeutics (ESCISIT). *Ann Rheum Dis* 2006; 65:1312-1324.
- (4) Roddy E, Zhang W, Doherty M. Is gout associated with reduced quality of life? A case-control study. *Rheumatology (Oxford)* 2007;46:1441-1444.
- (5) Lee SJ, Hirsch JD, Terkeltaub R et al. Perceptions of disease and health-related quality of life among patients with gout. *Rheumatology (Oxford)* 2009;48:582-586.
- (6) Chandratre P, Roddy E, Clarson L et al. Health-related quality of life in gout: a systematic review. *Rheumatology (Oxford)* 2013;52:2031-2040.
- (7) Aati O, Taylor WJ, Horne A, Dalbeth N. Toward development of a Tophus Impact Questionnaire: a qualitative study exploring the experience of people with tophaceous gout. *J Clin Rheumatol* 2014; 20:251-255.
- (8) Khanna P, Nuki G, Bardin T et al. Tophi and frequent gout flares are associated with impairments to quality of life, productivity, and increased healthcare

resource use: Results from a cross-sectional survey. *Health Qual Life Outcomes* 2012;10:117.

- (9) Chen CJ, Yen JH, Chang SJ. Gout patients have an increased risk of developing most cancers, especially urological cancers. *Scand J Rheumatol* 2014;43:385-390.
- (10) Choi HK, Mount DB, Reginato AM. Pathogenesis of gout. *Ann Intern Med* 2005;143:499-516.
- (11) Zhang Y, Chaisson CE, McAlindon T et al. The online case-crossover study is a novel approach to study triggers for recurrent disease flares. *J Clin Epidemiol* 2007;60:50-55.
- (12) Zhang Y, Woods RF, Chaisson CE et al. Alcohol consumption as a trigger of recurrent gout attacks. *Am J Med* 2006;119:800.e13-8.
- (13) Hunter DJ, York MF, Chaisson CE et al. Recent diuretic use and the risk of recurrent gout attacks: the online case-crossover gout study. *J Rheumatol* 2006;33:1341-1345.
- (14) Kolz M, Johnson T, Sanna S et al. Meta-analysis of 28,141 individuals identifies common variants within five new loci that influence uric acid concentrations. *PLoS Genet* 2009;5:e1000504.
- (15) Choi HK, Atkinson KF, Karlson EW, Willett W, Curhan G. Purine-rich foods, dairy and protein intake, and the risk of gout in men. *N Engl J Med* 2004;350:1093-1103.
- (16) Choi HK, Atkinson K, Karlson EW, Willett W, Curhan G. Alcohol intake and risk of incident gout in men: a prospective study. *Lancet* 2004;363:1277-1281.

- (17) Choi HK, Curhan G. Soft drinks, fructose consumption, and the risk of gout in men: prospective cohort study. *BMJ* 2008;336:309-312.
- (18) Harris MD, Siegel LB, Alloway JA. Gout and hyperuricemia. *Am Fam Physician*. 1999;59:925-34.
- (19) Glazebrook KN, Guimaraes LS, Murthy NS et al. Identification of intraarticular and periarticular uric acid crystals with dual-energy CT: initial evaluation. *Radiology* 2011;261:516-524.
- (20) Chowalloor PV, Keen HI. A systematic review of ultrasonography in gout and asymptomatic hyperuricaemia. *Ann Rheum Dis* 2013;72:638-645.
- (21) Janssens HJEM, Fransen J, van de Lisdonk EH et al. A diagnostic rule for acute gouty arthritis in primary care without joint fluid analysis. *Arch Intern Med* 2010;170:1120-1126.
- (22) Annemans L, Spaepen E, Gaskin M et al. Gout in the UK and Germany: prevalence, comorbidities and management in general practice 2000-2005. *Ann Rheum Dis* 2008;67:960-966.
- (23) Kuo CF, Grainge MJ, Mallen C, Zhang W, Doherty M. Eligibility for and prescription of urate-lowering treatment in patients with incident gout in England. *JAMA* 2014;312:2684-2686.
- (24) Mikuls TR, Farrar JT, Bilker WB et al. Gout epidemiology: results from the UK General Practice Research Database, 1990-1999. *Ann Rheum Dis* 2005;64:267-272.
- (25) Roddy E, Zhang WF, Doherty M. Concordance of the management of chronic gout in a UK primary-care population with the EULAR gout recommendations. *Ann Rheum Dis* 2007;66:1311-1315.

- (26) Wall GC, Koenigsfeld CF, Hegge KA, Bottenberg MM. Adherence to treatment guidelines in two primary care populations with gout. *Rheumatol Int* 2010; 30:749-753.
- (27) Nuki G, Perez-Ruiz F, Cutolo M et al. Chronic Gout in Europe in 2010: Clinical Profile of 1,380 Patients in the UK, Germany, France, Italy and Spain. *Ann Rheum Dis* 2011;70 (Suppl 3):105.
- (28) Doherty M, Jansen TL, Nuki G et al. Gout: why is this curable disease so seldom cured? *Ann Rheum Dis* 2012;71:1765-1770.
- (29) Weaver AL. Introduction: professionals in dialogue: sharing insights and knowledge into gout management. *J Clin Rheumatol* 2008;14(5 Suppl):S41.
- (30) Spencer K, Carr A, Doherty M. Patient and provider barriers to effective management of gout in general practice: a qualitative study. *Ann Rheum Dis* 2012;71:1490-1495.
- (31) Singh JA. Challenges faced by patients in gout treatment: a qualitative study. *J Clin Rheumatol* 2014;20:172-174.
- (32) Lindsay K, Gow P, Vanderpyl J, Logo P, Dalbeth N. The experience and impact of living with gout: a study of men with chronic gout using a qualitative grounded theory approach. *J Clin Rheumatol* 2011;17:1-6.
- (33) Rees F, Jenkins W, Doherty M. Patients with gout adhere to curative treatment if informed appropriately: proof-of-concept observational study. *Ann Rheum Dis* 2013;72:826-830.
- (34) Khanna D, Khanna PP, FitzGerald JD et al. 2012 American College of Rheumatology guidelines for management of gout. Part 2: therapy and

- antiinflammatory prophylaxis of acute gouty arthritis. *Arthritis Care Res (Hoboken)* 2012;64:1447-1461.
- (35) Khanna D, FitzGerald JD, Khanna PP et al. 2012 American College of Rheumatology guidelines for management of gout. Part 1: systematic nonpharmacologic and pharmacologic therapeutic approaches to hyperuricemia. *Arthritis Care Res (Hoboken)* 2012;64:1431-1446.
- (36) Sivera F, Andres M, Carmona L et al. Multinational evidence-based recommendations for the diagnosis and management of gout: integrating systematic literature review and expert opinion of a broad panel of rheumatologists in the 3e initiative. *Ann Rheum Dis* 2014;73:328-335.
- (37) Agency for Healthcare Research and Quality. Diagnosis of gout. <http://effectivehealthcare.ahrq.gov/search-for-guides-reviews-and-reports/?pageaction=displayproduct&productID=1937>. Accessed 17/6/15.
- (38) Agency for Healthcare Research and Quality. Management of gout. <http://effectivehealthcare.ahrq.gov/index.cfm/search-for-guides-reviews-and-reports/?productid=1992&pageaction=displayproduct>. Accessed 17/6/15.
- (39) Graf SW, Whittle SL, Wechalekar MD et al. Australian and New Zealand recommendations for the diagnosis and management of gout: integrating systematic literature review and expert opinion in the 3e Initiative. *Int J Rheum Dis* 2015;18:341-351.
- (40) Araújo F, Cordeiro I, Teixeira F, Rovisco J, Ramiro S, Mourão AF et al. Portuguese recommendations for the diagnosis and management of gout. *Acta Reumatol Port* 2014;39:158-171.

- (41) Richette P, Pascual E, Doherty M et al. Updated EULAR Evidence-based recommendations for the diagnosis of gout. *Ann Rheum Dis* 2014;73 (Suppl 2):783-784.
- (42) Guyatt GH, Oxman AD, Kunz R et al. Going from evidence to recommendations. *BMJ* 2008;336:1049-1051.
- (43) Shekelle PG, Woolf SH, Eccles M, Grimshaw J. Clinical guidelines: developing guidelines. *BMJ* 1999;318:593-596.
- (44) Roddy E, Zhang W, Doherty M et al. Evidence-based clinical guidelines: a new system to better determine true strength of recommendation. *J Eval Clin Pract* 2006;12:347-52.
- (45) Garcia de la Torre I. A comparative double-blind parallel study with tenoxicam vs placebo in acute gouty arthritis. *Invest Med Int* 1987;14:92-97.
- (46) Terkeltaub RA, Furst DE, Bennett K et al. High versus low dosing of oral colchicine for early acute gout flare: Twenty-four-hour outcome of the first multicenter, randomized, double-blind, placebo-controlled, parallel-group, dose-comparison colchicine study. *Arthritis Rheum* 2010;62:1060-1068.
- (47) Rees F, Hui M, Doherty M. Optimizing current treatment of gout. *Nat Rev Rheumatol* 2014;10:271-283.
- (48) Agudelo CA, Schumacher HR, Phelps P. Effect of exercise on urate crystal-induced inflammation in canine joints. *Arthritis Rheum* 1972;15:609-616.
- (49) Moi JHY, Sriranganathan MK, Falzon L et al. Lifestyle interventions for the treatment of gout: a summary of 2 Cochrane systematic reviews. *J Rheumatol* 2014;92 (Suppl) :26-32.

- (50) Khanna PP, Gladue HS, Singh MK et al. Treatment of acute gout: a systematic review. *Semin Arthritis Rheum* 2014;44:31-38.
- (51) Schumacher Jr HR, Boice JA, Daikh DI et al. Randomised double blind trial of etoricoxib and indometacin in treatment of acute gouty arthritis. *BMJ* 2002;324:1488-1492.
- (52) Chen LC, Ashcroft DM. Risk of myocardial infarction associated with selective COX-2 inhibitors: meta-analysis of randomised controlled trials. *Pharmacoepidemiol Drug Saf* 2007;16:762-772.
- (53) National Institute for Health and Care Excellence. Clinical Knowledge Summaries: Gout 2013. <http://cks.nice.org.uk/gout>. Accessed 17/6/15.
- (54) Ahern MJ, Reid C, Gordon TP et al. Does colchicine work? The results of the first controlled study in acute gout. *Aust N Z J Med* 1987;17:301-304.
- (55) van Echteld IA, van Durme C, Falzon L et al. Treatment of gout patients with impairment of renal function: a systematic literature review. *J Rheumatol* 2014;92 (Suppl):48-54.
- (56) British National Formulary.
<https://www.medicinescomplete.com/about/publications.htm>. Accessed 21 September 2015
- (57) Terkeltaub RA, Davis MW. Reply. *Arthritis Rheum* 2011;63:3648.
- (58) Hsu WC, Chen WH, Chang MT, Chiu HC. Colchicine-Induced Acute Myopathy in a Patient With Concomitant Use of Simvastatin. *Clinical Neuropharmacology* 2002;25:266-68.

- (59) Justiniano M, Dold S, Espinoza LR. Rapid Onset of Muscle Weakness (Rhabdomyolysis) Associated With the Combined Use of Simvastatin and Colchicine. *J Clin Rheumatol* 2007;13:266-8.
- (60) Tufan A, Dede DS, Cavus S et al. Rhabdomyolysis in a patient treated with colchicine and atorvastatin. *Ann Pharmacother* 2006;40:1466-1469.
- (61) Wechalekar MD, Vinik O, Schlesinger N, Buchbinder R. Intra-articular glucocorticoids for acute gout. *Cochrane Database Syst Rev* 2013;4:CD009920.
- (62) Fernandez C, Noguera R, Gonzalez JA, Pascual E. Treatment of acute attacks of gout with a small dose of intraarticular triamcinolone acetonide. *J Rheumatol* 1999;26:2285-2286.
- (63) Alloway JA, Moriarty MJ, Hoogland YT et al. Comparison of triamcinolone acetonide with indomethacin in the treatment of acute gouty arthritis. *J Rheumatol* 1993;20:111-3.
- (64) Siegel LB, Alloway JA, Nashel DJ. Comparison of adrenocorticotrophic hormone and triamcinolone acetonide in the treatment of acute gouty arthritis. *J Rheumatol* 1994;21:1325-7.
- (65) Janssens HJ, Lucassen-Peter LBJ, Van-de-Laar FA, Janssen M, Van-de-Lisdonk EH. Systemic corticosteroids for acute gout. *Cochrane Database of Systematic Reviews* 2008.
- (66) Janssens HJ, Janssen M, Van-De-Lisdonk EH, van-Riel PL, Van Weel C. Use of oral prednisolone or naproxen for the treatment of gout arthritis: a double-blind, randomised equivalence trial. *Lancet* 2008;371:1854-1860.

- (67) Kamalaraj N, Gnanenthiran SR, Kathirgamanathan T et al. Improved management of acute gout during hospitalization following introduction of a protocol. *Int J Rheum Dis* 2012;15:512-520.
- (68) Schlesinger N, Moore DF, Sun JD, Schumacher HRJ. A survey of current evaluation and treatment of gout. *J Rheumatol* 2006;33(10):2050-2052.
- (69) Schlesinger N, Mysler E, Lin HY et al. Canakinumab reduces the risk of acute gouty arthritis flares during initiation of allopurinol treatment: results of a double-blind, randomised study. *Ann Rheum Dis* 2011;70:1264-1271.
- (70) Schlesinger N, De Meulemeester M, Pikhlak A et al. Canakinumab relieves symptoms of acute flares and improves health-related quality of life in patients with difficult-to-treat Gouty Arthritis by suppressing inflammation: results of a randomized, dose-ranging study. *Arthritis Res Ther* 2011;13:R53.
- (71) Terkeltaub RA, Schumacher HR, Carter JD et al. Riloncept in the treatment of acute gouty arthritis: a randomized, controlled clinical trial using indomethacin as the active comparator. *Arthritis Res Ther* 2013;15:R25.
- (72) So A, De ST, Revaz S, Tschopp J. A pilot study of IL-1 inhibition by anakinra in acute gout. *Arthritis Res Ther* 2007;9:R28.
- (73) Ghosh P, Cho M, Rawat G, Simkin PA, Gardner GC. Treatment of acute gouty arthritis in complex hospitalized patients with anakinra. *Arthritis Care Res (Hoboken)* 2013;65:1381-1384.
- (74) Sivera F, Wechalekar MD, Andres M, Buchbinder RF, Carmona L. Interleukin-1 inhibitors for acute gout. *Cochrane Database of Systematic Reviews* 2014;9:CD009993.

- (75) Report of Medical Research Council Working Party on Mild to Moderate Hypertension. Adverse reactions to bendrofluazide and propranolol for the treatment of mild hypertension. *Lancet* 1981;2:539-543.
- (76) National Institute for Health and Care Excellence. Hypertension CG127 2011. <https://www.nice.org.uk/guidance/cg127>. Accessed 17/6/15.
- (77) Hueskes BAA, Roovers EA, Mantel-Teeuwisse AK et al. Use of Diuretics and the Risk of Gouty Arthritis: A Systematic Review. *Semin Arthritis Rheum* 2012;41:879-889.
- (78) Bruderer S, Bodmer M, Jick SS, Meier CR. Use of Diuretics and Risk of Incident Gout: A Population-Based Case-Control Study. *Arthritis Rheum* 2014;66:185-196.
- (79) Dalbeth N, Petrie KJ, House M et al. Illness perceptions in patients with gout and the relationship with progression of musculoskeletal disability. *Arthritis Care Res (Hoboken)* 2011;63:1605-1612.
- (80) Harrold LR, Mazor KM, Peterson D et al. Patients' knowledge and beliefs concerning gout and its treatment: a population based study. *BMC Musculoskelet Disord* 2012;13:180.
- (81) Singh JA, Reddy SG, Kundukulam J. Risk factors for gout and prevention: a systematic review of the literature. *Curr Opin Rheumatol* 2011;23:192-202.
- (82) Neogi T, Chen C, Niu J et al. Alcohol quantity and type on risk of recurrent gout attacks: an internet-based case-crossover study. *Am J Med* 2014;127:311-318.
- (83) Dalbeth N, Ames R, Gamble GD et al. Effects of skim milk powder enriched with glycomacropeptide and G600 milk fat extract on frequency of gout flares: a proof-of-concept randomised controlled trial. *Ann Rheum Dis* 2012;71:929-934.

- (84) Jacob RA, Spinozzi GM, Simon VA et al. Consumption of cherries lowers plasma urate in healthy women. *J Nutr* 2003;133:1826-1829.
- (85) Zhang Y, Neogi T, Chen C et al. Cherry consumption and decreased risk of recurrent gout attacks. *Arthritis Rheum* 2012;64:4004-4011.
- (86) Andres M, Sivera F, Falzon L, Buchbinder R, Carmona L. Dietary supplements for chronic gout. *Cochrane Database Syst Rev* 2014;10:CD010156.
- (87) Juraschek SP, Miller ER, Gelber AC. Effect of oral vitamin C supplementation on serum uric acid: a meta-analysis of randomized controlled trials. *Arthritis Care Res (Hoboken)* 2011;63:1295-1306.
- (88) Stamp LK, O'Donnell JL, Frampton C et al. Clinically insignificant effect of supplemental vitamin C on serum urate in patients with gout: a pilot randomized controlled trial. *Arthritis Rheum* 2013;65:1636-1642.
- (89) Fink HA, Wilt TJ, Eidman KE et al. Medical management to prevent recurrent nephrolithiasis in adults: a systematic review for an American College of Physicians Clinical Guideline. *Ann Intern Med* 2013;158:535-543.
- (90) Lotan Y. Medical management strategies to prevent recurrent nephrolithiasis are stagnant and stronger evidence is needed to reduce morbidity. *Evid Based Med* 2014;19(1):12.
- 91) Primates P, Plana E, Rothenbacher D. Gout treatment and comorbidities: a retrospective cohort study in a large US managed care population. *BMC Musculoskelet Disord* 2011; 12:103.
- (92) Krishnan E, Svendsen K, Neaton JD, Grandits G, Kuller LH, MRFIT Research Group. Long-term cardiovascular mortality among middle-aged men with gout. *Arch Intern Med* 2008;168:1104-1110.

- (93) Goicoechea M, de-Vinuesa SG, Verdalles U et al. Effect of allopurinol in chronic kidney disease progression and cardiovascular risk. *Clin J Am Soc Nephrol* 2010;5:1388-1393.
- (94) Teng GG, Ang LW, Saag KG et al. Mortality due to coronary heart disease and kidney disease among middle-aged and elderly men and women with gout in the Singapore Chinese Health Study. *Ann Rheum Dis* 2012;71:924-928.
- (95) Li QH, Dai L, Li ZX et al. Questionnaire survey evaluating disease-related knowledge for 149 primary gout patients and 184 doctors in South China. *Clin Rheumatol* 2013;32:1633-1640.
- (96) Te Karu L, Bryant L, Elley CR. Maori experiences and perceptions of gout and its treatment: a kaupapa Maori qualitative study. *J Prim Health Care* 2013;5:214-222.
- (97) Faruque LI, Ehteshami-Afshar A, Wiebe N et al. A systematic review and meta-analysis on the safety and efficacy of febuxostat versus allopurinol in chronic gout. *Semin Arthritis Rheum* 2013;43:367-375.
- (98) Sriranganathan MK, Vinik O, Falzon L et al. Interventions for tophi in gout: a Cochrane systematic literature review. *J Rheumatol* 2014;92 (Suppl):63-69.
- (99) Ye P, Yang S, Zhang W et al. Efficacy and Tolerability of Febuxostat in Hyperuricemic Patients With or Without Gout: A Systematic Review and Meta-Analysis. *Clin Ther* 2013;35:180-189.
- (100) Ottaviani S, Richette P, Allard A, Ora J, Bardin T. Ultrasonography in gout: a case-control study. *Clin Exp Rheumatol* 2012; 30:499-504.
- (101) Ferraz MB, O'Brien B. A cost effectiveness analysis of urate lowering drugs in nontophaceous recurrent gouty arthritis. *J Rheumatol* 1995;22:908-914.

- (102) Bhole V, de Vera M, Rahman MM, Krishnan E, Choi H. Epidemiology of gout in women: Fifty-two-year followup of a prospective cohort. *Arthritis Rheum* 2010;62:1069-1076.
- (103) Campion EW, Glynn RJ, DeLabry LO. Asymptomatic hyperuricemia. Risks and consequences in the Normative Aging Study. *Am J Med* 1987;82:421-426.
- (104) Johnson ES, Smith DH, Thorp ML, Yang X, Juhaeri J. Predicting the risk of end-stage renal disease in the population-based setting: a retrospective case-control study. *BMC Nephrol* 2011;12:17.
- (105) Levy GD, Rashid N, Niu F, Cheetham TC. Effect of Urate-lowering Therapies on Renal Disease Progression in Patients with Hyperuricemia. *J Rheumatol* 2014;41:955-962.
- (106) Siu YP, Leung KT, Tong MK-H, Kwan TH. Use of Allopurinol in Slowing the Progression of Renal Disease Through Its Ability to Lower Serum Uric Acid Level. *Am J Kid Dis* 2006;47:51-59.
- (107) Marchini GS, Sarkissian C, Tian D, Gebreselassie S, Monga M. Gout, stone composition and urinary stone risk: a matched case comparative study. *J Urol* 2013;189:1334-1339.
- (108) Zoref E, De VA, Sperling O. Mutant feedback-resistant phosphoribosylpyrophosphate synthetase associated with purine overproduction and gout. Phosphoribosylpyrophosphate and purine metabolism in cultured fibroblasts. *J Clin Invest* 1975;56:1093-1099.
- (109) Jinnah HA, De GL, Harris JC, Nyhan WL, O'Neill JP. The spectrum of inherited mutations causing HPRT deficiency: 75 new cases and a review of 196 previously reported cases. *Mutat Res* 2000;463:309-326.

- (110) Zhang W, Bao CD, Gu YY, Ye S. Glycogen storage disease manifested as gout and myopathy: three case reports and literature review. *Clin Rheumatol* 2008;27:671-674.
- (111) Williams SE, Reed AAC, Galvanovskis J et al. Uromodulin mutations causing familial juvenile hyperuricaemic nephropathy lead to protein maturation defects and retention in the endoplasmic reticulum. *Hum Mol Genet* 2009;18:2963-2974.
- (112) Yu KH, Luo SF. Younger age of onset of gout in Taiwan. *Rheumatology (Oxford)* 2003;42:166-170.
- (113) Matsuo H, Ichida K, Takada T et al. Common dysfunctional variants in ABCG2 are a major cause of early-onset gout. *Sci Rep* 2013;3:2014.
- (114) Wan W, Xu X, Zhao DB, Pang YF, Wang YX. Polymorphisms of uric transporter proteins in the pathogenesis of gout in a Chinese Han population. *Genet Mol Res* 2015;14:2546-2550.
- (115) Krishnan E, Lessov-Schlaggar CN, Krasnow RE, Swan GE. Nature versus nurture in gout: a twin study. *Am J Med* 2012;125:499-504.
- (116) Taylor TH, Mecchella JN, Larson RJ, Kerin KD, Mackenzie TA. Initiation of allopurinol at first medical contact for acute attacks of gout: a randomized clinical trial. *Am J Med* 2012;125:1126-1134.
- (117) Shoji A, Yamanaka H, Kamatani N. A retrospective study of the relationship between serum urate level and recurrent attacks of gouty arthritis: evidence for reduction of recurrent gouty arthritis with antihyperuricemic therapy. *Arthritis Rheum* 2004;51:321-325.

- (118) Perez-Ruiz F, Calabozo M, Pijoan JI, Herrero-Beites AM, Ruibal A. Effect of urate-lowering therapy on the velocity of size reduction of tophi in chronic gout. *Arthritis Rheum* 2002;47:356-360.
- (119) Perez-Ruiz F, Herrero-Beites AM, Carmona L. A two-stage approach to the treatment of hyperuricemia in gout: the "dirty dish" hypothesis. *Arthritis Rheum* 2011;63:4002-4006.
- (120) Ascherio A, LeWitt PA, Xu K et al. Urate as a predictor of the rate of clinical decline in Parkinson disease. *Arch Neurol* 2009;66:1460-1468.
- (121) Euser SM, Hofman A, Westendorp RGJ, Breteler MMB. Serum uric acid and cognitive function and dementia. *Brain* 2009;132:377-382.
- (122) Auinger P, Kiebertz K, McDermott MP. The relationship between uric acid levels and Huntington's disease progression. *Mov Disord* 2010;25:224-228.
- (123) Paganoni S, Zhang M, Quiroz ZA et al. Uric acid levels predict survival in men with amyotrophic lateral sclerosis. *J Neurol* 2012;259:1923-1928.
- (124) Jain S, Ton TG, Boudreau RM et al. The Risk of Parkinson Disease Associated with Urate in a Community-Based Cohort of Older Adults. *Neuroepidemiology* 2011;36: 223–229.
- (125) Seth R, Kydd ASR, Falzon L et al. Preventing Attacks of Acute Gout When Introducing Urate-Lowering Therapy: A Systematic Literature Review. *J Rheumatol* 2014;92:42-47.
- (126) Schumacher HR, Becker MA, Wortmann RL et al. Effects of febuxostat versus allopurinol and placebo in reducing serum urate in subjects with hyperuricemia and gout: a 28-week, phase III, randomized, double-blind, parallel-group trial. *Arthritis Rheum* 2008;59:1540-1548.

- (127) Becker MA, Schumacher HR, Espinoza LR et al. The urate-lowering efficacy and safety of febuxostat in the treatment of the hyperuricemia of gout: the CONFIRMS trial. *Arthritis Res Ther* 2010;12(2):R63.
- (128) Jennings CG, Mackenzie IS, Flynn R et al. Up-titration of allopurinol in patients with gout. *Semin Arthritis Rheum* 2014;44:25-30.
- (129) Beard SM, von Scheele BG, Nuki G, Pearson IV. Cost-effectiveness of febuxostat in chronic gout. *Eur J Health Econ* 2014;15:453-463.
- (130) Jutkowitz E, Choi HK, Pizzi LT, Kuntz KM. Cost-effectiveness of allopurinol and febuxostat for the management of gout. *Ann Intern Med* 2014;161:617-626.
- (131) Kim SC, Schmidt BMW, Franklin JM et al. Clinical and Health Care Use Characteristics of Patients Newly Starting Allopurinol, Febuxostat, and Colchicine for the Treatment of Gout. *Arthritis Care Res (Hoboken)* 2013;65:2008-2014.
- (132) Hershfield MS, Callaghan JT, Tassaneeyakul W et al. Clinical Pharmacogenetics Implementation Consortium guidelines for human leukocyte antigen-B genotype and allopurinol dosing. *Clin Pharmacol Ther* 2013;93:153-158.
- (133) Zineh I, Mummaneni P, Lyndly J et al. Allopurinol pharmacogenetics: assessment of potential clinical usefulness. *Pharmacogenomics* 2011;12:1741-1749.
- (134) Hande KR, Noone RM, Stone WJ. Severe allopurinol toxicity. Description and guidelines for prevention in patients with renal insufficiency. *Am J Med* 1984;76:47-56.

- (135) Dalbeth N, Kumar S, Stamp L, Gow P. Dose adjustment of allopurinol according to creatinine clearance does not provide adequate control of hyperuricemia in patients with gout. *J Rheumatol* 2006;33:1646-1650.
- (136) Vazquez-Mellado J, Morales EM, Pacheco-Tena C, Burgos-Vargas R. Relation between adverse events associated with allopurinol and renal function in patients with gout. *Ann Rheum Dis* 2001;60:981-983.
- (137) Stamp LK, Taylor WJ, Jones PB et al. Starting dose is a risk factor for allopurinol hypersensitivity syndrome: a proposed safe starting dose of allopurinol. *Arthritis Rheum* 2012;64:2529-2536.
- (138) Stamp LK, O'Donnell JL, Zhang M et al. Using allopurinol above the dose based on creatinine clearance is effective and safe in patients with chronic gout, including those with renal impairment. *Arthritis Rheum* 2011;63:412-421.
- (139) Becker MA, Schumacher HR, Wortmann RL et al. Febuxostat compared with allopurinol in patients with hyperuricemia and gout. *NEJM* 2005;353:2450-2461.
- (140) Jackson R, Hunt B, MacDonald P. The efficacy and safety of febuxostat for urate lowering in gout patients ≥ 65 years of age. *BMC Geriatr* 2012;12:1-9.
- (141) Abeles AM. Febuxostat hypersensitivity. *J Rheumatol* 2012;39:659.
- (142) Chohan S. Safety and efficacy of febuxostat treatment in subjects with gout and severe allopurinol adverse reactions. *J Rheumatol* 2011;38:1957-1959.
- (143) European Medicines Agency.<http://www.medicines.org.uk/emc/medicine/22830/SPC>. Accessed 21 September 2015.

- (144) National Institute for Health and Care Excellence. Febuxostat for the management of hyperuricaemia in people with gout TA164 2011.
- (145) White WB, Chohan S, Dabholkar A, Hunt B, Jackson R. Cardiovascular safety of febuxostat and allopurinol in patients with gout and cardiovascular comorbidities. *Am Heart J* 2012;164:14-20.
- (146) Scottish Medicines Consortium. Febuxostat 80 mg and 120 mg tablets (Adenuric[®]). SMC No. 637/10. 2010.
<http://www.scottishmedicines.org.uk/files/advice/febuxostat-Adenuric-FINAL-August-2010.pdf>. Accessed 21 September 2015.
- (147) Talbott JH, Bishop C, Norcross BM, Lockie LM. The clinical and metabolic effects of benemid in patients with gout. *Trans Assoc Am Physicians* 1951;64:372-377.
- (148) Kydd ASR, Seth R, Buchbinder R, Edwards CJ, Bombardier C. Uricosuric medications for chronic gout. *Cochrane Database Syst Rev* 2014; 11:CD010457.
- (149) Pui K, Gow PJ, Dalbeth N. Efficacy and tolerability of probenecid as urate-lowering therapy in gout; clinical experience in high-prevalence population. *J Rheumatol*. 2013;40(6):872-6.
- (150) Reinders MK, van-Roon EN, Jansen TL et al. Efficacy and tolerability of urate-lowering drugs in gout: a randomised controlled trial of benzbromarone versus probenecid after failure of allopurinol. *Ann Rheum Dis* 2009;68:51-56.
- (151) Reinders MK, Haagsma C, Jansen TLet al. A randomised controlled trial on the efficacy and tolerability with dose escalation of allopurinol 300-600 mg/day versus benzbromarone 100-200 mg/day in patients with gout. *Ann Rheum Dis* 2009;68:892-897.

- (152) Perez-Ruiz F, Calabozo M, Fernandez-Lopez MJ, Herrero-Beites A, Ruiz-Lucea E, Garcia-Erauskin G et al. Treatment of Chronic Gout in Patients with Renal Function Impairment An Open, Randomized, Actively Controlled Study. *J Clin Rheumatol* 1999;5:49-55.
- (153) Lee MH, Graham G, Williams K, Day R. A Benefit-Risk Assessment of Benzbromarone in the Treatment of Gout. *Drug-Safety* 2008;31:643-665.
- (154) Wurzner G, Gerster JC, Chiolero A et al. Comparative effects of losartan and irbesartan on serum uric acid in hypertensive patients with hyperuricaemia and gout. *J Hypertens* 2001;19:1855-1860.
- (155) Choi HK, Soriano LC, Zhang Y, Rodriguez LAG. Antihypertensive drugs and risk of incident gout among patients with hypertension: population based case-control study. *BMJ* 2012;344:d8190.
- (156) Desager JP, Hulhoven R, Harvengt C. Uricosuric effect of fenofibrate in healthy volunteers. *J Clin Pharmacol* 1980;20:560-564.
- (157) Feher MD, Hepburn AL, Hogarth MB, Ball SG, Kaye SA. Fenofibrate enhances urate reduction in men treated with allopurinol for hyperuricaemia and gout. *Rheumatology (Oxford)* 2003;42:321-325.
- (158) Lee YH, Lee CH, Lee J. Effect of fenofibrate in combination with urate lowering agents in patients with gout. *Korean J Intern Med* 2006;21:89-93.
- (159) Takahashi S, Moriwaki Y, Yamamoto T et al. Effects of combination treatment using anti-hyperuricaemic agents with fenofibrate and/or losartan on uric acid metabolism. *Ann Rheum Dis* 2003;62:572-575.

- (160) Goldfarb E, Smyth CJ. Effects of allopurinol, a xanthine oxidase inhibitor, and sulfinpyrazone upon the urinary and serum urate concentrations in eight patients with tophaceous gout. *Arthritis Rheum* 1966;9:414-423.
- (161) Perez-Ruiz F, Calabozo M, Erauskin GG, Ruibal A, Herrero-Beites AM. Renal underexcretion of uric acid is present in patients with apparent high urinary uric acid output. *Arthritis Rheum* 2002;47:610-613.
- (162) Azevedo VF, Buiar PG, Giovanella LH, Severo CR, Carvalho M. Allopurinol, Benzbromarone, or a Combination in Treating Patients with Gout: Analysis of a Series of Outpatients. *Int J Rheumatol* 2014;2014:263720.
- (163) Maekawa M, Tomida H, Aoki T et al. Successful treatment of refractory gout using combined therapy consisting of febuxostat and allopurinol in a patient with chronic renal failure. *Intern Med* 2014;53:609-612.
- (164) Saag KG, Adler S, Bhakta N et al. Lesinurad, a Novel Selective Uric Acid Reabsorption Inhibitor, in Two Phase III Clinical Trials: Combination Study of Lesinurad in Allopurinol Standard of Care Inadequate Responders (CLEAR 1 and 2). *Arthritis Rheum* 2014; 66 (Suppl 10);L10.
- (165) Latourte A, Bardin T, Richette P. Prophylaxis for acute gout flares after initiation of urate-lowering therapy. *Rheumatology (Oxford)* 2014;53:1920-1926.
- (166) Paulus HE, Schlosstein LH, Godfrey RG, Klinenberg JR, Bluestone R. Prophylactic colchicine therapy of intercritical gout. A placebo-controlled study of probenecid-treated patients. *Arthritis Rheum* 1974;17:609-614.

- (167) Borstad GC, Bryant LR, Abel MP et al. Colchicine for prophylaxis of acute flares when initiating allopurinol for chronic gouty arthritis. *J Rheumatol* 2004;31:2429-2432.
- (168) Wortmann RL, MacDonald PA, Hunt B, Jackson RL. Effect of prophylaxis on gout flares after the initiation of urate-lowering therapy: analysis of data from three phase III trials. *Clin Ther* 2010;32:2386-2397.
- (169) Karimzadeh H, Nazari J, Mottaghi P, Kabiri P. Different duration of colchicine for preventing recurrence of gouty arthritis. *J Res Med Sci* 2006;11:104-107.
- (170) Schlesinger N, Mysler E, Lin HY et al. Canakinumab reduces the risk of acute gouty arthritis flares during initiation of allopurinol treatment: results of a double-blind, randomised study. *Ann Rheum Dis* 2011;70:1264-1271.
- (171) Mitha E, Schumacher HR, Fouche L et al. Riloncept for gout flare prevention during initiation of uric acid-lowering therapy: results from the PRESURGE-2 international, phase 3, randomized, placebo-controlled trial. *Rheumatology (Oxford)* 2013;52:1285-1292.
- (172) Schumacher HR, Jr., Evans RR, Saag KG et al. Riloncept (interleukin-1 trap) for prevention of gout flares during initiation of uric acid-lowering therapy: results from a phase III randomized, double-blind, placebo-controlled, confirmatory efficacy study. *Arthritis Care Res (Hoboken)* 2012;64:1462-1470.
- (173) Sundy JS, Schumacher HR, Kivitz A et al. Riloncept for gout flare prevention in patients receiving uric acid-lowering therapy: results of RESURGE, a phase III, international safety study. *J Rheumatol* 2014;41:1703-1711.

- (174) Roughley MJ, Belcher J, Mallen CD, Roddy E. Gout and risk of chronic kidney disease and nephrolithiasis: meta-analysis of observational studies. *Arthritis Res Ther* 2015;17:90.
- (175) Curiel RV, Guzman NJ. Challenges associated with the management of gouty arthritis in patients with chronic kidney disease: a systematic review. *Semin Arthritis Rheum* 2012;42:166-178.
- (176) Abdellatif AA, Elkhalili N. Management of gouty arthritis in patients with chronic kidney disease. *Am J Ther* 2014;21:523-534.
- (177) Nderitu P, Doos L, Jones PW, Davies SJ, Kadam UT. Non-steroidal anti-inflammatory drugs and chronic kidney disease progression: a systematic review. *Fam Pract* 2013;30:247-255.
- (178) National Institute for Health and Care Excellence. Chronic kidney disease: early identification and management of chronic kidney disease in adults in primary and secondary care CG182 2014.
- (179) Wallace SL, Singer JZ, Duncan GJ, Wigley FM, Kuncl RW. Renal function predicts colchicine toxicity: guidelines for the prophylactic use of colchicine in gout. *J Rheumatol* 1991;18:264-269.
- (180) Ungprasert P, Cheungpasitporn W, Crowson CS, Matteson EL. Individual non-steroidal anti-inflammatory drugs and risk of acute kidney injury: A systematic review and meta-analysis of observational studies. *Eur J Intern Med* 2015;26:285-291.
- (181) Wason S, Faulkner RD, Davis MW. Colchicine Dosing Guideline for Gout Patients with Varying Degrees of Renal Impairment Based on Pharmacokinetic Data. *Arthritis Rheum* 2011;63 (Suppl 10): 2581.

- (182) Terkeltaub R. Prophylaxis of attack of acute gouty arthritis. *Gout and Other Crystal Arthropathies*. 2012:187-193
- (183) Sriranganathan MK, Vinik O, Bombardier C, Edwards CJ. Interventions for tophi in gout. *Cochrane Database Syst Rev* 2014;10:CD010069.
- (184) Sundy JS, Baraf HSB, Yood RA et al. Efficacy and tolerability of pegloticase for the treatment of chronic gout in patients refractory to conventional treatment: two randomized controlled trials. *JAMA* 2011;306:711-720.
- (185) Richette P, Brière C, Hoenen-Clavert V, Loeuille D, Bardin T. Rasburicase for tophaceous gout not treatable with allopurinol: an exploratory study. *J Rheumatol* 2007;34:2093-2098.
- (186) Simmonds HA, Cameron JS, Goldsmith DJ, Fairbanks LD, Raman GV. Familial juvenile hyperuricaemic nephropathy is not such a rare genetic metabolic purine disease in Britain. *Nucleosides Nucleotides Nucleic Acids* 2006;25:1071-1075.
- (187) van Veen TR, Haeri S. Gout in pregnancy: a case report and review of the literature. *Gynecol Obstet Invest* 2015;79:217-221.
- (188) Flint J, Panchal S, Hurrell A et al. BSR & BHPR guideline on prescribing drugs in pregnancy and breastfeeding. Part II: analgesics and other drugs used in rheumatology practice. *Rheumatology (Oxford)* 2016;55:1698-702.
- (189) Flint J, Panchal S, Hurrell A et al. BSR & BHPR guideline on prescribing drugs in pregnancy and breastfeeding. Part I: standard and biologic disease modifying anti-rheumatic drugs and corticosteroids. *Rheumatology (Oxford)* 2016;55:1693-7.

- (190) Rabinovitch O, Zemer D, Kukia E et al. Colchicine treatment in conception and pregnancy: two hundred thirty-one pregnancies in patients with familial Mediterranean fever. *Am J Reprod Immunol* 1992;28:245-246.
- (191) Trifirò G, Morabito P, Cavagna L et al. Epidemiology of gout and hyperuricaemia in Italy during the years 2005-2009: a nationwide population-based study. *Ann Rheum Dis* 2013;72:694-700.

Figure 1 Algorithm for the management of gout

Table I **Principal Clinical Questions considered**

1. In patients with acute gout, does the use of ice packs reduce pain?
2. In patients with acute gout, what medication should be used to manage acute attacks?
3. For patients on diuretic therapy presenting with acute gout, should diuretic therapy be discontinued?
4. What are the potential patient and healthcare professional barriers to management of patients with gout?
5. Is patient education effective for patients with gout and, if so, in what format?
6. Is dietary advice effective in the management of patients with gout?
7. In patients with gout and renal failure, should the dose of allopurinol be adjusted?
8. Should patients with gout be screened for co-morbidities?
9. In patients with hyperuricaemia or gout, when should urate-lowering therapy be commenced?
10. In patients with gout, should allopurinol be used as first-line urate-lowering therapy?
11. In patients with gout, should febuxostat be used as an alternative urate-lowering therapy to allopurinol and, if so, in what situations?
12. In patients with gout, should other medications such as benzbromarone, sulfapyrazone, and probenecid be used?
13. In patients initiating urate-lowering therapy, for how long should prophylactic colchicine be continued?

14. In patients initiating urate-lowering therapy, should canakinumab and riloncept be used to prevent gout attacks?

15. In patients with hyperuricaemia, gout and hypertension, should an angiotensin II blocker rather than an angiotensin-converting-enzyme blocker be used?

16. In patients with gout and hyperlipidaemia, should fenofibrate be used as an adjunctive urate-lowering agent?

17. In patients with debilitating chronic tophaceous gout refractory to oral urate-lowering drugs, or in whom these drugs are contraindicated, should pegloticase be used?

Table 2 Starting regime of allopurinol according to glomerular filtration rate (reproduced with permission from Stamp LK et al, Arthritis and Rheumatology, Starting dose is a risk factor for allopurinol hypersensitivity syndrome: a proposed safe starting dose of allopurinol, Volume 64, issue 8, pages 2529-2536¹³⁷)

Estimated GFR ml/minute/1.73m ²	Allopurinol starting dose
<5	50mg/week
5-15	50mg twice weekly
16-30	50mg every 2 days
31-45	50mg/day
46-60	50mg and 100mg on alternate days
61-90	100mg/day
91-130	150mg/day
>130	200mg/day

GFR, glomerular filtration rate